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# The Role of Research and Technology Organizations (RTOs) in Open Service Innovation

## A dual perspective

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*This PhD project was one of the biggest challenges I had to encounter so far in my life and I would not be able to complete it successfully without the presence of the people that provided their help and support in this endeavour.*

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# 1 General introduction

In the current complex and networked innovation landscape, new paradigms such as the "open innovation" paradigm of Chesbrough (2003) suggest that R&D openness and collaboration among many innovation actors has become a strategic necessity (Lichtenthaler 2005). Open and collaborative innovation has many benefits in addressing major challenges associated with the innovation process; such as lack of internal resources (including knowledge), organizational rigidities and inadequacies, risk of innovation (including the risk of technological spillovers), brand issues, novel technologies or not fully defined markets (Tether 2002).

Although innovation has always been open to some extent (Dahlander & Gann 2010), nowadays enterprises cannot afford to rely merely on internal capabilities, in order to successfully innovate, but need to collaborate with other firms, customers, communities of practice, suppliers, the academic world and/or consultants. Teece (1989) argued that firms are likely to search for capabilities that lie outside their innovating potential and thus they may seek collaboration with other firms, universities and research organizations. Therefore, new technologies and new knowledge are widely generated through the interaction of the firm with its environment and are further developed internally (Hipp 2010).

Special attention has been given over the years in the relationship between academia and industry, its positive impact on the innovation outcomes (Mansfield et al. 1991; Cohen et al. 2002; Caloghirou et al. 2004; Perkmann & Walsh 2007; Alexander & Martin 2013; Okamuro & Nishimura 2013; Cowan & Zinovyeva 2013) and the related technology transfer mechanisms (Cohen et al. 2002; Perkmann & Walsh 2007; Ruiz 2010; Alexander & Martin 2013; D'Este & Perkmann 2011). The distinct impact of public research on industrial R&D in a broad range of industries is greatly acknowledged (Cohen et al. 2002; Cowan & Zinovyeva 2013), as inter-organizational relationships between academia and industry play an important role in driving the innovation process (Perkmann & Walsh 2007; Peters & May 2004). Cooperation with academia is a way for companies to undertake R&D projects that may otherwise be considered as too risky (Vavakova 1995).

Indeed, a vast literature exists on university-industry cooperation for innovation and related knowledge/technology transfer mechanisms such as Technology Transfer Offices (TTOs) (Etzkovitz & Goktepe 2005; Debackere & Veugelers 2005; Rasmussen 2008; Comacchio et al. 2012). Universities, facing the contemporary turbulent environment and the scarcity of public funds have been increasingly assuming a third mission (Leydesdorff & Etzkowitz

1996; Leydesdorff & Etzkowitz 1998; Etzkowitz 1998). They are required and subsidized, for this reason, by local governments (Caloghirou et al. 2001) to enlarge their activities beyond the traditional teaching and basic research to assume a more active role in R&D by forming collaborations with industrial partners (Carayannis et al. 2000). A large stream of research has been dedicated on the role of universities on technology transfer mechanisms and innovation especially since the introduction of the Bayh-Dole Act in US, which gave incentives to universities to actively seek revenues from their research outputs (Mowery et al. 2001; Nelson 2001; Grimaldi et al. 2011; Howells, Ramlogan & S.-L. Cheng 2012). Similarly, in the European context, the European Framework programs, funded by the European Commission, have also been an important incentive for universities to engage in partnerships with several and diverse partners (Caloghirou et al. 2001).

The public research landscape does not only comprise universities though. The Research and Technology Organisations (RTOs) are also an important part of the academic and public research world and a contributor in the current complex knowledge economies (Metcalfe 2010). In fact RTOs are a significant part of what is called the "extra-university research organizations" sector (Arnold et al. 2010).

According to the European Association of RTOs (EARTO), RTOs are defined as *"organizations which as their predominant activity provide research and development, technology and innovation services to enterprises, governments and other clients…"* (EURAB 2005). RTOs are, therefore, service providers in the national innovation systems (Preissl, 2006) and focus on innovation as their mission is to support the local economies by providing innovation services (EURAB 2005). In this perspective they help companies move "one step beyond" their existing capabilities and reduce the risks associated with innovation to allow for a faster rate of economic development (Arnold et al. 2007). Moreover, they have a distinct place in the national innovation systems, being positioned between *academia and industry* and having strong links with the *government* (Arnold et al. 2010; Arnold et al. 2007). Therefore, they are often defined as intermediary organizations that effectively manage collaborative research projects and foster the relationships with the different innovation actors (Readman et al. 2015).

In Europe, RTOs have an important presence. According to the EARTO, there are currently 350 RTOs in Europe operating in 23 countries involving a network of 150.000 researchers, engineers and technicians. RTOs act as intermediaries between basic research and practical application by providing innovative services to 100.000 companies per year on diverse do-

mains such as health, security, energy, transportation, materials, agriculture (to mention just a few), with an overall economic impact of 40 billion euros (www.earto.org). RTOs are, therefore, an important part of the academic and public research world due to their innovative service offering that fosters their intermediary role (Howells 2006) between science and industry.

Despite the important presence of RTOs in national innovation systems, we manifest a scarcity of publications about their particular role in open and collaborative innovation (Albors-Garrigos et al. 2010). RTOs have not been extensively studied until now, since studies related to science and technology policy and innovation have mainly focused on universities or business firms (Sharif and Baark, 2011). Moreover, RTOs are often blended and studied together with universities (e.g. the study of Perkmann and Walsh 2007), partly also due to the fact that it is a challenging task to give a clear definition of RTOs, because of their diverse inherent characteristics (Tann et al. 2002).

As a result, there is a need to study RTOs as distinct organizations, in order to understand what drives their innovative performance. As mentioned before RTOs are R&D service providers in national innovation systems, but we have not seen any studies addressing the way RTOs develop these services innovation, in order to be able to effectively serve their industrial clients. Therefore, we have to look into their internal organization, in order to explore what makes them efficient service innovators.

Moreover, after having explored the service innovation capabilities of RTOs we have also to examine whether their impact on industry, vis-à-vis universities, is the same. Previous research claims that RTOs are not substitutable with universities (Arnold et al. 2007; Astrom et al. 2008) although they provide similar services but we have not seen any empirical studies addressing the comparison between the two. Therefore, we need to take an external perspective of RTOs and compare them with universities in order to understand what makes them distinct innovators.

The purpose of this PhD project is, therefore, to fill these gaps in the literature by studying the role of RTOs in the open service innovation landscape by taking a dual perspective; namely an internal and an external one. More specifically, our research focuses on two research questions: *1. what constitutes the service innovation capabilities of RTOs* and 2. *What is the role of RTOs compared to universities in the science-industry relationship?* Since the research

objective of the PhD is divided into two distinct research questions, we organize our research accordingly into two distinct parts.

In order to answer the first research question, in the first part of the project, we study RTOs from the internal perspective. Building on the resource based view of the firm (Penrose 1959), the resource-process framework of service innovation (Froehle & Roth 2007), and the NSD process literature **we construct a theoretical framework for the development of service innovation capabilities in RTOs.** Then we empirically confront this theoretical framework following a qualitative approach (Yin 2003) with case studies in 4 selected and renowned RTOs in Europe. The multi-case analysis, (based on double-coding of the empirical data according to the predefined theoretical framework that served as a grid of analysis) resulted in **a thorough mapping of resource- and process-related practices that support the particular and unique service innovation capabilities of RTOs.** Subsequently, we focus on creativity as the core element of successful innovation management (Oke, 2007), taking a more in depth analysis of our data. Our study enabled us to identify seven creativity reinforcing capabilities in service innovation; namely **attracting** creative people**, stimulating** creative environment**, combining** diverse input**, providing** relevant resources**, breeding** creative ideas**, opening up** to external influences **and accepting** risk, failure and criticism.

In the second part of the project we take an **external perspective** on RTOs, focusing on their special role between science and industry in the open innovation context. First we attempt to compare RTOs to Technology Transfer Offices (TTOs) of universities as innovation intermediaries, through the lens of two renowned theories, namely the transaction cost theory (Coase 1937; Williamson 1981; Williamson 2000) and the knowledge based view of the firm (Grant 1996; Spender 1996). **Our results indicate that while role of the universities' TTOs is to reduce the transaction costs of innovation by merely transferring already existing scientific knowledge to the industry, RTOs are more actively implicated in the process**. In fact, RTOs are more involved in the innovation process by fostering collaborative relationships with their industrial partners throughout the innovation process. In this perspective RTOs do not only transfer technologies but also allow for the transfer of tacit knowledge and through a process of co-creation are able to also develop new knowledge.

In the empirical part that follows, this comparison between RTOs and universities is further elaborated based on econometric analysis of the Community Innovation Survey micro-data from eight European countries. The objective of this part of the research was to understand: what "kind" of innovation are the firms, which deem RTOs as more important sources of

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knowledge than universities, more likely to develop. Our results show that firms that consider RTOs as more important knowledge sources than universities: **(i) are more likely to develop service innovation, (ii) have less need to invest in internal R&D but (iii) are less likely to be innovative and (iv) are less likely to develop world first innovation.**

The overall conclusions of this PhD project indicate that the role of RTOs in open service innovation is not only to be an intermediary between academic knowledge and industrial application, as widely believed until now. RTOs possess scientific knowledge, creativity capabilities, access to highly dynamic and important intellectual capital, the absorptive capacity to understand the industry needs and the service innovation capabilities to turn scientific results in industrial application though a co-creation process with the industry and not merely by transferring technologies. Therefore, we can conclude that RTOs are unique actors in the national innovation systems that are able not only to facilitate but also to catalyze the innovation process representing, in this perspective, a superior type of intermediary in open innovation.

Our research has several theoretical and practical implications. As far as theoretical implications are concerned we have managed to contribute significantly in the knowledge regarding RTOs. By proposing a relevant theoretical framework for the development of service innovation capabilities in RTOs and empirically confronting it through case studies in selected RTOs, we have contributed in better understanding what makes RTOs unique in the development of service innovation, especially as far as creativity is concerned. Moreover, our contribution is also valuable for the field of service innovation, in general, where the concepts of capabilities remain still abstract and rarely relevant empirical studies have been employed. Our proposed grid for identifying service innovation capabilities (as well as the specific proposal regarding creativity) can be used more generally in other research contexts as well. Furthermore, we have linked the service innovation concept with that of open innovation by highlighting the cognitive similarities of these two concepts, highlighting the fact that service innovation is inherently open.

Furthermore, we have also contributed to the knowledge about RTOs by comparing them to universities. The relevant literature on the links between science and industry is very much blending RTOs and universities by considering them as the same type of organizations. Our research, for the first (at least to our knowledge) time, compares RTOs and universities both theoretically and empirically. The comparison is, indeed, helpful due to the cognitive proximity of these organizations and it helped us to identify the elements that make RTOs special in the public research landscape without falling into general conclusions that could have been

true for both organizations. Our results contribute, therefore, in better understanding the different roles of these two public research actors in the open innovation context.

As far as practical implications are concerned we can briefly mention the following. First, the industry can understand the benefits that they can reap by collaborating with RTOs. RTOs are not only knowledge transfer organizations but unique knowledge co-creators. Therefore, RTOs can not only be seen as simple service providers but have a potential for innovation that may still be unexploited. Moreover, policy makers should give more importance to the special role of RTOs in open, networked and globalized innovation systems and position them accordingly compared to universities. RTOs represent important and effective policy tools that drive the economic development worldwide. Especially in the European context, RTOs can be seen as the solution to the "innovation gap" with the US (Chesbrough 2015). Therefore, if RTOs are indeed the new "open innovation" organizations as Chesbrough (2015) points out then the support of the government is indispensable, though available funding or structural supporting mechanisms for collaboration (though living labs or other structures), in order for these organizations to be able to unveil the whole spectrum of their capabilities. Ideally, the role of RTOs should be seen beyond national boundaries, in a European or even globalized perspective. Especially, in times were social challenges are abundant the contribution of RTOs to open innovation initiatives that could solve societal problems through co-creation seems indispensable.

The outline of the thesis is as follows. Initially, we provide a thorough description of RTOs including their activities and their position in national innovation systems, in chapter 2. Then the PhD manuscript is divided in two distinct parts the *internal perspective* and the *external perspective*.

In the internal perspective part, we start by explaining, in chapter 3.1, our theoretical background including a literature review on the concepts of services, (open) service innovation and the development of service innovation capabilities. Our research objectives and research question are explained in chapter 3.2 and the research design (conceptual and empirical part – qualitative study) is explained in chapter 3.3. The main results are presented in chapter 3.4, through three relevant papers that were drafted based on the results of the first part study.

The external perspective part that follows has a similar structure as the internal perspective. We start by explaining our theoretical framework including a literature review on the concepts of open innovation, the relevant benefits and challenges and the role of open innovation in-

termediaries in the science-industry relationship. Then in chapter 4.2 we present our research objectives and research question; the chapter 4.3 gives an overview of the research design (conceptual and empirical part – quantitative study) on how this research question will be answered. The main results are presented in chapter 4.4 through two relevant papers that were drafted based on the results of the second part of our study.

The discussion and concluding remarks in chapter 5.1 summarize the outcome of this research project by bringing together the results of the different research stages. In section 5.2 we discuss the practical implications of our research (for RTOs, the industry and the policy makers) and in chapter 5.3 we propose avenues for further research. Figure 1 below provides an overview of the thesis outline. Finally, in Appendix A we provide an anonymized description of our case studies, in Appendix B a short description of the targeted interviewees profiles, in Appendix C the capabilities mapping and interview guides grid for our case studies, in Appendix D we present the CIS 2012 questionnaire and in Appendix E the five papers that constitute the backbone of the PhD.

**GENERAL INTRODUCTION**

Exploring the role of RTOs in open (service) innovation

A dual perspective

**SECTION 2**

Getting acquainted with Research and Technology Organizations (RTOs)

**SECTION 3 – Internal Perspective**

RTOs' unique service innovation capabilities

*Theoretical Background*

*Research Question 1*

*Qualitative study multi-cases analysis*

*Main Results 1*

**SECTION 4 – External Perspective**

The role of RTOs vis-à-vis universities in the public research-industry open innovation relationship

*Theoretical Background*

*Research Question 2*

*Quantitative study of 2012 CIS data*

*Main Results 2*

**SECTION 5**

**Discussion and Concluding Remarks**

*Synthesis of Results and Discussion*

*Practical Implications*

*Further Research Avenues*

*Figure 1: Thesis outline*

## 2 Getting acquainted with Research and Technology Organizations (RTOs)

This initial part of the literature review will help us understand what an RTO is and how it is positioned in the national innovation systems. Therefore, we provide the reader with a thorough overview of RTOs, in order to understand what kind of organizations RTOs are, how they are defined, what are their functions and their collaborative activities with the academia and the industry and their importance in the national innovation systems.

### 2.1   *Defining RTOs*

RTOs represent an important part of the "extra-university research organizations" sector, which includes scientific research institutes, the governmental laboratories and applied research institutes and RTOs (Arnold et al. 2007). According to Arnold et al. (2010) the functions of the three previously mentioned entities are the following:

(i)   scientific research institutes do the same kind of research as universities and block grants constitute a big proportion of their income,

(ii)  government laboratories are generally owned by the state and their main function is to deliver services and policy-relevant information to the government, and finally

(iii) applied research institutes or RTOs focus on problem-oriented research for the benefit of the society and win most of their funds competitively.

RTOs are organizations that are involved in research and development activities but rarely engage in teaching, although they have close links with universities and might also employ doctoral students among their staff (Gulbrandsen 2011). Their research outputs range from basic research to product development and provision of research resources and infrastructure to being incubators for startup companies (Leitner 2005).

It is generally acknowledged that it is a challenging task to give a clear definition of RTOs, because of their diverse inherent characteristics (Tann et al. 2002). Gulbradsen (2011) calls them hybrid organizations (Figure 2) because of their position between applied and pure research and the public and private nature of their structure and knowledge.
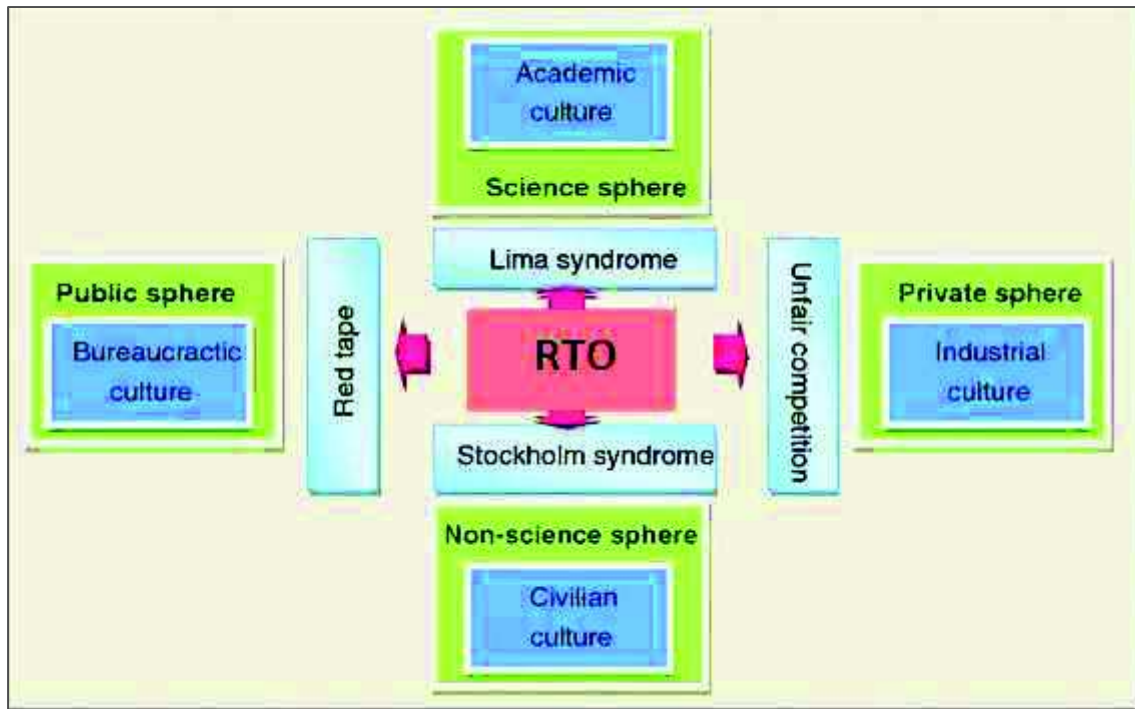
*Figure 2: The two hybrid dimensions, the four science policy cultures and the challenges to legitimacy for hybrid organizations in this landscape (adapted from Gulbrandsen, 2011)*

Moreover, it is true that several names have been used interchangeably with the term "RTO" in order to describe these organizations, some examples being: research institutes, research centers, public institutes, non-corporate research organizations or government laboratories. Furthermore, in some rare cases the name RTOs has also been used in previous research as a general term that includes universities and sometimes even private consultants. Nevertheless, in this project we chose to adopt the following EARTO's (European Association of Research and Technology Organizations www.earto.org) definition of RTOs, which is also the one that is most commonly used in the literature.

According to EARTO, RTOs *are "organizations which as their predominant activity provide research and development, technology and innovation services to enterprises, governments and other clients…"* (EURAB 2005). Their mission is to help companies (especially Small and Medium Size Enterprises (SMEs)) move "one step beyond" their existing capabilities and reduce the risks associated with innovation to allow a faster rate of economic development (Arnold et al. 2007).

RTOs might be public, semi-public or private; some of them are technology-oriented while others provide services in social sciences or economics. They can do basic or applied research

or sometimes both, some offer technology transfer and even implementation support while others deal with certification and standardization (Farina & Preissl 2000; EURAB 2005).

In practice, RTOs functions are very diverse; Table 1 gives a thorough overview of their activities.

*Table 1: Typical Functions of RTOs (adapted from EURAB 2005)*

| FUNCTION | EXAMPLES OF ACTIVITIES |
|---|---|
| **Fundamental/ strategic research** | • Fundamental research, in particular in areas considered to be of strategic importance, e.g. defence/security, nuclear energy, public health.<br>• Long-term studies |
| **Technological support to economic development** | • Contract research services to industry<br>• Long-range technological research<br>• Technology "extension"<br>• Support for SMEs |
| **Supporting public policy** | • Fundamental and precautionary research, e.g. environmental policy, public health, food safety, sustainable development<br>• *Ex-ante* policy design and impact analysis<br>• *Ex-post* surveillance and monitoring of the implementation of policy, e.g. pollution, seismic survey<br>• Expertise |
| **Technical norms, standards** | • Pre-normative research<br>• Implementation monitoring, e.g. metrology<br>• Certification (and certification of certifiers) |
| **Constructing, operating and maintaining key facilities** | • Big infrastructure (e.g. accelerators, research reactors, botanical gardens, large computing facilities).<br>• Large, unique, dangerous etc. collections<br>• Cost beyond the resources of other players<br>• Security and safety (physical concentration, accountable management)<br>• Large, long-term data collections |

According to the EARTO, there are 350 RTOs in Europe operating in 23 countries involving a network of 150.000 researchers, engineers and technicians. These organizations bridge the gap of basic research and practical application by providing innovative solutions to 100.000 companies per year on diverse domains such as health, security, energy, transportation, materials, agriculture (to mention just a few) with an overall economic impact of 40 billion euros. Examples of renown European RTOs[1] include Fraunhofer in Germany, VTT in Finland, TNO in the Netherlands, SINTEF in Norway, Technalia in Spain, SP in Sweden, CSEM in Switzerland, CEA Teach in France and LIST[2] in Luxembourg (for more details on the network of European RTOs and information on specific RTOs please see the detailed EARTO site on www.earto.eu).

RTOs are highly nationally dependent; therefore, the same term might mean different things in different national context. For instance, in some countries RTOs are very closely linked with universities to the extent that they share their premises, equipment and even their human resources. At the same time there are other RTOs that work more independently, similarly to consultancies and they are more focused on providing their services to their industrial partners.

## 2.2 The funding model of RTOs

Regarding funding, RTOs rely on a mix including public and private sources, such as membership subscriptions, fee-for-service activities, government core funding, contracts for public grant-funded research or competitive contracts from firms or governments, which is a result of their hybrid character (Berger & Hofer 2010). On the one hand, they generate their income from the market, offering services and capitalizing on know-how just like private enterprises, (e.g. Knowledge Intensive Firms). On the other hand, they qualify for public funding, because they provide public goods, such as basic research and academic publications, as well as support public innovation policy by facilitating technology transfer from science to industry and offering technical support especially to SMEs (Hales 2001). Moreover, some RTOs operate on a commercial basis, but still, a vast majority adopts a non-for-profit character and usually

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[1] Of course RTOs are not solely a European phenomenon. Renowned RTOs exist also in many other countries such as US, Canada, China, Brazil, India etc. The interested reader can find more information about RTOs in an international context through the website of WAITRO http://www.waitro.org/index.php. The scope of this research though lies in the European context and therefore we typically give more focus on the European RTOs.

[2] Former CRP Henri Tudor

they have a certain degree of autonomy in their management, while being still accountable to government and various stakeholders (Turki & Mention 2010).

The exact funding model of RTOs across countries varies substantially and it is very much nationally dependent. Since RTOs are a national instrument for driving R&D, the governmental funding contribution is an important element, but it depends on the importance that each government assigns to their national research and development strategy. Moreover, the availability of funds by the local industry and the capability of RTOs to address more international markets or to claim shares of European or international research programs (such as the European Framework Programs for instance) is also an important element of their funding model.

But although RTOs funding model is very much dependent on the national context, the mix of public and private funds is what constitutes their inherent characteristic that supports their special hybrid nature (Gulbrandsen 2011). In fact it is this balance between public and private, public science and private industrial application, which supports their position between the academic and the industrial world. As a result, RTOs are forced to develop capabilities over the two seemingly different dimensions of public research and pragmatic output. It is this special characteristic that supports their role as intermediary between academia and industry, by translating research outputs into commercial applications in collaboration with their industrial partners (Arnold et al. 2007; Arnold et al. 2010).

### 2.3 *Motivation for establishing RTOs: The valorization of public research*

As already implied by the definition of RTOs, the motivation behind the establishment of many RTOs was the intention of governments to enhance the industrial competitiveness in a time when there was important belief in the capabilities of public organizations to perform R&D (Barge-Gil & Modrego-Rico 2008; Sharif & Baark 2011). Indeed, the cooperative technology policy paradigm features an active role for government actors in technology development and transfer (Bozeman, 2000) so that productivity and innovation are promoted (Kash & Rycroft 1994). RTOs were expected to provide technological services to the industry and at the same time invest in research activities, keeping the future requirements of the industry in view (Mrinalini & Nath 2000). Therefore, they were created in order to serve the industry's technological needs (Mrinalini & Nath 2000) and with the explicit purpose of industrial and economic growth (Gulbrandsen 2011).

Barge-Gil and Modrego-Rico (Barge-Gil & Modrego-Rico 2008) argue that technology institutes such as RTOs are an effective tool of public intervention in the area of technology due to

their distinct role between academia and industry. The authors study Spanish RTOs through the lens of two theories: the neoclassical theory and the evolutionary theory. From the neoclassical perspective RTOs could fill the gap of real and optimal R&D investment, thus addressing market failures, such as uncertainty, indivisibilities appropriability and absence of well-defined information markets (EURAB 2005; Barge-Gil & Modrego-Rico 2008). On the other hand, from the evolutionary perspective, RTOs should act as technology transfer and diffusion entities that promote and foster creativity and are able to catalyze the collective efforts (Barge-Gil & Modrego-Rico 2008).

RTOs were often bound to national and historical legacies and were associated with specific industries, sectors or technology specialization (Readman et al. 2015). In UK, for instance, RTOs were established in order to propose services to specific industries (Readman et al. 2015). In Western Europe and North America, RTOs were instruments of public policy in order to catch-up in technological developments by transferring and assimilating new technologies from academia to industry, but also across different industries (Readman et al. 2015).

Arnold et al. (2010) propose in their report a view of the origins of RTOs in order to better understand their functionality. They define three typical cases:

*(i) Research Associations* which dealt with specific industry sectors and then became institutionalized.

*(ii) Technology Push Institutes* which were set up to promote industrial development.

*(iii) Services-Based Institutes, which* in their early years generally focused on measurement, testing and certification and which later moved upstream into research.

Over the time however, RTOs focused more on the provision of innovative services and technological know-how rather than focusing on specific industries (Readman et al. 2015). This shift was consistent with the development of industrial R&D and the changing role also of the universities which assumed a more active role in innovation activities (third mission of universities (Etzkovitz & Goktepe 2005)). In any case, profit maximization has never been the objective of these organizations that were rather focused on enhancing the technological capabilities of their clients (Nath & Mrinalini 2000).

The distinct role of RTOs in the innovation systems is also explaining why governments and industry (and RTOs themselves) are preoccupied with the impact of RTOs; each of them from their own perspective. Some studies address this impact by the definition of KPIs (Key Per-

formance Indicators) that assess the impact of RTOs on the industry (focus on SMEs) and the national economy (Mrinalini & Nath 2000; Mrinalini & Nath 2006; www.earto.org). Many of these studies are focusing on defining these KPIs based on the main objectives of RTOs which are: (i) to develop new technological knowledge and the necessary absorptive capacity to sustain this capability and (ii) to transfer technology to their partners/clients through various ways such as collaborative R&D, consulting services, training courses, other support services, publications, conferences etc. (Barge-Gil & Modrego-Rico 2008). EARTO is often undergoing such studies of impact assessment for selected European RTOs[3]

### 2.4 *The collaborative innovation model of RTOs, their position in national innovation systems and the focus on services*

The innovation model of RTOs, as described by the report of Arnold et al. (2010, pp.10–11), comprises the following stages:

(i) *exploratory research and development* to develop an area of capability or a technology platform,

(ii) *further work to refine and exploit that knowledge,* often in collaboration projects with the industry, and

(iii) *more routinized exploitation of this knowledge* via consulting, licensing and spin-off company creation.

RTOs are therefore performing innovation neither as universities nor as private firms. Thanks to the governmental funding they can invest in research for developing capabilities that their clients would not invest in for developing themselves; at the same time however, RTOs need to keep their links to the industry in order to assure the additional funds for their activities. So they have a quite distinct position in the innovation systems. Nevertheless, we cannot really rely on a simplified approach such as the "three hump" model (Figure 3) according to which universities do basic research, research institutes (like RTOs) do merely applied research in order to transfer the application of their knowledge to the industrial firms and industrial firms, in their turn, use this knowledge for profit (Arnold et al. 2010). This model seems to be over-

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[3] An example of a recent publication on the impact of 9 selected RTOs by EARTO: http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Brochure.pdf

simplified today. In reality the activities of the three innovation actors are overlapping, as illustrated in the right part of Figure 3. The three actors have not only overlapping but also complementary roles, with firms performing research or universities commercializing their research increasingly through their respective Technology Transfer Offices (TTOs).
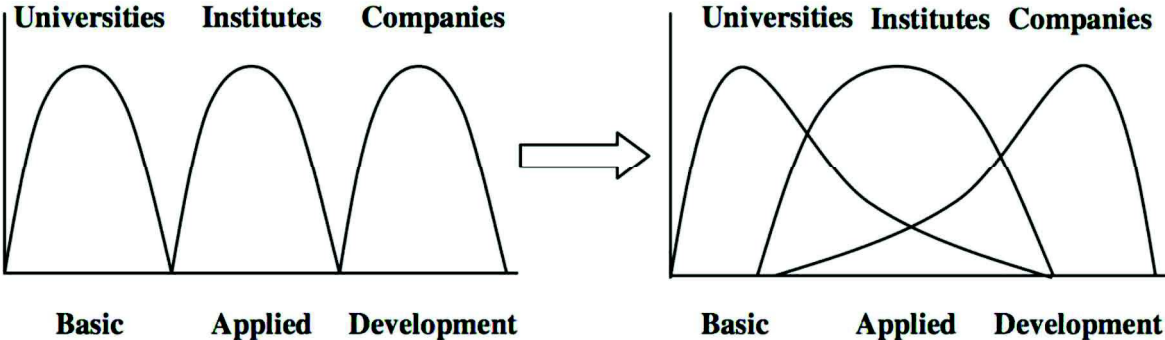


*Figure 3: The Breakdown of the "three-hump model". Source Arnold et al. (2010)*
*The significant role of RTOs in national innovation systems*

The collaborative innovation model of RTOs fosters their special position in the innovation system, being the interface between academia and industry. RTOs have close interactions with academia such as co-publications, joint PhD supervision, PhD placement, part-time employment of RTO staff as university teachers and vice versa and sharing of facilities (Arnold et al., 2010). Although RTOs and universities are increasingly overlapping, they cannot be seen as substitutes but they should rather be perceived as complements, having different expertise and core capabilities (Arnold et al., 2007). Nevertheless, they often do compete for the same funds (governmental or European research funds) and as a result they find themselves to be rivals. Their special position in the R&D landscape is described in Figure 4.
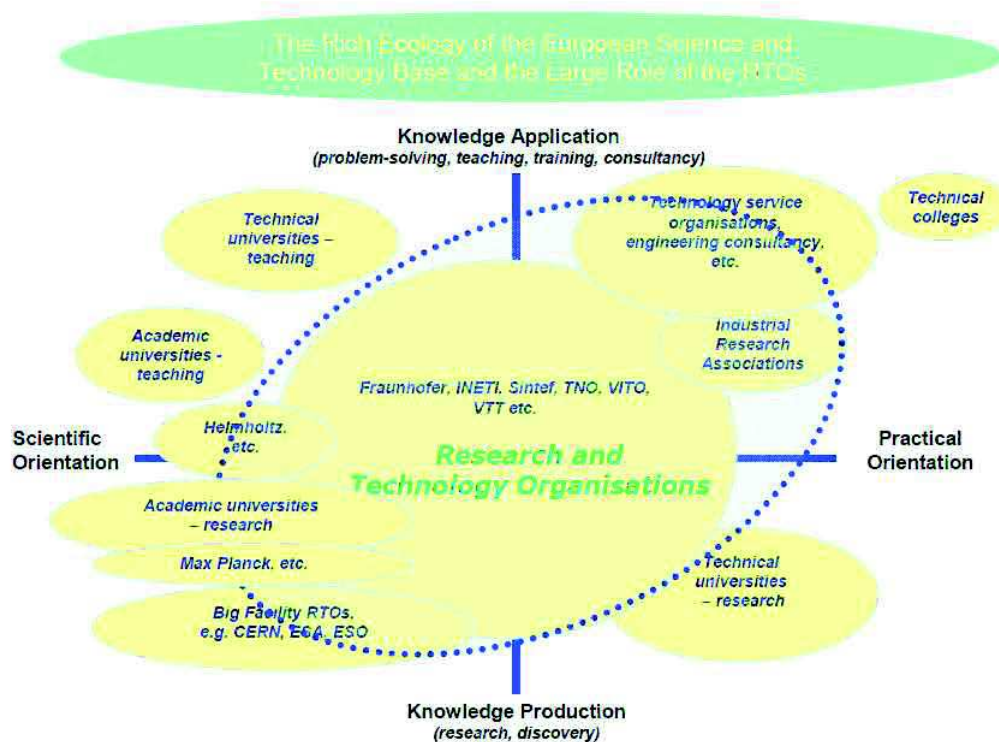
*Figure 4: Positioning RTOs in the R&D landscape (source EURAB, 2005)*

The relationships of the RTOs with the industry is represent also very important issue as they facilitate technology transfer and innovation. Ruiz (2010) identifies two types of technology and knowledge transfer: (i) a simple transaction of intellectual assets in return of some economic benefit (which the author presents as a linear process of technology push from universities or research centers) and (ii) a more sophisticated relationship with a series of interactions, collaboration and co-creation (consistent with open innovation paradigm).

It is indeed in the second type that RTOs seem to be more proficient, as the provision of innovation services requires a much closer interaction with the industrial partners/customers. In this perspective Hales (2001, p.9) mentions that RTOs are: *"suppliers of explicit innovation services, in a context that also contains 'self-service' elements of supply and the supply of tacit innovation services that are 'bundled' with non-service products or non-innovation services (i.e. operational services)"*. The author further elaborates on the type of services that RTOs provide (Figure 5) including explicit innovation services, traded knowledge-intensive business services and supply of tangible goods (as bundled innovation services).
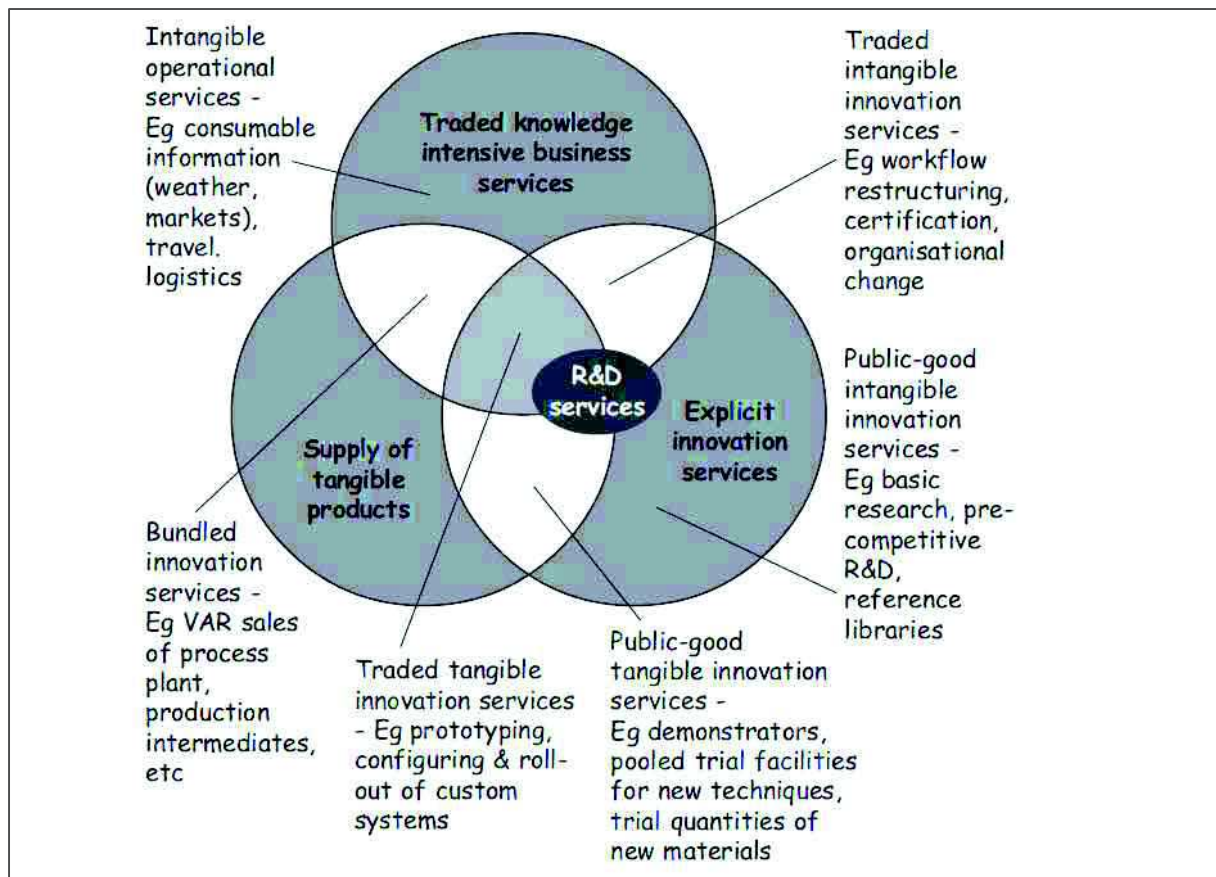
*Figure 5: Categories of technology and knowledge related services of RTOs (source Hales, 2001)*

## 2.5 RTOs challenges and transformation process

In the current competitive and complex R&D landscape, RTOs are under significant pressure and are undergoing reforms in order to become more competitive and to have more impact on the national economies (Preissl 2006). On the one hand universities are striving to excel in their third mission (Etzkowitz & Leydesdorff 2000) and on the other hand private firms exhibit increasingly important R&D skills. Therefore, previous research claims that RTOs' hybrid nature is difficult to defend as they cannot embody academic excellence nor direct economic competitiveness (Gulbrandsen 2011).

Similarly, Rincon and Albors (2013) acknowledge in their turn the increased challenges that RTOs are facing nowadays. They argue that RTOs should develop their internal capabilities in order to be involved in new technological areas and to network with other innovation actors (other RTOs, universities, industrial partners), in order to be able to sustain their competitiveness and adapt in the process of globalization of R&D (Sharif & Baark 2011). Indeed, the global competition has forced firms to look to global markets for new technologies and there-

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fore the knowledge production and diffusion process has become global (Mrinalini & Nath 2008). The role of RTOs in this globalized context is, therefore, vital.

Furthermore, nowadays RTOs have to compete for their funding under new knowledge production modes such as Mode II (Gibbons et al. 1994; Leitner 2005) at a time that financial resources become scarce in all countries around the world and governmental financial support is uncertain (Nath & Mrinalini 2002). Therefore, RTOs are forced to search for a large part of their funding among their industrial partners which might be in contrast with their initial role as non-profit organizations. This implies that RTOs have to be very proficient in keeping the balance between their non-profit nature and the need to ensure the essential funds for their development and sustainability.

In conclusion, we can argue that RTOs are faced to some important challenges nowadays. Their role and their mission are under transformation and they have to be able to overcome the difficulties in order to continue serving the local economies.

# 3 An internal perspective of RTOs: RTOs unique service innovation capabilities[4]

## *3.1 Theoretical Background*

In this chapter we will look at RTOs from an internal perspective. After having been acquainted with the definition, the functioning and the historical background of RTOs we will now try to look into the internal organization of RTOs to understand what drives their innovative performance. Building on the view that RTOs are suppliers of innovation services (Farina & Preissl 2000; Hales 2001) we aim at identifying the service innovation capabilities of RTOs. In order to do so, we will initially present the special characteristics of **services, (open) service innovation and the NSD (New Service Development) process** which is the main activity and mission of RTOs, as recent literature highlights (Readman et al. 2015; Perkmann & Walsh 2007; Arnold et al. 2007). Right after, we will mobilize the theory of the **Resource Based View (RBV) of the firm** in order to understand the **service innovation capabilities** of RTOs. Although the RBV represents a comprehensive framework for the development of innovation capabilities, there is also the process aspect in service innovation that needs to be taken into account. This important process perspective is expressed by the **resource-process framework of Froehle and Roth** (Froehle & Roth 2007) for the development of service innovation capabilities which will also be presented in the literature review that follows. This framework efficiently combines the **resources** that are essential for the development of service innovation capabilities together with the proficiency of the **NSD process**.

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[4] This part of the research project was undertaken under the context of the SERVICeABLE research project. This project was funded by the Fond National de Recherche de Luxembourg (FNR); the interested reader can find more information here. The project team comprised three team members: Dr. Pierre-Jean Barlatier (Principal Investigator and Project Manager), Dr. Lidia Gryszkiewicz (PhD student at the time) and myself. My participation in the project was 100% of my working time for 18 months and I was the only person that worked full time in the project meaning that I have undertaken the biggest part of the research work. As a result, the SERVICeABLE project was an important milestone in my engagement in a PhD project regarding the importance of RTOs in national innovation systems. Thus, the end of the project was the starting point and the kick-off of the conceptualization of my research project's objectives. Please note that the results of the project were presented in several conferences and journal papers during and after the completion of the project. Three of these papers, relevant to the present PhD project, are presented under the first part of this PhD project. Naturally, the papers are co-authored by the three members of the SERVICeABLE research project.

*3.1.1 Understanding services and service innovation*

Definitions of "service" vary in the respective literature. According to Grönroos (1990, p.27), a service is:

*"…an activity or series of activities of more or less intangible nature that normally, but not necessarily, take place in interactions between the customer and service employees and/or physical resources and/or systems of the service provider, which are provided as solutions for customer problems"*.

Kotler (1994) provides a definition of a service "*as any act or performance that one party can offer to another that is essentially intangible and does not result in the ownership of anything*". Moreover, Gadrey et al. (1995, p.4) state that:

*"To produce a service, therefore, is to organize a solution to a problem (a treatment, an operation) which does not principally involve supplying a good. It is to place a bundle of capabilities and competencies (human, technological, organizational) at the disposal of a client and to organize a solution, which may be given to varying degrees of precision."*

The latter definition focuses on what constitutes the very origin of a service, namely a system of resources and capabilities that does not only comprise the sole output but goes beyond that.

The inherent characteristics of services have often been used to explain the challenging nature of service innovation. According to de Jong's et al. (2003) these are:

• *Intangibility*: services cannot be seen or felt before they are bought. The degree of intangibility varies among services; but this is one of their basic characteristics that differentiate them from products.

• *Simultaneity*: they are produced and consumed simultaneously, often with the customer's presence. Again the degree of simultaneity changes according to the service and it depends on the percentage of contact time between the service provider and the customer.

• *Heterogeneity*: this characteristic is relevant to the variability of services. The value of services depends on who provides them and where they are provided; thus it is highly dependent on the customized character of services.

• *Perishability*: they cannot be maintained. Most of the services cannot be stored and reused after consumption (with few exceptions).

It is these specificities that make services and service innovation more challenging but also more interesting to study (Gallouj & Savona 2011). It is most of the times difficult to con-

sciously describe and analyse something intangible, such as services. This is the reason why services have so often been neglected in the innovation literature following the assumption that service innovation is only complementary to goods innovation. As a result, services have been perceived as non-innovative, as they have been regarded as merely supporting and complementary to product innovation (please see the thorough review of Gallouj & Savona (2009) on this). Moreover, services were thought to be mainly consumers of innovations, occasionally imitators or facilitators of innovations in manufacturing firms (Toivonen & Tuominen 2009).

However, this mindset has started to change. Scholars have identified the importance of service innovations and thus they have started studying innovation in services independently (Gallouj & Weinstein 1997; Evangelista 2000; Hipp 2010). It is Gallouj and Weinstein (1997) that highlighted the differences between innovation in services and innovation in manufacturing. Moreover, as Toivonen and Tuominen (Toivonen & Tuominen 2009) put it *"innovation in services shows some specific features which cannot be deeply understood if the models developed in the manufacturing context are applied"*. The quality of services, in contrast to manufactured products, becomes apparent only when they are actually in the process of being delivered (Preissl, 2006).

Den Hertog (2000) identifies four dimensions of innovations in services, namely:

*(i) service concept, (ii) client interface, (iii) service delivery system and (iv) technological options.* Later on den Hertog et al. (2010) have complemented this classification with two more dimensions; namely: *(v) value systems/business partners and (vi) revenue model.*

A service innovation can be any combination of the above stated dimensions. These dimensions reveal important elements that need to be taken into account in innovation in services, namely (i) the collaboration with clients and/or with other business partners, (ii) the role of technology for NSD and (iii) the birth of new services out of recombination of older ones. Similarly with den Hertog's (2000) classification, van der Aa and Elfring (2002) present their own typology building on Normann's (1984) work[5] on service management. Their classification is the following (with the three first categories falling under organizational innovations):

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[5] Normann (1984, 1991) identifies four forms of innovation, namely social innovations, technical innovations, network effects and reproduction innovations.

*(i) multi-unit organizations, (ii) new combinations of services, (iii) customer as co-producer and (iv) technological innovations.*

Although these two typologies were built for different contexts we can still recognise a degree of similarity among them. Den Hertog (2000) identifies important stakeholders in the service innovation process such as clients, suppliers but also the internal organization. Van der Aa and Elfring (2002) also identify the importance of clients, not only as an effective partner in innovation, but even as an extended part of the organization. Finally, the idea of developing new services through recombination of existing services is coming up again along with the importance of technology.

The above discussed characteristics of services/service innovation represent valuable elements of our analysis, on which we will come back when we define the practices that determine service innovation capabilities in RTOs (in Paper 2 and Paper 3).

### 3.1.2    Services in an open innovation context

The majority of research works on open innovation do not clearly distinguish between open innovation in services and open innovation in the service context. Very few studies exist on the applicability of open service innovation explicitly though. Some previous research, for instance, indicates that although open innovation is beneficial for both product and service innovation, there are differences among industries on how they adopt it. This is consistent with the view that specific mechanisms and outcomes of open innovation depend to a great extent on context and contingency (Tidd & Hull 2003).

Hipp (2010) identifies the intangibility of services as a characteristic that may hinder the trading of the service and hamper the ability to protect the related intellectual property via traditional links. This is very important in the open innovation context as the protection of intellectual property is one of the biggest challenges and barriers to open innovation (especially in software development (Blind et al. 2006)). Nevertheless, it was shown that service firms collaborate at the same intensity as manufacturing firms, although there was variety between different countries and industries (Tether et al. 2001; Hipp 2010). Moreover, based on an analysis of the data of the Community Innovation Survey (CIS-2)  in UK, Tether (2002) finds that high technology service firms are more likely to cooperate for innovation (he also argues that his findings are consistent with previous literature) (Tether & Tajar 2008). These firms are more likely to cooperate with consultants, clients and others but are less likely to cooperate with universities (Tether 2002). Finally, Fasnacht (2009) acknowledges the benefits of

open innovation in financial services by highlighting the importance of open and flexible business models that integrate clients in the innovation process more effectively.

However, the fact that the applicability of open innovation in the service context has emerged as an interesting research topic very recently is surprising for two reasons. Service innovation is attracting attention increasingly and the characteristics of services make service innovation open by definition (intense collaboration with clients, easier licensing etc.). Indeed, Chesbrough (2011, p.4) in his book on open service innovation argues that: *"Open innovation accelerates and deepens service innovation and growth by promoting specialization within the customers, suppliers, makers of complementary goods and services and other third parties surrounding the business, resulting in more choice and variety for customers"*.

Chesbrough (2011) defines the open process in service innovation as a value web (Figure 6), i.e. a highly interactive process, where customers play a central role but also other actors contribute significantly. The value web naturally reminds us the discussion of Gallouj and Savona (2011) about how service innovation challenges the linear models of innovation and is more in line with the interactive model (Kline & Rosenberg 1986; Sundbo & Gallouj 2000). We can, therefore, acknowledge the similarities of the nature of service innovation and open innovation.

What is broadly discussed in the case of open approaches in service innovation is the inclusion of the customer in the development of services. Of course this is understandable as the main characteristic of the service is its client-centric nature which makes it almost impossible to develop a new service without at least a minimum participation of the client. In Toivonen and Tuominen's (2009) main processes of services innovation, the role of client is heavily acknowledged in all three proposed models: the R&D model, the model of rapid application and the practice-driven model.

### 3.1.3   The operational side of service innovation: the New Service Development (NSD) process

The development of service innovation inherently contains an operational side as well which is represented by the operational side of innovation, namely the New Service Development (NSD) process. Innovation may seem as an abstract concept, however in order to achieve the development of an initial idea to real service, a well-defined process is needed (Voss et al. 1992; de Brentani & Ragot 1996). Thus, there is a need to formalize the development of new services in a certain process; the NSD process. This is even more important in the case of services which are by definition abstract and therefore require more a procedural approach in the innovation activities.

The NSD process and the relevant models have been much discussed in the respective literature. Nevertheless, the bulk of relevant research has been concentrated on product innovation and the relevant New Product Development (NPD) process. One of the first models that were created was the famous NPD model proposed by Booz, Allen and Hamilton (1982); this was called the BAH model (from the initials of the authors' names) which identifies six distinct stages: idea generation, screening, commercial evaluation, development, testing, and market launch. Moreover, Saren (1984) presents his departmental model which structures the innovation process according to the departments that are involved in the innovation process, such as R&D, Design, Engineering, Product and Marketing. However, the departmental-stage model is not very well suited for formalizing the NSD process since most service firms are very small to have specialized NSD departments (de Jong et al. 2003). Cooper et al. (1994) have also proposed their own version of the NPD model, consisting of five steps/stages, namely preliminary assessment, business case preparation, development, testing and full launch. Five relevant "gates" can also be found in this model in between the above mentioned stages. Finally, Kline and Rosenberg (1986) propose a chain linked model which is a highly iterative

model. Nevertheless, the validity of such NPD models in the context of services remains to be demonstrated (Stevens & Dimitriadis 2005).

Besides the application of the NPD models in NSD, there have also been some attempts to model the NSD process separately. Shostack (1984) developed one of the earliest linear models comprising ten discrete steps. Moreover, Scheuing and Johnson (1989) created their fifteen stages model (based on the BAH model) where they emphasized the importance of the concept development phase. Furthermore, Edgett and Jones (1991) propose a sequential model comprising 16 stages, including market research, business-plan, IT development, agreement and post-launching evaluation. What is important though is that the authors have identified the importance of co-operative behaviour among departments (Stevens & Dimitriadis 2005).

Nevertheless, the weaknesses of linear and sequential models were quickly acknowledged in service innovation (as in goods innovation). Bitran and Pedrosa (1998) created a generic development model (inspired by NPD models) which consisted of six stages, namely strategic assessment, concept development, system design, component design, implementation, feedback and learning. Tax and Stuart (1997) created an iterative model that shows that new services can be born in or out of existing service systems. De Jong et al. (2003) see the NSD process as a process comprising two stages: the search stage and the implementation stage, with three activities in each one: idea generation, screening and commercial evaluation for the search stage and development testing and launch for the implementation stage. Furthermore, Johnson et al. (2000) discuss the general iterative four-stage model involving design, analysis, development and full launch. The role of enablers (teams, tools, organizational culture) that facilitate the process of designing or redesigning the service delivery system is underlined in this model. Finally, more recently Zhou and Wei (2010), after reviewing various NSD processes, proposed a generic three-stage model comprising the idea phase, the development phase and the introduction phase.

Summarizing, we can conclude that the process aspect of service innovation is very important. It can generally comprise several concrete stages that do not have to be implemented in a linear but rather in an iterative and highly flexible way that address the particular nature of each service innovation project.

*3.1.4    Service Innovation through the lens of the Resource Based View (RBV) of the Firm*
The Resource Based View (RBV) of the firm, based on the seminal work of Penrose (Penrose 1959), shows that there is a link between the internal characteristics of a firm and its performance (Barney 1991). In fact according to the Resource-Based View (RBV), it is the organization's special and unique resources that ensure sustained competitive advantage (Barney 1991; Penrose 1959). Competitive advantage comes from a bundle of organizational resources that have four distinctive attributes; namely they are rare, valuable, imperfectly imitable and without equivalent substitute (Barney 1991).

Resources and capabilities are often discussed simultaneously in the literature. This is expected as these are two concepts that are empirically strongly interrelated. Some scholars actually define resources in a broad way to include capabilities in them (Ethiraj et al. 2005). However, we choose to align with the view that capabilities represent the firm's capacity to deploy their available resources, thus: *"a capability does not represent a single resource in the concert of other resources [...] but rather a distinctive and superior way of allocating resources"* (Schreyögg & Kliesch-Eberl 2007, p.914).

The capability of an organization to perform certain activities depends on its resources and the way these resources are exploited and combined internally in order to develop the respective capabilities. Penrose (1959) in her seminal work argues that resources are a bundle of potential services and while these resources are available to all firms the 'capability' to deploy them effectively is not always present (Ethiraj et al., 2005). Therefore, a capability represents an action or repeatable patterns of actions that an organization can use to achieve certain goals (Sanchez 2001). That is why capabilities have raised a lot of attention from researchers, as the competent organization has become a new ideal (Schreyögg & Kliesch-Eberl 2007).

But organizational capabilities bear also inherent risks and perils; for instance, the threat of remaining static. In turbulent environments, like the ones innovative organizations have to compete in nowadays, the threat of organizational inertia and lock-in in "old" practices is existent. Therefore, there is a pervasive need for change and adaptation. This is especially relevant in the case of service innovation where new services are easily initiated but also easily imitated (Voss et al. 1992). Therefore, it is not merely enough to develop capabilities, but also being able to manage and change them when needed. This is why the notion of dynamic ca-

pabilities has gained such an interest among scholars. Although there is no general consensus what a dynamic capability is, we present some recent definitions that are generally accepted[6].

Teece, Pisano and Shuen (1997, p.516) define 'dynamic capability' as *'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments'*. Dynamic capabilities *'reflect an organisation's ability to achieve new and innovative forms of competitive advantage despite path dependencies and core rigidities'* (Teece et al. 1997, p.516). Zollo and Winter (2002) argue that a dynamic capability is a learned and stable pattern of collective activity that gives the organization the ability to systematically generate and modify its operating routines in pursuit of improved effectiveness. Furthermore, Zahra et al. (2006) state that dynamic capabilities represent the ability to reconfigure a firm's resources and routines in a manner envisioned by its principal decision-maker(s).

### 3.1.5   *Complementing the RBV: The resource-process framework for service innovation*

It is not however only the efficient exploitation of resources that results in the development of innovation capabilities. Recent developments on service innovation capabilities have added a complementary view to the RBV perspective in the development of service innovation capabilities. Although resources are rent-generating assets (Ethiraj et al., 2005), sole resources cannot be a source of competitive advantage; they need to be exploited in order to create the relevant capabilities that will drive the innovation process effectively and efficiently. This is the reason why performance differs between service firms (Menor and Roth, 2008). The same resources can result in different capabilities if they are deployed in a different way and in different combinations (Ethiraj et al., 2005).

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[6] Our purpose is not to analyse thoroughly the concept of dynamic capabilities because this was one of the primary purposes of the SERVICeABLE project. The relevant results have also been published in a book chapter: *Gryszkiewicz, L., Giannopoulou, E. and Barlatier P.J. 2013 Service Innovation Capabilities Dynamization in Knowledge-Intensive Organizations: Evidence from Research and Technology Organizations. Self-reinforcing processes in and among organizationspp125-144 Palgrave Macmillan UK* .The purpose of this PhD was to focus on a holistic view of RTOs rather than study dynamic capabilities per se. We have therefore very briefly introduced the concept but we will not go into any further depth because it lies beyond the scope of this PhD project.

Froehle and Roth (2007) argue that "*a firm that develops competencies in both process-oriented and resource-oriented practices is better positioned to create an NSD capability that differentiates it from its competitors and support continuous innovation and growth*". According to the authors, there is a need to define the resources that are critical to service innovation and then to define the relevant NSD practices that focus on cultivating, motivating and developing the intellectual, organizational and physical resources of the organization that support their NSD capability. This is apparently the same approach as the one of the RBV which focuses on the specific organizational assets relevant to service innovation.

On the other hand, critical elements are also the process-oriented practices which focus on planning, defining and executing the NSD. We have seen above a review of the most important contribution of NSD processes and their importance in service innovation. According to Froehle and Roth (2007) the specific steps that comprise the NSD process of the organization are design, analysis, development and launch. Once again the need for a well-defined but flexible process that structures the NSD process is underlined.

In Figure 7 we present the Resource-Process framework of Froehle and Roth which is based on the interplay of resource- and process-oriented NSD practices for the development of NSD capabilities. This framework will be at the core of our research as explained in the next chapters.
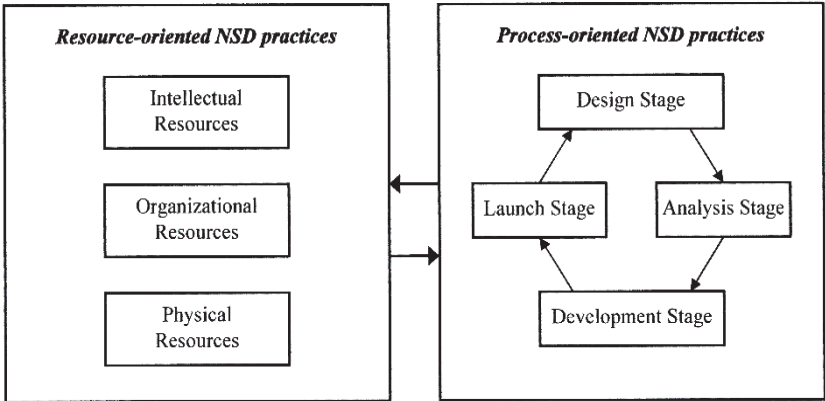


*Figure 7: The resource-process framework (RPF) of New Service Development (Froehle and Roth, 2007)*

We have reviewed the most important literature on services, the NSD process, (open) service innovation and relevant capabilities development in order to introduce the reader to these concepts that represent the backbone of our research on identifying the service innovation capa-

bilities of RTOs. These theories will now be critically synthesized and empirically confronted in the context of RTOs. The next chapter explains our specific research objectives.

## 3.2 Research Strategy: Research Objective and Research Design

This chapter explains our research design as far as the research objectives are concerned by formulating the main research question of this part of our research project. The way that this question will be answered is then explained in the Research Design part.

### 3.2.1 Research Question 1

The research objective of this part of the project is to identify what constitutes the service innovation capabilities of RTOs. As the literature on RTOs is scarce, we lack contributions on how RTOs build their service innovation capabilities in order to support their partners in innovation. RTOs have been mainly studied from the perspective of their partners but very few studies have been dedicated to the internal perspective of RTOs. So although we have seen theoretical studies praising the RTOs as a public policy tool, especially for supporting technology transfer and innovation in the industrial context by being an efficient partner in open and collaborative partner, we have rarely seen studies addressing the innovation capabilities of RTOs. How do RTOs innovate and then subsequently propose their innovative services to their partners? What makes them an efficient partner in service innovation?

Moreover, as we have also explained in chapter 3.1, service innovation constitutes also a research challenge. Although we are in the midst of a service-driven business revolution (Möller et al. 2008) where most economies are basing increasingly their development on services, still service innovation represents an abstract concept. This can be partly attributed to the fact that the majority of service innovation studies rely on theories of innovation rooted in a time where manufacturing was still the major economic activity. Therefore, new conceptual insights and developments for service innovation are needed (Drejer 2004). Furthermore, organizational forms and models that support service innovation rely on "traditional" perspectives of New Product Development (NPD) instead of focusing on services; they are most of the time unsuitable (Voss et al. 1992) for New Service Development (NSD). As a consequence, there is also a lack of well-established theoretical contributions and practical experiences regarding service innovation capabilities.

Therefore, this part of our research focuses on answering the following research question:

> **Research Question 1: What constitutes the service innovation capabilities of RTOs?**

In the following chapter 3.3 we explain the research strategy we undertake in order to answer this research question and in Chapter 3.4 we present our main results, based on three relevant papers.

### 3.2.2   Research Design

This chapter explains the research design of the first part of our research project which aims at answering our first research question. The research design consists of two parts (Table 2): the conceptual and the empirical part. In the conceptual part the theoretical framework of the project is built after a critical synthesis of the relevant literature. In the empirical part, which is based on qualitative research design, the case studies performed in four renowned European RTOs are thoroughly described.

*Table 2: Research Design of the first part of the project*

| Research Design – First part of the project focusing on the internal perspective of RTOs |
| --- |
| Conceptual part: Building the theoretical framework of the development of service innovation capabilities in RTOs |
| Empirical part: Case studies in four selected European RTOs |

### 3.2.3   Conceptualizing the theoretical framework of service innovation capabilities in RTOs

Our first concern was to build the theoretical framework of our project that would then serve as a grid for our case studies. In order to do so we have reviewed the most important contributions of the literature concerning services, service innovation and the development of service innovation capabilities. Our purpose was to cover the most noteworthy and recent contributions on these subjects. Then we have synthesized these contributions having in mind always the special context of RTOs. This exercise was performed in a highly dynamic way. At first, each of the three researchers involved in this study presented his/her own version of the interactions among the identified elements. The three perspectives were scrutinized and discussed through a "war room" exercise. Naturally some elements were modified, some grouped and

some removed. The final step was to synthesize the commonly agreed elements into a single model approved by the whole team. The resulting model which is presented under main re-sults – part 1 in Chapter 3.3.1 (Paper 1) served as our theoretical framework and as the main coding grid for our case studies explained in chapters 3.3.2 and 3.3.3 (Paper 2 and Paper 3). The full coding grid is available in the excel file *"Capabilities mapping coding grid and inter-view guides"* and comprises all the elements of our theoretical model translated in concrete questions that are linked to specific interviewee profiles and target in the identification of spe-cific resource-, process-, strategy-related practices (and their inter-linkages) and respective capabilities. Below a short extract of this grid is presented for illustration purposes (Figure 8). The full grid is available in Annex C.



*Figure 8: Capabilities mapping coding grid and interviews guide (extract)*

### 3.2.4    The qualitative part – Multiple case studies in European RTOs

The second part of our research design focused on empirically identifying the distinct service innovation capabilities of RTOs. Because organizational capabilities are socially-embedded (Schreyögg & Kliesch-Eberl 2007), we need to analyze tacit knowledge and complex pro-cesses and tools within RTOs. According to the socially embedded nature of these organiza-tional capabilities and respecting the exploratory nature of our research objectives, we have focused the methodological choices on qualitative methods.

From the different qualitative study methods, qualitative case study methodology was chosen because it excels at bringing us to a detailed contextual analysis of a limited number of events or conditions and their relationships through the use of a variety of data sources during the empirical inquiry (Yin 1994; Yin 2009). We followed three conditions in order to choose case studies as a research strategy, which are: (a) the focus of the study is to answer questions of

"how" and "why", (b) the investigator has little control over events and people involved in the study and (c) the objective of the study is to investigate a contemporary phenomenon in depth and within its real-life context.

Moreover, contextual conditions were also taken into account as relevant to the phenomena under study. Indeed, such complex situations as innovation capabilities of successful/mature RTOs could not be considered without the context, industrial and institutional environment, and more specifically RTOs settings as open/networked collaboration between private firms and public organizations.

Among the different types of case studies described by Yin (Yin 2003) and other scholars such as Miles and Huberman (1994), we have chosen a multiple case study strategy in order to explore the similarities and differences within and between cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully. Such research relies on theoretical sampling (i.e. cases are chosen for theoretical, not statistical, reasons, (Glaser & Strauss 1967)). Although there is no ideal number of cases, a number between 4 and 10 cases usually works well (Eisenhardt 1989) and a number between 4 and 6 is important for theoretical replication ("replication design") (Yin 2003). As a result, we chose to select 4 cases (Please see Appendix A for a general description of the anonymized – due to confidentiality agreements - RTOs/cases selected).

We sought RTOs with similarities that would provide a good ground for comparisons and replication, yet RTOs that have sufficient heterogeneity to help assessing first level, potential generalizability. To account for variety, we choose RTOs from countries of different size within Europe[7], thereby helping us to control for environmental variation, but also different organizational designs, service-innovation strategies, size, and maturity. The help of EARTO was crucial in the choice of the case studies, as our contact person[8] in the association provided valuable information on the RTOs to be selected.

*Data collection*
Data were collected through multiple techniques during site visits: non directive interviews with key informants and individuals directly involved in the innovation processes, corporate

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[7] Due to non-disclosure agreements we are not allowed to refer to the name of the organizations or the countries involved in the study.

[8] Mr. Christopher Hull, former general secretary of EARTO

documentation (i.e. annual reports, brochures, and any other written material describing the organization and its purpose), archival records, direct observations of daily routines and social interactions when possible.

7-10 persons were interviewed from each RTO, following the saturation principle (Eisenhardt 1989; Charmaz 2000). Interviewee profiles were defined upfront with the aim to capture various perspectives of the innovation process (please see Appendix B). In order to make the best use of each interviewee's knowledge, we created customized interview guides for each of the respondents based on their respective roles. These customized interview guides were derived from the excel file *"Capabilities mapping coding grid and interview guides"* after filtering the respective interviewee profile. Nevertheless, we insist on the fact that the resulting list of questions served as a flexible interview guide, rather than a strict questionnaire.

Interviews started with content mapping questions and then content mining ones as the conversation progressed, in order to make sure that relatively complete but also detailed information could be gathered (Legard et al. 2003). Naturally, the interview pace and tempo depended on the responsiveness of the interviewee and his/her expertise, so more focus could be given on specific matters, while it was not necessary that the list of questions was exhausted. Interviews were audio taped for later transcription and analysis. Each meeting was transcribed along with the researchers' observations; the latter were useful for the analysis of the interview data.

### *Data analysis*
Because case study research generates a large amount of data, systematic organization is important. Therefore, qualitative data analysis computer software was used, namely NVivo, which has been specifically designed for qualitative researchers working with very rich text-based and non-numerical or unstructured data like field notes, transcripts, audio recordings etc.

A first coding grid was elaborated based on the theoretical framework of the project. This grid was used to examine data using standardized coding instructions (Miles & Huberman 1994). Data were coded based on double coding technique (two researchers coding independently), then the results of the coding were compared among the two coders for inter-coding agreement. Disagreements were solved through discussion between the two coders and the coding grid was transformed by the emergence of new codes but also the elimination of others in a highly dynamic analysis process.

Each case was firstly analyzed independently as a separate case. Within-case analysis was the first analysis technique used with each RTO under study (Miles & Huberman 1994). As Eisenhardt (1989) puts it, the overall idea is to become intimately familiar with each case as a stand-alone entity. This process allows the unique patterns of each case to emerge before investigators try to generalize patterns across cases, but it also familiarizes the researchers with each case, therefore accelerating cross-case comparison.

After the single case analysis was finished, cross-case analysis was the next step (Miles & Huberman 1994). In this stage, we examined pairs of cases, categorizing the similarities and differences in each pair with the aim to understand the social, cultural, structural and strategic context of the RTOs and their innovation capabilities, new service development processes and related management practices.

### 3.3 Main Results 1 – Identifying the distinct service innovation capabilities of RTOs

The results of the first part of this research project have been published in three journal papers that are appended at the end of the manuscript. Paper 1 is describing the theoretical framework of the project while Paper 2 and Paper 3 are empirical papers that are presenting the results of the case studies. In the following sub-chapters we summarize the three papers, discuss our reflections on each of them and present their main contributions. The results of the three papers are then further synthesized in chapter 3.3.4 that concludes the first part of the research project (namely the internal perspective).

### 3.3.1 A theoretical framework for the development of service innovation capabilities in RTOs

*Paper 1: Giannopoulou, E., Gryszkiewicz, L., Barlatier, P. J. A conceptual model for the development of service innovation capabilities in Research and Technology Organisations. International Journal of Knowledge Management Studies, 4 (4), 2011, pp. 319-335*

The purpose of **Paper 1** was to build a model that would shed light on the development of service innovation capabilities in RTOs. In order to do so, we conducted a literature review on the topics of service innovation, RTOs, the Resource-Based View (RBV) of the firm and innovation capabilities. Our purpose was to cover the most noteworthy and important recent publications on these topics. While some of our findings were specifically relevant for RTOs, we also used general literature to complete our research.

In this paper we initially identified the external and internal drivers of service innovation capabilities for RTOs. Table 3 provides an overview of these drivers:

*Table 3: External and internal drivers of service innovation capabilities in RTOs*

**Drivers of service innovation capabilities in RTOs**

| External drivers | Selected references |
| --- | --- |
| **Government** | Berger and Hofer (2010), Preissl (2006) |
| **Academia** | Berger and Hofer (2010), Hauser (2010), Preissl (2006) |
| **Industry (suppliers, clients, RTOs etc.)** | Berger and Hofer (2010), Hauser (2010), Backer et al. (2008), Xin, Chai and Tan (2006) |
| **Internal drivers** | Selected references |
| **Strategy** | Barney (1991), de Jong et al. (2003), Lawson and Samson (2001), Wernerfelt (1984), Teece et al. (1997), Xin, Chai and Tan (2006) |
| **Organizational assets/resources** | Barney (1991), Froehle and Roth (2000) (2000), Gadrey et al. (1995), Möller et al. (2008), Xin, Chai and Tan (2006) |
| **NSD process** | Cooper et al. (1994), de Brentani (1995), Johnson et al. (2000), Froehle and Roth (2007) |

These elements were further synthesized in a theoretical model, where the interplay of resources and processes together with the innovation strategy defines the development of service innovation capabilities in RTOs. The model is presented in Figure 9.
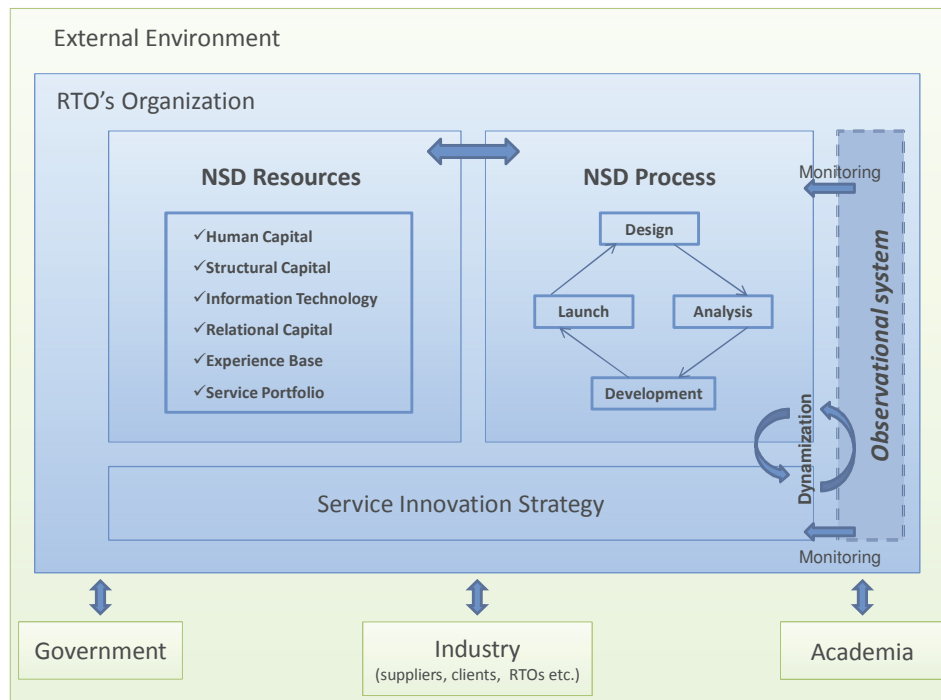
*Figure 9: Model of service innovation capabilities development and dynamization in RTOs*

The literature regarding innovation capabilities is too focused on the resource aspect, as it is highly influenced from the resource based view (RBV). Nevertheless, the process aspect is very important as well, as the NSD process is a crucial determinant of service innovation (Voss et al. 1992). That is the reason why the resource process framework of (Froehle & Roth 2007) was considered to be the most appropriate in the specific case. The special elements that should be taken into account are the iterative and non-linear aspect of the process which comprises specific stages but the relationship among them is not linear (Johnson et al. 2000). As far as resources are concerned, the unique human capital of Research and Technology Organizations should be emphasized, as it is actually one of the very special characteristics of RTOs which have the opportunity to employ diverse profile of highly qualified people (Mrinalini & Nath 2000). This is what makes an RTO a learning organization and an organization that is not only able to generate and transfer new knowledge but also to assimilate new knowledge (Nath & Mrinalini 2000). Indeed, innovative and productive RTOs strive to be learning organizations (Garvin 1993), with high absorptive capacity that is not general and abstract but highly targeted to the client base of the industry that they are serving. This is after all what makes an RTO a proficient and valuable partner in the innovation process.

Furthermore, the human capital together with the structural capital and the relational capital are considered as the main intangible assets that according to Leitner (2005) give RTOs the capability to successfully drive the innovation process for their customers. Especially as far as the relational capital is concerned, we consider RTOs to be a very prominent example. Their special position in innovation systems provides them with the benefit of having a unique network of partners from both the academic and the industrial world that can be extremely beneficial for their innovation capabilities development. Moreover, this is also very important in the case of open services innovation where the centricity of customer is indispensable (Toivonen & Tuominen 2009; Chesbrough 2011).

The external environment and more specifically the industry, the government and the academia represent important stakeholders of RTOs in the current highly interconnected and open innovation landscape. As we have also seen earlier, the government and industry are important partners but also funding sources for RTOs. Depending on the national setup the respective interdependence of the RTOs with one or the other varies. Moreover, the academic world remains an important partner, sometimes supporting even financially the RTOs through joint resources and research projects.

Finally, the model is also concerned with the dynamization of service innovation capabilities[9]. Capabilities are faced with the inherent threat of stagnation and rigidity (Leonard-Barton 1992). Therefore, RTOs, like all organizations, need to fight the capability-rigidity paradox (Leonard-Barton 1992) to sustain their service innovation capabilities. By incorporating in our model the Schreyögg and Kliesch-Eberl's (2007) dual-process model of capabilities dynamization we also account for the dynamic nature of service innovation. This dual-process model comprises two systems, namely an activity system and an observational one. From this perspective, the NSD process and related resources constitute the activity system of an RTO, as they represent the building blocks of service innovation capabilities. An observational system

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[9] We remind the reader that the purpose of this PhD project is not to analyse thoroughly the concept of dynamic capabilities because this was one of the primary purposes of the SERVICeABLE project. The relevant results have also been published in a book chapter: *Gryszkiewicz, L., Giannopoulou, E. and Barlatier P.J. 2013 Service Innovation Capabilities Dynamization in Knowledge-Intensive Organizations: Evidence from Research and Technology Organizations. Self-reinforcing processes in and among organizationspp125-144 Palgrave Macmillan UK* .The purpose of this PhD was to focus on a holistic view of RTOs rather than study dynamic capabilities per se. We have therefore very briefly introduced the concept but we will not go into any further depth because it lies beyond the scope of this PhD project.

is, therefore, essential for monitoring change and progress. This can be done by formal monitoring procedures (e.g., in the NSD process) or an informal culture of tolerating criticism (Schreyögg & Kliesch-Eberl 2007). It is then up to the organization itself to act on this observation (Schreyögg & Sydow 2010) in order to ensure the dynamic nature of services innovation capabilities.

*Main Contributions*

Our model represents an important theoretical contribution not only in the knowledge regarding RTOs but also for the identification of service innovation capabilities in general. First, this conceptual framework is constructed specifically for RTOs, which are very rarely discussed in the literature. Therefore, it allows to bring together the resource based view of the firm with the process aspect of service innovation and to include external factors as well, in order to identify the specific nature of service innovation capabilities in RTOs. Second, this framework proposes a basis for studying service innovation capabilities in general which is also a very under-researched domain due to the abstract nature of innovation in services, especially when it comes to the process aspect. Finally, we combine two robust frameworks: the resource-process framework of Froehle and Roth (2007) and the dual-process model of capability dynamization by Schreyögg and Kliesch-Eberl (2007), for the first time addressing also the dynamization and sustainability of service innovation capabilities.

As a result, this model represents a very thorough, rich and inclusive illustration of the development and dynamization of service innovation capabilities of RTOs. It includes important elements that deserve special attention. We could even see multiple distinct research projects studying in depth the different issues tackled in this model, or variations of this model, which could be dynamically adapted each time for the purposes of specific organizations studies.

*3.3.2   A proposed grid for mapping the service innovation capabilities of RTOs*

> **Paper 2:** *Gryszkiewicz, L., Giannopoulou, E., Barlatier, P. J. Service Innovation Capabilities: What are they? International Journal of Services, Economics and Management, 5 (12), 2013, pp. 125-153*

**Paper 2** presents the results of our case studies which comprise 34 interviews in the four selected RTOs. In the context of our empirical study we define service innovation as the ability

to efficiently and effectively combine resources to successfully execute the NSD process in order to achieve the strategic service innovation goals based on relevant literature (Schreyögg & Kliesch-Eberl 2007; Froehle & Roth 2007; Froehle et al. 2000; Lawson & Samson 2001). Therefore, we focused on the interplay between resources, the NSD process and the related strategy in order to identify service innovation capabilities of RTOs[10]. In order to do so we identify resources, processes and strategy elements within RTOs by carefully selecting related practices mentioned in the literature which we then map to exemplary practices that we identify in the context of our case studies.

The results of this empirical study are illustrated in **Paper 2** where a thorough mapping of service innovation capabilities, related literature and organizational practices in the researched RTOs are synthesized in detail. As far as resources are concerned, we find evidence for: intellectual capital, structural capital, relational capital, information technology and financial resources. While the NSD process is based on four-step iterative model of design, analysis, development and launch (Johnson et al. 2000; Froehle & Roth 2007). For illustration purposes, below in Table 4 we present a brief extract of the long table of capabilities that is fully explained in Paper 2.

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[10] This means that we focused on specific elements of the theoretical framework of Paper 1. Indeed since the theoretical framework was very reach in concepts we decided to opt for a more focused empirical analysis in order to be able to go more in depth in the notion of service innovation capabilities in RTOs.

*Table 4: Extract of the service innovation capabilities mapping in RTOs as presented in paper 2*

**RELATIONAL CAPITAL**

| Capability | Practice | Literature Reference | Exemplary Practice Quote |
|---|---|---|---|
| **Manage and orchestrate coalitions with various partners for the benefit of NSD** | Establish and maintain good communication with suppliers, partners, and clients outside the firm as potential sources of new ideas and enhanced market insight as well as cooperative activities; Actively look for and engage in alliances and networks of various partners to co-design and co-produce the service, as well as to access external knowledge | (Froehle and Roth, 2007: $) quoting Edvardsson and Olsson (1996), Voss et al.(1992); Kianto (2008); (den Hertog et al., 2010: $); (Schilke and Goerzen, 2010: @); (Kandampully, 2002: $); (OECD, 2005: $) | *"This is not my hobby, but it is my daily work, to build capacity with other partners, to build innovation capacity in a way with partners outside [RTO]" (Strategy Department Employee, Gamma)*<br><br>*"Very, very important asset. (…) 70% comes from your stakeholders in the market, the more important they become. It's a main asset or the relationship that you have with your partners in the market and not only the government." (Research Topic Manager 2, Gamma)* |
| **Brand and reputation** | Create a strong brand and good reputation as an organisation | | *"It is a pretty strong brand, it has credibility and it's closely interlinked with innovation and research, that's for sure."(Marketing Manager, Beta)"We have XX years of successful history in applied science so this is worth something" (Marketing Manager, Beta)*<br><br>*"(…)we want to preserve its brand as an expert organization and if someone says something on TV that doesn't really hold, it could be a huge set-back for this brand."(Researcher, Alpha)* |
| **Cooperation with clients throughout the NSD** | Establish a good communication with the client from the idea generation phase and the concept development and piloting phase to the service delivery. | (Chesbrough, 2011b :$); (Fasnacht, 2009 :$) | *"Actually what is really important in services it is that it's trans-disciplinary, that you need your customers to develop and innovate with you …) (Researcher, Alpha)* |

In fact this extensive capabilities mapping that is presented in Paper 2 should be seen as a long list of potential capabilities that can be relevant and important to each RTO in a different degree. Moreover, focusing on specific capabilities could also make sense and depends in the case of specific clients and/or specific projects that each RTO is dealing with. For instance, for a highly innovative project we expect that more attention should be devoted to the service design and analysis stages, where the variety of idea generation methods (Eric Reidenbach & Moak 1986; de Brentani 1989; Thwaites 1992; Froehle & Roth 2007; McKelvie & Davidsson 2009), the motivation for developing new ideas (Edvardsson & Olsson 1996; Froehle et al. 2000; Froehle & Roth 2007) and proper idea evaluation methods (de Brentani 1991; de Brentani 1995; Froehle & Roth 2007) - just to name a few of the mentioned capabilities - are highly important. On the other hand when the project is a more standardized project, then we expect the development and launch stage with the close interaction with the customer for customization purposes (Edvardsson & Olsson 1996; Bitran & Pedrosa 1998; Cook & Brown 1999; Froehle & Roth 2007; Kaasinen et al. 2010) and the formalized launch (Eric Reidenbach & Moak 1986; de Brentani 1989; de Brentani 1991; de Brentani 1995; Froehle & Roth 2007; Zhou & Wei 2010) to be more relevant.

*Main contributions*

The theoretical contribution of our work lies mostly in combining the existing (but scarce) literature on the service innovation capabilities development, as well as confronting it, with current service innovation practice to create an extensive mapping of service innovation capabilities and related activities. It is not indeed very often that such a detailed and thorough mapping of services innovation capabilities exists in the literature. Moreover, the novelty of this mapping is that it brings together the theoretical and practical perspective so that it represents a more complete view on service innovation capabilities. Specifically, we have identified service innovation capabilities related to strategy, NSD process (design, analysis, development and launch) and resources (intellectual, structural, relational, IT and financial).

Of course this mapping can be used in very different and dynamic ways by academics. It can for instance be modified and adapted to other organizations, especially knowledge intensive ones. We could imagine it for example being developed in order to study TTOs in universities or consultancy firms. Moreover, it could also be the starting point for building analysis grids or a survey questionnaire used in the context of a quantitative study or used with a focus on specific innovation aspects such as creativity which is presented below.

### 3.3.3 Reinforcing creativity in service innovation – 7 relevant capabilities proposition

> **_Paper 3:_** _Giannopoulou, E., Gryszkiewicz, L., Barlatier, P. J. Creativity for Service Innovation: A Practice Based Perspective. Managing Service Quality, 24 (1), 2014, pp.23-44_

As broadly defined, creativity is *"the production of novel and useful ideas in any domain"* (Amabile et al. 1996, p.1155), and its successful implementation within an organization is defined as innovation (Amabile et al. 1996). Creativity cannot just be seen as merely the sole "useful" idea production. It is rather defined as a *"high-level cognition" that aims at the "production of high quality, original, and elegant solutions to problems"* (Mumford et al. 2012, p.4). Therefore, creativity is the ultimate prerequisite for innovation as the management of creativity is a core element of successful innovation management (Oke 2007).

In **Paper 3** we focused on identifying the related-practices of reinforcing creativity in service innovation, by (partly) employing the above mentioned theoretical framework for the development of service innovation capabilities. In this case we focused on the identification of related resources and practices based on the definition of practices as the link between resources (Barney 1991) and organizational capabilities (Amit & Schoemaker 1993). This route of moving from resources, through practices, to capabilities is presented under Figure 10.

.

**Resources**

- **Literature review** on organisational resources for reinforcing creativity in service innovation

  - Intellectual resources
  - Organizational resources
  - Physical resources

**Practices**

- **Empirical results** from case studies in 3 renowned European RTOs comprising 24 interviews and analysis of secondary data

  - 8 intellectual resource related practices
  - 11 organizational resource related practices
  - 3 physical resource related practices

**Capabilities**

- **Analysis of results, synthesis** of resource related practices to extract creativity reinforcing capabilities

  - 7 capabilities propositions for reinforcing creativity in service innovation

*Figure 10: From Resources, through Practices, to Capabilities*

For the purpose of this study we focused on three selected cases, exemplar RTOs as far as creativity is concerned. The results revealed the importance of specific resource based practices in the different organizations. In order to distil them into creativity capabilities for service innovation we then employed the following method. Specifically, we used memos to capture first cross-case data analysis insights while coding and then we applied "within-category sorting" and "cross-category clustering" tactics that have led us to "summary tables" (Miles & Huberman 1994). In order then to derive capabilities from practices, we used cross-case synthesis word tables for pattern identification (Yin 2009), as well as "noting patterns and themes" and "clustering" practices (Miles & Huberman 1994).

Our study resulted in seven relevant capabilities; *namely **attracting** creative people**, stimulating** creative environment**, combining** diverse input**, providing** relevant resources**, breeding** creative ideas**, opening up** to external influences **and accepting** risk, failure and criticism.* Each capability results as the interplay of specific resource related practices as shown in Figure 11 below which provides an overview of the seven capabilities identified. Please note that each capability is linked to specific resource based practices through a coding which is pre-

sented on the far right window of each capability. The complete list of these resource based practices is presented in Paper 3.

## Attracting (creative people)

- This capability involves being able to attract the employees who are creative by nature. Such a capability can save the management a lot of time and effort afterwards on trying to *make* people creative. Offering a specific context is important too, and it involves tempting target employees with creative and free-thinking atmosphere, few short-term targets and limited time-pressure. Our research also shows that the employees value the diversity of the team and of the work itself, especially in the service context where the multi-disciplinarity is essential. Such conditions put together can constitute an interesting offer for unique creative individuals. Indeed, our data clearly show that creative employees often value such work context more than financial benefits of the job position. Therefore, organisations that want to boost the creativity of their new service development should pay attention to and consciously manage the messages they send out as potential employers by cultivating a matching organizational image.

IR1
IR3
IR4
OR4
OR5
PR3
OR11

## Stimulating (creative environment)

- The second capability we propose has to do with the creation of a stimulating environment in the relevant parts of the organisation. This capability includes the creation of multi-disciplinary working teams which invite people with various backgrounds to work together, stimulating creative ideas development through organisational contests and games, applying a challenging but supportive leadership style, frequently changing the organisational structure, encouraging a high employee turnover, enhancing intensive cross-departmental cooperation, or – on the contrary – provoking friendly inter-departmental competition. Service innovation is indeed about mobilizing the whole organization and having the flexibility to bring easily together people from different disciplines whenever it is needed (even just for short periods). Our research shows that creativity flourishes when an organisation is in constant "flow"; stagnation is the enemy when it comes to enhancing service innovation.

IR1
IR4
OR1
OR5
OR10
OR11

## Combining (diverse inputs)

- Another capability our research points towards is what we label the "combination" capability. Organisations that thrive in terms of constant service creativity and innovation have a unique ability to combine existing elements to come up with new solutions. By combining elements we mean not only placing people with different backgrounds in a single team or combining representatives of different departments into single projects. We also mean combining the existing knowledge, skills and competences to create new solutions. Or, creating new services by discovering an overlap between seemingly unrelated industries. Even more generally, combination capability can mean simply combining existing services into new solutions for different target markets. In sum, an ability to successfully combine ostensibly disparate dimensions, perspectives, or backgrounds seems to be one of the key features characterising creative service organisations.

IR1
IR4
IR5
OR1
OR11

## Providing (relevant resources)

- Our results demonstrate that the capability to provide relevant resources is another important factor at play in service-related creativity. It includes the provision of organisational creativity tools (such as software), processes (like idea submission procedures), funding and time for the creation of new service ideas. While by itself it does not really have large potential to be an instigator for creativity, it can serve as an enabler of creativity for service innovation in general.

**OR3 OR4 PR1 PR2 PR3**

## Breeding (creative ideas)

- Our work further emphasizes that once the right conditions have been created for an idea to come to existence, "breeding" of this idea is an important ability in the service innovation context. It is about creating a "greenhouse environment" where new "seeds of ideas" can safely start growing. However, in service innovation, where the creation of a prototype in order to demonstrate and develop one's idea, is often impossible, the breeding process can be very difficult and should be consistent with the intangible character of services. Hence, the relevant practices that we have identified included a trust-filled mentoring or idea sponsoring, granting the idea owners some legitimate opportunities to work on their initial thoughts to develop them further, creating an atmosphere of safe "playground" for new inventors and, last but not least, ensuring managerial support for personal motivation and guidance in the process.

**IR2 OR2 OR4 OR5 OR6 OR8 OR9 PR3**

## Opening up (to external influences)

- In the era of increased interconnectedness of both organisations and individuals, the will and ability to successfully open an organisation up to inspiring external influences has emerged from our study as yet another proposition of a key capability for increasing creativity in service innovation. Such capability involves the organisational skills of external knowledge exchange, partnership building, intellectual resourcesl sourcing and networking, to name but a few. Opening up also means effective adaptation of organisational processes and IP (Intellectual Property) procedures to catch up with the open innovation practices. This is a capability, especially relevant to the service context as services can rarely be developed in isolation; rather they have to include the client perspective and are often the result of external collaborations.

**IR4 OR5 PR1 PR2 OR11 IR6 IR7 IR8**

## Accepting (risk, failure and criticism)

- Finally, our research brings about one more potentially important organisational capability, which we in short call "accepting". This short label covers a spectrum of organisational skills and aptitudes related to tolerance of risk, acceptance of failure and an inviting attitude towards constructive criticism. In other words, it has to do with the organisational culture and processes that allow for making mistakes, but also for constant improvement. Active encouragement of calculated risk taking by the management, or rewarding of self-termination of unsuccessful projects are just some examples of how this capability manifested itself in our case studies. Although this is a capability that can apply to all types of innovation we consider it extremely important in the case of services due to the intangible and often disputed importance of service innovation.

**OR2 OR6 OR7 OR8 OR9 PR3 OR11**

*Figure 11: Seven capabilities for reinforcing creativity in RTOs*

RTOs represent a very important and interesting setting to study creativity reinforcing capabilities, mainly due to their inherent special characteristics. Indeed, as we have seen above (Barge-Gil & Modrego-Rico 2008) highlight the important role of RTOs to promote and foster creativity in the innovation process.

Our findings show that human factors are extremely important in the development of creativity reinforcing capabilities. This is particularly relevant for RTOs which have a unique human capital which is young, highly dynamic and qualified, such as PhD or post doc researchers, R&D engineers and in general people that are very innovation driven. Therefore, RTOs have the chance to employ very creative people. Moreover, RTOs, due to the mix of public and competitive funding that they possess, they have the chance to be rather flexible on their activities meaning that they are not always constrained by specific customer requirements. They are still able to have a "playground" and rather "experimental" approach on their activities.

Nevertheless, at the same time of course they depend to some extent from the industry as well, a fact that makes them keep a balance on their creativity, meaning that they have to also materialize their ideas in concrete innovation services. Therefore, they are characterized by the perfect blend and balance between creativity and implementation, idea generation and innovation generation. This special nature of RTOs is what gives them a competitive advantage towards consultancy firms that have often strong "profit maximization" constraints which may impose some barriers to their creativity, or towards universities that are often too focused in embryonic ideas and more basic research that does not always have to be translated into concrete output.[11]

The seven capabilities are extensively discussed in **Paper 3** but it is worth discussing a bit further the opening up capability in the context of our research and also in combination with the external perspective analysis. So far, we have extensively argued that the foundations of RBV lie in the combination of the firm's internal resources in order to develop capabilities. Nevertheless, the benefits of integrating external resources into the innovation process, as supported by the open innovation paradigm, are indeed challenging the classical RBV (Chesbrough & Appleyard 2007). In this perspective, our results clearly show that it is in fact the combination of internal and external resources that support creativity. Especially in the

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[11] Nevertheless, the third mode of universities and the current scarcity of financial resources has also made universities more active in pursuing concrete output out of their research activities. This is a growing trend around the world nowadays.

case of RTOs where openness is not a choice but rather the base operating model for these organizations, the benefits of opening up are extremely important. RTOs have indeed no role in closed innovation models as they need to be ahead of their stakeholders' needs. But what is equally important to be mentioned is that openness is also a competitive advantage for RTOs, since it is not only a way to provide their partners with their services but also a way to develop and reinforce their internal innovation capabilities. In this perspective the external environment is not only there to be served, but also benefits RTOs by helping them to develop their unique creativity capabilities and to develop their absorptive capacity.

*Main contributions*

We consider that the results of this paper have important theoretical contributions. Our work represents an advancement in relevant theory by explicitly proposing specific capabilities for reinforcing service innovation creativity in RTOs. RTOs' primary mission is to support the innovation process. Therefore, creativity is an indispensable ingredient of their business model. By revealing knowledge regarding the creativity reinforcing capabilities of RTOs, we are contributing to the sustainability of the functioning of RTOs, especially in a turbulent context where RTOs face many challenges, such as decreased funding and pressure to be more competitive often towards consultants and/or universities.

Moreover, we also contribute to the literature about service innovation in general as the capabilities for reinforcing creativity in service innovation have not been explicitly addressed until today. In fact, to our knowledge, the most important contributions in service innovation creativity remain mainly conceptual. Zeng et al. (2009) address creativity in service innovation through relevant strategies but this represents a purely theoretical contribution that is not paying due attention to the importance of relevant resources. Similarly, Zhang et al. (2005) study creativity in service innovation theoretically and from a process perspective merely, using the TRIZ approach. Moreover, Froehle and Roth (2007) indirectly address the practices that support the idea generation phase in NSD, but they do not explicitly discuss what constitutes capabilities for reinforcing creativity in a service innovation context. Moreover, den Hertog's et al. (2010) dynamic capabilities framework also represents a very interesting research on service innovation capabilities but it is purely conceptual and does not directly address creativity in service innovation; it rather focuses on the whole process of service innovation.

As a result, our work constitutes an important theoretical contribution on the topic of creativity in service innovation as: (i) it explicitly addresses creativity in the context of service inno-

vation, (ii) it critically synthesizes and empirically tests important existing theoretical contributions on the topic, (iii) it identifies specific resource-related practices that support service innovation creativity, (iv) it brings about rich empirical results from a very relevant service innovative context such as RTOs and (v) it helps us better understand the creative and dynamic service innovation development in RTOs.

### 3.3.4 *Conclusions of the first part of the research project*

This section concludes the first part of the research project that aimed at studying the RTOs from an internal perspective and answering the research question 1: ***What constitutes the service innovation capabilities of RTOs?***

Through three relevant papers we explained how RTOs develop their service innovation capabilities based on a resource-process framework that was empirically tested in four selected RTOs. Moreover, we specifically focused on creativity in order to identify what makes RTOs so unique in managing their creativity. Figure 12 illustrates an overview of the main results of the first part of our research. This figure shows how the interplay of service innovation-, resource- and practice- related practices lead to the development of service innovation capabilities in RTOs. Moreover the figure also demonstrates how from specific resource-related practices we were able to extract seven specific capabilities propositions for reinforcing creativity in RTOs.

In the next chapter we present our study on the external perspective of RTOs by studying RTOs in the public research industry open innovation relationship.

**RTOs Service innovation capabilities**

Service innovation strategy related practices

Creativity

- **Intellectual**
- **Structural**
- **Relational**
- **Inform. Techn.**
- **Financial**

- **Intellectual**
- **Organizational**
- **Physical**

*Attracting*

*Stimulating*

*Combining*

*Providing*

*Breeding*

*Opening up*

*Accepting*

Resource related practices

Design

Launch

Analysis

Development

NSD process related practice
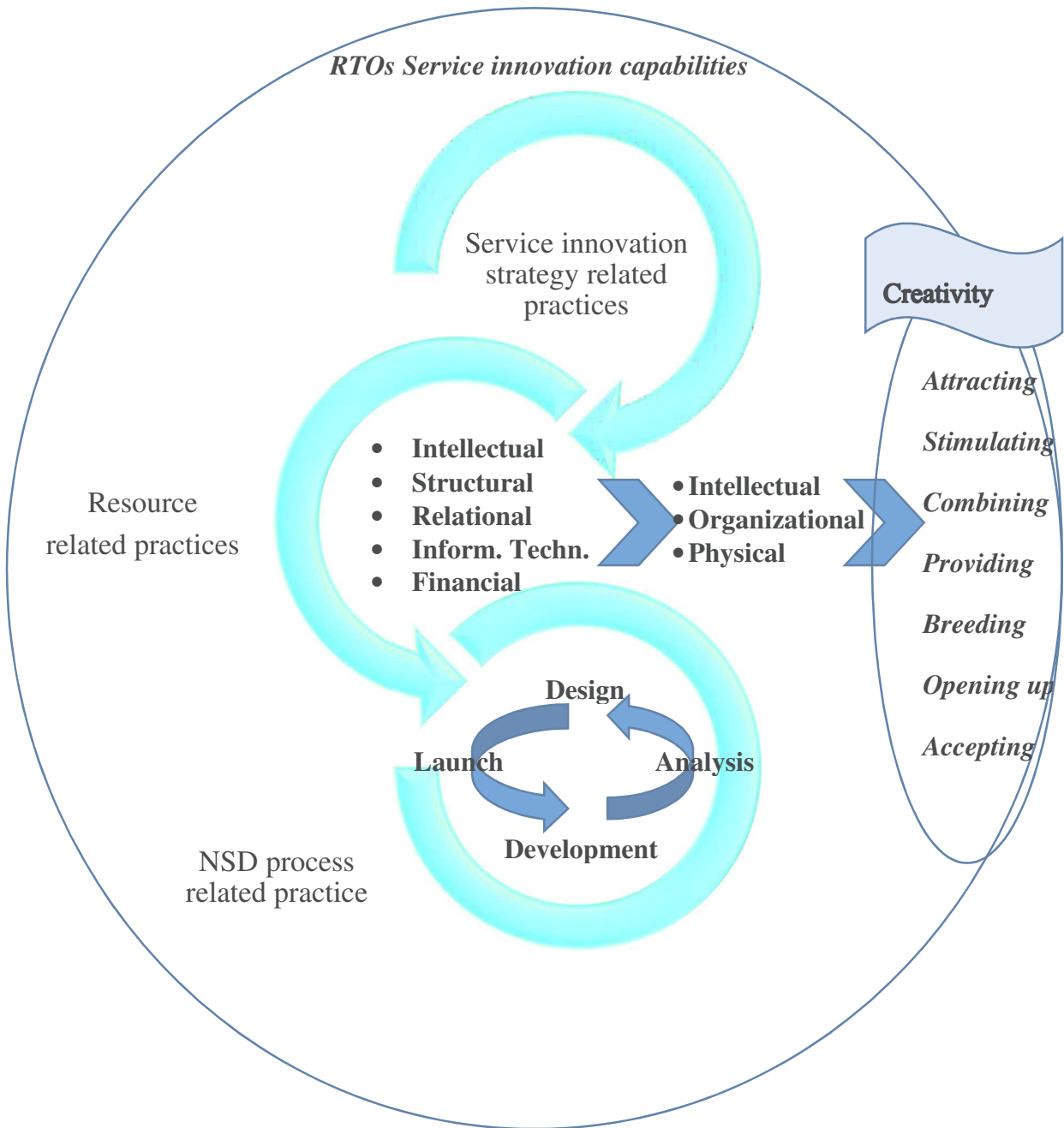
*Figure 12: The interplay of service innovation-, resource- and practice- related practices for the development of service innovation capabilities in RTOs and 7 capabilities propositions for specifically reinforcing creativity*

# 4 An external perspective: The role of RTOs vis-à-vis universities in the public research-industry open innovation relationship

Having studied the internal perspective of RTOs we now pass into the analysis of the external perspective. Chapter 4 is therefore dedicated to studying RTOs in the context of the open innovation paradigm, through a comparison with universities which represent an important stakeholder in public research world but also a similar organizations. The structure of this part of the PhD is similar to Chapter 3. First we start with a thorough literature review addressing **open innovation** and its different facets, its **benefits versus its risks** and the **open innovation intermediaries** with a focus on **science-industry relationship.**

Then our research objectives are presented together with the main research question of this second part of the PhD project[12]. Next, the research design proposes the way that we organize our study in order to answer our research question. The last part of this chapter presents our main results which are presented through the discussion of two relevant papers that were drafted based on this part of our research.

## 4.1 *Theoretical Background*

Innovation models have changed drastically over the years. Under the closed innovation[13] model, firms relied extensively on internal competences for the idea generation and the development of innovation projects while they used the firm's own distribution channels in order to commercialize their innovations (Herzog 2008). However, several new trends such as the mobility of skilled labor force, the developing technological start-ups, the increase of venture capital and the role of university research and its linkages with industry have given rise to a more open approach towards innovation (Costello et al. 2007). Even large firms nowadays find it difficult to produce all the knowledge required to innovate in-house, thus they are increasingly searching for innovation ideas outside their organizational borders rather than investing merely in in-house R&D (Mayer 2010). In this perspective Chesbrough (2003) coined the concept of open innovation. Open innovation is a paradigm according to which

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[12] This part of the research project was funded by the FNR (Fonds National de Recherche) Luxembourg under the AFR PhD funding scheme for the PhD project ROSIN (The Role of Research and Technology Organizations in Open Service Innovation) (3965993/PhD 2012-1/ID).

[13] Closed innovation, according to Chesbrough (2003), is defined as in contrast to the open innovation paradigm and suggests that there should be control over innovation activities. In this model innovations are conceptualized, developed and commercialized merely by internal to the organization means.

firms commercialize external (as well as internal) ideas by deploying outside (as well as inside) pathways to the market (Chesbrough 2003). Therefore in the open innovation paradigm the boundaries of the firm become permeable both from the inside-out but also the outside-in perspective.

### 4.1.1 The dimensions of openness

The open innovation paradigm is mainly described by three dimensions - namely the outside-in, the inside-out and the coupled one - and three relevant types of technology transactions: technology acquisition, technology exploitation and a combination of the two (Gassmann & Enkel 2004). These transactions can take place internally or externally and they represent the main dimensions of a firm's strategic approach to open innovation (Lichtenhalter 2008).

*Outside-in or inbound open innovation*

The *outside-in or inbound* dimension refers to the absorption of external knowledge and ideas from external partners such as suppliers, customers, competitors, universities and research organizations (Backer et al. 2008). In this perspective the locus of innovation is not necessarily the locus of knowledge (Enkel et al. 2009). Examples of the inbound approach are in-licensing agreements or strategic alliances (Lichtenthaler 2008), however it should be noted that the optimal exploration strategy is often hard and maybe sometimes even impossible to find. Kang and Kang (2009) examine three strategic approaches for technology sourcing; namely information transfer from informal network, R&D collaboration and technology acquisition with their relevant attributes.

Similarly, Bessant (2008) argues that firms need to adopt strategies that support their capability to detect and react to early signals about possible technological shifts in their environment. These strategies aim at keeping the firm updated in new technology trends through external sources such as participation in communities, the use of scouts and technology brokers, supporting internal capabilities of creativity, developing corporate venturing/entrepreneurship capabilities and leveraging creativity tools.

Dahlander and Gann (2010) identify two different types of inbound processes,; namely acquiring and sourcing depending on whether they are driven from pecuniary or non-pecuniary motives respectively. The authors define acquiring as the process of licensing-in and acquiring expertise from the external -to the firm- environment. Sourcing on the other hand refers to the process of using external sources of ideas after searching, assessing and making them fit with internal process.

*Inside-out or outbound open innovation*

On the other hand the *inside-out or outbound process* refers to commercializing technology assets exclusively or in addition to their internal application e.g., by means of out-licensing agreements or strategic alliances (Chesbrough 2003; Chesbrough et al. 2006; Backer et al. 2008). In this approach, the locus of innovation is different than the locus of exploitation (Enkel et al. 2009). It has to do with bringing ideas to the market for profit, through selling or licensing intellectual property (licensing fees, joint ventures, spinoffs, patenting etc.); the transition to the market is then done faster than it would take to internally develop them (2009).

The types of technology transactions in the markets for technology include licensing and selling, depending on whether or not patent ownership is transferred (Chiesa et al. 2008; (Jeong et al., 2013). Selling involves the transfer of patent ownership from a technology supplier to a buyer, while under licensing a technology supplier grants a licensee the right of exploiting and commercializing the technology protected by the patent. In return, the supplier receives a licensing fee during the contract period. Dahlander and Gann (2010) discuss two forms of the outbound process, namely selling and revealing, again according to the pecuniary or not nature of the process respectively. Selling refers to the process of external commercialization of the firm's inventions and technologies through selling or licensing out resources. Revealing on the other hand refers to how firms reveal internal resources without immediate financial rewards, but instead seeking indirect benefits.

Previous literature shows that inbound open innovation is more commonly used compared to outbound open innovation (West & Bogers 2014; Hossain et al. 2016). This can be accounted to the fact that outbound activities are more risky and firms face the risk of not being able to capture the created value (Schroll & Mild 2011). Indeed many firms are reluctant to engage in outbound open innovation as they fear that by externally commercializing their innovations they will lose their "corporate crown jewelry" (Rivette & Kline 2000).

*Coupled open innovation*

In addition to these two dimensions Gassman and Enkel (2004) propose a third dimension: the *coupled* process which refers to the combination of the inbound and outbound process by working in alliances with complementary knowledge. This approach brings together the two upper mentioned activities. In the coupled process co-creation takes place with partners

through alliances, joint ventures and cooperation where give and take is taking place simultaneously (Enkel et al. 2009).

In the coupled process it is important to be able to bridge the two dimensions of open innovation. Harryson (2008) develops a relevant theoretical framework according to which "the balancing act from exploration to exploitation can be seen as an act of transformation from weak to strong ties". Other strategies concern collaboration with communities (OSS), other companies (alliances) and customers, suppliers, government and universities (Morgan & Finnegan 2008); all these apply for both exploration and exploitation strategies. Vapola et al. (2008) explore why and how multinational companies complement their in-house R&D by forming strategic alliances in a coupled open innovation approach.

Moreover, open innovation implementation can also vary according to the formality and the market orientation of the interactions, the degree of the openness of the access to knowledge, the frequency and the importance of the interactions among the different actors of the innovation process, etc. (Gassmann & Enkel 2004). Jullien and Pénin (2014) propose, for instance, a classification based on the distinction between the outside-in and the inside-out open innovation and the degree of the importance of the interactions and relying on ICT (Table 5). More specifically, the authors identify two "versions of open innovation", namely "1.0" and "2.0" and they distinguish between the two by arguing that open innovation 2.0 is more interactive and community oriented and promotes the role of innovation intermediaries.

*Table 5: Open Innovation modes, Source : Jullien et Pénin (Jullien & Pénin 2014)*

| | Innovation ouverte 1.0 | Innovation ouverte 2.0 |
|---|---|---|
| Pure « Outside-in » | Licensing-in, Spin-in | Crowdsourcing |
| Collaboration ( « outside-in » & « inside-out ») | Co-conception, Co-development, Research consortium, Research joint-venture | Innovation with communities of users / open source |
| Pure « Inside-out » | Licensing-out, Spin-out | On line markets / e-Bay of ideas (Yet2.com) |

*4.1.2 The debate around open innovation*

Since its emergence open innovation has been a rising topic of discussion among scholars who try to define its theoretical elements, but also among practitioners who want to keep up with the revolutionary open paradigm. As a result, it has been associated with several things over the years; from user co-creation (Franke & Piller 2004) to user-centered innovation (Von Hippel 2005) and from distributed innovation (Sawhney & Prandelli 2000) to open source (West & Gallagher 2007), to name a few. For the latter in particular, it is argued that it represents the extreme facet of open innovation as it requires more interactivity and openness from the participating actors (Pénin 2011).

Consequently, the open innovation concept has received significant criticism over the last years (Trott & Hartman 2009). Faems (2008), for instance, expressed the opinion that there is a risk that open innovation is more a managerial fad than a theoretical concept due to the absence of a sound theoretical framework. Others believe that it represents nothing new, stating that collaboration in R&D or the inclusion of customers in the innovation process have been already proposed years before the open innovation concept was coined by Chesbrough (2003). Moreover, contrasted to open source innovation[14], open innovation has been accused of not being that open since it requires a certain level of secrecy, as the knowledge is only disclosed to the collaborating actors, and not widely (Pénin 2011). Finally, the linearity of the open innovation funnel has also been criticized (Trott & Hartman 2009).

If open innovation represents nothing new then why has it been accepted by such enthusiasm by the practitioners as well as a significant part of the researchers' communities? First and most importantly, it is the inside-out approach, the external commercialization of knowledge, that represents the most novel element of the concept (Pénin 2011). As far as the inbound process is concerned, many researchers have identified the value of external knowledge to innovation before Chesbrough but only in a supplementary role. In the open paradigm, the locus of innovation stops being the internal of the firm.

Thus, it is indeed true that some of the elements that the open innovation paradigm presents are not new, however the concept per se is new in the way that it assigns a single term to a collection of open activities; *"by giving it a label it got a face"*(Huizingh 2011, p.3). With open innovation the outside-in and the inside-out approach are gathered under one single con-

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[14] Open source innovation represents the application of the open source model in other sectors that software (Pénin, 2011).

cept (Huizingh 2011). Finally, what is also noteworthy and novel is that Chesbrough (2006), relates open innovation to business models in an attempt to explain how to benefit from open activities and, for the first time, someone discusses how firms can actually create value from innovation without necessarily adopting a defensive approach towards their intellectual property.

### 4.1.3   Open Innovation: benefits versus risks and challenges

Companies are increasingly searching for innovation ideas outside their borders rather than investing merely in in-house research and development (Mayer 2010). This is because even large firms find it difficult nowadays to internally produce all the knowledge required to innovate. They are, therefore, seeking for cooperation in innovation to make up for their lack of internal resources and because they want to reduce the innovation related risk such as knowledge spillovers, especially in the case of more complex innovation (Tether 2002). As a result, open innovation helps firms overcome current challenges of innovation such as: "*the instability of the world economy, the fast pace of scientific knowledge being produced in all disciplines, the complexity of the multidisciplinary knowledge required to support innovation, the rapid decrease of products and processes life cycles*" (Ramos et al. 2009, p.211). This is consistent with  Keupp and Gassmann (2009) who argue that firms that suffer from more obstacles in innovation (such as structural and strategic rigidities, cultural fear, innovation specific issues such as the NIH syndrome and resistance to change ) may benefit from adopting the open innovation paradigm.

Specifically, the beneficial impact of open innovation on innovative performance has also been substantially discussed in the literature. Open innovation is often considered to be a complement of internal R&D (Caloghirou et al. 2004; Lichtenthaler & Ernst 2008) contributing significantly to the innovative performance of the firm. An inward looking approach to innovation could make the enterprise lose the dynamics of interaction that can produce high added value and innovation (Caloghirou et al. 2004). Following the same reasoning, Vanhaverbeke and Cloodt (2008) argue that internal and external sources should be combined and in this perspective internal R&D is very important to effectively exploit external knowledge. This is in line with the concept of absorptive capacity  (Cohen & Levinthal 1990) that connects the existing knowledge base of the firm with its capacity to assimilate new knowledge; therefore higher levels of internal R&D could improve the firm's capability to use external sources of knowledge (Gambardella 1992).

Nevertheless, Laursen and Salter (2006) found that open innovation is a substitute rather than a complement to internal R&D. Laursen and Salter (2006) also argue that the search for external knowledge in the context of open innovation should be reasonable and that over-search (both in terms of breadth and depth) may hinder innovative performance. As openness comes with a cost companies need to find the right balance in order not to get lost in too many search channels (Laursen & Salter 2006). Moreover, as far as inside-out innovation is concerned, many firms are reluctant to engage in outbound activities, as they fear that by externally commercializing their innovations they will lose their "corporate crown jewels" (Rivette & Kline 2000).

Therefore, engaging in open innovation also has some risks and challenges. Keupp and Gassmann (2009) mention that open innovation relationships may be counteracted by the risks and costs of openness such as transaction costs for the search and evaluation of external knowledge and partner interaction, intellectual property issues (spillovers, disputes around jointly developed intellectual property), managerial challenges-leadership, change of mindset, etc. In the same perspective, Giannopoulou et al. (2011) based on an extensive literature review, have identified as the most important challenges in open innovation management the following: organizing for openness, co-creating value, leadership for diversity and IP management (Giannopoulou et al. 2010).

Especially, intellectual property management under the open innovation paradigm represents one of the biggest challenges for managers (Giannopoulou et al. 2011) as "intellectual property theft is typically identified as the most important risk of global innovation networks." (Backer et al. 2008, p.6). In general, the process of commercializing intellectual property is complex, highly risky, costly and time consuming (Bozeman 2000). This is why intellectual property was traditionally managed in a closed and defensive way. For instance patents were used in order to exclude competitors from developing similar technology. This defensive use of intellectual property assets has led to a low utilization of commercialization of new products and services (Backer et al. 2008).

But the open innovation paradigm requires a change of mindset. In this perspective new technological, strategic and legal capabilities for effectively managing IP need to be developed (Ayerbe et al. 2014). It is therefore essential to rethink the traditional intellectual property management strategies, with the aim of sharing and commercializing innovation output, instead of using them as defensive mechanisms. For instance patent licensing cross-licensing

agreements and other collaborative mechanisms can facilitate technology collaboration (Backer and Cervantes, 2008).Instead of considering patents as defense mechanisms it is important to take into account that strong patents can also promote vertical specialization (Arora et al. 2001) and by attracting financial capital, they allow inventors to specialize in intellectual assets that are then licensed to users (Lerner 1994). By reducing transaction costs of negotiating contractual agreements, they encourage users to license patented inputs, rather than to develop their own; thus they facilitate and support the open innovation paradigm[15].

Moreover, Young et al. (2008) look at the intellectual property management practices of public research centers and identify three categories, namely: *the open science-, licensing- and innovation- model*. According to the intellectual property science model, new knowledge is viewed as a public good and little priority is placed on intellectual property ownership. This is a strategy that is more compliant to a traditional academic mentality. In the licensing model on the other hand, a lot of focus is put on the exploitation of intellectual property, generally through patents and licenses. Finally, the innovation model is reflecting the current approach of universities towards intellectual property. More and more universities are trying to develop collaborative projects with the industry, investing in applied research and in this perspective they are willing to share the resulting knowledge from these collaborative activities.

### 4.1.4 *Reducing the risks and challenges of open innovation through innovation intermediaries*

It seems that it is neither easy nor straightforward for organizations to open up their boundaries and adopt open innovation due to the challenges that we have analyzed. Consequently, companies often need to use intermediaries, in order to smooth the open innovation process and to limit the risks and the challenges that, as we have discussed already above, are related to open innovation. There are many examples of how innovation intermediaries function, for instance markets for technology, in which firms buy and sell technologies (Arora et al. 2001). It is therefore important to understand the rationale behind the use of intermediaries in the case of open innovation (Howells 2006). By definition, the innovation intermediaries are agents (individuals or companies) that are situated among other actors. Howells (2006, p.720) defines these intermediaries as:

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[15] Strong patent protection enables disclosure and technology transfer; nevertheless it is still debatable if it can stimulate innovation in general (Gallini 2002).

*« An organization or body that acts as agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations ».*

The term has acquired a lot of importance and has evolved significantly over the last decade (Howells 2006; Benassi & Di Minin 2009; Dushnitsky & Klueter 2011; Sieg et al. 2010; Agogué et al. 2013; Alexander & Martin 2013; Boari & Riboldazzi 2014).

As a result researchers have tried to explain the activities of intermediaries which are in practice indeed very diverse. One example might be consulting activities, where a consultant represents the connecting point among different innovation actors (Howells 2006). Brokers in the patent markets are also an example of innovation intermediaries. They facilitate the contact and ensure the transaction between the patent seller(s) and buyer(s) (the buyer is often a manufacturing company and the seller is a technology company or even a university) (Benassi & Di Minin 2009; Dushnitsky & Klueter 2011; Pénin 2012). Another type of innovation intermediaries are those that form and manage patent pools and whose role is to facilitate the grouping of patents of similar technology in order to facilitate the diffusion of a certain technology (Merges 2001; den Uijl et al. 2013; Pénin et al. 2013). Moreover, crowdsourcing platforms can also have an innovation intermediary role (Howells 2006; Howe 2006).

So as we have seen above the literature has mainly studied intermediaries in the context of technology, inventions or existing actors. The purpose of the intermediary in this case is to facilitate the transmission of the technology to those who can take advantage of its value in the best way (the case of markets of technology or patent pools) or to put in contact actors that were not aware of each other up to that moment (the case of competitive clusters for instance). But Agogué et al. (Agogué et al. 2013) show that intermediation can go even further and actually concern technologies and inventions that are not yet mature or that imply the creation and emergence of new actors. Therefore, the intermediary is actually creating an ecosystem or in the words of the authors the intermediary is "an architect of collective exploration and knowledge creation" (Table 6).

*Table 6: The three types of intermediation in open innovation according to Agogué, Yström and Le Masson (2013). Source: Agogué, Yström et Le Masson (2013)*

| Type of inter-mediation | Brokering | Networking | Collective exploration |
|---|---|---|---|
| **Initiation** | An organization initiates contact with the intermediary | One or more organizations initiating contact with the intermediary that acts as a central hub in the network | Several organizations seek to collaborate on advanced research projects but cannot find partners. The intermediary is the initiator |
| **Results** | Content (knowledge, technologies) is transferred between the parties | Improved network connectivity | Creative atmosphere, new vision, new knowledge |
| **Process** | Bring together demand and supply. Combine existing ideas and knowledge | Create a link and co-ordination | Highly structured creative methodology |
| **Resources** | Reactivity, market expertise, technology expertise | Multiple connections with experts in and outside of the sectors concerned | Strong involvement in the project to enrich the vision, explore new ideas and find new partners |

This contribution is very important as it shows a new perspective of intermediaries. We move from the type of intermediary that is merely a passive player (having simply a linking role among innovation actors), to a more active player in the innovation process. In the latter case, the intermediary is clearly involved in the knowledge production process and is not only a facilitator. In other words we move from a role of actively reducing the costs of innovation (transaction costs in particular) to a role of knowledge creator.

*4.1.5   Open innovation relationships between industry and the academic world*

As we have seen until now, value creation forces are found in creative individuals, innovation communities, collaborative initiatives with other companies, supplier's government organizations and academia (Chesbrough & Appleyard 2007). One specific relationship that has attracted a lot of research attention is the one between industry and academia, as the latter is acknowledged to be an important collaborative actor in the open innovation paradigm (Perkmann & Walsh 2007) especially in the inbound but also in the coupled approach.

The academia-industry collaboration has been discussed however long before the Open Innovation concept was coined by Henry Chesbrough in 1992 (e.g. in the context of the US industry) (Mowery 2009). The Bayh-Dole act (in 1980) which facilitated the university patenting and licensing was one of the main triggers (Ghauri & Rao 2009; Mowery 2009). Cohen et al. (1981) and acknowledged the significant impact of public research on industrial R&D (in a broad range of industries, albeit in different ways) already in 1981. The trend continues until today due to the increasing patenting by universities, growing university revenues from licensing, more university researchers engaging in academic entrepreneurship and more science parks (Perkmann & Walsh 2007).

There are various channels of knowledge flow and relationship types between basic research and industry (Schartinger et al. 2002; Cohen et al. 2002; Perkmann & Walsh 2007; Ruiz 2010; D'Este & Perkmann 2011; Howells, Ramlogan & S. Cheng 2012; Alexander & Martin 2013). Table 7 provides an overview of them based on selected literature. What is noteworthy though is that Perkmann and Walsh (Perkmann & Walsh 2007) acknowledge that the most important links are research partnerships and contract research and consulting, because these links are based on human relationships. The authors acknowledge that these relationships are relevant in the context of open innovation as they imply higher level of commitment and relational involvement.

*Table 7:* **Summary of knowledge transfer channels/types of cooperation between academia (incl. universities, RTOs, and/or other public research organization) and industry**

| Knowledge transfer channels/Relationship types | Literature source |
| --- | --- |
| Shared facilities, patent or license, joint conference, spin-off, joint publication, networks, training and CPD, contract research and consultancy, student placements/ graduate employment, joint supervision, secondment, collaborative research and joint ventures | *Alexander and Martin (2013)* |
| Research partnerships, Research services, Academic entrepreneurship, Human resource transfer, Commercialization of IP (e.g. licensing), scientific publications and informal interaction (conferences and networking) | *Perkmann and Walsh (2007)* |
| Publications/reports, informal interaction , public meetings or conferences, contract research,  consulting,  joint or cooperative ventures,  patents,  personnel exchange,  licenses,  recently hired graduates | *Cohen et al. (2002)* |
| Simple transaction of intellectual assets in return of some economic benefit (linear process of technology push from | *Ruiz (2010)* |

| | |
|---|---|
| universities or research centers) More sophisticated relationship with a series of interactions, collaboration and co-creation | |
| Formal methods include patenting, licensing and entrepreneurial activities. Inter-organizational relationships/types of collaboration; (i) collaborative research: formal collaborative agreement aimed at cooperation in R&D (eligible for public funding), (ii) contract research: directly commercial projects usually more applied than in collaborative research (not eligible for public funding) and (iii) consulting: specific advisory services | *D'Este and Perkmann (2011)* |
| Scientific publications, reports, informal interactions, public lectures, contracts research, consultancy, collaborative research, patents, personnel exchanges, training students, creation of academic start-ups, etc. | *Howells et al. (2006)* |
| 15 types of interaction grouped into 4 categories: collaborative research, contract research, mobility and training. | *Schartinger et al. (2002)* |

The role of intermediaries in the public research industry relationships has also been discussed. In fact the relationship between academia and enterprises is not always straightforward because of the different cultures and mentality that can bring about conflicts (Núñez-Sánchez et al. 2012). For instance the incentives for engaging in collaborative innovation might not be the same as universities are more interested in the research perspectives that a collaboration might bring, while obviously the firm is driven by commercialization incentives. In this perspective, an intermediation structure such as a TTO of the university might be seen as an intermediary structure that bridges the gap between basic research and industrial application (Etzkovitz & Goktepe 2005). This is also the case of RTOs that are generally acknowledged to be closer to the industry in terms of mentality (Arnold et al. 2007).

We have reviewed the most important literature on open innovation and its determinants, the role of intermediaries, as well as the industry academia relationships in this context in order to be able to introduce the external perspective of RTOs; as it is the purpose of this part of the research project. We will now pass into the formulation of our research question in order to clearly define our research objectives.

### 4.2   *Research Strategy: Research Objectives and Research Design*

This chapter explains our research objectives for studying the external perspective of RTOs by formulating the main research question of this part of our research project. The way that this question will be answered is then explained in the Research Design part.

*4.2.1   Research Question 2*

Based on the above literature we have shown that open innovation is a paradigm that dominates innovation activities nowadays. A relationship that has particularly been studied over the years is the one between academia and industry. Our research objective is to examine the role of RTOs specifically in the academia-industry relationship in the open innovation context. The abundant literature is nonetheless not clear on this issue. The reason is double-fold, namely most of the times (i) either the literature focuses solely at the role of universities or (ii) RTOs are studied together with universities (and/or other types of research institutes). As a result, there is a blurred theoretical knowledge on what are the different roles and the distinct characteristics of RTOs. But firms seem to be able to make the distinction between the two and actually address the one or the other for different needs and problems to be solved, as exhibited by Arnold (Arnold et al. 2007; Arnold et al. 2010).  Table 8 provides an overview of the ideas that customers associate with RTOs and universities respectively.

*Table 8: Ideas customers associated with RTOs and universities (adapted from (Arnold et al., 2007))*

| **Research Institutes** | **Universities** |
|---|---|
| ✓ Resources<br>✓ Competences<br>✓ IPR handled professionally<br>✓ Confidentiality<br>✓ Used to working with industry<br>✓ Project Management<br>✓ routines in place<br>✓ Timelines (mostly)<br>✓ Can address focused research questions<br>✓ Close to applications and products<br>✓ Understand real industrial processes<br>✓ Understand industrial customer needs<br>✓ Less focus on publications than universities<br>✓ A "bridge" to scientific knowledge<br>✓ Bring in university partners where that is useful<br>✓ Proximity an advantage, easier to reach and collaborate with- especially when significant R&D projects are done together with an institute | ✓ Developing human resources, especially PhDs<br>✓ Basic and precompetitive research<br>✓ No timetable<br>✓ Difficult to steer or predict outcomes<br>✓ Poorly equipped, compared to the institutes<br>✓ May be opportunities to get additional state funding to carry on the project |

The purpose of this part of our research is to study RTOs as a distinct type of organizations and to understand the difference between RTOs and universities, as far as their role in the science-industry relationship is concerned. Therefore the research question that we aim at studying in this second part of our research project is the following:

*4.2.2   Research Design*

This chapter explains the research design of the second part of our research project which aims at answering our second research question. The research design, presented in Table 9, consists of two parts: the conceptual and the empirical part. In the conceptual part we undertake a literature review where a critical synthesis of the relevant literature is done for two purposes. By taking a critical view on the literature that broadly assumes that universities and RTOs are the same organization, we try to compare the two, first by (i) comparing the RTOs and TTOs of universities as intermediaries in the public research-industry open innovation relationship and then by (ii) understanding the different impacts of RTOs vis-a-vis universities on firms' innovation. The latter theoretical analysis is then crystallized in four relevant hypotheses that are tested empirically through econometric analysis of the 2012 Community Innovation Survey (managed by Eurostat) data.

*Table 9: Research Design of the second part of the project*

**Research Design – Second part of the project focusing on the external perspective of RTOs**

Conceptual part: Comparing the RTOs and TTOs/universities as intermediaries in the public research-industry open innovation relationship and understanding the different impacts of RTOs vis-a-vis universities on firm's innovation

Empirical part: Statistical analysis of the 2012 CIS data for studying the different impacts of RTOs vis-a-vis universities on firm's innovation

*4.2.3   Comparing RTOs to TTOs/universities as intermediaries in the science-industry relationship*

Our first concern was to build the theoretical background of this second part of our research project. In order to do so, we have reviewed the most important contributions of the literature

concerning **open innovation and innovation intermediaries** with a special focus on the **public research-industry relationship**. Our purpose was to cover the most noteworthy and recent contributions on these subjects. The outcome of the literature review was double fold. First we aimed at a more general theoretical analysis of the comparison between RTOs and TTOs of universities, building on the literature that acknowledges the role of **RTOs as intermediaries in the public research science relationship**. In order to do so we relied on two very renowned theories of the firm, namely the **transaction cost theory** and **knowledge based theory of the firm**. Specific cases for renowned RTOs and TTOs were also employed for illustration purposes in order to enrich our conceptual analysis. The results of this conceptual analysis are presented in Paper 4.

Second, we also looked into **the impact of RTOs vis-à-vis universities on firm innovation**. In this case we turn into the literature in order to understand the different effects of RTOs and universities on the enterprise. Starting from the general literature on open innovation we focused on the specific relationship between academia and industry and its impact on the innovative performance, the service innovation proficiency and finally the need to perform internal R&D. Our aim here was to build models and relevant hypotheses that would then be empirically tested through the econometric analysis of the Community Innovation Survey 2012 data, as explained in the next section.

### 4.2.4 *The quantitative part – Statistical analysis of the Eurostat's Community Innovation Survey microdata (year 2012)*

The empirical results of the second part of the PhD which aims at analysing RTOs from an external perspective is based on the statistical analysis of the most recent available Community Innovation Survey (CIS) data (year 2012).

The CIS aims at collecting information regarding the innovation activity (e.g. type of innovation, funding, sources of knowledge, performance etc.) of European enterprises[16]. The CIS provides statistics broken down by countries, type of innovators, economic activities and size classes. The CIS data are collected by Eurostat based on a harmonized questionnaire that is sent along the 28 Member States of the European Union, countries of the European Free

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[16] For more information on the Community Innovation Survey please refer to the Eurostat webpage: http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

Trade Association (EFTA countries) as well as candidate countries (Norway, Serbia and Turkey).

The CIS questionnaire is designed in a collaborative way among Eurostat and the countries accompanied by a set of definitions and methodological guidance. The main methodology and concepts are based on the Oslo Manual. The survey is run every two years and several updates are implemented in the questionnaire design from one year to the other.

The main statistical unit used in the CIS survey is the enterprise as defined in the European Union council regulation on statistical units or in the statistical register. The definition of the enterprise is the following: "*an enterprise is the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision making especially for the allocation of its current resources. It may carry out one or more activities at one or more locations and it may be a combination of legal units, one legal unit or part of a legal unit.*" (Source: Eurostat CIS metadata webpage)

Researchers can have access to the microdata of the CIS survey after the explicit authorization of Eurostat and the countries who have responded to the survey. The research projects go under a consultation process where they are assessed during a period of 8 weeks due to the inclusion of confidential data. The availability of country data depends on the year of the survey but also on some national specificities, e.g. certain data may not be available for specific countries or definitions might be slightly different. The results of the statistical analysis of the data go also through a control process, upon which the data that might bridge any confidentiality rules (e.g. small number of enterprises in specific categories) should be hidden.

Taking into account the purpose of this research project and the constraints of data availability and confidentiality, we focus on the results of the CIS 2012 from ten countries, namely Belgium, Spain, Italy, Luxembourg, Portugal, Finland, Sweden and Norway. Among the available data we chose to focus on these countries because they have long history in public research where:

(i)      important RTOs have been active according to EARTO (European Association of RTOs) and,

(ii)      there are important and renown universities and

(iii)      they are countries with a proven innovation record.

The statistical analysis of the data concentrated around three concrete hypotheses and relevant models that were built after a thorough review and synthesis of the available literature. The building of the hypotheses, the econometrical models used, the relevant variables (dependent, independent and controls) and the results are thoroughly described in Paper 5 appended at the end of this manuscript.

### 4.3 Main Results 2 – The role of RTOs vs universities in the science-industry relationship

This chapter presents the main results of the second part of our research focusing on the external perspective of RTOs and their role compared to universities in the science industry relationship. The results are presented through two relevant papers that are summarized and discussed below.

#### 4.3.1 RTOs vs TTOs as intermediaries: reduction of transaction costs vs. knowledge creation

**Paper 4**[17]**:** *Barlatier, P.-J., Giannopoulou, E., Pénin, J. Les intermédiaires de l'innovation ouverte entre gestion de l'information et gestion des connaissances : le cas de la valorisation de la recherche publique. Innovations, 49 (1), 2016, pp. 55-77*

In **Paper 4** we establish a comparison between RTOs and TTOs of universities as intermediaries between science and industry. Since we have shown that RTOs are positioned between science and industry, it makes indeed sense to compare them with TTOs of universities which are the main intermediary actor usually considered when it comes to the valorization of academic research (Etzkovitz & Goktepe 2005).

The use of innovation intermediaries in the case of university-industry relationships is particularly important because of the obvious differences between the academic and the industrial sector (culture, mentality, objectives, etc.) (Núñez-Sánchez et al. 2012). In this context, the role of the innovation intermediary is then to ensure that the research inventions, often in embryonic stage, are properly transferred, developed and exploited by companies. In this per-

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[17] There is also a related English version of Paper 4: *Barlatier, PJ, Giannopoulou, E, Pénin, J Exploring the role of open innovation intermediaries: The case of public research valorization Book chapter: Global Intermediation and Logistics Service Providers. IGI Global Publishing (to appear in 2016)*

spective, innovation intermediaries are contributing to cross the so called "Valley of death" that resides between basic research and successful innovation commercialization.

Based on the definitions of intermediaries in the literature we have analyzed the existence of intermediaries through the view of two renowned theories of the firm, namely (i) the theory of transaction costs that highlights the importance of innovation intermediaries in reducing the costs that are inherent to the interactions among the actors of an economy and (ii) the knowledge-based theory, that underline the challenges of transferring and sharing knowledge (especially tacit).

The transaction costs theory (Coase 1937; Williamson 1981) aims at explaining the costs that are inherent in the market interactions. Indeed, transaction costs are almost always high in the case of innovation activities and especially in the context of open innovation. Therefore, the theory of transaction costs identifies a key role for innovation intermediaries: reducing the transaction costs that are inherent in open innovation. This primary role of intermediaries highlights the importance of intermediaries for ensuring and formalizing relationships between the stakeholders of open innovation. This is the case of most intermediaries in the case of open innovation, such as patent brokers or crowdsourcing platforms. It is important, however, to note that in this context innovation intermediaries are not directly involved in the knowledge production process; because they are not involved in the learning process, for instance. They only help to transfer intellectual property, e.g. pieces of paper that describe contracts between organizations that possess already the knowledge. But a market of property rights has less social value than a market of knowledge (Lemley 1997).

Therefore, it is also important to take into account another aspect of innovation intermediaries especially in the current highly complex open innovation landscape. A commonly admitted limitation of the transaction cost theory is that it ignores the complex and dynamic nature of the knowledge production process. Thus, in order to fully understand the role of innovation intermediaries, we have employ an alternative look beyond the transaction cost theory (Coriat & Weinstein 2010), namely through the lenses of the "Knowledge-Based View" (KBV). Indeed, this theory focuses on the property of innovation and knowledge and - in particular - on the difficulties to share and exchange tacit knowledge via anonymous and instantaneous market transactions. We therefore argue that those challenges can also justify the presence of intermediaries, whose role is then not only to reduce transaction costs but also to contribute to the dissemination of knowledge (in particular sticky knowledge) in the economy.

Similarly, Perkmann and Walsh[18] (Perkmann & Walsh 2007) also propose a typology of relationships between university and industry based on the degree of involvement of the different actors (see Table 10).

*Table 10: A typology of university-industry links (source Perkmann and Walsh (2007))*

**Extent of relational involvement**

| High: relationships | Medium: mobility | Low: transfer |
|---|---|---|
| Research partnerships | Academic entrepreneurship | Commercialization of IP (e.g. licensing) |
| Research services | Human resource transfer | |

Use of scientific publications and informal interaction such as conferences and networking (can accompany all forms)

This typology is particularly interesting because it distinguishes clearly the roles of the two types of innovation intermediaries we have identified in the case of public research-industry relationships. On one side we have TTOs, whose mission is to reduce transaction costs related to the technology transfer between universities and companies by focusing on the effective intellectual property transfer by ensuring the contractual collaboration ("Low" interaction according to the typology of Perkmann and Walsh (Perkmann & Walsh 2007) in the Table 10). On the other hand, we find the RTOs (for "Research and Technology Organizations"), whose mission is to be actively involved in the process of knowledge creation and transfer knowledge ("High" interaction in Table 10). Indeed, according to Mrinalini and Pradosh (2008) the basic function of the RTO is to generate and diffuse knowledge. RTOs must be "skilled at creating, acquiring and transferring knowledge and modifying its behaviour to reflect new knowledge and insights." (Mrinalini & Nath 2008).

*Main contributions*

Our main contribution with this paper is that we have established **a theoretical comparison of RTOs versus TTOs in the context of the science to industry relationship** (through the

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[18] Please note that when the authors mention universities they include also RTOs in their analysis

lens of the transaction cost and the knowledge based theory) that to our knowledge has not been attempted until now. As a result, we have shown that RTOs represent an advanced type of intermediaries who do not only reduce transaction costs but are also able to be involved in the knowledge production process.

If the source of competitive advantage lies in the ability to create specific and idiosyncratic knowledge (not available in the market), merely reducing transaction costs is not enough. It also means that some intermediaries should play an active role, beyond a strictly intermediation sense, but as a partner or accelerator that transfers knowledge. It is a more advanced role of open innovation intermediaries to contribute directly to innovative business processes by disseminating knowledge[19]. This role of disseminating knowledge brings these intermediaries to engage directly in the process of knowledge creation, since - as argued by Amesse and Cohendet (2001) - tacit knowledge is never transferred (i.e. duplicated identically between a transmitter and a receiver), but is actually recreated by the receiver. The activity of knowledge transfer is thus always a productive activity.

Moreover, we have also shown that **RTOs can be an example of the collective exploration type of intermediary that Agogué et al.** (Agogué et al. 2013) **are presenting as they carry the initiation, outcome, process and resources attributes** that the authors are proposing for the collective exploration type of intermediary; contributing also in the general literature regarding innovation intermediaries.

In this perspective, we have also managed to **shed more light on the role of RTOs as intermediaries between science and industrial application** by showing that RTOs are not only proficient in bringing together the different collaborating parties, but can be also an important actor in driving the innovation process through their advanced resources and processes, unique innovation capabilities and distinct role in the crossroad of the education system, industry, and other organizations (Mrinalini & Nath 2008). Therefore, RTOs are valuable partners, not only because they have specialized technology basis to support the early stages of

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[19] Please note that this approach is similar to the perspective of Ruiz (2010), who identifies two types of technology and knowledge transfer: (i) a simple transaction of intellectual assets in exchange for an economic benefit, where the role of the intermediary is limited to ensuring contractually the transfer; (ii) a more sophisticated relationship assuming a series of interactions, collaboration and co-creation among the different actors and where the role of the intermediary is more complex, as they are, in this case, directly involved in the innovation process.

innovation, but because they also have extended collaboration and networking relationships across diverse industries (Readman et al. 2015).

### 4.3.2 RTOs vis-à-vis Universities as sources of knowledge and the different impacts on innovation

**Paper 5:** *Giannopoulou, E., Pénin, Julien and Barlatier, Pierre-Jean. The impact of Research and Technology Organizations on firm innovation: a comparison with universities (2016 - Working Paper)*

In **Paper 5**, we tried to empirically address the comparison of RTOs vis-à-vis universities to understand what is the competitive offering of RTOs compared to universities, based on statistical analysis of the CIS 2012 data. Our results showed that firms that deem RTOs as more important knowledge sources for their innovation activities **are more likely to develop services innovation, have less need to invest in internal R&D but are less innovative, including new to the world innovation.**

These results illustrate, in fact, a broadly consistent description of RTOs. RTOs' predominant activity is to provide innovation services to their industrial partners, therefore we expect from them to be proficient in service innovation. Indeed previous literature and our analysis showed that RTOs possess distinct service innovation capabilities, especially as far as the creativity part is concerned, which is the most important step in innovation (please refer to the first part of our research on the internal perspective).

The proficiency of RTOs in service innovation implies a "high" extent of relational involvement, according to Perkmann and Walsh (Perkmann & Walsh 2007). Indeed the co-creation with the customers is an inherent characteristic of services innovation, as the centricity of the customer is imperative in the concept of service and service offering (Toivonen & Tuominen 2009; Chesbrough 2011). Naturally, such a relationship would result in new knowledge creation and transfer. But universities are seen as slow to act and unresponsive to customer needs; consultancies and research institutes are considered as a better solution, from this perspective, since they can provide more applied knowledge and specialist skills and information (Tether 2002).

Indeed, according to the highly iterative and dynamic nature of the service innovation process, as we have seen in the first part of our analysis, the way RTOs develop their services is not a factory-type services creation. RTOs do not prepare their service-offering behind closed doors that they would then go and offer to the client as they would do with a piece of software or a prototype. On the contrary, the services that are offered from RTOs are being developed through the co-creation with customers, as every service is unique and highly customized[20]. It is the customer that brings the inspiration, since as we mentioned before RTOs open innovation model is also a part of their capabilities and therefore their relational capital (including a wide spectrum of partners, from academia through government to industrial firms) represents a unique asset.

Moreover, the fact that we have shown that firms that deem RTOs as more important sources of knowledge than universities have less need to invest in internal R&D further supports the role of RTOs as co-creators of knowledge, as we have perceived it until now. Of course, as mentioned in Paper 5, every firm needs a level of R&D investment to achieve innovation and to be able to choose the most suitable innovation partner. But in the case of RTOs this need is somehow also satisfied by the close relationship between the firms and the RTOs. This implies that RTOs accompany firms across the whole spectrum of innovation activities from research to development, as they have relevant capabilities that can bridge scientific research to the pragmatic output in order to successfully develop and launch an innovation. Actually, these are also stages that can create new knowledge, as we have seen in the case of services, where innovation does not only concentrate on the idea generation phase, but is spread across all the steps of the innovation process: from idea to final launch.

It is surprising however that we have found a negative relationship between the innovative performance and the use of RTOs vs universities as sources of knowledge. The role of RTOs implies that they are more focused towards applied research and therefore we would expect them to have more impact on the innovation process. This result though can be explained from the proficiency of RTOs in service innovation and the wide spread belief that services are less innovative than goods.

Finally, we have shown that firms that deem RTOs as more important sources of knowledge than universities are less likely to develop new-to-the-world innovation. This is also a normal

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[20] This is also one of the main results of the first part of our research regarding the service innovation capabilities of RTOs.

result taking into account that most radical innovations come vastly from goods innovation. Radical service innovation is very rare (Von Hippel 2005; von Hippel et al. 1999; Jones & Samalionis 2010). Most of the time, it is related to process improvements or modification of existing services. Moreover, sometimes it is even difficult to understand that a new service represents a radical innovation due to the intangibility of services and also due to the very rare patent applications (Sundbo 1997). This result is also in line with previous research that showed that firms that are innovation leaders are more likely to use universities in their innovation activities (Janeiro et al. 2013) and that high-tech manufacturing firms are also more likely to use universities (Zhou & Wei 2010)[21].

*Main contributions*

Our purpose with this paper was to find out **the different impacts of RTO versus universities on firms innovation**. In order to do so, we have studied RTOs vis-à-vis universities as far as their impact on innovation performance (including new-to-the-world innovation), proficiency in service innovation and need to invest on internal R&D are concerned. This is important because it is generally admitted that comparisons between knowledge providers have seldom been performed (Vivas & Barge-Gil 2015) despite the need, given that the choice of the most suitable partner in innovation, and more specifically in open innovation, is not an easy one.

To our knowledge this is **the first time that an empirical study is performed in order to understand the different impacts of RTOs vis-à-vis universities on firm's innovation**. Our empirical work represents a contribution in understanding the special role of each actor in the public research-industry relationship in the open innovation context.

As explained above our results are broadly in line with the theoretical definition of RTOs that describes RTOs as service providers in national innovation systems that can support enterprises in their innovation activities sometimes even by substituting part of their internal R&D. This is also in line with our results from Paper 4 that show that RTOs are more geared towards knowledge creation than simple technology transfer. What we found surprising though, was the rejection of hypothesis 1 regarding the innovative performance. Although we explained this result by the service innovation proficiency of RTOs, it also makes us wonder

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[21] The authors also show that high-tech service firms are more likely to use RTOs but low tech service firms are more likely to use universities.

whether the industry has somehow also a distorted idea of RTOs, thinking that they can only provide incremental service innovations which could be a misinterpretation that comes from the very definition of RTOs and the reasons why RTOs were established.

But the conditions of the innovation games have changed over the years and it is indeed questionable whether these organizations have unveiled the whole spectrum of their innovation capabilities, in particular for services. If there is radical service innovation this is very likely created through co-creation (Perks et al. 2012). Therefore, we have provided a fertile ground for future research to identify the important role of RTOs in this perspective, as RTOs could lead the development of service innovation, together with the firms and the academic partners, which could be radical and acknowledged as such.

### 4.3.3   Conclusions of the second part of the research project

This section concludes the second part of the research project that aimed at studying the RTOs from an external perspective and answering the research question 2: ***What is the role of RTOs compared to universities in the science-industry relationship in the open innovation context?***

Our results suggest that RTOs are distinct type of organizations compared to universities. First we have studied RTOs as intermediaries and we have theoretically shown that compared to the TTOs of universities they represent a more advanced intermediary, as they are not merely efficient in the simple technology transfer that aims at reducing transaction costs, but are investing in the co-development and transfer of knowledge (including tacit knowledge) that results from the closer interaction with the firm. Moreover, we also looked at RTOs compared to universities as sources of knowledge for firms. Our empirical results showed that are more likely to develop services innovation, have less need to invest in internal R&D but are less innovative including new-to-the-world innovation.

Figure 13 illustrates an overview of our results and attempts to explain the special role of RTOs versus universities in the public research-industry relationships in the context of open innovation. The figure contains the comparative advantages of RTOs vs universities and vice versa as we have analyzed them through our research. This figure does not imply, for instance, that RTOs do not have a positive effect on innovation performance but that we have shown that universities compared to RTOs are more probable to lead to firm's innovation (irrespectively of the type).

The balance appears to be equal in Figure 13. The side on which it will lean depends on the specific expectations and the respective strategic decision of the firm, as far as its relationship with public research is concerned.
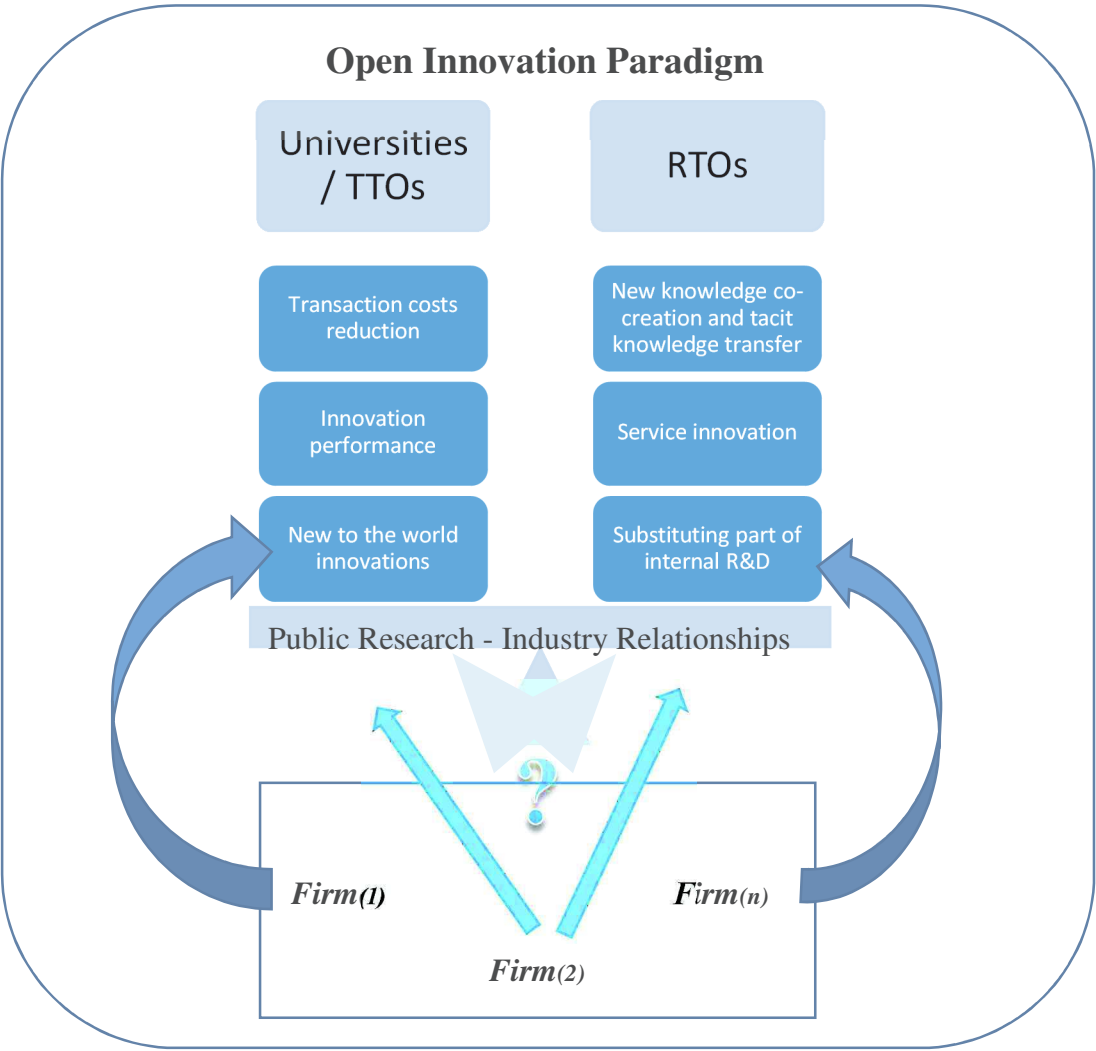


**Figure 13: Comparing RTOs vis-a-vis universities in the public research-industry relationship in the context of open innovation**

# 5 Discussion and Concluding Remarks

## 5.1   Synthesis of Results and Discussion

RTOs are key agents in national innovation systems, as they are generating and transferring knowledge, providing innovative services and acting as intermediaries between academia and industry (Tann et al. 2002, Barge Gil and Modrego 2008). Nevertheless, we manifest a scarcity of research (especially empirical) on these organizations (Sharif and Baark, 2011). Very often they are studied together with universities; as they are considered to be the same type of organizations. Regardless of the similarities between the two public research actors, RTOs represent distinct organizations that deserve special attention from researchers. The purpose

of this PhD project was therefore to shed light on the role of RTOs in open service innovation. In order to do so, we have employed a dual perspective approach, namely an internal and an external one. The internal perspective has helped us to understand what makes RTOs efficient innovators in services, while the external perspective has helped us to identify the role of RTOs in the open innovation landscape of public research-industry relationship, by comparing them to universities. The comparison is indeed helpful due to the cognitive proximity of these organizations and it helped us to identify the elements that make RTOs special in the public research landscape, without falling into general conclusions that could have been true for both organizations.

The first part of our research, aimed at answering the research question: "*what constitutes the service innovation capabilities of RTOs?*" By taking an internal perspective on RTOs, our study has revealed the unique service innovation capabilities of RTOs. The abstract nature of services and related service innovation capabilities (where most contributions remain theoretical) and the lack of research on RTOs made our work challenging but highly interesting due to its exploratory nature. Based on a theoretical review of the literature that helped us build our conceptual framework, we have conducted multiple case studies in four selected European RTOs, where we were able to propose a practice-based grid for the development of service innovation capabilities in RTOs. Our grid was built on the interplay of **practices** that relate to (i) **intellectual, structural, relational, IT and financial resources**, (ii) an **iterative NSD process, comprising four steps, namely design, analysis, development and launch** and (iii) elements of the **service innovation strategy.** This process-based perspective is what constitutes the main contribution of our research as it empirically proves the conceptual definition of services, which according to Gadrey et al. (1995) *"…is to place a bundle of capabilities and competences (human, technological and organizational) at the disposal of a client and to organize a solution…".*

Moreover, we moved a step further by proposing seven specific capabilities that reinforce creativity in service innovation in RTOs. The proposed capabilities were namely **attracting** creative people**, stimulating** creative environment**, combining** diverse input**, providing** relevant resources**, breeding** creative ideas**, opening up** to external influences **and accepting** risk, failure and criticism**.** These capabilities were defined out of the synthesis of specific resource-related practices that were found to have a positive effect on creativity of RTOs.

The second part of our research was dedicated to answering the research question: "*what is the role of RTOs compared to universities in the science-industry relationship in the open innovation context?*" Therefore, we have taken an external perspective of RTOs in order to identify the role of RTOs compared to universities in the **open innovation context and more specifically in the public research industry relationship**.

It is evident that the RTOs' innovation models carry a lot of the elements of the open paradigm of Chesbrough, even if they existed long before the term was invented. RTOs are often defined as technology **intermediaries** (Tann et al. 2002, Barge Gil and Modrego 2008) but are they merely that? It is indeed one of the primary roles of RTOs to act as intermediaries mainly between the academia and the industry. Howells (2006) promotes the role of service innovative organizations as innovation intermediaries and in this perspective we see how RTOs fit exactly this definition, especially as far as intermediation as a relationship is concerned[22]. Nevertheless, with this research we have gone one step further. By studying RTOs versus TTOs of universities, through the lens of the transaction cost theory and the knowledge-based view of the firm, we have shown that RTOs are not intermediaries in the classic sense of the concept, as they are not simply facilitators of the collaborative and innovation activities but rather active members of it.

The competitive advantage of RTOs then is **the ability to be involved in the process of knowledge creation, to transfer tacit in addition to codified knowledge and to be able to create also new knowledge through a co-development process with the industry**. Therefore, we acknowledge a more relational than transactional focus (Alexander & Martin 2013; Alexander et al. 2015) in their relationship with the industry. In this perspective we provide empirical evidence for what Agogué et al. (2013) have identified as a "collective exploration" type of intermediary. In this perspective RTOs (i) act as *initiators of innovation* due to their relational capital which comprises a diverse network of industrial and academic partners, (ii) *create new knowledge* through a co-development process (based on their strong service innovation capabilities), (iii) *foster a creative but structured process* due to their ability to adapt to the specificities of the partners and the project and (iv) have a *strong involvement in the innovation process* due to their unique resources but also the service mentality that is inherently

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[22] Howells (2006) in his thorough literature review categorizes intermediation as a function, process and relationship to show the different levels of consideration in the literature.

customer centric. These are, in fact, all elements of the definition of the "collective exploration" type of intermediary (Agogué et al. 2013).

Moreover, we have empirically compared RTOs to universities as sources of knowledge and proved that firms that deem RTOs as more important knowledge sources than universities **are more likely to develop services innovation, have less need to invest in internal R&D but are less innovative including new-to-the-world innovation.** These results are broadly in-line with the rest of our results and with the theoretical considerations regarding RTOs, but also with the stream of literature that acknowledges that RTOs and universities are not substitutes but complements, as they possess different skills and capabilities. This makes us wonder regarding the actual economic value of the third mission of universities. As in national innovation systems the roles of the different actors that perform innovation activities should be distinct (Christensen et al. 2005), we should wonder whether the shift of universities towards industry makes sense, especially in the context of increased specialization. The current complex innovation ecosystems require actors with specific and clear roles (Metcalfe 2010) that would be more efficient and more effective in driving the innovation process.

Furthermore, we also need to put into perspective the **proficiency of RTOs in service innovation**, as it shows the inherent inter-linkages of RTOs and service innovation with openness. In fact RTOs are by definition organizations that reflect the essence of open innovation. They would have no position and no role in a closed innovation ecosystem and in this perspective Chesbrough (2015) acknowledges them as the new open innovation organizations; although the characteristic "new" could be debated, as they could also be considered as the antecedents of open innovators.

In the same perspective we could wonder whether **service innovation** could in fact be closed. The special characteristics of service innovation prove the connection with the open innovation paradigm, even if still under-researched in the open innovation literature (Gassman et al. 2010; Chesbrough 2011; West et al. 2014), as they are under-researched in the innovation literature in general. The highly iterative, abstract and relational nature of service innovation that entails in it the concept of the knowledge co-creation (as inherently customer-centric) (Chesbrough 2011) is in fact consistent with the very nature of open innovation. This is in line with Djellal et al. (2013) that acknowledge as well the similarity of the special characteristics of service innovation and the open innovation paradigm; although they also argue that open innovation does not separately treat service innovation. As a result, we see that the research

highlights implications regarding the theoretical development of the concepts of service innovation and open innovation in a parallel way.

Moreover, in the context of public-private partnerships Djellal and Gallouj (2015) also acknowledge the central role of service providers such as RTOs (and universities) especially in the early stages of industrial maturity (crystallization)[23]. Nevertheless, we believe that the role of RTOs can lie further than this initial stage, especially due to the ability of RTOs to translate all their activities into services. As Hales (2001) describes it: *"… [RTOs are] suppliers of explicit innovation services, in a context that also contains 'self-service' elements of supply and the supply of tacit innovation services that are 'bundled' with non-service products or non-innovation services…".* Therefore, the interrelationships between RTOs, their service innovation distinct capabilities and their inherent open innovation business model justify the important catalyzing role of RTOs in open service innovation that can support the industrial growth in all its stages (Figure 14).
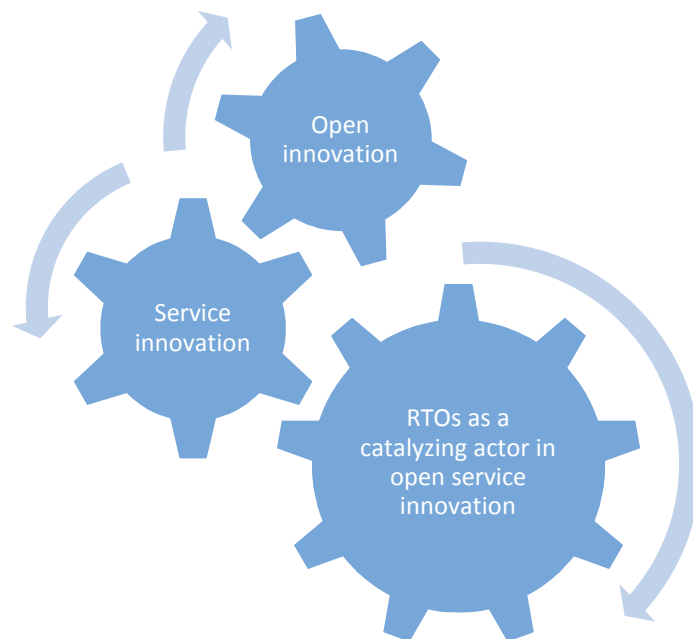


*Figure 14: RTOs, open innovation and service innovation as inter-connected concepts that support the catalyzing roles of RTOs in open service innovation.*

Finally, Table 11 summarizes and provides an overview of our most important results:

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[23] The authors go further than the public research industry relationships and study in depth public-private relationships including more public organizations.

***Table 11: The elements that crystallize the special role of RTOs in open service innovation***

- ✓ *distinct service innovation capabilities*

- ✓ *capabilities to support creativity in service innovation*

- ✓ *unique human capital that is highly dynamic and represent one of their most valuable assets*

- ✓ *a well-developed network of partners not only from the academic world but also from the industry, this network constitutes their relational capital that makes also part of their distinct innovation capabilities*

- ✓ *master the service innovation process which they manage in a highly dynamic and iterative way*

- ✓ *absorptive capacity to identify the needs of the industry and to provide relevant services*

- ✓ *"business-type" skills that makes industry trust them more than universities*

- ✓ *hybrid nature between industry and academia that is also reflected in their funding structure and makes them proficient in both worlds*

- ✓ *ability to understand and transform research in innovation and in this perspective their partners have less need to invest in internal R&D*

- ✓ *ability to reduce the risks of open innovation by ensuring technology transfer but also by providing innovative services through close interaction with their partners*

- ✓ *representing an advanced type of innovation intermediary that is able to create and transfer new knowledge in a dynamic way and catalyze the innovation process*

## 5.2 Practical Implications

### 5.2.1 Managerial Implications for RTOs

Our results give valuable lessons for the management of RTOs as they propose the development of service innovation capabilities within the specific context. More specifically, we argue that our research provides a starting point for assessing the maturity level of RTOs, as far as their service innovation capabilities are concerned. The capabilities mapping that was presented in Paper 2, as well as the seven capabilities for reinforcing creativity in service innovation, can be used as effective tools towards this direction. Due to their practice-based perspective, our results can be used as a means of evaluation of the service innovation capabilities within RTOs, in order to identify relevant strengths and weaknesses. Such an overview could be the trigger and a sound basis for building and supporting an effective strategy for reinforcing the service innovation development, making RTOs more competitive for their industrial clients, as suggested by recent literature (Rincón-Díaz & Albors-Garrigós 2013).

Moreover, the comparative analysis of RTOs vis-à-vis universities could also give valuable lessons to the managers of RTOs. By understanding what makes their organizations unique in their service offering, they can put more focus in advertising the competitive advantage of RTOs for its customers. The capabilities of RTOs in service innovation - especially in the era of tertiarization of the economy - and in the co-development of new knowledge due to its customer-centric mentality and the relational capabilities make RTOs an efficient and highly competitive partner in innovation. A partner that can provide the benefits of research novelty without the risks of cultural gap and differences in collaboration incentives; like the ones universities are very often accused to involve. In this perspective our research offers insights for building a concrete and sound strategy for RTOs with a clearer and more proactive marketing approach (Arnold et al. 2007).

### 5.2.2 Managerial Implications for the industry

Managers are becoming increasingly interested in the open innovation paradigm (Ramos et al. 2009). In this perspective, the pursuit of the suitable partner is a challenging matter. Our research has revealed valuable knowledge regarding the role of RTOs in open service innovation and therefore it provides helpful information to companies that are interested in opening up their innovation process. The choice to collaborate with a public research institution is not always easy and straightforward. The differences in mentality between academic/researchers and business people is inevitable due to the different culture and incentives to do R&D (as we

have already seen before). But all public research partners are not the same as widely be-lieved. Our results can therefore help the business community understand that RTOs can be an efficient partner in innovation which has the service innovation capabilities to support their innovation process, in a business-like way, but at the same time offering a window to the pub-lic research landscape with all its related benefits (novel technologies, public funding oppor-tunities, visibility etc.).

Moreover, we also argue that our results are relevant for potential competitors of RTOs such as KIBS, consultancies or even universities (rather their TTOs or related technology transfer structures). The managers of these organizations may learn a lot from the results of this study, especially as far as the service innovation capabilities development is concerned. Our capabil-ities mapping could serve as a grid that can be adapted in other business functions. In the same perspective, the seven proposed capabilities for reinforcing creativity can be applied to any organization that would like to benefit from the creative but still innovative environment of RTOs. Finally, as universities aim more and more to excel in their third mission they can also get lessons from the results of our work in order to identify ways of being more profi-cient in applied research, being more customer-oriented and in this perspective more market-pull than technology-push in their collaborations with the industry.

### 5.2.3 Policy Implications

We believe that our study offers important implications for policy makers as well. We have seen that RTOs represent and important public policy tool for supporting industrial innovation and economic growth (Mrinalini & Nath 2000; Barge-Gil & Modrego-Rico 2008; Gulbrandsen 2011; Sharif & Baark 2011). Therefore the results of this study can provide val-uable lessons for better supporting and better positioning RTOs in the innovation systems. In a time where financial resources are scarce and public funding is valuable, addressing issues of overlapping activities between RTOs, universities and/or TTOs in the public research-industry relationships seems very relevant. In the same perspective, we could also wonder whether it makes sense, for instance, to have RTOs and universities compete for the same funds.

Howells et al. (2012) question how well can universities support their new role of moving closer to the industry, through active commercialization of the university's research outcomes and whether public policy has equiped them accordingly. But if RTOs can bridge efficienty the gap between research and industry, then one could wonder what is the purpose of moving

also universities closer to the industry. The new knowledge economy needs clear roles between the multiple actors in the national innvoation systems (Metcalfe 2010). In this perspective, policy makers need to reflect on whether it is worth spending valuable resources in making universities adopting a role that does not seem to be fully compatible with their primary mission of education and research. Otherwise, we run the risk of universities having to make choices among their different roles and between a market pull against a science push perspective, in order to remain viable.

In this perspective, policy makers have to consider the benefits and the risks of such a choice. Can we afford to end up with a university that moves steadily towards commercialization? And what are the implications for basic research and scientific advancement in this case? Instead of pushing universities to maintain costly TTOs, shouldn't policy makers take advantage of RTOs by better linking them to university, e.g. through more joint activties, shared facilities (as it is already the case in some countries)? As a result, policy makers need to be able to clearly define and support the different roles of the RTOs vis-a-vis universities in the open innovation landscape, but also emphasize the benefits of their complementary nature.

## 5.3    Further research avenues

### 5.3.1    Replication with more case studies and/or in another context
In our first empirical part (i.e. case studies) we employed a grid for identifying capabilities within selected RTOs. This grid served as our questionnaire guide which was flexibly adapted according to the specificities of each organization and interviewee profile. We believe that this broad grid, or parts of it, can be further elaborated to create a survey questionnaire to study the development of service innovation capabilities. This questionnaire could be employed in the context of other RTOs or other service innovative organizations (such as KIBS) in order to study the development of service innovation capabilities. Nevertheless, the analytical generalizability and the transferability of our results to other contexts needs to be made with caution and following Yin's recommendations (Yin 2009). Contextual factors should also be taken into account when trying to apply our results to other contexts such as other knowledge-intensive organisations.

In terms of comparisons, and since these have rarely been done (Vivas & Barge-Gil 2015), it would be interesting to replicate the study by comparing RTOs with other knowledge sources; e.g. the CIS survey includes other types of knowledge sources such as consultants or suppliers. As we have seen, RTOs have a hybrid nature (Berger & Hofer 2010; Gulbrandsen 2011)

that allows them to place one foot in the public research and one in the business landscape. Therefore it would also be interesting to compare them with business-type partners (such as consultancies or suppliers) in the context of open innovation.

Finally, the European character of the study raises cultural or national specificity issues, especially since RTOs seem to be very dependent on the national governments and their respective innovation policies and strategies, but also to national industry and their needs (Gulbrandsen 2011; Readman et al. 2015). Therefore, it would be interesting for example to replicate our study in the Asian (case of developing economies) or American (more maturity from both RTOs and universities in the commercialization aspects) RTOs, in order to study their special characteristics and innovation capabilities, but also how they compare to the local universities. In this perspective, comparisons among the different continents could give interesting messages especially for policy makers. Within Europe, though, we argue that we provide a quite satisfactory level of diversity as we cover different in size countries and from different parts of Europe.

### 5.3.2 The role of RTOs in bringing more openness to innovation and the implications for their Intellectual Property management

We have seen that the innovation model of RTOs is particularly open, as this is their mission, and as a result there would be no place and no reason for them to exist in a closed innovation model. In fact we can argue that their role lies even beyond the open paradigm and reaches the boundaries of open source innovation, which represents the application of open source perspective in open innovation (Pénin 2011). RTOs are engaged in openness and interactivity and therefore it would be interesting to understand what the role of RTOs in open source innovation could be. In the same perspective, the role of RTOs bridging the open innovation and open science - as mentioned by Chesbrough (2015) - could also be further examined. Of course, we could relate this new role of RTOs to open social innovation (Chesbrough & Di Minin 2014) as well. In fact, some science and public policy studies have addressed the determinants of societal impact, mostly rooting it into universities' characteristics and public research (Bornmann 2014), whereas a handful of other studies of societal impact mostly refer to approaches developed by practitioners (Ebrahim & Rangan 2014). The role of RTOs, in these challenging times, can be catalytic in bringing the two approaches together.

Naturally, all the above raise questions regarding the management of the Intellectual Property (IP) of RTOs. Of course, this is not a new discussion as the open source software has triggered research on the field of effective IP management (e.g. the studies of (Hippel & Krogh

2003; Lakhani & von Hippel 2003; Harison & Cowan 2004; Blind et al. 2006)). The hybrid nature of RTOs, supported by their mixed funding and their interactivity with both private and public actors, makes it even more difficult to find a balance between openness and disclosure. We have seen for instance earlier, that RTOs have different choices of intellectual property management practices, such as: *the open science-, licensing- and innovation- model* (Young et al. 2008). But what is the optimal balance among these strategies that can be beneficial for RTOs (in order to sustain their profitability and viability), their industrial partners but also society (Hippel & Krogh 2003)? In this perspective, future research could look into the specific IP management capabilities (Ayerbe et al. 2014) that RTOs have to develop in order to effectively manage their IP in the current complex open innovation landscape.

### 5.3.3 *The role of RTOs in supporting entrepreneurship*

Another research standpoint that may arise from this research is the role of RTOs in strengthening entrepreneurship; especially in the European context where there is a need in these economically turbulent times to support innovation and entrepreneurship as a lever for stimulating employment and sustainable growth (Curley & Formica 2013). Indeed, discussions about academic entrepreneurship as a privileged mode of technology transfer and business creation in Europe (Mustar 1997; Clarysse et al. 2005) have been already launched despite the fact that the academic turn towards entrepreneurship (Etzkowitz 1998; D'Este & Perkmann 2011) only recently started in Europe compared to USA (Czarnitzki et al. 2012). It is indeed one of the roles of RTOs to support entrepreneurship through the creation of spin-offs in business incubators. Nevertheless, we have not seen any research addressing the impact of these entrepreneurial activities of RTOs on specific industries or on the growth and productivity of the European economy. Consequently, we need to understand what the role of RTOs in national and European entrepreneurship is, also in relation to universities and firms, in order to be able to develop the effective structures and mechanisms in supporting this potential entrepreneurial role of RTOs.

### 5.3.4 *The internationalization of RTOs: is it feasible?*

The internationalization of RTOs is also a subject that requires more attention as it has already been mentioned by previous literature (Berger & Hofer 2010; Loikkanen et al. 2011). Berger and Hofer (2010) argue that only a few RTOs have gone down the road of internationalization at least in a business-way; they are merely doing some international joint research or attracting EU-level funding. The authors argue that this might be due to two reasons: (i) there

are following a staged way to internationalisation and (ii) they are too much dependent on governmental funding that keeps them tight to national markets. Future research needs to give more attention on these aspects. Therefore we need to know if some RTOs follow this road and if yes what are their motives and what kind of strategies they are using in order to succeed in it. Is it through extensive marketing campaigns to attract specific customers in a consultancy type of way, or is it through partnerships with universities outside their national borders, or through international networks?

Moreover, the open innovation paradigm does not imply that openness should be merely national. In the era where internationalization trends touch even the public sector, such international perspectives should not be a taboo for RTOs either. Nevertheless, the benefits versus the risks of such an internationalization process of RTOs need to be thoroughly studied by researchers, in order to understand if it makes sense for RTOs to move to more international markets. Is it a part of their transformation process that could be an answer to reduced governmental or even national industrial funding? What is the right balance between national and international activities? Certainly the respective implications on the position, the mission and the role of RTOs in the national innovation systems would a very interesting field of study for future research.

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# APPENDIX A – RTOs case studies description (anonymized)

| RTO | Brief (anonymized) case description |
| --- | --- |
| **Alpha** | RTO Alpha is a European organisation that has about two thousand employees with various research focus areas such as materials, energy, information and communication and electronics, among others. RTO Alpha has recently put strategic focus on services. The organisational design of this research centre is carefully deployed with an aim to address and balance its different functions; namely R&D, contract and applied research. |
| **Beta** | RTO Beta has a very good reputation in the country in which it operates. It employs thousands of researchers working in very different knowledge domains, working in different locations, including some foreign offices. Different parts of the organisation focus on different topics and cooperate strongly with different universities. As RTO Beta is a very large and diverse organisation, we focused our research on one independent institute which is financially, strategically and geographically independent from other organisational parts. We have selected the one concerned the most with service innovation. |
| **Gamma** | RTO Gamma employs several thousand people, recently reorganized along research topics and expertise areas. The organisation has also recently introduced a new strategy, in which the main focus is to increase impact (on both the industry and society) through demand-driven research. Besides the research activities, RTO Gamma also focuses on incubating and spinning off new companies through an associated business structure. There are multiple locations in the country and some satellite offices abroad. |
| **Delta** | RTO Delta employs several hundreds of researchers and R&D engineers and has very strong links with the local industry. It is a multinational, project–based organization which puts a lot of focus on service innovation through a living lab approach with its diverse partners and stakeholders. The "overall mission" of the RTO Delta is to deliver "service science-based service innovation for the benefits of the public and private stakeholders as well as for policy decision makers". |

# APPENDIX B – Target interviewee profiles

| Position | Profile Description |
|---|---|
| Top management team member | A person from the top management who has a strategic view and can explain its implementation as well as the vision of the organization regarding service innovation. |
| Business unit manager | Medium level management responsible for the human resources management in the specific department or unit dealing with the development of new services. |
| Service department / service portfolio / service line manager | Responsible for the development of specific service(s) or (part of) service portfolio for the organization. A person who acts internally to develop a line of services but may have a vision of the market as well. |
| Marketing / PR / BD manager | Responsible for external relations including marketing, public relations and business development. |
| New service development project manager | Manager responsible for the development of a new service. This could be a standardized or customized project. This person has an overview of the development process and the resources that are essential in order to carry it through. He/she should also be aware of financial issues required for the specific project. |
| New service development team member / R&D engineer | Person working in a specific new service development project team, both internally and at the client site. This person is directly involved in one, more or all the stages of the development process. |
| Quality manager / Business process manager | A person who is responsible for the organizational processes, relevant documentation and improvement practices within the organization. He/she may be involved in standardization processes (such as ISO, CMMI etc.) as well. |
| Innovation manager / R&D manager / Scientific coordinator | A manager responsible for R&D or innovation strategy of the organization. We consider this person to be in a position to drive the organization's decisions about service innovation. He/she could also be the connecting point with academia (joint projects, doctoral and scientific training, etc.). |
| Knowledge manager | Person responsible for knowledge management in the broad sense e.g. best practices guide, project databases, qualifications repositories, IP management, knowledge sharing culture and strategy, knowledge champions and maps, external knowledge sharing and co-creation. |
| IT manager | Responsible for Information and Communication Technology provided as part of the service (he/she could also be involved in back-office support but not as the main task). |

**APPENDIX C - The capabilities mapping coding grid and interviews guide (exemplar presented)**

**Framework reference**

| Context | | Resources | | | | | | NSD process | | | | | | Interview guide [long-list of questions to be adapted to specific interviewers and interviewees] | Top manager | Middle manager / HC | Service portfolio / service line | Marketing / PR / BD / CRM | NSD project manager | NSD team member | Quality manager / BPM | Innovation manager / R&D | Knowledge manager | IT manager | Secondary data | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Environment | Organization | Human Capital | Organizational | ICT | Relational Capital | Experience Base | Service Portfolio | Design | Analysis | Development | Launch | Capability | Practice | | | | | | | | | | | | | |

**Introductory questions**

| | | | | | | | | | | | | | | | Could you please shortly describe your role ad responsibilities in the organisation? | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | Practice |
| | | | | | | | | | | | | | | | What is your role in service innovation, and specifically in new service development? | ? | √ | √ | √ | √ | √ | √ | √ | √ | √ | | Practice |
| | √ | | | | | | | | | | | | | | What is the organisational structure of your RTO? (probably answer based (also) on documentation analysis) How is distributed across different locations? | √ | √ | | | | | | | | | √ | Practice |
| | √ | | | | | | | | | | | | | | What is the autonomy of different locations? | √ | √ | | | | | | | | | √ | Practice |

**Defining service innovation strategy**

**External environment**

| | | | | | | | | | | | | | | | How does your organisation position itself in comparison to other RTOs? E.g. do you carry out benchmarking to keep up with the competition? (probably answer based (also) on documentation analysis) | √ | √ | √ | √ | | | | √ | ? | | √ | Kianto (2008) |

| | Question | | | | | | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| √ | What is the funding structure of your organisation? Who are your key clients? (probably answer based (also) on documentation analysis) | √ | √ | √ | √ | | | | | | | √ | Farina & Preissl (2000) |
| √ | Who are the main external actors influencing your organisation? (e.g. academia, industry and government) | √ | √ | ? | √ | | | | √ | | | | Practice |
| √ | How does government influence your organisation, including your strategy? Please explain which mechanisms does government us to support or control the organisation? (e.g. funding, support, KPIs, requirements) | √ | √ | | √ | | | | √ | | | | Hales, 2001, as cited in Berger and Hofer |
| √ | How does industry influence your organisation, including your strategy? E.g. Is your organisation part of industry associations in which decisions are taken that influence your strategy? Or (how) do your clients influence your strategy? Are you part of any strategic alliances? | √ | √ | | √ | | | | √ | | | | Preissl, 2006 |
| √ | How does academia influence your organisation, including your strategy? E.g. how do you collaborate with universities, how do new scientific developments influence your strategic directions | √ | √ | | √ | | | | √ | | | | Preissl, 2006 |
| √ | (How) does your organisation position itself in terms of interface between the academia and industry? In which way (if at all) does it influence the innovation systems in the economy? | √ | √ | | √ | √ | | | √ | | | | Practice |

## Service Innovation Strategy Objectives

| Category | Requirement | Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *How do you cooperate with other RTOs? E.g. is your RTO part of any strategic alliances with other RTOs?* | √ | √ | ? | ? | √ | | √ | ? | Practice |
| | | *What is the mission of your organisation? (probably answer based (also) on documentation analysis)* | √ | √ | | | | | √ | | Practice |
| | | *What is the vision of your organisation? (probably answer based (also) on documentation analysis)* | √ | √ | | | | | √ | | Practice |
| | | *What is the strategy of your organisation? (probably answer based (also) on documentation analysis)* | √ | √ | | | | | √ | | Practice |
| | | *What is the origin of your strategic choices?* | √ | √ | | | | | | | Practice |
| Service innovation strategy | Service innovation strategy objectives are explicitly mentioned in the strategy | *Are your service **innovation** strategy objectives explicitly mentioned in your strategy?* | √ | √ | √ | √ | | √ | | √ | Lawson & Samson (2001) |
| | Service innovation strategy objectives are well communicated through the broad organisation | *Are your service innovation strategy objectives communicated to the broad organisation? How? (what communication mechanisms are used?)* | √ | √ | | | | √ | | | Kianto (2008) |
| **Sustainable** service innovation strategy | Service innovation strategy objectives include the objective of continuous service innovation | *Does your strategy explicitly focus on the continuity/sustainability of your service innovation? Please give the explicit example* | √ | √ | √ | | | √ | √ | | Practice |
| **Sustainable** service innovation strategic framework application | Define service value related to the opportunity identification activities | *Do you, on strategic level, have a specific plan on how to identify opportunities?* | √ | √ | ? | | | √ | | | Absil et al. (2008), Bernacconi et al. (2008) |

| | Item | Question | | | | | | | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Define service design, meaning the definition of the services functional characteristics | *Do you, on strategic level, define service design, meaning the definition of the services functional characteristics?* | √ | √ | ? | | | | | √ | | | Absil et al. (2008), Bernacconi et al. (2008) |
| | Define service exposition, which is related to the promotion activities | *Do you, on strategic level, perform promotion activities for your services? E.g. do you have ISO or other certifications? Do you use them for the promotion activities?* | √ | √ | √ | √ | | | | √ | | | Absil et al. (2008), Bernacconi et al. (2008) |
| | Manage the service by providing tools for monitoring and measuring the performance of the service | *Do you have tools for monitoring and measuring the performance of the services you provide?* | √ | √ | √ | | | | | √ | | | Absil et al. (2008), Bernacconi et al. (2008) |
| | Practice service capitalisation which covers the activities related to the collection and analysis of assesment data | *(How) do you use the results of this measurement? Do new services emerge from this process?* | √ | √ | √ | | | | | √ | | | Absil et al. (2008), Bernacconi et al. (2008) |
| Sustainable service innovation monitoring and measurement | Results are monitored on the aggregate level of top management | *How do you monitor the results of service innovation (on the top management level?)* | √ | √ | √ | | | | | √ | | | Practice |
| | Innovation performance indicators and are in place | *Do you have explicit KPIs for service innovation performance? (probably answer based (also) on documentation analysis)* | √ | √ | √ | | | | | √ | | | Practice |
| | Focus on both "exploitation" ("insight"/"mainstream"/"reinforcement"/"incremental innovation") and "exploration" ("foresight"/"newstream"/"transformation"/"radical innovation") | *What is the focus of your KPIs (e.g. efficiency and effectiveness, such as "bring out services faster than competitors", versus quality, flexibility and innovativeness)?* | √ | √ | √ | | | | | √ | | | Boer and Gertsen (2003); Corso (2002); Lawson & Samson (2001); Subramanian & Youdt (2005); Zhou and Wwei (2010); Schang et al. (2002) |

| | | | Questions | Refs |
|---|---|---|---|---|
|  | Adapting service innovation strategy to results of the monitoring | *What is the focus of top management: optimising current innovation efforts or identifying new opportunities outside of the current innovation activitie ?* | √ √ √       √ | Boer and Gertsen (2003); Corso (2002); Lawson & Samson (2001); Subramanian & Youdt (2005); Schang et al. (2002) |
| | | *How do you adjust service innovation strategy to the results of this monitoring?* | √ √ √       √ | Practice |
| | | *Can one NSD project influence the service innovation strategy? How? Please give us an example* | √ √ √       √ | Practice |
| | Strategy is adapted to (mostly government's) requirements as far as economic, ecological and social impacts are concerned | *What are the environmental, social or economic constraints that are posed on your organisation? Please give examples. How does your organisation contribute to sustainable development?* | √ √   √     √ | Foxon and Andersen 2009 |
| | | *How are economic, ecological and social responsibility requirements translated into your service innovation strategy? E.g. are you focused on providing services in environmental or social areas (green energy, fair trade)? Are you promoting sustainability as a way of working in your own organisation (e.g. printing less, travelling less)* | √ √ √ √     √ | Foxon and Andersen 2009 |
| | | *How do you perceive the double meaning of the word "sustainability"? (continuous versus responsible) Do you think that the two sides of sustainability are enforc-* | √ √ √ √     √ | Practice |

| | | | | | | Question | | | | | | | | | | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*ing each other or are contradictory in case of your organisation?*

*Does your organisation have a Sustainability Report and/or use Sustainability KPIs?* — √ √ √ √ √ √ — Practice

## Implementing service innovation strategy

| | | | | | | | | | | | | | | Question | checks | Source |

√ ... √ — *What services does your organisation currently provide?* — √ √ √ √ √ √ √ — Practice

√ ... √ — *Are these general offerings or customised services for specific clients?* — √ √ √ √ √ √ √ — Practice

√ ... √ — *How are the services provided chosen from a strategy point of view?* — √ √ — Practice

√ ... √ — *How many services have you developed this year? (radical vs. incremental)* — √ √ √ √ √ — Practice

√ ... √ — *What is the plan for next year in terms of number of services to be developed (radical vs. incremental)* — √ √ √ √ √ — Practice

***Do you have a formalised new service development model? Or, do you for example use a new product development model for your processes?*** — √ √ √ √ √ √ √ √ √ ? — Zhou and Wwei (2010); Barlatier et al. (2010); Kianto (2008)

*Could you very shortly describe your new service development model? Is it linear or are different steps intertwined?* — √ √ √ √ √ √ √ — Toivonen & Tuominen (2006)

Strategic alignment of NSD process | The way in which NSD projects are managed is directly derived from and consistent with the strategy | *Is your new service development process in line with the service innovation strategy? (e.g. if your strategy states that service innovation process should be very fast* — √ √ √ √ — Practice

| | | | | | | | | | | | Criterion | Description | Question | | | | | | | | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | *and flexible, the underlying NSD process should be adequate, meaning including limited number of stages, limited bureaucracy etc.)* | | | | | | | | | | |
| | | | | | | | | | | | New service development process is adapted to economic, ecological and social impacts requirements | *(How) does the new service development process take into account the social, economic and environmental requirements of sustainability? (both in terms of providing sustainability services and in terms of working in a sustainable way)* | | | | √ | √ | √ | | | | |

**Design Stage** — *How are new services designed?* (√ √ √ √ √ √ √)

| Criterion | Description | Question | Source |
|---|---|---|---|
| Strategic definition | Define and communicate goals for the new service concept | *(How) are the goals for the new service concept defined and communicated?* | Froehle and Roth (2007) quoting: Meyers (1984); Bitran and Pedrosa (1998) |
| Diverse creativity | Cultivate and utilize a variety of sources for new ideas | *What sources are used for new ideas? Is diversity valued?* | Froehle and Roth (2007) quoting: Loch et al.(1996); de Brentani (1989) |
| Idea generation | Develop both formal and informal methods of generating new service ideas | *What methods are used for new service idea generation?* | Froehle and Roth (2007) quoting: Reidenbach and Moak (1986); de Brentani (1989); Thwaites (1992) |
| Employee design input | Actively consider ideas and suggestions from employees for new service ideas and improvements | *Are ideas and suggestions from employees concerning new services actively considered and rewarded?* | Froehle and Roth (2007) quoting: de Brentani (1989,1995); Zhou and Wwei (2010) |

Left-side marks:
- Strategic definition: √ √ √ √ √ √ ? √ √
- Diverse creativity: √ √ ... √
- Idea generation: √ √ ... √
- Employee design input: √ ... √

Right-side marks:
- Strategic definition: √ √ √ √ ?
- Diverse creativity: √ √ √ √ √ √ √
- Idea generation: √ √ √ √ √ √ √
- Employee design input: √ √ √ √ √ √ √

| | √ | | √ | √ | √ | √ | | √ | √ | | | Signalling user needs / client design input / Client focus | Emphatically understand users and sense their (potential) needs well in advance by interacting intensively with (potential) clients / Gather input from clients during initial conceptualization of the new service / Focus on meeting the needs of a specic client or market segment during initial conceptualization of the new service | *How are new user needs signalled in the design stage of the NSD?* | | | ? | √ | √ | √ | | √ | ? | | | Den Hertog et al. (2010), quoting Teece (2007: 1326), Wang and Ahmed (2007: 37), Bruni and Verona (2009: 107); Lawson & Samson (2001); Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996); Cooper et al.(1994); Bitran and Pedrosa (1998); Goldstein et al.(2002); Froehle and Roth (2007)quoting: Hedvall and Paltschik (1991); Cooper et al.(1994); Kianto (2008); "The agency of users does not mean that they should be considered as equal partners with designers. However users can be a source of learning and a source of innova-tions and product improvements" (Kaasinen et al., |

2010, p.47); "In today's competed and changing market situations, one promising way to support market success is innovations originating from the needs of the customers. Service orientation in business changes the connection to the customers. The service and its tangible elements together create the overall customer experience. It is not enough to be able to sell the product to the customer once but the service customer has to be kept satisfied every day. This requires a firm connection to the customer and ways to monitor customer experiences. Service providers need to know their customers better and offer

them better pos-
sibilities to be
involved in ser-
vice develop-
ment." (Kaasinen
et al., 2010, p. 52)

E.g.: dialogs with lead users,

*e.g. do you have regular dialog
with lead users about their needs?*

Den Hertog et al.
(2010); Lawson &
Samson (2001)

| | | | | | | | | | | | | | | Name | Practice | Question | | | | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | account management systems, | e.g. do you use account management systems for getting to know client needs? | | | | | | | | | | | Den Hertog et al. (2010) |
| | | | | | | | | | | | | | | | client profiling, | e.g. do you do client profiling to discover client needs? | | | | | | | | | | | Den Hertog et al. (2010) |
| | | | | | | | | | | | | | | | detailed analysis of how current services are used, | e.g. do you perform analysis of how current services are used tin order to better design the service? | | | | | | | | | | | Den Hertog et al. (2010); Lawson & Samson (2001) |
| | | | | | | | | | | | | | | | trend analysis in client groups | e.g. do you perform trend analysis in client groups to discover client needs? | | | | | | | | | | | Den Hertog et al. (2010) |
| √ | | √ | √ | √ | √ | ? | √ | √ | | | | | | Client concept feedback | Obtain client feedback on the initial new service concept prior to beginning formal design | (How) is the client feedback on the initial new service concept received prior to beginning formal design? | | | | | √ | √ | √ | | ? | | | Froehle and Roth (2007)quoting: Cooper and de Brentani (1991); de Brentani (1995); Goldstein et al.(2002) |
| √ | | √ | √ | √ | √ | ? | √ | √ | | | | | | Alliance design input | Present the initial new service concept to partners for early feedback and input prior to beginning | (How) is the initial new service concept presented to partners for early feedback and input prior to the beginning of the design? | | | | √ | √ | √ | √ | | ? | | | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996); Loch, Stein, and Terwiesch (1996) |
| √ | | √ | √ | √ | √ | | √ | √ | | | | | | Signalling new technological options | Make sure to be informed about the latest options that technologies offer in the concerned and related industries | (How) are emerging technological options monitored and signalled? | √ | √ | √ | √ | √ | ? | | √ | | | Den Hertog et al. (2010) quoting Kindstrom et al. (2009: 336) and Teece et al. (2007: 324) |
| √ | | √ | √ | √ | √ | ? | √ | √ | | | | | | Development motivation | Ensure that the new service concept meets real client or business need (versus just using the latest technology) | (How) do you ensure that the new service concept meets real client or business need (versus just using the latest technology)? | | | √ | √ | √ | | | √ | | | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996) |

| | Stage / Activity | Description | Question | | | | | | | | | | | | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Reflecting / monitoring — Deliberately monitor and reflect on the way Design Stage of the NSD process is managed

*Who and how (if at all) monitors the way in which design of a new service is managed? (e.g. by asking: "What have we learned from our latest set of service experiments?", "Are we experimenting enough with new revenue models?", "How can we make sure we generate enough cues for service innovation?")*

Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007)

Adapting — Adapt the way Design Stage of the NSD process is managed, based on results of reflection

*(How) are the conclusions from this monitoring actually adapted in the way design process of a new service is managed in general, i.e. for other services? (e.g. change of the procedure, change of the involved resources etc.)*

Den Hertog et al. (2010)

**Analysis Stage**

*How are new services analysed?*

Idea evaluation — Develop both formal and informal methods of evaluating new service ideas

*What methods are used for new service idea evaluation?*

Froehle and Roth (2007)quoting: de Brentani (1995); Cooper and de Brentani (1991)

Financial analysis — Analyze the financial/economic viability of the new service concept prior to beginning formal development

*(How) is the financial/economic viability of the new service concept analysed prior to beginning formal development?*

Froehle and Roth (2007)quoting: Cooper and de Brentani (1991);de Brentani (1995,1989); Edvardsson and Olsson (1996);Reidenbach and Moak (1986)

| | Term | Description | Question | | Reference |
|---|---|---|---|---|---|
| √ ... √ | Project authorization | Formally approve and authorize the new service development project | *(How) is the new service project formally approved and authorised?* | √ √ √ √ √ √ | Froehle and Roth (2007)quoting: Meyers (1984) |
| √ √ √ √ √ ? ... √ | Competitor analysis | Analyze and consider competitors'strategies and services when evaluating the viability of the new service concept | *(How) do you analyze and consider competitors' strategies and services when evaluating the viability of the new service concept?* | √ √ √ √ √ | Froehle and Roth (2007)quoting: Meyers (1984), Roth and Jackson (1995), Cooper et al. (1994), Roth (1993), Thwaites (1992), de Brentani (1989), Edvardsson and Olsson (1996); Lawson & Samson (2001); Kianto (2008) |
| √ √ √ √ √ ? √ ... √ | Market research | Perform an in-depth market analysis to help define the initial new service concept prior to beginning formal design | *(How) do you perform an in-depth market analysis to help define the initial new service concept prior to beginning formal design?* | √ √ √ √ √ | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996), de Brentani (1989, 1995), Cooper et al.(1994), Cooper and de Brentani (1991); Kianto (2008) |
| √ ... √ | Product line analysis | Analyze existing service line to identify synergies and conflicts with the new service concept | *(How) do you analyze existing service line to identify synergies and conflicts with the new service concept?* | √ √ √ √ √ √ | Froehle and Roth (2007)quoting: Bitran and Pedrosa (1998); Evangelist et al.(2002) |
| √ √ ... √ | Reflecting / monitoring | Deliberately monitor and reflect on the way Analysis Stage of the NSD process is managed | *Who and how (if at all) monitors the way in which analysis of a new service is managed?* | √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |

**Development Stage** — How are new services developed?

| | | | Concept/Question | | References |
|---|---|---|---|---|---|
| √ √ √ √ √ √ √ | Adapting | Adapt the way Analysis Stage of the NSD process is managed, based on results of reflection | *(How) are the conclusions from this monitoring actually adapted in the way analysis process of a new service is managed in general, i.e. for other services? (e.g. change of the procedure, change of the involved resources etc.)* | √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |

**Development Stage**

*How are new services developed?* — ? √ √ √ √ √ √

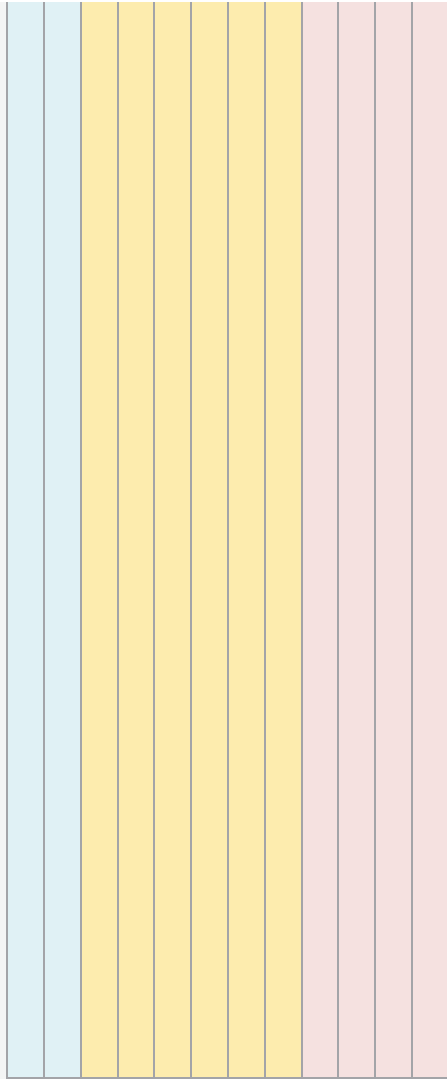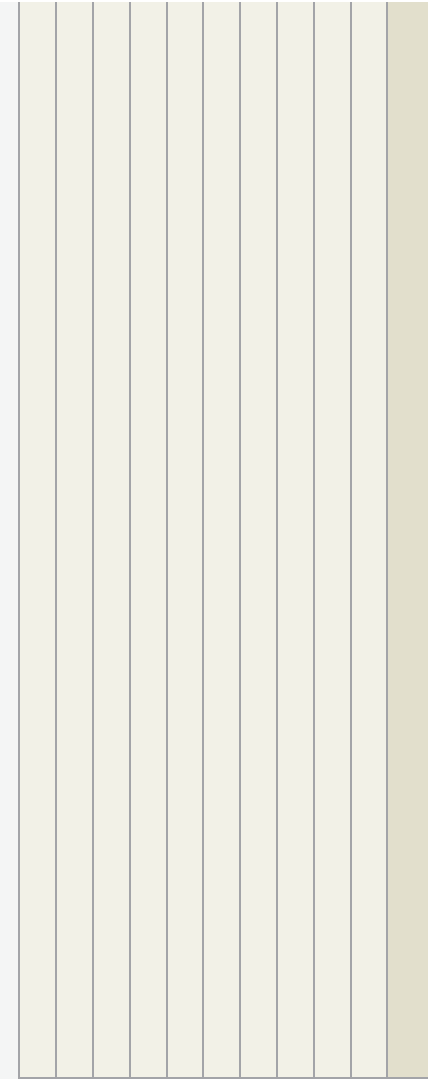| | | | | | |
|---|---|---|---|---|---|
| √ √ √ √ √ √ | Signalling user needs | Emphatically understand users and sense their (potential) needs well in advance by interacting intensively with (potential) clients | *How are new user needs signalled in the development stage of the NSD?* | ? √ √ √ √ | Den Hertog et al. (2010), quoting Teece (2007: 1326), Wang and Ahmed (2007: 37), Bruni and Verona (2009: 107); Zhou and Wwei (2010) |
| | | E.g.: dialogs with lead users, | *e.g. do you have regular dialog with lead users during development?* | | Den Hertog et al. (2010); Lawson & Samson (2001) |
| | | joint experimentation and prototyping, | *e.g. do you organise joint experimentation and prototyping during development?* | | Den Hertog et al. (2010); Kianto (2008) |
| | | user panels, | *e.g. do you organise user panels to implement client needs in development stage?* | | Den Hertog et al. (2010) |
| | | detailed analysis of how current services are used, | *e.g. do you perform analysis of how current services are used for the purpose of improving the development?* | | Den Hertog et al. (2010) |
| √ √ √ √ √ | Pre-launch testing | Fully test and "debug" new service prior to launch | *(How) is the new service tested and "debugged" prior to launch?* | √ √ √ √ √ √ | Froehle and Roth (2007) quoting: Cooper and de Brentani (1991); de Brentani (1989, 1995); |

| Item | Description | Question | Reference |
|---|---|---|---|
| | | | Voss et al.(1992) |
| Prototyping tools | Use prototyping tools to test new service process/system | *Do you use prototyping tools to test new service process / system?* | Froehle and Roth (2007)quoting: Bitran and Pedrosa (1998); Cooper et al.(1994); Edvardsson and Olsson (1996); Loch, Stein, and Terwiesch (1996); Reidenbach and Moak (1986) |
| Service fail-safing | Reduce potential sources of error/variance in new service | *How do you reduce potential sources of error/variance in new service?* | Froehle and Roth (2007)quoting: Stewart and Chase (1999); Stewart and Grout (2001); de Brentani (1989) |
| Market confirmation | Conduct market tests in order to confirm the new service product is marketable, appropriately developed, and ready for launch | *(How) are the market tests performed in order to confirm the new service product is marketable, appropriately developed, and ready for launch?* | Froehle and Roth (2007)quoting: Cooper et al.(1994); Bitran and Pedrosa (1998); Reidenbach and Moak (1986) |
| Staff recruiting | Recruit and hire new front-line staff that will be needed to offer the new service offering | *Do you recruit and hire new front-line staff that will be needed to offer the new service offering?* | Froehle and Roth (2007)quoting: Bitran and Pedrosa (1998); Edvardsson and Olsson (1996) |

| | Technique | Description | "How" question | | References |
|---|---|---|---|---|---|
| √ ... √ | Staff training | Extensively train front-line staff on how to support the new service being developed | (How) is the front-line staff trained on how to support the new service being developed? | √ √ √ √ √ √ √ | Froehle and Roth (2007)quoting: Loch, Stein, and Terwiesch (1996); Cooper et al. (1994); de Brentani (1989,1995); Edvardsson and Olsson (1996); Cooper and de Brentani (1991) |
| √ ... √ | Technology development | Identify and analyze conflicts between the new service concept and currently existing IT systems | (How) are the conflicts between the new service concept and currently existing IT systems identified and analysed? | √ √ √ √ ... √ | Froehle and Roth (2007)quoting: Identified by practitioners |
| √ √ √ ... √ | Process flowcharting | Create a service "blueprint"in order to solidify the processes, people, and information flows involved in providing the new service | (How) do you create a service "blueprint" in order to solidify the processes, people, and information flows involved in providing the new service? | √ √ √ √ √ √ √ √ | Froehle and Roth (2007)quoting: de Brentani (1989,1995); Shostack (1984); Cooper and de Brentani (1991) |
| √ √ √ √ ? √ ... √ | Multilevel development | Ensure that both core and supporting services are co-developed prior to launch of the new offering | (How) do you ensure that both core and supporting services are co-developed prior to launch of the new offering? | √ √ √ √ ... √ | Froehle and Roth (2007)quoting: Bitran and Pedrosa (1998); Edvardsson and Olsson (1996) |
| √ ... √ √ √ √ ? √ ... √ | client interaction | Development the new service so that the client will have positive interactions with other elements of the service environment | When developing the service, (how) do you ensure that the client will have positive interactions with other elements of the service environment such as contact with staff, advice on demand etc.? | √ √ | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996); Bitran and Pedrosa (1998); Cook et al.(2002); Hill et al.(2002) |

| | Description | Question | | References |
|---|---|---|---|---|
| Reflecting / monitoring | Deliberately monitor and reflect on the way Development Stage of the NSD process is managed | Who and how (if at all) monitors the way in which development of a new service is managed? | √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| Adapting | Adapt the way Development Stage of the NSD process is managed, based on results of reflection | (How) are the conclusions from this monitoring actually adapted in the way development process of a new service is managed in general, i.e. for other services? (e.g. change of the procedure, change of the involved resources etc.) | √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |

**Launch Stage**

| | Description | Question | | References |
|---|---|---|---|---|
| | | *How are new services launched?* | ? √ √ √ √ √ √ | |
| Formalized launch | Develop and implement a detailed program to launch new service | To what extent is the launch of the service formalized? | √ √ √ √ √ √ | Froehle and Roth (2007) quoting: de Brentani (1989,1995); Cooper and de Brentani (1991); Reidenbach and Moak (1986) |
| Formalized promotion | Implement a detailed promotional program for the newly introduced service | To what extent is the promotion of the service formalized? | √ √ √ √ √ √ | Froehle and Roth (2007) quoting: de Brentani (1989,1995), Cooper and de Brentani (1991), Reidenbach and Moak (1986); Zhou and Wwei (2010) |
| Expectation setting | Establish realistic expectations in your clients for the newly introduced service through appropriate marketing | How do you manage client expectations? (i.e. do you ensure expectations set are realistic?) | √ √ √ √ √ | Froehle and Roth (2007) quoting: Edvardsson and Olsson (1996) |
| client training | Train new clients how to use newly introduced service | (How) do you train new clients how to use newly introduced ser- | √ √ √ √ | Froehle and Roth (2007) quoting: |

|  | Stage | Description | Question |  | References |
|---|---|---|---|---|---|
|  |  |  | *vice?* |  | Edvardsson and Olsson (1996); Bitran and Pedrosa (1998) |
| √ √ √ √ ? √ ... √ | Internal promotion | Market and promote the new service to front-line employees and others involved in supporting it | *(How) do you market and promote the new service to front-line employees and others involved in supporting it?* | √ √ √ | Froehle and Roth (2007) quoting: Cooper and de Brentani (1991); Voss et al.(1992); Edvardsson and Olsson (1996); Cooper et al.(1994); de Brentani (1989,1995) |
| √ √ √ √ ? √ ... √ | Post-launch evaluation | Formally evaluate the development and introduction of new service after launch | *(How) do you evaluate the development and introduction of new service?* | √ √ √ √ √ √ √ √ | Froehle and Roth (2007) quoting: Voss et al.(1992); de Brentani (1989,1995) |
| √ √ ... √ | Reflecting / monitoring | Deliberately monitor and reflect on the way Launch Stage of the NSD process is managed | *Who and how (if at all) monitors the way in which launch of a new service is managed?* | √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| √ √ √ √ ? √ ... √ | Adapting | Adapt the way Launch Stage of the NSD process is managed, based on results of reflection | *(How) are the conclusions from this monitoring actually adapted in the way launch process of a new service is managed in general, i.e. for other services? (e.g. change of the procedure, change of the involved resources etc.)* | √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |

**Other questions on NSD in general**

| Dimension | Sub-dimension | Description | Question | | Source |
|---|---|---|---|---|---|
| | Innovation is perceived in a broader level than NSD | Different NSD projects are managed within a common innovation framework which allows one NSD project to benefit from other NSD projects | How often and in what circumstances does it happen that one NSD project in specific development phase benefits from another NSD project carried out at the moment, but maybe being in another development phase (please give examples)? Is this process of cooperation between different projects somehow consciously monitored and managed? | √ √ √ √ √ √ ? √ √ | Corso (2002) |

**Organising service innovation strategy**

| Dimension | Sub-dimension | Description | Question | | Source |
|---|---|---|---|---|---|
| Resources | | | *What resources are available and used for the NSD process? (please define what you consider to be key resources)* | √ √ √ √ √   √ √ √ √ | Froehle and Roth (2007); Zhou and Wwei (2010); Lawson & Samson (2001) |
| | Strategic alignment of resources | The management of resources for the service innovation purpose is directly derived from the strategy | *When you choose your strategy/NSD project do you already know if you will have resources to implement it?* | √ √ √ √ √   √ | Practice |
| | | | *Does your strategy explicitly define how your resources should be used for the NSD process?* | √ √   √   √ | IT: Lawson & Samson (2001); Org: Zhou and Wwei (2010) |
| **Human Capital** | | | *How is Human Capital mobilized for the NSD process?* | √ √   √   ? ? | |
| | Employee recruitment and selection | Recruit and select employees who will contribute to service innovation (support the firm's new service development efforts) | *Do you have a proactive recruitment strategy? (or do you reactively recruit ad hoc?)* | √ √   √   ? | Practice |
| | | | *Do you have a slack of resources? Is it general or specific? How do you manage it?* | √ √   √   ? | Practice |

| | Concept | Description | Question | | Source |
|---|---|---|---|---|---|
| | | | How do you renew your Human Resources base (and respective capabilities)? E.g. by employing prospective Phd and PostDoc students | √ √     √     √ | EARTO (2010) |
| | | | Does the recruitment and selection process take candidate's potential for innovation (e.g. creativity, thinking out of the box) into account? | √ √     √     √ | Practice |
| √         √ √ √ √ | Employee training | Train employees and promote learning in the field of service innovation and new service development | Is there a training programme devoted to service innovation / new service development? How is learning by doing promoted? | √           √ √ √ | Practice, Kianto (2008) |
| √         √ √ √ √ | Employee motivation | Motivate staff to help support the firm's new service development efforts | Is the staff motivated to support new service developments efforts? Are emplyees empowered for innovation? If so, how? If not, why in your opinion? | √ √ √ √ √ √     √ √ | Froehle and Roth (2007); Lawson & Samson (2001); Kianto (2008) |
| √ √       √ √ √ √ | (Sustainable) innovation-oriented culture | Promote culture that supports (sustainable) service innovation | Please describe your organisational culture in the following respects: | √ √ √ √ √ √ √ √ √ √ | Kianto (2008) |
| | Ambiguity tolerance | Tolerate ambiguity | Do your managers and peers tolerate uncertainty and ambiguity in the new service development process? | √ √ √ √ √ √ √ √ √ √ | Lawson & Samson (2001); Lee & Kelley (2008); Kianto (2008) |
| | Creativity support | Promote thinking out of the box, experimentation and prototyping | Is thinking out of the box, experimentation and prototyping culturally accepted? | √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Lawson & Samson (2001); Lee & Kelley (2008); Kianto (2008) |
| | Criticism tolerance | Tolerate and encourage constructive criticism of the way things are done | What happens if somebody criticizes the current way of doing things? To what extent are "devil's advocates" and "no-sayers" ac- | √ √ √ √ √ √ √ √ √ √ | Schreyogg & Kliesch-Eberl (2007); Kianto (2008) |

| | | | Question examples | | References |
|---|---|---|---|---|---|
| | | | cepted? (How) is criticism of the established practices encouraged? | | |
| | Openness for changes | Tolerate and encourage proposi-tions of changes to improve the way things are done | What happens if somebody pro-poses to change a well established way of doing things? To what extent are "mavericks" tolerated? (How) is bringing new ideas for changing existing practices en-couraged? | √ √ √ √ √ √ √ √ √ √ | Schreyogg & Kliesch-Eberl (2007); Kianto (2008) |
| √ √ ... √ √ √ √ | Reflecting / monitoring | Deliberately monitor and reflect on the way Human Capital is managed for the NSD process? | How often, in what circumstances and who reflects on the way peo-ple and their skills are used for the NSD purpose? E.g. who asks the following questions: "are we using our people and their skills in the most efficient way when develop-ing new service?"; "Are we moti-vating and rewarding people ade-quately for their contribution to new service development?" | √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| √ ... √ √ √ √ | Adapting | Adapt the way Human Capital is managed for the NSD process based on results of reflection | (How) are the conclusions from this reflection process actually adapted to the way people and their skills are managed for the NSD process? (e.g. (how) do you change or add people to NSD, (how) do you adjust the rewards and other people management practices to better serve the NSD process? | √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |
| √ ... √ √ √ √ | Feedback from NSD to Human Capi-tal | Existing NSD projects influence the way Human Capital is man-aged | (How) do specific new service development projects influence the way people and their skills are managed? (e.g. (how) do conclu-sions from lessons learned in a specific project lead to changes in | √ √ √ √ √ √ √ √ √ √ | Practice |

**Org. Processes & Structure**

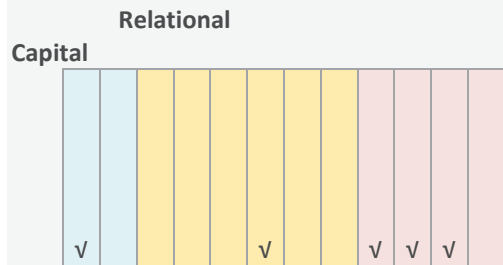| | | Prescription | Question | Checks | Reference |
|---|---|---|---|---|---|
| | | | *How does the organisational structure support the NSD process?* | √ √ √ √ √ √ √ √ √ √ | Froehle and Roth (2007); Zhou and Wwei (2010); Lawson & Samson (2001) |
| √ | √ √ √ √ | Development champion | Establish and empower a new service development "champion" to oversee and manage the firm's new service initiatives | *Is there an official position of a new service development "champion" or similar to oversee and manage the firm's new service initiatives? What is this person's role? Do you have specific structures responsible for service innovation in general? e.g. Innovation Board, Business Development departement* | √ √ √ √ √ √ √ ? | Froehle and Roth (2007)quoting: Voss et al.(1992); de Brentani (1989);; Lawson & Samson (2001) |
| √ | √ √ √ √ | Lines of responsibility | Make sure the firm's organizational structure defines lines of responsibility and authority for developing new services | *Are the lines of responsibility and authority for developing new services clearly defined?* | √ √ √ √ √ √ √ ? | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996) |
| √ | √ √ √ √ | Team development | Develop your employees' ability to work effectively in cross-functional NSD teams | *Are the new service development teams cross-functional?* | √ √ √ √ √ √ √ ? | Froehle and Roth (2007)quoting: Froehle et al.(2000), Edvardsson and Olsson (1996), Terrill (1992), de Brentani (1989), Loch et al.(1996); Zhou and Wwei (2010); Lee & Kelley (2008); |

| | Concept | Description | Question | | Reference |
|---|---|---|---|---|---|
| | | | | | Kianto (2008) |
| √ ... √ √ √ √ | Internal communication | Ensure that functional areas or departments involved in developing new services communicate effectively with each other | *How do functional areas or departments involved in developing new services communicate with each other and is this communication effective?* | √ √ √ √ √ ... √ ? | Froehle and Roth (2007)quoting: Meyers (1984), de Brentani (1989), Voss et al.(1992), de Brentani (1995), Lievens and Moenaert (2000); Lawson & Samson (2001); Kianto (2008) |
| √ ... √ √ √ √ | Managerial support | Require support from and involvement of senior management | *How does senior management support and involve in the new service development? Do they lead by example by making time for innovation themselves?* | √ √ √ √ √ ... √ ? | Froehle and Roth (2007)quoting: de Brentani (1989), Chiesa, Coughlan, and Voss (1996); Lee & Kelley (2008); Kianto (2008) |
| √ ... √ √ √ √ | Rewards structure | Base rewards on innovation criteria (performance of NSD team versus individual reward; risk acceptance versus risk avoidance; creativity) | *How is the performance of the new service development team members rewarded (what are the evaluation criteria?) Are rewards based on team or individual effort? Is risk taking rewarded or punished? Is creativity and thinking out of the box rewarded?* | √ √ √ √ √ ... √ ? | Froehle and Roth (2007); Lawson & Samson (2001); Zhou and Wwei (2010) |
| √ ... √ √ √ √ | Ensuring time for innovation | Provide employees with time for innovation | *Do employees have sanctioned time for innovation?* | √ √ √ √ √ √ ... √ √ | Lawson & Samson (2001); Kianto (2008) |

| Item | Description | Question | Source |
|---|---|---|---|
| Reflecting / monitoring | Deliberately monitor and reflect on the way organisational structure is managed for the NSD process | *How often, in what circumstances and who reflects on whether the current structure and procedures are adequate for the new service development?* | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| Adapting | Adapt the way organisational structure is managed for the NSD process based on results of reflection | *(How) are the conclusions from this reflection process actually adapted in practice? E.g. (how) is structure or team set up or a certain procedure improved to better serve the new service development purpose?* | Den Hertog et al. (2010) |
| Feedback from NSD to Organisational Processes & Structures | Existing NSD projects influence the way Organisational Processes and Structure are managed | *How do specific new service development projects influence the way Organisational Processes & Structure are managed in general? E.g. (how) do conclusions from lessons learned in a specific project lead to changes in team structure, communication lines etc.? Please give examples.* | Practice |

**Information Technology**

| Item | Description | Question | Source |
|---|---|---|---|
| | | ***How does IT support the NSD process? What kind of IT tools are used for this purpose?*** | Froehle and Roth (2007) |
| Communication enablement | Create information/telecom systems capable of enhancing communication among staff | *How do ICT tools support the communication among staff for new service development? Are the systems actually used by the staff? Are relevant IT trainings provided?* | Froehle and Roth (2007)quoting: Froehle et al.(2000); Rayet al.(2004) |
| External connectivity | Create information/telecom systems capable of enhancing communication with government, academia, industry, partners, and clients | *How do ICT tools support the communication with government, academia, industry, partners, and clients?* | Froehle and Roth (2007)quoting: Froehle et al.(2000);; Lawson & Samson (2001) |
| Physical facilities | Provide appropriate physical facilities for new service devel- | *What physical facilities (e.g. team rooms, war rooms, creativity* | Froehle and Roth (2007)quoting: |

| | | | | | | | | Practice | Description | Question | | | | | | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | opment efforts | rooms) are available for new service development efforts? Are they appropriate? | | | | | | | | | | | | Bitran and Pedrosa (1998) |
| | | √ | | | √ | √ | √ | √ | Systems compatibility | Ensure that the IT systems used by those developing new services are compatible | Are various IT systems used for developing new services compatible with each other? | | | | | √ | √ | | ? | | √ | | Froehle and Roth (2007)quoting: Van Reil, Lemmink, and Ouwersloot (2004) |
| | | √ | | | √ | √ | √ | √ | Back-office development | Maintain back-office and administrative IT systems that can support the firm's new service development efforts | What are the back-office and administrative IT systems that supporting new service development efforts? | | | | | √ | √ | √ | | | √ | | Froehle and Roth (2007)quoting: Edvardsson and Olsson (1996) |
| √ | √ | √ | | | √ | √ | √ | √ | Reflecting / monitoring | Deliberately monitor and reflect on the way IT (ICT) is managed for the NSD process | How often, in what circumstances and who reflects on the way in which ICT is used for new service development? E.g. by asking questions such as "Are our current IT systems adequately supporting the new service development?" | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| | | √ | | | √ | √ | √ | √ | Adapting | Adapt the way IT (ICT) is managed for the NSD process based on results of reflection | (How) are the conclusions from this reflection process actually adapted in practice? (How) is IT changed or improved to better serve the new service development requirements? | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | Den Hertog et al. (2010) |
| | | √ | | | √ | √ | √ | √ | Feedback from NSD to IT (ICT) | Existing NSD projects influence the way IT (ICT) is managed | How do specific new service development projects influence the way IT (ICT) is managed in general? E.g. (how) do conclusions from lessons learned in a specific project lead to changes in software or hardware used for other projects? E.g. do new identified IT needs lead to new IT implementation? Please give examples. | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | | Practice |

**Relational Capital**

| | Subcategory | Description | Question | Checks | Reference |
|---|---|---|---|---|---|
| | | | *How do you cooperate outside of the organisation when developing new service?* | √ √ √ √ √ √ √ | Schilke & Goertzen (2010) |
| √ | External relations | Establish and maintain good communication with suppliers, partners, and clients outside the firm as potential sources of new ideas and enhanced market insight | *(How) are external partners, suppliers and clients used as potential sources of new ideas? (How) do you apply the concepts of open innovation?* | √ √ √ √ √ √ √ | Froehle and Roth (2007) quoting: Voss et al.(1992), Edvardsson and Olsson (1996); Kianto (2008) |
| | Co-producing and orchestrating: Alliance engagement | Actively look for and engage in alliances and networks of various partners (e.g. other RTOs, clients, government, academia and industry) to co-design and co-produce the service | *Do you actively look for and engage in alliances and networks of other RTOs, clients and other stakeholders (e.g. academia, government, industry) to co-design and co-produce the service?* | √ √ √ √ √ √ | Den Hertog et al. (2010); Schilke & Goertzen (2010) |
| | | Manage and orchestrate coalitions with various partners for the benefit of NSD | *(How) do you manage coalitions with various partners for the benefit of new service development? Please give an example of a new serice development project that you have carried out in alliance with one or more partners. How often do you engage in such multi-partner developments?* | √ √ √ √ √ √ √ | Den Hertog et al. (2010) quoting Teece (2007: 1320); Schilke & Goertzen (2010) |
| | | | *How is knowledge created in such collaborations communicated inside the organisation? How is that knowledge absorbed or maintained?* | √ √ √ √ √ √ | Schilke & Goertzen (2010) |
| √ √ √ √ √ √ √ √ | Reflecting / monitoring | Deliberately monitor and reflect on the way organisational relations (relational capital) are managed for the NSD process | *How often, in what circumstances and who reflects on the way in which organisational relations, both external and internal, are used for the NSD purpose? E.g. by asking questions such as "Are we collaborating enough internally when developing new services?",* | √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |

| Dimension | Description | Question | Assessment | Source |
|---|---|---|---|---|
| | | "Are we engaging enough with collaboration networks with external partners when developing new services?" | | |
| Adapting | Adapt the way organisational relations (relational capital) are managed for the NSD process based on results of reflection | (How) are the conclusions from this reflection process actually adapted in practice? Do you engage in more internal or external collaborations for the purpose of new service development? | √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |
| Feedback from NSD to Relational Capital | Existing NSD projects influence the way Relational Capital is managed | How do specific new service development projects influence the way organisational relations are managed in general? (e.g. (how) do lessons learned from a specific project lead to changes in external alliances) Please give examples. | √ √ √ √ √ ? √ √ √ √ | Practice |

**Experience base**

| Dimension | Description | Question | Assessment | Source |
|---|---|---|---|---|
| | | *How are past experiences used in the development of new service?* | ? √ √ √ √ √ √ √ √ √ | Practice |
| | | *Do you have a best practices guide?* | √ √ √ √ √ √ √ √ √ | |
| Strategic alignment of experience base | The management of experience base for the service innovation purpose is directly derived from the strategy | *Does your strategy explicitly cover the topic of using your experiences for new service development? E.g. are there any strategic projects developed to the recording of your experiences? Are your experiences defined as one of your key strategic resources and are they managed from a top management perspective? (e.g. do you have a top management sponsor for experience-base related projects?)* | √ √ √ √ √ | Practice; Kianto (2008) |

| Dimension | Item | Question | References |
|---|---|---|---|
| Organisational alignment of experience base | The management of experience base is officially accounted for in the organisational structure | Is there an official position of knowledge manager (or similar) in your organisation who is supporting knowledge management for the purpose of new service development? Do you have specific knowledge management tools (e.g. systems) supporting the new service development? | Practice; Kianto (2008) |
| Explicit knowledge / Feedback from NSD to Experience Base | Keep track of failed and successful service innovation efforts | (How) are previous failed and successful innovation efforts recorded? (e.g. lessons learned, qualifications, after action reviews, statements of experience, debriefing documents) | Den Hertog et al. (2010); Lawson & Samson (2001); Kianto (2008) |
| Explicit knowledge | Use existing repositories of codified best practices, previous project documentations, methodologies etc. for the NSD process purposes | (How) are existing repositories of best practices, previous project documentations, methodologies etc. used for new service development? (e.g. qualifications database used for quoting competences in new service proposals, methodologies applied to new services) | General: Nonaka and Takeuchi (1995); O'Dell and Grayson (1998), Kianto (2008); Specific for services: Leiponen (2006) |
| Tacit knowledge | Share tacit knowledge internally: Involve experienced employees in the NSD process to benefit from their knowledge (know-how, best practices) | (How) do you benefit from experienced employees' knowledge in the new service development process? (e.g. by inviting experts to the team, by organising debriefing lessons learned sessions, by including experienced employees in a steering committee) Is it an ad hoc or structural approach? Do you 'know-who' to invite? Are employees motivated to do it? | General: Nonaka and Takeuchi (1995); O'Dell and Grayson (1998); Kianto (2008); Specific for services: Leiponen (2006) |
| | Share tacit knowledge externally: Acquire know-how from partner organisations | (How) do you benefit from partner organisations' know-how in the new service development process? | Cavusgil, Calantone and Zao (2003); Kianto |

| | Capability/Practice | Description | Diagnostic question | Source |
|---|---|---|---|---|
| | | | *(e.g. by cooperating closely with experts from partner organisations)* | (2008) |
| √ √ √ √ √ √ √ | Diversity appreciation | Promote the sharing of ideas and knowledge related to NSD across functional boundaries within the organization | *How do you share ideas and knowledge related to new service development across functional boundaries of the organisation? Is this process promoted? (how?/why?)* — √ √ √ √ √ √ √ √ | Froehle and Roth (2007)quoting: Froehle et al.(2000), Edvardsson and Olsson (1996), Terrill (1992), de Brentani (1989), Loch et al.(1996); Lee & Kelley (2008); |
| | Trust and openness to sharing | Promote trust and openness to sharing ideas | *Do people trust each other and is there an open atmosphere for sharing ideas and knowledge? Or is there a proprietary mentality?* — √ √ √ √ √ √ √ √ | Practice |
| | Openness to new ideas | Fight 'not invented here' syndrome | *Do people use ideas invented by others easily or, rather, is there a culture of "re-inventing the wheel" and "not invented here'' syndrome?* — √ √ √ √ √ √ √ √ | Practice |
| √ √ √ √ √ √ √ | Reflecting / monitoring | Deliberately monitor and reflect on the way experience base is managed for the NSD process | *How often, in what circumstances and who reflects on the way in which existing experiences are used in new service development? E.g. by asking questions such as "Are we using our past experiences to the full extent when developing new service?"* — √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |
| √ √ √ √ √ | Adapting | Adapt the way experience base is managed for the NSD process based on results of reflection | *(How) are the conclusions from this reflection process actually adapted in practice? How is the way of using past experience enhanced to better serve new service development?* — √ √ √ √ √ √ √ √ √ √ | Den Hertog et al. (2010) |

**Service portfolio**

| Construct | Description | Interview question | Reference |
|---|---|---|---|
| | | Do you have an 'official' service portfolio? How do you use existing service portfolio when developing new services? | Barlatier, Bernacconi et al. (2010) |
| Strategic alignment of service portfolio | Align service portfolio is with the business vision, strategy and objectives | Does your current service portfolio reflect the business vision, strategy and objectives, as well as specifically the service innovation objectives? What is the interaction between Service Portfolio and innovation strategy? | Banarjee and Aziz (2007) |
| Bundling of services or their functionalities | Bundle, enrich and blend existing services to create new ones | (How) do you bundle, enrich and blend existing services to create new ones? | Den Hertog et al. (2010) quoting Normann (2002) |
| Unbundling of services or their functionalities | Unbundle existing services or strip them down to bare essentials to create new ones | (How) do you unbundle existing services or strip them down to bare essentials to create new ones? | Den Hertog et al. (2010) quoting Normann (2002) |
| Scaling up successful service innovations | Codify and transplant essential elements of the service to other parts of the organisation | (How) do you transfer essential elements of successful service innovation to parts of the organisation so that they can scale them up in developing their new services? | Den Hertog et al. (2010) |
| Stretching core service offering | Launch innovative service concepts using the existing service brand name | (How) do you launch new services based on existing service brand names? | Den Hertog et al. (2010) |
| Reflecting / monitoring | Deliberately monitor and reflect on the way service portfolio is managed for the NSD process | How often, in what circumstances and who reflects on the way in which existing service portfolio is used in new service development? E.g. by asking "Can we use bundling and unbundling strategies for deriving new services?" | Den Hertog et al. (2010); Schreyogg and Kliesch-Eberl (2007) |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | √ | √ | √ | √ | Adapting | Adapt the way service portfolio is managed for the NSD process based on results of reflection | *(How) are the conclusions from this reflection process actually adapted in practice?* | √ | √ | √ | √ | √ | √ | √ | √ | √ | Den Hertog et al. (2010) |
| | | | | √ | √ | √ | √ | √ | Feedback from NSD to Service Portfolio | Existing NSD projects influence the Service Portfolio | *How do specific new development projects influence the service portfolio? What conditions need to be met to include the results of a one-off NSD project in the organisation's 'official' service portfolio? Is service portfolio 'updated' for specific clients (how often?)* | √ | √ | √ | √ | √ | √ | √ | √ | ? | Practice |

**QUALITY MANAGER**

**Example interview guide - to be further adapted to specific person**

**INTRO**

| | |
|---|---|
| 10 | *Your role and responsibilities* |

| | |
|---|---|
| 20 | *Your role in sevice innovation / NSD* |

**NSD**

| | |
|---|---|
| 400 | **A formalised NSD model?** *(Or e.g. NPD models?)* |
| 410 | **Describe your NSD model**? *Linear or intertwined?* |
| 430 | *Does NSD take into account* **social, economic & environmental** *requirements? (both services provided & way of working)* |

| | |
|---|---|
| 440 | **How are new services designed?** |

| | |
|---|---|
| 590 | *Who and how (if at all)* **monitors the way in which design** *of a new service is managed?* *(e.g. by asking: "What have we learned from our latest set of service experiments?", "Are we experimenting enough with new revenue models?", "How can we make sure we generate enough cues for service innovation?")* |
| 600 | **Conclusions from this monitoring actually adapted** *in the way* **design** *process is managed in general, i.e. for other services? (e.g. change of the procedure, change of the involved resources etc.)* |

| | |
|---|---|
| 610 | **How are new services analysed?** |
| 620 | *What* **methods for new service idea evaluation**? |
| 630 | *(How) is the* **financial/economic viability** *of the new service concept analysed?* |
| 640 | *New service project* **formally approved and authorised**? |

| | |
|---|---|
| 680 | *Who and how (if at all)* **monitors the way in which analysis** *of a new service is managed?* |

| 690 | *Conclusions from this monitoring actually adapted?* |
|---|---|

|  |
|---|
|  |

| 700 | *How are new services developed?* |
|---|---|
| 760 | *(How) is the new service **tested and "debugged"** prior to launch?* |
| 810 | ***Front-line staff trained** on how to support the new service?* |
| 820 | *(How) are the **conflicts between the new service concept and currently existing IT systems** identified and analysed?* |
| 830 | *(How) do you **create a service "blueprint"**?* |

|  |
|---|
|  |

| 860 | *Who (…) **monitors the way in which development** of a new service is managed?* |
|---|---|
| 870 | ***Conclusions from this monitoring actually adapted**?* |

|  |
|---|
|  |

| 880 | *How are new services launched?* |
|---|---|
| 890 | *Service's **launch formalized**?* |
| 900 | *Service's **promotion formalized**?* |
| 910 | ***Manage client expectations**?* |
| 920 | ***Train new clients** how to use newly introduced service?* |
| 940 | ***Evaluate the development and introduction** of new service?* |

|  |
|---|
|  |

| 950 | ***Monitoring of the way in which launch** of a new service is managed?* |
|---|---|
| 960 | ***Conclusions from this monitoring actually adapted**?* |

|  |
|---|
|  |

| 970 | *One NSD **project benefits from another project in another development phase** (examples)? Conscious?* |
|---|---|

|  |
|---|
|  |

| | **RESOURCES** |
|---|---|
| 980 | *What resources are available and used for the NSD process? (What you consider to be key resources?)* |
| | |
| 1010 | *How is Human Capital mobilized for the NSD process?* |
| 1060 | *Training programme on service innovation / NSD? **Learning by doing**?* |
| | |
| 1080 | *Organisational culture:* |
| 1090 | *Do managers and peers **tolerate uncertainty and ambiguity** in NSD?* |
| 1100 | *Is **thinking out of the box, experimentation and prototyping** culturally accepted?* |
| 1110 | *What happens if somebody **criticizes the current way of doing things**?* |
| | *"Devil's advocates" and "no-sayers" accepted? Criticism of the established practices encouraged?* |
| 1120 | *What happens if somebody **proposes to change a well established way of doing things**?* |
| | *"Mavericks" tolerated? Bringing new ideas for changing existing practices encouraged?* |
| | |
| 1130 | *Reflection on the way people and their skills are used for the NSD purpose?*<br>*E.g. ask: "are we using our people and their skills in the most efficient way when developing new service?";*<br>*"Are we motivating and rewarding people adequately for their contribution to new service development?"* |
| 1140 | *Conclusions from this reflection process actually adapted?*<br>*(e.g. change or add people to NSD, adjust the rewards and other HR practices to better serve the NSD process?* |
| | |
| 1150 | *Specific NSD projects influence the way people and their skills are managed? (e.g. conclusions from lessons learned in a specific project lead to changes in FTEs, employee reward system, organisational culture etc.?). Examples.* |
| | |
| 1160 | *How does the organisational structure support the NSD process?* |

| | |
|---|---|
| 1240 | *Reflection on whether the current structure and procedures* are adequate for the NSD? |
| 1250 | *Conclusions from this reflection process actually adapted in practice*? |

| | |
|---|---|
| 1260 | *Specific NSD projects influence the way Organisational Processes & Structure are managed in general*? E.g. conclusions from lessons learned in a specific project lead to changes in team structure, communication lines etc.? Examples. |

| | |
|---|---|
| 1270 | *How does IT support the NSD process? What kind of IT tools are used for this purpose?* |
| 1280 | ICT tools support the *communication among staff* for NSD? *Systems actually used* by staff? Relevant *IT trainings provided*? |
| 1290 | ICT tools support the *communication with government, academia, industry, partners, and clients*? |
| 1320 | *Back-office and administrative IT systems* supporting NSD? |

| | |
|---|---|
| 1330 | Who *reflects on how ICT is used for NSD*? E.g. by asking questions such as "Are our current IT systems adequately supporting the new service development?" |
| 1340 | *Conclusions from this reflection process actually adapted in practice?* |

| | |
|---|---|
| 1350 | *Specific NSD projects influence the way ICT is managed in general?* E.g. conclusions from lessons learned in a specific project lead to changes in software / hardware used for other projects? New identified IT needs lead to new IT implementation? Examples. |

## RELATIONAL CAPITAL

| | |
|---|---|
| 1410 | Who *reflects on the way in which organisational relations are used for the NSD*? E.g. by asking questions such as "Are we engaging enough with collaboration networks with external partners when de- |

*veloping new services?"*

1420    **Conclusions from this reflection process actually adapted in practice?**

 

1430    **Specific NSD projects influence the way organisational relations are managed in general?** *(e.g. lessons learned from a specific project lead to changes in external alliances) Examples.*

 

## EXPERIENCE BASE

1440    **How are past experiences used in the development of new service?**

1450    **Best practices guide***?*

1480    *Previous* **failed and successful innovation efforts recorded***?*
      *(e.g. lessons learned, qualifications, after action reviews, statements of experience, debriefing documents)*

1490    *Existing repositories of best practices, project documentations, methodologies etc.* **used for new service development***?*

 

1550    *Who* **reflects on the way in which existing experiences are used in NSD**
      *E.g. by asking questions such as "Are we using our past experiences to the full extent when developing new service?"*

1560    **Conclusions from this reflection process actually adapted in practice***?*

 

# APPENDIX D - The Community Innovation Survey (CIS) 2012 questionnaire

# The Community Innovation Survey 2012

### THE HARMONISED SURVEY QUESTIONNAIRE, JULY 23, 2012

This survey collects information on your enterprise's innovations and innovation activities during the three years 2010 to 2012 inclusive.

An innovation is the introduction of a new or significantly improved product, process, organisational method, or marketing method by your enterprise.

An innovation must have characteristics or intended uses that are new or which provide a significant improvement over what was previously used or sold by your enterprise. However, an innovation can fail or take time to prove itself.

An innovation need only be new or significantly improved for your enterprise. It could have been originally developed or used by other enterprises.

Sections 2 to 7 only refer to product and process innovations. Organisational and marketing innovations are covered in sections 8 and 9.

Please complete all questions, unless otherwise instructed.

Person we should contact if there are any queries regarding the form:

Name: _____

Job title: _____

Organisation: _____

Phone: _____

Fax: _____

E-mail: _____

## 1. General information about the enterprise

Name of enterprise _____ ID

Address[1] _____ NUTS

Postal code _____ Main activity[2] _____ NACE

**1.1 In 2012, was your enterprise part of an enterprise group?** (A group consists of two or more legally defined enterprises under common ownership. Each enterprise in the group can serve different markets, as with national or regional subsidiaries, or serve different product markets. The head office is also part of an enterprise group.)  GP

Yes ☐ In which country is the head office of your group located? [3] _____ HO

No ☐

**If your enterprise is part of an enterprise group:** Please answer all further questions about your enterprise only for the enterprise for which you are responsible in [your country]. Exclude all subsidiaries or parent enterprises.

**1.2 During the three years 2010 to 2012 did your enterprise:**

|  | Yes | No |  |
|---|---|---|---|
|  | 1 | 0 |  |
| Merge with or take over another enterprise | ☐ | ☐ | ENMRG |
| Sell, close or outsource some of the tasks or functions of your enterprise | ☐ | ☐ | ENOUT |
| Establish new subsidiaries in [your country] or in other European countries* | ☐ | ☐ | ENNWEUR |
| Establish new subsidiaries outside Europe | ☐ | ☐ | ENNWOTH |

**1.3 In which geographic markets did your enterprise sell goods and/or services during the three years 2010 to 2012?**

|  | Yes | No |  |
|---|---|---|---|
|  | 1 | 0 |  |
| A. Local / regional within [your country] | ☐ | ☐ | MARLOC |
| B. National (other regions of [your country]) | ☐ | ☐ | MARNAT |
| C. Other European Union or associated countries* [4] | ☐ | ☐ | MAREUR |
| D. All other countries | ☐ | ☐ | MAROTH |

Which of these geographic areas was your largest market in terms of turnover during the three years 2010 to 2012? (Give corresponding letter) _____ LARMAR

*: Include the following European Union (EU) and associated countries: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom

[1] NUTS 2 code

[2] NACE 4 digit code

[3] Country code according to ISO standard

[4] Each NSO needs to remove their own country from the list of European countries.

## 2. Product (good or service) innovation

A product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components or sub-systems.

> Product innovations (new or improved) must be new to your enterprise, but they do not need to be new to your market.
> Product innovations could have been originally developed by your enterprise or by other enterprises or institutions.

A good is usually a tangible object such as a smartphone, furniture, or packaged software, but downloadable software, music and film are also goods. A service is usually intangible, such as retailing, insurance, educational courses, air travel, consulting, etc.

### 2.1 During the three years 2010 to 2012, did your enterprise introduce:

|  | Yes 1 | No 0 |  |
|---|---|---|---|
| Goods innovations: New or significantly improved goods (exclude the simple resale of new goods and changes of a solely aesthetic nature) | ☐ | ☐ | INPDGD |
| Service innovations: New or significantly improved services | ☐ | ☐ | INPDSV |

**If no to all options, go to section 3**

**Otherwise go to question 2.2**

### 2.2 Who developed these product innovations?

Tick all that apply

|  | Goods innovations | | Service innovations | |
|---|---|---|---|---|
| Your enterprise by itself | ☐ | INITGD | ☐ | INITSV |
| Your enterprise together with other enterprises or institutions* | ☐ | INTOGD | ☐ | INTOSV |
| Your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions* | ☐ | INADGD | ☐ | INADSV |
| Other enterprises or institutions* | ☐ | INOTHGD | ☐ | INOTHSV |

*: Include independent enterprises plus other parts of your enterprise group (subsidiaries, sister enterprises, head office, etc.). Institutions include universities, research institutes, non-profits, etc.

**2.3 Were any of your product innovations (goods or services) during the three years 2010 to 2012:**

|  |  | Yes 1 | No 0 |  |
|---|---|:---:|:---:|---|
| New to your market? | Your enterprise introduced a new or significantly improved product onto your market before your competitors (it may have already been available in other markets) | ☐ | ☐ | NEWMKT |
| Only new to your firm? | Your enterprise introduced a new or significantly improved product that was already available from your competitors in your market | ☐ | ☐ | NEWFRM |

**Using the definitions above, please give the percentage of your total turnover[5] in 2012 from:**

New or significantly improved products introduced during the three years 2010 to 2012 that were new to your market

TURNMAR

☐☐☐ %

New or significantly improved products introduced during the three years 2010 to 2012 that were only new to your firm

TURNIN

☐☐☐ %

Products that were unchanged or only marginally modified during the three years 2010 to 2012 (include the resale of new products purchased from other enterprises)

TURNUNG

☐☐☐ %

Total turnover in 2012    1 0 0 %

**2.4 To the best of your knowledge, were <u>any</u> of your product innovations during the three years 2010 to 2012:**

|  | Yes 1 | No 0 | Don't know 2 |  |
|---|:---:|:---:|:---:|---|
| A first in [your country] | ☐ | ☐ | ☐ | INPDFC |
| A first in Europe* | ☐ | ☐ | ☐ | INPDFE |
| A world first | ☐ | ☐ | ☐ | INPDFW |

*: Include the following European Union (EU) and associated countries: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.[6]

**If no world-first product innovations go to Section 3, otherwise go to question 2.5**

**2.5 What percent of your total turnover in 2012 was from world first product innovations introduced between 2010 and 2012?** *(This should be a subset of your new-to-market turnover share in question 2.3 above)*

FWTURN

| 0% to less than 1% | ☐ | 1 |
| 1% to less than 5% | ☐ | 2 |
| 5% to less than 10% | ☐ | 3 |
| 10% to less than 25% | ☐ | 4 |
| 25% or more | ☐ | 5 |
| Don't know | ☐ | 6 |

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[5] For Credit institutions: Interests receivable and similar income, for insurance services: Gross premiums written

[6] Each NSO needs to remove their own country from the list of European countries.

## 3. Process innovation

A process innovation is the implementation of a new or significantly improved production process, distribution method, or supporting activity.

> Process innovations must be new to your enterprise, but they do not need to be new to your market.
> The innovation could have been originally developed by your enterprise or by other enterprises or institutions.
> Exclude purely organisational innovations – these are covered in section 8.

### 3.1 During the three years 2010 to 2012, did your enterprise introduce?

|  | Yes 1 | No 0 |  |
|---|---|---|---|
| New or significantly improved methods of manufacturing or producing goods or services | ☐ | ☐ | INPSPD |
| New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services | ☐ | ☐ | INPSLG |
| New or significantly improved supporting activities for your processes, such as Maintenance systems or operations for purchasing, accounting, or computing | ☐ | ☐ | INPSSU |

**If no to all options, go to section 4**

**Otherwise go to question 3.2**

### 3.2 Who developed these process innovations?

|  | Tick all that apply |  |
|---|---|---|
| Your enterprise by itself | ☐ | INITPS |
| Your enterprise together with other enterprises or institutions* | ☐ | INTOPS |
| Your enterprise by adapting or modifying processes originally developed by other enterprises or institutions* | ☐ | INADPS |
| Other enterprises or institutions* | ☐ | INOTHPS |

*: Include independent enterprises plus other parts of your enterprise group (subsidiaries, sister enterprises, head office, etc). Institutions include universities, research institutes, non-profits, etc.

### 3.3 Were any of your process innovations introduced during the three years 2010 to 2012 new to your market?

|  | INPSNM |
|---|---|
| Yes | ☐ 1 |
| No | ☐ 0 |
| Do not know | ☐ 2 |

## 4. Ongoing or abandoned innovation activities for product and process innovations

Innovation activities include the acquisition of machinery, equipment, buildings, software, and licenses; engineering and development work, design, training, and marketing when they are specifically undertaken to develop and/or implement a product or process innovation. Also include all types of R&D activities.

**4.1 During the three years 2010 to 2012, did your enterprise have any innovation activities that did not result in a product or process innovation because the activities were:**

|  | **Yes** | **No** |  |
|---|---|---|---|
|  | 1 | 0 |  |
| Abandoned or suspended before completion | ☐ | ☐ | INABA |
| Still on-going at the end of the 2012 | ☐ | ☐ | INONG |

**If your enterprise had no product or process innovations or innovation activity during the three years 2010 to 2012 (no to all options in questions 2.1, 3.1, and 4.1), go to section 8**

**Otherwise, go to section 5**

## 5. Activities and expenditures for product and process innovations

**5.1 During the three years 2010 to 2012, did your enterprise engage in the following innovation activities:**

|  |  | Yes | No |  |
|---|---|---|---|---|
|  |  | 1 | 0 |  |
| In-house R&D | Research and development activities undertaken by your enterprise to create new knowledge or to solve scientific or technical problems (include software development in-house that meets this requirement) | ☐ | ☐ | RRDIN |
|  | If yes, did your enterprise perform R&D during the three years 2010 to 2012: |  |  | RDENG |
|  | Continuously (your enterprise has permanent R&D staff in-house) ☐ 1 |  |  |  |
|  | Occasionally (as needed only) ☐ 2 |  |  |  |
| External R&D | R&D that your enterprise has contracted out to other enterprises (including other enterprises in your group) or to public or private research organisations | ☐ | ☐ | RRDEX |
| Acquisition of machinery, equipment, software & buildings | Acquisition of advanced machinery, equipment, software and buildings to be used for new or significantly improved products or processes | ☐ | ☐ | RMAC |
| Acquisition of existing knowledge from other enterprises or organisations | Acquisition of existing know-how, copyrighted works, patented and non-patented inventions, etc. from other enterprises or organisations for the development of new or significantly improved products and processes | ☐ | ☐ | ROEK |
| Training for innovative activities | In-house or contracted out training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes | ☐ | ☐ | RTR |
| Market introduction of innovations | In-house or contracted out activities for the market introduction of your new or significantly improved goods or services, including market research and launch advertising | ☐ | ☐ | RMAR |
| Design | In-house or contracted out activities to design or alter the shape or appearance of goods or services | ☐ | ☐ | RDSG |
| Other | Other in-house or contracted out activities to implement new or significantly improved products and processes such as feasibility studies, testing, tooling up, industrial engineering, etc. | ☐ | ☐ | RPRE |

**5.2** **How much did your enterprise spend on each of the following innovation activities in <u>2012</u> only?**

Innovation activities are defined in question 5.1 above. Include current expenditures (including labour costs, contracted-out activities, and other related costs) as well as capital expenditures on buildings and equipment.[7]

*Please fill in '0' if your enterprise had no expenditures for an activity in 2012*

*With a lack of precise accounting data please use estimates*

In-house R&D (Include current expenditures including labour costs and capital expenditures on buildings and equipment specifically for R&D)
RRDINX

External R&D
RRDEXX

Acquisition of machinery, equipment, software & buildings (Exclude expenditures on these items that are for R&D)
RMACX

Acquisition of existing knowledge from other enterprises or organisations
ROEKX

All other innovation activities including design, training, marketing, and other relevant activities
ROTRX

Total expenditures on innovation activities (Sum of expenditures for all types of innovation activities)
RALLX

**5.3 During the three years 2010 to 2012, did your enterprise receive any public financial support for innovation activities from the following levels of government?** Include financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees. Exclude research and other innovation activities conducted entirely for the public sector* under contract.

| | Yes | No | |
| --- | --- | --- | --- |
| | 1 | 0 | |
| Local or regional authorities | ☐ | ☐ | FUNLOC |
| Central government (including central government agencies or ministries) | ☐ | ☐ | FUNGMT |
| The European Union (EU) | ☐ | ☐ | FUNEU |
| If yes, did your enterprise participate in the EU 7th Framework Programme for Research and Technical Development? | ☐ | ☐ | FUNRTD |

*The public sector includes government owned organisations such as local, regional and national administrations and agencies, schools, hospitals, and government providers of services such as security, transport, housing, energy, etc.

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[7] Give expenditure data in 000's of national currency units to eight digits.

## 6. Sources of information and co-operation for product and process innovation

**6.1 During the three years 2010 to 2012, how important to your enterprise's innovation activities were each of the following information sources?** Include information sources that provided information for new innovation projects or contributed to the completion of existing projects.

Degree of importance
Tick 'not used' if no information was obtained from a source.

| | Information source | High 3 | Medium 2 | Low 1 | Not used 0 | |
|---|---|---|---|---|---|---|
| Internal | Within your enterprise or enterprise group | ☐ | ☐ | ☐ | ☐ | SENTG |
| Market sources | Suppliers of equipment, materials, components, or software | ☐ | ☐ | ☐ | ☐ | SSUP |
| | Clients or customers from the private sector | ☐ | ☐ | ☐ | ☐ | SCLPR |
| | Clients or customers from the public sector* | ☐ | ☐ | ☐ | ☐ | SCLPU |
| | Competitors or other enterprises in your industry | ☐ | ☐ | ☐ | ☐ | SCOM |
| | Consultants and commercial labs | ☐ | ☐ | ☐ | ☐ | SINS |
| Education & research institutes | Universities or other higher education institutions | ☐ | ☐ | ☐ | ☐ | SUNI |
| | Government, public or private research institutes | ☐ | ☐ | ☐ | ☐ | SGMT |
| Other sources | Conferences, trade fairs, exhibitions | ☐ | ☐ | ☐ | ☐ | SCON |
| | Scientific journals and trade/technical publications | ☐ | ☐ | ☐ | ☐ | SJOU |
| | Professional and industry associations | ☐ | ☐ | ☐ | ☐ | SPRO |

**6.2 During the three years 2010 to 2012, did your enterprise co-operate on any of your innovation activities with other enterprises or institutions?** Innovation co-operation is active participation with other enterprises or institutions on innovation activities. Both partners do not need to commercially benefit. Exclude pure contracting out of work with no active co-operation.

Yes ☐

No ☐ **(Please go to question 7.1)** CO

**6.3 Please indicate the type of innovation co-operation partner by location**

(Tick all that apply)

| Type of co-operation partner | [Your country] | Other Europe** | United States | China or India | All other countries |
|---|---|---|---|---|---|
| A. Other enterprises within your enterprise group | ☐ Co11 | ☐ Co12 | ☐ Co13 | ☐ Co14 | ☐ Co15 |
| B. Suppliers of equipment, materials, components, or software | ☐ Co21 | ☐ Co22 | ☐ Co23 | ☐ Co24 | ☐ Co25 |
| C. Clients or customers from the private sector | ☐ Co311 | ☐ Co312 | ☐ Co313 | ☐ Co314 | ☐ Co315 |
| D. Clients or customers from the public sector* | ☐ Co321 | ☐ Co322 | ☐ Co323 | ☐ Co324 | ☐ Co325 |
| E. Competitors or other enterprises in your sector | ☐ Co41 | ☐ Co42 | ☐ Co43 | ☐ Co44 | ☐ Co45 |
| F. Consultants and commercial labs | ☐ Co51 | ☐ Co52 | ☐ Co53 | ☐ Co54 | ☐ Co55 |
| G. Universities or other higher education institutions | ☐ Co61 | ☐ Co62 | ☐ Co63 | ☐ Co64 | ☐ Co65 |
| H. Government, public or private research institutes | ☐ Co71 | ☐ Co72 | ☐ Co73 | ☐ Co74 | ☐ Co75 |

**6.4 Which type of co-operation partner did you find the most valuable for your enterprise's innovation activities? (Give corresponding letter)** _____ PMOS

*The public sector includes government owned organisations such as local, regional and national administrations and agencies, schools, hospitals, and government providers of services such as security, transport, housing, energy, etc.

**: Include the following European Union (EU) and associated countries: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

## 7. Competitiveness of your enterprise's product and process innovations

**7.1 How effective were the following methods for maintaining or increasing the competitiveness of product and process innovations introduced during 2010 to 2012?**

| | Degree of effectiveness | | | | |
|---|:---:|:---:|:---:|:---:|---|
| | **High** | **Medium** | **Low** | **Not used** | |
| | 3 | 2 | 1 | 0 | |
| Patents | ☐ | ☐ | ☐ | ☐ | CMPAT |
| Design registration | ☐ | ☐ | ☐ | ☐ | CMRCD |
| Copyright | ☐ | ☐ | ☐ | ☐ | CMCO |
| Trademarks | ☐ | ☐ | ☐ | ☐ | CMCTM |
| Lead time advantages | ☐ | ☐ | ☐ | ☐ | CMLTAD |
| Complexity of goods or services | ☐ | ☐ | ☐ | ☐ | CMCPX |
| Secrecy (include non-disclosure agreements) | ☐ | ☐ | ☐ | ☐ | CMSEC |

Note: Countries that provide utility patents should include this as a sub-question after patents.

## 8. Organisational Innovation

An organisational innovation is a new organisational method in your enterprise's business practices (including knowledge management), workplace organisation or external relations that has not been previously used by your enterprise.

> It must be the result of strategic decisions taken by management.
> Exclude mergers or acquisitions, even if for the first time.

**8.1 During the three years 2010 to 2012, did your enterprise introduce:**

| | Yes | No | |
|---|:---:|:---:|---|
| | 1 | 0 | |
| New business practices for organising procedures (i.e. supply chain management, business re-engineering, knowledge management, lean production, quality management, etc.) | ☐ | ☐ | ORGBUP |
| New methods of organising work responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralisation, integration or de-integration of departments, education/training systems, etc.) | ☐ | ☐ | ORGWKP |
| New methods of organising external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc.) | ☐ | ☐ | ORGEXR |

## 9. Marketing innovation

A marketing innovation is the implementation of a new marketing concept or strategy that differs significantly from your enterprise's existing marketing methods and which has not been used before.

It requires significant changes in product design or packaging, product placement, product promotion or pricing. Exclude seasonal, regular and other routine changes in marketing methods.

### 9.1 During the three years 2010 to 2012, did your enterprise introduce:

| | Yes<br>1 | No<br>0 | |
|---|:---:|:---:|---|
| Significant changes to the aesthetic design or packaging of a good or services (exclude changes that alter the product's functional or user characteristics – these are product innovations) | ☐ | ☐ | MKTDGP |
| New media or techniques for product promotion (i.e. the first time use of a new advertising media, a new brand image, introduction of loyalty cards, etc.) | ☐ | ☐ | MKTPDP |
| New methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation, etc.) | ☐ | ☐ | MKTPDL |
| New methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems, etc.) | ☐ | ☐ | MKTPRI |

## 10. Public sector procurement and innovation

### 10.1 During the three years 2010 to 2012, did your enterprise have any procurement contracts to provide goods or services for:

| | Yes<br>1 | No<br>0 | |
|---|:---:|:---:|---|
| Domestic public sector organisations* | ☐ | ☐ | PUBDOM |
| Foreign public sector organisations* | ☐ | ☐ | PUBFOR |

*The public sector includes government owned organisations such as local, regional and national administrations and agencies, schools, hospitals, and government providers of services such as security, transport, housing, energy, etc.

**If no to both options go to section 11**

**Otherwise go to question 10.2**

### 10.2 Did your enterprise undertake any innovation activities as part of a procurement contract to provide goods or services to a public sector organisation? *(Include activities for product, process, organisational and marketing innovations)*

*(If your enterprise had several procurement contracts, tick all that apply)*

| | | |
|---|:---:|---|
| Yes and innovation required as part of the contract | ☐ | PBINCT |
| Yes but innovation not required as part of the contract | ☐ | PBNOCT |
| No | ☐ | PBNOINN |

## 11. Strategies and obstacles for reaching your enterprise's goals

**11.1 During the three years 2010 to 2012, how important were each of the following goals for your enterprise?** (It does not matter if your enterprise was able to attain these goals)

| | **Degree of Importance** | | | | |
|---|---|---|---|---|---|
| | High | Medium | Low | Not relevant | |
| | 3 | 2 | 1 | 0 | |
| Increase turnover | ☐ | ☐ | ☐ | ☐ | GOTURN |
| Increase market share | ☐ | ☐ | ☐ | ☐ | GOMKT |
| Decrease costs | ☐ | ☐ | ☐ | ☐ | GOCOS |
| Increase profit margins | ☐ | ☐ | ☐ | ☐ | GOPRF |

**11.2 During 2010 to 2012, how important were each of the following strategies for reaching your enterprise's goals?**

| | **Degree of Importance** | | | | |
|---|---|---|---|---|---|
| | High | Medium | Low | Not relevant | |
| | 3 | 2 | 1 | 0 | |
| Developing new markets within Europe* | ☐ | ☐ | ☐ | ☐ | STMKEUR |
| Developing new markets outside Europe* | ☐ | ☐ | ☐ | ☐ | STMKOTH |
| Reducing in-house costs of operation | ☐ | ☐ | ☐ | ☐ | STIHCOS |
| Reducing costs of purchased materials, components or services | ☐ | ☐ | ☐ | ☐ | STEXCOS |
| Introducing new or significantly improved goods or services | ☐ | ☐ | ☐ | ☐ | STINNPD |
| Intensifying or improving the marketing of goods or services | ☐ | ☐ | ☐ | ☐ | STMKT |
| Increasing flexibility / responsiveness of your organisation | ☐ | ☐ | ☐ | ☐ | STFLEX |
| Building alliances with other enterprises or institutions | ☐ | ☐ | ☐ | ☐ | STALL |

**11.3 During 2010 to 2012, how important were the following factors as obstacles to meeting your enterprise's goals?**

| | **Degree of Importance** | | | | |
|---|---|---|---|---|---|
| | High | Medium | Low | Not relevant | |
| | 3 | 2 | 1 | 0 | |
| Strong price competition | ☐ | ☐ | ☐ | ☐ | OBSPR |
| Strong competition on product quality, reputation or brand | ☐ | ☐ | ☐ | ☐ | OBSQL |
| Lack of demand | ☐ | ☐ | ☐ | ☐ | OBSLDE |
| Innovations by competitors | ☐ | ☐ | ☐ | ☐ | OBSCP |
| Dominant market share held by competitors | ☐ | ☐ | ☐ | ☐ | OBSDMK |
| Lack of qualified personnel | ☐ | ☐ | ☐ | ☐ | OBSPRS |
| Lack of adequate finance | ☐ | ☐ | ☐ | ☐ | OBSFIN |
| High cost of access to new markets | ☐ | ☐ | ☐ | ☐ | OBSAMK |
| High cost of meeting government regulations or legal requirements | ☐ | ☐ | ☐ | ☐ | OBSREG |

*: Include the following European Union (EU) and associated countries: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

## 12. Basic economic information on your enterprise

**12.1 What was your enterprise's total turnover for 2010 and 2012?**[8] Turnover is defined as the market sales of goods and services (Include all taxes except VAT[9])

|   |   | 2010 |   |   |   |   |   | 2012 |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|

TURN10                                TURN12

**12.2 What was your enterprise's average number of employees in 2010 and 2012?**[10]

|   | 2010 |   |   |   |   | 2012 |   |
|---|---|---|---|---|---|---|---|

EMP10                                EMP12

**12.3 Approximately what percent of your enterprise's employees in 2012 had a tertiary degree?**[11]

EMPUD

| | | |
|---|---|---|
| 0% | ☐ | 0 |
| 1% to 4% | ☐ | 1 |
| 5% to 9% | ☐ | 2 |
| 10% to 24% | ☐ | 3 |
| 25% to 49% | ☐ | 4 |
| 50% to 74% | ☐ | 5 |
| 75% to 100% | ☐ | 6 |

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[8] Give turnover in '000 of national currency units. Leave space for up to nine digits.

[9] For Credit institutions: Interests receivable and similar income; for Insurance services give gross premiums written.

[10] If administrative data are used and the annual average is not available, give results for the end of each year. Leave space for up to six digits for question 12.2.

[11] ISCED 2011 levels 5 to 8.

# APPENDIX E - The five papers included in this PhD project

1.    **Giannopoulou, E.,** Gryszkiewicz, L., Barlatier, P. J. *A conceptual model for the development of service innovation capabilities in Research and Technology Organisations.* International Journal of Knowledge Management Studies, 4 (4), 2011, pp. 319-335

2.    Gryszkiewicz, L., **Giannopoulou, E.,** Barlatier, P. J. *Service Innovation Capabilities: What are they?* International Journal of Services, Economics and Management, 5 (12), 2013, pp. 125-153

3.    **Giannopoulou, E.,** Gryszkiewicz, L., Barlatier, P. J. *Creativity for Service Innovation: A Practice Based Perspective.* Managing Service Quality, 24 (1), 2014, pp.23-44

4.    Barlatier, P.-J., **Giannopoulou, E.,** Pénin, J. *Les intermédiaires de l'innovation ouverte entre gestion de l'information et gestion des connaissances : le cas de la valorisation de la recherche publique*. Innovations, 49 (1), 2016, pp. 55-77

5.    **Giannopoulou, E.,** Pénin, Julien and Barlatier, Pierre-Jean. *The impact of Research and Technology Organizations on firm innovation: a comparison with universities* (2016 - Working Paper)

# A conceptual model for the development of service innovation capabilities in Research and Technology Organisations

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Abstract: As services dominate developed economies all over the world, service innovation represents an important challenge for organisations wanting to ensure their successful performance over time. In this paper, we propose a conceptual model for the development of service innovation capabilities within a special type of service-intensive organisation: Research and Technology Organisations (RTOs), which are important innovation actors in contemporary economies. This model focuses on the interplay between resources and processes, and highlights the importance of service innovation strategies for developing relevant capabilities. Finally, "dynamisation" perspectives that ensure the sustainability of these capabilities are also presented.

Keywords: service innovation capabilities; NSD; new service development; resource-process framework; capabilities dynamisation; RTOs; research and technology organisations.

Biographical notes: Eleni Giannopoulou obtained a Diploma (Msc Degree) in Electrical and Computer Engineering from the National Technical University of Athens (Greece) in 2003 and a Master's Degree in Management and Economics of Innovation from Chalmers University of Technology (Gothenburg, Sweden) in 2009. She has worked for several years as a telecom and software development engineer in multinational telecommunication companies. Since 2010 she is working as a researcher in CRP (Centre de Recherche Public) Henri Tudor in Luxembourg. Her research interests focus on technology management, innovation management, economics of innovation, innovation in services and open innovation.

Lidia Gryszkiewicz has graduated from University of Lodz (Poland) as MSc in Management and from University of Maastricht (The Netherlands) where she obtained her second MSc Degree in International Business. She started

her professional career at PricewaterhouseCoopers in Amsterdam (The Netherlands), where she was responsible for knowledge management projects. After that she joined Arthur D. Little strategy consultancy in Benelux as a consultant for innovation and technology management, as well as strategy development topics. Since 2010 she is a researcher at CRP Henri Tudor (Luxembourg) and a PhD student at Louvain School of Management (Belgium), working in service innovation domain.

Pierre-Jean Barlatier received a Doctorate Degree in Management Sciences from the University of Nice-Sophia Antipolis (France) in 2006. He joined the CRP-Henri Tudor in 2007 as researcher in the Centre for IT Innovation. Before that, he was a research and teaching assistant from the University of Nice-Sophia Antipolis (France) and a Marie Curie Fellow in Copenhagen Business School (Denmark). His current research interests are: strategic management of networks and communities of practice, organisational learning and knowledge management, as well as innovation in services and new service development.

## 1 Introduction

We are in the midst of a service-driven business revolution (Möller et al., 2008), as most developed countries' economies rely increasingly on services. Moreover, the dynamic and highly competitive business environment presupposes that innovation is an important determinant of success in service organisations that want to gain and sustain competitive advantage (Voss et al., 1992). Especially in turbulent periods of rapid change, innovation seems to be the only way to prosper, if not to survive. Thus, it is critical for organisations to engage in service innovation.

However, as obvious as the need for innovation in services may seem today, it still represents a great challenge for both researchers and practitioners. Where research is concerned, this can be partly attributed to the fact that the majority of service innovation studies rely on theories of innovation rooted in a time where manufacturing was still the major economic activity. Therefore, new conceptual insights and developments for service innovation are needed (Drejer, 2004). A similar assessment can be made about practitioners. Since most organisational forms and models that support service innovation rely on "traditional" perspectives of New Product Development (NPD) they are most of the time unsuitable for New Service Development (NSD) (Voss et al., 1992). In practice, few organisations actually manage service innovation actively (Kim and Meiren, 2010; de Jong et al., 2003).

Therefore, as we lack well-established theoretical contributions and practical experiences to support service innovation, there is a need for more research in this field. More specifically, it is highly important for service organisations to be able to continuously innovate. From this perspective, the development of service innovation capabilities represents a significant concern. As capabilities bear the inherent threat of stagnation and rigidity (Leonard-Barton, 1992), there is a need to shed light on those practices that allow for the development of new services in a continuous way.

We propose to study the development of service innovation capabilities in the context of Research and Technology Organisations (RTOs). RTOs are organisations that focus on applied research and provide innovation services to government, companies and other

actors. Thus, they are important innovation drivers for the economy as a whole. Moreover, they represent an interesting field of research, because service innovation is their 'core activity' and, therefore, they are expected to be more proficient in it. However, little research has been focused on RTOs so far.

Thus, this contribution intends to build a model that will shed light on the development of service innovation capabilities in RTOs. More specifically, by reviewing contemporary literature, we identify and gather the most important external and internal drivers for the development of service innovation capabilities. These elements are then synthesised in a model that explains how RTOs can develop and sustain their service innovation capabilities.

The remainder of the paper is structured as follows: first, we present our research approach. Then, we define our main concepts, namely services, service innovation and service innovation capabilities, as well as RTOs. In Chapter 5 we present both external and internal drivers for developing service innovation capabilities. Subsequently, based on the interactions of these elements, we construct a model showing how RTOs can develop and sustain their service innovation capabilities. In Chapter 7, we discuss this conceptual model compared to the relevant literature and emphasise our contributions. Finally, the last part of the paper presents our conclusions as well as some implications for further research.

## 2   Research approach

To construct our model, we followed two concrete steps. First, we conducted a literature review on the topics of service innovation, RTOs, the Resource-Based View (RBV) of the firm and innovation capabilities, both organisational and dynamic. Our purpose was not to be exhaustive as far as the relevant literature was concerned, but rather to cover the most noteworthy and recent contributions. Hence, the most important drivers for the development of service innovation capabilities were identified. While some of our findings were specifically relevant for RTOs, we also used general literature to complete this study.

In the second step, these previously identified elements were synthesised into a model that explains how service innovation capabilities can be developed and sustained within RTOs. This model was constructed in a joint way. At first, each of the three researchers involved in this study presented his/her own version of the interactions among the identified elements. Finally, the three perspectives were synthesised through a war room exercise into a single model approved by the whole team.

## 3   Service innovation capabilities

### 3.1   Defining services

To understand service innovation and relevant capabilities, we first need to define what a service is. According to Grönroos (1990, p.27) a service is

> "an activity or series of activities of more or less intangible nature that normally, but not necessarily, take place in interactions between the customer

> and service employees and/or physical resources and/or systems of the service
> provider, which are provided as solutions for customer problems."

However, the definition of a service is not enough to fully convey its essence. Therefore, the inherent characteristics of services have often been used to explain their challenging nature. These features are (according to de Jong et al. (2003)):

• Intangibility: services cannot be seen or felt before they are bought

• Simultaneity: services are often produced and consumed simultaneously

• Heterogeneity: services represent high variability

• Perishability: services cannot be maintained.

## 3.2   Innovation in services

A noteworthy definition by Menor et al. (2002, p.138) presents service innovation as: "an offering not previously available to a firm's customers resulting from additions to or changes in the service concept". In general, though, there is a lack of consensus about what service innovation is and, as a consequence, no widely shared definition has emerged. This can be partly attributed to the assertion that for many years the service sector has been perceived as less innovative than manufacturing. Today, however, the majority of researchers agree that service firms do indeed innovate, but in a different way from manufacturing organisations (de Jong et al., 2003), because of their special inherent service characteristics.

## 3.3   Service innovation capabilities

Capabilities are often discussed in the literature together with resources, as they are two concepts that are interrelated strongly, theoretically and empirically. According to the Resource Based View (RBV) of the firm, based on the work of Penrose (1959), competitive advantage comes from a bundle of organisational resources which have four distinctive attributes; namely they are rare, valuable, imperfectly imitable and without equivalent substitute (Barney, 1991). Some scholars actually define resources in a broad way to include capabilities in them (Ethiraj et al., 2005). However, capabilities represent the firm's capacity to deploy its available resources (Penrose, 1959); thus, although they are strongly interrelated, they address different levels:

> "a capability does not represent a single resource in the concert of other
> resources […] but rather a distinctive and superior way of allocating
> resources." (Schreyögg and Kliesch-Eberl, 2007, p.914).

Moreover, according to Sanchez (2001), a capability represents an action or a repeatable pattern of actions that an organisation can use to get things done. Schreyögg and Sydow (2010) develop this relation between capabilities and practices even further by arguing that a capability is not established unless a reliable practice has evolved over time. Thus, we can define service innovation capabilities as those reliable or mature practices that allow the organisation to innovate in services.

Capabilities, however, bear the inherent threat of stagnation, also known as the capability-rigidity paradox (Leonard-Barton, 1992); Schreyögg and Kliesch-Eberl (2007) identify path-dependency and lock-in, structural inertia and commitment as the

challenges of this paradox. In other words, organisational capabilities are prone to becoming fixed to the constellations in which they proved to be successful (Schreyögg and Kliesch-Eberl, 2007).

Researchers have tried to address the capability-rigidity paradox. The concept of dynamic capabilities, which according to Teece et al. (1997), is defined as the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments, is presented as a solution. But as promising as the dynamic capability perspective seems to be, this concept still fails to be empirically studied, especially in the service context, and remains mostly a theoretical contribution.

How can we then ensure the dynamic nature of organisational capabilities in order to make the organisation capable of sensing, shaping and seising opportunities and of maintaining competitiveness through enhancing, combining and restructuring the available organisational assets (Teece et al., 1997)? Identifying the shortcomings of dynamic capabilities, Schreyögg and Kliesch-Eberl (2007) propose a slightly different approach: a dual-process model that comprises two systems, namely an activity system and an observational one.

The activity system, comprising capabilities practices, is stable and does not involve learning or improvement by itself. The second system involves observation of the first one, by monitoring it for necessary improvements and changes. It is not separate from the organisation, as stated by Schreyögg and Kliesch-Eberl (2007, p.929):

> "[…] capability monitoring cannot be assigned to a single specialised position or department; it needs rather to be managed as a broadly scattered activity across the entire organisation."

Of course it is then in the "due diligence" of the organisation to take action on the results of these observations and proceed with the necessary changes (Schreyögg and Sydow, 2010).

## 4 Defining Research and Technology Organisations (RTOs)

As the purpose of this paper is to study the development of service innovation capabilities in RTOs, it is important to first define and understand these special types of organisations.

It is a challenging task to give a clear definition of RTOs, though, because of their diverse inherent characteristics. According to the European Association of Research and Technology Organisations (EARTO, http://www.earto.org),

> "RTOs, as their predominant activity, provide research and development, technology and innovation services to enterprises, governments and other clients." (EURAB, 2005, p.1).

RTOs are specialised in applied research; some offer technology transfer and even implementation support, while others deal with certification and standardisation (EURAB, 2005; Preissl, 2006).

Regarding their funding, RTOs rely on a mix of public and private sources, such as membership subscriptions, fee-for-service activities, government core funding, contracts for public grant-funded research or competitive contracts from firms or governments (Berger and Hofer, 2010). Thus, on one hand, RTOs generate income on market offerings and by capitalising on know-how, just like private enterprises. On the other hand, they

qualify for public funding and support public innovation policy by facilitating technology transfer from science to industry (Berger and Hofer, 2010).

Furthermore, the innovation model of RTOs, as described by the report of Arnold et al. (2010, pp.10, 11), comprises the following stages:

• exploratory R&D on a capability area or a technology platform

• further work to refine and exploit that knowledge, often in collaboration projects with the industry

• more routinised exploitation via consulting, licensing and spin-offs.

Hence, RTOs' innovation activities are neither similar to universities nor resemble those of firms. Their role in the innovation system is quite distinct, as they transform research into pragmatic outputs. Moreover, they address concerns regarding the development of service innovation capabilities, as they are expected to offer practical tools and methods for facilitating, managing and organising the service innovation activities of their customers or partner organisations. For these reasons, they provide a fruitful context for studying service innovation.

## 5    External and internal drivers for the development of service innovation capabilities in RTOs

Studying service innovation capabilities in RTOs calls for the identification of the important drivers that foster them. Building on the work of Xin et al. (2006) we argue that there are both external and internal drivers for the development of service innovation capabilities in RTOs.

Externally, the authors refer to the importance of customers and suppliers. However, due to the special character of RTOs, it is not only the clients and suppliers (which we include, together with other RTOs and companies, in the "industry" category), but also the government and academia that are taken into account.

Internally, the strategy of an RTO regarding the development of service innovation capabilities, the NSD process, as well as the available resources (in which we include culture and IT, addressed separately in the work by Xin et al. (2006)), are taken into account.

All the above mentioned drivers, which are gathered in Table 1, will be presented in details in the following chapters.

Table 1    External and internal drivers for the development of service innovation capabilities in RTOs

| Drivers of service innovation capabilities in RTOs | |
| --- | --- |
| External drivers | Selected references |
| Government | Berger and Hofer (2010) and Preissl (2006) |
| Industry (suppliers, clients, RTOs etc.) | Berger and Hofer (2010), Hauser (2010), OECD (2008) and Xin et al. (2006) |
| Academia | Berger and Hofer (2010), Hauser (2010) and Preissl (2006) |

Table 1     External and internal drivers for the development of service innovation capabilities in RTOs (continued)

| Drivers of service innovation capabilities in RTOs | |
| --- | --- |
| Internal drivers | Selected references |
| Strategy | Barney (1991), de Jong et al. (2003), Lawson and Samson (2001),Wernerfelt, (1984), Teece et al. (1997), Xin et al. (2006) |
| Organisational assets | Barney (1991), Froehle and Roth (2007), Gadrey et al. (1995), Möller et al. (2008) and Xin et al. (2006) |
| NSD process | Cooper et al. (1994), de Brentani (1995), Johnson et al. (2000), Froehle and Roth (2007) |

## 5.1 External drivers for service innovation capabilities: government, industry and academia

The definition of RTOs shows strong interrelations with three external actors, namely government, industry and academia.

The government supports and at the same time controls RTOs. It can leverage several mechanisms to do this, namely public ownership, direct control, a charter, a franchise or service agreement, formal stakes in the management board. Thus, the government is an important (if not the most important) stakeholder, as RTOs owe their existence and development mainly to the government's support, which also implies their dependence.

As far as industry and academia are concerned, RTOs occupy a position at the interface of academic research and market processes (Preissl, 2006). They share equally important links with academia and industry, as they can enable industry to exploit new and emerging technologies by providing a business-focused capability that bridges academic research and technology commercialisation (Hauser, 2010). This is a noteworthy interaction, as researchers often argue that there is an industry-academia gap hindering or delaying the commercialisation of important scientific advances. This gap can be filled by RTOs.

In summary, RTOs today (like other innovative organisations) operate in the context of broader collaboration with other RTOs, suppliers, customers, universities, etc. It is the "open" character of RTOs' innovation activities that makes this type of organisation noteworthy contributors to innovation systems fostering collaboration and knowledge transfer. As a result, RTOs can support local economies in a sustainable way by directly or indirectly shaping the systems of innovation that support the open paradigm of Chesbrough (2003).

In this dynamic context, where the firm's as also the industry's boundaries are shifting, new organisational structures are needed (OECD, 2008). This appears to have an effect on the way the innovation process is performed, or even the way innovation capabilities are mobilised. As a result, the strategy of the organisation has to be adapted accordingly, as the benefits of external collaboration cannot be disregarded. Moreover, the strategic alliances that these collaborations may result in can have a significant effect on the way the image of the industry is formed. We consider all these interactions to have an impact on RTOs across all organisational levels.

## 5.2   Internal drivers for service innovation capabilities

### 5.2.1   The service innovation strategy

Since innovation has become a significant determinant for competitive advantage and long term performance, it cannot be perceived anymore as an ad hoc activity. It requires a common vision and a strategic direction, without which interest and attention can be lost (Lawson and Samson, 2001). De Jong et al. (2003), in discussing the antecedents of NSD, identify strategy as an important success factor for an innovative climate. For them, based on the work of Bart (1996), a business vision that incorporates the culture of innovation and communicates it to the employees is essential. Moreover, they identify clear strategic innovation objectives as an important antecedent of the innovative behaviour of co-workers (de Jong et al., 2003). Finally, they emphasise the importance of the new services' fit in the overall strategy of the firm.

Furthermore, there is an inherent relationship between strategy and the development of capabilities. Indeed, the topic of organisational capabilities has attracted a lot of interest in the field of strategic management. In particular, RBV theorists have treated concepts of resources and capabilities as core elements of the generation and development of sustainable competitive advantage (Barney, 1991; Wernerfelt, 1984). Teece et al. (1997) also identify the importance of dynamic capabilities development in the strategic management of organisations.

Based on the above, RTOs' strategy objectives should express the effort to support the development of service innovation capabilities. Finally, what is also essential for the organisation is to be able to confront rigidities and renew itself with such a balanced strategy that "is not too rigid to undermine change, but not too loose to create chaos" (Kianto, 2008, p.72).

### 5.2.2   Resources for New Service Development (NSD)

There have been some significant attempts to relate the RBV to the development of new services. Gadrey et al. (1995) argue that performing a service involves mobilising a bundle of human, technological and organisational competencies. Following the same reasoning, Froehle and Roth (2007) state that intellectual capital, organisational resources and physical resources have significant effect on the effectiveness of NSD. We complement the latter list by three additional resources; namely the relational capital of the organisation, its experience base and its service portfolio. We gather all these elements in an extended resource base, and for the sake of clarity, we separate them analytically, though they are empirically entangled.

1   Human capital. Human skills and intellectual resources constitute the organisation's human capital (Barney, 1991). RTOs are knowledge-intensive and so are their NSD processes; as a result, human capital plays a crucial role in the development of RTO services. But it is not only technical skills and specialised knowledge that count. Froehle and Roth (2007) also bring forward soft skills like the ability to collaborate, an open mindset and creativity as skills that should not be neglected.

2   Structural capital. According to Miller (1986), the most innovative firms are characterised by adaptive, organic organisational structures that foster collaboration

and open and informal communication systems to introduce new products. Thus, they benefit from cross-functional teamwork and enhance knowledge combination perspectives (Froehle et al., 2000). Furthermore, structural capital also includes the organisational culture (Froehle and Roth, 2007), namely a system of informal rules that spell out how people are to behave (de Jong et al., 2003).

3   Information Technology. IT has quickly become a crucial element for service firms (Fitzsimmons and Fitzsimmons, 1998). IT tools allow for the regeneration of the knowledge that lies within the organisation, which in turn results in better processes and better service products (Froehle et al., 2000). We consider the benefits of IT for NSD to be twofold:

   •   IT can raise organisational effectiveness in generating information efficiencies (Dewett and Jones, 2001);

   •   IT can foster collaboration and creativity in contributing to boundary-spanning information synergies.

4   Relational capital. Recently, companies have tended to open up their boundaries and rely increasingly on external resources (Chesbrough, 2003). They have started creating alliances with other firms, suppliers, clients or academia, using practices of distributed co-creation. Thus, the classical RBV theory, according to which internal capabilities are among the firm's biggest competitive advantages, has been challenged (Chesbrough and Appleyard, 2007). Möller et al. (2008) discuss the limitations of the RBV view and extend it by analysing the ways of value co-creation with customers in the innovation process. As a result, external relations constitute one of an organisation's key assets, since the value they create has a significant effect on all stages of the innovation process (Möller et al., 2008).

5   Experience base. In the RBV, the notion of previous experience often comes up as an important asset to be exploited (Zollo and Winter, 2002). We consider the experience base to be a bundle of experiences and accumulated knowledge regarding previous NSD process deployment that can be reused for the development of new services. The experience base thus represents the "organisational memory" (Walsh and Ungson, 1991), where both the tacit and explicit knowledge of previous NSD experience are capitalised on and managed.

6   Service portfolio. The service portfolio is an important resource for the development of innovation capabilities (Barlatier et al., 2010). It is a consolidation of selected services developed by the organisation, and it contains functional as well as non-functional requirements of the service. For RTOs in particular, Barlatier et al. (2010) have identified two main benefits of service portfolio management:

   •   it increases services' visibility for the clients, as it fosters interaction between the organisation and the markets;

   •   it involves customers in the co-design process by exposing them to already developed services.

### 5.2.3  The New Service Development process

Many models of NSD have been proposed in the literature, both linear and iterative. We argue, like many researchers, that the iterative models are more likely to describe the NSD process effectively, as they combine structure with flexibility. In this perspective, Johnson et al. (2000) have created a general highly iterative four-stage model involving design, analysis, development and launch.

1   Design stage. In this stage, the concepts of new services based on new ideas are generated and evaluated. Objectives for the new services are defined according to customer's requirements (Cooper et al., 1994; de Brentani, 1995). Finally, a testing of the initial concept may also be a part of this stage (Froehle and Roth, 2007).

2   Analysis stage. This stage is concerned with the assessment of the new service offering regarding alignment with the overall strategy of the organisation (de Brentani, 1995). This is a critical stage for the continuation of a specific project (Froehle and Roth, 2007). If the concept looks promising, then project authorisation is given.

3   Development stage. This stage deals with the activities for turning a service concept into a viable service offering for the market. All steps that will be followed in the delivery of the service are defined, as well as the required infrastructure to support them (Bitran and Pedrosa, 1998; Froehle and Roth, 2007). Development should also include prototyping and market testing activities (Cooper et al., 1994).

4   Launch stage. This is the last stage of the NSD process, and it comprises activities that bring the newly developed service to the market. Formalised promotion and advertising take place, as well as customer training in the use of the new service (de Brentani, 1995). Moreover, gathering of marketing data and customer feedback are important procedures in this phase to assure the quality of the new service. Post-launch analyses may follow to ensure the effectiveness of the overall NSD process and to provide feedback used for improvement (Voss et al., 1992).

Finally, as also mentioned in the discussion of relational capital, collaborating with customers throughout all the stages of innovation, from idea creation to post-launch feedback, can be extremely beneficial. Indeed, researchers increasingly recognise the importance of client participation in the innovation process (Bogers et al., 2010).

## 6   A conceptual model for the development of service innovation capabilities in RTOs

Having reviewed the important drivers for the development of service innovation capabilities in RTOs, we will now synthesise all these elements into a model that explains how innovation capabilities can be developed and sustained within RTOs (see Figure 1).

The model includes the interactions of the external environment (industry, academia, government) with the RTO, as described in the previous chapter. While we acknowledge the fact that most of the interactions are identified at (or pass by) the strategy level, we show in the next section that we cannot neglect direct interactions with organisational resources or the NSD process.

Figure 1    A conceptual model for the development of service innovation capabilities within RTOs
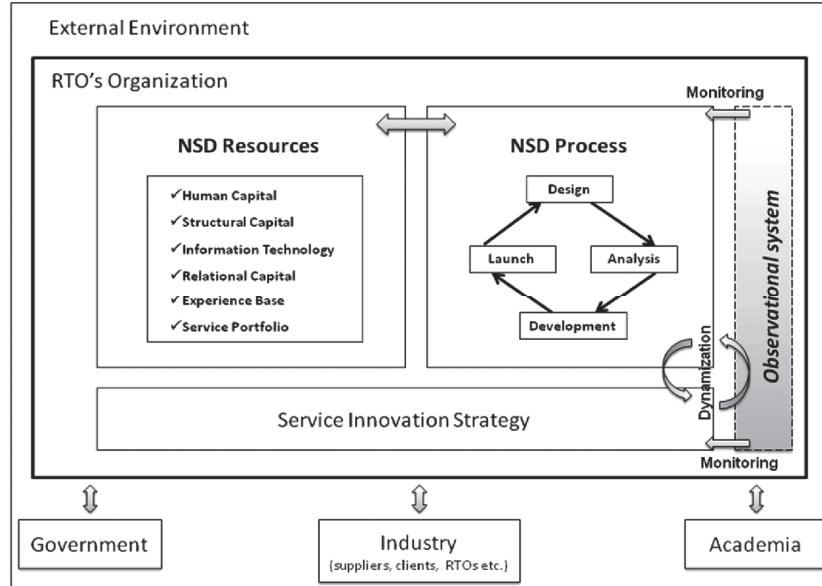


The strategy of the organisation should ensure the development of service innovation capabilities. Organisational strategy should be congruent with both resources and process management mechanisms for NSD to develop capabilities that will enable an RTO to innovate in services. Finally, to sustain these service innovation capabilities and confront their inherent inclination to stagnation, RTOs need to dynamise them through constant monitoring and relevant action. In the following sections, we describe the internal organisational dynamics taking part in this process in more detail.

Specifically, our model emphasises two distinct but complementary high-order managerial issues. On the one hand is the interplay between resources and processes dedicated to NSD to increase operational efficiency, and on the other hand are the monitoring and dynamisation of these resources and processes, as well as the RTO's strategy, to ensure the sustainability of its service innovation capabilities.

## 6.1   The resource-process framework for the development of service innovation capabilities

The importance of both resources and processes for NSD has been acknowledged by Froehle and Roth (2007) in their resource-process framework. According to this framework, it is not only the efficient exploitation of resources that results in the development of capabilities, as the RBV dictates. The two authors argue:

> "A firm that develops competencies in both process-oriented and resource-oriented practices is better positioned to create an NSD capability that differentiates it from its competitors and support continuous innovation and growth." (Froehle and Roth, 2007, p.170).

The theoretical distinction between resources and processes is important when considering their contributions to the service innovation capabilities of an RTO. According to Froehle and Roth (2007), there is a need to first define those resources

and processes that are critical to NSD and then to identify the respective practices that support their service innovation capability.

Resources should be mobilised and combined to support the different phases of the NSD process. It is not enough to have a proficient NSD process if you cannot manage your resources to support it accordingly; and conversely, it is not enough to have all the necessary resources if the RTO does not know how to consciously use them throughout specific stages of the NSD process. Thus, it is highly essential for the organisation to foster an effective management of both its resources and processes for NSD, in accordance with the service innovation strategy.

But there is another interaction that is noteworthy. The feedback from the NSD process can also be valuable for enriching all the organisational resources. The development of a new service may lead to the development of new skills, a new process or a new IT system associated with this process, contributing in this way to the resource base of the organisation. Based on the same reasoning, the development of a new service resulting from collaboration can result in a new relation added to the relation base of the organisation, and of course, all the knowledge and experience gained from it should find its way into the relevant knowledge management tools. Finally, when the service is developed, its packaging and integration in the service portfolio are also essential.

## 6.2    Dynamisation for the development of service innovation capabilities

As already discussed, capabilities are faced with the inherent threat of stagnation. Thus, RTOs need to fight the capability-rigidity paradox to sustain their service innovation capabilities.

We propose to follow Schreyögg and Kliesch-Eberl's (2007) dual-process model of capabilities dynamisation. From this perspective, the NSD process and related resources as well as the current strategy constitute the activity system of an RTO, as they represent the building blocks of service innovation capabilities. To dynamise them, an observational system is needed that monitors activity relating to amendments, renewal, replacement or dismissal. This can be done in various ways, from formal monitoring procedures (e.g., in the NSD process) to an informal culture of tolerating criticism (Schreyögg and Kliesch-Eberl, 2007). It is then up to the organisation itself to either ignore or implement the conclusions from this observation (Schreyögg and Sydow, 2010). If the latter takes place, the dynamisation of service innovation capabilities is ensured.

## 7    Discussion

### 7.1    Our model and the respective literature

The purpose of our study was to construct a conceptual model to shed light on the practices that allow RTOs to develop service innovation capabilities. This model brings forward several interesting points that are worth discussing.

First, we should note that this is one of the few models specifically addressing RTOs, as we have noted a scarcity of relevant publications. Most of the relevant literature concentrates on the interactions of RTOs with their external environment, but very few

studies exist on how these organisations are functioning internally. For instance, the development of service innovation capabilities has not been addressed explicitly by the RTO literature. Our model presents a comprehensive approach of how RTOs can, in practice, develop service innovation capabilities by leveraging external and internal drivers.

Second, the decision to adopt the resource-process framework of Froehle and Roth (2007) is also worth noting, as it concerns NSD in particular. Most of the literature on innovation capabilities, influenced by the RBV, focuses merely on relevant resources. However, it would be an omission not to include the process perspective, especially since a proficient NSD process is an important determinant of service innovation (Voss et al., 1992).

We should note, however, that we propose to develop the work of Froehle and Roth (2007) as far as the relevant resources are concerned. Relational capital is an important resource for the organisation, especially in the contemporary business environment, where the benefits of cooperation and collaboration are commonly acknowledged. Although Froehle and Roth (2007) recognise the importance of co-creation (e.g., with customers or suppliers) in the NSD process, they have not explicitly addressed relational capital as a separate resource.

By the same reasoning, the fact that we have also included the experience base in the resource base of RTO represents a complement to the recent relevant literature. The knowledge base of the organisation has been the subject of many discussions in the relevant literature, mostly in relation to human capital. For us though, it is not merely the organisational knowledge that is interesting. The concept of experience, which comprises the knowledge as well as the 'know-how' of the organisation, is essential for the development of capabilities. Indeed, according to Winter (2003), capabilities are considered as a repository of historical experience in organisational resource deployment and organisational learning.

Furthermore, we also consider the service portfolio to be an important driver for the development of service innovation capabilities. Especially for services, where new concepts can be born from existing services (de Jong et al., 2003), previously defined offerings can be a significant source for bundling and unbundling of new service concepts, an important service innovation capability (den Hertog et al., 2010).

Moreover, our model brings forward the importance of an RTO's service innovation strategy for the development of service innovation capabilities. In light of the resource-process framework of Froehle and Roth, we add service innovation strategy as a significant driver. Indeed, Froehle and Roth (2007) discuss the importance of the interplay between resources and processes and relevant practices, but they do not explicitly refer to the importance of strategy for service innovation capabilities development.

## 7.2  Contributions

We consider the contributions of this study to be two-fold.

On the one hand, as far as the theoretical contributions are concerned, the model is original for several reasons. First, this service innovation capability development conceptual framework is constructed specifically for RTOs, which are very rarely discussed in the literature. Second, it comprises both external and internal drivers for the development of service innovation capabilities, while the majority of studies on

capabilities, being based purely on RBV, address solely the internal determinants. Third, our model suggests that three additional resources, namely relational capital, service portfolio and experience base, are important for the development of NSD capabilities; besides human capital, organisational structure and IT. Finally, we combine two robust frameworks: the resource-process framework of Froehle and Roth (2007) and the dual-process model of capability dynamisation by Schreyögg and Kliesch-Eberl (2007), for developing sustainable service innovation capabilities in RTOs.

As for practical implications, on the other hand, we argue that our study presents a comprehensive and applicable model for the development of service innovation capabilities. We argue that the transparency of the model is its advantage. Managers can consider the double perspective of available resources and processes for the development of service innovation capabilities without neglecting the role of strategy in this process. Thus, what managers need to do is to identify the resources – and process-based practices, along with the innovation strategy, that allow for the efficient development of new services. Moreover, through constant monitoring, the sustainability of these practices and of relevant capabilities can be ensured by modifying or eliminating existing practices or establishing new ones. However, RTOs should be aware that merely monitoring is not enough; they need to be ready to take relevant action (Schreyögg and Sydow, 2010). Thus, this can be an effective answer to the stagnation threat that, sooner or later, every organisation not careful about renewing its capability base will confront.

## 8   Conclusion

The aim of this paper is to provide a better understanding of how service innovation capabilities are developed and sustained within RTOs. To do so, we propose a conceptual model dedicated to RTOs – a specific type of service innovative organisation. Based on the recent literature, we gathered important drivers of service innovation capabilities: namely external ones such as industry, government and academia, as well as internal drivers including strategy, NSD resources and processes. Subsequently, by establishing the interactions among the above-mentioned elements, we have created a model that explains how service innovation capabilities can be developed within RTOs. As capabilities bear the inherent threat of stagnation, it is very important to show not only what the practices that ensure the capability to innovate in services are, but also how these practices can be dynamised (monitored and adapted respectively) to ensure their continuity.

The model provides a starting point for future research on how the interplay among NSD processes, organisational assets and service innovation management practices determines service innovation capabilities. Future empirical work to address and modify this model should investigate what practices constitute service innovation capabilities, and how they are being dynamised. Moreover, further research may identify, through multiple case studies, the differences associated with service innovation managerial practices and performance across organisations.

## Acknowledgements

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# Service innovation capabilities: what are they?

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**Abstract:** As innovation is of crucial importance in services, service-intensive organisations should pay attention to the management of their new service development capabilities. Still, academics have so far been focusing on predominantly conceptual discussions regarding the core definition of organisational capability, rather than on investigating what concretely constitutes specific capabilities, let alone in the service innovation context. Therefore, based on a literature review, as well as 34 exploratory interviews in several service-intensive highly innovative organisations, we have created a mapping of concrete service innovation capabilities and related practices, approached from a strategy, resource and process perspective. Our goal is to allow for a better understanding and management of service innovation capabilities, combining both theoretical and practical perspectives.

**Keywords:** service innovation capabilities; service innovation; capabilities mapping; new service development; NSD.

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# 1   Introduction

Service sectors are the major development force for most developed economies in the world (Apte et al., 2008). Moreover, the importance of services is growing even for manufacturing firms, as delivered services are becoming an even more important weapon against competitors than the tangible products themselves (OECD, 2005; Xin et al., 2006). Innovation is critical for services (den Hertog et al., 2010) because it lies at the basis of sustaining competitive advantage (Miller et al., 2007) and it is one of the few ways to fight the threat of commoditisation (Lyons et al., 2007). Thus, in order to be able to maintain or increase their performance, organisations must continuously create new services (Storey and Kelly, 2001) and for this, they need well developed innovation capabilities (Schang et al., 2010).

Nevertheless, very few studies investigate the development of service innovation capabilities, even less in terms of answering the concrete question *'what concretely constitutes service innovation capabilities?'* Current research has been mostly focused on theoretical concepts of organisational capabilities (Amit and Schoemaker, 1993; Sanchez, 2001) and dynamic capabilities (Teece et al., 1997; Zahra et al., 2006). The discussion has been predominantly carried out on a strictly theoretical level, investigating various hierarchies of capabilities or various theoretical approaches to them. However, except for some notable exceptions (den Hertog et al., 2010; Froehle and Roth, 2007), *service innovation capabilities* have rarely been specifically defined or investigated. Similarly, organisations themselves rarely consciously manage their new service development (NSD) (Kim and Meiren, 2010), nor do they measure its success (Wu et al., 2010). Yet, without the clear and concrete understanding of what constitutes service innovation capabilities, academics will stay on the very conceptual level of discussion and managers will not be able to manage service innovation capabilities effectively.

Therefore, we propose to investigate, based both on a literature review and on exploratory interviews held in service-intensive innovative organisations, what concretely comprises service innovation capabilities. The creation of such a specific capabilities overview has been strongly advocated by Collis (1994), who states that

due to the complex nature of organisational capabilities, as well as their varying value dependent on the industry or time of analysis, researchers should focus on creating lists of capabilities in specific contexts. Similarly, the work of Amara et al. (2010) suggests that innovation capabilities in services are varied and complementary and thus managers who focus too much on the development of isolated innovation capabilities rather than groups of them may under-appreciate how various capabilities reinforce each other.

In summary, this paper aims at developing a theory- and practice-based overview of concrete capabilities and related practices required for successful service innovation. With this contribution, we hope not only to enhance the academic discussion on service innovation capabilities, but also to provide practical insights for managers dealing with the challenges of NSD.

Our paper is structured as follows. First, we discuss the existing academic body of knowledge regarding the concept of capabilities for innovation in the service context. Then, following a short method description, we present an extensive mapping of service innovation capabilities and related practices. We close off with discussion, as well as our work's limitations and future research directions.

## 2 Current understanding of service innovation capabilities

### 2.1 Capabilities

Organisational capabilities are defined as "a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end" [Amit and Schoemaker, (1993), p.35]. Capabilities should not become rigidities themselves, as this would lead to them being an inhibitor rather than an enabler of innovation (Leonard-Barton, 1992; Atuahene-Gima, 2005). Thus, next to the concept of organisational capability, various ideas on how to ensure that capabilities do not remain static have been developed. First one, for instance, is the notion that organisational capabilities develop over time. Once they are mature, they can be renewed, redeployed, recombined, replicated, or become retrenched or retired (Helfat and Peteraf, 2003). Second is the concept of 'dynamic capability', based on the seminal work of Teece et al. (1997), who defined dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p.516). The third approach to 'dynamising' capabilities has been included in the proposition that there are various hierarchies of capabilities, each of them presenting different levels of dynamism (Collis, 1994; Danneels, 2002; Zahra et al., 2006; Ambrosini et al., 2009). Finally, Schreyögg and Kliesch-Eberl (2007), instead of 'dynamising' the capability itself, view capability evolvement and system dynamisation as two separate, countervailing and simultaneous processes: capability practices (on operational level) and capability monitoring (on observational level). As much as these discussions are interesting on conceptual level, they do not bring us much closer to identifying what is, concretely, constituted, by *innovation* capabilities, let alone specifically in the service innovation context.

## 2.2   Innovation capabilities

Therefore, moving to the topic of innovation capabilities in general, Lawson and Samson (2001) propose an 'innovation capability' construct with seven elements. These are: vision and strategy, harnessing the competence base, organisational intelligence, creativity and idea management, organisational structures and systems, culture and climate, and management of technology. Also, Lee and Kelley (2008) have performed a very insightful study on organisational level, nevertheless it was focused on building capabilities for innovation only in manager-project leader relationship's context. Kianto (2008) has indirectly contributed to the discussion on innovation capabilities as well, by creating an instrument to measure organisational renewal capability. Finally, Schang et al. (2010, p.315) investigated the required capabilities for continuous innovation and concluded that they involve dynamic entrepreneurship with both foresight and insight capabilities, as well as "cyclical processes of resource integration, experience, learning and transformation".

## 2.3   Service innovation capabilities

While there is vast literature on innovation in general, including some interesting works on innovation capabilities, as discussed above, very few studies actually investigate this topic in the specific context of services. This is a paradox because the academics do agree that service innovation differs greatly from product innovation in various respects, for instance the dichotomy of 'product/process' innovations is less evident in services (Droege et al., 2009; Sundbo and Gallouj, 1998) and the role of technology is less prominent in service innovation (Gallouj and Weinstein, 1997). Some notable exceptions of works that do focus on service innovation capabilities specifically include the contributions of Froehle and Roth (2007), Menor and Roth (2008), den Hertog et al. (2010) and Zhou and Wei (2010). Froehle and Roth (2007), in their 'resource-process framework of NSD capability, have identified specific practice constructs underlying both the resource-oriented (intellectual, organisational and physical) and the process-oriented (design, analysis, development, and launch) sides of NSD capability. The work of Froehle and Roth (2007) is probably the most extensive contribution to the service innovation capabilities topic. The authors were the first to really stress the importance of both resource- and process-related aspects of NSD. Their contribution is the cornerstone of the theoretical side of our work. Menor and Roth (2008) conceptualised NSD competence as a second-order construct represented by formalised NSD processes, market acuity, NSD strategy and IT use and experience. They also show that while formalised NSD process is the least important, market acuity is the strongest NSD competence indicator. We take their findings into account in our overview. den Hertog et al. (2010) also provide a very interesting contribution to the service innovation subject. They propose that there are six dynamic service innovation capabilities:

1   signalling user needs and technological options

2   conceptualising

3   (un-)bundling capability

4    co-producing and orchestrating

5    scaling and stretching

6    learning and adapting.

These are very insightful propositions, however, it should be noted that they are purely conceptual ones. Zhou and Wei's (2010) work, on the contrary, is empirical. Nevertheless, this analysis is a quantitative evaluation of service innovation capabilities maturity level rather than a contribution that helps us understand the content of capabilities for innovation in services.

We can conclude that, to our knowledge, except for the contributions discussed above, little work has been performed on what concretely constitutes service innovation capabilities. This paper aims at decreasing this gap.

## 3    Method

In order to create an overview of service innovation capabilities that is detailed and as complete as possible, we took the available works on this topic as basis of our mapping. We further enriched it with practitioner interviews to make sure that the results would be closely aligned with the organisational reality. We decided that our target interviewees should be practitioners of service innovation, preferably with a broad perspective on the topic through the involvement in various types of service innovation initiatives and collaboration with various types of stakeholders, as this would give us a rich complementary input to the service innovation literature-based mapping. Therefore, we selected our interviewees from the pool of Research and Technology Organisations (RTOs[1]), as they are both highly innovative and highly focused on continuously developing new services. RTOs provide R&D, technology and innovation services to companies, governments and other clients, bridging the gap between research and commercialisation (Hauser, 2010). This means that they continuously develop new, innovative services as part of their organisational mission. RTOs' mission is also to support service innovation capabilities of the organisations they serve. In practice, thus, the interviewed service innovation experts operate in vast range of industries, including different service as diverse as IT, healthcare, training, hospitality, architecture, etc. We believe this gives them an even broader perspective on service innovation. Consequently, RTOs represent a very interesting source of interviewees in terms of service innovation capabilities. With the help of the European Association of Research and Technology Organisations (EARTO), we selected four most suitable European RTOs (dubbed Alpha, Beta, Gamma, Delta in this study), ranging from several hundred to several thousand employees and being active for several decades. We interviewed 7 to 10 persons from each of them, according to the saturation principle (Eisenhardt, 1989; Charmaz, 2000). Our interviewees were very carefully chosen with the aim to provide various perspectives on service innovation. Thus, we defined interviewee profiles upfront (see Figure 1) and then we searched for persons matching them (or representing the roles described) in each of the studied organisations.

In order to make the best use of each interviewee's knowledge, we created customised interview guides for each of the 34 respondents based on the role(s) they held. Starting from a capability and related practice resulting from the literature review, we created a relevant question (or several ones), allowing for collecting information through a semi-structured interview. We then mapped the questions to relevant interviewee profiles, according to who we believed were the best persons to provide well-informed answers. Nevertheless, we insist on the fact that the resulting list of questions served as a flexible interview guide, rather than a strict questionnaire. This process made it possible for each interview to be flexibly adjusted to specific interviewees, on one hand, and to be complete in terms of information collection, on the other. In general, we started the interview with content mapping questions (based on the sketch of mapping developed in literature review step) and we moved to content mining ones as the conversation progressed; this way we made sure that we gathered a relatively complete but also detailed information (Legard et al., 2003). The interviews lasted between one and two hours and were recorded, transcribed and, in 90% of the interviews, double-coded using the qualitative data analysis software. The coding grid was based on the results gathered from the literature review, but it evolved in the process to reflect the emerging categories (Miles and Huberman, 1994).

**Figure 1**     Targeted interviewee profiles

| Role | Description |
|---|---|
| Top management team member | A person from top management who has a strategic view as well as the vision of the organization regarding service innovation. |
| Business unit manager | Medium level management responsible for the human resources management in the specific department or unit dealing with the development of new services. |
| Service department / portfolio / line manager | Responsible for the development of specific service(s) or (part of) service portfolio for the organization. |
| Marketing / PR / BD manager | Responsible for external relations including marketing, public relations and business development. |
| New service development project manager | Manager responsible for the development of a new service. This person has an overview of the development process and the involved resources . |
| New service development team member / engineer | Person working in a specific new service development project team and he/she is directly involved in one, more or all the stages of the development process. |
| Quality manager / Business process manager | A person who is responsible for the organizational processes, relevant documentation and improvement practices within the organization. |
| Innovation or R&D manager / Scientific coordinator | Manager responsible for R&D or innovation strategy of the organization. He/she could also be the connecting point with the academia. |
| Knowledge manager | Responsible for knowledge management in the broad sense e.g. best practices guide, project databases, qualifications repositories, IP management etc. |
| IT manager | Responsible for Information Technology provided as part of the service (he/she could also be involved in back-office support but not as the main task). |

In an iterative process, when the empirical results were suggesting interesting additions to the existing service innovation capabilities base of knowledge, we looked in the general innovation literature for potential references that could in some way shed light on the phenomena we observed in practice. We combined both the theoretical and practical insights in one single overview of service innovation capabilities as presented in the next chapter.

## 4 Results: service innovation capabilities mapping

Organisational capabilities involve allocating resources to address processes (Schreyögg and Kliesch-Eberl, 2007). In the service innovation context specifically, the NSD success is based on a capability to manage both NSD resources and NSD processes (Froehle and Roth, 2007). Moreover, the desired direction of innovation should be guided by an innovation strategy (Lawson and Samson, 2001). We thus define service innovation capability *as ability to efficiently and effectively combine resources to successfully execute the NSD process, in order to achieve the strategic service innovation goals.*

Investigation of capabilities is closely linked to understanding organisational practices related to them: "capabilities are close to action. Conceptually they cannot be separated from acting or practicing" [Schreyögg and Kliesch-Eberl, (2007), p.915]. Some scholars even define innovation capabilities "as a set of practices aimed at enabling novel approaches for assembling and integrating resources to achieve innovative outcomes" [Lee and Kelley, (2008), p.156]. Also, Froehle and Roth (2007) have identified specific practice constructs underlying the NSD capability.

In fact, our contribution is largely based on the foundations laid by Froehle and Roth (2007) in their resource-process framework. However, based on the results of extended literature review and the interviews performed with service innovation practitioners, we enrich and adjust the original framework significantly in many respects.

Firstly, we explicitly distinguish a group of capabilities relating to *service innovation strategy*, because strategy is often mentioned as the key component of service innovation activities (Sundbo and Gallouj, 1998). Top management should therefore decide on the desired innovation direction and invest in innovation capabilities development, respectively (Soosay, 2008). Strategy should reflect the innovation ambitions of an organisation and provide organisational conditions and external focus to enable the realisation of innovation goals. Lawson and Samson (2001) make it very clear:

> "The link between vision, strategy and innovation is important to effective innovation management. Strategy determines the configuration of resources, products, processes and systems that firms adopt to deal with the uncertainty existing in their environment. It requires that firms make decisions about what businesses and functions they should be performing and in what markets requires a clear articulation of a common vision and the firm expression of the strategic direction. This is a critical step in institutionalising innovation. Without a strategy for innovation, interest and attention become too dispersed." [Lawson and Samson, (2001), p.389]

In sum, while the resource-process framework of NSD (Froehle and Roth, 2007), as the name suggests, is solely focused on the NSD, we believe that service innovation is a broader concept encompassing also the strategic aspects that should be included when talking about service innovation capabilities.

Secondly, we modify the original *resource side* of Froehle and Roth's (2007) framework by explicitly distinguishing relational capital as a separate resource, because of the fact it was very often stressed by the interviewed practitioners. Specifically, our experts often named clients and partners as crucial contributors to service innovation. The literature review supports this empirical finding. Academics are aware of the fact that current business environment does not let us neglect the benefits of collaboration and

cooperation in innovation (Bughin et al., 2008). The new rules that came into play, as advocated by the open paradigm of Chesbrough (2003), explicitly demand an open approach towards innovation, including cooperation among multiple actors, such as clients, suppliers, partners, etc. Issues of how these relationships can be managed more effectively rise together with the need to define the related open innovation (Chesbrough, 2003) capabilities. This is even more evident in the case of service innovation (Chesbrough, 2011a), where the client needs to be included in the whole process of NSD, as mentioned in our interviews. In cases where services are less standardised, this interaction and collaboration is even more essential. While the literature mostly focuses on relational capital as important asset for innovation in general, our interviewees have often mentioned also one specific aspect of it, namely brand and reputation, because *"brand as a name is very important to get into contact with other market"* (Service Manager, Gamma).

Moreover, what Froehle and Roth (2007) call physical resources seems to be mostly comprised of two key assets in the service context: IT and financial resources. IT is often perceived as the enabler of services innovation (Gago and Rubalcaba, 2006; OECD and EUROSTAT, 2005) and our empirical evidence confirms this view. The degree to which the potential of IT in service innovation is exploited can vary, though. While some organisations simply use it as support for various processes, others build their services around their technological capabilities, daily operating *"in an environment where you always have the "best in class" technology, new leading technologies and everything around and even technology that doesn't officially exist in the market yet"* (Project Manager, Beta).

Financial resources, finally, are also indispensable for service innovation. Even though new services development often requires less financial investment than product development, due to the intangible nature of services, often time and thus money is a constraint when it comes to both coming up with and following up on new ideas. As one Researcher/Consultant (Beta) put it, *"even if you have a good idea, if you don't find an option to get money for this idea, (…) then it often happens that the idea is not realized"*.

In terms of the process perspective, we apply the NSD framework of Johnson et al. (2000) comprising design, analysis, development and launch, same as Froehle and Roth (2007). Nevertheless, we include new theoretical and practical aspects resulting from our study. It should be noted here that the four 'stages' mentioned above are not steps in terms of chronological order. Rather, they are groups of activities that need to be performed in order for a service to be developed. In fact, their order may vary according to the type of the new service being developed (Toivonen and Tuominen, 2009).

Finally, it should be stressed that our overview is a merely illustrative visualisation of the vastness of the service innovation capabilities topic and in no way is it meant to represent an exclusive or exhaustive list of service innovation capabilities. Indeed, Collis (1994) advises to remain realistic in this respect:

> "(…) researchers should have a more limited agenda. They should generate lists of the enormous variety of capabilities and develop normative prescriptions for actually building those capabilities that have apparent potential in a particular industry in the near future, while recognizing that these might always be blindsided by a substitute or higher-order capability." [Collis, (1994), p.151]

The resulting overview is presented in Table 1.

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Service innovation strategy* | | | |
| Explicit service innovation strategy | Explicitly mention service innovation strategy objectives in the overall strategy and communicate them well through the broad organisation | Lawson and Samson (2001; @), Kianto (2008; @), and Xin et al. (2006; $) | *"(…) it must be like our strategy (…) or something like that services and service innovation is there, is present. Maybe before it was there but it's was a bit hidden, now it's there better."* (Researcher, Alpha) |
| Strategic focus on continuity/ sustainability of service innovation | Service innovation strategy objectives include the objective of continuous service innovation. Focus on both 'exploitation' ('insight'/ 'mainstream'/'reinforcement'/ 'incremental innovation') and 'exploration' ('foresight'/'newstream'/transformation/ 'radical innovation') | Atuahene-Gima (2005; @), Boer and Gertsen (2003; @), Corso (2002; @), Lawson and Samson (2001; @), Schang et al. (2010; @), Subramaniam and Youndt (2005; @) and Zhou and Wei (2010; $) | *"It's become more pressing to really focus on "is this still a innovative service or has it become repeat business?"* (Expertise Area Director, Gamma)<br><br>*"It's a continuous process. We don't think that our service portfolio is finished or is ready, so there is always that new knowledge development. So it's not a kind of balance in that sense. It's a continuous process. The focus is on new developments."* (Research Topic Manager, Gamma) |
| Service innovation monitoring and measurement | Develop and use innovation performance indicators | | *"It is important to have phases, to have criteria, to make decisions."* (Strategic Planner, Gamma) |
| Strategic alignment of service portfolio | Align service portfolio is with the business vision, strategy and objectives | | *"We checked our portfolio last year. (…) We decided that about 20% of our portfolio was repeat business. It was profitable, that was really nice. But it was repeat business and we said in the new strategy (…), that really doesn't fit within the new organization and we spun that out."* (Expertise Area Director, Gamma) |
| *NSD process* | | | |
| NSD process | Utilise an effective and efficient, but not necessarily structured NSD process | Toivonen and Tuominen (2009; $) and Xin et al. (2006; $) | *"I think if you would ask most of my colleagues whether we have standard processes for service development they would say we don't have but in effect I think we have some."* (Competence Center Leader, Beta)<br><br>*"Interviewer: The question is if you have some kind of model for developing new solutions? Interviewee: Well, I should have but (…) that's more flexible in that sense. To my opinion, that's real question directed."* (Research Topic Manager, Gamma) |

*Source:*   Adapted from Frohle and Roth (2007)

**Table 1**    NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *NSD process* | | | |
| Strategic alignment of NSD process | Manage the NSD in a way that is directly derived from and consistent with the strategy | | *"(…) If we take this portfolio management in this theme way of steering the organization seriously we have to also translate it in an organization which also facilitates that. So we are now talking about theme based project organization."* (Strategy Director, Gamma) |
| Innovation broader than NSD | Manage different NSD projects within a common innovation framework so that one NSD project can benefit from others | Corso (2002; @) | *"And that is as well an approach of, yeah, not inventing the wheel completely new but creating new services out of things that have already been established."* (Researcher/Consultant, Beta) |
| *Service design* | | | |
| Cultivation of creativity | Cultivate and actively consider ideas and suggestions from employees for new service ideas and improvements | Froehle and Roth (2007; $), quoting de Brentani (1989), Loch et al. (1996), Björk et al. (2010; @), McKelvie and Davidsson (2009; @) and Zhou and Wei (2010; $) | *"From our point of view, the key resource for innovation is first of course the kind of invention (…) without invention there's nothing to innovate. Somehow you have to have an idea of what you can do."* (Competence Center Leader 1, Beta) |
| | | | *"We really stimulate automatic creativity and take it very seriously."* (Research Topic Manager, Gamma) |
| Variety of idea generation methods | Develop both formal and informal methods of generating new service ideas | Froehle and Roth (2007; $), quoting de Brentani (1989), Reidenbach and Moak (1986), Thwaites (1992) and McKelvie and Davidsson (2009; @) | *"We have an annual cycle of planning where broad input from our organization is being asked in a formal and structured way. On top of this, there is always the opportunity to come up with new ideas. We have an intranet opportunity where people dump new ideas and they are discussed online and evaluated online."* (Research Topic Manager 3, Gamma) |
| Strategic definition of new service concept goals | Define and communicate goals for the new service concept | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), and Meyers (1984) | *"There are also some documents which have been discussed with service line manager, a document about strategy of the service line, define the strategy of the service line, […] where we identify what is the target of the service line, what are we doing in this service line, what are the current services and what are the new services or the adaptation we can make on existing services in the following areas."* (Service Line Manager, Delta) |

*Source:*    Adapted from Frohle and Roth (2007)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| | *Service design* | | |
| Signalling user needs/client design input/client focus | Emphatically understand users and sense their (potential) needs well in advance by interacting intensively with (potential) clients/gather input from clients during initial conceptualisation of the new service/focus on meeting the needs of a specific client or market segment during initial conceptualisation of the new service, e.g., dialogs with lead users, account management systems, client profiling, detailed analysis of how current services are used, trend analysis in client groups | den Hertog et al. (2010; $) quoting Bruni and Verona (2009, p.107), Teece (2007, p.1326), Wang and Ahmed (2007, p.37), Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), Cooper et al. (1994), Edvardsson and Olsson (1996), Goldstein et al. (2002), Hedvall and Paltschik (1991), Kianto (2008; @), Lawson and Samson (2001; @) and Kaasinen et al. (2010; $) | *"(...) we have to listen to the market and that is what we call 'demand-driven steering' or the demanding and guidance, you could say, from the market so we have to organize meetings, workshops with our customers, with new customers, potential customers, with branch organization, to listen to them and based on that, make a kind of roadmap for the future where the questions of the future are included. So technology, trends, etc."* (Strategic Planner, Gamma) |
| Client concept feedback/ alliance design input | Obtain client feedback on the initial new service concept prior to beginning formal design | Froehle and Roth (2007; $) quoting Cooper and de Brentani (1991), Goldstein et al. (2002), Edvardsson and Olsson (1996), and Loch et al. (1996) | *"So that's the first phase. First, we develop our own projects, our own ideas and we check these ideas with our stakeholders."* (Research Topic Manager 2, Gamma) |
| Signalling new technological options | Make sure to be informed about the latest options that technologies offer in the concerned and related industries | Miller (1993), den Hertog et al. (2010; $) quoting Kindstrom et al. (2009, p.336) and Teece et al. (2007, p.324) | *"It's difficult for us to miss trends (...) because we have talk a lot to people like to other colleagues, to other departments, we go to fairs to do you know lots of things. So, usually you run into all the hot topics when they get hot for sure."* (Researcher/Consultant 1, Beta) |
| Ensuring the right development motivation | Ensure that the new service concept meets real client or business need (versus just using the latest technology) | Froehle and Roth (2007; $) and quoting Edvardsson and Olsson (1996) | *"The focus on one of the main criteria for internal projects is industrial relevance. That means, is there a market for the result? The result could be a tool, could be a method, could be a lab... is there a market? Could it be sold to companies? That's... there are also other criteria (...) but this market-oriented, customer-oriented criteria, are one of the most important."* (Competence Center Leader 2, Beta) |
| Bundling or unbundling of services or their functionalities | Bundle, enrich and blend existing services to create new ones<br><br>Unbundle existing services or strip them down to bare essentials to create new ones | den Hertog et al. (2010; $) and quoting Normann (2002) | *"Yeah, so from these small pieces [of services] I should identify the ones which are going together."* (Service Line manager, Delta) |
| Belief in the idea | Have motivation and personal belief that a service idea has potential for success | | *"I think it starts with a person who believes in his project, in his idea. There it starts. (...) Start with a good idea...and if you really believe in your idea, you have to find some stakeholders and a budget and then you can go into business."* (Research Topic Manager, Gamma) |

*Source:* Adapted from Frohle and Roth (2007)

**Table 1**    NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| | *Service analysis* | | |
| Proper idea evaluation methods | Develop both formal and informal methods of evaluating new service ideas | Froehle and Roth (2007; $) quoting de Brentani (1995), and Cooper and de Brentani (1991) | *"There is the screening part that was the most important in terms of working intensity because it is the process the most evident that has been implemented in the centre (…)"* (Unit Manager, Delta) |
| Financial analysis of new service concept | Analyse the financial/economic viability of the new service concept prior to beginning formal development | Froehle and Roth (2007; $) quoting de Brentani (1995, 1989), Cooper and de Brentani (1991), Edvardsson and Olsson (1996), and Reidenbach and Moak (1986) | |
| Formalised project authorisation | Formally approve and authorise the new service development project | Froehle and Roth (2007; $) and quoting Meyers (1984) | *"And then you formalize it. (…) But then it becomes formal and so in most cases the position is that you put something against it. So, then you turn to Business Developer or Project Leader or Senior or you have to do something."* (Research Topic Manager, Gamma) |
| Competitor analysis | Analyse and consider competitors' strategies and services when evaluating the viability of the new service concept | Lawson and Samson (2001), Kianto (2008; @), Atuahene-Gima (2005; @) quoting Narver and Slater (1990), Froehle and Roth (2007; $) quoting de Brentani (1989), Cooper et al. (1994), Edvardsson and Olsson (1996), Meyers (1984), Roth (1993), Roth and Jackson (1995), and Thwaites (1992) | *"In the tool of research commercialization of Alpha, in the fourth step of the process, where the business plan of the new service idea is presented, the competition of the market of the chosen business concepts need to be explicitly described."* (Source: Secondary Data Alpha) |
| Market research | Perform an in-depth market analysis to help define the initial new service concept prior to beginning formal design | Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Cooper et al. (1994), Cooper and de Brentani (1991), Edvardsson and Olsson (1996) and Kianto (2008: @) | *"Now we have a ranking here which could be a MABA analysis, market attractiveness, business attractiveness (…)"* (Strategic Planner, Gamma) |
| Product line analysis | Analyse existing service line to identify synergies and conflicts with the new service concept | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998) | *"(…) compare the strength of the product-market combinations relative to each other."* (Strategic Planner, Gamma) |

*Source:*    Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Service development* | | | |
| Signalling user needs | Emphatically understand users and sense their (potential) needs well in advance by interacting intensively with (potential) clients, e.g., dialogs with lead users, joint experimentation and prototyping, user panels and focus groups, detailed analysis of how current services are used, observation | Atuahene-Gima (2005; @) quoting Narver and Slater (1990), den Hertog et al. (2010) quoting Bruni and Verona (2009, p.107), Teece (2007, p.1326), Wang and Ahmed (2007, p.37), Zhou and Wei (2010; $), Lawson and Samson (2001; @) and Kaasinen et al. (2010: $) | *"We propose a solution but we adapt it to the customer needs (...) we are normally happy to adapt all the processes."* (Researcher/Consultant, Beta) |
| Pre-launch testing and prototyping, market testing | Fully test and 'debug' new service (using prototyping tools) prior to launch to reduce potential sources of error/variance in new service; conduct market tests in order to confirm the new service product is marketable, appropriately developed, and ready for launch | Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Bitran and Pedrosa (1998), Cooper et al. (1994), Edvardsson and Olsson (1996), Reidenbach and Moak (1986), Loch et al. (1996), Stewart and Chase (1999), Stewart and Grout (2001), and Voss et al. (1992) | *"Yeah, we build some sort of prototype that we then pilot with the customer and for instance if it's totally something new I would say that, we also discuss with the customer that this is really the pilot case that we are doing (...)"* (Middle Manager, Alpha) *" (...) we would all it piloting for example when we either decide that this could be something that a wide range of customers would be interested in, then we make a pilot project with some of our customers and we tell them that we'd like them to help us creating this service."* (Middle Manager, Alpha) |
| Front-line staff recruitment and training | Recruit and hire new front-line staff that will be needed to offer the new service offering Extensively train front-line staff on how to support the new service being developed | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), Cooper et al. (1994), de Brentani (1989,1995), Cooper and de Brentani (1991), Edvardsson and Olsson (1996), and Loch et al. (1996) | |
| Service blueprint creation | Create a service 'blueprint' in order to solidify the processes, people, and information flows involved in providing the new service | Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Cooper and de Brentani (1991), and Shostack (1984) | |
| Supporting services co-development | Ensure that both core and supporting services are co-developed prior to launch of the new offering | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), and Edvardsson and Olsson (1996) | |
| Client interaction | Co-develop the service with the client | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), Cook et al. (2002), Edvardsson and Olsson (1996), Hill et al. (2002) and Kaasinen et al. (2010; $) | *"(...) when a specific customer exists for this project which I guess is the case most of the times there is a constant collaboration with the customer."* (Middle Manager, Alpha) |

*Source:* Adapted from Frohle and Roth (2007)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| | | *Service launch* | |
| Formalised launch | Develop and implement a detailed programme to launch new service | Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Cooper and de Brentani (1991), and Reidenbach and Moak (1986) | |
| Formalised promotion | Implement a detailed promotional program for the newly introduced service | Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Cooper and de Brentani (1991), Reidenbach and Moak (1986) and Zhou and Wei (2010; $) | *"Well, normally we make some kind of brochure or at least presentation slides and when we contact the potential customers which we have identified during the development process and approach them and tell them that we have developed this kind of new service, new technology, are you interested, we would like to come and present it to you."* (Top Manager, Alpha) |
| Realistic expectation setting | Establish realistic expectations in your clients for the newly introduced service through appropriate marketing | Froehle and Roth (2007; $) and quoting Edvardsson and Olsson (1996) | *"But the customer, he has to be very knowledgeable to understand how he can benefit from our knowledge and so this process (referring to the commercialization toolbox) we like to turn the knowledge to benefits so that we can sell benefits to customer and it's much more easier for the customer to understand that okay if those are benefits when I get value of service."* (Middle Manager, Alpha) |
| Client training for the new service | Train new clients how to use newly introduced service | Froehle and Roth (2007; $) quoting Bitran and Pedrosa (1998), and Edvardsson and Olsson (1996) | *[Interviewer: do you train your clients?]* <br><br> *Interviewee: "in some cases, we follow so that we look at what is happening and is there any need for adjustments."* (Top Manager, Alpha) |
| Internal promotion of the new service | Market and promote the new service to front-line employees and others involved in supporting it | Froehle and Roth (2007; $) quoting Cooper et al. (1994), de Brentani (1989, 1995), Cooper and de Brentani (1991), Voss et al. (1992), and Edvardsson and Olsson (1996) | |
| Scaling up successful service innovations | Codify and transplant essential elements of the service to other parts of the organisation | den Hertog et al. (2010; $) | *"Then I try with this service to address some other markets so then to modify the service in order to answer for example to E-Government services, how can I address with one service which has been developed for private society, how can I address it in public sector?"* (Service Line Manager, Delta) |

Source:   Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Service launch* | | | |
| Stretching core service offering | Launch innovative service concepts using the existing service brand name | den Hertog et al. (2010; $) | *"So, you are starting a new project, having actually no real experience on it, you are performing a project and you realize you set up a pretty good structure for that project and it works pretty fine. And you see that other companies are struggling, basically, the same challenge and you say well you could transfer the approach of that project to other ones as well. And you could easily offer it as a service and you could say you have already done it in that way and go to the public with this approach."* (Researcher/Consultant, Beta) |
| Post-launch evaluation | Formally evaluate the development and introduction of new service after launch – both internally and through client feedback | Froehle and Roth (2007; $) quoting Voss et al. (1992), and de Brentani (1989,1995) | *"This is more done on a non-structured and relatively informal level. So, the people who worked in the project try to keep in contact with the customer after the project to check if they were happy (…)"* (Researcher/Consultant, Beta) |
| | | | *"We have yearly inquiries by an expert or agency on customer satisfaction. So this would be a random selection of a number of projects where the customers are being interviewed on their satisfaction on many aspects of the project."* (Scientific Coordinator, Gamma) |
| *Resources for NSD* | | | |
| Strategic alignment of resources | Manage the resources for the service innovation purpose based directly on the strategy | Froehle and Roth (2007; $), Lawson and Samson (2001; @) and Zhou and Wei (2010; $) | |
| *Intellectual capital* | | | |
| Proactive recruitment and selection of employees | Recruit and select employees who will contribute to service innovation | Aronson et al. (2008; @), Atuahene-Gima (2005; @) quoting Chandy and Tellis (1998), and Gatignon and Xuereb (1997) | *"(…) if people have not already some seed inside themselves it doesn't create new ideas. (…) I think it's basically has to do with people, which is difficult because the only thing – what can you do, educate them in school but it's also difficult."* (Competence Center Leader, Beta) |
| Employee training for NSD | Train employees and promote learning in the field of service innovation and new service development | Aronson et al. (2008; @), Kianto (2008; @) and Xin et al. (2006; $) | *"We are quite happy to have our service researchers all over the organization (…) but it's important that they know each other and somehow also disseminate this kind of service research thinking because it can be applied to many, many things. (…)"* (Researcher, Alpha) |

*Source*: Adapted from Frohle and Roth (2007)

**Table 1**   NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Intellectual capital* | | | |
| Diversity appreciation | Promote the sharing of ideas and knowledge related to NSD across functional boundaries within the organisation | Lee and Kelley (2008; @), Froehle and Roth (2007; $) quoting de Brentani (1989), Edvardsson and Olsson (1996), Loch et al. (1996), Terrill (1992) and Froehle et al. (2000; $) | *"I think the really main advantage [RTO] has, is its multidisciplinarity. And if you can combine these disciplines, you're the organization to beat. And if we can achieve that we will survive in the coming years."* (Research Topic Manage, Gamma) |
| | | | *"Some people from completely different organizations come to me and say, "Hey, you're working on [topic X], I have something, which could be part of your idea." (…) Well, that's the way of thinking. It's a complete new way of thinking and new links with other departments."* (Research Topic Manager, Gamma) |
| Explicit knowledge capitalisation | Use repositories of codified best practices, previous project documentations, methodologies etc. for the NSD process purposes; keep track of failed and successful service innovation efforts | den Hertog et al. (2010; $), Kianto (2008; @), Leiponen (2008; @), Nonaka and Takeuchi (1995; @) and O'Dell and Grayson (1998; @) | *"I have something, what we have called the Service Portfolio Management, and… I built a model or something like that to be able to have all sort of information about my services in my service line and so at the beginning I was really for that and now I refer to it in order to be able to define the service with."* (Service Line Manager Delta) |
| Internal tacit knowledge sharing | Share tacit knowledge internally: involve experienced employees in the NSD process to benefit from their knowledge (know-how, best practices) | Kianto (2008; @), Leiponen (2008; @), Nonaka and Takeuchi (1995; @) and O'Dell and Grayson (1998; @) | *"There are, of course, knowledge sharing, other possibilities. There are some events on a regular basis here. Team meetings, on a various small scale, there is a team meetings. In the team, of course, you know each other, you talk about the development and everything – this is not the problem and not the question (…)"* (Project Manager, Beta) |
| External tacit knowledge sharing | Share tacit knowledge externally: acquire know-how from partner organisations | Cavusgil et al. (2003; @) | *"The basic idea is we should find out in which areas we can join forces to create capacity, (…) to build complementary skills."* (Strategy Department Employee, Gamma) |

*Source*:   Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Structural capital* | | | |
| Clear lines of responsibility for NSD | Make sure the firm's organisational structure defines lines of responsibility and authority for developing new services; establish and empower a new service development 'champion' to oversee and manage the new service initiatives | Froehle and Roth (2007; $) quoting de Brentani (1989), Edvardsson and Olsson (1996), Voss et al. (1992), Lawson and Samson (2001; @), Johne and Harborne (2003; $) and Xin et al. (2006; $) | *"I can define my role as being interface between the unit and the market, the programs, so my main role is to identify capabilities of the unit in terms of research, identify some research which can be used for service for certain program or market, so identify this piece of research which can be useful for the market and on the other way around identify the needs of the different market and program, regarding my service line [..]. So I think I'm more in the middle, able to understand market needs and to report it to research and the other way around."* (Service Line Manager, Delta) |
| Cross-functional team development | Develop your employees' ability to work effectively in cross-functional NSD teams; enhance creation of formal and informal managerial networks | Colarelli et al. (2008; @), Froehle and Roth (2007; $) quoting de Brentani (1989), Edvardsson and Olsson (1996), Loch et al. (1996), Terrill (1992), Kianto (2008; @), Zhou and Wei (2010; $), Froehle et al. (2000; $) and Xin et al. (2006: $) | *"If I need a project leader, I'll go looking for a project leader and if he comes from another department I don't care. (…)That's definitely an advantage."* (Research Topic Manager 1, Gamma)<br><br>*"We do cooperate across the groups (…) We think that's actually this is going to be a lot of innovation in the future just like I think a lot of products right now comes from this cross-industry innovation or cross-technologies."* (Researcher/Consultant, Beta) |
| Effective internal communication | Ensure that functional areas or departments involved in developing new services communicate effectively with each other; foster socialisation, especially in design phase | Atuahene-Gima (2005; @) quoting Narver and Slater (1990), Zahra and Nielsen (2002), Froehle and Roth (2007; $) quoting de Brentani (1989, 1995), Meyers (1984), Lievens and Moenaert (2000), Voss et al. (1992), Kianto (2008; @), Lawson and Samson (2001; @), Schulze and Hoegl (2006; @) and Xin et al. (2006; $) | *"The openness is very…yeah, everybody want to share something. Even on our intranet, a lot of people are communicating (…) a lot of people from this building are using that platform and they are not… reluctant to share their ideas. They want to share their ideas."* (Research Topic Manager, Gamma) |
| Managerial support for service innovation | Require support from and involvement of senior management for service innovation | Froehle and Roth, 2007: $) quoting de Brentani (1989), Chiesa et al. (1996), Kianto (2008; @), Lee and Kelley (2008; @), Lyons et al. (2007; $) and Xin et al. (2006; $) | *"(…) the head of our [department] he looks at it and he usually, there's no criticisms also, but he rather you know, he tries to help us (…)"* (Researcher/Consultant, Beta)<br><br>*"No one tells you "OK, you just do this, this, this, and this," you know? It's just "OK, in two weeks, we need a result for a prototype" or something, I don't know, "and you can be completely be free in realizing it."* (Project Manager, Beta) |

*Source:*  Adapted from Frohle and Roth (2007)

**Table 1**    NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Structural capital* | | | |
| Innovation based rewards structure | Base rewards on innovation criteria (performance of NSD team versus individual reward; creativity) | Froehle and Roth (2007; $), Lawson and Samson (2001; @) and Zhou and Wei (2010; $) | *"In most of research organizations you can become a manager or head of department by waiting. That means you have to wait until one guy will leave the [department] and you can replace him. [Here] the model is if you could finance three people and in the next year five people, you could, you will get your own research team (…) it's maybe like an entrepreneurial model that you have internal entrepreneurs that push their topics and there's a clear system, a reward system for successful activities."* (Competence Centre Leader, Beta) |
| Employee motivation for service innovation | Motivate staff to help support the firm's new service development efforts | Froehle and Roth (2007; $), Kianto (2008; @) and Lawson and Samson (2001; @) | *"I think the motivation of the people here is a key aspect, so that they want to create new things, try out new things and are keen to do industrial projects and to apply their knowledge within the industry."* (Researcher/Consultant, Beta) |
| (Sustainable) innovation-oriented culture | Promote culture that supports (sustainable) service innovation | Kianto (2008; @), Liu (2009; $), Lyons et al. (2007; $) and Xin et al. (2006; $) | *"What leads most to innovation is the freedom and, therefore, the culture."* (Research Topic Manager 1, Gamma) |
| | | | *"The biggest challenge for management is not to spoil that motivation. Not to kill it. And that sounds easy but it isn't. Because at the same time, we have to make sure that doing highly innovative and risky projects we still don't lose money. (…) And to match those two, that I think is the biggest challenge, motivationally, so we have to give room to the creativity of our researchers which shouldn't cost us money."* (Expertise Area Director, Gamma) |

*Source:*    Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Structural capital* | | | |
| Ambiguity and risk tolerance | Tolerate ambiguity and risk taking | Kianto (2008; @), Lawson and Samson (2001; @), Lee and Kelley (2008; @) and Robertson and Swan (2003; $) | *"I feel it is not it is not too much regulated (…) So setting it too much into structures and regulations it is not very helpful for creativity."* (Researcher/Consultant 3, Beta) |
| | | | *"And I think what you do as management is live your example. Show that it's no problem to make mistakes. And I think strongly even we don't make mistakes we're not taking risks. And show that you reward initiative instead of only check whether everybody has followed the right procedures."* (Expertise Area Director, Gamma) |
| | | | *"To avoid that people are afraid that they get a bad [evaluation] they stop with a product-market combination and the boss "Ah, you were not able to bring it to success, etc." we said "when you have the guts to stop it, it is a positive sign not a negative sign."* (Strategic Planner, Gamma) |
| Creativity support | Promote thinking out of the box, experimentation and prototyping | den Hertog et al. (2010; $), Lawson and Samson (2001; @), Lee and Kelley (2008; @), Kianto (2008; @), and Lyons et al. (2007; $) | *"I don't wanna be too strict coz if you... It's so easy to kill an idea. (…) Yeah, you kill the sparkle in person. There was a management guru and said that knowledge workers, basically, our people, they are intrinsically motivated until they meet a manager. (…) Yeah, I don't want to be a manager that kills their flame."* (Research Topic Manager 1, Gamma) |
| Criticism tolerance | Tolerate and encourage constructive criticism of the way things are done | Kianto (2008; @), Miller (1993, 1994), and Schreyögg and Kliesch-Eberl (2007; @) | *[When asked about criticism] "Well, here in this building, it's appreciated very well. We like this type of culture."* (Research Topic Manager, Gamma) |
| | | | *"There's also a tendency, like the management, they develop something and we'll see, it's not automatically accepted. So, if somebody goes into it - perfectly."* (Research Topic Manager 1, Gamma) |
| Openness for changes | Tolerate and encourage propositions of changes to improve the way things are done | Kianto (2008; @), and Schreyögg and Kliesch-Eberl (2007; @) | *"Part of what we do in these months is to shout at everybody: "if something doesn't work don't just fix it, tell us 'cause we can help to fix it for the whole organization."* (Expertise Area Director, Gamma) |

*Source:* Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Relational capital* | | | |
| Manage and orchestrate coalitions with various partners for the benefit of NSD | Establish and maintain good communication with suppliers, partners, and clients outside the firm as potential sources of new ideas and enhanced market insight as well as cooperative activities; Actively look for and engage in alliances and networks of various partners to co-design and co-produce the service, as well as to access external knowledge | Froehle and Roth (2007; $) quoting Edvardsson and Olsson (1996), Voss et al. (1992), Kianto (2008), den Hertog et al. (2010; $), Schilke and Goerzen (2010; @), Kandampully (2002; $) and OECD (2005; $) | *"This is not my hobby, but it is my daily work, to build capacity with other partners, to build innovation capacity in a way with partners outside [RTO]."* (Strategy Department Employee, Gamma) |
| | | | *"Very, very important asset. (…) 70% comes from your stakeholders in the market, the more important they become. It's a main asset or the relationship that you have with your partners in the market and not only the government."* (Research Topic Manager 2, Gamma) |
| Brand and reputation | Create a strong brand and good reputation as an organisation | | *"It is a pretty strong brand, it has credibility and it's closely interlinked with innovation and research, that's for sure."* (Marketing Manager, Beta) |
| | | | *"We have XX years of successful history in applied science so this is worth something."* (Marketing Manager, Beta) |
| | | | *"(…) we want to preserve its brand as an expert organization and if someone says something on TV that doesn't really hold, it could be a huge set-back for this brand."* (Researcher, Alpha) |
| Cooperation with clients throughout the NSD | Establish a good communication with the client from the idea generation phase and the concept development and piloting phase to the service delivery | Chesbrough (2011b; $) and Fasnacht (2009; $) | *"Actually what is really important in services it is that it's trans-disciplinary, that you need your customers to develop and innovate with you …"* (Researcher, Alpha) |
| *Information technology* | | | |
| Communication enablement | Create information/telecom systems capable of enhancing communication among staff | Froehle and Roth (2007; $) and Froehle et al. (2000; $) | *"We are using quite a lot of, all sorts of electrical equipment, for example video conferencing or MS live meeting."* (Researcher, Alpha) |
| | | | *"I think that this IT facilitated meetings they are very every day in people's mind (…) So they feel it very easy (…) Here it's every day and people speak about it as very natural and not at all problematic."* (Professor, Alpha) |

*Source:*    Adapted from Frohle and Roth (2007)

**Table 1** NSD capabilities and enriched on basis of other service innovation literature (marked as $), as well as insights gained from 34 field interviews with service innovation practitioners. Further references added to general innovation and management literature (marked as @) (continued)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Information technology* | | | |
| External connectivity | Create information/telecom systems capable of enhancing communication with government, academia, industry, partners, and clients | Lawson and Samson (2001; @), Froehle and Roth (2007; $) and Froehle et al. (2000; $) | *"(…) of course, we have implemented, like, blog systems or this Wiki platform."* (Project Manager, Beta) |
| Physical facilities for NSD | Provide appropriate physical facilities for new service development efforts | Froehle and Roth (2007; $) and quoting Bitran and Pedrosa (1998) | *"I think what we realized is that we have to come up with ways to show and prove what we're doing and make it more interesting because we don't have a product to sell (…) We definitely have more showcases and labs and demonstration centers (…) Sometimes even projects have their own showcase (…) because it's pretty boring to just hand people over a pile of papers things which is well, what we're doing. It's really interesting."* (Marketing and Communication Manager, Beta) |
| | | | *"A couple of years ago, we have started to really build demonstration laboratories, demonstration centers to actually show that we don't know only to write these reports, make nice Power Point slides, but really show that things work in a smaller setting."* (Researcher/Consultant, Beta) |
| Systems compatibility | Ensure that the IT systems used by those developing new services are compatible | Froehle and Roth (2007; $) and quoting Van Reil et al. (2004) | *"For us it's important, integration is a need in terms of, as I said before, because if you do not integrate the systems into something that is a demonstrated pilot prototype which works, you will not sell anything, and that's our measure of our success."* (Competence Center Leader 1, Beta) |
| Innovation management | Provide tools for knowledge and innovation management | Hidalgo and Albors (2008; @) | *"We have a group decision room over there, which is IT-based brainstorming tool."* (Research Topic Manager 2, Gamma) |
| | | | *[in NSD context] "With the help of our ICT research unit we developed a strategic blog (…) so everyone could put comments on that."* (Strategy Director, Gamma) |

*Source:* Adapted from Frohle and Roth (2007)

| Capability | Practice | Literature reference | Exemplary practice quote |
|---|---|---|---|
| *Information technology* | | | |
| Back-office development | Maintain back-office and administrative IT systems that can support the firm's new service development efforts | Froehle and Roth (2007; $) and quoting Edvardsson and Olsson (1996) | *"Of course, I use, for the description and for the communication, visualization, I use the classical systems, Office, whatever you can think about that we have, graphic software, it's all there on the machine. (…) this means we help you to develop concepts for testing and developing service so the technology that I use is Word or whatever. (…)"* (Project Manager, Beta) |
| *Financial resources* | | | |
| Financial resources/time for idea creation phase | Provide relatively easily available start-up money to motivate people to propose and develop new ideas | Lawson and Samson (2001; @) and Kianto (2008; @) | *"So we have like, they call it green field money so we have some money at our disposal that we can use for ourselves for whatever we would like to do (...)"* (Researcher/Consultant, Beta) |
| | Provide employees with time for innovation | | *"You get some free time, play time."* (Research Topic Manager 1, Gamma) |
| | | | *"And I thought wow, this is great, I could interact with them and see how they build their tool but no money and no time. It's not a problem of money, it's a problem of time. We do have a lot of money but we don't have time."* (New Service Developer, Delta) |
| Financing the piloting phase | Provide available funding for creating prototypes or piloting projects in the development stage. The contribution of customers can be valuable in this point | | *"You need to be able to demonstrate the technology or the product concept, the challenge could be that if the customer requires let's say industrial scale pilot, it will cost usually a lot (...) So the question is that how do you sell the idea to the final customer that they should finance the most part of the pilot."* (Researcher, Alpha) |

*Source:*    Adapted from Frohle and Roth (2007)

## 5 Discussion

After having collected both theoretical and practical insights about various services innovation capabilities, we can conclude that the resulting mapping should be seen as a long-list of *potentially* important capabilities. The degree to which different ones are actually required for the successful service innovation in a specific organisation varies. For instance, in the development stage of service innovation, the testing and prototyping of service as well as front line staff training are typical practices that would take place in the process of developing a very standardised service. On the contrary, they are not required, nor are they necessary, for tailor-made client service projects. Similarly, in the launch stage, specific marketing capabilities would be required for a service that is highly repeatable and standardised and 'advertised' as readily available to clients. They would not be needed for services that are performed on client request in a one-off form. Also, on the resource side the exact capabilities of specific organisation or service type would vary. For instance, the IT-related capabilities might be more advanced for organisations with IT-based services, while they might play a marginal role for services based on human skills mostly.

## 6 Contribution

The aim of this paper was to answer the question what concretely constitutes service innovation capabilities. In our attempt to address this issue we performed a literature review followed by a set of 34 interviews with service innovation practitioners holding various roles in four highly innovative European RTOs.

The theoretical contribution of our work lies mostly in combining the existing (but scarce) literature on the subject, as well as confronting it, with current service innovation practice to create an extensive mapping of service innovation capabilities and related activities, therefore decreasing the evident academic research gap in this area. Specifically, we have identified service innovation capabilities related to strategy, NSD process (design, analysis, development and launch) and resources (intellectual, structural, relational, IT and financial).

In terms of practical contribution, because our mapping is created on an organisational level, it is operational enough to be used in the environment of a specific organisation. It thus enables academics and practitioners (both consultants and managers) to have a basis for analysing the service innovation capabilities of their case-study objects, clients or their own organisations. Specifically, our work can serve as a starting point for building analysis grids, interview guides or questionnaires. Also, the results of such an investigation can be extended beyond the research domain to support the management process. Potential managerial implications include input for organisational service innovation metrics or score cards, strategic review processes, organisational service innovation diagnosis, internal audit or planning. Finally, the methodological approach we have used can be applied to other capabilities, for example to mapping knowledge management capabilities.

## 7    Limitations and future developments

Independently of the discussed contribution of our work, we are aware of our research's inherent limitations. Specifically, our sample of four organisations for investigation is quite limited, but it is due to the in-depth character of our qualitative study. Also, there is a risk that our experts coming from the RTOs might represent similar perspectives on service innovation. Further works may involve confirmatory, quantitative research, preferably in different contexts, such as other types of service organisations or other geographical regions than Europe. Moreover, specific research projects could be devoted to more focused investigation of different types of service innovation capabilities. In terms of relational capital-related capabilities, for instance, we argue that the open capabilities of service innovation are a still emerging research issue that calls for more theoretical and empirical studies. The intellectual property (IP) related challenges, for instance, that the open approach inevitably brings about, especially in the case of services where the protection of IP is even more demanding, need special attention. Our work may also represent the starting point for empirical research about the NSD capabilities dynamisation, as it provides a quite complete list of NSD-related activities. Such identification of practices can also serve as basis for the definition of a diagnostic tool to help practitioners evaluate organisational service innovation maturity levels.

## Acknowledgements

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**Notes**

1   According to EARTOs studies: Europe's RTOs have a combined turnover of about
    €23 bn/year, their economic impact is up to €40 bn annually, they coordinate around one-third
    of all Framework Programme projects and support some 100,000 companies each year,
    especially SMEs (http://www.earto.eu/about-rtos/facts-and-figures.html). Some prominent
    examples of European RTOs include Fraunhofer, INRIA, SINTEF, TNO, etc. For a complete
    list of European RTOs, as well as more info on the sector, please refer to the official site of
    EARTO (http://www.earto.eu/).

# Creativity for service innovation: a practice-based perspective

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## Abstract

**Purpose** – The success of service innovation is largely dependent on creativity. So far, however, the question of how to reinforce creativity in the development of innovative services, while being an important managerial issue, has not attracted much attention from the academics. The purpose of this paper is to fill in this gap, by studying what constitutes capabilities for reinforcing creativity in service innovation, from a practice-based perspective.

**Design/methodology/approach** – Through the theoretical lens of the resource-based view we set out to conduct three case studies in highly service-innovative European research and technology organisations (RTOs). Through 24 interviews and analysis of secondary sources, we collect our data, which are then analysed from a multi-case perspective, in order to gain understanding on the resource-related practices and resulting capabilities for reinforcing creativity in service innovation.

**Findings** – By studying the resource-related practices of reinforcing creativity in service innovation, this study brings about seven relevant capabilities; namely attracting, stimulating, combining, providing, breeding, opening up and accepting. In this perspective, our work represents an important theoretical contribution in terms of explicitly proposing specific capabilities for reinforcing service innovation creativity.

**Originality/value** – The research is original for a couple of reasons. First, creativity in service innovation has not been explicitly studied before, especially through empirical research. Second, our findings offer a set of original capabilities propositions that can be practically applied in service-innovative organisations. Finally, our research is carried out in a novel field, as RTOs have rarely been studied regarding service innovation-related creativity, even though they represent a very interesting type of organisations in this perspective.

**Keywords** Resource-based view, Creativity, Service innovation, Capabilities, Practices, Research and technology organizations (RTOs)

**Paper type** Case study

## Introduction

Innovation in services is crucial as it allows for the sustaining of competitive advantage (Miller et al., 2007), diminishes the threat of commoditisation (Lyons et al., 2007), helps service companies outperform their peers (Cainelli et al., 2004), creates opportunities to increase the quality and efficiency of the delivery process and supports the introduction of new service concepts (van der Aa and Elfring, 2002). The importance of innovation in services is clearly represented by the recently increased academic interest in the topic (Miles, 2006) but it is also accompanied by the calls to bridge the gap between research and practice, namely how to actually manage service innovation (Crevani et al., 2011).

The first step to any innovation requires creativity: "all innovation begins with creative ideas" (Amabile et al., 1996, pp. 1154), and without creativity, "there is no potential for innovation" (Howard et al., 2008, pp. 160). This is equally true in the

service context; creativity is an integral part of service development (Zeng et al., 2009). Thus, it is crucial to understand which practices and capabilities are actually needed to reinforce creativity in service innovation, especially that in practice "creativity gets killed more often than it gets supported" (Amabile, 1998, pp. 77).

So far, although some researchers have looked at related topics such as service innovation tools (Jin et al., 2012), capabilities or practices in general (den Hertog et al., 2010; Froehle and Roth, 2007), or service innovation antecedents (Gebauer et al., 2008), little research has explicitly targeted the question of creativity in the new service development (NSD) context. Even the few authors who have recently studied the topic postulate that the creative idea generation in service innovation has not been addressed adequately in the literature (Zhang et al., 2005), and that more research on boosting creativity in service development is required (Zeng et al., 2009). This is an equally pressing issue from a managerial point of view, as thus far, idea generation practice in NSD "has been dependent largely on inspiration, luck and flair" (Zhang et al., 2005).

Therefore, this paper aims to answer the question of how creativity in service innovation can be reinforced, by studying creativity-enabling practices. The use of the practice-based view has recently gained on importance in service innovation literature (Russo-Spena and Mele, 2012). As creativity sources are organisationally embedded and can have different origins (Mumford et al., 2012), we propose to rely on a resource-based framework to better capture the diversity of creative practices for NSD. We take relevant organisational resources as a starting point, we set out to identify the related practices applied by the studied organisations, and finally, we make an attempt to distil those into a preliminary set of organisational capabilities for supporting service innovation creativity. Hence, we base our research approach on the definition of practices as the link between resources (Barney, 1991) and organisational capabilities (Amit and Schoemaker, 1993). This route of moving from resources, through practices, to capabilities, in order to deepen our understanding of supporting service innovation creativity, is reflected in the structure of our paper as presented in Figure 1.
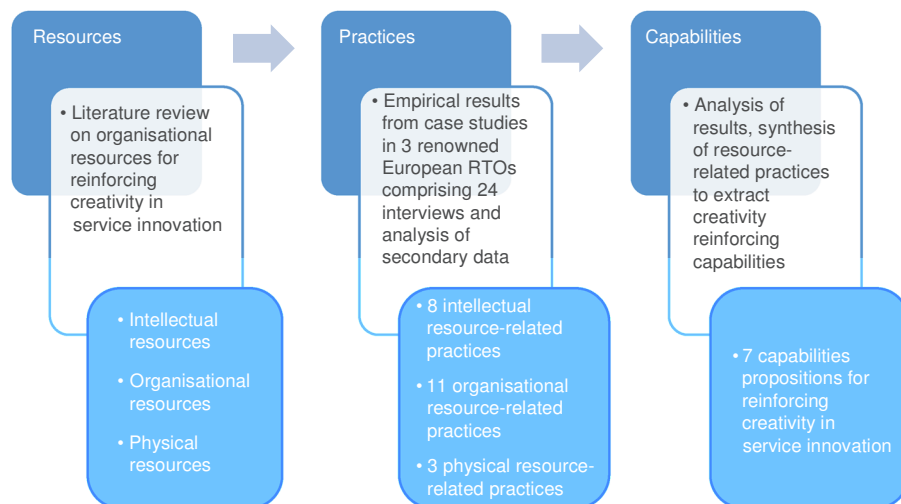


Figure 1.
Research approach and respective results – from resources through practices to capabilities

Due to the limited research on the topic, we take a largely exploratory, empirical approach to tackling this issue by applying a multiple-case study of three service-innovative applied research organisations. Our work contributes both to the theory of service innovation, and to the practice of managing and enhancing creativity in the NSD context.

## Theoretical framework
### Service innovation and the need for creativity
According to the Oslo Manual (OECD and EUROSTAT, 2005), service innovation is defined as a type of product innovation involving the introduction of a service that is new or significantly improved with respect to its characteristics or to its intended uses. The aspects of "newness" and "significant improvement" imply that there must be some type of creative activity leading to the development of an innovative service. Indeed, more and more high value-adding services, such as advertising, web-page design or architectural design (Hill and Johnson, 2003), display creativity at the core of their offering.

As broadly defined, creativity is "the production of novel and useful ideas in any domain" (Amabile et al., 1996, pp. 1155), and its successful implementation within an organisation is defined as innovation (Amabile et al., 1996). Early studies aimed at explaining why some individuals, teams or organisations are more likely than others to generate novel, useful and goal-oriented ideas, processes, results, products or services ( James and Drown, 2012). Recent scholar works argue that creativity cannot be limited to the sole "useful" idea production. It is rather defined as a "high-level cognition" dedicated to "the production of high quality, original, and elegant solutions to problems" (Mumford et al., 2012, p. 4).

The management of creativity is a core element of successful innovation management (Oke, 2007), as complex processes, such as the development of new services, require some anarchy, improvisation and internal competition (Edvardsson et al., 1995). Consequently, new skills, competences, organisational tools and resources for creativity represent a key contribution to a more comprehensive, systemic and social approach to service innovation (Rubalcaba et al., 2012). While it is clear that creativity is important for service innovation, little research has been dedicated to how it can actually be reinforced. Some works indirectly point to creativity among other aspects of service innovation (Froehle and Roth, 2007; den Hertog et al., 2010), but we did not find studies focusing specifically on this topic.

Therefore, to compensate for this theoretical gap, in the section that follows we look into service innovation creativity through the lens of the resource-based view (RBV).

### A practice-based perspective for creativity in service innovation
According to the RBV, it is the organisation's special and unique resources that ensure sustained competitive advantage (Barney, 1991; Penrose, 1959). In her seminal work, Penrose (1959) argues that resources have to be combined efficiently and effectively to develop organisational capabilities in order to assure organisational success. Indeed, capabilities are defined as "a firm's capacity to deploy resources, usually in combination, using organisational processes, to effect a desired end" (Amit and Schoemaker, 1993, p. 35). Therefore, the value of such capabilities comes from creating, integrating, recombining and releasing resources (Eisenhardt and Martin, 2000). From this perspective, it is clear that an organisation cannot merely rely on one type of resource in order to support creativity in service innovation.

Various researchers successfully link the RBV to the service context (Madhavaram and Hunt, 2008), or more precisely to the ability of the organisation to be innovative in terms of NSD (Gadrey *et al.*, 1995; Froehle and Roth, 2007). Barney (1991) refers to three broad categories of resources: human, organisational and physical. This categorisation has been supported as relevant to the service innovation context through the empirical study of Froehle and Roth (2007). The authors similarly use three key resource groups as the base of their NSD capabilities study: intellectual, organisational and physical.

On the basis of this resource framework, Froehle and Roth (2007) have identified a set of relevant practices that support NSD capabilities. Indeed, in the service context, practices are crucial for value creation and are "resource integrators" (Korkman *et al.*, 2010). A practice definition is that it "involves the subject, the action, the tools and the context. It is not an experience, and it is not the result of the action or the mental status of individuals. It is a way of doing" (Russo-Spena and Mele, 2012, p. 532). Moreover, the investigation of practices can lead to a better understanding of related capabilities, as capabilities cannot be conceptually separated from practicing (Schreyögg and Sydow, 2010). Therefore, we argue that practices are in fact the tangible facet of resources. Thus, they can be seen as the link between resources and capabilities.

Based on the above-mentioned study, which has been well grounded in both existing literature and empirical research, we apply the same three resource groups as a basic framework to analyse the current state-of-the-art in the field of service innovation-related creativity. As there is scarce evidence of research dealing directly with the topic in the service innovation context, Table I summarises key resources for creativity in service innovation, complemented by general creativity literature (marked with *) where necessary, in order to create a broad "grid" that will guide our empirical research.

Method
Due to the exploratory and novel character of our research, we chose to employ a qualitative multiple-case study of selected research and technology organisations (RTOs) (Yin, 2009). We chose RTOs as our field of study for several reasons. First, RTOs are focused on service innovation, as their predominant role, according to the European Association of Research and Technology Organisations (EARTO), is to provide innovative services. Thus, RTOs depend on reinforcing their creativity capabilities to develop new and innovative solutions. Second, RTOs benefit from a specific funding approach, balanced among governmental support, contract research and competitive R&D funding. This allows them to think outside of the box and to go after novel ideas, as a large portion of public funding is a way of de-risking innovation (Arnold *et al.*, 2010). This is not always possible in other service organisations where the constant pressure to ensure client revenue can hinder organisational creative activities. Third, RTOs are exemplary cases, as far as creativity is concerned, because of their unique human resources. RTOs employ people with very diverse and international backgrounds, who are inspired by the innovative aspects of applied research. Moreover, RTOs have access to fresh ideas via a constant flow of human resources, such as PhD students, visiting professors or contract researchers. In addition, the strong links with the academia allow RTOs to access breakthrough research, while the links with the industry help them understand the needs of the market. Both relationships are extremely beneficial for strengthening creativity.

In terms of the case selection process, we applied theoretical sampling as the relevant case selection method for inductive approach (Denzin, 1978). Five RTOs of

| Resources | Definition | Creativity-related elements/concepts | Literature sources (service innovation and general creativity; the latter marked with *) |
|---|---|---|---|
| Intellectual resources | The intellectual resources include the knowledge, skills and experience of employees as well as the organisational knowledge and the knowledge resulting from its external relations (Barney, 1991; Froehle and Roth, 2007) | Specific employee characteristics; the "entrepreneur" profile | Coelho and Augusto (2010), Lages and Piercy (2012), Crevani et al. (2011) |
| | | Multi-disciplinarity | Froehle et al. (2000) |
| | | Ability to recombine existing knowledge and to apply it to another context | Zeng et al. (2009), den Hertog et al. (2010) |
| | | Variety of sources for new ideas | Froehle and Roth (2007), de Brentani (1989), Loch et al. (1996) |
| | | External sources of knowledge | Chesbrough and Appleyard (2007), Chesbrough (2011), Russo-Spena and Mele (2012) |
| | | Customers as source of creativity | Pedrosa (2012), Gustafsson et al. (2012), Kristensson and Magnusson (2010), Witell et al. (2011), Chesbrough (2011), Russo-Spena and Mele (2012) |
| | | Diversity, sharing of ideas and knowledge | Froehle et al. (2000), Froehle and Roth (2007), Edvardsson et al. (2005), de Brentani (1989), Terrill (1992), Loch et al. (1996) |
| Organisational resources | The organisational resources include the formal structure of the firm, the controlling and coordinating systems, the corporate culture as well as the formal and informal relationships within the firm and between the firm and its environment (Barney, 1991; Froehle and Roth, 2007) | Organisational design | Froehle and Roth (2007), Stevens and Dimitriadis (2005), Cummings (1965)* |
| | | Level of freedom and autonomy of employees | Dougherty (2008), Amabile (1998)* |
| | | Innovation/creativity-related organisational roles | Voss (1992), O'Connor and De Martino (2006), de Brentani (1989), Froehle and Roth (2007), Tann et al. (2002)* |
| | | Cross-functional teams | Froehle et al. (2000), Crevani et al. (2011) |
| | | Level of rules, regulations and procedures | Crevani et al. (2011), Hunter et al. (2012), Zhang et al. (2005) |
| | | Rewards for creativity | Zhou and Wei (2010), West and Sacramento (2012)*, Amabile (1998)*, Klotz et al. (2012)* |
| | | Organisational culture and climate fostering idea generation, collaboration and knowledge transfer | de Jong et al. (2003), Slowinski et al. (2009), Crevani et al. (2011), Froehle and Roth (2007), Oke (2007) |
| | | Perceived managerial support and transformational leadership | Mascitelli (2000)*, Amabile et al. (2004)*, Gumusluoglu and Ilsev (2009)* |
| | | Personal interrelation among employees, collaboration, trust and emotional safety | den Hertog (2010), Mascitelli (2000)*, Isaksen et al. (2001)* |
| | | Risk taking, accepting criticism and failure tolerance | Amabile et al. (1996)*, Agars et al. (2012)* |

(continued)

Table I.

| Resources | Definition | Creativity-related elements/concepts | Literature sources (service innovation and general creativity; the latter marked with *) |
|---|---|---|---|
| | | Processes for capturing and sourcing creative ideas externally | Oke (2007) |
| | | Allowing time for creativity | Amabile (1998)*, Unsworth (2001)*, Chirumbolo et al. (2004)*, Crevani et al. (2011) |
| Physical resources | The physical resources include facilities, equipment, information technology and tools (Barney, 1991; Froehle and Roth, 2007) | Time pressure | Unsworth (2001)*, Ohly et al. (2006)*, Amabile et al. (2002)* |
| | | Financial resources for creativity-enhancing equipment | Lewis and Moultrie (2005)*, Sternberg et al. (1997)* |
| | | External connectivity equipment for absorbing external knowledge | Froehle et al. (2000) |
| | | Creativity-related IT tools | Kandampully (2002), Gago and Rubalcaba (2006) |
| | | IT for linking employees, codifying knowledge and improving boundary spanning capabilities | Gadrey et al. (1995), Dewett (2003)* |

different size, age and service innovation intensity were initially chosen as potential candidates for our study. We subsequently applied intensity sampling (Miles and Huberman, 1994), in order to focus on the cases that reflect strong and positive examples of the phenomena we aimed to study (Yin, 2009). A pre-screening phase was carefully designed and conducted to further select three most relevant cases as far as creativity in service innovation in RTOs is concerned. Throughout the whole process we collaborated closely with EARTO to benefit from their overview and good knowledge of European RTOs and to aid our sample selection. We also collected and studied relevant publicly available information for each organisation, and we performed preliminary interviews with one contact person in each of the five RTOs as well. These persons were proposed by EARTO and played the role of "key informants" (Yin, 2009). Paying attention not to let the pre-screening phase become a mini case study in itself (Yin, 2009), we ended up with three exemplary cases that also corresponded to three of the top European RTOs.

We then asked our contact persons in each RTO to direct us to the right respondents in their respective organisation for detailed interviews. The profiles of our interviewees were carefully pre-defined and included all employee levels, from junior researchers to top management. Seven to nine semi-structured interviews lasting one to two hours were performed in each case organisation. Short descriptions of each RTO, along with the profiles of targeted interviewees, are presented in Figure 2.

Our interview guides (which are available on request) reflected our literature-based framework. This framework focused on the importance of three organisational

**RTO Alpha**

• Description: RTO Alpha is a European organisation which has about two thousand employees with various research focus areas such as materials, energy, information and communication and electronics, among others. RTO Alpha has recently put strategic focus on services. The organisational design of this research centre is carefully deployed with an aim to address and balance its different functions; namely R&D, contract and applied research.

Interviewee profiles
Directors (2), Middle Managers (3), Senior Researcher/Project Manager (1), Researcher (1), Professor (1)

**RTO Beta**

• Description: RTO Beta has a very good reputation in the country in which it operates. It employs thousands of researchers working in very different knowledge domains, working in different locations, including some foreign offices. Different parts of the organisation focus on different topics and cooperate strongly with different universities.
As RTO Beta is a very large and diverse organisation, we focused our research on one specific institute which is financially, strategically and geographically independent from other organisational parts.
We have selected the one concerned the most with service innovation.

Interviewee profiles
Research Unit Leaders (2), Project Manager (1), Researcher/ Consultants (3), Marketing Manager (1)

**RTO Gamma**

• Description: RTO Gamma employs several thousand people, recently reorganized along research topics and expertise areas. The organisation has also recently introduced a new strategy, in which the main focus is to increase impact (on both the industry and society) through demand-driven research. Besides the research activities, RTO Gamma also focuses on incubating and spinning off new companies through an associated business structure. There are multiple locations in the country and some satellite offices abroad.

Interviewee profiles
Strategy Team (3), Research Topic Managers (3), Scientific Coordinator (1), Strategy and Planning Manager (1), Competence Manager (1)
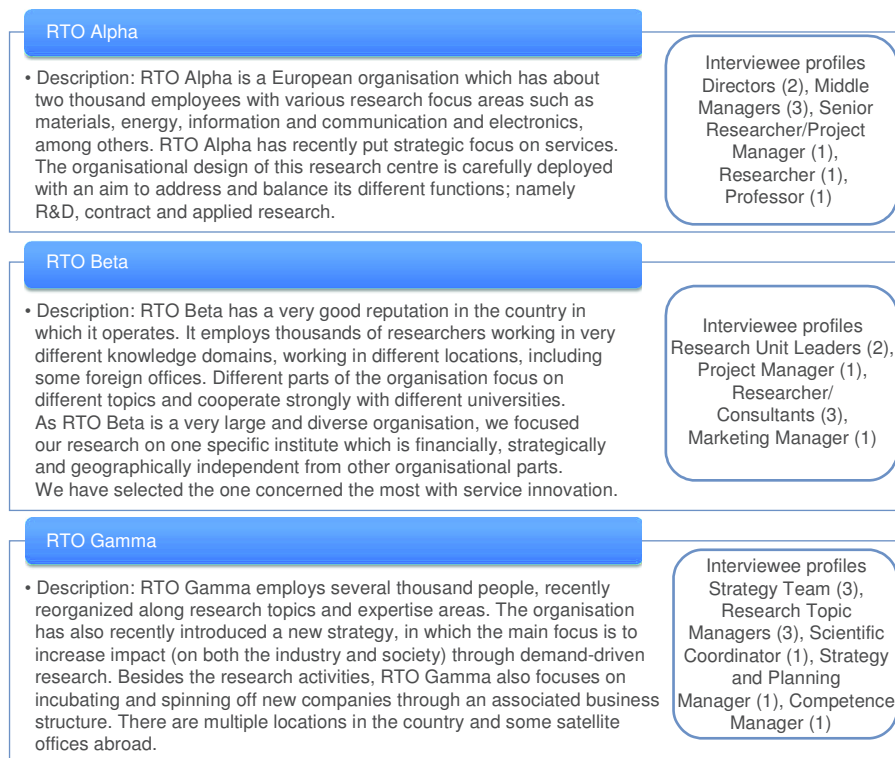
Figure 2.
Short description of studied RTOs and respective interviewees' profiles

resources for identifying practices to reinforce creativity in service innovation. The interview guides also included open questions to allow for new information to surface. The guides were adapted to the profiles of the interviewees. Interviews were recorded and the necessary written confidentiality agreements were made. The recordings were then transcribed using a professional external supplier and sent back to the interviewees for validation. Subsequently, the transcripts were double-coded using qualitative analysis software. Our codes were dynamically and regularly updated throughout the coding process. We reached an inter-coder agreement of over 90 per cent (Miles and Huberman, 1994).

The analysis of each separate case was extended beyond interviews to also include organisational documentation, such as annual reports, strategy documents, etc. The final step of the single-case analysis involved the presentation of the results to each RTO's contact person as the ultimate step for empirical validation. We then performed a multiple-case analysis allowing for a comparative overview of our results (Yin, 2009). Several tactics were used throughout this stage in order to identify the resource-based creativity practices and to subsequently distil them into creativity capabilities for service innovation. Specifically, we used memos to capture first cross-case data analysis insights while coding. Then, in order to condense the cross-case data, we applied "within-category sorting" and "cross-category clustering" tactics that have led us to "summary tables" (Miles and Huberman, 1994; see Table II).

To then move from practices to the proposition of capabilities, we used cross-case synthesis word tables for pattern identification (Yin, 2009), as well as the tactic of "noting patterns and themes" and "clustering" practice (Miles and Huberman, 1994), which have helped us arrive at the mapping of capabilities and related practices (see Figure 3). The conceptual coherence was assured by following the bottom up "abduction" process (Miles and Huberman, 1994). Finally, in the discussion step, we have reflected back on the literature to find statements both supporting and conflicting our findings (Eisenhardt, 1989).

## Results
### Intellectual resources-related practices
Most of our interviewees, in all three cases, stressed the importance of attracting the right people for service innovation creativity. Beta employees mentioned that, without creative people, no tools or processes would be sufficient: "If people have not already some seed inside themselves, it doesn't create new ideas" (Research Unit Leader 1, Beta). Therefore, it was seen as crucial to create the image of a creative employer in order to attract the most fitting employees. In the same perspective, staff turnover was actively supported as a positive factor for creativity in all three cases. New people constantly joining the organisation brought in a "breath of fresh air" by ensuring continuous access to new knowledge and creative ideas.

Furthermore, the effective management of knowledge was also an important issue. Besides the tool aspect, which we will discuss later on, the reutilisation of previous experience was perceived as a source of new ideas at all three organisations. For instance, the application of an already developed service to another context, with the necessary modifications, could lead to the development of a completely new service without having to "reinvent the wheel".

Moreover, practices ensuring the team's multi-disciplinarity were often mentioned. At Alpha, multi-disciplinarity was supported by an internal service innovation network. At Beta, it was encouraged by a fluid and flexible organisational structure,

| Resources | Good practices – description | RTO Alpha | RTO Beta | RTO Gamma |
|---|---|---|---|---|
| Intellectual resources | IR1. Investing in multi-disciplinarity for creativity | Highly supported (e.g. by structure, services-innovation network) | Naturally supported due to organisational activities | Supported by new matrix structure |
| | IR2. Allowing for employees' intrinsic creativity | High due to personal expectations | Highly stimulating environment encourages personal creativity | Depending on the person, but in general inherent to most employees |
| | IR3. Promoting the image of a creative employer organisation | People are attracted by innovation | Organisation attracts creative researchers thanks to its image | Organisation attracts creative researchers thanks to its image |
| | IR4. Encouraging a continuous "flow" of people | High turnover (visiting researchers, professors) People encouraged to travel | High always new people with fresh ideas | Being a "springboard for talent" explicitly encouraged & even stated as target in the strategy |
| | IR5. Combining and reusing existing knowledge | Use of the internal services portfolio for developing new services | Access to existing knowledge through web-based past project descriptions | Application of previously developed services to other contexts |
| | IR6. Reaping the benefits of collaborating with academia | Depending on the profile of the researchers | Extremely close collaboration RTO co-located with a university; shared resources | Important links but not very tight |
| | IR7. Involving creative clients | Working closely Direct client-researchers contacts | Always working in close collaboration with clients | Research consortia with clients Demand-driven research On-going collaborations |
| | IR8. Anticipating/Being two steps ahead of client needs | No info | Always aiming to be more advanced in innovation than clients | regular road mapping exercises Technology advancement audits |
| Organisational resources | OR1. Providing a creativity-friendly formal organisation | Network | Fluid and virtual | Matrix |
| | OR2. Supporting freedom and autonomy through supportive leadership | High | High | High |
| | OR3. Ensuring that there are relevant creativity processes in place | Informal/surpassing bureaucracy is supported by top management | Informal | Next Best Idea contest, formal annual planning cycle and intranet ideation process |
| | OR4. Rewarding creativity & innovation | Recognition and intrinsic rewards only | Opportunity to create own team | Recognition and intrinsic rewards only |
| Organisational Resources | OR5. Supporting an open, friendly and collaborative climate | Depending on personalities Informal communication supported Cultivating good relationships with the management | Working with open doors; information flow supported through social-media types of tools; the "lunch time patent developments" | Conscious changes to organisational structure to improve communication and collaboration Cultivating good relationships with the management |

(continued)

Table II.
Resource-related practices
in the three studied RTOs

31

Creativity for
service
innovation

Table II.

| Resources | Good practices – description | RTO Alpha | RTO Beta | RTO Gamma |
|---|---|---|---|---|
| | OR6. Cultivating trust between colleagues | Depending on personalities Co-worker help and support | Trust and openness within the team, but friendly competition between departments | Very strong |
| | OR7. Welcoming criticism | Speaking openly | Criticism accepted | Constructive criticism explicitly encouraged and elicited by top management |
| | OR8. Accepting failure | No info | Failure is accepted when dealing with research | Employees encouraged to admit to failure and stop their own unsuccessful projects (positive for their evaluation) |
| | OR9. Taking creativity-related risks | No info | Taking risks is accepted but lack of competence is not | Researchers actively encouraged by the management to take calculated risks |
| | OR10. Stimulating creative competition | Slight competition between old and young researchers | Actively encouraged cross-departmental "friendly" competition | Competition not encouraged |
| | OR11. Supporting open service innovation processes | Very important Supported by top management Inclusion of external stakeholders in internal service network | High interaction with stakeholders Various sources of new ideas (press, fairs, internet, etc.) | Knowledge arenas New projects checked with stakeholders early on Environment regularly actively scanned for new trends and ideas |
| Physical Resources | PR1. Providing collaborative idea generation tools | Existing, but not commonly used | No evidence of tools in use | Intranet platform, intranet blog, IT brainstorming tools |
| | PR2. Using creative service development tools | Standard office software; toolbox for turning research into services | 3D visualisation, service theatre, service scripting, service process modelling, service blueprinting | Standard office software only |
| | PR3. Ensuring an easily available budget for initial idea development | Informally available initial budget | Formal "green field budget" | Various forms of "play time budget" |

**Attracting (creative people)**

- This capability involves being able to attract the employees who are creative by nature. Such a capability can save the management a lot of time and effort afterwards trying to make people creative. Offering a specific context is important too, and it involves attracting target employees with a creative and free-thinking atmosphere, few short-term targets and limited time-pressure. Our research also shows that the employees value the diversity of the team and of the work itself, especially in the service context where multi-disciplinarity is essential. Such conditions put together can constitute an interesting offer for unique creative individuals. Indeed, our data clearly show that creative employees often value such work context more than financial benefits of the job position. Therefore, organisations wishing to boost the creativity of their new service development should pay attention to and consciously manage the messages they send out as potential employers, by cultivating a matching organisational image.

IR1
IR3
IR4
OR4
OR5
PR3
OR11

**Stimulating (creative environment)**

- The second capability we propose has to do with the creation of a stimulating environment in the relevant parts of the organisation. This capability includes the creation of multi-disciplinary working teams which invite people with various backgrounds to work together. This may happen by stimulating creative ideas development through organisational contests and games, applying a challenging but supportive leadership style, frequently changing the organisational structure, encouraging a high employee turnover, enhancing intensive cross-departmental cooperation, or – on the contrary – provoking friendly inter-departmental competition. Service innovation is indeed about mobilizing the whole organisation and having the flexibility to bring together people from different disciplines easily whenever this may be needed (even just for short periods). Our research shows that creativity flourishes when an organisation is in constant "flow"; stagnation is the enemy when it comes to enhancing service innovation.

IR1
IR4
OR1
OR5
OR10
OR11

**Combining (diverse inputs)**

- Another capability our research points towards is what we label the "combination" capability. Organisations that thrive in terms of constant service creativity and innovation have a unique ability to combine existing elements to come up with new solutions. By combining elements we mean not only placing people with different backgrounds in a single team or combining representatives of different departments into single projects. We also mean combining the existing knowledge, skills and competences to create new solutions. Or, creating new services by discovering an overlap between seemingly unrelated industries. Even more generally, combination capability can mean simply combining existing services into new solutions for different target markets. To sum up, an ability to successfully combine ostensibly disparate dimensions, perspectives, or backgrounds seems to be one of the key features characterising creative service organisations.

IR1
IR4
IR5
OR1
OR11

**Providing (relevant resources)**

- Our results demonstrate that the capability to provide relevant resources is another important factor at play in service-related creativity. It includes the provision of organisational creativity tools (such as software), processes (like idea submission procedures), funding and time for the creation of new service ideas. While by itself it does not really have large potential to be an instigator for creativity, it can serve as an enabler of creativity for service innovation in general.

OR3
OR4
PR1
PR2
PR3

(continued)

**Breeding (creative ideas)**

- Our work further emphasizes that once the right conditions have been created for an idea to come to existence, "breeding" of this idea is an important ability in the service innovation context. It is about creating a "greenhouse environment" where new "seeds of ideas" can safely start growing. However, in service innovation, where the creation of a prototype in order to demonstrate and develop one's idea is often impossible, the breeding process can be very difficult and should be consistent with the intangible character of services. Hence, the relevant practices that we have identified included a trust-filled mentoring or idea sponsoring, granting the idea owners some legitimate opportunities to work on their initial thoughts to develop them further, creating an atmosphere of safe "playground" for new inventors and, last but not least, ensuring managerial support for personal motivation and guidance in the process.

IR2
OR2

OR4
OR5
OR6
OR8
OR9
PR3

**Opening up (to external influences)**

- In the era of increased interconnectedness of both organisations and individuals, the will and ability to successfully open up an organisation to inspiring external influences has emerged from our study as yet another proposition of a key capability for increasing creativity in service innovation. Such capability involves the organisational skills of external knowledge exchange, partnership building, intellectual resources sourcing and networking, to name but a few. Opening up also means effective adaptation of organisational processes and IP (Intellectual Property) procedures to catch up with the open innovation practices. This is a capability particularly relevant to the service context, as services can rarely be developed in isolation. Rather, they have to include the client perspective and are often the result of external collaborations.

IR4
OR5
PR1
PR2
OR11
IR6
IR7
IR8

**Accepting (risk, failure and criticism)**

- Finally, our research brings about one more potentially important organisational capability, which we in short call "accepting". This short label covers a spectrum of organisational skills and aptitudes related to tolerance of risk, acceptance of failure and an inviting attitude towards constructive criticism. In other words, it has to do with the organisational culture and processes that allow for making mistakes, but also for constant improvement. Active encouragement of calculated risk-taking by the management, or rewarding of self-termination of unsuccessful projects are just some examples of how this capability manifested itself in our case studies. Although this is a capability that can apply to all types of innovation we consider it extremely important in the case of services, due to the intangible and often disputed importance of service innovation.
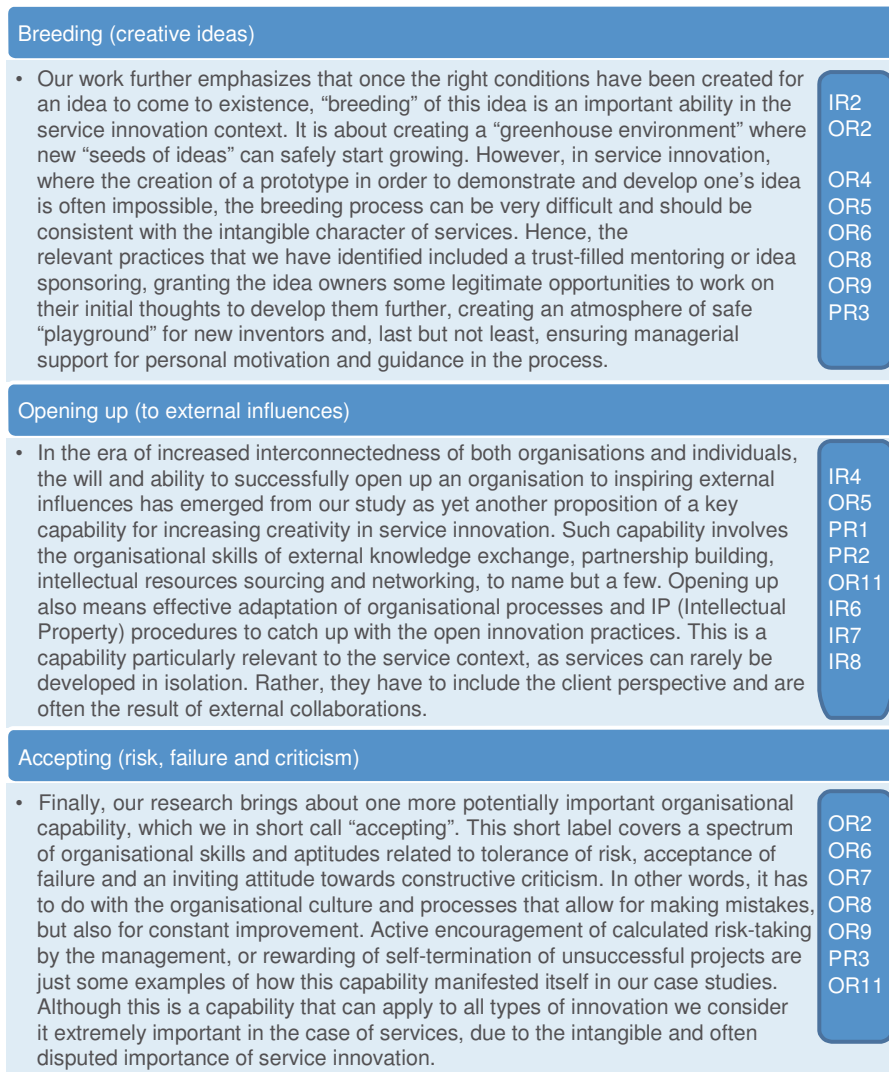
OR2
OR6
OR7
OR8
OR9
PR3
OR11

Figure 3.

by broad recruitment practices and by rewarding multi-disciplinary service innovation ideas. Similarly, at Gamma, multi-disciplinarity was supported by a matrix structure and it was seen as a means to promote new ways of thinking and collaboration with other organisational departments.

Another interesting practice was related to high-calibre innovative services. The studied organisations needed to continuously observe current trends to constantly stay ahead of today's needs and to be able to identify and take advantage of opportunities. Also, active involvement in external relationships played an important role in the creative process of developing new services. As one interviewee put it, "it's interaction with the outside world. Nothing internal is comparable to that. You don't

get ideas if you're just sitting in your office or sitting in a group with your colleagues" (Director, Alpha).

Having direct client interaction was also seen as a very important source of new ideas for service innovation: "direct contact with the customers [ɣ] because it's interaction that is creating the click that this is an excellent idea for the project" (Director, Alpha). In all cases, researchers found it very important to include the client early in the ideation phase to fuel the creation of prospective solutions. Often, demand-driven approach to service innovation was applied. Clients were also invited to joint research projects, or even pre-research stage "knowledge arenas" to brainstorm creative solutions together with the RTO and with other organisations (Gamma), or to common seminars to learn together and tackle emerging market trends in a creative way (Beta).

## Organisational resources-related practices

In terms of the organisational practices affecting creativity for service innovation, ensuring the appropriate organisational design was an important aspect. Hence, all three cases represented a flat and decentralised organisational structure. Alpha applied a transversal approach to the structural support of organisational creativity through the creation of an organisation-wide network for service innovation. This network linked different organisational departments to "ideate and innovate together, even if they actually don't speak the same language" (Researcher, Alpha). A different practice was applied at Beta where virtual organisational units were created and often dissolved. They followed the developments of the topics they covered and were therefore always closely reflecting the changes in the creative interests of the employees. Gamma represented yet another approach – the structure was pre-defined by the strategy as a matrix of market innovation areas and expertise areas. Such split was perceived as beneficial for increasing the multi-disciplinarity of project teams and thus the innovativeness of the work performed.

When it comes to the process aspect, there were not many formal procedures guiding creativity for service innovation at neither Alpha nor Beta. Gamma was the most formalised in this respect, as it used a "Next Best Idea" contest to encourage the employees to come up with new service offerings. Ideas were also regularly elicited at the organisation level, via a strategic idea blog. Moreover, being creative was supported by various informal practices, e.g. by investment in prototypes.

Managers often assumed that their role was not only to encourage the creation of new project ideas but also to be careful not to kill the creative flame in people. "It's so easy to kill an idea [ɣ] I don't want to be a manager that kills their flame" (Research Topic Manager 1, Gamma). What also surfaced from the interviews is that ensuring informal support from a mentor or senior sponsor was often useful to advance a creative idea. It was recommended to "talk to those who are known to be able make things happen" (Director 1, Alpha).

In terms of rewarding creativity for innovation, there were no explicit remuneration practices in place. Instead, personal motivation was seen as a driver for creativity in all studied cases. Therefore, recognition of the superiors seemed to be an important reward in itself. There was only one particular practice example of explicitly rewarding organisational creativity and initiative. At Beta, researchers were given the opportunity to create their own team if they had become successful in the field they had initiated: It's maybe like an entrepreneurial model [ɣ], a reward system for successful activities" (Research Unit Leader 1, Beta).

The case organisations also paid close attention to the less tangible or "softer" aspects of their organisational practices, acknowledging the importance of a supporting organisational culture for creativity. Employees at all three organisations claimed to have a lot of freedom to pursue their interests and work in a non-restricted way, thanks to the management believing that too much control is not good for creativity. Furthermore, the majority of our interviewees stated that there was an open culture for new ideas characterised by trust and sharing among colleagues, as well as by the researchers' good relationships with the top management. At Beta, the research leaders also encouraged the creative culture through informal practices even outside of the direct professional life.

Although collaboration was clearly promoted, some competition was also cultivated. At Beta, for instance, the management induced competition between the departments that had overlapping activities. While this was apparently hindering the collaborative activities to some extent, many interviewees also saw it as a "friendly competition" which kept them alert and at the forefront of novel developments, thereby increasing their creative potential.

Moreover, at Gamma, interviewees mentioned other culture-related practices related to accepting criticism and tolerating failure as having a positive impact on creativity. Employees did not feel that they were judged when expressing their ideas, nor were they afraid of failure Thus, they were more likely to take risks. Researchers would even get a positive point in their evaluation when proposing to stop their own project if it turned out to be non-promising. At Beta the situation was similar; researchers were encouraged to take risks as management understood that potential failure is an inherent part of innovation.

Throughout all cases there was ongoing collaboration with various stakeholders in the innovation process. For instance, Alpha expressed the need to invite clients to its internal services network, while Gamma organised knowledge arenas with potential clients in order to create roadmaps for the future. Interestingly, these practices sometimes brought in the risk that clients might not be as advanced as the researchers in terms of creative solutions. Finally, the external environment monitoring to identify signals relevant for service innovation was taking place either via internal structures, or by having people in external structures monitor recent developments and new trends.

Physical resources-related practices
Practices linked to the use of IT tools were the most prominent in this category, with the three organisations using different solutions in practice. At Alpha, there was a web platform for collaborative idea generation where anybody could put their idea (plant a seed) so that others could further contribute to it (grow a plant). In individual projects pen and paper or regular office software were usually used in the creative phase. On a service level, there was a new tool under development that would bridge the gap between research and market service development, supporting the respective idea generation processes.

At Beta, the IT-related practices in the creative process of NSD were very advanced. The organisation wanted to go further than standard PowerPoint slides, so it had built state-of-the-art IT-supported tools to aid service innovation and employed creative solutions, such as service blueprinting, service process modelling, 3D service theatre and service scripting.

On the contrary, at Gamma, we have only found some fairly generic (but still perceived as effective) IT-related practices in the creative phase of service innovation,

in fact, employees would "dump new ideas" onto an online platform. There was also an organisational blog used for strategic planning-related idea generation, as well as an IT-based brainstorming tool.

Another noteworthy practice involved providing an initial budget for the further creative development of promising new ideas. For instance, Beta introduced a "green field budget" which gave employees the freedom to work on new things for some time. Similarly, Gamma made a small budget available for "play time" for promising ideas: "You can just start Friday afternoon if you are here, just start. No forms, no bureaucracy, nothing [ᵞ]" (Strategic Planner, Gamma).

Up to this point, we have presented the main resource-related aspects of creativity reinforcing for service innovation using a practice-based perspective. We present a detailed summary of the identified practices in Table II.

## Discussion: towards seven capabilities for reinforcing creativity in service innovation

Most of the identified practices are largely based on the importance of human factors such as motivation, culture or leadership. This points to the conclusion that enhancing creativity for service innovation is mostly the art of managing people rather than "hard" aspects of the organisation. Moreover, creativity is not merely related to the practices around the actual idea generation phase, but also covers other aspects of the new service innovation process, such as the development or even the launch of a service. This is consistent with the specific nature of services where a creative concept is only a part of what defines service innovation, along with changes in the delivery process or the client interface (den Hertog, 2000).

As explained before, we synthesised the identified creativity-reinforcing practices list in order to propose seven creativity-reinforcing capabilities in the NSD context. The fact that our starting point was a resource-based structure remains very important, as it provided us with a robust framework in order to identify the practices in question. We followed the reasoning that innovation capabilities can be defined "as a set of practices aimed at enabling novel approaches for assembling and integrating resources to achieve innovative outcomes" (Lee and Kelley, 2008, p. 156). In order to illustrate the results of the synthesis process, next to each capability, we provide the associated resource-related practices (using each practice reference code from Table II) that each capability is resulting from.

It is important for every organisation to attract the right people through fostering the organisational image of an attractive employer (Tsai and Yang, 2010) and supporting diversity (Williams and Bauer, 1994). In the case of services, where a certain mentality and thinking is essential to understanding the specific nature of service provision, this is equally relevant and important. Moreover, accepting risk and failure are positively related to the creativity of an organisation (Agars *et al.*, 2012; Lawson and Samson, 2001). This might not be a service specific result; however, we consider it very important for every kind of innovation, as innovation efforts bear the element of failure in themselves. Furthermore, breeding creativity by empowering employees through supportive leadership is an element that impacts job engagement to the benefit of every organisation (Bordin *et al.*, 2007). This is in line with Froehle and Roth (2007) who acknowledge the importance of multi-disciplinarity, diversity and management support in service innovation, although their work did not address creativity explicitly, but rather the whole process of NSD.

Moreover, a capability that is particularly relevant in the service context is the combining capability. This capability is consistent with the (un-)bundling capability of den Hertog *et al.* (2010), as in services in particular the capability of creating new services based on existing ones is particularly important (Tax and Stuart, 1997). The same reasoning is supported by Zeng *et al.* (2009), who identify the importance of conceptual expansion and combination in ideation for service innovation. In this perspective we, along with Carlborg *et al.* (2013), identify the importance of service modularity which refers to the smallest unit of service that can be used as building block for the creation of new services.

Furthermore, the opening up capability is also essential in the service context, as in service innovation collaborations between several stakeholders, especially with clients, are essential to increase the creative potential of the organisation. The importance of identifying and reflecting clients' needs in the idea generation phase of service innovation, or the importance of co-creating with various actors (from customers, to suppliers, etc.) was also identified by den Hertog *et al.* (2010). Especially in the case of services, co-creation as Prahalad and Ramaswamy (2004) define it, where the customer is not just in focus but an active member of value creation, is imperative. This is also supported by Aarikka-Stenroos and Jaakkola (2012) who underline the value of the customer as co-designer and value co-creator in knowledge intensive services. The benefits of integrating external resources, such as client knowledge and expertise, into the organisation are challenging the classical RBV according to which internal capabilities are among the firm's biggest competitive advantage (Chesbrough and Appleyard, 2007). Our results show clearly that what supports creativity in service-innovative organisation is the efficient combination of internal and external resources.

The stimulating capability is very relevant to the case of services, where the whole organisation often needs to be mobilised, by easily creating multi-disciplinary temporary working groups, in order to ideate for the development of novel services. The issue of how to organise for service innovation is also identified as a critical one by Carlborg *et al.* (2013). Finally, the providing capability represents an interesting finding as in case of services, it is not the specific equipment for the development of an innovation that counts (as for products), but rather the tools that facilitate collaborative idea generation and easily available start-up money.

Contributions
To our knowledge, the capabilities for reinforcing creativity in service innovation have not been explicitly addressed until today and the most important contributions in the field remain mainly conceptual. Zeng *et al.* (2009) seem to be very straightforward in addressing creativity in service innovation through relevant strategies. However, this is a purely theoretical contribution that is not paying due attention to the importance of relevant resources in service innovation creativity. The same stands for the work of Zhang *et al.* (2005) who study creativity in service innovation from a process perspective only, by using the TRIZ approach. Regarding previous works that deal with service innovation capabilities, Froehle and Roth (2007) indirectly address the practices that support the idea generation phase in NSD. They do not explicitly state what constitutes capabilities for creativity in service innovation. As far as den Hertog's *et al.* (2010) dynamic capabilities framework is concerned, we consider their work to be very interesting. It is, however, purely conceptual and does not directly address creativity in service innovation, but rather focuses on the whole process of service

innovation. Based on all the above, we argue that our work constitutes an important theoretical contribution to the topic of creativity in service innovation as: first, it explicitly addresses the creativity in service innovation, second, it identifies specific resource-related practices that support service innovation creativity, third, it brings about rich empirical results from a very relevant service-innovative context (RTOs) and fourth, it proposes relevant capabilities.

In terms of practical implications, we consider our work to give managers several recommendations for fostering creativity in service innovation in order to ensure the quality in the development of new services. Indeed, the seven propositions of capabilities that we present are far from being merely conceptual. On the contrary: as they result from a practice-based approach, they are especially relevant to the specificities of service innovation. Although we performed our study in the context of RTOs, we consider our results to be potentially relevant to, or at least inspiring for, other kinds of service-innovative organisations as well. RTOs' place in the national innovation lies between academia and industry, or, in other words, between scientific novelty and market applications. Our results suggest that RTOs strike the balance between creativity and commercialisation successfully and can thus provide interesting lessons for organisations that face problems regarding either aspect.

We argue that managers should foster the creative "playground" environment of RTOs in their organisations if they want to reap the benefits of their creative human resources. In this view, they should not be afraid to provide the time, the autonomy, the funding and the required managerial and organisational support and flexibility for their people to "play", release their creative potential and develop novel and quality services, even if it means accepting higher risks. It is also important to attract the right expertise to the organisation in the form of skilled employees, but also through links with the external environment, in order to fuel the creative process of service innovation. Of course we are well aware of the fact that due to the high costs most organisations cannot allow themselves the "luxury" to renew their human capital as often as RTOs do. However, this can be "substituted" by actively encouraging the combination or "mingling" of skills, viewpoints and competences, not only internally, but also with external actors in their respective environments.

## Limitations and further research

While we strove to minimise the inherent flaws of our research, there are still some aspects that could potentially limit the applicability of our work. Being qualitative in nature, our paper carries an inherent issue of generalisability with it. However, we sought the richness and depth of experience-based evidence. The choice of RTOs as the field of study is justified by our research question. The aim to collect interesting exploratory data made RTOs very suitable for our purpose.

We believe our paper lays ground for interesting further research opportunities. Most importantly, it may be the source of empirically grounded propositions, which can then be further tested and refined in quantitative studies. For instance, future research could investigate the relative importance of these capabilities by establishing a relevant measuring system. Such a measuring system could then be applied in different contexts in order to investigate potential differences between various kinds of services. Finally, it would be worthwhile to see whether the proposed creativity capabilities are also valid in non-service contexts.

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# LES INTERMÉDIAIRES
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Dans une logique d'innovation ouverte les entreprises innovantes ne peuvent plus rester isolées. Elles doivent s'ouvrir, i.e. interagir et collaborer avec les autres acteurs du processus d'innovation (Chesbrough, 2003 ; West, Bogers, 2014). Les formes de l'innovation ouverte sont multiples (Pénin *et al.*, 2013). Il peut s'agir, par exemple, d'accords de collaboration formels en R&D, d'échanges informels de connaissances, d'échanges marchands de technologie (*licensing-in* et *out*), de la formation de « pools de brevet », de standards, de collaborations avec des communautés d'utilisateurs et/ou open source, de *crowdsourcing*, etc.

Les modalités de l'innovation ouverte peuvent être classées selon que l'objectif de l'entreprise est d'acquérir des technologies (*outside-in*), d'en céder (*inside-out*) ou les deux ensemble (*coupled*, Gassman, Enkel, 2004) ; selon que l'interaction est plus ou moins formelle et marchande ; selon que l'accès aux connaissances est plus ou moins ouvert ; selon que les interactions

sont plus ou moins fréquentes et importantes, etc. Jullien et Pénin (2014) proposent, par exemple, une catégorisation basée sur la distinction entre *outside-in* et *inside-out* et le degré plus ou moins important des interactions et du recours aux technologies de l'information et de la communication (TIC) (voir Tableau 1). En particulier, ils distinguent l'innovation ouverte 1.0 de l'innovation ouverte 2.0 qui mobilise davantage les TIC et est souvent largement plus interactive et communautaire.

*Tableau 1* – Les modalités de l'innovation ouverte

|  | Innovation ouverte 1.0 | Innovation ouverte 2.0 |
|---|---|---|
| « Outside-in » Pure | Licensing-in, Spin-in | Crowdsourcing |
| Partenariat (mixe d'« outside-in » et d'« inside-out ») | Co-conception, Co-développement Consortium de recherche Research joint-venture | Innovation avec des communautés / open source |
| « Inside-out » Pure | Licensing-out, Spin-out | Places de marchés en ligne / e-Bay des idées (Yet2.com) |

*Source :* Jullien et Pénin (2014)

Parmi toutes ces modalités, très différentes les unes des autres, au moins un élément de récurrence semble se dégager (particulièrement en ce qui concerne l'innovation ouverte 2.0) : le recours à une structure d'intermédiation. En effet, si dans certains cas le développement des TIC a réduit la nécessité de recourir à des intermédiaires (on pense notamment aux réseaux de pairs-à-pairs), cela n'est pas le cas pour les pratiques d'innovation ouverte. Il semble que le recours à l'ouverture ne soit pas forcément naturel pour les organisations. Il est ainsi souvent nécessaire d'utiliser des intermédiaires afin d'aplanir les difficultés qui peuvent surgir dans le processus d'ouverture.

Par exemple, les marchés des technologies sur lesquels les entreprises achètent et vendent des technologies, généralement par le biais de licences de brevet (Arora *et al.*, 2001), reposent sur la présence de courtiers en brevet tels que *Yet2.com* ou *TechTransferOnline* (Benassi, Di Minin, 2009). La valorisation de la recherche publique dans la plupart des pays passe très souvent par l'existence de *Technology Transfer Offices* (TTO). La pratique du *crowdsourcing* repose également sur l'utilisation d'une plateforme en ligne telle qu'Innocentive ou Hypios (Pénin *et al.*, 2013). *Lego*, une entreprise mondialement reconnue pour sa capacité à mobiliser ses communautés d'utilisateurs, a créé une plateforme baptisée *Lego Ideas*. La formation de pool de brevets ainsi que l'agrégation de brevets passent également

par des intermédiaires (*France brevet* par exemple ou *Intellectual Venture*) (Merges, 2001).

L'objectif de notre travail est ainsi de mieux comprendre les différentes raisons du recours à ces sociétés d'intermédiation. En particulier, nous distinguons les intermédiaires dont l'objectif est de réduire les coûts de transaction et de faciliter l'organisation marchande de la production (Coase, 1937 ; Williamson, 1975 ; Williamson, 2000), de ceux dont l'objectif est de contribuer à créer et diffuser des connaissances (Kogut, Zander, 1992 ; 1996 ; Spender, 1996 ; Amin, Cohendet, 2004). La connaissance est en effet un bien difficile à partager aux travers de contrats marchands anonymes et instantanés, notamment lorsqu'elle est tacite. Ces difficultés limitent la portée des intermédiaires dont le principal rôle est de sécuriser le cadre juridique de la transaction. La nature spécifique de la connaissance peut ainsi justifier la présence d'intermédiaires, plus sophistiqués, qui vont s'impliquer activement dans le processus de recherche et ainsi contribuer à disséminer les savoir-faire dans leur environnement (ce qui peut passer par des activités très diverses, allant du conseil, à la prestation de service, etc.). Ces intermédiaires s'inscrivent ainsi véritablement dans une logique de gestion des connaissances et non pas simplement de gestion de l'information (Cohendet, Llerena, 1999).

Evidemment, ces deux types d'intermédiaires sont des idéaux-types. En réalité, la plupart des acteurs, en particulier ceux impliqués dans la valorisation de la recherche publique, se trouvent entre ces deux extrêmes. Par exemple, les TTOs font souvent partie des organismes de recherche et associent les laboratoires de recherche et les chercheurs à leurs activités. De même, les RTOs sont également généralement impliqués dans les questions de contractualisation et de *licensing*. Cependant, cette simplification (comme tout travail de modélisation) a le mérite de mettre en avant des caractéristiques distinctives essentielles des différents intermédiaires de l'innovation ce qui permet d'affiner notre compréhension de leur rôle économique.

Dans la partie suivante nous rappelons les différents rôles des intermédiaires d'innovation identifiés dans la littérature. La partie 3 propose ensuite deux arguments pour justifier la présence de ces intermédiaires : l'existence de coûts de transaction et la difficulté de transférer des connaissances, et montre que ces arguments aboutissent chacun à un rôle différent pour les intermédiaires d'innovation. La partie 4 illustre ces différences dans le cas de la valorisation de la recherche publique, en distinguant les *Technology Transfer Offices* (TTOs), dont le rôle se limite à réduire les coûts de transaction du transfert de technologie, et les *Research and Technology Organizations* (RTOs), qui s'impliquent activement dans le processus de transfert des savoirs académiques.

# INTERMÉDIAIRES D'INNOVATION : DÉFINITION, FONCTIONS ET TYPOLOGIE

Même si, comme le rappelle Howells (2006), on peut trouver des traces d'intermédiaires de l'innovation dès les 17e et 18e siècles (avec l'existence de *Middlemen*, littéralement « hommes au milieu ») et si dès la fin du 20e siècle apparaissent les premières traces d'écrits sur les intermédiaires d'innovation (Bessant, Rush, 1995 ; Hargadon, Sutton, 1997 ; Hargadon, 1998), c'est surtout avec la multiplication des études sur l'innovation ouverte dans la dernière décennie que ce concept s'est imposé (Howells, 2006 ; Benassi, Di Minim, 2009 ; Dushnitsky, Klueter, 2010 ; Sieg *et al.*, 2010 ; Agogué *et al.*, 2013 ; Alexander, Martin, 2013 ; Boari, Riboldazzi, 2014).

Par définition, les intermédiaires de l'innovation sont des agents – individus ou entreprises – qui se situent « entre » ou « au milieu » d'autres acteurs. Howells (2006, p. 720) définit ces intermédiaires de la manière suivante :

> *"An organization or body that acts as agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations".*

*Tableau 2* – Les dix fonctions des intermédiaires de l'innovation selon Howells (2006)

| |
|---|
| 1. *Prévisions et diagnostics* |
| 2. *Traitement de l'information* |
| 3. *Processeur de connaissances (combinaison ∕ recombinaison)* |
| 4. *Courtage* |
| 5. *Test et validation* |
| 6. *Accréditation* |
| 7. *Validation et régulation* |
| 8. *Protection des résultats* |
| 9. *Commercialisation* |
| 10. *Evaluation des résultats* |

*Source :* Howells (2006). Traduction libre des auteurs.

Cette définition permet ensuite à Howells d'identifier dix fonctions caractéristiques des intermédiaires de l'innovation (voir Tableau 2). Plus simplement, en suivant Agogué *et al.* (2013) il est possible de rassembler les activités des intermédiaires de l'innovation en deux grandes catégories : les activités de courtage et les activités de réseautage. Les premières étant des

activités visant à faciliter l'interaction entre les acteurs de l'innovation en offrant divers contenus (médiation, ajout d'information, contractualisation, vérification et garantie, standardisation, etc.) et les secondes des activités de mise en contact entre deux entités (parfois le courtier réalise les deux en même temps).

En pratique, les activités des intermédiaires de l'innovation sont ainsi très diverses. Il peut s'agir, par exemple, d'activités de conseils, un consultant étant souvent amené à jouer le rôle de connecteur entre différents acteurs (Bessant, Rush, 1995). Il peut également s'agir de courtiers sur les marchés des brevets, dont le rôle est de faciliter la mise en relation et d'assurer la transaction entre acheteurs et vendeurs de brevet (l'acheteur étant souvent une entreprise manufacturière et le vendeur une entreprise technologique ou une université) (Benassi, Di Minin, 2009 ; Dushnitsky, Klueter, 2009 ; Pénin, 2012 voir Tableau 3). Un récent rapport de l'OCDE a recensé un grand nombre de ces courtiers (Yanagisawa, Guellec, 2009). Il peut également s'agir d'acteurs formant et gérant des pools de brevet dont le rôle est précisément de faciliter le regroupement de brevets portant sur une même technologie et donc de faciliter la diffusion de cette technologie en unifiant sa propriété (Merges, 2001 ; den Uijl *et al.*, 2013 ; Pénin *et al.*, 2013). Les plateformes de *crowdsourcing* jouent également un rôle d'intermédiation (Howe, 2006). Elles mettent en relation des entreprises qui cherchent à résoudre des problèmes (des *seekers*) avec des individus prêts à consacrer du temps pour trouver des solutions (des *solvers*). Enfin, les pôles de compétitivité, incubateurs et autres *living labs* peuvent également être considérés comme des intermédiaires de l'innovation puisqu'ils offrent un environnement favorable à la création et l'invention et facilitent la mise en contact.

*Tableau 3* – Exemples de courtiers en technologie et de leur activité

| Fonction | Modèle d'affaires | Exemples d'organisations |
|---|---|---|
| Conseil | Conseils stratégiques, financiers, juridiques, etc. | IPCapital Group ; IP strategy Group ; IP investments ; Intellectual assets |
| Trading | Places de marché en ligne, enchères, société de transfert de technologies | Innocentive ; NineSigma ; Yet2.com ; Ocean Toma ; SATT ; US TTO |
| Agrégateur offensifs | Gestion de *patent pools*, acquisitions de brevets complémentaires | MPEG LA ; 3G Licensing ; Intellectual Venture |
| Agrégateurs défensifs | Sécuriser la liberté d'exploitation | Open Invention network ; Eco-patent Commons Project |
| Sociétés financières | Fonds d'investissement, financement structuré | Intellectual Venture ; IP Finance |

*Source :* Pénin *et al.* (2013). Inspiré de Guellec et Yanagisawa (2009)

À ce jour, la littérature a surtout étudié les intermédiaires dans le cas de technologies, d'inventions ou d'acteurs existants. L'objectif de l'intermédiaire dans ce cas est de faciliter la transmission de la technologie à celui qui est dans la meilleure position pour la valoriser (dans le cas des marchés des technologies ou des pools de brevet) ou de faire se rencontrer des acteurs qui s'ignoraient jusque-là (dans le cas des pôles de compétitivité, par exemple). Agogué *et al.* (2013) montrent alors que l'intermédiation peut aller encore plus loin et concerner des technologies et inventions encore en devenir ou impliquer la création et l'émergence de nouveaux acteurs. L'intermédiaire dans ce cas prend le rôle de créateur d'écosystème ou, pour le dire avec les mots des auteurs « d'architecte de l'exploration collective et de création de connaissances ». Ils identifient et caractérisent ainsi trois types d'intermédiation : le courtage, la mise en réseau et l'exploration collective (Tableau 4).

*Tableau 4* – Les trois types d'intermédiation de l'innovation ouverte selon Agogué, Yström et Le Masson (2013)

| Type d'intermédiation | Courtage | Réseautage | Exploration collective |
|---|---|---|---|
| Initiation | Une organisation initie le contact avec l'intermédiaire | Une ou plusieurs organisations initient le contact avec l'intermédiaire qui joue le rôle d'un Hub central dans le réseau | Plusieurs organisations cherchent à collaborer sur des projets de recherche avancés mais ne trouvent pas de partenaires. L'intermédiaire est l'initiateur. |
| Résultats | Contenu (connaissances, technologies) est transféré entre les parties | Amélioration de la connectivité du réseau | Atmosphère créative, nouvelle vision, nouvelles connaissances |
| Processus | Faire se rencontrer une demande et une offre. Combiner des idées et connaissances existantes | Créer du lien et de la coordination | Méthodologie créative hautement structurée |
| Ressources | Réactivité, expertise de marché, expertise technologique | Connections multiples avec des experts dans et en dehors des secteurs concernés | Implication forte dans le projet pour enrichir la vision, explorer des nouvelles idées et trouver des nouveaux partenaires |

*Source :* Agogué, Yström, Le Masson (2013). Traduction libre des auteurs.

Cet ajout nous semble essentiel car il implique un basculement fondamental : d'une vision de l'intermédiaire comme acteur passif (ayant simplement

un rôle de connecteur entre les vrais acteurs de l'innovation), on passe à une vision de l'intermédiaire comme acteur actif de l'innovation, qui contribue à produire des connaissances.

## LA RAISON D'ÊTRE DES INTERMÉDIAIRES DE L'INNOVATION : GESTION DE L'INFORMATION VERSUS GESTION DES CONNAISSANCES

Cette différence dans le rôle des intermédiaires de l'innovation se retrouve au niveau des théories économiques permettant de justifier leur existence. D'un côté la théorie des coûts de transaction insiste sur l'importance des intermédiaires pour réduire les coûts et risques inhérents aux interactions entre acteurs de l'économie. D'un autre côté les théories des organisations fondées sur les connaissances soulignent l'importance du savoir-faire tacite qui est, par définition, difficile à transférer et à partager lors de transactions marchandes, ce qui permet ainsi de justifier l'émergence d'intermédiaires œuvrant à faciliter le transfert de ces connaissances. Autrement dit, deux rôles de l'intermédiaire de l'innovation peuvent être mis en avant : comme processeur d'information, i.e. acteur permettant de réduire les coûts de l'innovation (les coûts de transaction en particulier), d'une part, et comme processeur de connaissances, d'autre part (Cohendet, Llerena, 1999).

### L'approche par les coûts de transaction

La théorie des coûts de transaction (Coase, 1937 ; Williamson, 1975) s'intéresse aux coûts inhérents aux interactions marchandes. Elle est fondée sur deux postulats fondamentaux : (1) les acteurs de l'économie ont une rationalité limitée, i.e. ils ne sont pas capables de tout prévoir et de tout organiser ; et (2) ils sont opportunistes dans le sens où ils ne laissent pas passer des opportunités d'accroître leur gain, même si cela suppose d'adopter des comportements moralement répréhensibles (par exemple revenir sur une promesse, trahir son interlocuteur, etc.). Ces deux postulats impliquent que, pour un acteur économique, toute interaction avec un tiers est coûteuse (dans le sens de risquée) car il est possible d'être trahi.

La théorie des coûts de transaction est ainsi au cœur d'un choix essentiel pour les acteurs de l'économie : faire ou faire-faire. Autrement dit, faut-il pour une entreprise réaliser elle-même une activité ou faut-il la faire réaliser par un autre et l'acheter ? Toutes choses égales par ailleurs, plus les coûts de transaction sont faibles et plus il est intéressant pour une entreprise d'externaliser ses activité.

Pour la théorie des coûts de transaction, l'essor des pratiques d'innovation ouverte est ainsi intrinsèquement lié à l'existence de coûts de transaction dans l'organisation du processus innovant. Si les coûts de transaction sont trop élevés, chaque entreprise a intérêt à rester repliée sur elle-même (innovation fermée). L'innovation ouverte est ainsi rendue possible par la réduction lors des dernières décennies des coûts de transaction dans le processus innovant, réduction induite en particulier par le renforcement des droits de propriété intellectuels et la codification croissante de la base de connaissances dans de nombreux secteurs, tels les sciences de la vie ou les technologies de l'information (Chesbrough, 2003 ; Pénin *et al.*, 2013).

Cependant, s'ils ont été réduits, les coûts de transaction sont loin d'avoir entièrement disparu dans le cas de l'innovation et du transfert de connaissances (Teece, 1998) : par exemple, lorsque des entreprises collaborent en R&D, comment peuvent-elles s'assurer que le partenaire n'est pas en train de se comporter en passager clandestin (en s'emparant de certains secrets de fabrication par exemple) ? De même, lorsque des entreprises achètent et vendent des technologies, comment éviter les situations de type paradoxe d'Arrow (Arrow, 1962) ? Dans le cas du *crowdsourcing* également, comment éviter que les acteurs se comportent en passager clandestin ? Le rôle des intermédiaires de l'innovation est ainsi précisément de réduire ces coûts de transaction afin justement de faciliter le fonctionnement de l'innovation ouverte.

Ainsi, sur les marchés des technologies, le rôle des courtiers en brevet et en technologie est clairement de limiter les risques inhérents à la transaction technologique. En particulier, les courtiers en brevet contribuent à résoudre le paradoxe d'Arrow car ils : (1) facilitent la mise en relation entre vendeurs et acheteurs de technologies ; (2) offrent une prestation de conseil pour évaluer la valeur financière de la transaction ; (3) offrent une assistance juridique pour rédiger les contrats et sécuriser la transaction ; (4) garantissent que les droits de chacune des parties seront respectés et qu'aucune ne se comportera en passager clandestin (voir Tableau 3) (Guellec, Yanasigawa, 2009). De même, l'émergence de « pool de brevet » gérés par des intermédiaires peut également être considérée comme une manière de réduire les coûts de transaction liés à la prolifération des brevets. La multiplication des brevets dans certains secteurs implique en effet que les utilisateurs potentiels d'une technologie doivent négocier avec un très grand nombre de titulaires de brevets. Cela contribue naturellement à multiplier les coûts de transaction et à accroître les risques de « tragédie des anticommuns » et de *royalty stacking*, i.e. les risques qu'au final la technologie soit sous-utilisée (David, 2011). Les pools de brevet sont ainsi des structures intermédiaires entre les titulaires de brevet et les utilisateurs des

technologies qui permettent de réunifier la propriété et ainsi de faciliter le transfert de technologie.

Également, les plateformes de *crowdsourcing* ne font pas autre chose que de réduire les coûts de transaction. En effet, la relation de *crowdsourcing* implique qu'une entreprise révèle des informations stratégiques concernant ses projets d'innovation afin de permettre à des individus anonymes d'éventuellement trouver des solutions. Dans ce cadre, comment l'entreprise peut-elle s'assurer que les *solvers* ne se servent pas des informations transmises par l'entreprise pour lui nuire (par exemple en les transmettant à la concurrence) ? De même, comment les *solvers* peuvent-ils s'assurer qu'une fois qu'ils ont transmis la bonne solution, l'entreprise les rémunérera (paradoxe d'Arrow) ? C'est justement le rôle des intermédiaires, des plateformes de *crowdsourcing* de limiter ces problèmes d'opportunisme, en particulier en contractualisant la relation et en organisant le transfert de propriété intellectuelle (Liotard, 2012a ; 2012b).

En résumé, la théorie des coûts de transaction permet d'identifier un rôle essentiel pour les intermédiaires de l'innovation : réduire les coûts de transaction inhérents à l'innovation ouverte. Ce rôle amène ainsi à insister sur l'importance des intermédiaires afin de sécuriser et de formaliser les relations entre les acteurs de l'innovation ouverte.

### Les apports des théories de la firme fondées sur les connaissances

Une limite bien connue de la théorie de coûts de transaction est qu'elle néglige la nature complexe et dynamique du processus de production de connaissances. Pour elle, il s'agit simplement d'organiser au mieux les transactions en limitant les comportements opportunistes. Dans ce cadre les intermédiaires de l'innovation contribuent à transférer des droits de propriété, i.e. des bouts de papier, entre des organisations qui maîtrisent déjà chacune parfaitement la connaissance en question (Lemley, 2007). Rien n'est dit sur les difficultés à partager des connaissances, notamment tacites, les questions d'apprentissage, de capacité d'absorption (Imbert, Chauvet, 2012), éléments qui entraînent le plus souvent des relations plus sophistiquées entre les acteurs de l'innovation, qui sont souvent obligés d'entrer dans une série d'interactions, de collaboration et de co-création des connaissances. Dans ce type de relation l'intermédiaire n'est pas seulement un facilitateur mais est clairement impliqué dans le processus de production de connaissances.

Autrement dit, la théorie des coûts de transaction considère l'innovation comme étant un problème de traitement d'information et néglige

l'importance de la connaissance (Cohendet, Llerena, 1999). Une autre approche pour comprendre le rôle de l'intermédiaire d'innovation, complémentaire à la théorie des coûts de transaction, réside alors dans la *knowledge-based view* (KBV) qui tient clairement compte des propriétés complexes de la connaissance (Coriat, Weinstein, 2010).

La KBV est une approche récente en management stratégique, issue notamment du fait de l'émergence de l'économie fondée sur les connaissances (Foray, 2000) et de l'intérêt croissant porté ces dernières années sur la connaissance organisationnelle, l'apprentissage organisationnel et l'innovation comme sources d'avantages compétitifs. Par conséquent, étudier et conceptualiser la manière selon laquelle les entreprises bénéficient de l'innovation et de la création de connaissances est devenu une des préoccupations centrales de la KBV, de telle sorte que l'on parle actuellement de *knowledge-based theory of the firm*, i.e. d'une théorie de la firme fondée sur les connaissances (Spender, 1996 ; Grant, 1996).

Selon Grant (1996), la connaissance est une ressource clé, et le principal rôle d'une entreprise est d'intégrer des connaissances individuelles spécialisées dans la production de biens et / ou services. La tâche du management est alors d'assurer la coordination nécessaire afin de permettre l'intégration de savoirs individuels. Ainsi, si la plupart des recherches tendent vers la problématique de la coopération, Grant souligne que la complexité de l'intégration de connaissances, particulièrement lorsque l'on parle de connaissances plutôt tacites, montre que la coordination est aussi une problématique essentielle. Cela sous-tend que les formes organisationnelles « classiques » doivent être remodelées, conduisant au développement de nouvelles formes organisationnelles incluant des structures horizontales, de travail en équipe et les alliances inter-firmes (Grant, 1996).

Spender (1996) ajoute que l'enjeu de la KBV est d'élaborer une théorie de la firme plus dynamique, avec la connaissance comme principe clé, une théorie de la firme fondée sur les connaissances différente de la perception évolutionniste et de la théorie des ressources, où la connaissance n'est pas vue comme une ressource mais comme un processus. Cette vision souligne que la connaissance est essentiellement liée à l'action, est contenue dans les réseaux d'acteurs et augure de l'importance de l'étude des frontières de la firme.

En complément, l'analyse de Kogut et Zander (1996) sur la KBV soutient que les firmes peuvent être appréhendées comme des communautés sociales spécialisées dans la création et le transfert de connaissances. Elles sont des organisations qui représentent des connaissances sociales de coordination et d'apprentissage (Kogut, Zander, 1996). Selon eux la firme est

une forme de coordination supérieure au marché lorsqu'un phénomène identitaire conduit à des connaissances sociales qui développent la coordination et la communication. La firme, en tant que forme de coordination, se distingue ainsi du marché parce que la coordination et l'apprentissage sont situés non seulement physiquement en un lieu, mais également mentalement dans une identité partagée. Pour Kogut et Zander (1996), c'est dans les bénéfices de l'identité collective de la firme que réside sa supériorité sur le marché en tant que forme de coordination. Ainsi, la réflexion de Kogut et Zander (1996) sur la « raison d'être » des firmes souligne leur dimension sociale et leur efficacité en tant que forme organisationnelle de création de connaissances. L'avantage d'une firme n'est pas simplement une réduction des coûts. Il réside également dans la création d'un contexte de dialogue et d'apprentissage qui promeut l'innovation et les comportements motivés (Kogut, Zander, 1996, pp. 510-511).

En définitive, les théories fondées sur les connaissances s'intéressent ainsi moins aux problèmes de comportements opportunistes et d'asymétries d'information qu'aux problèmes liés aux propriétés de la connaissance et du processus d'innovation. Ce dernier étant largement collectif et la connaissance étant largement tacite, la réduction des coûts de transaction n'est le plus souvent pas suffisante pour assurer la création et le transfert de connaissances.

## Intermédiaires de l'innovation et gestion des connaissances

La KBV permet d'identifier un second rôle essentiel pour les intermédiaires de l'innovation : être co-créateur de connaissances localisées, contextuelles et tacites, et de faciliter leur transfert dans une perspective d'innovation ouverte. Il s'agit alors pour certains intermédiaires de jouer un rôle actif non pas seulement en tant que partenaire créateur et/ou accélérateur du processus d'innovation mais également en facilitant la coordination des activités innovantes et/ou le transfert de connaissances tacites. Agogué *et al.* (2013), ont bien mis en avant cette évolution du rôle de l'intermédiaire. Cependant, ils insistent exclusivement sur le rôle de l'intermédiaire comme coordinateur, architecte de l'innovation collective. Nous ajoutons ici les aspects liés à la dissémination des connaissances tacites, qui entrent également clairement dans les attributions de l'intermédiaire, et qui, selon nous, prend de plus en plus d'importance dans le cadre de l'innovation ouverte.

En effet, si l'origine de l'avantage compétitif se trouve dans une capacité supérieure de création de connaissances idiosyncrasiques (i.e., spécifiques

et non disponibles sur le marché), il est fondamental pour les entreprises de construire cette capacité de production de connaissances tacites, notamment en absorbant les connaissances tacites externes. Or, ces dernières étant largement « collées » à leur détenteur, pour les diffuser il ne s'agit pas simplement de rédiger des contrats de transfert adéquat. Il convient de favoriser l'apprentissage, le travail en face-à-face, etc. Favoriser la dissémination des savoir-faire et connaissances tacites, intrinsèquement difficiles à diffuser largement, pour faire en sorte qu'ils profitent aux entreprises partenaires, c'est là une mission d'intermédiation fondamentale.

Ce rôle de disséminateur de connaissances amène ainsi ces intermédiaires à s'impliquer directement dans le processus de création de connaissances, puisque, comme le rappellent Amesse et Cohendet (2001), une connaissance tacite n'est jamais transférée, i.e. dupliquée à l'identique entre un émetteur et un récepteur, mais elle est toujours recréée par le récepteur. Si une information peut être transférée à l'identique, ce n'est jamais le cas d'une connaissance qui suppose toujours une réappropriation cognitive du récepteur. L'activité de transfert des connaissances est ainsi toujours une activité de production, i.e. certains intermédiaires de l'innovation, de par leur implication dans la diffusion des savoir-faire au sein de leur environnement, sont amenés à contribuer explicitement à la production de savoirs.

Le cas de la valorisation de la recherche publique dans les pays développés illustre parfaitement les différences entre des intermédiaires dont le rôle se limite à gérer de l'information et ceux qui gèrent des connaissances.

## LE CAS DES INTERMÉDIAIRES DE LA VALORISATION DE LA RECHERCHE PUBLIQUE : TTOS VERSUS RTOS

Dans le cas des relations université-entreprise les intermédiaires jouent un rôle important du fait des différences entre les milieux académiques et industriels (cultures, objectifs, etc.). En particulier, un rôle essentiel des intermédiaires est de contribuer à ce que les inventions, souvent embryonnaires, issues de la recherche publique soient correctement transférées et utilisées par les entreprises (ne pas laisser les inventions mourir sur les étagères des universités). Il s'agit de franchir la fameuse « vallée de la mort » située entre la recherche fondamentale des universités et la recherche plus appliquée des entreprises.

Les canaux de transmission de la recherche fondamentale vers l'industrie sont nombreux : publications scientifiques, rapports, interactions informelles, conférences publiques, contrats de recherche, activité de conseil, recherche collaborative, brevets, échanges de personnels, formation d'étudiants, création de start-up académique, etc. (Howells *et al.*, 2012). Schartinger *et al.,* (2002) identifient ainsi quinze types d'interaction qu'ils groupent en quatre catégories : recherche collaborative, contrats de recherche, mobilité et formation. De la même manière Perkmann et Walsh (2007) proposent une typologie des liens entre université et entreprises selon le degré d'implication des différents acteurs (voir Tableau 5).

Cette typologie nous semble particulièrement intéressante car elle permet de distinguer clairement les rôles des deux types d'acteurs intermédiaires qui interviennent dans la relation science-industrie. D'un côté les TTOs (pour *Technology Transfer Offices*), dont la mission est principalement de réduire les coûts de transaction lors du transfert de technologie entre universités et entreprises. Ils interviennent surtout afin de transférer la propriété intellectuelle et de sécuriser les contrats de collaboration (« interactions faibles » pour reprendre la typologie de Perkmann et Walsh dans le Tableau 5). D'un autre côté, les RTOs (pour *Research and Technology Organizations*), dont la mission est également de s'impliquer activement dans le processus de création et de transfert de connaissances (« interactions fortes »).

*Tableau 5* – Une typologie des relations entre science et industrie

| Nature de l'implication relationnelle | | |
|---|---|---|
| Forte | Moyenne | Faible |
| Partenariat de recherche | Transfert de ressources humaines (mobilité) | Relation marchande, commercialisation de propriété intellectuelle (licences) |
| Services de recherche | Entrepreneuriat académique | |
| Publications scientifiques et interaction informelles (conférences) peuvent accompagner les trois formes d'implication | | |

*Source :* Perkmann et Walsh (2007). Traduction libre des auteurs.

## Les TTOs et la gestion de l'information

Les premiers TTOs ont été créés aux États-Unis dans les années 1970s. Leur existence s'inscrit dans une tendance croissante ces dernières décennies à insister sur l'importance de la valorisation de la recherche académique. Aussi, les universités à travers le monde se sont dotées de services dont la

mission est de faciliter les relations avec les entreprises et le transfert de technologies. Aux Etats-Unis, le Bayh-Dole Act, voté en 1980, est un symbole de cette évolution. En France, la loi du 12 juillet 1999 sur l'innovation et la recherche, qui a notamment instauré la création des SAIC (service des activités industrielles et commerciales) pour toutes les universités, reflète également cette évolution. Plus récemment, en 2012, des SATT (sociétés d'accélération du transfert de technologie) ont été mises en place dans un certain nombre de régions. Également, des associations professionnelles chargées de promouvoir l'importance de la valorisation de la recherche académique ont été créées, comme l'AUTM (Association of University Technology Managers) aux États-Unis en 1974.

Tout en étant conscient des importantes différences entre les pays et de l'hétérogénéité forte entre les différents TTOs (Schoen *et al.*, 2012), le point essentiel à nos yeux est que l'ensemble de ces organisations chargées de la valorisation, quel que soit leur pays, leur structure de gouvernance ou leur source de financement, restent inscrites dans une logique de réduction des coûts de transaction c'est-à-dire dans une logique de contractualisation et de sécurisation du transfert de technologie. Il s'agit moins pour ces TTOs de transférer des connaissances en s'impliquant dans la recherche que de transférer des brevets et de sécuriser l'environnement transactionnel. Ce point apparaît de manière évidente à la lecture des missions et objectifs, tels qu'ils apparaissent notamment sur les sites web de l'ensemble des TTOs à travers le monde. Remarquons d'ailleurs que l'AUTM fondée en 1974 aux Etats-Unis s'appelait initialement la « Society of University Patent Administrators ».

Par exemple, sur le site web du TTO de l'université de Stanford (Stanford office of technology licensing, OTL, http://otl.stanford.edu, accès 28/4/2014) on trouve les éléments suivants :

> "OTL is responsible for managing the intellectual property assets of Stanford University.
>
> At OTL our charter is to help turn scientific progress into tangible products, while returning income to the inventor and to the University to support further research.
>
> OTL receives invention disclosures from Stanford faculty, staff and students. We evaluate these disclosures for their commercial possibilities, and when possible license them to industry. If the inventions are successfully licensed, cash royalties collected by OTL provide funding to the inventors' departments and schools, as well as personal shares for the inventors themselves.

*Although patentable inventions constitute the majority of OTL's licen-
sing activities, we also handle copyright (software), Tangible Research
Property (TRP), and outgoing Material Transfer Agreements for bio-
logical materials".*

La situation est analogue en France. Les SAIC ont pour mission essen-
tielle de gérer les contrats de recherche passés entre l'université et les entre-
prises et de gérer les portefeuilles de droits de propriété intellectuels des uni-
versités et notamment les licences accordées aux entreprises. Leurs missions
telles que l'on peut les retrouver sur la plupart des sites web sont d'assurer
la sensibilisation aux activités de valorisation, la gestion de la propriété
intellectuelle de l'Université, la négociation des partenariats, l'ingénierie
de projets (CIFRE, aide à l'innovation), les relations avec les partenaires
de l'innovation (Anvar, Incubateur, Technopôle, RDT, Pépinière) et enfin
d'assister à la création d'entreprise.

Par rapport au SAIC, les SATT sont des structures indépendantes des
universités et sont dotées de moyens importants leur permettant d'investir
dans la maturation de projets de valorisation afin d'emmener des inventions
embryonnaires le plus proche possible du marché et de faciliter leur transfert
vers des entreprises industrielles (ces fonds de maturation servent ainsi à
financer des études complémentaires, à hauteur parfois de plusieurs cen-
taines de milliers d'euros, telles que des preuves de concept par exemple).
Cependant leurs activités restent inscrites dans une logique pure de réduc-
tion des coûts de transaction. Les SATT ne réalisent en effet pas d'activités
de recherche elles-mêmes (elles externalisent les études de maturation). Il
est d'ailleurs remarquable que la création de ces structures indépendantes
des universités éloigne en un sens l'acteur intermédiaire (la SATT) de l'ac-
teur de la recherche (le laboratoire et le chercheur) et ainsi rend le pro-
blème de la légitimité des TTOs encore plus aigu (O'Kanea *et al.*, 2015).
Aussi, plusieurs organismes de recherche ont-ils préféré garder la gestion de
leurs contrats de recherche en interne, limitant ainsi les SATT à des simples
vendeurs de propriété intellectuelle.

En conclusion, le rôle des TTOs est fondé sur une vision du proces-
sus d'innovation qui est réduit à de la production d'informations. Dans ce
cadre, les compétences affichées des TTO sont : identification d'inventions
transférables, mise en réseau, contractualisation, propriété intellectuelle,
sensibilisation, négociation (voir Figure 1, dans le cas du TTO de Stanford).
En d'autres termes, il s'agit sans ambiguïté de réduire les coûts de transac-
tion inhérents au transfert de technologie entre universités et entreprises
sans s'impliquer directement dans le processus de transfert de connais-
sances.

*Figure 1* – Le processus de transfert de technologie
selon l'université de Stanford
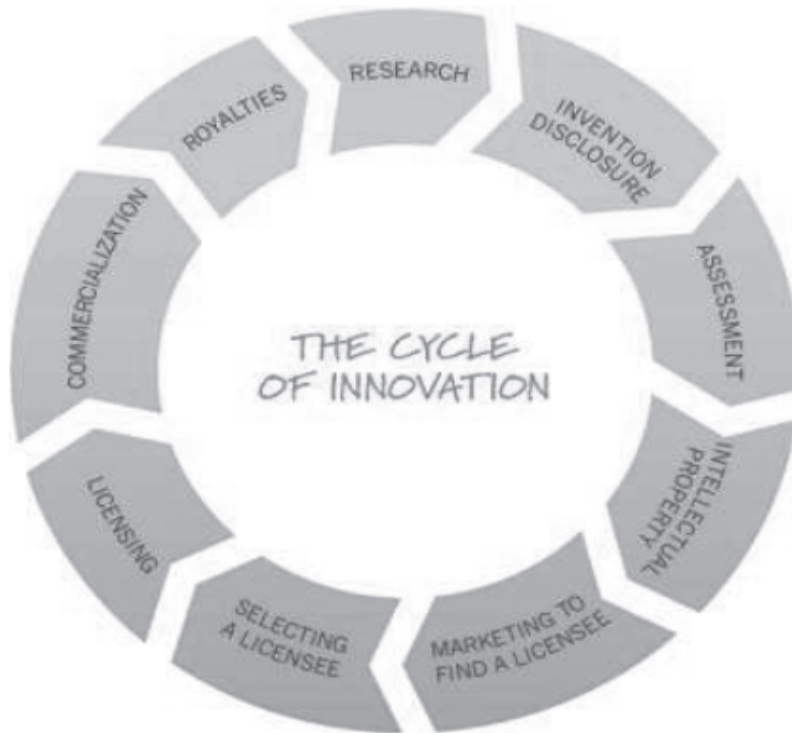
## Les RTOs et la gestion des connaissances

Très différent est alors le rôle des RTOs. En effet, l'EARTO (European Association of Research and Technology Organizations) définit les RTOs comme étant des organisations : « *dont l'activité prédominante est de fournir des services de R&D, de technologie et d'innovation à des entreprises, gouvernements et autres clients* ». Les différents RTOs en Europe réalisent un chiffre d'affaires d'environ 23 milliards d'euros chaque année et travaillent avec environ 100 000 entreprises, surtout des PMIs (http://www.earto.eu/about-rtos/facts-and-figures.html). Parmi les RTOs les plus connus on peut citer les instituts Fraunhofer en Allemagne, VTT en Finlande, TNO aux Pays-Bas, SINTEF en Norvège, SP en Suède, LIST au Luxembourg, etc. En France, plusieurs organisations peuvent être assimilées à des RTOs (même si elles ne

sont pas toutes membres de l'EARTO) : Onera, CEA Tech, les CRITT, les réseaux CTI, Armines, etc.

Le financement des RTOs comprend un mélange de sources publiques (subventions publiques, contrats de recherche publique, etc.) et privées (prestation de conseil, service, etc.), résultant de leur caractère hybride, entre science et technologie (Berger, Hofer, 2010). Ainsi les RTOs peuvent générer des revenus en facturant leurs prestations technologiques et de savoir-faire comme le feraient des entreprises. D'un autre côté, étant aux côtés des acteurs de la recherche fondamentale publique et contribuant à la production d'un bien public, ils sont également éligibles à de nombreux financements et bourses publics.

Bien qu'ils semblent jouer un rôle important dans les systèmes d'innovation nationaux (Preissl, 2006), notamment dans les phases de rattrapage technologique comme disséminateurs de savoir technologique (Sharif, Baark, 2011), les RTOs ont peu fait l'objet d'études en économie et gestion (en tous les cas beaucoup moins que les universités et les TTOs). Ils constituent pourtant des objets d'étude intéressants car, quel que soit leur pays, leur structure de fonctionnement ou leur source de financement, les RTOs constituent des partenaires d'innovation actifs (et pas seulement des agents impliqués dans les transactions technologiques, Giannopoulou *et al.*, 2011). Ils répondent ainsi à des questions centrées sur la gestion des connaissances et non pas simplement sur la gestion de l'information.

En effet, selon Arnold *et al.* (2010), les RTOs développent les activités suivantes :

(i) Réalisent de la recherche exploratoire (généralement avec des acteurs scientifiques et des universités) afin de développer des domaines d'expertises et de compétences et de construire des plateformes technologiques ;

(ii) Capitalisent sur cette recherche en réalisant des projets de recherche communs, parfois également très exploratoire, avec des industriels ;

(iii) Réalisent de la recherche plus « routinisée » (davantage dans une logique d'exploitation) afin d'offrir des activités de conseils et de prestations de recherche aux entreprises.

À l'instar des TTOs, les RTOs sont donc clairement au carrefour des mondes académiques et industriels (Barlatier, Giannopoulou, 2011). Mais à l'inverse des TTOs, les RTOs ne sont pas des simples intermédiaires dans une logique transactionnelle. S'ils peuvent parfois contribuer à réduire les coûts de transaction (les RTOs sont souvent impliqués dans des activités de *licensing*), ils existent avant tout afin de garantir la dissémination des recherches

scientifiques et leur valorisation au sein de leur environnement économique. Pour ce faire, ils investissent dans la recherche scientifique (souvent avec l'aide de financements publics) afin de développer des capacités technologiques et des compétences que la plupart des entreprises ne possèdent pas. En même temps, ils collaborent avec les entreprises afin de valoriser commercialement ces compétences et d'assurer un flux de revenu. Au final, les RTOs offrent une solution aux problèmes de transfert de connaissances tacites, d'apprentissage, de capacité d'absorption, etc., et contribuent ainsi largement à réduire le fossé entre science et industrie et à permettre à des nombreuses inventions à franchir la vallée de la mort.

Les illustrations en de multiples domaines ne manquent pas, tant les activités innovantes des RTOs sont nombreuses. En guise d'exemples, considérons le projet « The Hague Security Delta » (HSD) développé aux Pays-Bas afin de faire de la ville de la Haye, cité internationale de la paix et de la justice, la capitale de la cybersécurité en Europe. Ce projet conduit par le TNO, un RTO européen majeur (plus de 3000 spécialistes) d'origine néerlandaise (www.tno.nl) apporte son expertise et organise la coopération entre les multiples parties de ce projet (entreprises et gouvernement) pour fonder le Cyber Security Lab et permettre, dans une logique d'open innovation, à plusieurs PMEs de développer de nombreuses applications industrielles sur la base des nouvelles technologies de cyber-sécurité.

Autre exemple dans le domaine de l'industrie, Le RTO finlandais VTT (2600 personnes ; www.vtt.fi) a développé avec une demi-douzaine de partenaires industriels des solutions innovantes permettant de réduire considérablement les niveaux de bruits et de vibrations de machines en utilisant de nouveaux matériaux epoxy et de la modélisation virtuelle.

Enfin, dans un autre domaine et pour proposer un exemple d'innovation à fort impact, nous citerons le format de compression audio MP3. Cette innovation, issue des travaux d'un institut Fraunhofer, (le plus important RTO européen : 23000 chercheurs sur 67 sites ; www.fraunhofer.de ; qui développe plus de deux applications de brevets par jour travaillé) et de Philips, TDF, France Télécom, IRT et Technicolor notamment, finalisée en 1995 est devenue un standard largement répandu désormais.

En définitive, ces exemples illustrent ainsi nos deux postulats : (1) les RTOs se situent clairement entre la recherche fondamentale universitaire et l'industrie et en ce sens peuvent être considérés comme des intermédiaires de l'innovation ouverte ; (2) les RTOs sont impliqués activement dans le processus innovant et dans les questions de gestion des connaissances. Ils créent de la valeur dans la chaîne de l'innovation en se positionnant comme un partenaire privilégié capable d'interagir avec différents acteurs et ce, de

différentes manières, en fonction du contexte et de l'objectif d'innovation et/ou de transfert de connaissances et technologies.

## CONCLUSION

L'objectif de ce travail était d'analyser le rôle des intermédiaires de l'innovation ouverte, en étudiant plus particulièrement le cas des intermédiaires dans la valorisation de la recherche publique. L'apport central de ce travail a été de distinguer les intermédiaires standards, dont le rôle consiste à réduire les coûts de transaction et qui s'inscrivent ainsi dans une logique de gestion de l'information, d'intermédiaires plus sophistiqués, qui s'impliquent dans le transfert de connaissances tacites et de savoir-faire généralement difficiles à partager, s'inscrivant ainsi dans une véritable logique de gestion des connaissances. Dans le cas de la valorisation de la recherche publique, ce travail nous a ainsi permis de distinguer deux acteurs intermédiaires très différents.

D'un côté, les sociétés de transfert de technologies classiques, appelée TTOs ou SAIC et SATT en France. Ces intermédiaires ne participent pas activement au transfert mais seulement à son organisation juridique et administrative. Ils ne sont pas directement impliqués dans le transfert des connaissances techniques et ne font pas directement de recherche. Leur rôle se limite ainsi à organiser et sécuriser le transfert de savoirs codifiés entre des organisations qui détiennent déjà chacune ces connaissances.

D'un autre côté, les sociétés de recherche et de transfert de technologie, appelés RTOs. Ces intermédiaires de l'innovation ouverte se distinguent d'intermédiaires standards dans le sens où ils ne font pas que faciliter le transfert de technologie universités-entreprises mais sont réellement impliqués dans le processus de création de connaissances, en collaboration avec d'autres acteurs de recherche publique et/ou privée. Ils facilitent ainsi la co-création et le transfert de connaissances et de savoirs entre les universités et les entreprises.

La première approche de l'intermédiation de l'innovation ouverte renvoie à une conception institutionnelle inscrite dans un paradigme d'allocation de ressources existantes où il s'agit de minimiser les coûts. La seconde approche, en revanche, correspond à une conception de maximisation de la valeur créée inscrite dans un paradigme de création de ressources.

Pour autant, ces deux approches apparaissent comme davantage complémentaires que substituables. Dans le futur il est d'ailleurs envisageable que les deux fonctions convergent et que les structures d'intermédiation, en particulier, dans le cas de la recherche publique, se concentrent sur les deux aspects. Cette évolution se reflète, par exemple, en France dans la création

des instituts Carnot qui incluent souvent des entités de recherche qui travaillent en étroite collaboration avec des services de valorisation (c'est le cas par exemple du CEA LIST ou CEA LETI). Une telle fusion résulterait ainsi en des super-intermédiaires de l'innovation, capables non seulement réduire les coûts de transaction mais également de favoriser la dissémination des connaissances en surmontant les obstacles liés à la nature tacite des savoirs (Amesse, Cohendet, 2001).

Les implications de notre recherche sont doubles : en premier lieu, d'un point de vue politique il est important de comprendre les différents enjeux liés à l'intermédiation de l'innovation afin de mettre en œuvre des politiques favorisant le transfert de technologie entre les acteurs de l'innovation. Dans le cas de la valorisation de la recherche publique en France en particulier, les RTOs peuvent compléter les dispositifs de valorisation basés sur les SATT. Notre recherche souligne a minima qu'il pourrait être pertinent d'insister davantage sur ces dispositifs encore assez peu connus en France.

En second lieu, d'un point de vue managérial, cette recherche permet de mieux comprendre les enjeux liés aux TTOs et aux RTOs. Ces derniers sont d'importants partenaires potentiels à la fois pour les universités et pour les entreprises. Par là même, cette contribution permet d'affiner les choix partenariaux au sein des projets d'innovation pluri-organisationnels et permet ainsi de développer le dialogue entre gestion des connaissances et innovation. En particulier, un apport central de notre recherche est de mettre en avant le fait que l'intermédiation de l'innovation ouverte ne doit pas se limiter à une conception basée sur l'information mais doit incorporer explicitement les questions liées à la gestion des connaissances.

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# Working Paper

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# The impact of Research and Technology Organizations on firm innovation: a comparison with universities

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**Abstract**

In this paper, we focus on the linkages between public research organizations and firms. More specifically, we look at the role of Research and Technology Organizations (RTOs) compared to universities and analyze what kind of innovation firms, which see RTOs as more important sources of knowledge than universities, are more likely to develop. In particular our objective is to show whether or not RTOs and universities lead to similar outcomes as regard to industrial innovation. Our study is based on statistical analysis of the most recent Community Innovation Survey available micro-data (CIS 2012). Our results suggest that companies that deem RTOs as more important sources of knowledge than universities have a higher probability to develop *service innovation*, have *less need to invest in internal R&D* but are *less likely to be innovative including new to the world innovation.*

**Keywords:** Research and Technology Organizations (RTOs), Universities, Service Innovation, Innovation Performance, Innovation Impact, Open Innovation, Radical Innovation, R&D investment.

## 1   Introduction

It is well established that the innovation process has become increasingly open and includes the collaboration of many and diverse partners (Chesbrough 2003). A firm cannot rely merely on internal capabilities, in order to successfully innovate, but needs to collaborate with other firms, even competitors, customers, communities, suppliers, the public research world and/or consultants, by taking part in smaller or bigger consortia (Teece 1989). Therefore an open innovation national system with interaction

between many innovation stakeholders is the key to competitiveness in the current knowledge based economy (Chen 2008).

More specifically, special attention has been given over the years in the relationship between academia and industry and its positive impact on the innovation outcomes (Caloghirou et al. 2001; D'Este & Perkmann 2011) as inter-organizational relationships between academia and industry play an important role in driving innovation processes (Markus Perkmann & Walsh 2007). Universities, facing the contemporary turbulent environment and the scarcity of public funds have been increasingly required and subsidized by local governments (Caloghirou et al. 2001) to enlarge their activities beyond the traditional teaching and basic research to assume a more active role in R&D by forming collaborations with industrial partners[1].

This stream of research on public research – industry relationships and their importance in national innovation systems is very much focused on universities (Lundvall 1992; Mowery et al. 2005; Etzkowitz & Leydesdorff 2000; Etzkovitz & Goktepe 2005; Debackere & Veugelers 2005; Rasmussen 2008; Comacchio et al. 2012; Sharif & Baark 2011). The public research landscape, though, does not only comprise universities. The Research and Technology Organisations (RTOs) are also an important part of the academic and public research world and a contributor in the current complex knowledge economies (Metcalfe 2010). In fact RTOs are a significant part of what is called the "extra-university research organizations" sector (Arnold et al. 2010). RTOs have diverse inherent characteristics which often makes it difficult to clearly define them; for instance we find different names for RTOs, in the literature, such as public institutes, research institutes, technological institutes (Gulbrandsen 2011).

RTOs are, according to the European Association of Research and Technology Organizations (EARTO), *"organizations which as their predominant activity provide research and development, technology and innovation services to enterprises,*

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[1] A prominent example is the introduction of the Bayh-Dole Act in US, which gave incentives to universities to actively seek revenues from their research outputs, and a large stream of research has been dedicated on the role of universities on technology transfer and innovation (Mowery et al. 2001, Howells et al. 2012, Nelson 2001, Grimaldi et al. 2001). Similarly, the European Framework programs have also been an important incentive for universities to engage in partnerships with several and diverse partners (Caloghirou et al.2001).

*governments and other clients…"* (EURAB 2005) p. 1. This is in line with Albors-Garrigos et al. (2010) who also define RTOs as organizations whose main business is R&D and their purpose being to enhance the innovative performance of their customers.

RTOs might be public, semi-public or private, some of them are technology-oriented while others provide services in social sciences or economics. Gulbrandsen (2011) highlights their hybrid[2] nature as they operate between public and private organizations and they are at the boundary between the notion of Knowledge-Intensive Business Service Firm (KIBS) and academia. The innovation model of RTOs as described by the report of Arnold et al. (2010, pp.10–11) comprises the following stages: (i) exploratory research and development to develop an area of capability or a technology platform; (ii) further work to refine and exploit that knowledge, often in collaboration projects with the industry; (iii) more routinized exploitation of this knowledge via consulting, licensing and spin-off company creation.

Despite the important presence of RTOs[3] in the national innovation systems there is a lack of theoretical and empirical studies about them (Modrego-Rico et al. 2005; Gulbrandsen 2011). In fact, one of the reasons why there is a scarcity of research on RTOS is that most of the times they are blended and studied together with universities (M Perkmann & Walsh 2007). But recent literature shows that companies may address RTOs for different reasons than they address universities (Arnold et al. 2007).

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[2] RTOs rely on a mix including public and private sources, such as membership subscriptions, fee-for service activities, government core funding, contracts for public grant-funded research or competitive contracts from firms or governments, which is a result of their hybrid character (Berger & Hofer 2010).

[3] According to the EARTO there are 350 RTOs in Europe[3] operating in 23 countries involving a network of 150.000 researchers, engineers and technicians. These organizations bridge the gap of basic research and practical application by providing innovative solutions to 100000 companies per year on diverse domains such as health, security, energy, transportation, materials, agriculture (to mention just a few) with an overall economic impact of 40 billion euros. Of course RTOs are not solely a European phenomenon. Renowned RTOs exist also in many other countries such as US, Canada, China, Brazil, India etc. The interested reader can find more information about RTOs in an international context through the website of WAITRO http://www.waitro.org/index.php. The scope of this research though lies in the European context and therefore we give naturally more focus on the European RTOs.

Therefore, RTOs and universities are distinct types of organizations (Arnold et al. 2007; Readman et al. 2015; Barlatier et al. 2016) that deserve special attention as they can *"fulfill a different role in an economy's knowledge economy"*(Metcalfe 2010, p.22).

The objective of this paper is to fill in this gap in the literature by analyzing the distinct role of RTOs versus universities in the innovation process. More specifically, we study what kind of innovation firms which view RTOs as more important sources of knowledge and information than universities are more likely to develop. Our study is based on statistical analysis of the most recent Community Innovation Survey (CIS 2012) data from 8 European countries. Our results suggest that companies that deem RTOs as more important sources of knowledge have a higher probability to develop *service innovation*, have *less need to invest in internal R&D* but are *less likely to develop new to the market or new to the world.* These results are broadly in line with theoretical analysis of the role of RTOs (Tann et al. 2002; Preissl 2006; Arnold et al. 2007; Arnold et al. 2010; Albors-Garrigos et al. 2010; Readman et al. 2015).

The remainder of the paper is structured as follows. First we survey the most recent literature in order to build our theoretical hypotheses regarding the impact of RTOs versus universities on firm's innovation performance, service innovation development and the need to invest in internal R&D; the hypotheses are presented in Section 2. Then we present the empirical design of our study in Section 3 and Section 4 summarizes our main results. Finally, a discussion of these results and their research implications for practitioners and policy makers conclude the paper in Section 5.

## 2   Literature review and formulation of research hypotheses

### 2.1  RTOs vs Universities as sources of knowledge: the effects on firms' innovation performance

The effects of open innovation on innovative performance have been long debated. It has been shown in general that the use of external knowledge has a positive impact on the firm's innovation performance (Laursen & Salter 2006). Laursen and Salter (2006) also argue that the search for external knowledge in the context of open innovation should be reasonable and that over-search (both in terms of breadth and depth) may hinder innovative performance. In general, it is recommended that managers should use diverse types of knowledge providers which complement each other ( Tether &

Tajar 2008) while maintaining the right balance in order not to get lost in too many search channels (Laursen & Salter 2006).

In Western and Europe and North America, RTOs were instruments of public policy in order to catch-up in technological developments, by transferring and assimilating new technologies from academia to industry but also across different industries (Readman et al. 2015). A consultation carried out by the "Association of Donors for the German Economy" in 2006 showed that cooperation between enterprises and RTOs is considered as highly beneficial for both parties.

Cooperating with universities is also positive for companies as it does not merely contribute to the innovation process by delivering inventions but it also offers creative ways of solving problems, opportunities to access human capital (e.g. students) and to gaining "windows" on emerging technologies and knowledge for specific innovations (Perkmann & Walsh 2007; D'Este & Perkmann 2011).

Therefore, we can argue that both the collaboration with RTOs and universities have a positive effect on the innovative performance of firms. Nevertheless, the proficiency of RTOs in a variety of technologies and services, coupled with a focus on tangible outcomes (Tann et al. 2002) shows a greater propensity to impact on pragmatic innovation outcomes. RTOs were created with the explicit purpose to support the firms' innovation activities (Arnold et al. 2007; Arnold et al. 2010). Therefore RTOs core activity as it is evident from their definition is to perform applied research and commercialize them together with their industrial partners (Arnold et al. 2010) while for universities this is only their third mission after teaching and basic research (Etzkowitz & Leydesdorff 2000). Furthermore, the cognitive proximity of RTOs and industry (as RTOs lie in the interface between academia and industry) makes it easier to understand and translate business needs and scientific knowledge into pragmatic innovation output. This is not always possible with universities, where the different culture with their industrial partners has often been mentioned as a barrier in the developments of collaborative innovation projects (Siegel et al. 2007). Therefore, we can formulate our first hypothesis:

*Hypothesis 1a: Companies that deem RTOs as more important sources of knowledge than universities are more likely to be innovative (introduce more innovations irrespectively of their type and impact).*

While RTOs proficiency in translating scientific research into a pragmatic output has been acknowledged by the relevant literature little has been said regarding the contribution of RTOs to breakthrough-radical innovations. On the contrary, Caloghirou et al. (2001) have shown that when collaborating with universities, firms primarily aim at keeping up with major technological developments, achieving research synergies and reducing R&D costs. In fact in this case it is universities that are praised to contribute to world class innovation. Evidence is provided by many scientific domains such as pharmaceuticals or software engineering and aerodynamics (Feller 1990; D'Este & Perkmann 2011; Perkmann et al. 2013). This is normal if we consider the fact that universities are more concerned with basic and more experimental research that is more likely to generate breakthrough, first in the world innovations (Caloghirou et al. 2001; Perkmann et al. 2013; Feller 1990). Therefore, we can expect that:

*Hypothesis 1b: Companies that deem RTOs as more important sources of knowledge than universities are less likely to develop world-class innovations.*

## 2.2 Impact on the type of innovation: RTOs proficiency in service innovation

Another difference that can be expected between RTOs and universities deals with the type of innovation (service versus goods) they induce in the economy. The main mission of RTOs is to support the local economies by providing innovation services[4] (Tann et al. 2002; EURAB 2005; Arnold et al. 2007). Firms expect from RTOs to be able to offer them knowledge-based services in order to make up for the knowledge that they do not possess and are not willing to invest in (Mrinalini & Nath 2008). Therefore, RTOs have to be able to make their service offering compatible with new knowledge generation (Modrego-Rico et al. 2005).

The growth of the tertiary sector has raised the attention on services; for instance the importance of knowledge intensive services has been emphasized in the literature as being a strategic tool for companies for developing new markets, new process and new products (Metcalfe & Miles 2000; Gonzalez-Moreono & Saez-Martinez 2009). Moreover, scholars have identified the importance of innovation in services separately from goods (Gallouj & Weinstein 1997; Evangelista 2000; Hipp 2010). Service

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[4] On the other hand, if RTOs can be considered as more focused towards service innovations, Tether and Tajar (Bruce S Tether & Tajar 2008) show that universities are more focused towards industrial problems and tend to provide firms with product and process innovation

innovation is highly abstract due to the inherent characteristics of services and it is often considered as complementary to goods innovation (Gallouj & Weinstein 1997; Gallouj & Savona 2011). In this perspective, Toivonen and Tuominen (2009, p.899) argue that "innovation in services shows some specific features which cannot be deeply understood if the models developed in the manufacturing context are applied".

Furthermore, service innovation capabilities have very recently started to be discussed from academics but most of the contributions remain theoretical (e.g. den Hertog et al. 2010). One of the most prominent frameworks about the development of service innovation capabilities was developed by Froehle and Roth (2007) which is based on the interplay between resources and process. This framework was further refined and studied in the context of RTOs empirically (Giannopoulou et al. 2012; Gryszkiewicz et al. 2012; Gryszkiewicz, Giannopoulou & P. J. Barlatier 2013). The results showed that RTOs have distinct service innovation capabilities mainly because of their unique human capital which is actually one of the very special characteristics of RTOs as they have the opportunity to employ diverse profile of highly qualified people (Mrinalini & Nath 2000). Furthermore, the relational capital of RTOs with various stakeholders such as industry, government and academia (Arnold et al. 2007; Arnold et al. 2010) provides them also with an important asset on service innovation capabilities development. Finally, RTOs were shown to also have unique capabilities in fostering creativity in service innovation thanks to their highly stimulating and dynamic working environment (Giannopoulou et al. 2014). This is in line with Gadrey et al. (1995) who argue that human, technological, organizational related capabilities are at the heart of a service offering. Therefore, we expect that:

*Hypothesis 2: Firms that deem RTOs as more important sources of knowledge than universities are more likely to develop service innovation.*

## 2.3 RTOs vs Universities as sources of knowledge and the need to invest in internal R&D

Internal R&D does not only generate innovations, but it also helps the firm to develop the ability to identify, assimilate, and exploit knowledge from the environment-what is called a firm's 'learning' or 'absorptive' capacity (Cohen & Levinthal, 1989; 1990). A lot of research has been dedicated to finding out whether external sources of knowledge or inbound open innovation as often called is a complement or a substitute of internal R&D. Open innovation and more specifically use of external sources of

knowledge is often considered to be a complement of internal R&D (Lichtenthaler & Ernst 2008) contributing significantly to the innovative performance of the firm. Following this reasoning, Vanhaverbeke et al. (2008) argue that internal and external sources should be combined and in this perspective internal R&D is very important to effectively exploit external knowledge. However, Laursen and Salter (2006) found that open innovation is a substitute rather than a complement to internal R&D.

When it comes to public research in particular, Cohen and Levinthal (1998) have shown that there is a direct link between the firm's R&D activities and the use of public research. More specifically, the two authors argue that companies are investing in internal R&D not only for generating innovations but also to be able to develop the absorptive capacity to identify important external knowledge such as coming from public research of universities or government laboratories. Moreover, it has already been shown that the R&D intensity of the firm is positively correlated with the use of external knowledge from universities (Mohnen & Hoareau 2003; Laursen & Salter 2004).

As compared to universities RTOs are more focused on applied research; while universities core activity (together with teaching) is to perform basic research, as we have already discussed before. But "fundamental knowledge is too abstract in many cases to map easily onto practical problems in firms, and a translational or development gap usually needs to be bridged" (Metcalfe 2010, p.23). Therefore, since ideas coming from universities are more premature and require more work until they reach the stage of commercialization, it follows that firms which collaborate with universities need to invest in internal R&D in order to reuse knowledge stemming out of university labs (Rogers 2003). RTOs on the other hand can cover this need with their unique innovation capabilities (Gryszkiewicz et al. 2012). The capability of RTOs to manage effectively the innovation process from the idea to the commercialization stage is therefore an asset in the collaboration projects, since it might reduce firms' need to invest in internal R&D. Thus we expect that:

*Hypothesis 3: Companies that deem RTOs as more important sources of knowledge than universities exhibit a lower need to invest in internal R&D.*

# 3 Empirical design

## 3.1 Data collection

The data that we use in order to test the above mentioned hypotheses come from the 2012 Community Innovation Survey (CIS) which is administered by Eurostat[5].The CIS aims at collecting information regarding the innovation activity, namely type of innovation, funding, sources of knowledge, performance etc., of European enterprises. The main methodology and concepts are based on the Oslo Manual.

Taking into account the purpose of this research project and the constraints of data availability and confidentiality we focus on the results of the CIS 2012 from eight countries, namely Belgium, Spain, Italy, Luxembourg, Portugal, Finland, Sweden and Norway. These countries have long history in public research where:

(i)     important RTOs have been active according to EARTO (European Association of RTOs) and,

(ii)     there are important and renown universities and

(iii)     they are countries with a proven innovation record.

Our sample consisted of 31255[6] enterprises in total from eight countries, as mentioned above, different in size (ranging from SMEs to MNEs[7]) from all NACE activities (the NACE classification used is explained in Table 2).

## 3.2 Description of the Variables used in the Econometric treatment

In order to test our four hypotheses we build four different models (see section 3.3). Before explaining them, we provide, in Table 1, an overview of our main dependent and independent variables while in Table 2 we present our control variables. For each variable we provide a description, as well as the min, max values, standard deviation and means.

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[5] http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

[6] Naturally, this number is adjusted in the relevant models as specific observations have been removed due to missing data for specific variables.

[7] Exact numbers regarding the size cannot be disclosed for confidentiality reasons

*Table 3: Dependent and independent variables for all econometric models: means, standard deviation, min and max values*

| H1a | H1b | H3 | H4 | Variable name | Variable code | Description | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Dependent variables* | | | | | | |
| √ | | | | Turnover from new to the market products | TURNMAR | % of turnover in new or improved products introduced that were new to the market | 0.1 | 0.2 | 0.0 | 1.0 |
| √ | | | | New to the market products | NEWMKT | NEWMKT=1, if the enterprise has introduced a product new to the market | 0.3 | 0.5 | 0.0 | 1.0 |
| | √ | | | New to the world products | WORLD_FIRST | WORLD_FIRST=1, if the enterprise has introduced a world first innovation. Constructed variable WORLD_FIRST=1, if INPDFW[8]=1 | 0.1 | 0.3 | 0.0 | 1.0 |
| | | √ | | Service innovation | INPDSV | INPDSV=1, if the company has introduced onto the market a new or significantly improved service | 0.1 | 0.3 | 0.0 | 1.0 |
| | | | √ | Investment in internal R&D | INT_RD_P | Fraction of in-house R&D investment to turnover. Constructed variable INT_RD_P = RRDINX/TURN12[9] | 0.2 | 18.1 | 0.0 | 3,493.0 |
| | | | | *Independent variables* | | | | | | |
| √ | √ | √ | √ | Relative Importance of RTOs vs Universities as source of knowledge | RTOVSUNI | RTOVSUNI= {-3,-2,-1,0,1,2,3}, denotes the relative importance of RTOs vs universities as source of knowledge. Constructed variable: RTOVSUNI=SGMT-SUNI | -0.03 | 0.8 | -3 | 3.0 |
| √ | √ | √ | √ | RTOs as source of knowledge | SGMT | SGMT={0,1,2,3}, denotes the degree of importance of government or public research institutes as source of knowledge, 0= not used, 1=low,2=medium and 3=high | 0.7 | 1.0 | 0.0 | 3.0 |
| √ | √ | √ | √ | Universities as source of knowledge | SUNI | SUNI={0,1,2,3}, denotes the degree of importance of universities or other higher education institutes as source of knowledge, 0= not used, 1=low,2=medium and 3=high | 0.8 | 1.0 | 0.0 | 3.0 |

[8] CIS 2012 variable, INPDFW={0,1,2} World first innovation: 0= no, 1=yes and 2 =do not know
[9] CIES 2012 variables, RRDINX=expenditure on in-house R&D (in thousands of national currency), TURN12=total turnover (in thousands of national currency)

*Table 4: Control variables for all econometric models: means, standard deviation, min and max values*

| H1a | H1b | H3 | H4 | Variable name | Variable code | Description | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Control Variables* | | | | | | |
| √ | √ | √ | √ | Employees Nr | EMP12 | Number of enterprise employees | 141.6 | 1,002 | 0.0 | C |
| √ | √ | √ | √ | Belonging to a group | GP | GP=1, if the enterprise is part of a group | 0.4 | 0.5 | 0.0 | 1.0 |
| √ | √ | √ | √ | Presence in international market | INT_MARKET | INT_MARKET=1, if the enterprise is present in international market. Constructed variable: INT_MARKET=1, if MAROTH[10]=1 OR MAREUR[11]=1 | 0.5 | 0.5 | 0.0 | 1.0 |
| √ | √ | √ | | R&D capital intensity | RDINT_2 | Fraction of R&D expenditures to number of employees. Constructed variable RDINT_2=RALLX/EMP12[12] | 5,327.3 | 49,631.2 | 0.0 | 8,024,409.0 |
| √ | √ | √ | √ | Cooperation | CO | CO=1, if the enterprise has cooperation arrangements on innovation activities | 0.2 | 0.4 | 0.0 | 1.0 |
| √ | √ | √ | √ | Cooperation breadth | CO_TOT | CO_TOT={0,1,2,…,38,39,40} Denotes the breadth of collaboration taking into account the collaboration with different actors in different locations. Constructed variable CO_TO_SQ=CO11+CO12+CO13+…+CO | 0.6 | 2.3 | 0.0 | 40 |
| √ | √ | √ | √ | Cooperation breadth squared | CO_TOT_SQ | CO_TOT_SQ = {0,1,4,9,..., 1600}. Squared term of CO_TOT variable | 5.7 | 39.1 | 0.0 | 1,600 |
| √ | √ | √ | √ | Search breadth | SEARCH_ADJ | SEARCH_ADJ= {0, 1, 2, 3, 4, 5, 6, 7}. Denotes the search breadth taking into account the sources of external knowledge used irrespectively of the intensity (except Universities (SUNI) and RTOs (SGMT)). Constructed variable SEARCH_ADJ=SSUP_ADJ+SCLPR_ADJ+SCOM_ADJ+ | 4.7 | 2.4 | 0.0 | 7.0 |

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[10] CIS 2012 variable, MAROTH=1 if the enterprise is present in all other countries
[11] CIS 2012 variable, MAREUR=1 if the enterprise is present in EU/EFTA/CC market
[12] CIS 2012 variables, RALLX=overall expenditures on R&D (in thousands of national currency), EMP12= number of employees

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SINS_ADJ+SCON_ADJ+SJOU_ADJ+SPRO_ADJ[13] | | | | |
| √ | √ | √ | √ | Search breadth squared | SEARCH_ADJ_SQ | SEARCH_ADJ_SQ= {0,1,4,9,16,25,36,49}. Squared term of SEARCH_ADJ variable | 27.5 | 18.9 | 0.0 | 49 |
| √ | √ | √ | √ | Search depth | DEPTH_ADJ | DEPTH_ADJ= {0,1,2,3,4,5,6,7}. Denotes the search depth taking into account the sources of external knowledge that are highly used (except Universities (SUNI) and RTOs (SGMT)). Constructed variable DEPTH_ADJ= SSUP_ADJ_2+ SCLPR_ADJ_2+SCOM_ADJ_2+ SINS_ADJ_2+ SCON_ADJ_2+SJOU_ADJ_2+SPRO_ADJ_2[14] | 0.9 | 1.2 | 0.0 | 7.0 |
| √ | √ | √ | √ | Search depth squared | DEPTH_ADJ_SQ | DEPTH_ADJ_SQ= {0,1,4,9,16,25,36,49}. Squared term of DEPTH_ADJ variable | 2.4 | 5.6 | 0.0 | 49 |
| | | | √ | Rest of R&D intensity | REST_RD_P | Fraction of R&D expenditures (except of in-house R&D) to number of employees. Constructed variable RDINT_2=(RALLX-RRDINX)/EMP12[15] | 0.1 | 3.7 | 0.0 | 568.0 |
| √ | √ | √ | √ | NACE dummies | NACE_CORE[16] | Adjusted NACE CORE, NACE={NACE-EWG, NACE-Financial and insurance, NACE-Information and Communication, NACE-Manufacturing, NACE-Mining and QUARRYING, NACE-Transportation and Storage, NACE-Wholesale and Retail Trade, NACE-Other} | | | | |
| √ | √ | √ | √ | Country dummies | NUTS | Country code, NUTS = {Belgium, Spain, Italy, Luxembourg, Portugal, Finland, Sweden, Norway} | | | | |

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[13] SPRO_ADJ=1, if CIS 2012 variable SPRO = {1,2,3}, same applies to the rest of the variables (please see also figure 2 for explanation on the proposed knowledge sources in the CIS questionnaire. Please also note that SCLPU variable referring to public sector was excluded due to confidential/lack of data from most of the countries in the sample)

[14] SPRO_ADJ_2=1, if CIS 2012 variable SPRO = 3, same applies to the rest of the variables (please see also figure 2 for explanation on the proposed knowledge sources in the CIS questionnaire. Please also note that SCLPU variable referring to public sector was excluded due to confidential/lack of data from most of the countries in the sample)

[15] CIS 2012 variables, RALLX=overall expenditures on R&D (in thousands of national currency), RRDINX=expenditure on in-house R&D (in thousands of national currency), EMP12= number of employees

## 3.3 Econometric treatment

### 3.3.1 Model 1 – Hypothesis 1a

In order to test hypothesis 1a we first need a proxy of the innovative performance of the firm. In model 1a the dependent variable is therefore a binary variable based on the answer to the question of the survey regarding whether or not firms report having introduced innovation which are new to the market (NEWMKT- Figure 1), which takes the value 1 if the answer is yes and takes the value of 0 in all other cases.

*Figure 1: Questions related to hypotheses 1a and 1b*



The main independent variable is the relative importance of RTOs vs universities as a knowledge source. For this we will construct a new variable based on two existing variables, namely the importance of RTOs and Universities. The importance of RTOs and universities will be taken from the response to the question of how important the respondents find several sources of innovation (Figure 2).

*Figure 2: Question 6.1 CIS 2012*



**6.1 During the three years 2010 to 2012, how important to your enterprise's innovation activities were each of the following information sources?** Include information sources that provided information for new innovation projects or contributed to the completion of existing projects.

Degree of importance
Tick 'not used' if no information was obtained from a source.

| | Information source | High | Medium | Low | Not used | |
|---|---|---|---|---|---|---|
| Internal | Within your enterprise or enterprise group | ☐ | ☐ | ☐ | ☐ | SENTG |
| | Suppliers of equipment, materials, components, or software | ☐ | ☐ | ☐ | ☐ | SSUP |
| Market sources | Clients or customers from the private sector | ☐ | ☐ | ☐ | ☐ | SCLPR |
| | Clients or customers from the public sector* | ☐ | ☐ | ☐ | ☐ | SCLPU |
| | Competitors or other enterprises in your industry | ☐ | ☐ | ☐ | ☐ | SCOM |
| | Consultants and commercial labs | ☐ | ☐ | ☐ | ☐ | SINS |
| Education & research institutes | Universities or other higher education institutions | ☐ | ☐ | ☐ | ☐ | SUNI |
| | Government, public or private research institutes | ☐ | ☐ | ☐ | ☐ | SGMT |
| Other sources | Conferences, trade fairs, exhibitions | ☐ | ☐ | ☐ | ☐ | SCON |
| | Scientific journals and trade/technical publications | ☐ | ☐ | ☐ | ☐ | SJOU |
| | Professional and industry associations | ☐ | ☐ | ☐ | ☐ | SPRO |

We take SUNI variable as the indicator of the importance of universities and SGMT variable as the best proxy of RTOs' importance in the innovation process. We subtract the two in order to create a new variable that denotes the relative importance of RTOs vs universities (SGMT-SUNI). This new variable takes values from -3 to 3 (since variables SUNI and SGMT takes values from 0 to 3). Positive values of the new constructed variable mean that the specific company thinks RTOs as more important source of innovation than universities while negative values mean the opposite.

Nevertheless, besides the relative importance of the two we also look into them separately in order to have a more complete analysis and discussion.

Finally, as our dependent variable is a binary variable we are dealing with a logit model (Wooldridge 2009).

*Control variables*

We will employ several control variables based on relevant literature. First we control for some general characteristics such as the size of the enterprise which is expressed by the log of number of employees, the country where the company operates and the NACE activity. Especially for the size of enterprise, cooperation with universities and other research organizations may increase with size, as bigger companies have more resources to engage in innovation collaborations (Tether 2002).

Moreover, previous research has shown that the fact whether the company belongs in a group and the presence of the firm in other markets than the national one (e.g. European or International markets) has an effect on the innovative outcome of the firm.

Furthermore, since it has widely been shown in the relevant literature that the R&D investment of a firm is important for the innovation outcome we also control for the R&D intensity of the enterprise which is expressed as the fraction of expenditures in R&D to the number of employees (Asikainen & Mangiarotti 2016).

Based on the work of Laursen and Salter (2006) we also control for search breadth meaning the extent to which a company uses other sources of information in their innovation process (such as consultants, costumers etc. besides RTOs and universities, please see Figure 2 above). This variable takes values from 0 to 7. According to Laursen and Salter the squared term of this variable is also taken into account to account for diminishing effects. Similarly to search breadth, we also include in our controls the search depth which expresses the intensity of information source. In this case we take into account how many sources the firm thinks are highly important, again this takes values from 0 to 7 and the squared term is also employed.

The cooperation of the firm is also an important factor for which we control based on a binary variable (response whether the company has been active in any cooperation activities in innovation).

*Alternative model for testing hypothesis 1a*

In addition to this logit model we also use an alternative dependent variable in order to test hypothesis 1a, namely the share of turnover that comes from new to the market products (variable TURNMAR- Figure 2) instead of the binary variable NEWMKT. In this case we are dealing with a double censored regression model (left censored at 0 and right censored at 1). The rest of the independent and control variables remain the same as in Model 1a.

### 3.3.2 Model 1b– Hypothesis 1b

In this model, aimed at testing hypothesis 1b, the dependent variable is a binary variable (WORLD_FIRST- see Table 1) that we construct based on the answer to the question 2.4 of the survey (Figure 2) regarding the degree of novelty of the innovation. In this case our new variable takes the value 1 if the INPDFW (world first product innovation) variable takes the value 1 (yes answer) and 0 otherwise. The main

independent variable as in the previous two models is the relative importance of RTOs vs universities as sources of knowledge (include name of the variable) and we also look into the two separately. The control variables included in this model are the same as the control variables used in models 1a and 1b (see Table 2).This is again a logit model.

### 3.3.3 Model 2 – Hypothesis 2

In order to test hypothesis 2, we chose as the dependent variable the answer to the question of the CIS questionnaire regarding the development of service innovation, this is expressed by the binary variable INPDSV (Figure 3). In model 1 the dependent variable is therefore a dummy variable which takes the value 1 if the firm reports having introduced service innovation (0 otherwise). Since we are dealing with a binary dependent variable the most appropriate choice is a logit model (Wooldridge 2009).

*Figure 3: Question 2.1 CIS 2012*



The main independent variable as in the previous two models is the relative importance of RTOs vs universities as sources of knowledge (RTOVSUNI) and we also look into the two separately. The control variables included in this model are the same as the control variables used in models 1a and 1b (see Table 2).

### 3.3.4 Model 3– Hypothesis 3

In the third model which aimed at testing hypothesis 3, the dependent variable is the fraction of internal R&D expenditures to the firm's turnover (INT_RD_P – see Table 1). In the 2012 CIS questionnaire, the expenditures on R&D are requested under the following question (Figure 4). The figure we retain corresponds therefore to the variable RRDINX, i.e. the total amount of in-house R&D performed by the firm (therefore excluding external R&D). The information on turnover is also available in the questionnaire.

In this case, since the dependent variable is the fraction of internal R&D expenditures to the firm's turnover, only positive values are possible. Moreover, there is no upper

limit (as the expenditure on R&D can exceed the turnover of the company).We use, therefore, a censored regression Tobit model (Wooldridge, 2008).

*Figure 4: Question 5.1 CIS 2012*



The main independent variable is the relative importance of RTOs vs universities as a knowledge source, as explained above (RTOVSUNI-see Table 1). As before in this hypothesis also we look at the RTOs and universities separately.

The control variables are the same as explained in Model 1a with the exception of R&D intensity. Since in this case our dependent variable is the fraction of internal R&D expenditures to the firm's turnover, we cannot control for R&D intensity, which includes expenditure on in-house R&D, like in the previous model. Therefore, we now construct a new control variable (REST_RD_P) that is defined as the fraction of expenditure on all other activities except in-house R&D (RALLX-RRDINX) to turnover (please refer to Figure 4 and Table 1).

## 4 Results
### 4.1 RTOs, universities and firms' probability to innovate *(H1a-H1b)*

The first model deals with the performance of the firm, measured in terms of new to the market products, as the result of the relative importance that the firm gives to RTOs vs universities sources of information. Here we employed two different measures. First we look into the dummy variable that expresses the development of first to the market innovations and then we look into the fraction of the turnover that comes from such

products. In both cases we find that the probability of firms to innovate (introduce new to the market innovations) is lower for companies that deem RTOs more important sources of knowledge compared to universities. Therefore, our hypothesis 1a is rejected. The results of the two models can be found in Tables 3 and 4, respectively. Moreover, in Table 5 we also show the results of the regression with the new to the world variable. There again we find that the probability of firms to develop first to the world innovation is lower for companies that deem RTOs more important sources of knowledge compared to universities. This is in line with hypothesis 1b.

Nevertheless, we do not only show the relative importance of RTOs vs universities in Table 3 and Table 4 but also the importance of the two organizations taken separately. As expected the respective coefficients for new to the market products are positive in the two cases. This suggests that collaborations with both RTOs and universities that have positive effects on the innovation performance of firms, as shown by recent literature. Nevertheless, this is not the case for the new to the world product, where we find a negative effect of RTOs (although weakly significant) (please see Table 5).

*Table 3: Model 1a (Logit): Innovation performance (new to the market products) RTOs vs. Universities[17]*

| | Dependent variable: | | | |
|---|---|---|---|---|
| | New to the market products (=1) | | | |
| | (1) | (2) | (3) | (4) |
| Relative Importance of RTOs vs Universities | -0.037** | -0.038** | | |
| | (0.018) | (0.018) | | |
| RTOs as source of knowledge | | | 0.059*** | 0.053** |
| | | | (0.021) | (0.021) |
| Universities as source of knowledge | | | 0.124*** | 0.119*** |
| | | | (0.020) | (0.020) |
| Employees Number (log) | 0.071*** | 0.052*** | 0.059*** | 0.044*** |
| | (0.012) | (0.012) | (0.012) | (0.013) |
| Belonging to a group (=1) | 0.046 | 0.050 | 0.042 | 0.046 |
| | (0.034) | (0.034) | (0.034) | (0.034) |
| Industry dummies | yes | yes | Yes | yes |
| Country dummies | yes | yes | Yes | yes |
| Presence in international markets (=1) | 0.297*** | 0.285*** | 0.292*** | 0.281*** |
| | (0.035) | (0.035) | (0.035) | (0.035) |
| R&D investment | 5.908e-07*** | 5.489e-07*** | 5.502e-07*** | 5.246e-07*** |
| | (6.476e-08) | (6.543e-08) | (6.478e-08) | (6.539e-08) |
| Cooperation (=1) | 0.543*** | | 0.462*** | |
| | (0.033) | | (0.034) | |
| Search Breadth | 0.076*** | 0.037 | 0.047*** | 0.052* |
| | (0.007) | (0.029) | (0.008) | (0.029) |
| Search Breadth squared | | 0.004 | | -0.001 |
| | | (0.004) | | (0.004) |
| Cooperation Breadth | | 0.127*** | | 0.110*** |
| | | (0.009) | | (0.009) |
| Cooperation Breadth squared | | -0.003*** | | -0.002*** |
| | | (0.0005) | | (0.001) |
| Search Depth | | 0.013 | | 0.018 |
| | | (0.027) | | (0.027) |
| Search Depth squared | | -0.004 | | -0.008 |
| | | (0.006) | | (0.006) |
| Constant | -1.026*** | -0.834*** | -0.953*** | -0.845*** |
| | (0.088) | (0.096) | (0.088) | (0.096) |
| Observations | 21,335 | 21,345 | 21,335 | 21,345 |
| Log Likelihood | -13,745.560 | -13,715.290 | -13,705.850 | -13,682.760 |
| Akaike Inf. Crit. | 27,537.120 | 27,484.580 | 27,459.710 | 27,421.520 |
| *Note:* | *p<0.1; **p<0.05; ***p<0.01 | | | |

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[17] All regressions were implemented using the R statistical software.

**Table 4: Model 1a (Tobit): Innovation performance (turnover share) RTOs vs. Universities**

| | Share of turnover from new to the market products | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Relative Importance of RTOs vs Universities | -0.005* | -0.006* | | |
| | (0.003) | (0.003) | | |
| RTOs as source of knowledge | | | 0.012*** | 0.011*** |
| | | | (0.004) | (0.004) |
| Universities as source of knowledge | | | 0.022*** | 0.021*** |
| | | | (0.004) | (0.004) |
| Employees Number (log) | -0.008*** | -0.011*** | -0.010*** | -0.012*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Belonging to a group (=1) | 0.007 | 0.007 | 0.006 | 0.006 |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Presence in international markets (=1) | 0.047*** | 0.046*** | 0.046*** | 0.045*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Industry dummies | Yes | yes | yes | yes |
| Country dummies | Yes | yes | yes | yes |
| R&D investment | 5.908e-07** | 5.489e-07*** | 5.502e-07*** | 5.246e-07*** |
| | (6.476e-08) | (6.543e-08) | (6.478e-08) | (6.539e-08) |
| Cooperation (=1) | 0.075*** | | 0.058*** | |
| | (0.006) | | (0.006) | |
| Search Breadth | 0.010*** | 0.0001 | 0.005*** | 0.003 |
| | (0.001) | (0.006) | (0.001) | (0.006) |
| Search Breadth squared | | 0.001* | | 0.0002 |
| | | (0.001) | | (0.001) |
| Cooperation Breadth | | 0.017*** | | 0.013*** |
| | | (0.001) | | (0.002) |
| Cooperation Breadth Squared | | -0.0005*** | | -0.0004*** |
| | | (0.0001) | | (0.0001) |
| Search Depth | | 0.001 | | 0.0004 |
| | | (0.001) | | (0.001) |
| Search Depth squared | | -0.002 | | -0.002 |
| | | (0.005) | | (0.005) |
| logSigma | -1.051*** | -1.052*** | -1.053*** | -1.054*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Constant | -0.126*** | -0.094*** | -0.113*** | -0.096*** |
| | (0.016) | (0.018) | (0.016) | (0.018) |
| Observations | 21,040 | 21,050 | 21,040 | 21,050 |
| Log Likelihood | -10,376.240 | -10,362.780 | -10,334.740 | -10,329.470 |
| Akaike Inf. Crit. | 20,800.470 | 20,781.560 | 20,719.470 | 20,716.940 |
| Bayesian Inf. Crit. | 20,991.370 | 21,004.290 | 20,918.330 | 20,947.630 |
| Note: | *p<0.1; **p<0.05; ***p<0.01 | | | |

*Table 5: Model 1b (logit): RTOs vs Universities and new to the world products*

| | *Dependent variable:*<br>*New to the world products (=1)* | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Relative Importance of RTOs vs Universities | -0.096*** | -0.116*** | | |
| | (0.033) | (0.034) | | |
| RTOs as source of knowledge | | | -0.020 | -0.052 |
| | | | (0.039) | (0.041) |
| Universities as source of knowledge | | | 0.153*** | 0.160*** |
| | | | (0.037) | (0.037) |
| Employees Number (log) | 0.137*** | 0.109*** | 0.126*** | 0.102*** |
| | (0.022) | (0.023) | (0.022) | (0.023) |
| Belonging to a group (=1) | 0.285*** | 0.295*** | 0.281*** | 0.293*** |
| | (0.071) | (0.071) | (0.071) | (0.071) |
| Presence in international markets (=1) | 1.477*** | 1.456*** | 1.468*** | 1.449*** |
| | (0.095) | (0.095) | (0.095) | (0.095) |
| Industry Dummies | Yes | yes | yes | yes |
| Country dummies | Yes | yes | yes | yes |
| R&D investment | 3.542e-06*** | 2.892e-06*** | 3.358e-06*** | 2.793e-06*** |
| | (5.827e-07) | (5.722e-07) | (5.812e-07) | (5.696e-07) |
| Cooperation (=1) | 0.693*** | | 0.636*** | |
| | (0.060) | | (0.062) | |
| Cooperation Breadth | | 0.106*** | | 0.098*** |
| | | (0.012) | | (0.013) |
| Cooperation Breadth squared | | -0.001** | | -0.001** |
| | | (0.001) | | (0.001) |
| Search Breadth | 0.074*** | 0.033 | 0.050*** | 0.046 |
| | (0.016) | (0.068) | (0.017) | (0.069) |
| Search Breadth squared | | 0.003 | | -0.001 |
| | | (0.008) | | (0.008) |
| Search Depth | | 0.058 | | 0.061 |
| | | (0.050) | | (0.050) |
| Search Depth squared | | -0.010 | | -0.013 |
| | | (0.010) | | (0.010) |
| Constant | -4.560*** | -4.249*** | -4.491*** | -4.264*** |
| | (0.173) | (0.205) | (0.174) | (0.205) |
| Observations | 13,451 | 13,461 | 13,451 | 13,461 |
| Log Likelihood | -4,414.931 | -4,399.208 | -4,408.409 | -4,395.492 |
| Akaike Inf. Crit. | 8,869.862 | 8,846.415 | 8,858.819 | 8,840.983 |
| *Note:* | *p<0.1; **p<0.05; ***p<0.01 | | | |

## 4.2 RTOs, universities and service innovations *(H2)*

The results of Model 2, which are presented in Table 6, tend to confirm hypothesis 2, as we indeed find a positive relationship between the probability of the firm to develop service innovation and the relative importance of RTOs vs. universities. This suggests as expressed by hypothesis 2 that, *ceteris paribus*, firms which see RTOs as more important source of knowledge than universities are more likely to introduce service innovation.

As far as the rest of the variables are concerned, we find a positive and statistically significant effect of the cooperation variable and the size of the firm, as well as for search breadth and a negative one for search breadth squared, as expected following recent literature. Nevertheless, we find a negative relationship between service innovation and the variables belonging to a group, presence in international markets and R&D intensity which is not in line with the relevant literature. This is not surprising though as we are dealing with service innovation which cannot be explained with the same measures as goods innovation (Hipp & Grupp 2005).

*Table 6: Model 2 (logit): RTOs vs universities and service innovation*

|  | Dependent Variable | | | |
|---|---|---|---|---|
|  | Service Innovation=1 | | | |
|  | (1) | (2) | (3) | (4) |
| Relative Importance of RTOs vs Universities | 0.030* | 0.029* | | |
|  | (0.016) | (0.017) | | |
| RTOs as source of knowledge | | | 0.035* | 0.019 |
|  | | | (0.019) | (0.019) |
| Universities as source of knowledge | | | -0.025 | -0.037** |
|  | | | (0.019) | (0.019) |
| Employees Nr(log) | 0.086*** | 0.071*** | 0.086*** | 0.072*** |
|  | (0.011) | (0.011) | (0.011) | (0.011) |
| Belonging to a group(=1) | -0.132*** | -0.126*** | -0.132*** | -0.126*** |
|  | (0.031) | (0.031) | (0.031) | (0.031) |
| Presence in international markets (=1) | -0.028 | -0.04 | -0.028 | -0.039 |
|  | (0.031) | (0.031) | (0.031) | (0.031) |
| Country dummies | Yes | Yes | Yes | Yes |
| Industry dummies | Yes | Yes | Yes | Yes |
| R&D intensity | -4.342e-07 | -9.213e-07** | -4.462e-07 | -9.020e-07** |
|  | (3.277e-07) | (3.780e-07) | (3.304e-07) | (0.01686) |
| Search Breadth | 0.106*** | 0.130*** | 0.105*** | 0.128*** |
|  | (0.006) | (0.026) | (0.007) | (0.026) |

| | | | | |
|---|---|---|---|---|
| Search Breadth squared | | -0.005 | | -0.004 |
| | | (0.003) | | (0.003) |
| Cooperation (=1) | 0.426*** | | 0.422*** | |
| | (0.030) | | (0.032) | |
| Cooperation Breadth | | 0.093*** | | 0.095*** |
| | | (0.008) | | (0.008) |
| Cooperation Breadth squared | | -0.002*** | | -0.002*** |
| | | (0.0004) | | (0.0004) |
| Search Depth | | 0.048* | | 0.047* |
| | | (0.025) | | (0.025) |
| Search Depth squared | | 0.001 | | 0.001 |
| | | (0.005) | | (0.005) |
| Intercept | -0.929*** | -0.870*** | -0.926*** | -0.869*** |
| | (0.082) | (0.089) | (0.082) | (0.089) |
| Observations | 30,511 | 30,521 | 30,511 | 30,521 |
| Log Likelihood | -16,906.880 | -16,871.280 | -16,906.760 | -16,870.830 |
| Akaike Inf. Crit. | 33,859.760 | 33,796.560 | 33,861.520 | 33,797.660 |

*Note: *p<0.1; **p<0.05; ***p<0.01*

## 4.3 RTOs, universities and the need to invest in internal R&D *(H3)*

As regard to our third hypothesis, we find that companies that deem RTOs as more important sources of knowledge than universities have less need to invest in internal R&D (Table 7). This is an expected result, , in line with hypothesis 3, as RTOs are able not only to provide the research but also the development part to firms, meaning that they can to a certain extent cover part of firms' needs of performing internal R&D activities. Moreover, this is also a consistent result with the first hypothesis as we expect in the case of service innovation to have less need to invest in R&D as there is less need for special equipment, materials or labs for instance, as in the case of goods innovation. Service innovation requires more investment in human capital and idea generation processes.

Like in the previous example we also look into RTOs and universities separately and we see a positive sign in the relationship between these two sources of knowledge and the investment in internal R&D, supporting the common assumption that a level of internal R&D is always needed as absorptive capacity is highly important for the development of innovations. This result is also consistent with the results of (Gonzalez-Moreono & Saez-Martinez 2009) that have shown that investment in internal R&D is positively correlated with the probability of firms collaborating with universities and research institutes. This also proves that the negative relationship

between the relative importance of RTOs vs universities and the need to invest in internal R&D does not only come from the service innovation effect; otherwise the coefficient between RTOs separately and investment in internal R&D would also be negative.

As for the rest of the control variables we see a positive relationship between cooperation and search breadth confirming that external sources of knowledge are rather a complement and not a substitute of R&D investment.

*Table 7: Model 3 (Tobit): RTOs vs Universities and the need to invest in internal R&D*

|  | *Dependent variable:* | | | |
|  | Investment in internal R&D | | | |
|  | (1) | (2) | (3) | (4) |
| Relative Importance of RTOs vs Universities | -0.605*** | -0.585*** | | |
|  | (0.160) | (0.160) | | |
| RTOs as source of knowledge | | | 0.413** | 0.639*** |
|  | | | (0.186) | (0.188) |
| Universities as source of knowledge | | | 1.573*** | 1.757*** |
|  | | | (0.184) | (0.186) |
| Employees Number (log) | 0.634*** | 0.649*** | 0.527*** | 0.569*** |
|  | (0.117) | (0.119) | (0.118) | (0.120) |
| Belonging to a group (=1) | 0.085 | 0.211 | 0.053 | 0.174 |
|  | (0.330) | (0.330) | (0.330) | (0.330) |
| Country dummies | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes |
| Presence in international markets (=1) | 3.246*** | 3.159*** | 3.175*** | 3.099*** |
|  | (0.343) | (0.343) | (0.343) | (0.344) |
| Rest of R&D intensity (except internal) | 1.622*** | 1.622*** | 1.617*** | 1.616*** |
|  | (0.028) | (0.028) | (0.028) | (0.028) |
| Cooperation (=1) | 4.439*** | | 3.438*** | |
|  | (0.305) | | (0.320) | |
| Search Breadth | 1.360*** | 2.902*** | 1.027*** | 3.042*** |
|  | (0.067) | (0.275) | (0.074) | (0.276) |
| Search Breadth squared | | -0.198*** | | -0.262*** |
|  | | (0.033) | | (0.034) |
| Cooperation Breadth | | 0.963*** | | 0.712*** |
|  | | (0.078) | | (0.081) |
| Cooperation Breadth squared | | -0.035*** | | -0.029*** |
|  | | (0.004) | | (0.004) |
| Search Depth | | 0.361 | | 0.417 |
|  | | (0.262) | | (0.262) |
| Search Depth squared | | -0.039 | | -0.100* |
|  | | (0.056) | | (0.056) |

| | | | | |
|---|---|---|---|---|
| logSigma | 3.028*** | 3.027*** | 3.027*** | 3.027*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Constant | -15.722*** | -17.067*** | -15.110*** | -17.359*** |
| | (0.846) | (0.923) | (0.848) | (0.924) |
| | | | | |
| Observations | 29,821 | 29,831 | 29,821 | 29,831 |
| Log Likelihood | -76,796.290 | -76,830.290 | -76,740.020 | -76,753.610 |
| Akaike Inf. Crit. | 153,640.600 | 153,716.600 | 153,530.000 | 153,565.200 |
| Bayesian Inf. Crit. | 153,839.900 | 153,949.100 | 153,737.600 | 153,806.000 |
| Note: | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 | | | |

# 5 Discussion and concluding remarks

The acquisition of external knowledge has become extremely important to firms (Dahlander & Gann 2010);and with the rise of the open innovation paradigm a lot of interest has been given by the academic community to understand the relationship of s firms with external sources of knowledge.

RTOs are important actors in national innovation systems yet little is known about their special characteristics especially because most of the times they are studied together with universities. In order to address this gap we studied the impact of RTOs on firm's innovation compared to universities. This is an important contribution because it is generally admitted that comparisons between knowledge providers have seldom been done (Vivas & Barge-Gil 2015) although there is such a need since the choice of the most suitable partner in innovation, and more specifically in open innovation, is not an easy one.

More specifically we have shown that companies that place more importance to RTOs than universities as sources of knowledge are less likely to develop *new to the market or new to the world innovation* but are more likely to develop *service innovation* and have *less need to invest in internal R&D*. Our results illustrate a consistent description of RTOs (Tann et al. 2002; Preissl 2006; Arnold et al. 2007; Arnold et al. 2010; Albors-Garrigos et al. 2010; Readman et al. 2015). RTOs predominant activity is to provide innovation services to their industrial partners therefore we expect for them to be proficient in service innovation (Preissl 2006; Arnold et al. 2007; Arnold et al. 2010). Indeed previous literature shows that RTOs possess distinct service innovation

capabilities (Gryszkiewicz et al. 2013; Giannopoulou et al. 2014). But this proficiency of RTOs in service innovation has some further implications.

Hypotheses 1a and 1b show that companies that deem RTOs as more important knowledge providers than universities are less likely to develop new to the market or new to the world products. This is a surprising result taking into account the main mission of RTOs which is to support the innovative process within organizations (Mrinalini & Nath 2000; Barge-Gil & Modrego-Rico 2008; Gulbrandsen 2011; Sharif & Baark 2011). But it could be explained by the fact that most radical innovations come vastly from goods innovation. Radical service innovation is very rare (von Hippel et al. 1999; Jones & Samalionis 2010). Most of the time, it is related to process improvements or modification of existing services. Moreover, sometimes it is even difficult to understand that a new service represents a radical innovation due to the intangibility of services and to the very rare patent applications (Sundbo 1997). Nevertheless, if there is radical service innovation this is very likely be created through co-creation (Perks et al. 2012), therefore the role of RTOs in this perspective is very important as RTOs could lead the development of radical service innovations.

Sundbo (1997), in his seminal work, was wondering if there exists innovation in services and how does it looks like. The author concludes that innovation in services does exist but it is unsystematic process that has different characteristics than innovation in goods. Indeed, Hipp and Grupp (2005) show in their research that innovation process in services does not only take place in the R&D departments known from the manufacturing companies but covers a number of functional units of the firm. In fact this is reflected in the low internal R&D intensity of service companies from the traditional R&D statistics' point of view (Hipp et al. 2003).This is consistent with our results in the sense that we already noticed the negative relationship between the service innovation development and the R&D intensity of the firm in Model 2.

Moreover, we have also shown that the relative importance of RTOs to universities is negatively correlated to the internal R&D investment. This indicates that RTOs cover a need of both research and development for the companies supporting the view that RTOs are not only service but also knowledge providers (Barlatier et al. 2016). The unique innovation capabilities of RTOs are indeed an important asset in the collaboration with the industry as RTOs can cover the whole spectrum of the innovation process form idea generation to development and commercialization. On

the other hand universities' research, being more embryonic and basic, needs more refinement before not only reaching the commercialization stage (Rogers 2003; Metcalfe 2010) but also in order to be understood and assimilated by enterprises.

Moreover, it is also worth noting that in our results we did not only show the relative importance of RTOs vs universities but also the two organizations separately. This was deliberately done in order to show that these organizations are still very close cognitively and most of the firms still see them as very similar organizations. Indeed, Goduscheit and Knudsen (2015) study the difference between RTOs and universities and find out that firms (SMEs in particular) do not perceive one as better collaborating partner than the other, which does not support the mediating role of RTOs in the relationship between universities and firms. Therefore, we could question the common belief that RTOs are merely intermediaries that convert the science-based knowledge from the universities into applied knowledge that can be absorbed more easily by the SMEs (Goduscheit & Knudsen 2015). In this respect RTOs are important knowledge co-creators that are actively involved in the innovation process and can provide much more than mere technology transfer(Barlatier et al. 2016).

*Practical Implications*

Our research has several implications for practitioners, as well as policy makers. First of all, firms can understand the benefits that they can reap by collaborating with RTOs and make an informed choice between RTOs and universities. RTOs can not only be seen as simple service providers but have a potential for service innovation that may still be unexploited. Consistently, RTOs management should also invest more on advertising the unique capabilities of RTOs in innovation especially compared to universities addressing the need for a clearer and more proactive marketing approach (Arnold et al. 2007). RTOs should therefore insist on the fact that they are not only knowledge transfer organizations but unique knowledge co-creators.

Finally, policy makers should give more importance to the special role of RTOs in open, networked and globalized innovation systems. If RTOs are indeed the new "open innovation" organizations as Chesbrough (2015) points out then the support of the government is indispensable, though available funding or structural supporting mechanisms for collaboration (though living labs or other structures), in order for these organizations to be able to unveil the whole spectrum of their capabilities. In a more

ideal situation this would even be not nationally bounded but in a European or even globalized perspective. Especially, in times were social challenges are abundant the contribution of RTOs to open innovation initiatives that could solve societal problems through co-creation is indispensable.

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**Eleni GIANNOPOULOU**

# The Role of Research and Technology Organizations (RTOs) in Open Service Innovation

## A dual perspective

## Résumé

Dans une logique d'innovation ouverte une attention particulière a été accordée à la relation entre le monde académique et l'industrie, en focalisant surtout sur les universités. Mais les "Research and Technology Organizations" (RTOs) sont également une partie importante, quoique peu étudiée, du monde académique. Le but de ce projet est d'étudier le rôle des RTOs dans l'innovation ouverte de service, en prenant en compte une double perspectif; interne et externe. Plus précisément, dans la première partie du projet, nous entreprenons une analyse théorique et des études de cas dans 4 RTOs, afin d'identifier les capacités d'innovation de service uniques des RTOs. Dans la deuxième partie du projet, nous étudions les RTOs du point de vue externe, en comparant les RTOs aux TTOs/universités en termes de leur «offre» à l'industrie. L'analyse est effectuée au niveau conceptuel mais aussi empiriquement basée sur l'analyse statistique des données de l'Enquête Communautaire sur l'innovation (ECI). Nos résultats indiquent que les RTOs sont des types supérieurs d'intermédiaire qui sont en mesure non seulement de faciliter, mais de catalyser le processus d'innovation.

## Abstract

In the current complex and open innovation landscape, researchers have given special attention in the relationship between academia and industry, focusing mainly on the role of universities. But Research and Technology Organizations (RTOs) are also an important, yet understudied, part of public research world. The purpose of this PhD project is to study the role of RTOs in the open service innovation landscape, taking a dual perspective. More specifically, in the first part of the project, we undertake a theoretical analysis together with case studies in 4 selected and renowned RTOs, in order to identify the unique service innovation capabilities of RTOs. In the second part of the project we take an external perspective, comparing RTOs to TTOs/ universities in terms of their "offering" to their partners. The analysis is performed on the conceptual level but also empirically based on statistical analysis of the Community Innovation Survey data. Our overall results indicate that RTOs represent a superior type of intermediary in open innovation that are able not only to facilitate but also to catalyse the innovation process.