

CO-PATENTING AND CO-OWNERSHIP AS DRIVERS FOR UNIVERSITY BUSINESS INNOVATING The case of public universities in Spain

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ABSTRACT

Purpose – The aim of the present paper is to explore whether in the context of universities as complex services, it is possible to develop new business models rooted in Service Dominant Logic (SDL), where the constituent actors generate resources and co-create value for and within the system. In this context, the innovating perspective (Russo-Spena et al. 2017) can bring to universities the need for the development of institutions in universities (Vargo and Lusch, 2016) that bring out new co-creation formulas (such as co-patenting and co-ownership), which in turn facilitate “system equilibrium” (balanced centricity) in university and business contexts.

Methodology– A conceptual approach is applied to develop and propose a framework for a deeper understanding of the “University Business Ecosystem” from the perspectives of SDL (Vargo and Lusch, 2016) and value co-creation (Russo-Spena and Mele, 2012; Quero and Ventura, 2015). Quantitative and qualitative case-study research was conducted using various methods of generating data, including personal interviews and a netnographic analysis of 95% of public universities in Spain.

Findings– The findings reveal that enterprises with a technological focus are increasing their relationship with universities and attempting to build up an ecosystem that we refer to as the “service business ecosystem”, and are building new strategies for value co-creation such as co-ownership, co-patenting, and co-ideation. These new formulas of value co-creation can be the basis for the design of strategies, but they need to be re-conceptualized from an open-economy, SDL, and ecosystem perspective.

Research limitations/implications (if applicable) – The paper is a conceptual study combined with an empirical approach. The empirical approach relies on a quantitative approach using 6 case studies in Spanish public universities. Research in the private sector and in other countries could improve the perspective afforded by the proposed model.

Practical implications – From the present study, we conclude that there is a need to develop specific strategies for innovating in the university context. New strategies are proposed in order to develop a University Business Innovation Model that facilitates the transition in which most universities are embedded: from closed to open innovation. The conceptual perspective, and notions of the Ecosystem and viable systems, can help to develop strategies to allow open innovation, improving the university’s third mission, namely the transfer of knowledge to business and other social actors.

Originality– The present paper suggests that University Business Innovation occurs within complex service structures such as public universities in Spain. The model aims to contribute to the literature given the lack of previous research that adapts SDL and innovation theory to the reality of a complex university system. Following an in-depth literature review, the paper redefines concepts such as innovation in complex service ecosystems, university business ecosystems, co-patenting, co-ownership, and co-ideation.

Key words (max 5): Innovating, Service Dominant Logic, value co-creation, co-patenting, co-ownership, service ecosystems, systems of value co-creation.

Paper type –Research paper

Introduction

There is growing interest in the process by which universities obtain value from research and technology transfer (Galán-Muros et al., 2017; Muschio et al. 2016; Perkman et al. 2013; Baldini, 2010; Gomez Gras et al., 2008; Lockett and Wright, 2005). This process is usually linked to innovation; generally, the strategy involves organizational development of institutions policies (rules/institutions) that encourage scholars and other university staff to take part, and both academics and graduates benefit from the results (i.e., through the creation of job opportunities), as proposed by Rizzo (2015) and Friedman and Silberman (2003). Scandura (2016, p.1907) highlights the relevance of the university in this process: “The exchange of knowledge between academia and industry is therefore an essential mechanism to bring science to the market and foster innovation and economic growth”. In the most recent report on Science, Research and Innovation Performance of the EU (2018, pp.4) the European Commissioner for Research, Science and Innovation posits that “Europe currently benefits from distinctive strengths, but also faces weaknesses that we need to address. Europe is the world’s largest producer of high quality scientific knowledge, and yet its innovation performance remains far below its potential. (...) Europe generates many exciting start-ups but has been largely left behind in the development of major new digital platforms, and lacks those transformational entrepreneurs that have disrupted entire industries at a global scale”. In the present paper, we aim to find out how to improve the innovation process in both the University-Industry relationship and within their social networks.

Obstfeld (2005, p. 100) was the first to bring together the concept of innovation by drawing attention to the social networks of organizations, raising the need for research because “the social nature of the innovation process remains unanswered”. For their part, Muscio et al. (2016, p. 1386) contend that “university policies can play a crucial role in influencing spinoff creation”. However, little literature has studied the phenomenon of innovation from a network and Service Dominant Logic perspective. The present paper analyses how in a growing open and networked economy based on the open innovation model (Chesborough, 2003), there is a need to include more activities and actors than were assigned to the traditional model of innovation (Van de Vrande et al., 2009), to provide a description of the process of enabling innovation through network value co-creation (Kostela-Huotari and Vargo, 2016; Edvardsson et al. 2014). The purpose of the study is to develop a university business ecosystem model based on achieving innovation (innovating) through institutionalization in order to improve the so called “third mission” of universities (Di Berardino and Corsi, 2018; Castells et al., 2016; Capellari and De Stefano, 2014;). We aim to identify the criteria that can be used to assess whether a university can be considered to behave as an ecosystem and, in such cases, how it develops strategies of value co-creation to reach system equilibrium (Gummesson, 2008; Polese et al., 2017). The Service Dominant (SD) Logic (Vargo and Lusch, 2004, 2008, 2014, 2016) and its service ecosystem perspective (Vargo et al, 2016; Vargo and Lusch, 2014; Akaka et al., 2012; Chandler and Vargo, 2011;) provide the theoretical basis of this research. Specifically, the present paper builds on the PF 6 / axiom 2 (“value creation is interactional” and the PF9/ axiom 3 (“all economic and social actors are resource integrators”, and “the context of value creation is networks of networks (resource integrators”). In our case, we analyse whether changes in co-patenting and co-ownership can improve the configuration of the university as a “business ecosystem”. The research questions to be addressed are:

RQ 1. What are the requisites for a university to be considered a complex service ecosystem?

RQ 2. When performing as an ecosystem, how is value co-created to better generate innovation?

The remainder of the paper is organised as follows. First, we review the relevant literature on ‘innovating’, innovation, and value co-creation in university business ecosystems. Preliminary research using recent publications in marketing, complex service innovation, and other related studies through the databases EBSCO, JSTOR, and ABI Inform allowed us to conduct a systematic review of the literature. Second, the gap between innovation (innovating) in service ecosystem and

value co-creation through co-ideation, co-patenting and co-ownership is described, and research questions are proposed to describe the theoretical model of the research. Third, the empirical approach is described and the results of the qualitative research are analysed. We conclude by discussing the implications for theory and practice and outline several suggestions for future research.

Innovating in complex service ecosystems

The study of innovation has a long tradition, and therefore multiple perspectives on innovation have arisen from different fields of knowledge. Our perspective is framed from one stream of research that emphasises co-innovation (or collaborative innovation) in line with the open innovation perspective and the flow of ideas across organisations and among other actors (Chesborough and Bogers, 2014). From the Service Dominant Logic perspective (SDL), Vargo et al. (2015, p. 63) posit that innovation has been emphasised as the “combinatorial evolution of new useful knowledge”. The introduction of the concept of “innovating” (Mele et al., 2017, p.3) added a new dynamic perspective that addressed the lack of dynamism suggested by the traditional concept of innovation to indicate that “innovating is an action that is happening, not only the result of an action”. This perspective is one that best meets our conceptualisation of the innovation that applies to the university business ecosystem context. Capellari and De Stefano (2014, p. 313) refer to the third mission of universities as “the application of knowledge outside the academic environment [which] is a topic of growing importance in the agendas of both (R&D) policymakers and university administrators.” Other authors also make heterogeneous contributions seeking to explore the transfer of technology to industry and its effects on economic development (Veugelers and Del Rey, 2014; Etzkowitz, 2002; Jaffe, 1989) through different routes: hiring students, sponsored research, licensing, creation of university spin-off firms or knowledge spillovers, co-invention of patents, co-publications, researcher mobility, etc. (Levy et al. 2009; Bercovitz and Feldmann, 2006). This phenomenon has been attracting growing attention from researchers and policymakers because it is considered to have important implications in terms of innovation performance (Levy et al, 2009).

Previous literature has highlighted a core need to improve the management of complexity and viability in service ecosystems (Gummesson et al., 2017; Polese et al., 2017a,b), and has led to “calls for more research on the significance of institutions and institutional arrangements and their enabling or inhibiting effect on the actor value co-creation efforts”. When developing a SD Logic and ecosystem perspective for the university context, the first research question arises:

RQ 1. What are the requisites for a university to be considered a complex service ecosystem?

The types of structures and processes through which universities have integrated their role in the business context are varied and diverse. The literature confirms the high level of importance of heterogeneous processes of institutionalisation (Geuna and Rossi, 2011). The SD logic approach can help us to identify the theoretical requirements that allow something to be considered an ecosystem.

When complex networks are sustained by reciprocal service provision between multiple actors, in dyads, triads, and complex networks that are interconnected by multiple resources, they can be identified as service ecosystems or value networks (Chandler and Vargo, 2011; Lusch, Vargo and Tanniru, 2010). Economic and social actors create value in networks or in what are interchangeably termed “service ecosystems” (Vargo and Lusch 2011) or “service systems” (Maglio and Spohrer 2008). In the sense described by Vargo and Lusch (2011, p. 185): “A service ecosystem is a spontaneously sensing and responding spatial and temporal structure of largely loosely coupled, value-proposing social and economic actors interacting through institutions, technology and

language to (1) co-produce service offerings, (2) engage in service provision and (3) co-create value”.

Value co-creation between actors in service ecosystems occurs primarily at three levels:

- a. Micro-context: At this level, there is a direct service-for-service exchange. It is the traditional dyad that Gummesson (2009, p. 45) termed “the classic dyad”, a two-party relationship in which direct service-for-service exchange takes place (Chandler and Vargo, 2011; Madhvaram and Hunt, 2008; Barney et al., 2001).
- b. Meso-context: At this level, there is an indirect service-for-service exchange through a triad. In addition to the direct service received, there is an interaction between actors receiving the service from the same provider (Chandler and Vargo, 2011; Gummesson, 2006; Grönroos, 2006). In our case, the university (actor 1, A1) interacts with the research groups (A2) and /or individual researchers (A3) in order to develop technology transfer with a third actor (A3).
- c. Macro context: the service becomes complex, in that it includes direct and indirect services, creating a network (Gummesson, 2006; 2009). In this network, actors, dyads and triads create synergy among multiple simultaneous direct and indirect service-for-service exchanges (Achrol and Kotler, 1999, 2012; Kogut, 2000; White, 2002; Felzensztein et al., 2009). Different kinds of actors with different interests co-create value in order to see their project delivered. In the university context, all actors become connected through networks in which value is exchanged.

Defining service innovation

Wittel et al. (2016) identify three perspectives on the concept of service innovation (SI):

- *Assimilation perspective*: researchers applying this approach do not recognise service as a separate category and use the term “innovation” for products, services, and processes. Giannopoulou et al. (2014, pp. 25) posit service innovation is “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”.
- *Demarcation perspective*: this perspective entails a view of service innovation as a new service or new offer that entails some form of change for either the firm or the customer. Breuning et al. (2014, pp. 46) explains service innovation as a “new service experience or service solution that consists of one or several of the following dimensions: a new service concept, new customer interaction, new value system/business partners, new revenue mode or new organizational or technological service delivery system”.
- *Synthesis perspective*: this last perspective is the closest perspective to the SD logic approach, in that it is a perspective that involves several actors in the process of achieving innovation. Michel, Brown and Gallan (2008, pp. 50) define service innovation as “finding new ways of co-solving customer problems”.

The synthesis perspective better meets our view of innovating in complex service ecosystems, which we define as the continuous evolution of all actors in an ecosystem to find new ways of co-solving each other’s problems and innovating for the benefit of the system. From this perspective, service innovation is understood as a social construction to include the collective nature of service innovation (Mele et al., 2018), and innovation is conceptualised as “innovating” to add an active and continuous perspective of change (Mele et al., 2017).

Co-invention, Co-patenting and Co-ownership

Although the so-called ‘third mission’ of universities already encompasses a wide spectrum of academic activities (consulting, contract research, entrepreneurship, etc.), university patenting (Mugia, G., 2018; Fish et al., 2015; Geuna and Nesta, 2006) and different ways of driving knowledge into market innovation and co-innovation (co-invention, co-patenting, and co-

ownership) are considered novel research areas in need of scholarly advance (Belderbos et al., 2014; Capellari and De Stefano, 2014).

Concept	Literature	Perspective on the study with universities
Co-invention	Capellari and De Stefano, 2014. Leydesdorff and Meyer, 2007.	“Co-invention networks allow the analysis of the channels through which knowledge flows from science to industry and relational data retrieved from patents can represent the collaboration patterns between the two realms” (Capellari and De Stefano, 2014, pp. 314).
Co-patenting	Belderbos et al., 2014, pp. 841. Murgia, G. 2018 Fisch et al., 2015 Geuna and Nesta, 2006. Briggs, 2015. Funk, 2013. Su et al, 2015.	“Co-patents are inventions whose property rights are shared among a university and other applicant organizations involved in their development” (Murgia, 2018, pp. 3).
Co-ownership	Belderbos et al., 2014.	“Value-appropriation is an implication of co-patenting” (Belderbos et al., 2014, pp. 841).

The SD Logic perspective can offer tools to shape the way value is co-created between universities and industry through three formulas of value co-creation that are highly interrelated: co-invention, co-patenting, and co-ownership. There is currently a lack of academic research on how these formulas of value co-creation can be integrated into the transition from closed economies (based on closed R&D and closed innovation) to open economies (open innovation and open R&D). The present paper aims to build on this area of interest, leading to our second research question:

RQ 2. When performing as an ecosystem, how is value co-created to better generate innovation?

University Business Ecosystem

Using the SD Logic perspective as a theoretical approach to ecosystems, we have identified four actors in the process of university - industry (UI) collaborations: the university (actor 1, A1), research groups (actor 2, A2), individual researchers (actor 3, A3), the organization that is recipient and co-developer of the research and is in charge of commercialization or co-commercialization with the university (business, actor 4, A4), and co-consumer/industrial/individual (actor 5, A5).

At the micro-level of the ecosystem, the university and industry behave separately, exchanging value with their respective clients / users / actors. When building on the meso-level, different structures arise to integrate the triad. At this level, recent literature (Siltaloppi and Vargo, 2017) suggests different alternative means of structuring the relationship among five actors: university (A1) – technology developers or co-developers (A2 and/or A3) – business (A4) and consumer-user (A5). Three conditions must be met for this to be regarded as a service business ecosystem:

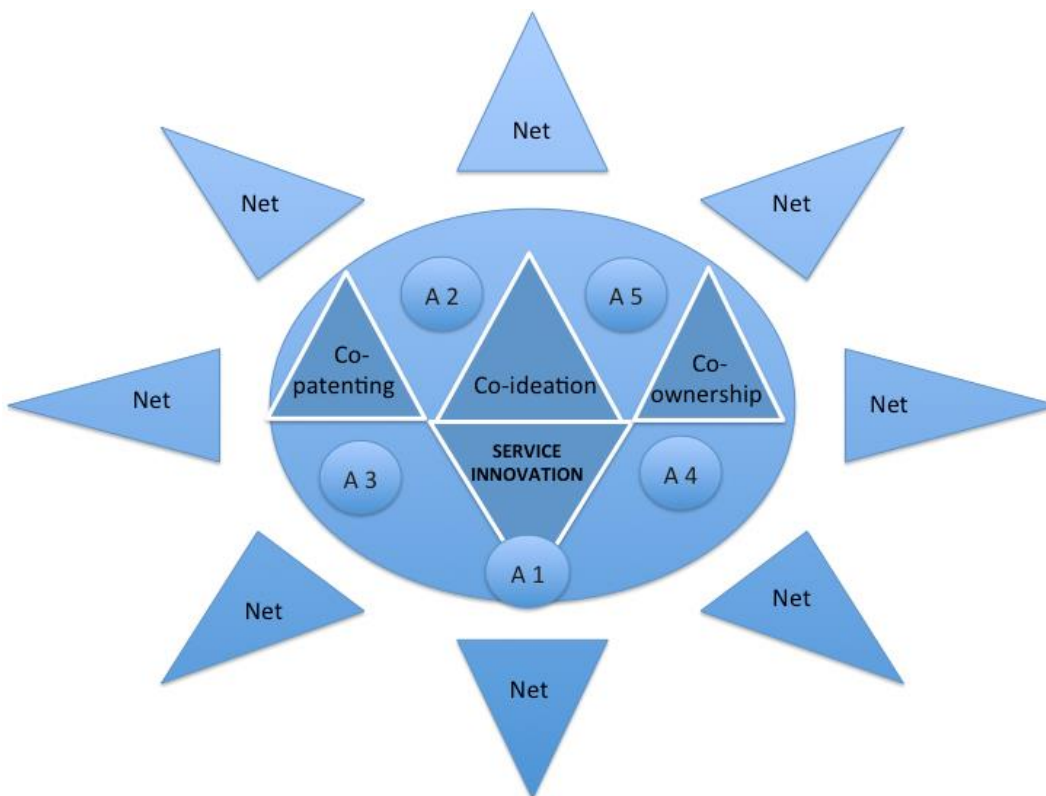
(1) Co-production of service offerings: A1, A2, A3, A4, and A5 engage in a joint project where each actor shares a part of the production process.

(2) Engagement in service provision: A1 (University) provides resources related to competence and research (together with A2 and A3) and A5 builds on commercial knowledge (business).

(3) Co-creation of value: according to literature, in UI transfer we can identify at least nine formulas of value co-creation. Seven types are developed by the theory: co-ideation (Russo Spena and Mele, 2009), co-valuation of ideas (Russo Spena and Mele, 2009), co-design (Russo Spena and Mele, 2009), co-testing (Russo Spena and Mele, 2009), co-launch (Russo Spena and Mele, 2009), co-investment (Quero and Ventura, 2015; Ordiani et al., 2011), co-consumption /“presumption” (Payne et al., 2008; Grönroos and Ravald, 2011; Gebauer et al., 2010), and to these we add three specific formulas of value co-creation in the UI context: co-ownership (Belderbos et al., 2014), co-patenting (Belderbos et al., 2014; Mugia, G. 2018; Fisch et al., 2015; Geuna and Nesta, 2006; Briggs, 2015; Funk, 2013; Su et al, 2015), and co-invention (Capellari and De Stefano, 2014; Leydesdorff and Meyer, 2007).

Starting from these theoretical premises, Figure 1 depicts the University Business Ecosystem. We note that co-invention, co-ideation, and co-patenting are the three formulas of value co-creation that share the core value co-creation process in the UI innovating schema. When, at the meso level, the relationship among actors follows the structure of a cooperation triad, there is an easy transition to develop networks where problems are co-solved by actors, and service innovation is facilitated (synthesis perspective, Wittel et al, 2015; Michel et al., 2008).

Figure 1. University Business Ecosystem



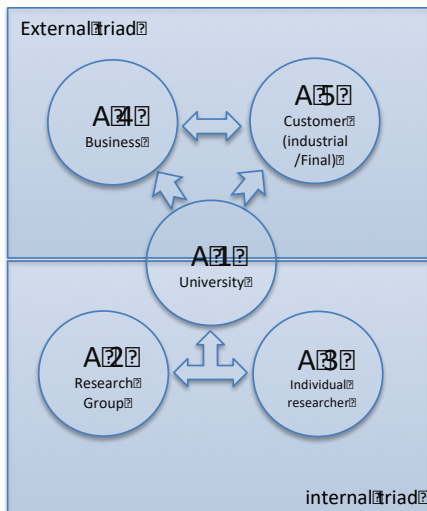
Source: the authors.

From this perspective, the University Business Ecosystem can be conceptualised as an “open group of actors in the university context that exchange active resources co-creating value to co-produce innovating service offerings that allow for the engagement of service provision”. Although all universities have the potential to build an ecosystem, still we find in the literature that the third mission of universities (the application of knowledge outside the academic environment) “is a topic of growing importance in the agendas of both research and development (R&D) policymakers and university administrators”(Capellari and De Stefano, 2014, pp.313). From the SD logic, the

ecosystem approach can help actors involved in this process to develop strategies from an open innovation perspective, developing structures and making decisions by taking into account the viability of the whole system and their networks, and not only the actors involved in the exchange.

In Figure 2 we conceptualize two main triads in the UI context, namely the internal triad, where the universities organise and institutionalise internal relationships between the university, research groups, and individual researchers, and the external triad where the relationship between university, business, and customer (whether industrial or final) is structured. It is in this context that co-patenting and co-ownership arise with different regulations (institutions) among universities.

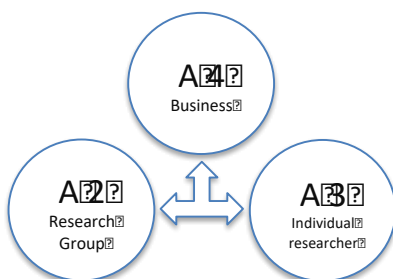
Figure 2. University-industry co-ideation, co-patenting, and co-ownership triad.



Source: the authors.

In the process of developing the third mission of universities, the literature refers to co-ideation as a highly desirable resource that businesses look for when contacting universities. Capellari and De Stefano (2014, pp. 314) refer to this process as the “co-invention network”, and highlight the importance of the analysis of the channels through which knowledge flows from science to industry, and specify that patents can represent the patterns of collaboration between the two realms. With respect to the individual researcher, Liasoni (2010) refers to them as “academic inventors”, and suggests that the resources and aims of individual researchers are also different from those of the research group as a whole (“academic patenting”).

Figure 3. University industry co-ideation triad.



Source: the authors.

Method

When a research topic is underexplored (as is the case of the university business ecosystem), use of case study (and case theory) can be an effective option (Gummesson, 2017; Yin, 2014; Gartner and Birley, 2002). Specifically, a single case study that typically presents an in-depth analysis of a societal unit is an appropriate means to examine a service ecosystem (Aal et al., 2016; Baron et al., 2018). The research design uses two six studies, which have been part of our research since 2014, as part of a research unit on complex service systems in the research group SEJ 314 of the University of Málaga. 45 public universities in Spain (representing 95% of public universities in Spain) took part in qualitative research. Personal in-depth interviews with Technology Transfer Officers (TTOs) were carried out by an external enterprise (Grupo Item <http://www.grupoitems.com/index.html>). Interviews were transcribed and analysed by the research group.

Table 1. Universities in the sample

U. Almería, U. Autónoma de Madrid, U. Granada, U. Miguel Hernández, U. País Vasco, U. Politécnica de Madrid, U. Alcalá de Henares, U. Pompeu Fabra, U. A Coruña, U. Alicante, U. Autònoma Barcelona, U. Burgos, U. Carlos III, U. Castilla La Mancha, U. Complutense, U. Cádiz, U. Córdoba, U. Barcelona Fundació Bosch, U. Lleida, U. Extremadura, U. Huelva, U. Islas Baleares, U. Jaume I, U. La Laguna, U. La Rioja, U. Las Palmas, U. León, U. Murcia, U. Navarra, U. Pablo Olavide, U. Politécnica de Cartagena, U. Politécnica de Cataluña, U. Politécnica de Valencia, U. Rey Juan Carlos, U. Rovira, U. Santiago de Compostela, U. Zaragoza, U. Girona, U. Oviedo, U. Sevilla, U. Valencia U. Vigo, U. UNED, U. USAL, U. Valladolid
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Results

The in-depth interviews developed with the responsible person at each TTO gave us two clear profiles of universities, those with a high level of business activity and others in which enterprise creation is around 112 in total (until 2019). The present research involved a search for models that best meet the requirements for a university business ecosystem, and we decided to proceed with those which, according to our interview and to the National register of public universities co-patenting (Spanish Office of Patents and Trademarks, 2018), were in the first category (Universidad Politécnica de Madrid, 583 patents and Universidad de Granada, with 248 patents). We additionally included an expert from the recent publication on “Science, Research and Innovation Performance of the EU 2018”.

The data extracted from the global sample allowed us to confirm that there are three kinds of universities depending on the number of businesses that have been created through or with university participation (High – medium – low business activity). The university as co-owner or co-partner participation ranks from 5% to 10% in 95% of the cases. Table 2 provides relevant information on the three profiles.

Table 2. Types of universities according to their business activity

Type of university according to the business activity	Nº	Average business creation (accumulated)	Average co-patenting	Co-owning
High (> 30)	7	112,6	348	5 % - 10%
Medium (14 to 30)	12	24,7	155,8	5 % - 10%
Low (< 15)	26	6,7	85,4	5 % - 10%

Source. Primary data from the research except for Average co-patenting (Spanish Office of Patents and Trademarks, 2018).

The theoretical approach to the university business ecosystem guided the research towards the analysis of those universities with a high level of business activity: U. Poliécnica de Cataluña, U. Politécnica de Madrid, U. de Granada, U. del País Vasco, U. Autónoma de Barcelona and U. de Sevilla and U. de Málaga We contacted them in a second round of research to propose a telephone interview.

We also added to the experts panel the authors of the 2018 EU research (as described previously). In the second round, we wished to integrate their perspective on the theoretical model of “university business innovation” and consider how this could help universities in their transition from closed to open economies. The questions to be addressed regarding RQ 1 and RQ 2 and relevant quotes are shown in Tables 3 and 4.

Table 3. Relevant quotes for RQ 1.

Actor	Question/ Quote
Expert A	<p>Would you say universities behave like as an ecosystem in generating innovation through their relationships with surrounding actors? Or do they still behave like closed businesses in generating innovation and transferring innovation? Comment on actors in the process and the model developed on figure 1.</p> <p>“We are developing an active role trying the University to act as a real ecosystem. For us, the Spinoffs are a way to reach technology transfer to the market and the society” (...) “The more actors in the process, the more possibility for success (...) We have clear that, not only actors 1 to 5 have to be on the process, but also other networks, relationships with other universities, etc. This is what makes a process successful and strong”</p>
Expert B	<p>“I absolutely agree we have to become an ecosystem” (...) “In general, effective collaboration among actors in the ecosystem should be improved (...) the same at the micro level (encouraging, motivating for researchers, etc.) to the macro (joint institutionalized programs: corporate – investment – startups – university)”</p>
Expert D	<p>“Yes I do believe this, as a matter of fact, I believe that close innovation should be the exception. Innovation and technology transfer from the university is such an extremely difficult task that the diversity implied in open innovation makes it more likely to succeed then the closed one”</p>
Expert F	<p>“Of course, the open economy perspective should be integrated in the University. I thing we are working on this way” (...) “University TT services and some researchers are every day more aware of market information, technology, challenges, trends,... and try to incorporate such knowledge in the research activity and, mainly, in technology development” (...) “Also, latest initiatives in the TTOs are more focused into establishing informal relationships between researchers and companies before the research project arises”</p>

Table 4. Relevant quotations on RQ 2.

Actor	Question/ Quote
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	RQ 2. When performing as an ecosystem, how is value co-created to better generate innovation? Explain how co-patenting, co-ownership and co-ideation relate to each other.
Expert A	“For us these three concepts are absolutely related to one another and have to be managed together” (...) “For us, co-patenting and co-ownership are the result of a collaborative work among institutions “ (...) “Increasingly (in much more than 50% of the cases, innovation generation is linked to co-patenting and co-ownership (...)”.
Expert B	“I think all these three concepts are interrelated and must be jointly and strategically managed in order to reach common objectives for all the actors in an innovation environment, oriented to the market”
Expert D	“Co-patenting and co-ownership are very common in the university innovation context” (...) “The challenge is to establish a fair and stimulating value to both the contributions of each part in the co-development of “something” and to the rights for the exploitation of such “thing””.
Expert F	“In our university (and I think in most of Spanish ones), the co-ownership is usually managed by technical staff (from TTO) before the collaborative (university – industry) research relationship starts. In these cases, co-ownership and consequently co-patenting are negotiated over economic aspects and legal restrictions”.

The results point to two important conclusions:

- a. Co-patenting and co-owning, as managed in practice by public universities, show a clear closed-economy perspective. According to the results from the Ministry of Energy, Tourism and Digital Agenda (2018), co-patenting is a process of protecting rights in relation to the results of innovation, but less than 35% of universities with high business activity actually become businesses.
- b. Co-owning is also a standardized process, which ranks in all cases but one (which has a value of participation of 1%) between 5% (which is the fashion) and a maximum of 10%. There are no signs of value co-creation or engagement content.
- c. In the Spanish public universities context, those with a higher patenting /startup creating results are absolutely conscious of the need for changing the model (see table 3). The expert A makes a clear SDL Ecosystem approach to the reality, while others, like expert F, is conscious of the need to work on this direction”. Also, expert A explains how “developing this process alone is hard, and the shortage of universities with this perspective damages the system”.
- d. Those universities with a higher level of development from the service ecosystem perspective was not able to separate the concepts “co-patenting”, “co-owning” and “co-creation”. In this sense, Expert A posit “these three concepts are the result of collaboration among institutions”.

Theoretical contribution

The present paper builds on the Service Dominant Logic perspective (SDL) to improve the understanding of the much demanded “university third mission”. As Mugia (2018, pp. 1) posits: “numerous studies have demonstrated the central role of universities in the development of

innovation ecosystems, however the literature in which universities might construct and maintain their R&D collaborations is highly limited”.

With this general aim, we proposed two research questions that shed light on this complex reality using the perspective and tools provided by the SDL:

RQ 1. What are the requisites for a university to be considered a complex service ecosystem?

RQ 2. When performing as an ecosystem, how is value co-created to better generate innovation?

Our approach to the university as a complex service in the process of transition from a closed to an open economy guided the research to identify the conditions needed for a complex service ecosystem structure to arise. Following Vargo and Lush (2011) and Chadler and Vargo (2011) the requisites are that the structure: (1) co-produces service offerings, (2) engages in service provision and (3) co-creates value. In a second stage of the research, we considered a brief analysis of different conceptualisations of service innovation and found that the “synthesis perspective” matches the SDL and ecosystem perspective, because it relies on actors’ co-creation relationships to solve problems. This active perspective of innovation drove us to adopt Mele at al’s (2017) concept of “innovating” to bring the idea of an active and continuous change process, more appropriate to an open economy perspective. With this theoretical background, we define innovating in a service ecosystem as the continuous evolution of all actors in an ecosystem to find new ways of co-solving problems collaboratively and innovating for the benefit of the system.

The present paper frames the university, and specifically the process of technology transfer, though which innovation is expected to arise to benefit business and society. The new concept of “innovating in service ecosystems” allows us to build on ecosystem theory to add to the types of co-creation developed by the literature. We offer three additional specific co-creation formulas that arise in the process of university technology transfer: co-invention, co-patenting, and co-ownership. The relevant literature makes heterogeneous and generally case-study contributions to these processes (Murgia, 2018; Belderbos et al., 2014; Arqué-Castells et al., 2016; Geuna and Rossi, 2011; Caldera and Debande, 2010). However, there is a lack of theoretical models that frame the university as a complex service system from the SDL and ecosystem innovation perspective.

This theoretical approach drove us to conceptualise the “University Business Ecosystem” as an open group of actors that exchange active resources in co-creating value to co-produce innovating service offerings that allow for the engagement on service provision. The theoretical model that led to this conceptualisation allowed us to identify five actors whose relationships are structured into triads in the core of the university business ecosystem. Following Sitaloppi and Vargo (2017), in the context of a university business ecosystem, we find an internal triad, an external triad (where co-patenting and co-ownership cooperation relationships are framed) and a co-ideation triad (where innovation arises and is transferred from the university (academic inventors / research groups).

The “on demand” evolution of the theory taking place in the UI process opens the need for future research on the process in which universities are actually engaged: the transition from closed to open economies. Just a small part of this process is in evidence when knowledge is transferred to the society in the form of a business structure, facilitating the process of technology transfer to the benefit of all actors: the university, researchers, and business and, in the end, to society. New contributions to identify new structures, influencing actors or triad structures in this process are needed and would improve the theoretical models developed. Furthermore, new formulas or typologies of co-ownership, co-patenting or co-innovation would improve the understanding of the process.

From the SDL perspective our contribution is framed by four interrelated concepts in the context of the processes of university technology transfer and business creation (in the value-in-context perspective developed by Chandler and Vargo, 2011). Our theoretical approach materialises in three theoretical contributions:

- a. Conceptualisation of “innovating in service ecosystem”
- b. Conceptualisation of “university business ecosystem” (FP 9/ axiom 5).
- c. Formulas of value co-creation specific to the university business ecosystem: co-ownership, co-patenting, and co-ideation, which improve the design of co-creation types (FP 6, Axiom 3).

Managerial contribution

The present paper has important contributions for practice. There is a shared interest amongst public institutions, politicians, society and, of course, the university in the aim of improving the process of technology transfer from the research (university) to the entrepreneurial dimension. In a recent paper, Sterzi et al. (2019, pp. 309) posit that “lack of experience in managing patents inventions explains our results for technological importance but not for exploitation”. The present research sheds light on this process using a theoretical and empirical approach. The results of both approaches highlight the following issues that need to be addressed in order to improve the way universities operate:

- (1) European universities need to improve the technology transfer process to improve the so-called “third mission” as stated in the last Science, Research and Innovation Performance of the EU (2018).
- (2) The concept of innovation in complex service organizations (which is the case in universities) with the SDL approach led us to suggest that universities are still in transition from closed to open innovation.
- (3) From a SDL approach, we raise two important strategic issues that need to be addressed:
 - a. Universities need to be structured as complex service ecosystems in order to reach innovation in an open model structure (Chesborough and Bogers, 2014). Theory on SDL (FP9/ axiom 3) explains that, to reach such a structure, the university has to be conceptualized from a value-in context perspective (Chandler and Vargo, 2011), where the context of value creation is networks of networks.
 - b. When performing as an ecosystem, the FP 6/Axiom 2 led us to put the actor’s engagement and value co-creation at the core of the innovation process. The results of the empirical approach suggest there is a need to re-conceptualise the co-ideation, co-patenting, and co-innovation concepts, because in practice, they do not respond to an open innovative pattern to improve innovation.

Guerrero et al. (2014) highlight the need to improve understanding of similarities and differences in the manifestation of “entrepreneurial university” among universities sharing similar social, economical, and political conditions. We have shed some light on this process, but there is still a significant amount of work to do on the theoretical and empirical side. The concept of the University Business Ecosystem opens new lines for future research, some of which we are starting to work on because we consider a priority:

- How to re-design co-owning and co-patenting structures to better meet the demand of innovation through value co-creation and service engagement involving the service ecosystem conceptualisation (Chandler and vargo, 2011).

- How to get actors more involved in order to make them a more active part of the production process in the university context (co-produce).
- The transit from closed to open economy requires an in-depth process of institutional change that must follow from the FP 11 / Axiom 4.
- We have focused on the business side of the university as one of the results of technology transfer (the university's third mission) but there are many other dimensions that need to be included under the same open innovation perspective.
- Other conceptualisations such as a "Viable Systems Approach" could improve the approach to the "university business ecosystem" and shed light on how to develop the process.

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