Understanding the Role of Technology in Service Innovation: A Theoretical Overview

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Abstract

Innovation is not exclusive to manufacturing, services firms are also innovative. Moreover, services firms are responsible for a large portion of the GDP worldwide and the trend shows how this indicator has been increasing the last years in developed countries. Technology has played an important role in this rise of the service sector in developed countries, contributing to improve productivity. However, there is a new role for technology in services, which has origin in technological change. The new main role for technology is as a source for innovation, since technology is enabling and facilitating innovation in services firms. Understanding this new role contribute to service firms to respond properly to the challenges of modern economy, gain sustainable competitive advantage for the firm, improve performance in service innovation and generate more variety in response to the customers’ needs.

This thesis is submitted in partial fulfillment of the requirements for the degree of Masters of Entrepreneurship & Innovation Management at KTH, and it compiles the most important aspects to establishing the role of technology in service innovation, contributing at the same time to a better understanding of this phenomenon. To do so, the first chapter exposes the introduction and the methodological explanation. In the second chapter, the importance and characteristics of the services sector in developed countries is explained. Next, in the third chapter, the relationship between services and innovation is analyzed. In the fourth chapter, describes the most relevant aspects of the relation between technology and service innovation from three dimensions: services as users of Information technology, agents of technology diffusion and producers of technology. Finally, in the last chapter, conclusions are presented.
Table of Contents

Abstract ................................................................................................................................................... 1
Table of Figures ....................................................................................................................................... 6
Table of Tables ........................................................................................................................................ 7
1 Introduction .................................................................................................................................... 8
   1.1 Background ............................................................................................................................. 8
   1.2 Research Objectives and Question ......................................................................................... 9
   1.3 Methodology ........................................................................................................................... 9
   1.4 Limitations ................................................................................................................................ 9
   1.5 Structure ................................................................................................................................... 10
2 The Service Sector and Innovation: Breaking Paradigms ............................................................. 11
   2.1 Service Activities are Not Homogenous ................................................................................ 11
       2.1.1 Services Definition ........................................................................................................ 11
       2.1.2 Services Dimensions ...................................................................................................... 13
   2.2 The Tertiary Sector is Not a Parasitic Sector ......................................................................... 13
       2.2.1 Services are Not Residual Activities .............................................................................. 13
       2.2.2 Services are Intensive in Low Skill Labor Force ............................................................. 15
       2.2.3 Services Activities are not Isolated Activities ................................................................. 16
       2.2.4 The line Between the Tertiary and Secondary Sectors is not Clear .............................. 18
3 Shaping Innovation in the Service Firm ........................................................................................ 20
   3.1 Building a Frame for Innovations in the Service Firm ........................................................... 20
       3.1.1 Targets Susceptible to Innovation in the Firm .............................................................. 20
       3.1.2 Types of Innovation in Services ..................................................................................... 21
       3.1.3 Extent of Novelty Involve in Service Innovation ........................................................... 22
       3.1.4 The Market is the Natural Limit for Innovation ............................................................ 23
   3.2 Innovation Patterns in Services Firms ................................................................................... 23
4 Service innovation and Information Technology .......................................................................... 26
   4.1 Sources of Technological Innovations in Services ................................................................. 26
   4.2 Services as Users, Producers and Agents of Information technology ................................. 27
       4.2.1 Information Technology adoption and innovation in services .................................... 27
4.2.2 Services as Sources of Technology ................................................................. 28
4.2.3 Services as Agents of Technology ................................................................. 29
4.2.4 Other Relations between Technology and Service Innovation ..................... 31
4.3 Consequences of Technology in Service Innovation ........................................ 32
5 Conclusion ........................................................................................................... 35
Further research .................................................................................................... 36
References ............................................................................................................. 37
Table of Figures

Figure 1 “Service Value added from 1970 to 2008 (% of GDP) in North America, OECD members and worldwide” .......................................................... 13
Figure 2 “Service Value added from 1970-2009 (% of GDP) in some developed Countries” ............ 14
Figure 3 "Interaction between sectors in the modern economy" ......................................................... 17
Figure 4 “Targets susceptible to innovation in the firm” .................................................................... 20
Figure 5 "Frame for Service Innovation” .......................................................................................... 23
Table of Tables

Table 1 “Broad Structure of NACE Rev. 2” ................................................................. 11
Table 2 “Firms functions susceptible to be outsourced and examples” ...................... 15
Table 3 "Production relation: Microsoft, Cisco and Google" ...................................... 29
Table 4 "Diffusion relation: IBM server services and SAP" ...................................... 30
Table 5 “Examples of Substitution relation within Self-Service” ................................. 32
Table 6 "Determination relation: Internet and new services and professions" ............. 33
1 Introduction

1.1 Background

In the last 40 years in developed countries like United States and the European Union, the economy has been experiencing a shift in its composition where the service sector has been seen to significantly increase its share while surpassing the manufacturing sector. Nowadays in these countries, services are responsible for more than 70% of the GDP. As a consequence, there is also a shift in employment and the labor market, since services rely strongly on labor forces and require more skilled employees.

Innovation has played the role of the main driver in the rise of service sector. However, as the capacity to innovate in a firm increases, it gains competitive advantage and generates a broader variety of offerings for its customer. In this sense, service firms need to be customer-oriented, considering that the customer is the one who selects from the variety of the offerings and acts as the determining factor behind the success of the firms. Besides this, service activities are heterogeneous and innovation varies in extent and form between industries.

Moreover, the competitiveness of a firm also depends upon its capacity to adapt and exploit technology in order to fulfill and exceed beyond customers’ needs and expectations, while maximizing resource utilization. The extent of adoption and interest in technology varies amongst the different sub-industries within the service sector. However, some surveys reveal that in developed economies, the service sector is the biggest user and buyer of information technologies among other sectors, particularly ICT.

This thesis analyzes the conceptual and theoretical framework of the role of Information Technology in Service Innovation from the perspective of modern economy and tries to contribute towards a better understanding of the phenomenon. Additionally, it differs from the idea that services have a passive role in the innovation system, since it considers services as an innovative sector. The approach to the research question is done through an overview of the existing literature with examples from the modern economy. The scope is limited to the services produced and carried out by organizations through innovation process in developed countries. Moreover, the scope also does not include how an organization can utilize their resources, processes and various dynamics to become innovative.
1.2 Research Objectives and Question

Even though the relation between technology and the innovation process in the manufacturing sector has been intensively studied, experiences of this sector cannot be fully applied to the innovation process in services. These aspects differ especially in technology and knowledge development, because of the particularities of the service sector (Boden & Miles, 2000).

“Which is the role of technology in service innovation” is the research question. Answering this question contribute to firms to respond properly to the challenges of the modern economy, gain sustainable competitive advantage for the firm, improve performance in service innovation and generate more variety in the response to the customers’ needs. Moreover, usually information regarding service innovation and technology is scattered in various sources and not compiled; therefore summarizing the important aspects in one document can be helpful in understanding the concept effectively.

1.3 Methodology

The research question and objectives are underpinned through an overview of existing literature and conceptual work, which require an intensive recompilation of information from primary and secondary sources. This requires selecting and extracting relevant information to provide a conceptual framework and a theoretical foundation to evaluate the research question. Within this context, services and service innovation are the main objects of this study while highlighting the role of information technology in these objects. Additionally, the study includes relevant examples from the modern economy, in order to provide a pedagogic exposition of theoretical concepts.

1.4 Limitations

The scope is limited to the services produced and carried out by organizations through innovation process in developed countries. The analysis does not consider how the innovation processes and resources are organized inside the firms in order to limit the research and avoid confusion.
Moreover, research on services reveal different approaches on innovation, assimilation approach, demarcation approach and synthesis approach (Coombs & Miles, 2000). This research will continuously shift between the demarcation approach through authors like Barras (1986) and Boden and Miles (2000) when highlighting differences between both sectors, and the synthesis approach through Gallouj & Weinstein (1997) when highlighting the trend in the transformation of those differences into similarities.

Considering the limitations in terms of time and that the main interest is on studying the services innovation phenomenon, less importance has been provided to technology itself. Consequently, technology is not studied extensively, even though it could be expected to dedicate a chapter to analyze this element individually. Finally, it is important to highlight that the term technology in this document refers particularly to Information technologies and IT whereas the concepts presented in the third chapter are oriented to technology intensive services and knowledge intensive services.

1.5 Structure

This thesis consists of five chapters. The chapters include an introduction with a methodological explanation, theoretical discussion divided in three chapters and conclusions.

Consequently, the first chapter is dedicated to the introduction and the methodological explanation. In order to create a general framework, a broader introduction of the service sector and its relevance in developed countries is presented in the second chapter which also discusses some paradigms that led this sector to a relegated position in the past. In the third chapter, the relation between services and innovation is analyzed, since services have certain particularities that differentiate the sector from others and determine the shape of the innovation within the sector. In the fourth chapter, the role of Information Technology in service innovation is discussed while describing the most relevant aspects of the relation between technology and service innovation from three dimensions: services as users of Information technology, agents of technology diffusion and producers of IT and particularly ICT technologies, which are considered for some the third generation of information technology. Finally, in the last chapter, the conclusion is presented.
2 The Service Sector and Innovation: Breaking Paradigms

2.1 Service Activities are Not Homogenous

2.1.1 Services Definition

There are several definitions for services, see (Alter, 2008, pp. 63-64), and it seems that there is no consensus on a particular definition. This document adopts the definition proposed by Alter in his work, which originally came from a dictionary. This definition refers to services as:

“Services are acts performed for others including the provision of resources that others will use.”

Service firms provide mainly intangible products or acts; however this provision can be followed by a tangible product or resource which complements the service. For example, dental services provide people with artificial teeth and fillings (Miles & Boden, 2000, p. 8).

Table 1 “Broad Structure of NACE Rev. 2”
Source: (Eurostat, European Commission, 2008)

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Divisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A*</td>
<td>Agriculture, forestry and fishing</td>
<td>01-03</td>
</tr>
<tr>
<td>B*</td>
<td>Mining and quarrying</td>
<td>05-09</td>
</tr>
<tr>
<td>C*</td>
<td>Manufacturing</td>
<td>10-33</td>
</tr>
<tr>
<td>D</td>
<td>Electricity, gas, steam and air conditioning supply</td>
<td>35</td>
</tr>
<tr>
<td>E</td>
<td>Water supply; sewerage, waste management and remediation activities</td>
<td>36-39</td>
</tr>
<tr>
<td>F*</td>
<td>Construction</td>
<td>41-43</td>
</tr>
<tr>
<td>G</td>
<td>Wholesale and retail trade; repair of motor vehicles and motorcycles</td>
<td>45-47</td>
</tr>
<tr>
<td>H</td>
<td>Transportation and storage</td>
<td>49-53</td>
</tr>
<tr>
<td>I</td>
<td>Accommodation and food services activities</td>
<td>55-56</td>
</tr>
<tr>
<td>J</td>
<td>Information and communication</td>
<td>58-63</td>
</tr>
<tr>
<td>K</td>
<td>Financial and insurance activities</td>
<td>64-66</td>
</tr>
<tr>
<td>L</td>
<td>Real estate activities</td>
<td>68</td>
</tr>
<tr>
<td>M</td>
<td>Professional, scientific and technical activities</td>
<td>69-75</td>
</tr>
<tr>
<td>N</td>
<td>Administrative and support services activities</td>
<td>77-82</td>
</tr>
<tr>
<td>O</td>
<td>Public administration and defense; compulsory social security</td>
<td>84</td>
</tr>
<tr>
<td>P</td>
<td>Education</td>
<td>85</td>
</tr>
<tr>
<td>Q</td>
<td>Human health and social work activities</td>
<td>86-88</td>
</tr>
<tr>
<td>R</td>
<td>Arts, entertainment and recreation</td>
<td>90-93</td>
</tr>
<tr>
<td>S</td>
<td>Other services activities</td>
<td>94-96</td>
</tr>
<tr>
<td>T</td>
<td>Activities of household as employers; undifferentiated goods and services</td>
<td>97-98</td>
</tr>
</tbody>
</table>

1 The reference or source is not provided in Alter’s work, (2008)
Additionally, this definition highlights the main characteristic of service activity, the diversity of the activities and business that the sector comprises, since the definition refers to services as acts, and do not provide any limitation to these acts. Services goes from activities or acts that require basic knowledge like house cleaning to more complex and specialized activities like health care services. Table 1 “Broad Structure of NACE Rev. 2” shows this variety of the services activities, where services have presence in 17 of the 21 activities defined by NACE².

Moreover, each service activity can comprise several activities, which contribute to extend the diversity of the sector. For example, Transportation services comprise land transportation, air transportation, ocean transportation, rail transportation and recently space transportation (Virgin Galactic). Transportation can also have a public or a private character, which makes the classification more complex. Moreover, depending if the objective is to transport people or goods, each activity becomes a different industry. Transporting containers in a big ship from China to Copenhagen is a different business compared to transporting tourists in a luxury cruise along The Bahamas in the Caribbean Sea. There are differences in customer’s expectations, risk, knowledge, regulations, pricing system and resources involved in developing the activity.

Other important characteristic of services is that they are value added activities, since service activities go beyond the standard expectations of their target customers through innovation in their offering. Moreover, the service sector gains additional value through peripheral services. Considering that services are defined as the fusion of two sets of activities: core services and peripherals services, where the peripheral services deliver product differentiation to the firm (Gallouj F., 2000, pp. 129-128). For example, the mobile network operators have the same core service, to operate mobile networks and to provide communication services. The customers make their choices considering the additional services that each company offers. For example, number of instant messages allowed, price system: per minute or per call, internet access and time in terms of hours, contract time, and connection to other networks or operators.

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² Is the Statistical Classification of Economics Activities in the European community, is derived from ISIC. This classification is used in most OECD countries.
2.1.2 Services Dimensions

The variety of the service sector can be seen in the type of industry and business comprised within the sector. However, studies conducted by Sunbdo (2000) shows this variety from a different perspective that leads to several dimension of services. These dimensions are not exclusive categories; certain service can develop more than one dimension.

The first dimension involves producer services and consumer services. Some examples of this type of services are household services such as cleaning, gardening, security services and financial services. A second dimension of services includes Knowledge intensive services (KIBS) like transportation and health care. This type also includes manual services, like catering and tourism. The next dimension of services corresponds to mass services and individual services. Examples of mass services are banks and cleaning companies, while individual services, which are more customized to the needs of each customer, are consultancy and care service.

Finally, the last type of services involves technology intensive services and technology extensive services. Technology intensive services include Information and communication technologies (ICT), for example software firms and banks, as well as services intensive in other technologies, like transportation technology and medical technology. Educational services, care services for elderly people and house repair are examples of technology extensive services, which are more craft oriented work, use less advance technology and non standardized methods.

2.2 The Tertiary Sector is Not a Parasitic Sector

2.2.1 Services are Not Residual Activities

Services have a new role in the economy, particularly in developed economies. In the last 40 years, in Western Countries and some of Eastern European countries, services are transforming economy’s composition, due to the rapid grow of the sector, see Figure 1 “Service Value added from 1970 to 2008 (% of GDP) and Figure 2 “Service Value added from 1970-2009 (% of GDP)”.

Figure 1 “Service Value added from 1970 to 2008 (% of GDP) in North America, OECD members and worldwide”
In these countries, the service sector surpasses and doubles manufacturing sector’s contribution to the economy. Services accounts for more than 70% of the GDP (World Bank national accounts data, and OECD National Accounts data files). However, this phenomenon vary in extent between developed economies because of the differences in several interrelated factors like services policy conditions, market dynamics, climate for risk taking, venture capital supply and regulation barriers (OECD, 2000, p. 4).

An important factor in this growth of the service sector is that outsourcing activities are increasing their share in the economy. The division of labor allowed the manufacturing sector to focus upon specialization of production or the core of the business in order to increase their profits (Arora & Gamberdella, 1994). As a consequence, manufacturing firms tend to contract out those activities that were more expensive to carry out within the firm or were less efficient (Coombs R., 1999). Now days, all different sectors appeal to outsourcing, even the service sector. Moreover, demand for these activities
previously carried in-house is increasing and external providers are becoming more specialized, contributing to enhance the service economy and narrowing the manufacturing sector (Stigler, 1951).

Table 2 “Firms functions susceptible to be outsourced and examples”

Source: Adapted from (Miozzo & Grimshaw, 2006)

<table>
<thead>
<tr>
<th>Internal management functions</th>
<th>Relate market for business services</th>
<th>Example of major providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration</td>
<td>Management Consultancy</td>
<td>McKinsey, KPMG</td>
</tr>
<tr>
<td></td>
<td>Legal Services</td>
<td>Deloitte Touche Tohmatsu</td>
</tr>
<tr>
<td></td>
<td>Auditing and Accountancy</td>
<td>Accenture</td>
</tr>
<tr>
<td>Human Resources</td>
<td>Temporary Work Agencies</td>
<td>Manpower</td>
</tr>
<tr>
<td></td>
<td>Personal Recruitment</td>
<td>Adecco</td>
</tr>
<tr>
<td></td>
<td>Professional Training</td>
<td>Spherion Corporation</td>
</tr>
<tr>
<td>Finance</td>
<td>Banking</td>
<td>Citigroup, Bank of America</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>Generali Group</td>
</tr>
<tr>
<td></td>
<td>Renting and Leasing</td>
<td>Rental Services from Atlas</td>
</tr>
<tr>
<td>Information systems</td>
<td>Software and IT Services</td>
<td>Microsoft, IBM</td>
</tr>
<tr>
<td></td>
<td>Telecommunications</td>
<td>Vodafone, China Mobil</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>Advertising</td>
<td>Omnicom Group</td>
</tr>
<tr>
<td></td>
<td>Distributive Trade</td>
<td>Edelman</td>
</tr>
<tr>
<td></td>
<td>Public Relations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fairs and Exhibitions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After sales-services</td>
<td></td>
</tr>
<tr>
<td>Transport and Logistics</td>
<td>Logistic</td>
<td>DHL, UPS</td>
</tr>
<tr>
<td></td>
<td>Transport services</td>
<td>MAERSK</td>
</tr>
<tr>
<td></td>
<td>Express courier services</td>
<td>FedEx</td>
</tr>
</tbody>
</table>

Table 2 “Firms functions susceptible to be outsourced and examples” shows some internal functions in the firm susceptible to contract through outsourcing, followed by some examples of more specialized activities and examples of the larger provider of those services in the modern economy.

2.2.2 Services are Intensive in Low Skill Labor Force

The rise of the service sector is also affecting employment and labor market. Services are surpassing the manufacturing industry in number of employees and producing a shift in the distribution of employment and patterns in the division of labor (Miles & Boden, 2000, p. 4). In developed countries, three quarters of labor force is employed in the service sector (Preißl, 2000, p. 66). Some of this new labor force is low skilled while
other is mainly high skilled. For example, some services activities like consultancy firms, that sell knowledge to other organizations, and banks that provide information to their customers, require more educated employees, with specialized knowledge and special skills to manage customers. Moreover, skills are becoming more important in the service firms, especially technical and client skills, considering the need of the contact with the client.

The large number of employees in the service activities led the sector to less productivity than in the manufacturing sector (Preißl, 2000, pp. 67-68). Services are employing more people than manufacturing and the services share in GDP is less than in employment. Therefore, each employee from the services sector produces less output than an employ from the manufacturing sector. Services’ share in employment and GDP also differ amongst countries due to the differences in the job market composition. Part time jobs are more widespread in the service sector and in specific countries. However, on average, output per person increase faster in the manufacturing sector than in services.

In order to improve productivity, service firms in developed countries are adopting technology. Since, according to the Baumol Effect, as economy develops, services become more expensive while manufactured products become less expensive (Bannock, Ron, & Davis, 2003, p. 27). Increase in productivity leads to lower prices, and productivity improve through investment in technology. However, technology adoption leads to the framework of the “productivity paradox”, where it is expected that investment on IT over time will be reflected in improvements in profitability or productivity for the firm. Nevertheless this return does not always shows up clearly on the bottom line of firms (Attewell, 1994, p. 24), perhaps because of the difficulty in measuring services outputs, which are hard to define precisely.

2.2.3 Services Activities are not Isolated Activities

Services activities are not isolated in the economic system, contrary to the classical theories; services are more and more related and integrated to other sectors in the modern economy, and there is permanent exchange between all the sectors. Services are using technological products of the manufacturing sector, from lifts and drills in construction, to trains and automobiles in the transport sector. Other sectors are demanding more and more services and innovations. Moreover, services add value to other sectors (Howells, 2001, pp. 60-67); since services add differentiation and
sustainable advantage to them through outsourcing services, complementary services and embodied services see Figure 3 "Interaction between sectors in the modern economy".

As mentioned before, the manufacturing sector experienced a rise of the outsourcing activities, increasing the market for specialized service provision. In this context services providers like KIBS add value to the manufacturing sector through innovation; their services are not just a substitution of activities developed previously in house (Gallouj & Weinstein, 1997). Companies like FedEx and UPS allow the manufacturing sector to deliver their products to their customers in record time and to keep them informed of the shipment status through internet. No manufacturing company can deliver their own products with the same efficiency and affectivity than specialized companies.

Figure 3 "Interaction between sectors in the modern economy"

Source: Own creation

Complementary services are adding value to the manufacturing sector’s offerings. In order to satisfy demand more effectively and focusing on customers needs, the manufacturing sector is changing the way which could address customers, since it includes services related to their products in the offering (Porter, 2008, p. 23) (Howells, 2001, p. 61). For example General Electric, count today with “the world’s largest retailer finance program provider”³, GE Money Bank, which was created initially to finance the purchase of GE home appliance products and in technology companies

for example, one half of revenue come from services (Wood, 2007) like maintenance and technical support, extended warranty, training and business consulting.

Another practice used is the encapsulation of products with a service (Howells, 2001), like Rolls Royce with their aerospace engine. Instead of selling a product for a fixed price, the company turns to offer a service in terms of hours of flight. This example shows how the customer is more aware of the life cycle of the products and is demanding services that integrate all stages of the product life cycle. The differentiation of the product is not only the features and the efficiency in particular task. As a result, services allow the manufacturing sector to establish a long term relationship with their clients, and add value to their offerings as a source of sustainable and strategic competitive advantage (Grönroos, 2000, p. 6).

2.2.4 The line Between the Tertiary and Secondary Sectors is not Clear

Despite the diversity of the service activities, within the services it is possible to identify some common variables or characteristics (Tidd & Bessant, 2009, p. 427), like quality and performance perception, product intangibility, simultaneity in production and consumption, need of interaction with customers, customization, regulation and difficulty to storage. These characteristics represent the fundamental differences between services and manufacturing. However, additional differences can be derived from these attributes, like technology orientation, innovation cycles and technology impact in employment productivity among others.

Services attributes differ on intensity or level in each service, depending on its nature, aims and situation. For example, the food service activity comprises two trends, one is where the restaurant staff offers service and the other is self-service. If the restaurant staff offers service, it adds value and convenience for the customer whereas Self-service aims for cost efficiency and low cost for the business. Both services differ in the intensity in quality perception, customization and interaction with the customer. Services characteristics vary between services activities.

Over time these characteristics and their extents within a service industry can change, because of the market dynamics and the adoption of new technological innovations. For example in the bank industry, customers wanted to utilize bank related services without moving from their places. As a result, banks adopted new technologies and today they provide their services across multiple platforms, like internet and mobiles. In this industry, the place where the service is produced is not anymore the same place
where it is consumed and the face to face interaction with customers each day is reducing. This transformation is taking place in all service industries; almost all services have changed from how they were a few years ago.

Moreover, services in some cases are adopting characteristics traditionally associated with products (Gallouj F., 2000, p. 129). For example, in the entertainment industry, movies and other performances can be recorded and produced on a mass scale for further consumption, which is a characteristic from products. Furthermore, the movies are boxed and exhibited in the store’s shelves like any other manufactured product. Services are permeating the whole economy and each time is more difficult to distinguish if a company belongs to the service sector or to the manufacturing sector (Barras, 1986) (OECD, 2000, p. 7).
3 Shaping Innovation in the Service Firm

3.1 Building a Frame for Innovations in the Service Firm

3.1.1 Targets Susceptible to Innovation in the Firm

Services can be seen as the composition of four basic components: Production, Offering, Delivery and Finance.

Figure 4 “Targets susceptible to innovation in the firm” shows these four components and the targets covered by each dimension. Production and offering refer to the core competencies that posses the firm and the services that can be produced with those competences. Delivery and Finance correspond to customers’ needs, and how the firm can create new business models or a new network of partnerships to deliver a service that satisfies their customer’s needs.

Figure 4 “Targets susceptible to innovation in the firm”
Source: Adapted from (Ezell, Ogilvie, & Rae, 2007, p. 7)

The extent and the forms in which the firm innovates vary between the services firms (Pavitt, 1984, p. 353). Identifying the targets of renewal in a firm can lead to the
identification of the innovation pattern followed. For example, an analysis of the car rental industry in United States reveals that most of the innovativeness effort of this industry is in customer service, service system and service performance targeting (Ezell, Ogilvie, & Rae, 2007, p. 7). Moreover, this analysis combined with customer needs can be useful to identify which are potential targets to be renewed.

3.1.2 Types of Innovation in Services

Francis and Bessant (2005, pp. 172-180) proposed in their four types of innovation in services: product innovation, process innovation, positioning innovation and paradigm innovation. These forms of innovation are similar to the ones proposed by Schumpeter apart from what he called new raw material innovation, which is relevant to manufacturing. Gallouj (2000, pp. 139-143) introduced other forms of innovation in services that Francis & Bessant did not cover completely with their classification: Formalization innovation and Ad hoc innovation.

The different components of a service can be associated with the types of innovation mention above. Process innovation is related with the production component, since this type of innovation change the way the offering is created. Innovation positioning takes form changing the context in which the offering is delivered and most cases of this innovation are related with brands changing their target market or creating a new one.

The offering component in services can be related to product innovation, formalization innovation and ad hoc innovation. The introduction by ICA of a new supermarket format is considered a product innovation, because it depicts a change in organizations product or service. The organization of work in McDonald’s is an example of formalization innovation and it consists of putting in order the service characteristics, whether tangible or intangible. Ad hoc innovation refers to how a service can be customized or adapted for the specific needs of a client.

Finally, paradigm innovation is related to the finance component and occurs when the change takes place in the mental model which frames what the organization does. This type of innovation in turn can be categorized into two types of innovations, inner-directed (organizational competences) paradigms and outer-directed paradigms (business models) innovation.
Innovation in services is often more integrated than in other sectors like the manufacturing sector (Sunbdo, 2000, p. 112). The simultaneity of production and consumption characterized in services provide more integration amongst the production process and the product, in time and function, than manufacturing. Therefore, innovation taking place in service inherits this characteristic and each innovation often involve several types of innovation (Sunbdo, 1992), where process innovation has more emphasis.

However, over time the evolution of knowledge and the technological change make possible to the service firm to innovate or transform targets that were unthinkable before, generating new types of innovation and increasing the possibilities to innovate to a huge number.

### 3.1.3 Extent of Novelty Involve in Service Innovation

Innovation is about transformation and according to the extent of novelty involve in the change, the innovation in the service can be radical or incremental (Freeman & Perez, 1988, pp. 45-47). Radical innovations are discontinuous events, which result from a deliberated research process and the product is a totally new service with different characteristics and competences from the old service. Insurance companies of care and assistance products for example, are seen as radical innovators that has created a new system (Gallouj F., 2000, p. 139). These companies are not any more offering life insurance, saving or damage insurance products, instead are providing services. Radical innovations provide companies with the advantage of the first mover.

Mean while, incremental innovation occurs more or less continuously, and this innovation comes from suggest inventions and improvements made by the individuals involve directly in the production process or as a result of initiatives and proposal from users. These innovations improve specific attributes by substitution or addition of characteristics, without modifying the structure of the target or system (Gallouj F., 2000, p. 139), providing the company with strategic and cost advantage. Most service innovations are non-technological and mostly involve small and incremental changes in process and procedures.
3.1.4 The Market is the Natural Limit for Innovation

From a Schumpeterian perspective, innovation differs to an invention in the sense that innovation is adopted by a market and this market is the filter to the survival of the innovation over time. This leads to establish the meaning of market in terms of innovation. The market is the user or potential users of the innovation which can be completely new or already existing referred to as current. Similarly, radical innovations can be interpreted as “new to the world” while incremental innovations are “new to a region or a country” or “new to a sector or an industry”.

**Figure 5 "Frame for Service Innovation"**

*Source: Adapted from (Ezell, Ogilvie, & Rae, 2007, p. 7)*

![Frame for Service Innovation](image)

The frame for innovation can be represented with three axes, represented by degree of novelty, target being transformed and the market, see Figure 5 "Frame for Service Innovation".

3.2 Innovation Patterns in Services Firms

Innovation is not an isolated process (Coombs & Matcalfe, 1998, p. 11), and a substantial rate of innovation comes from co-operative efforts (Howells & Tether, 2004, p. 26). Innovation is more a result from interaction between several institutions like suppliers, competitors and customers, among others. Therefore innovation capabilities are everyday less allocated within a single firm and increasingly distributed across a range of firms and other knowledge generating institutions. As a consequence,
bi-lateral and multi-lateral cooperation between manufacturing and service firms are more frequently reached within the innovation process. Usually these efforts also turn into collaboration with public research establishments or involve the end user.

However, the firm is the one who lead the innovation process according to their own requirements. Service firms are diverse and innovations are approached differently in each firm. Sudbo and Gallouj (2000) identify six innovation patterns in services firms. Below are described these patterns complemented with examples from KIBS (Miles, 2003, pp. 86-87). These patterns reflect the variety in the innovative efforts within the service sector and the variety of industries within the KIBS.

The classic R&D pattern is followed by firms that dedicate specialized centers to research & develop and innovation is a continuous effort within the firm. This is the case with large software and telecommunication firms within KIBS, which are specialized in production of standardized operational services. Generally these firms have more similarities with the manufacturing firms than with other firms within the service sector. This is the case with companies like SAP and Accenture which have large networks of R&D centers. SAP for example, have a “SAP Labs network” with more than 10 labs or R&D centers worldwide.

The medium sized “professional knowledge” KIBS follows a service professional pattern. This pattern is characterized by the use of certain norms and methods in a cooperative innovation process. Firms that commercialize their experiences and understandings to resolve problems in specialized disciplines are examples of service professional pattern. Accountancy, management and some IT firms like IBM use a combination of this pattern and the classic R&D pattern. For example, IBM and MIT School have a partnership through MIT Computational and Systems Biology Initiative (CSBI) to research in areas such as proteomics, genomics, image informatics and structural biology.

The third type of innovation pattern corresponds to the organized strategic innovation pattern. This pattern does not implicate a classic R&D department and research and development are seen as diffused and are accomplished by ad hoc teams. However, innovation is an important aspect of the strategy in these types of firms. This is also the most common pattern in innovative service firms and KIBS like accountancy firms, financial and market analysis firms and global consulting firms. Some examples are Delloite, PriceWaterhouseCoopers and Generali Group.

\[5 \text{http://csbi.mit.edu/overview/index.html}, \text{10/04/2011}\]
Entrepreneurial pattern is followed by firms’ dedication towards creating and commercializing services around radical innovations. These firms do not possess an R&D department; therefore their innovative orientation is to make improvements to the initial innovation. Several IT services and other KIBS can be catalogued in this type of pattern.

Restaurants, cleaning services, guard services and hotels, and small KIBS addressing local markets follow the artisanal pattern. These small service firms do little or no innovative effort. Finally, Network pattern applies when several service firms create a network firm, which innovate on behalf of the members or induce innovation to them. Some tourism services, financial services and KIBS needing sponsorship to innovate, or needing to reach out to the market through ecommerce follow this pattern.
4 Service innovation and Information Technology

To satisfy customers’ needs is the main challenge for firms. In this sense, service companies need to be customer oriented. Moreover, the competitiveness of the service firms depends on their skills to adapt and exploit technology in terms of cost, delivery requirements, service level, customization and service flexibility. This is required in order to maximize their customer experience and performance for resources (Metters, King-Metters, Pullman, & Walton, 2008). Therefore according to the industry, the extent of adoption and interest in technology vary within service firms. However the services sector in average is the main buyer and user of information technologies in developed economies (Kustscher & Mark, 1983).

In chapter 2, the concept “Knowledge Intensive Services” (KIBS) was introduced as a service dimension. Services comprised in this dimension provide other firms with knowledge that solve certain requirement of client’s organization, from the public and private sector. KIBS generally, operate within a narrow area of knowledge or expertise. Therefore, the character of this knowledge shapes the innovation effort and the contribution of the KIBS in the service innovation (Miles, Kastrinos, & Flanagan, 1995), KIBS are considered the most innovative firms within the service sector.

Some KIBS are traditional professional services, while others are new technology based services. In this chapter, the role of technology in service innovation is explained through KIBS examples since these firms are users, agents and producers of technology, particularly information and communication technologies.

4.1 Sources of Technological Innovations in Services

Sectors differ in extent and forms of innovation (chapter 2), in the intensity and characteristics of technology adopted (technological trajectories) and in sources of technology (Pavitt, 1984). Considering that service firms are users and developers of technologies, Soete and Mizzo (1990) based on Pavitt’s work suggests three different patterns of technological innovations in service firms. Their work is grounded on the sources of technological innovations, user needs and appropriating benefits. Considering that technology is not the only source for innovation, this taxonomy lacks consideration in the non-technological component of innovation (Gallouj & Gallouj, 2000, p. 30). However, it is still relevant for the purpose of the research in this document.
“Supplier dominated” is the first of the three types of services firms proposed by Soete and Mizzo. In this type of service firm, the source of innovation is dominated by suppliers of equipment and technical systems. These firms do not participate in the development of the technologies they use, their technological trajectories are defined in terms of cost efficiency, therefore a relatively high portion of their innovation activities are oriented to process innovation. These firms can be classified under two subcategories: personal services and public & social services. Personal services, like food and hospitality, generally respond to small firms where users are sensitive to performance. The second type, public and social services, correspond to education, health care and public administration. Generally, this last type of supplier dominated firm is associated with large firms, where users are sensitive to quality and technology appropriation is not allowed or is public.

The other two types of service firms are “physical and information networks” and “specialized supplier and science based firms”. These services firms are more involved in the development of the technology they used. Network firms take advantage of technology to reduce cost and support their networking strategy, users are price sensitive, the firm size is large and technology appropriation is by standards and norms. These firms can be associated with physical networks, like transport and wholesale distribution, or with information networks, like finance, insurance and communications. The sources of technology in network firms are in-house through engineering and production departments or suppliers of equipment and technical systems.

The third type of service firms is “specialized supplier and science based firms”. These types of firms have an important output of technological innovations. These technological innovations are researched and developed in-house, the user is performance sensitive and the firm size generally is relatively small. Technologies are adopted mainly based on the system design and protection of this technology is ensured through copyrighting, product differentiation and know-how.

4.2 Services as Users, Producers and Agents of Information technology

4.2.1 Information Technology adoption and innovation in services

In a first stage, services firms adopt technology to improve actual process efficiency in the services provided, while decreasing costs. After gaining improved quality and delivery in these services through radical innovation, technology provides the basis for a complete new service. Consequently, in the third stage can emerge new industries or
can occurs a diversification in the firms offering, in order to supply the new services. This process of technology adoption in services is called “reverse product cycle” (Barras, 1986).

Consequently with barras model, in the first stage of technology adoption, innovation in services is in some sense spontaneous, it does not follow a specific pattern, since there is no R&D effort and the source is “supplier dominated” (Gallouj & Gallouj, 2000). Innovation is characterized by incremental process to improve efficiency. In the second stage innovation is performed through radical process innovations in order to improve effectiveness. Finally in the third stage innovation is no longer dominated by supplier, and the driver is to generate product differentiation. This is achieved through radical product innovations and lead to emergence of the different patterns of innovation suggested by Soete and Mizzo (1990), due to the need of establishing an R&D function (Barras, 1986).

“Extensive technology services” follow the first stage of technology adoption, whereas these firms usually do not proceed with a second stage of technology adoption. Meanwhile intensive technology services develop the three stages of technology adoption. However, technology itself does not provide economic benefits to the firms. The capacity of the firm to adapt to technology and its benefits depends on their capacity to translate those benefits into product and process and to defend them against imitators.

4.2.2 Services as Sources of Technology

Services acts as a source of technology due to the production or co-production of technology (Gallouj & Gallouj, 2000, pp. 25-26). KIBS comprise ICT services among others services, which are telecommunication companies and software producers. In this case, services become technology producers directly, in order to provide themselves or their customers with new technologies. Additionally, a service firm can become a technology producer through pressure or persuade other producers indirectly, see Table 3 "Production relation: Microsoft, Cisco and Google".
Table 3 "Production relation: Microsoft, Cisco and Google"

<table>
<thead>
<tr>
<th>Case</th>
<th>New service</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota-Microsoft⁶</td>
<td>Partnership to develop a solution that bring access to multimedia, telecommunication information, GPS and energy management on the go, in Toyota’s vehicles</td>
<td>Toyota persuades Microsoft to develop a new service in order to add value to their vehicles.</td>
</tr>
<tr>
<td>Cisco with Apple and Android⁷</td>
<td>Cisco developed video support for their devices allowing them to run Android and Apple’s operating system, including iPhone and iPads.</td>
<td>Customer’s expectations and the dominant position of these OS pushed Cisco to enhance their service of IP interoperability and communication system.</td>
</tr>
<tr>
<td>Google with Internet Media and HDTV⁸</td>
<td>Google TV allows users to search for internet content and online video from their television screens. Google have agreement with Sony, Logitech and Vizio (running on Intel’s ship) now is working in a new agreement with Samsurn, who is going to develop its own ship for Google.</td>
<td>Google persuaded producers to run their service in order to develop a new market of video on line and create an opportunity to increase revenue from more ads.</td>
</tr>
</tbody>
</table>

4.2.3 Services as Agents of Technology

These service firms are users of technology however, their importance lies in their role as producers and transfer agents of new technologies. KIBS like consultancy firms and training services are direct agents and carriers of technology (Miles, Kastrinos, & Flanagan, 1995). This is the case of several technological companies which provide training and project assistance in order to diffuse their own technology or a technology from a partner, generating an additional source of incomes. Table 4 "Diffusion relation: IBM server services and SAP" show examples of high technology consultancy firms that assist to disseminate technological and organizational innovations (Moulaert, Martinelli, & Djellal, 1990). Other services play this role indirectly through the provision of services that favors the diffusion of technology or services that provide knowledge about a specific solution, in order to make it sustainable for client over time (Miles, Kastrinos, & Flanagan, 1995).

Miles (2003, pp. 101-105) distinguish in his model six different roles of KIBS as agents of innovation. These roles can be informative, diagnostic, advisory, facilitative, turnkey and managerial.

Table 4 “Diffusion relation: IBM server services and SAP”

Source: IBM Website\(^9\), SAP Website\(^10\) and Microsoft Website\(^11\)

<table>
<thead>
<tr>
<th>Firm</th>
<th>Service</th>
<th>Technology or innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM and their server services</td>
<td>Optimization and Integration</td>
<td>IBM System i™</td>
</tr>
<tr>
<td></td>
<td>Server Managed</td>
<td>IBM System p™</td>
</tr>
<tr>
<td></td>
<td>Emerging Server Technology</td>
<td>IBM System x™</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IBM System z™ servers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linux(^<em>) and Microsoft(^</em>) operating systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>non-IBM server products</td>
</tr>
<tr>
<td>SAP</td>
<td>Business analytic</td>
<td>Sap Business Suite</td>
</tr>
<tr>
<td></td>
<td>Performance and insight optimization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IT transformation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business transformation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Program, project management, and quality assurance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Software maintenance and support</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Custom development</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training and certification</td>
<td></td>
</tr>
<tr>
<td>Microsoft</td>
<td>Microsoft Office Specialist</td>
<td>Ms Office</td>
</tr>
<tr>
<td></td>
<td>Microsoft Office Specialist Master</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microsoft Office Specialist Expert</td>
<td></td>
</tr>
</tbody>
</table>

The informative role contribute with information of attributes of the companies environment or position within it, from where the client derivate their obstacles and the strategic response. The service firm invests in research to collect, translate and analyze data, in order to transform it into relevant information for their client. Market intelligence, financial analysis and digest of regulations are examples of informative role.

The second role is diagnostic, assisting the client to scheme and distinguish the character of a problem. This is the case of the market research firm which points the issues in the client image. The advisory role proposes and evaluates several alternatives.

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to solve clients’ problems. This role implicates active interaction with the client across the firm. For example, computer services suggest and help to select the appropriated system or group of systems to be used within the firm.

“Facilitative” is the fourth role and support the firm with the aspect of implementing a solution. Training services provide the firm with the skills required to support a process within the organization, and may be adopted despite the absence of technological innovations. Generally this role is used when the staff is to be provided with skills and capabilities to develop their job.

When the knowledge provided by the KIBS correspond to generate and install the resources require to accomplish the solution for the client and the know how to maintain the solution over time, it is called Turnkey role. Finally, the managerial role is when the KIBS execute the solution for the client. Outsource computer, telecommunication and building management are examples, where the KIBS perpetuate their current role in managing the resource.

4.2.4 Other Relations between Technology and Service Innovation

The relation between technology and services is not limited by the adoption, usage and diffusion of technology in services, according to Gallouj & Gallouj (2000, pp. 25-26) other relations can be distinguished: substitution relation, identity relation, determination relation.

A substitution relation for example, is when substituting technical capital for human capital in the back office or in the interaction with the customer. Automated teller machines and other technologies which support the self-service are examples of this relation (Gershuny, 1978). Table 5 “Examples of Substitution relation within Self-Service” illustrates some examples related to the self-service.

Identity relation is when the characteristics of the service provided influence the value of the technology. This is the case of telecommunication services with electronic mailing, fax and high definition video. Determination relation is another type of relation between technology and services. In this type of relation, technological innovations are the origin of the new service function. Information technology is an example, which gives rise to new professions and services.
Table 5 “Examples of Substitution relation within Self-Service”

<table>
<thead>
<tr>
<th>Service Industry</th>
<th>Human Contact</th>
<th>Technology Assisted service</th>
<th>Electronic Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking</td>
<td>Teller</td>
<td>ATM</td>
<td>Online Banking</td>
</tr>
<tr>
<td>Grocery</td>
<td>Checkout Clerk</td>
<td>Self-Checkout Station</td>
<td>Online order/Pickup</td>
</tr>
<tr>
<td>Airlines</td>
<td>Ticket Agent</td>
<td>Check in Kiosk</td>
<td>Print Boarding Pass</td>
</tr>
<tr>
<td>Restaurants</td>
<td>Wait Person</td>
<td>Vending Machine</td>
<td>Online order/Delivery</td>
</tr>
<tr>
<td>Movie Theater</td>
<td>Ticket Sale</td>
<td>Kiosk Ticketing</td>
<td>Pay for View</td>
</tr>
<tr>
<td>Book Store</td>
<td>Information Clerk</td>
<td>Stock-Availability Terminal</td>
<td>IPAD</td>
</tr>
<tr>
<td>Music Store</td>
<td>Information Clerk</td>
<td>DVD reader</td>
<td>IPHONE/IPOD</td>
</tr>
<tr>
<td>Library</td>
<td>Librarian</td>
<td>Computer Database</td>
<td>Electronic library</td>
</tr>
<tr>
<td>Education</td>
<td>Teacher</td>
<td>Computer Tutorial</td>
<td>E-Learning</td>
</tr>
<tr>
<td>Gambling</td>
<td>Poker Dealer</td>
<td>Computer Poker</td>
<td>Online Poker</td>
</tr>
</tbody>
</table>

4.3 Consequences of Technology in Service Innovation

As mentioned in chapter 2, new technological innovations are changing the characteristics and its extent in some services. This change is affecting different services in a different way, considering the diversity of the sector and the differences in extent and forms of innovation. However, innovation in services are being impacted through the adoption of new technology in their production, delivery, offering and finance components, see Figure 4 “Targets susceptible to innovation in the firm”.

The service production is being facilitated by the adoption of technology, considering that the innovation process and the core process of the firm are improved due to the interaction between the different stakeholders and transfer of knowledge. This allows them to extend their core competence through know-how integration (Kandampully, 2002) and the automation of their access to primary sources of information. Additionally, it links the firm with the customer (Kandampully, 2002) and acts also as a customer experience integrator.

The service delivery is being affected, since the need of interaction with the client is being changed by a “substitution relation”. As a result, the need of face to face interactions in some services is disappearing and the delivery of the service is changing in time and space, integrating more and more consumption and production of services.
Other characteristics of services delivery like intangibility, and storage difficulties are also changing through the adoption of information and communication technologies, ICT.

Table 6 "Determination relation: Internet and new services and professions"

<table>
<thead>
<tr>
<th>Internet</th>
<th>New Service or profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>Websites</td>
<td>Web designer</td>
</tr>
<tr>
<td></td>
<td>Web content administrator</td>
</tr>
<tr>
<td></td>
<td>Internet security specialist</td>
</tr>
<tr>
<td>Ads- Marketing online</td>
<td>Internet Marketing specialist</td>
</tr>
<tr>
<td></td>
<td>Blog</td>
</tr>
<tr>
<td></td>
<td>Blogger</td>
</tr>
<tr>
<td>Sales online</td>
<td>Pay online system (Paypal)</td>
</tr>
<tr>
<td></td>
<td>Secondhand sale (Blocket.se)</td>
</tr>
<tr>
<td></td>
<td>Purchases in group (Group-on)</td>
</tr>
<tr>
<td>Social Networking</td>
<td>Social Games (Farm Ville)</td>
</tr>
<tr>
<td></td>
<td>Data mining from Social Networks</td>
</tr>
<tr>
<td>Communications</td>
<td>E-mail</td>
</tr>
<tr>
<td></td>
<td>Chat</td>
</tr>
<tr>
<td>Others</td>
<td>Maps (Google maps)</td>
</tr>
<tr>
<td></td>
<td>Translators online</td>
</tr>
<tr>
<td></td>
<td>Information backup online</td>
</tr>
<tr>
<td></td>
<td>Search engines</td>
</tr>
<tr>
<td></td>
<td>Access to free music (Spotify)</td>
</tr>
<tr>
<td></td>
<td>Online certifications (Vue Person)</td>
</tr>
</tbody>
</table>

The service offering is been affected. Technology adoptions can originate new services through the “determinant relation”. Internet is an example, which gave rise to new professions and an uncountable number of online services, see Table 6 "Determination relation: Internet and new services and professions". In this case technology is the base for innovation in services.

Finally service finance is impacted; technology provides the possibility to innovate the targets in new ways which were previously unthinkable, like business models. Zynga Inc. developed an interesting business model base in the social network gaming. This business model corresponds to Farm Ville, an online game on Facebook by Zynga, which consists of “build up a virtual self worth”. This game engages users with free play and sells virtual items to accelerate the game or building of their “net worth”.

As a general consequence, the innovation cycle in service firms is becoming shorter, which is a challenge for the service firms, considering that they need to adapt to face the conditions of high competence and higher rate of change created in the market place.
5 Conclusion

The findings of this research suggest that technology and services in some extent share a symbiotic relationship. The service sector through KIBS, intensive technology services in particular, is a user, producer and agent of technology, which contributes to the development and diffusion of technological innovations. All the levels of technology adoption lead to innovation in service firms. Therefore, we can conclude that technology has an important role in services innovation.

The proposed research question has been answered by extensively investigating and discussing how the adoption of technology or technological innovations is affecting innovation in the service firm. This help in identifying and understanding “Which is the role of technology in service innovation”. For instance, technology facilitates the integration and transfer of knowledge from different sources, and the interaction among different stakeholders of the innovation process, both external and internal. It also modifies service characteristics, which lead to shorter services cycles, impacting the production and delivery of new services, while targeting clients more effectively. Furthermore, technological innovations are enabling service innovation creating new possibilities to innovate. This belief is complemented by considering that they provide a platform for new services and professions, and impact components of the services that before were difficult. This impacts all the targets susceptible of innovation within the firm, providing new opportunities to innovate.

Finally, from a holistic view, one can conclude that the main role of technology in service innovation is as a source for innovation. Technology facilitates and enables innovation, which can lead the firm to gain sustainable competitive advantage in current markets or to establish new markets through novel or improved services. The traditional role of technology as source to improve productivity in the firm continues valid. However, this research contributes to understand how technology is not only a source for efficiency and effectiveness in services. Technology can also contribute in productivity from the innovation process, as a source for innovation, which can be reflected in larger improvements in profitability.

Moreover, this conclusion represents a challenge to the service firm, since it leaves room for a non-technological driver for innovation in the firm. This driver defines the firm’s propensity to innovate and exploit the possibilities and opportunities that technology provide in the innovation process on behalf of the customers.
Further research

Through the document is proposed a system to identified innovation in service firms ground in the component of services. However, the method or methodology require to measure service innovation based on technology or to which extent innovation in a service firms correspond to technology, should be addressed by further research.
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Understanding the Role of Technology in Service Innovation: A theoretical Overview

http://www.slidefinder.net/l/ISM_270_Service_Engineering_Management/29926963


