How do firms open up the front-end of service innovation? A case study of IT-based service firms in Thailand.

Abstract

This paper focuses on openness in the front-end phase of service innovation and its impact on innovation success. The early stages of innovation are fuzzy and unstructured, thus often being called "fuzzy front-end" (FFE) by scholars. The FFE begins when an opportunity is considered worthy of further ideation, exploration, and assessment and ends when a firm decides to invest in – or terminate – an idea. Although openness has been identified as pivotal to innovation performance, little effort has been put into exploring its role in the early phase of innovation. By drawing on the data of a multiple case study in Thai online service firms, we are able to identify four key dimensions of FFE openness competence: prior related knowledge, top management support, the presence of workable prototype, and slack resource. Furthermore, we found three openness activities often take place in the FFE phase of successful online service innovation, i.e., external search, inter-firm partnerships and customer experimentation. From a managerial perspective, our study provides useful insights to innovation managers aiming at enhancing front-end performance through openness.

Keywords

Online Service Innovation; Service-Dominant Logic; Fuzzy Front-End; Inbound Open Innovation; Openness Competence

1   Introduction

In recent years, innovation in services has attracted much attention from academics and practitioners alike and has emerged as a strategic imperative for not only service but also manufacturing firms (Chesbrough, 2011). Empirical findings in the service innovation literature suggest the importance of the early stages or the "fuzzy front-end" (FFE) phase, which is often characterised as lowly formalised and involving high levels of uncertainty (Khurana and Rosenthal, 1998), to service innovation success (Alam, 2006; Magnusson, 2009). This is because the cost of coming up with several interesting ideas is significantly lower than the cost of bringing any one idea to the market (Reid and De Brentani, 2004). Moreover, during the FFE of service innovation, a service concept specifying key components (i.e., people, skills, procedures and resources) and how to integrate them must be explicitly defined. Conceptualising a new service concept is not an easy task because one could easily oversimply and overlook crucial issues as since services are intangible, heterogeneous, and delivered over time and space (Bitner et al., 2008).

To innovate successfully, the open innovation literature has identified two key approaches. Firstly, to acquire and assimilate ideas and knowledge from external sources (Chang et al., 2012; Chiang and Hung, 2010) and, secondly, to co-develop with external partners, such as suppliers, customers, competitors, universities, firms in other industries etc. (Brunswicker and Hutschek, 2010; Fey and Birkinshaw, 2005; Oliveira and von Hippel, 2011; Ordanini and Parasuraman, 2011). This is termed as "inbound openness" by Chesbrough (2003), who argues that openness underlies innovation success by allowing the innovating firms to lower R&D cost, increase innovation productivity and newness, and reduce time to market (Chesbrough, 2003; Enkel et al., 2009).

By embracing the concept of openness, we propose that firms should apply openness to their innovation process as early as possible for they to fully realise its benefits. Therefore, this article aims to gain a better understanding of how to foster the ability of a FFE team to gather and apply operant resources from external sources (i.e., openness competence) and to explore a link between openness within the FFE and innovation success in Thai online services context. Further, we extend previous inquiries by embracing a more integrative way of thinking. We adopted the principles of service-dominant (S-D) logic (Vargo and Lusch, 2004; 2008) as an analytical lens.

Innovation in services has been considered the key driver of Asian emerging economies (Thakur and Hale, 2013). In 2014, the service sector was accounted for around 52 percent of Thailand's GDP and employed 49 percent of the country's employment. The government sees the crucial role of the service sector and is aiming to push the percentages to 70 percent (Suriyatanin, 2015). A way to achieve that goal is to encourage innovation in the service sector. However,

Thailand's index level of service innovation capability (1.84) is low and far behind its product innovation capability (2.29) (Wonglimpiyarat, 2010). In addition, the applicability of models and frameworks of service innovation developed in more economically developed countries to the context of developing countries, such as Thailand, is found to be limited (Uchupalanan, 2000). Furthermore, innovation in developing countries has many disadvantages compare to developed countries and newly industrialized countries (NICs) (Numprasertchai and Igel, 2005). One of main handicaps is the limited R&D investment. According to the Thai National Science Technology and Innovation Policy Office (STI, 2014), Thailand's R&D expenditure in 2011 was only around 0.37 percent of GDP, whereas the corresponding rates in NICs were 3.7 percent in Korea and 2.2 percent in Singapore. Networking (Chaminade et al., 2012) and collaboration with research institution (Numprasertchai and Igel, 2005) have been proposed as a way to alleviate the lack of funding problem. Therefore, our attempt to understand openness competence in Thai context could benefit service innovation in both Thailand and other developing countries facing similar constraints.

Rather fewer studies have investigated openness in the front-end phase of service innovation as compared with studies in product innovation contexts (Alam, 2006). Moreover, apart from a few exceptions (e.g., Alam, 2006; Magnusson, 2009; Ozer, 2007), empirical studies focusing on opening up the FFE process can be considered limited. The current study is among the first to try to explore key openness activities in the FEE as well as identify competences supporting those activates. Further, we are not aware of research that has taken a services-dominant (S-D) logic integrative approach to examine the FFE of service innovation. In addition, the majority of prior studies on open innovation is at the firm level (e.g., Chesbrough and Crowther, 2006; Laursen and Salter, 2006; van de Vrande et al., 2009), thus implying that decisions of open innovation strategy is made at the firm level (Bahemia and Squire, 2010). However, we argue that since objectives and characteristics of individual innovation projects are likely to vary within the same organisation, each of them might require a different strategy with regard to openness. Therefore, we focus at the project-level of analysis. To address these gaps, two research questions are identified:

- How do firms nurture openness in the FFE of service innovation projects? and;

- Does early openness contribute to service innovation success? If yes, how?

To this end, the paper is organised as follows: in the second section, we present a review of the literature on the topics of service innovation, the FFE and openness. Then, in the third section, we outline how we conducted the case study, and analysed the collected data. The fourth section presents the findings. In the fifth section, we discuss the findings, put forth an "open service innovation" (OSI) model and propositions, and bring out the theoretical and managerial implications of the research. We conclude with limitations, and avenues for future research.

2   Theoretical Background

2.1   Service Innovation

The literature on service innovation can be classified into three main approaches, namely assimilation, demarcation and synthesis (Gallouj and Savona, 2009). The main argument of the "assimilation" approach is that innovation in the service sector is primarily driven by the adoption of technologies (e.g., ICTs) (Gallouj and Savona, 2009). Research anchored in this school often suggests that key drivers of product and service innovation are similar, albeit with differences regarding their relative importance between the two contexts (e.g., Atuahene-Gima, 1996; Ettlie and Rosenthal, 2011). Nevertheless, the overemphasis on technology-based innovations and overestimation of technological dimensions have been reprimanded as showing ignorance of non-technological service innovations (Gallouj, 1998) and being too limited to describe the dynamic of innovation in services (Drejer, 2004; Gallouj and Savona, 2009).

In contrast with the assimilation approach, research in the "demarcation" approach focuses on studying distinctive features and concepts of innovation in services which, in turn, makes it difficult to apply knowledge and frameworks from a manufacturing context. Research taking this view often highlighted four unique characteristics of services, namely intangibility, heterogeneity, inseparability and perishability, which have been heavily criticised for their claim of universal generalisability to all services (Lovelock and Gummesson, 2004).

As a response to the limitations of the aforementioned approaches, we propose the S-D logic-based "synthesis" approach. The overarching idea of the S-D logic is that service, being defined as the application of operant resources (knowledge and skills), is the basis of all economic exchange – i.e., "service is exchanged for service" (Vargo and Lusch, 2008, p. 7). All economies are service economies; and goods are only a distribution mechanism for services (Vargo and Lusch, 2008). The S-D logic highlights the importance of operant resources (resources that are capable of acting on other resources) over operand resources (resources on which an operation or act is performed to produce an effect) as the fundamental source of competitive advantage in both service and product contexts (Vargo and Lusch, 2004; 2008). The S-D perspective seems particularly suitable for studies of innovation in services because it moves away from the distinction between products and services; thus providing an integrated, overarching view on innovation in both services and physical goods. Such an integrative approach is arguably the most suitable for studying the complexity of innovation (Drejer, 2004; Gallouj and Savona, 2009). Moreover, the traditional goods-dominant paradigm seems to fall short in explaining new forms of service innovation made possible by new technologies, such as cheap memory, high-speed internet, and powerful smartphones (Michel et al., 2008).

The S-D logic defines service as "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity and the entity itself" (Vargo and Lusch, 2004, p. 2). Moreover, it emphasises on "the collaborative nature of value creation" with the customers and others in the innovation network (Vargo and Lusch, 2008, p. 7). This logic is consistent with various theories frequently applied in innovation literature such as resource-based view (Barney, 1991), core competency theory (Prahalad and Hamel, 1990), customer-active paradigm (Von Hippel, 1978), and open innovation (Chesbrough, 2003).

With the S-D logic in mind, this study defines "service innovation" as "a value proposition or an offering not previously available to the firm's customers that requires either the innovating firm or the customer or both to renew, create, integrate and transform their collection of competences" (adapted from Lusch et al., 2007, p. 5). We argue that using S-D logic is appropriate for investigating openness in service innovation research for two main reasons. Firstly, the S-D view equips us with a new way of thinking about innovation by shifting the focus from trying to create and/or deliver new products/services; to finding new ways of co-solving customer problems (Michel et al., 2008). Secondly, unlike the goods-dominant paradigm which considers the external environment (legal, competitive, social, technological, etc.) as largely uncontrollable, the S-D logic views the external environments as operant resources with which the innovating firms should draw upon and proactively co-create (Lusch et al., 2007, p. 7). Therefore, the S-D logic's principles and its fundamental premises (FPs) are used as the analytical lens of the current study.

2.2 Service Innovation in Thailand

The literature on service innovation in Thailand is still in its early stages as well as the country's service innovation capability (i.e., service innovation capability index is 1.84 versus 2.29 for product innovation (Wonglimpiyarat, 2010)). The majority of innovation studies conducted in Thailand emphasises mainly on innovation in manufacturing contexts (e.g., Munkongsujarit and Srivannaboon, 2011; Numprasertchai and Igel, 2005; Sawang et al., 2007); only few have investigated innovation in services. Furthermore, most of the previous works tended to employ the assimilation approach portraying Thai service firms as merely technology users (e.g., Limthongchai and Speece, 2003; Sebora et al., 2009). To our knowledge, research taking the synthesis approach and investigating new services generation in Thai context is scarce. Furthermore, as pointed out by Uchupalanan (2000), who studied the historical development of IT-based service innovations in Thai banking industry, innovation in Thailand is different to those with more developed economies. At the national level, Thai innovative firms are facing four major inhibitors (Chaminade et al., 2012), which could make innovation in Thailand, or in other developing countries, different from and more challenging than in developed countries. First, networking at the local/regional level is underutilized; and supportive

mechanisms for networking is lacking. An absence of technical and market information for innovation is the second issue. Third, Thailand also has limited quality science and technology infrastructure both in terms of human resources and research institutions. Lastly, supportive institutions, such as venture capitals, government's incentive policies, intellectual property agencies, are weak and lacking compared to those in developed countries.

To boost Thailand's service innovation capability, the authors suggest that open innovation (Chesbrough, 2003) could be a remedy for the country's innovation problems and should be adopted as early as possible in the innovation process to promote creativity and innovation. Therefore, in the following sections, the current knowledge on the FFE of service innovation as well as openness in the FFE is described.

2.3   The FFE of Service Innovation

To be successful in service innovation, firms should use a systemic process for developing new services (de Jong and Vermeulen, 2003). Koen et al. (2001) suggested that activities involved in the development of new products or services can be grouped into three main phases, namely, front-end, development, and commercialisation phases.

The front-end phase of innovation, typically, begins when an opportunity is first considered worthy of further ideation, exploration, and assessment and ends when a firm decides to invest in or to terminate the idea (Khurana and Rosenthal, 1998). The front-end literature offers several frameworks emphasising stages/processes/activities. For example, Koen et al. (2001) suggested that the front-end of innovation involves five elements: opportunity identification, opportunity analysis, idea genesis, idea selection, and concept and technology development. Enkel et al. (2005) proposed a five-phase model structured in cycles and consisting of: knowledge generation, idea generation, opportunity identification, prototype development, and concept definition phases. In a similar but more parsimonious way, Alam (2006) identified a three-stage model of the FFE of service innovation, namely idea generation, idea screening and concept development. Thus, the main goals of the FFE are to generate as many ideas as possible and be able to select the most potential ones.

The front-end of innovation is particularly important to success because it is characterised as being highly uncertain and as the most information intensive phase (Alam, 2006; Moenaert et al., 1995; Verworn, 2009; Verworn et al., 2008; Zhang and Doll, 2001), thus often called "fuzzy front-end" (FFE) – a term first coined by Smith and Reinertsen (1991). Moreover, activities in the FFE have the largest potential for improvements with the greatest time saving and the least expense, in comparison with activities in the later phases. This is because the cost of generating several potential ideas is considerably lower than the cost of implementing any one idea (Reid and De Brentani, 2004).

In addition, success and failure of an innovation project often depend on the proficiency of front-end activities. Langerak et al. (2004) discovered that the proficiency in the firm's predevelopment activities (i.e., strategic planning and idea generation) directly affect new product performance. Similarly, Verworn et al. (2008) found that early reduction of market and technical uncertainty has a positive contribution on the innovation project's effectiveness. More recently, Markham (2013) empirically unearthed a positive and independent impact of front-end performance on overall success, time to market, market penetration and financial performance, even after controlling for the use of formal implementation processes, innovation strategy and champions.

We recognise that the quality of the development and commercialisation phases is also important, as "a company's capacity to innovate is only as good as the weakest link in its innovation value chain" (Hansen and Birkinshaw, 2007, p. 126). Nevertheless, according to Luoma et al. (2008), although resources used in the FFE accounted for only 10% of the total cost of new product or service development, 70% of the total costs are committed at this phase. Moenaert et al. (1995) also discovered that uncertainty has been reduced on average as much during the FFE in successful innovation projects as it has been during the whole cycle in unsuccessful ones. Therefore, we agree with Moenaert et al. (1995) on the idea that the majority of information acquisition and uncertainty reduction takes place in the front-end phase, while the later stages are mainly concerned with the implementation of the agenda developed during the front-end. Therefore, a focus on improving FFE performance could prove very fruitful, since such a phase is inexpensive to improve upon and has a significant impact on the outcomes.

The current study argues that the performance of Thai service innovation could be significantly improved with greater openness in the FFE. Firstly, since Thai innovative firms tend to face budget and supports constraints, focusing their efforts on front-end activities, that have a larger room for improvement and often much less expensive rather than on the following phases (Reid and De Brentani, 2004), could help them alleviate the problems. Also, sharing the risks of innovation with others early in the process where risks and uncertainty are high might help Thai innovative firms reduce costs and time to market. Furthermore, we think that Thai firms' underutilization of networking may be due to lack of trust and communication among partners. We therefore argue that innovation networks should be established as early as the idea generation stages. This could help build trust and encourage communication in the latter stages of the innovation process (Verworn, 2009).

2.4   Openness in the FFE Phase

For tasks involving very high uncertainty, such as the FFE of new product/service development, one of the strategies suggested by Galbraith (1974) is that a firm must create lateral relationships aiming to relieve the information-processing burden of a small number of decision

makers to others sharing the problem in order to effectively reduce uncertainty. This is consistent with the concept of open innovation (Chesbrough, 2003) which has a central idea of being more open to the outside world, i.e., "openness". Since no single firm can employ all smart people (Chesbrough, 2003), tapping into complementary operant resources of others (e.g., customers, suppliers, universities, etc.) surrounding the process of value creation is essential (Michel et al., 2008){Lusch, 2007 #567}. Opening up the innovation process by searching for external innovation sources and innovatively co-developing with other organisations can be highly rewarding (Chesbrough, 2003). Enkel et al. (2009) proposed an open innovation archetypes framework, consisting of an outside-in process, an inside-out process and a coupled process. However, while the inside-out process concerns earning profits from the generated ideas, the outside-in and coupled processes are relevant to idea generation activities taking place in the FFE phase. Therefore, in this study, we focus mainly on the outside-in and the coupled processes.

The "outside-in process" involves "enriching the company's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing" (Enkel et al., 2009, p. 312). Implications of such activities have been identified in the literature. For example, scholars have suggested a positive relationship between a firm's external knowledge search and its innovation performance (Chang et al., 2012; Chiang and Hung, 2010; Henttonen and Ritala, 2013).

The "coupled process" refers to "co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success" (Enkel et al., 2009, p. 313). Inter-organisational partnerships allow firms to gain access to and draw from diverse knowledge, resources and capabilities to generate innovative new products or services (Eisingerich et al., 2009). In addition, alliance networks may also be necessary in situations where economies of scale could not be achieved by a sole firm, and/or diverse skills, technologies and competencies are required (Chesbrough, 2011; Zeng et al., 2010). Co-creation with external partners, such as customers (Alam, 2006; Oliveira and von Hippel, 2011), business partners (Ordanini and Parasuraman, 2011), suppliers (Den Hertog, 2000; Hsieh and Tidd, 2012), intermediaries (Howells, 2006; Zeng et al., 2010), universities and research organisations (Fey and Birkinshaw, 2005), and firms operating in distant industries (Enkel and Mezger, 2013) have also been found to impact innovation success.

While the entire process of new product or service development could benefit from being more open, we argue that openness might be most useful in the FFE where the majority of information acquisition and uncertainty reduction takes place (Moenaert et al., 1995). Also, openness may be crucial to success of the FFE as it can help the front-end members generate a lot of ideas and select the right ones more effectively. In addition, since the risk of "cooperation failures" in innovation can be

reduced through previous experiences in partnership (Lhuillery and Pfister, 2009), early involvement of innovation partners might help strengthen the partnerships before venturing into the development phase, thus mitigating the risk.

In summary, we define "openness" as a concept involving both the outside-in and coupled processes, and propose that a development team's ability to open up the front-end process effectively is one of the key antecedents of FFE success, which may in turn impact on the ultimate success of the innovation project.

3 Research Design and Methods

The main purposes of this research are to uncover the key dimensions of openness competence within the FFE as well as to explore the role of openness in the FFE of service innovation. To achieve these aims, a theory-building case study approach is considered as an appropriate strategy for two reasons. First, given the limited amount of prior research on the FFE phase of service innovation (Alam, 2006), case study is a suitable method to identify patterns or to provide new perspectives about the phenomena (Eisenhardt, 1989). Second, we argue that the front-end of service innovation is typically fuzzy, unstructured, and requires multi-party involvement. Therefore, a case study strategy is particularly suited to such a poorly understood social phenomenon (Yin, 2009).

3.1 Research Context

Regarding the Thai context, the service sector is very important to the country's economy. The service sector was accounted for around 52 percent of Thailand's GDP and employed 49 percent of the country's employment. The government sees the crucial role of the service sector and aiming to push the percentages to 70 percent (Suriyatanin, 2015). Improvements in the country's service innovation are important to achieving such an ambitious goal. We focus on Thai online service context because it has been on the rise recently. According to a report by TNSO (2013), sales of e-commerce in Thailand had gone up from 427,460 million THB (~7,890 million GBP) in 2008 to 608,587 million THB (~11,240 million GBP) in 2011. In addition, there is an emerging trend of tech startups providing innovative online services in Thailand. In 2015, there were more than 60 tech startups funded by venture capitals and angel investors, compared to 3 funded startups in 2012 (Team, 2016). Even though online service innovation in Thailand is gaining momentum, it is still far behind those in NICs. For example, in 2015, there were 220 funding deals in Singapore compared to 60 in Thailand (Tegos, 2016). This may partly due to those constraints of service innovation in Thailand discussed in section 2.2, which, in our opinion, could be alleviated by the use of a more open approach to innovation. The findings could help guide service innovation practitioners in both Thailand and other developing countries with similar limitations.

3.2 Data Collection

Since the purpose of this study is to inductively develop theory, our case selection strategy was driven by "purposeful theoretical sampling" (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Yin, 2009). The particular approach that we took was "polar types, in which a researcher samples extreme (e.g., very high and very low performing) cases in order to more easily observe contrasting patterns in the data" (Eisenhardt and Graebner, 2007, p. 27). We used online service innovation projects as the unit of analysis and targeted two types of project: projects with an open FFE and projects with a closed FFE. Those with an "open" FFE are expected to externally search for ideas and knowledge and extensively co-develop with external partners, while those with a "closed" FFE search more narrowly and have very few innovation ties, if any, with other organisations. To be more specific on the distinction between "open" and "closed" cases, while all of the online service projects that we interviewed searched external sources to some extent during the FFE, the more "open" ones employed knowledge sources that are more difficult or more costly to gain access, such as events, seminars, and universities. The more "closed" cases sourced information and knowledge mainly from users, the internet and competitors which relatively less costly and easier to gain access. In addition, the more "open" cases collaborated with a greater number of external partners as well as put more effort and resources into the innovative cooperation (see Table 2).

In terms of data collection, following Yin (2009), preliminary interviews were conducted to screen for possible candidates. A set of screening criteria was used for the selection process. The criteria were: (1) the projects are an online service innovation, (2) the projects fit into the open versus closed categories, and (3) the FFE phase is completed. Our target population is firms who have recently introduced new online services. We searched the internet for news on introduction of new online services and contacted those firms in the news. However, asking those firms to openly talk about their front-end process was very challenging. The first author (a Thai national) who conducted the interviews was only a PhD candidate at that time, so it seemed to us that he did not have adequate social status to attract attention from the management of those firms. In addition, since this study is exploratory and focuses on theory development, rather than confirmation and generalization, representativeness of the sample is not the essence here. Accordingly, we decided to change our strategy to snowball sampling. Initially, we contacted the first author's acquaintance working in 2 online service firms. From the initial contacts, we were able to gain access to 9 firms developing 11 online service innovations. We spoke with the person who participated in the FFE of their most recent online service innovation project. The respondents were asked about the project description, their responsibilities, and external sources and partners involved in the FFE. All 11 projects were analysed against our three screening criteria and then the "polar" projects were selected, i.e., the three projects that were most clearly open and the three projects that were most clearly closed. The six projects and

the five firms from which they were drawn are shown in Table 1. The bulk of the data collected were interview scripts gathered by semi-structured in-depth interviews of 12 participants. The participants were those who involved in the FFE and were willing to be interviewed. In all of our cases, front-end participants tend to be management, such as executives, project managers and senior developers as displayed in Table 1. The data collection period was four months (May to September 2013).

The length of each interview was between one and one and a half hours. The interview questions were developed based on an initial conceptual framework regarding openness in the innovation process. We avoided using academic language and encouraged the interviewees to express their thoughts in their own words. At the beginning of each interview the researchers explained the key terms being addressed in the questions (e.g., the front-end phase, service innovation, openness, etc.). Each interviewee was asked the same set of questions focusing on the background of the project, the role and importance of the project to the organisation, the interviewee's role in and key activities of the FFE, issues faced during the FFE, performance assessment and whether/how they opened up. However, the order of the questions was varied depending on the flow of the discussion. The nature of the interviewing was open, which allowed new ideas to be brought up. Whenever interesting ideas came up, they were further explored by improvised questions. The interviews were audio-recorded and transcribed verbatim in Thai; and, after the analysis, relevant quotes were translated into English by one of the researchers and a professional translator. The names of the participants and the organisations have been anonymised in the interests of confidentiality.

3.3   Data Analysis

Our data analysis process followed the recommendations delineated in Eisenhardt (1989) and Miles et al. (2013); we first undertook within-case analysis and then searched for cross-case patterns. The within-case analysis was conducted in a two-cycle fashion as suggested by Saldaña (2009). In the first cycle, the interview transcripts were read carefully, analytic memos were written, and codes were applied to the data chunks. Specifically, based on code typologies suggested in Saldaña (2009), structural, descriptive, in vivo and process codes were used. In the second cycle, we worked with the resulting codes from the first cycle, and pattern coding was employed. We grouped the first-cycle codes into a more meaningful and parsimonious constructs. This process laid the groundwork for the cross-case analysis (Miles et al., 2013).

For triangulation, in addition to interview questions on how the interviewees evaluated success, we conducted a follow-up survey by asking the project manager of each case about whether the innovation project achieved their initial success objectives (Appendix A). Moreover, we also collected additional data from other sources including websites, online articles, statistics available on the Internet, Apple's App Store, and Android's Play Store (Appendix B).

Regarding the cross-case analysis, a case-oriented strategy was used (Miles et al., 2013). Specifically, we made comparisons between types of innovation projects that share patterns (i.e., open and closed front-ends classified by the number of external sources and partners of innovation used in the FFE phase – see Table 2) with the aim of unearthing tentative relationships between the constructs. To make sure that the emergent propositions fit with the case data, we also iteratively compared both the constructs and the relationships between the constructs with the evidence from each case (Eisenhardt, 1989). The next section describes the findings of this study.

4   Findings

The background information of all cases can be found in Table 1. The cases involve online service innovations in forms of either mobile or web application or both. The first three cases (Case 1 - 3) are classified as being more "open", while the other three (Case 4 - 6) are more "closed", based on the criteria described in Section 3.2. The analysis results and relevant quotes are presented below.

4.1   Openness Activities in the FFE

Throughout all open cases, the informants mentioned various activities that were employed to promote openness in the FFE phase. The results suggest that there are three key openness activities in the FFE, which are external search, inter-firm partnership and customer experimentation.

4.1.1   External Search

In all three open FFE cases, searching for knowledge and ideas from external sources were used to a great extent (see Table 2). In the more open cases, external sources being employed during the FFE require a higher level of effort, such as attending events and seminars, as well as consulting university professors, as the project manager of Case 1 described:

"Wherever there were events or conferences for teachers involving the use of ICT in education, we would definitely participate. We wanted to listen to the senior officers [in the Ministry of Education] for their vision about the direction of Thai education. They often mentioned about what [kind of services] they want to see in Thai education system, which no one is providing. In addition, in this kind of event, we also met other firms who are developing educational applications as well as government agencies, such as SIPA [Software Industry Promotion Agency]. This allows us to know what the others were doing." (Project manager – Case 1)

Table 1: Summary of the cases in this study

	Firm (size)	*Project description*	*Overall development time (year started)*	*No. of informants*	*Type of informants (Years of exp.)*
Case 1	Firm A (Medium)	An e-learning system including a website and a tablet application. The system can be explained as a simple process initiated by the teachers. Teachers create exercises or exam papers on the website. Students complete the exercises and get the results instantly on their tablet. Finally, on the tablet, parents monitor their child's scores and progresses as well as feedbacks from the teachers. The firm is the first to provide online classroom exercise services in Thailand. Although there are several similar systems in other countries, one of its unique functionalities is that, in addition to the ability to provide the correct answers and results for the exercise instantly, it is able to give detailed explanations on why those answers are correct.	7 months (2012)	2	- Project manager (2) - Senior developer (4)
Case 2	Firm A (Medium)	This service innovation was developed by the same company who developed the project in Case 1. It involves a web application that empowers ordinary users to create their own mobile application on most of the platforms available (e.g., iOS, Android). Its distinctive functionality is "loyalty programme management". Thus, its target customers are individuals and small shops who want to have their very own mobile application. In addition, the firm also provides a tailor-made service targeting on large organisations who want to add very specific features to their mobile application. Nevertheless, the tailor-made applications are built on the same platform used by typical customers. Such a concept considerably reduces the costs and time needed to develop a made-to-order mobile application.	6 months (2012)	2	- Project manager (4) - Business development manager (4)
Case 3	Firm B (Small)	A mobile application that allows buyers and sellers to meet. When a seller want to sell a product, he or she starts with snapping some photos of the product. The second step is to apply some tags to help buyers find it when they search. The final step is to post the product's photos and details – e.g., a short description, the price, and the preferred payment methods. The whole process can be less than one minute. For the buyers, they can casually scroll through the visually endless list of	3 months (2012)	3	- Chief technology officer and co-founder (5) - Marketing director and co-founder (4) - Senior designer (3)

		merchandises on their smartphone. When a buyer finds the product that he/she wants to buy, he/she can have a private conversation with the seller through the application's messaging system to find out more about the product. However, the application does not provide any tools to facilitate online trading – e.g., online payment systems, tracking systems, etc. It only provides the private messaging system that allows sellers and buyers to negotiate the prices and to discuss on how and where the exchange will take place.			
Case 4	Firm C (Small)	A web application that allows people to create their own e-commerce website without having any computer programming knowledge. The website provides website creation tools with drag and drop features, shopping cart, online payment, and shop administration systems. Even though the concept of website creator was not new, some of the functionalities provided by the website were highly advanced and new to Thai market at the time that the project started in 2009. Some examples are high levels of customisability and mixable website templates.	24 months (2009)	2	- Chief executive officer (4) - Managing director (4)
Case 5	Firm D (Small)	A website that compares the prices of merchandises being sold on Thai e-commerce websites. The website is the number one price comparison website in Thailand. At the time that this project started, there was no other price comparison websites and online shopping in Thailand was still in the infancy stage. Due to its first-mover advantage, the website now has the largest variety of merchandise as well as user base.	12 months (2009)	1	- System architect and co-founder (7)
Case 6	Firm E (Medium)	A mobile application for Android devices that supplies stock market information and allows the users to trade stock anywhere and anytime on their mobile. Firm E who developed OnlineStockTrade is a subsidiary of the Stock Exchange of Thailand. The company core businesses involve operating Thailand's stock trading system and providing channels for investors to complete stock trade transactions and to obtain stock details and information. The firm developed this project with the aim to provide a new channel for investors who use Android devices to be able to access stock information and to trade in the stock exchange market of Thailand.	3-4 months (2012)	2	- Project manager (4) - Senior marketing executive (2)

The result of being proactively open up the front-end phase could be a radical transformation of the core service concept as the business development manager in Case 2 described:

"When we participated at 'CommunicAsia' in Singapore last year [2012], we received customer comments saying that 'This loyalty programme application is what I wanted, this is the right feature but I want to have it with my shop's name […]. The product transformed to becoming an application creator specialised in the loyalty programme features." (Business development manager – Case 2)

Instead of just searching through the internet or exploring competitors' products in an office, people involving in the open FFE got out of their building in order to search for ideas and knowledge. One of the drivers pushing them to go out was top management with open-mind and outward-looking attitudes as suggested by the marketing director and co-founder in Case 3:

"Actually, initially most of our team prefer working in their comfort zone. However, our visionary CEO told us that he adheres to the principle that you have to get out of the building in order to ask others for ideas or attend seminars. […] Finally, we tried to find the time to go out." (Marketing director and co-founder – Case 3)

However, to be able to absorb knowledge effectively and efficiently, the respondents in open and closed cases emphasise the crucial role of prior related knowledge. A participant pointed out that relevant background knowledge help him acquire new knowledge more easily and quickly.

"Actually, my background was not graphic designer. I was a furniture designer before. […] Since I have an undergrad degree in product design, it was like I had the foundation knowledge of design. I just had to do some additional study in the Internet on the basic rules of [mobile] application or website design." (Senior designer – Case 3)

One of the informants similarly stressed on the importance of past experience to the team's ability to learn. While past experience enables learning at a sophisticated level, only basic knowledge could be obtained in the situation when past experience is lacking:

"We had a problem with the [mobile] application part in which we never implemented before. Basically, we could develop it. We could make it work. However, we did not know how to make it work well because we had not had any background about it before." (Project manager - Case 6)

In addition, the project manager of Case 1 indicated that her previous experience working as a teacher help her decide which ideas from similar foreign products should work in Thai context.

"I looked at several competitors. […] For example, Blackboard which has a lot of features. Too many. Some would never been used [if it were to be used in Thai school]. So, I used my own

experiences, when I was teaching. [To decide] What a [Thai] teacher really need? Based on my direct experience. I also talked with my friends, who are teachers, asking them for additional requirements." (Project manager – Case 1)

However, from the data, we were able to unearth an issue that comes with external search. Openness often generate great amount and variety of ideas that came from external parties with different background, experience and requirements. However, since startup firms typically do not have enough financial and human resources to pursue all interesting ideas, prioritising those ideas is therefore an important issue. To deal with such a problem, the interviewees suggested two approaches. First, the informants identified relevant background knowledge and previous experiences on similar projects as important when deciding on which ideas to focus. The second solution involves customers who pay and use the innovation. In Case 3, an informant mentioned on how they prioritised ideas:

"They [mentors and investors] threw some interesting business ideas at us and suggested on the functions that we should have. In the end, it was up to us whether to implement them. However, we usually asked the users [by inviting them into the office to conduct experiments]. They helped us make the decisions. Not necessary to just sit with them and talk with them. We also collected [users'] usage data, such as click streams, browsing history, etc." (CTO and co-founder – Case 3)

4.1.2 Inter-firm Partnership

The closed cases involved less or no external partners in the FFE phase when compared with their open counterparts (Table 2). In addition, the more open FFEs put a lot more effort into opening up the front-end phase. Not only gathering knowledge from more demanding external sources (e.g., events, seminars or universities), they also collaborate with external organizations which seemed to be very costly as well. In Case 1, the FFE team tested their concept by piloting their prototype in a real classroom environment. A public school agreed to participate but they did not currently use tablets in classes, so the team had to collaborate with a government agency for the provision of the needed devices. Similarly, in Case 2, the team assigned a person to take care of their partners whom they developed mobile applications for them with no charges in exchange for valuable customer insights. For Case 3, the team's cooperation with an innovation accelerator, mentors, and investors was mandatory because they attended a boot camp organized by the accelerator. However, all three interviewees agreed that the cooperation was hugely beneficial. The collaboration not only helped them consolidate their core service concepts but also taught them on how to run a startup company.

In the open cases, the respondents reported that they had put in a lot of effort to ensure smooth communication and collaboration with their partners by, for instance, having a dedicated contact

person, constantly updating the partners on the project's progress, and trying to learn their partners' needs as an interviewee commented:

"We assigned one marketing staff to support [the partner and pilot organisations]. […] This one person – his job was to closely take care of the partners who co-developed their (mobile) application with us. What are their needs? Does our system capability match their needs?" (Project manager – Case 2)

Table 2: Activities and structural factors promoting openness in the FFE phase

Activities/Structural Factors	Open FFE			Closed FFE		
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
External search						
External idea and knowledge sources:						
- Events and seminars	●		●			
- Academics	●	●				
- Similar and/or competitors' products	●	●	●	●	●	●
- The internet	●	●	●	●	●	●
- Customers/end-users	●	●	●		●	
- Government agencies				●		
Inter-firm partnerships						
External partners:						
- Pilot organisations	●	●				
- Government agencies	●					
- Intermediaries			●			
- Consultants					●	
- Suppliers		●				
Customer experimentation	●	●	●			
The presence of a workable prototype for early customer experimentation	●	●	●			

'●' represents the innovation source, partner and activity in the leftmost column involved during the FFE.

On the other hand, lack of mutual interests and limited collaborative efforts could resulted in coordination problems and project delays:

"There was a problem regarding the coordination between the ministry of ICT and the pilot school – about documentation. This is because both parties had to sign a mutual agreement document concerning the pilot of the SmartEdu system. […] The document that we had written was agree upon by the ministry of ICT, whereas the director of the school suggested that some should be added to the document. Sometime, the time frame of each party conflicted. […] As a result, the

delivery of the tablets had to be postponed and, consequently, the pilot sessions had to be postponed as well." (Project manager – Case 1)

We also found that limited prior related knowledge hinders smooth communication among the parties involved in the co-creation process. Specifically, seamless collaboration among all front-end parties requires a sufficient level of background knowledge:

"Since our partners were not in the IT business, they sometimes did not know what they really wanted. So, our marketing team had to interpret their requirements, their problems. Occasionally, this led to confusion or missing the main points." (Project manager – Case 2)

4.1.3   Customer Experimentation

In all three open cases, the participants mentioned about involving customers early in the innovation process. They extensively invested time and resources to work closely with their customers to solidify their service concepts. Furthermore, it is notable that, in all three open cases, the informants suggested that, since the innovations were quite new to the market, the presence of a workable prototype was vital to successful customer experimentation.

For Case 1, one of the interviewees reported that she piloted the prototype of her product in a primary school during the FFE phase. The team collaborated with the school and a government agency providing tablets used in the pilot. The intention was to observe both teachers' and students' behaviour in order to make improvement and uncover hidden requirements.

"We interviewed students, parents, and teachers who piloted the system. […] We observed the classroom when the teachers and students used the application. We observed the students' actions. For example, the application provides four ways of answering a question, i.e., multi-choice, yes/no, short text and long text. We wanted to know how the students answered the questions and their typing habits in order to make modifications, such as what changes should be made to the UI [user interface]." (Project Manager – Case 1)

In the FFE of Case 2, the team partnered with several of their target customers (i.e., small shops and SMEs who would like to have their own mobile application). They went to the customers and asked for their feedback on the product. However, since the concept of creating a mobile application on a website was very new at the time, the team had to work closely with the customers to help them create their own application on the platform. The objectives of these experiments were to:

"[We wanted to know] What they think of our product? To check their attitude toward this kind of services. Do they think they pricing was too high? What additional features that they [the customers] want in order to help them grow their business." (Project Manager – Case 2)

The FFE team of Case 3 relied heavily on the customers. The team invited 5-10 customers into their office. They conducted an experiment by showing the customers their workable prototype and observed the customers' behavior. In addition, when there were several competing ideas that they could not decide, they designed a selection of screenshots based on those ideas and let the customers make the decision as the senior designer of Case 3 described:

"We invited the customers in and let them use the app [the prototype] until they reach the point that we think it was problematic. We observed whether they have the problem that we think they would have had. If they got stuck, we then asked their opinions and expectation. After that, we showed the screenshots and ask the customers to choose. If they said none of the screenshots help, we would modify the screenshots according to their comments [on the spot]." (Senior Designer – Case 3)

4.2   Openness Activities in the FFE and Success

When being asked about success, the informants reported various success measures that they used, such as customer feedback, sales, profitability, number of downloads, transaction volume, website stats, etc. Table 3 displays how the informants articulated project success and the project success survey results (Appendix A). Table 4 shows links between openness activities in the FFE and the overall project success (i.e., the "success ratings" in Table 4 are based on the synthesis of the interview data and the follow-up survey results in Table 3). The information in both tables suggests that, unlike the closed cases, the more open cases put a considerable amount of effort into opening up the FFE process and, as a result, they are more likely to be successful.

Early openness is likely to result in a more robust service concept. For example, in Case 3, the team had an opportunity to attend a 100-day seed accelerator programme organised by an intermediary firm. At the end of the programme, the team pitched their product to a group of investors. Finally, they got an investment fund of more than 500,000 USD. The front-end process of this project was described by the marketing director and co-founder:

"At the beginning, we hardly did anything we just designed screenshots and put them on a website for people who were interested in using our service to register. This let us know that the concept was needed and traction can be built. We then brought the concept forward and developed a prototype to test with the users. […] Risks and uncertainties were gradually reduced in each step." (Marketing director and co-founder – Case 3)

Moreover, opening up for ideas in the front-end can sometime revolutionise the core concept of an innovation. This happened in Case 2 where the core service concept was changed from a mobile application that intended to be a replacement for paper loyalty cards to a platform that allow shop

owners to create their very own mobile application with loyalty card features. The former was later become, as commented by an interviewee, the company's "flagship" product.

In addition, early reduction of technological uncertainty using a more open approach was found to be crucial in narrowing the technology-related knowledge gaps. The informant described how studying mistakes made by competitors was helpful:

"Because we saw how the competitor's servers went down, we put preventive measures at the very beginning of the development process. The main problem of this particular competitor was that their servers went down quite often and for a long period of time which put off the customers. The cause [of the problem] was that they have only one set of servers to serve several hundred thousand stores [customers' online stores]. So, the failures are unavoidable. We, therefore, split up our system into many sub-systems […] to mitigate the risks." (CEO – Case 4)

In contrast, lack of openness activities in the front-end phase can also lead to considerable hardship in the following phases. For example, there were several market-related and technical issues in the commercialisation phase of Case 5:

"Yes, there were a lot of problems [after the launch]. We thought that the traffic will come. However, the reality was very few people visit our website. […] Problems kept coming actually. Sometimes, we added new features and no one even used those features; or we could not make money as much as we thought we should have, so we added more features which slowed down the website. We had to keep fixing the problems." (System architect and co-founder – Case 5)

To sum up, the findings suggest that being more open early in the innovation process can lead to positive outcomes later, as it allows the team to solidify their service concepts early as well as helps reduce risks and uncertainty which are typically high in innovation development projects.

4.3 Why not open?

As we showed earlier, openness in the FFE can be linked to innovation success. Despite that there are many firms that still take a more closed view to the FFE. The data that we had collected from closed cases suggest several underlying motives for those dismissals.

In all three cases with a closed FFE, the front-end team tended to be inward-looking. For example, the senior marketing executive in Case 6 explained why they did not involve the customers in the front-end phase of the project:

"If we asked for their [the customers] comments in the early stages, the development process would have been more difficult. Because it would be chaotic if someone were to direct us 'you should put this button here', 'labels should be named like this or that' or 'I want this colour not that one'.

Moreover, since this product belongs to our company, […] we should have the control on how the design or the usability should be so that the final product will have the scent of our company or have our signature on it." (Senior marketing executive – Case 6)

From our cross-case analysis, we also found that resource and time constraints seem to hinder openness in the FFE. As we described in Section 4.1 and 4.2, the more open cases tend to invest considerably more attention, time and resources to opening up the front-end. In contrast, the importance of the FFE seemed to be overlooked in the closed cases. The FFE was short and the team did not pay much attention to evaluating their ideas.

"Actually, we did not spend much time [on the FFE]. Because we are developers we just roughly visualised the product concept. […] The idea generation phase was very short. We started developing some of the parts and then went back to discuss how we can improve the product." (CEO – Case 4)

One reasons behind the overlooking may be financial and time constraints faced by the front-end teams as the participants in Case 5 and Case 6 described:

"At that time [i.e., the FFE phase], we were all working part-time on this project. We just wanted to break even and the website can continue running by its own money. […] We were not really worried about anything. If it did not work and we had to shut it down, it was fine." (System architect and co-founder – Case 5)

"Android [phones] has a screen resolution problem. So, we decided to do it differently from other products in the market. The competitors' are native apps, but ours is web embedded in app. As I mentioned earlier, we tried minimise the efforts [at that time, the team thought that the number of Android users in Thailand was low and the trade volume would be insignificant]. We just wanted to provide users with another trade channel and basic stock information." (Project manager – Case 6)

Interestingly, in two of the closed cases (Cases 4 and 5), the participants argued that, since the concepts of the service innovations were not very new, they know both the technology, the market and the customers well. Further, they also articulated that their front-end members possessed most necessary knowledge, thus limited need for external knowledge:

"I did not ask for ideas or help from others outside because I used to develop e-commerce websites and also involved in almost every stage of e-commerce processes. […] Therefore, I think that I know what a [e-commerce] website wants. […] I and another in the team [who also have background knowledge about e-commerce] understood the user's perspective to some extent, so we hardly asked for comments from the outside." (CEO – Case 4)

Table 3: Success measures mentioned by the interviewees

	Success measures	*Survey Rating****
Case 1 (Open)	**(+) Positive feedback from prospective customers:** "When we were trying to pilot our system. […] The teachers of the pilot school that we contacted seem to be happy and very co-operative. Initially, we wanted to pilot in only 2 subject areas. It turned out that more teachers than we expected were interested and wanted to try as well. Consequently, we piloted in 4 subject areas."	**6.5**
Case 2 (Open)	**(+) Positive feedback from prospective customers:** "Since we launched, we have participated in 3-4 exhibitions. In every exhibition, we had got interests from prospective customers. Some contacted us and now in the negotiation process." **(+) Custom-made Sales:** Several mobile application development projects have been sold to organisational customers. The applications were built with the system which significantly reduce development time and costs. **(+) B2B Sell:** The firm was in the process of signing a contract with a large communication firm to sell a bulk of credits for using the application creator service.	**5.33**
Case 3 (Open)	**(+) Traction*:** More than 70,000 downloads (25-30% are active users) and 800 new items are being listed by the merchants every day. **(+) The ability to attract investment funds:** The firm received funding of more than 500,000 USD from two venture capital firms to support the development of the service innovation. **(-) Profitability:** The application has yet to make money because the firm has yet to find an appropriate business model.	**5.83**
Case 4 (Closed)	**(+) Traction:** More than 100,000 shops in the firm's system. **(+) Market share:** "In terms of customer base, we are number three in the market. Currently, the big three are market.com, shop.com and us. In the past, who was the number three was not very clear." **(+) Transaction value:** Transactions running on the site worth more than 8 million GBP in 2012. **(-) Profitability:** "The income target that we thought we would achieve was quite high. However, when we launched the first service, we got only 20,000 – 30,000 Bath (~ 400 – 600 GBP) in that month." (i.e., they just started making profit in March 2013) **(-) Development time:** almost 2 years	**4.83**

Case 5 (Closed)	**(+) Traction:** More than 100,000 unique IP per day. **(+) Market share:** Number one price comparison website in Thailand **(-) Profitability:** The website has been online since 2010 but it just started making profit in 2013. **(-) Failure of the initial launch:** When the website was first launched in 2009, it suffered from many technical problems and was not able to build traction. The website was therefore relaunched in 2010 with a new design based on what the team had learned from the first website.	**2.17**
Case 6 (Closed)	**(+) Traction*:** More than 100,000 downloads **(-) Negative users' feedbacks*:** Average rating of 2.7 stars from 860 users. Some of the comments from the Google Play Store were, for example, "Why this update want to know my (fine GPS) location? :(-- The program took too long to retrieve data." and "Need to improve much more. The interface isn't appealing, looks kinda awful. Needs to match or outdo iOS version.") **(-) The plan to revamp the application:** The firm is now considering redeveloping the application entirely as a native Android application which theoretically should improve the performance and user experience.	**4.83**

* The information was gathered from Google Play Store (access on 19 January 2014).
** The informants' perceptions of the project's success (mean value of the response, i.e., min = 1 and max = 7).

Table 4: The impact of front-end openness on service innovation success

	Openness activities	*Success Rating**
Case 1 (Open)	They actively participated in seminars and events related to education and technology. Additionally, domestic and foreign competitors' products were studied.	☆☆☆☆
	Users and education professionals were consulted; and they also collaborated with a school in piloting the prototype.	
	People with previous background in education were recruited for concept development and IU design in the FFE phase.	
Case 2	Since the product concept was very new in Thailand, they did a lot of market research and studied similar foreign	☆☆☆☆

(Open)	products.	
	They involved prospective customers early to test the prototype.	
	People with the strongest technical background in the firm were teamed up to study the technological feasibility of the new service concept.	
Case 3 (Open)	The informants stressed on the importance of having the simplest version of the new service concept (a workable prototype) and customer involvement. A first iteration of the product with only core functions and with minimum effort and time was used to learn about the customers and the market.	☆☆☆
	The opportunity to participate in the 100-day boot camp and co-develop with the intermediary was pointed out as very important. A number of mentors were consulted regarding technological, design and methodological issues.	☆☆
Case 4 (Closed)	The informants suggested that asking the users is time-wasting. So, they made all decisions concerning the website functionalities by themselves as some people in the team had experienced with developing and running e-commerce websites before.	☆☆☆
	The team studied technical mistakes made by the competitors. This resulted in several preventive measures.	
Case 5 (Closed)	Competitor's products were studies; and friends were consulted regarding usability issues. Also, a consultant was hired to design the website.	☆
	They did not concern much about technical uncertainty during the front-end phase since they were confident in their technical knowledge.	
Case 6 (Closed)	The informants described that none were done to reduce uncertainty since the main objective was just to provide another channel to the existing service with minimum effort.	☆☆
	Lack of experience in mobile application development was mentioned as a main issue. Therefore, they tried to improve that by sending the developers to trainings, searching the internet and consulting experts.	

*The ratings were given by the authors (ranging from 1 star to 5 stars). They are based on a compilation of the information in Table 3.

5   Discussion

By comparing and contrasting the cases in the two polar categories (i.e., open FFE vs. closed FFE), we were able to identify an interesting pattern. Unlike the closed front-ends, in the open FFE cases, more effort had been made to open up the FFE, which leaded to successful outcomes (Table 4). The information-processing theory (Galbraith, 1974) could be used to explain such a pattern. Specifically, the open teams might try to increase their information-processing capacity by exploring and assimilating information and knowledge externally (Brunswicker and Hutschek, 2010; Chang et al., 2012), and to share the information-processing burden by co-developing new products or services with external partners (Ettlie and Pavlou, 2006; Tsou and Chen, 2012). Furthermore, we also found that in open cases, customers were involved early. They were invited to participate in experiments and pilots so that the FFE team can gather ideas and elicit hidden requirements. Consistently, scholars have also suggested the important role of users or customers in service innovation (Oliveira and von Hippel, 2011; Von Hippel, 2005). Accordingly, we argue that if a FFE team open up by externally searching, building inter-firm partnerships, and conducting experiments with customers, the project is likely to be successful as the team enhance its information processing capability through openness.

5.1   Openness Activities in the FFE

As S-D logic's foundational premises (FP) no. 4 indicates "operant resources are the fundamental source of competitive advantage" (Vargo and Lusch, 2008, p. 7), we found that the first key activity concerns external searching of knowledge and sources of innovation (i.e., operant resources) with external and wider orientation rather than internal and narrow sources. In all three open cases relatively more effort were put into knowledge gathering activities in the FFE and innovation sources that are costly to gain access were used. In addition, the data also indicate that a front-end team with open-minded and outward-looking characteristics is likely to actively engage in external knowledge searching more widely and frequently, which leads to more successful outcomes (Chang et al., 2012; Chiang and Hung, 2010; Henttonen and Ritala, 2013).

Vargo and Lusch's (2008, p. 7) FP9 (i.e., "All social and economic actors are resource integrators") suggest the significant role of innovation networks in new service development. Our results show that the more open FFE teams saw the importance of collaboration with other firms and, as a consequence, spent more time and resources comparing to their closed counterparts. The outcomes of those collaborations are considered very successful by the interviewees. Consistently, scholars have identified the importance of communication in stimulating creative thinking and idea generation in the early stages of service innovation (Blazevic and Lievens, 2004), as well as

highlighting the role of innovation networks (de Vries, 2006) and the firms' ability to co-create with other organisations (Chen et al., 2009a; Tsou and Chen, 2012) as essential for innovation success.

Finally, as FP6 (i.e., "the customer is always a co-creator of value") of the S-D logic suggested, it is crucial to involve customers as early as possible in the innovation process. Consistent with the S-D logic, this study found that customers were intensively consulted during the FFE of the three open cases. The literature on user innovation has suggested that, in product innovation contexts, users and producers tend to develop different types of innovations (Oliveira and von Hippel, 2011). This is because users usually have a more accurate and more detailed picture of their needs while manufacturers have the specialised skills required. As a result, users tend to develop innovations that are functionally novel incorporating technologies in their everyday life, while manufacturers tend to develop innovations that include cutting-edge technology to solve well-known needs (Riggs and von Hippel, 1994). However, for services, the innovation process has often been described as a value-co-creation process (Maglio and Spohrer, 2008; Vargo and Lusch, 2004) and users are viewed as an important co-creator (Alam, 2006; Vargo and Lusch, 2008; Vargo and Lusch, 2004). In contrast to manufacturing firms, the majority of innovative service companies are considered as technology users (Den Hertog, 2000; Miozzo and Soete, 2001). In other words, rather than creating new technologies, innovative service firms adopt technologies already exist in the market to enable new services that help solve customers' problems more efficiently and effectively. Accordingly, we argue that early customer involvement may be more vital to success of service innovation than to product innovation success; because, for service innovation, both service providers and users (lead users in particular) are likely to have similar levels of knowledge about the technology. Nevertheless, users are likely to have a more accurate model and insight on their needs than service providers have.

From the discussion above, we propose our first proposition related to three key openness activities in the FFE: external search, inter-firm partnership, and customer experimentation. It is important to note that, while the two former activities are significant to success in both service and product innovation, the last activity may be more important to the front-end phase of service innovation that to the FFE of innovation in products.

Proposition 1: There are three main openness activities in the FFE of service innovation which are external search, inter-firm partnership, and customer experimentation.

5.2 Key Dimensions of FFE Openness Competence

Based on the case data, we propose four dimensions that may positively influence a FFE team's propensity to successfully executing the proposed three openness activities in the front-end.

Those dimensions are aggregately called "FFE openness competence" comprising of: prior related knowledge, open-minded top management, the presence of workable prototype, and slack resource.

Our first dimension of FFE openness competence captures the vital role of operant resources possessed by the FFE team. Prior related knowledge is often suggested as an antecedent of innovation performance by the literature on absorptive capacity (Chen et al., 2009b; Zahra and George, 2002). Prior related knowledge enhances learning, problem-solving skills and creativity (Cohen and Levinthal, 1990). Furthermore, it allows the innovation team to comprehend from the external environment important trends and know-how (Lusch et al., 2007). Our data suggest that the possession of sufficient prior related knowledge by the participants is a prerequisite for seamless innovative cooperation and allows the FFE team to search more efficiently and to learn complex knowledge.

Proposition 2a: A sufficient level of prior related knowledge of the FFE team allows effective execution of the key front-end openness activities.

Interestingly, we also found that, in two of the closed cases, the participants did not actively engage in external knowledge sourcing and inter-firm partnerships because they were confident in their knowledge of the market and the technology (Table 4). One of the explanations may be that, since the service concepts and the technologies employed in those cases were not very new, the degree of uncertainty may not be as high as the more open cases, and thus a team with strong background knowledge may be sufficient. A similar relationship between innovation novelty and intensity of knowledge sharing and communication has also been found by Hsieh and Tidd (2012). Consistently, Atuahene-Gima (2005) found that exploiting existing competencies is positively related to incremental innovation performance but has an adverse effect on radical innovation performance.

Proposition 2b: In projects with low to moderate innovativeness, a high level of prior related knowledge could be used to substitute for external knowledge sourcing, innovation partnerships and customer experimentation.

The second key dimension is top management's positive attitude to openness. In one of the open cases. The informants reported that top management commitment to openness was the main driver to their efforts to open up the FFE. This may be because top management who recognises the importance of openness is likely to encourage the FFE team to search and collaborate with other parties. The encouragement was in forms of, for instance, encouraging speeches, knowledge sharing sessions, knowledge-sharing facilities, and resource dedication for openness activities. The CTO and co-founder of Case 3 described how he encourage openness in his front-end team:

"We had weekly meetings for sharing new ideas. For interesting ideas, I asked the team to dig deeper. […] When an [competitor's] application shut down, I asked [the development team] for its

flow chart and the reasons why this particular app was shutting down." (CTO and co-founder – Case 3)

This is consistent with the extant open innovation literature since such a support is essential in creating an organisational setting that facilitates and encourages learning behaviours (Blazevic and Lievens, 2004). Chiaroni et al. (2011) conducted a case study of early adopters of open innovation in Italy and suggested that strong commitment from top management was crucial to the initial stages of a firm's journey towards open innovation. This enabling role of top management is also well established in the literature on strategic change (Brunninge et al., 2007; Wiersema and Bantel, 1992). In contrast, the data from the more closed FFEs suggest an inward-looking mind set of the front-end members which, in our opinion, could be due to a lack of top management's support for openness. Thus our next proposition is:

Proposition 3: Top management's positive attitude towards openness is an important motivation behind the FFE team's ability and willingness to open up the FFE phase.

Resource slack allows the FFE team to have more flexibility to take advantage of potential opportunities by incorporating ideas and knowledge from outside of the firm boundaries (Sisodiya et al., 2013). This was support from the evidence in Case 2. Opportunities obtained from prospect customers in an event that the team attended were pursued and eventually transformed the core concept of the service innovation. In addition, for all open FFE teams that we studied, inter-organization partnerships were established and considerable amount of efforts were put into facilitating smooth and successful partnerships. Relationship commitment, being defined as "firms' willingness "to walk the extra mile" to keep exchange partners (p. 346)", was found to have a positive effect on a firm's service innovation focus as well as the firm's performance (Eisingerich et al., 2009). On the other hand, data from the closed cases suggest that resource and time constraints limit both duration and amount of efforts spent in the FFE, thus inhibiting early openness activities. The open innovation literature has often warned about coordination expenses and attention problems incurred from openness (Chesbrough et al., 2006). This may limit outside-in activities to shallow external search (Garriga et al., 2013) and little or no innovative collaboration. Thus, our fourth proposition:

Proposition 4: Resource slack enables flexibility and commitment to openness in the FFE whereas resource constraints hinder openness activities in the FFE.

Next, we discuss about the presence of workable prototype. In all open cases, interviewees mentioned about the importance of having a workable prototype to inter-firm partnership and customer experimentation. A prototype allows partners to perceive value and expertise that the team can offer as well as easily understand key concepts of the innovation.

"Before they [their partners] decided to partner with us, they asked about our expertise and resources. The most important thing was that we had a prototype to show them. This was very important since a prototype reflected many things, such as professionalism, expertise and understanding of the market, etc." (Business development manager – Case 2)

Consistenly, Souder et al. (1998) suggested that, when perceived technical uncertainty is high (like in the FFE of innovation), a high level of prototype development proficiency may be required.

In addition, unlike physical products, when designing a new service, designers have to make decisions on what components (i.e., processes, people skills, and materials) are needed and how to integrate them to come up with a concrete service concept (Goldstein et al., 2002). However, since services are intangible, heterogeneous, and delivered over time and space, oversimplification and incompleteness is often present in the specification and interpretation of a service concept (Bitner et al., 2008). Accordingly, a workable prototype is vital to the success of customer experimentation as it allows potential customers to gain a better understanding of intangible new service concepts. Moreover, prior research has also suggested that a prototype can be used as a medium for economically transferring sticky information between two key sites of innovation, such as customers and innovating firms (Pavlou and El Sawy, 2011). Our fifth proposition is:

Proposition 5: The presence of workable prototype early in the innovation process is an essential enabler for innovative collaboration and customer experimentation.

5.3   FFE Openness and Success

The cross-case analysis results suggest a relationship between openness in the FFE and service innovation success. We argue that a high level of openness in the FFE can be translated into efficiency and effectiveness in executing of other activities in the later stages leading to successful innovations. Similar recommendations can be found in the literature on open innovation (Chesbrough and Euchner, 2011; Chesbrough, 2003; Love et al., 2011). Chesbrough (2003) proposed that exploration and acquisition of external knowledge, and innovative collaboration firms to lower R&D costs, increase innovation productivity and reduce cycle time. Similarly, the literature on dynamic capability highlights the significance of sensing capability (Kindström et al., 2013; Pavlou and El Sawy, 2011; Teece, 2007).

Some empirical studies have discerned a positive influence of external searching (Chen et al., 2011; Chiang and Hung, 2010), co-developing with innovation partnerships (Ettlie and Pavlou, 2006; Ordanini and Parasuraman, 2011; Zeng et al., 2010) and customer involvement (Carbonell et al., 2009; Melton and Hartline, 2010), whereas others found negative effects of too much openness (Knudsen and Mortensen, 2011; Laursen and Salter, 2006). However, the conflicting results may be due to the

fact that these studies either focus on openness at a firm level or a project level rather than at a particular stage of innovation. We argue that the information-intensive characteristics of front-end activities are likely to fit well with costly and time-consuming openness activities, than with activities in the subsequent phases. Generally, the cost of generating and evaluating several potential ideas is much cheaper than developing or commercialising any one idea (Reid and De Brentani, 2004). The FFE therefore does not suffer as much as the later stages from the extra costs of openness. This study's final proposition is:

Proposition 6: Effective execution of the proposed three openness activities in the FFE can ultimately lead to service innovation success.

5.4 Theoretical Implications

This research makes several contributions to the open innovation literature. Firstly, while researchers found conflicting results for the contribution of openness to innovation success, this study offers evidence suggesting that openness should be employed early rather than later in the innovation process in order to be successful. Secondly, as communication problems within and between organisations are among the most important barriers to implement open innovation practices (van de Vrande et al., 2009), our findings make contributions to the alleviation of such problems. Specifically, the inductive process allowed us to identify the key drivers of innovation cooperation, namely, prior related knowledge, slack resource and a workable prototype; and to understand how they affect the ability to communicate and collaborate with external partners during the fuzzy and highly uncertain front-end of service innovation. Thirdly, the literature has found that firms developing innovations with a greater degree of newness are more likely to gather knowledge and information from a wider variety of sources (Bahemia and Squire, 2010; Nieto and Santamaría, 2007; Tether, 2002). Our findings may suggest a plausible reason behind such a finding. Specifically, as suggested by proposition 2b, for innovations with a lower degree of novelty, locally owned knowledge may be sufficient. Fourthly, the findings of the current study also support the argument that open innovation can be applied to the service sector in not only developed but also developing countries (Chen et al., 2011; Chesbrough, 2003). Nevertheless, emerging strategies, such as crowdsourcing or outbound open innovation, were not found in our cases.

Finally, although this research is amongst the first to empirically apply the principles and FPs of the S-D logic (Vargo and Lusch, 2004; 2008) to the front-end of service innovation, we hope that this perspective will be able to provide innovation researchers with a new lens, terminology and understanding through which to view innovation in services in general as a process of gathering and assimilating operant resources in order to co-create value in a world driven by a service economy.

5.5   Managerial Implications

Having highlighted the three crucial openness activities in the FFE and their impact on service innovation success, we encourage service firms to acquire external knowledge, co-develop with external partners and experiment with customers as much as possible during the FFE in order to compete more effectively through service innovation (proposition 1 and 6).

Improving the proposed dimensions of openness competence within the FFE could be the focus for managers who want to be successful in service innovation. First, In the FFE of novel service innovations, managers might wish to employ a team with strong related knowledge to allow effective knowledge search and innovative collaboration (propositions 2a and 2b). Next, top management support may be crucial for openness activities in the front-end (proposition 3). Management should therefore put emphasis on creating a shared norm and supportive organisational settings to nurture openness. Third, for successful service innovation, we encourage innovation managers to assign sufficient resources and time to facilitate external search, communication and coordination with external partners and customer experimentation, particularly in the FFE phase (proposition 4). Finally, managers should emphasise on developing a workable prototype in order to firm up the new service concept as well as enable smooth collaboration with partners and customers.

6   Summary

Looking through the S-D logic lens, we investigated the FFE phase of online service innovations. Our inductive theory-building case study suggests a link between openness competence and service innovation success through effective execution of external search, inter-firm cooperation, and customer experimentation. We discussed the key dimensions enhancing the three openness activities in the FFE and, as a result, proposed six propositions.

One limitation concerns the possible bias from the use of interviews as the interviewees have to rely on their memory and may try to impress the interviewer (Eisenhardt and Graebner, 2007). To limit such bias, we interviewed the participants from different hierarchical levels and functionalities, and triangulated the interview data with other sources (i.e., websites, user stats and related news) (Eisenhardt and Graebner, 2007). Secondly, since qualitative studies are subjected to interpretation of the researchers during the data analysis, we strictly followed the procedure suggested by Miles et al. (2013) to ensure a close fit between the emerging theories and the data. Thirdly, although the generalisability of our results to other contexts may be limited, our focus is rather on producing new insights about a phenomenon and on the plausibility of the inductive reasoning used in analysing the case study findings and drawing conclusions from them (Lincoln and Guba, 1985), i.e., our aim is to

gain understanding and to build theory. Fourthly, further research should consider collecting data from customers and other collaborators involved in the FFE phase to provide insights from a different viewpoint. Lastly, due to the cross-sectional nature of this study, we do not claim to establish robust causal relationships.

The propositions proposed in this study could provide a starting point for a confirmatory quantitative study focusing on openness in the front-end of innovation. Future research could focus on identifying inter-relationships between the proposed dimensions of openness competence in the FFE. For example, if FFE team possesses a high level of prior related knowledge and resource slack, they might be able to search and coordinate more effectively. Furthermore, since this study is an exploratory study of inbound openness in the predevelopment phase of innovation, future research focusing on the other aspect (i.e., outbound) may lead to a more complete picture of openness (Chesbrough, 2003) in the FFE phase. Finally, Lusch et al. (2007) claimed strongly that in order to compete through service, firms must shift from a goods-dominant logic to a S-D logic regardless of the sector they are in. Therefore, another interesting research opportunity is to replicate and extend our results in manufacturing contexts in order to provide an empirical evidence of this claim.

7 Appendix

Appendix A: Service innovation success questionnaire

Six months after launch, to what extent do you agree or disagree with the statement below:

- The new service exceeds sales objectives.
- The new service exceeds market share objectives.
- The new service exceeds profit margin objectives.
- The new service increased customer satisfaction and loyalty.
- The new service improved our competitive position.
- The new service enabled expansion into new markets.

(Options: a 7-point Likert scale, where 1 represents 'strongly disagree' and 7, 'strongly agree')

Appendix B: Additional materials for the compilation of project success

Case	Material	Source
Case 1	- Meeting records	Obtained from the participants
Case 2	- An online article	https://www.techinasia.com/shoppening-app
Case 3	- Download statistics on Google Play Store	https://play.google.com/store/apps/details?id=com.shopspot&hl=th
	- Online articles	https://techcrunch.com/2013/02/19/thai-mobile-shopping-app-shopspot-adds-brands-gets-630000/
		https://www.techinasia.com/shopspot-funding-intouch
Case 4	- The company's website	https://www.lnwshop.com/
Case 5	- Truehits.net web rank	https://truehits.net/index_ranking_new.php
Case 6	- Users' rating on Google Play Store (The company has recently revamped the application to be a native app. Since then the rating has improved significantly)	https://play.google.com/store/apps/details?id=com.settrade.streaming&hl=th

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