



## The Third Mission of the university: A systematic literature review on potentials and constraints



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### ARTICLE INFO

#### Keywords:

Co-creation  
Entrepreneurial university  
Innovation  
Knowledge transfer  
Third Mission  
University-industry

#### JEL codes:

I2  
O3  
L26

### ABSTRACT

In recent years, there has been increasing pressure on Universities to shift from focusing primarily on teaching and performing research, and to add an equivocal Third Mission (TM), labelled “a contribution to society”. Unprecedented challenges have been redesigning the missions of Universities, which are often perceived as being at a crossroads. The TM is a multidisciplinary, complex, evolving phenomenon linked to the social and economic mission of Universities in a broad sense. Existing studies mainly focus on Universities in accomplishing their traditional missions, or they offer a narrow perspective of the TM. To the best of our knowledge, no systematic literature review has been performed on the TM to comprehensively explore its heterogeneous functions, constraints, clashes and incorporation within education and research. This paper presents a systematic review of the state of knowledge and develops a novel framework for the enactment of the TM. The paper reveals the potential and the constraints of the recurring themes of the TM, focusing especially on the engagement of non-academic stakeholders. It also suggests, to scholars and policymakers, a selection of measures through which some of the challenges might be faced. The paper offers both a descriptive and a thematic analysis, through examination of 134 peer-reviewed articles which were published between 2004 and May 2019.

*Every skill and every enquiry and, similarly, every action and rational choice, is thought to aim at some good; and so the good has been aptly described as that at which everything aims (Arist., EN. 1.1094a).*

### 1. Introduction

The rise of the knowledge economy, along with globalisation, and both the financial and the environmental crises, are unprecedented challenges that have contributed considerably to redesigning and extending the missions of Universities (Trencher et al., 2014; El Hadidi and Kirby, 2016; Rubens et al., 2017). The dynamics of knowledge production are changing, as is the way in which societies are regarding expectations and values. In this context, academia can be perceived as being at a crossroads in teaching, research, and the Third Mission (TM) (Bortagaray, 2009).

Indeed, in recent years, there has been increasing pressure on Universities, to shift from mainly teaching and performing research, and adding a TM, portrayed as “a contribution to society” (Abreu et al.,

2016; Urdari et al., 2017). Universities engaged in TM activities are becoming engines that contribute to the social, economic and cultural development of the regions in which they operate, by transferring knowledge and technologies to industry and to society at large (De Jong et al., 2014; Secundo et al., 2017a; Agasisti et al., 2019). Simultaneously, academia is facing the challenge of having to demonstrate both its sense of responsibility, and its efficient use of public funding, by introducing strategic management (Callagher et al., 2015; Benneworth et al., 2016; Aragonés-Beltrán et al., 2017; De La Torre et al., 2017; Mariani et al., 2018).

The expression TM is rather nebulous (Gregersen et al., 2009) and ambiguous (Laredo, 2007; Pinheiro et al., 2015a). On the one hand, from a general point of view, it consists of wide-ranging and recurring concepts such as the ‘entrepreneurial university’, ‘technology transfer’ and ‘Triple Helix Model (THM) partnerships’ (Trencher et al., 2014). On the other, the TM refers to an extensive array of activities performed by higher education institutions which seek to transfer knowledge to society in general and to organizations, as well as to promote entrepreneurial skills, innovation, social welfare and the formation of

**Authors’ contributions:** Lorenzo Compagnucci conceived the research framework and wrote the manuscript. Francesca Spigarelli and Lorenzo Compagnucci jointly reviewed and edited the final manuscript.

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<https://doi.org/10.1016/j.techfore.2020.120284>

Received 20 March 2020; Received in revised form 20 July 2020; Accepted 26 August 2020

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human capital. Furthermore, it concerns the development of science and society through various forms of communication and social engagement (Etzkowitz, 2003b; Rothaermel et al., 2007; Di Bernardino and Corsi, 2018). These activities are usually classified in relation to research (technology transfer and innovation), to teaching (lifelong learning/continuing education) and to university engagement in social and cultural life (Mora et al., 2015).

In other words, the TM is a complex and evolving phenomenon which, over the past few decades, has been being articulated in policy as a result of dialogue between university, industry, government and society (Vorley and Nelles, 2009; Predazzi, 2012; Giuri et al., 2019). From this perspective, the TM is not only a regulatory regime but also a boundary enactment transaction, one through which universities endeavour to create a more favourable environment (Vakkuri, 2004).

Thus, one fundamental challenge is how best to rediscover, understand and capture the contribution of research, and of higher education in general, to the cultural life of nations (Smith, 2013). To this end, the engagement of universities in TM activities represents a radical departure from their traditional 'ivory tower' stance in which teaching and research have always been treated as ends in themselves (Nakwa and Zawdie, 2016). It means that academia should abandon their ivory towers and address social needs and industrial objectives as well (Kapetaniou and Lee, 2017).

Despite the fact that there has been widespread recognition, amongst both policy makers and universities, that the TM is becoming increasingly important (Benneworth et al., 2015), the TM has only recently been implemented, starting in the late 1980s (Etzkowitz, 1998, 2001, 2003, H. 2012) and has triggered considerable amount debate. Indeed, the TM has frequently clashed with traditional academic missions, values and culture, and has even, at times, generated individual crises of identity amongst scholars (García-Aracil and Palomares-Montero, 2012; de la Torre et al., 2017). Hence, the TM is potentially both the most crucial mission and the one which most needs innovation within the organization of universities (Laredo, 2007).

Existing studies have mainly portrayed universities as having two traditional missions: teaching and research. Less attention has been paid to identifying and analysing universities' strategies in the TM area (Giuri et al., 2019). There are concerns regarding the "one size-fits-all" approach to how the TM can best be performed, managed, and applied to countries or universities with homogeneous capacities (Kitagawa et al., 2016; Secundo et al., 2018). Furthermore, nurturing the "star player syndrome" (Shore and McLauchlan, 2012), raises important, but as yet unanswered, questions: such as the role of the university and its contribution to society. Moreover, there has been a lack of critical reflection on the ways in which universities have adopted and incorporated the TM into their existing core activities. Providing answers is crucial for current policy and for academic debates (Benneworth et al., 2016).

The field of TM university–society research is vast and multi-disciplinary, indeed, is considered an almost Herculean task to draw up a detailed and exhaustive picture of the state-of-the-art in the literature (Geuna and Muscio, 2009; Loi and Di Guardo, 2015). There have been systematic literature reviews (SLRs), but these have only investigated some aspects of the TM, for example, technology transfer in a quadruple helix framework (Miller et al., 2018) or university–industry collaboration (Ankrah and Al-Tabbaa, 2016). Other SLRs have focused on the engagement of scholars in university–industry knowledge transfer (Perkmann et al., 2013). Knowledge transfer has also been reviewed as a function of the TM in a specific country (Vick and Robertson, 2018). On the other hand, to the best of our knowledge, no SLR has been carried out on the TM of the university in a systematic and integrated way, comprehensively addressing this evolving phenomenon so as to further investigate its complexity and go beyond a more narrow economic focus.

This paper seeks to perform an SLR of the existing scholarly discussion on the TM of universities in a comprehensive, transparent and replicable way. The contribution of this SLR is two-fold: first, it seeks to

identify the gaps in the literature which need to be filled to further expand knowledge about the TM. More specifically, the SLR focuses on potentials and constraints on the enactment of the TM; second, the SLR suggests an innovative framework that could support the policymaking process and foster the TM, by tackling the issues raised. To this end, this paper addresses the following research questions:

- 1) What are the key constraints in the recurring themes of the TM?
- 2) What measures might be able to support policy making and the enactment of the TM?

The rest of this paper is structured as follows. Section 2. describes the methodology used for the SLR. Section 3. provides a descriptive analysis of the papers reviewed. Then, the paper offers a thematic analysis of the recurring and interlinked themes of the TM, highlighting both challenges and constraints. The themes addressed are: the evolving concept of the TM; the entrepreneurial shift in higher education; the entrepreneurial university; knowledge transfer (KT) as a function of the TM, including knowledge transfer offices (KTOs) and entrepreneurship education; the engagement of university staff and external stakeholders in TM activities; the evaluation of the TM and its impact; the strategic orientation of the university and, the emerging function of co-creation for sustainability. Each of these recurring themes offers a selection of measures which might support both policy intervention and the enactment of the TM of a university. Conclusions and future avenues for research are suggested at the end of the paper.

## 2. Methodology

The methodology adopted in this paper is that of a systematic literature review of double-blind peer-reviewed academic articles which focus on the TM of universities. From a general point of view, an SLR establishes the state of current knowledge in a given field (Tranfield et al., 2003). Indeed, SLRs are increasingly being adopted in the social sciences (Mangas-Vega et al., 2018) to ensure a reliable and rigorous process in order to reduce both subjective bias and the risk of overlooking relevant literature. In addition, an SLR is a structured and multiple-stage system for reviewing a large volume of literature over long periods of time (Denyer and Neeley, 2004). For scholars, an SLR can enhance methodological rigour as well as suggesting further avenues for research. For practitioners, an SLR can help address managerial issues by creating a reliable knowledge base through putting together findings from a range of studies (Briner and Denyer, 2012; Rousseau, 2012).

An SLR involves several steps, namely: identifying relevant work; assessing the quality of the studies; summarizing the evidence and interpreting findings (Kahn et al., 2003). However, an SLR is neither a formal full-length literature review nor a meta-analysis, because it conforms to a rigorous set of core principles. Indeed, this kind of review is: systematic (organized according to a method designed to address the review questions); transparent (explicitly stated); reproducible and updatable; and synthesized (summarizing the evidence relating to the review questions) (Briner and Denyer, 2012). Drawing on Tranfield et al. (2003), the findings of this SLR have been articulated in two analyses. Firstly, a descriptive analysis of the field and, secondly, a thematic analysis of key emerging themes and the extent to which consensus is shared across these themes.

The methodology used for this SLR is described below.

**Stage 1. Formulating research questions and search terms.** In order to define the boundaries of the subject, as well as desk research, experts in the area of TM (namely Rector delegates, scholars and knowledge transfer office staff) were also consulted. This approach initially resulted in six core search terms, including "university", "third mission", "third stream", "innovation", "knowledge transfer" and "co-creation". This first step made it possible to obtain insights into the general framework of the TM and the challenges for enacting TMs at the local level.

**Stage 2. Database search.** Thomson Reuters Web of Science (WoS), Elsevier's Scopus, and Google Scholar, were the three main sources for bibliometric data. However, only WoS and Scopus restrict their coverage to peer-reviewed material. Scopus is the largest abstract and citation database of peer-reviewed literature, it contains the most important journals for our research topic. Indeed, Scopus indexes 50% more journals in the Social Sciences than does WoS (Manatos et al., 2015). Consequently, the target Electronic Database (ED) was Scopus. We refined the search to peer-reviewed journal articles published in English and we avoided both books and grey literature, such as reports and policy documents. Research on the TM is, to some extent, both broad and multidisciplinary. Furthermore, the concept of the TM is relatively new. As a result, we did not start by restricting the search to specific academic journals as it was important to include all peer-reviewed journals in order to make sure we had captured every mention of the concept. To do this, we searched using the terms "third mission" AND "university" in paper abstracts. The search was not limited to any period of time. We refined the search to May 2019. At this point, we had 144 journal articles in our sample.

**Stage 3. Articles download and selection.** The 144 papers located during the initial search were downloaded, with the exception of a few inaccessible articles which were collected through correspondence with the authors. All the listed papers were then manually checked by reading the abstracts. Ten articles were excluded: either doubled items, or papers not considering the TM as the main topic, or articles not addressing our research questions in any way. Hence, the complete search resulted in a list of 134 papers. Next, the snowballing technique (Jalali and Wohlin, 2012) was also adopted and used for the articles obtained from the download, on the basis of the relevant citations appearing in the 134 results. As a consequence, 10 extra papers were reviewed. Appendix – Table A displays the list of the selected articles on which this SLR is based.

**Stage 4. Data extraction.** The 134 papers were fully read, analysed and coded. The aim of the analysis here was to minimize researcher subjectivity. Hence, on the basis of Tranfield et al. (2003), a standardised data extraction process was performed by means of a protocol, which was carried out for all 134 articles. The protocol was based on assigning the following codes to each paper and recording them in a table: (1) Author(S); (2) Title; (3) Year published; (4) Journal; (5) Number of citations; (6) Abstract; (7) Research question(S); (8) Methodology; (9) Results; (10) Geographical area considered in the study; (11) Analysis period; (12) Notes section for recording any information appertaining to the research questions. The Notes section focuses on the challenges of the TM and on measures to foster TM. The protocol resulted in a final document of 187 pages (on average 1.4 pages; lines 1.15 spaced; 11 font; of data was extracted for each paper).

**Stage 5. Descriptive analysis: thematic reading guide and coding system.** The most appropriate way to organize the findings of an SLR, is to build an analytical framework (Figueiró and Raufflet, 2015). A thematic reading guide and a coding system were elaborated by drawing on Ahl (2002), and on Henry et al. (2013), (Table 1). The characterization techniques used by de Lage Junior and Godinho Filho (2010), Slager et al. (2012), De Carvalho Ferreira et al. (2016), and Sharma et al. (2018), were adapted to develop the descriptive analysis. The thematic reading guide includes: (1) the geographical area considered in the study (codes A-L); (2) the methodology incorporated in the articles (codes A-E); (3) the results (codes A-C); (4) and, the period of analysis considered in the study (codes A-E).

**Stage 6. Thematic analysis.** While analysing the content of the papers, recurring themes were identified and further investigated (Dixon-Woods et al., 2005). At this point, the potentials and constraints of the TM encompassed in the themes identified were reviewed. We will present a table for each of the themes, both to synthesize the evidence gathered (Denyer and Tranfield, 2009) and to suggest a selection of measures which might be able to support a novel framework for the development of the TM of a university.

Fig. 1 displays the steps of the methodology used in the SLR.

### 3. Descriptive and thematic analysis

With respect to the descriptive analysis, peer-reviewed papers on the TM have appeared in a wide range of international journals. Table 2 shows that, to May 2019, Science and Public Policy, Industry and Higher Education, the Journal of Technology Transfer and Technological Forecasting and Social Change had published the greatest number of articles about the TM. Appendix – Table B displays the full descriptive statistics on journal publishing of TM contribution articles to May 2019.

It is clear that articles on the TM have been being published since 2004 and that, there was a sharp, steady rise in the number of papers published between 2012 and 2017 after which the number declined steeply (Fig. 2).

The 134 articles on TM were categorized as regards each of the classifications, as presented in Table 1 (coding and categorization criteria). Table 3 displays the number of papers in each category, as described in Table 1. The numbers in parentheses show the percentage of journal articles falling into the respective categories. The codes which were not applicable to some categories have been marked as N / A.

The majority of the papers reviewed focused on Europe (63.26%), Africa (6.12%) and the USA (3.40%). The disparity, as reflected in the concentration of research, is supported by the fact that, in Europe, the TM has only recently been applied which has resulted in considerable debate amongst scholars, particularly in well-established research-intensive universities (Etzkowitz, 1998, 2001, 2003, H. 2012). On the contrary, since the passing of the Land-Grant College Acts (1862 and 1890) by the US Congress, US universities, encouraged by the ideological pragmatism of their surrounding communities, have been much more willing to collaborate with external parties and to adapt education and research in light of external events and expectations (Pinheiro et al., 2015a, 2015b). As regards Africa and developing countries, there is a growing body of studies which emphasises the engagement of universities with local communities to address economic, social and environmental issues.

As regards the methodology adopted by the existing literature included in this SLR, the papers studied can be divided into three main groups: theoretical-conceptual studies/model building (28.35%), case studies (27.61%) and empirical studies (29.10%). A smaller body of the literature is based on the comparison between case studies (14.92%). It should be noted this SLR is the first to address the complex phenomenon of the TM in a systematic and comprehensive way.

Due to the fact that the TM is still developing and that every paradigm change requires a certain period of time to make its effects felt (Secundo et al., 2017a, 2017b), the majority of the papers suggest new perspectives (61.94%), while less articles present results that are consistent with the existing literature (28.35%). Furthermore, the majority of the papers studied (32.83%) considered a wide time span of analysis, starting from more than 10 years ago to date. This is because the TM of a university is a complex and evolving phenomenon, which will have been articulated in policy as a result of dialogue between university, industry, government and society at large, over past decades (Vorley and Nelles, 2009; Predazzi, 2012; Giuri et al., 2019).

Regarding the thematic analysis, the following Sections identify the recurring themes of the TM and present the key findings which emerged from this SLR, focusing, in particular, on the potentials and constraints of TMs. A table has been drawn up for each of the recurring themes in order to suggest a selection of measures which might be able to support an innovative framework for both policy intervention and for the enactment of the TM of universities.

#### 3.1. The Third Mission of universities: an evolving concept

Many unprecedented challenges, such as the knowledge economy, globalisation, the financial, and the environmental crises, are contributing significantly to redesigning and extending the missions of universities (Trencher et al., 2014; El Hadidi and Kirby, 2016; Rubens et al., 2017). Implicit in the concept of the TM, there have, historically, been both a first

**Table 1**  
Coding and categorization criteria.  
Source: Authors' elaboration.

Category	Significance	Codes	Significance
1	Geographical area	A B C D E F G H I L	USA and Canada Europe China Japan, South Korea, Taiwan, and Singapore Rest of Asia Africa South America Australia and New Zealand Rest of the world Not specified
2	Methodology	A B C D E	Theoretical-conceptual publication/model building Case study Empirical study Literature review Comparative study
3	Results	A B C	New perspectives Consistent with the literature Review models with different dataset/time periods
4	Analysis period	A B C D E	Less than 3 years ago Between 3 and 5 years ago Between 5 and 10 years ago More than 10 years ago Not applicable

and a second mission already: teaching and research (Ridder-Symoens, 2003). As far back as Aristotle, in 335 B.C.E., one of the first examples of higher education institutions (HEIs) was the Lyceum, which focused on training the elite members of the community (Natali, 1991; Roper and Hirth, 2005; Berti, 2012). The conservation and transmission of knowledge, through teaching, was also regarded as the primary task of early universities in the Middle Ages (Nelles and Vorley, 2010c; Cooper, 2011). In this context, the word “university” was coined from the Latin expression *universitas magistrorum et scholarium*, which means “community of masters and scholars”. One of the first and most important of these communities was founded in Bologna (Italy), in 1088, in order to teach liberal arts (Rubens et al., 2017). This means that universities have participated in modelling the development of both Europe and the World, playing a key role ever since their early emergence in Greece and through their progressive institutionalization in the Middle Ages (Montesinos et al., 2008).

There was a radical change in the higher education system in the early 19th century when the Humboldtian reforms (Rüegg, 2004) initiated the first academic revolution (Etzkowitz and Webster, 1998). The German tradition: the University of Berlin, started to combine teaching with scientific research (Urdari et al., 2017) and gradually all universities began to take on the dual role of education and research (Rolfo and Finardi, 2014; Rinaldi et al., 2017; Sá et al., 2018).

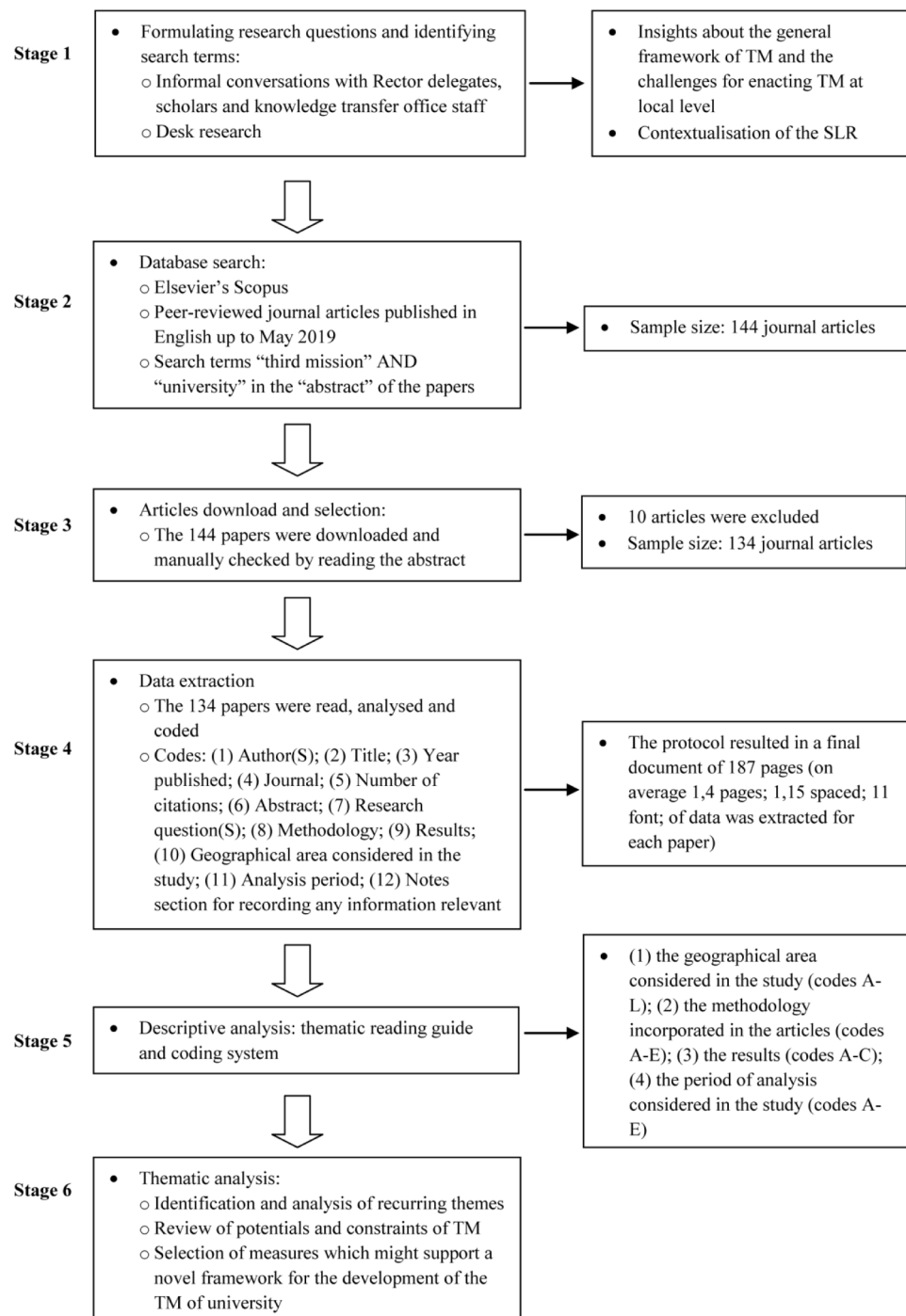
Building upon the first wave of reform, a second academic revolution has been underway since the late 1980s (Etzkowitz, 1998, 2001, 2003, H. 2012). Universities embraced a TM of being the providers of knowledge proffered in order to be translated into intellectual property that could be exploited in practical terms (Rolfo and Finardi, 2014). US universities in particular, have been increasing their entrepreneurial activities in many areas, including patenting and licensing, building science parks, promoting academic spin-offs and, also, by investing equity in start-ups (Mowery et al., 2004; Siegel, 2006; Mariani et al., 2018). Along with the commodification of knowledge (Naidoo and Jamieson, 2005), the TM began to be introduced so as to identify both the contribution of universities to economic and social development (O'Carroll et al., 2006), and the interactions between universities and society at large (Molas-Gallart et al., 2002).

Now, in the 21st century, universities have become key actors in cultural and economic growth, as well as fostering competitiveness in the global arena (Klofsten and Jones-Evans, 2000; Mueller, 2006; Svensson et al., 2012). On the other hand, universities are also evolving more and more into institutions engaged with industry and society at large (Etzkowitz and Leydesdorff, 2000; Vorley and Nelles, 2008; Berbegal Mirabent and Solé Paredada, 2012). In other words, over the last few decades, universities have been undergoing a fundamental change from their traditional missions of teaching and research, to encompass the TM (Chanphirun and van der Sijde, 2014) which implies driving regional development (Perkmann et al., 2013).

Kerr (1963) made one of the first attempts to explore the changing roles of universities. The author coined the term multi-versity to identify how the roles of universities had been and were evolving to meet the changing demands of society, both in economic and cultural terms (Vorley and Nelles, 2009). The debate on the concept of the TM, as a set of activities aimed at linking the university to its surrounding environment, has always been an issue amongst academics and university stakeholders (Castells, 2001; Pinheiro et al., 2015b).

The literature predominately states that a universal concept of the TM, whether technological or societal, simply does not exist and that there is no consensus either regarding what functions may, or may not, be included in the concept of the TM, or on the boundaries of teaching and research (Göransson et al., 2009; Jäger and Kopper, 2014; Pinheiro et al., 2015a). As stated above, the term TM is still rather nebulous (Gregersen et al., 2009) and ambiguous (Laredo, 2007; Pinheiro et al., 2015a). It has been argued that this ambiguity of the concept of the TM depends upon three interrelated aspects: (i) the configuration of the activities carried out in a given university; (ii) the degree of its territorial embeddedness; (iii) the institutional frameworks in which the university operates (Laredo, 2007; Jäger and Kopper, 2014). Furthermore, Giusepponi and Tavoletti, 2018 have observed that the kind of community involved, local, regional, national or international, can contribute to enhancing this ambiguity of the term TM.

A range of studies highlight the fact that neither the basic nomenclature of the TM, nor its conceptual foundations, have yet been fully



Source: Authors's elaboration

Fig. 1. Flowchart of the methodology used in the SLR.

Source: Authors' elaboration

developed because the literature on TMs is still in its infancy (Jäger and Kopper, 2014; Pinheiro et al., 2015a; Piirainen et al., 2016). Furthermore, the diverse meanings that different scholars attach to TM reflect their diverse visions of higher education. For example, expressions like 'third stream' of HEIs (Laredo, 2007), 'technology transfer' (Hackett and Dilts, 2004), 'university-business cooperation' (Adamson-Fiskovica et al., 2009), 'community engagement' (Jongbloed et al., 2008) 'public engagement', 'service mission' and 'community service' are usually used as if they were synonymous with the TM (Vargiu, 2014). As a result, "TM" remains unclear and multi-interpretable (Vorley and Nelles, 2009). On the other hand, one train of thought in the literature does highlight both

the importance of establishing a definitive nomenclature and the need to make opportune distinctions. This latter is fundamental for planning, financing and measuring the TM, and will long remain a challenge, worldwide, to scholars and policymakers (Sharrock, 2009; Vargiu, 2014).

From a general point of view, the TM is the relationship between universities and stakeholders from the non-academic world. A TM is the sum of all activities concerned with the generation, use, application and exploitation of university knowledge, capabilities and resources, outside of the academic environment (Molas-Gallart et al., 2002; Schoen et al., 2006; Molas-Gallart and Castro-Martinez, 2007; Ramos-Vielba et al., 2010; Calcagnini et al., 2016; Secundo et al., 2017b;

**Table 2**

Top 10 academic journals ranked by number of publications on TM to May 2019.

Rank	Journal	Number of papers	Percentage*
1	Science and Public Policy	15	11,19%*
2	Industry and Higher Education	10	7,46%
3	Journal of Technology Transfer	9	6,71%
4	Technological Forecasting and Social Change	8	5,97%
5	Journal of Intellectual Capital	6	4,47%
6	European Journal of Higher Education	6	4,47%
7	Research Evaluation	6	4,47%
8	Higher Education Policy	5	3,73%
9	Scientometrics	5	3,73%
10	Tertiary Education and Management	3	2,23%

\*Percentage of the total which corresponds to 134 journal articles

Source: Authors' elaboration.

Meoli et al., 2018). Furthermore, this collaboration between academia and society at large will seek to contribute to the social, cultural and economic development of communities (Molas-Gallart et al., 2002; Driscoll, 2008; Nelles and Vorley, 2010b; de la Torre et al., 2017).

On the other hand, according to a wide range of studies of the 'entrepreneurial university' (see Section 3.2) (e.g. Etzkowitz, 1983; Rothaermel et al., 2007; Etzkowitz et al., 2008; Foss and Gibson, 2015), a TM represents the gradual shifting of universities towards economic-based, or inspired, activities in the sense of commercialising knowledge (Günther and Wagner, 2008). A TM refers to the activities and the assets of an entrepreneurial university, one which links research to the commercialisation of technological and innovative outcomes (Rothaermel et al., 2007; Van Looy et al., 2011; Shore and McLauchlan, 2012). This means that TM activities are those visible initiatives, that deeply affect the academic ethos (Montesinos et al., 2008; Aragonés-Beltrán et al., 2017; de la Torre et al., 2018), and involve economic actors so as to create and strengthen partnerships (Kotosz et al., 2016).

However, a growing body of the literature states that the TM includes, but is not restricted to, commercializing scientific research. In fact, a TM is a process of regional regeneration and of interactive support, as it engages the surrounding community (Hellström et al., 2013; Jäger and Kopper, 2014; Ramachandra and Mansor, 2014; Vargiu, 2014; Kohtamäki, 2015). A TM implies providing education to audiences beyond traditional students and contributing to public debates and cultural activities (Laursen and Salter, 2004; Lawton-

Smith, 2007; Perkmann and Walsh, 2007; Bekkers and Bodas Freitas, 2008; Rosli and Rossi, 2016).

Some scholars have suggested that the TM is the service(s) provided by the university to society, above and beyond teaching and research. A TM is a deliberate effort, on the part of university actors, to disseminate a sense of reciprocal community engagement (Gulbrandsen and Sliemersaeter 2007; Montesinos et al., 2008; Inman and Schuetze, 2010; Cai and Hall 2015; Giusepponi and Tavoletti, 2018; Backs et al., 2019), to address issues of relevance to society, and to contribute to innovation and social change (Vargiu, 2014; Pinheiro et al., 2017; Mariani et al., 2018). The work of Albulescu et al. (2014) in particular, specifies that the service to society is voluntary and it can only succeed in a friendly environment which is able to: (1) ensure the integration of innovation policies; (2) foster the creation and development of public private R&D partnerships; and (3) promote the transfer of knowledge to all users. Furthermore, the service to society is based on the duty of the university to repay society's economic efforts and to renew the original contracts between universities and their regions (Mora et al., 2015).

There are many other definitions. Some studies effectively assert that the TM includes everything which is not classified as teaching and research (Jongbloed et al., 2008; Göransson et al., 2009; E3M, 2010) and is performed by universities both in place of, and in relation to, other agencies (Lebeau and Cochrane, 2015). On the other hand, another vein emerging in the literature asserts that a TM cannot be considered as a residual function, but rather should be seen as being complementary to education and to scientific research (Predazzi, 2012; Secundo et al., 2017b). Indeed, TM is a complex and evolving phenomenon, which is articulated in policy as a result of the dialogue between science and society over the last few decades (Vorley and Nelles, 2009; Predazzi, 2012; Giuri et al., 2019).

Although there is no consensus on either the exact definition of the TM or on what activities may be included in this mission (Vorley and Nelles, 2009; Neary and Osborne, 2018), universities are continuing to develop the TM as an evolving concept (Bortagaray, 2009; Vorley and Nelles, 2009; Predazzi, 2012; Giuri et al., 2019).

The following Section 3.2. focuses on the concept of the entrepreneurial university which is acknowledged as being the earliest model of the TM. The entrepreneurial university prioritizes the combination between academic research and business needs and imperatives. In particular, the following Section offers insights into the concerns and the motives, that have fuelled the shift towards a university model that combines teaching, research, and entrepreneurial activities. Definitions of entrepreneurial universities as a model for the TM of universities are also explored.

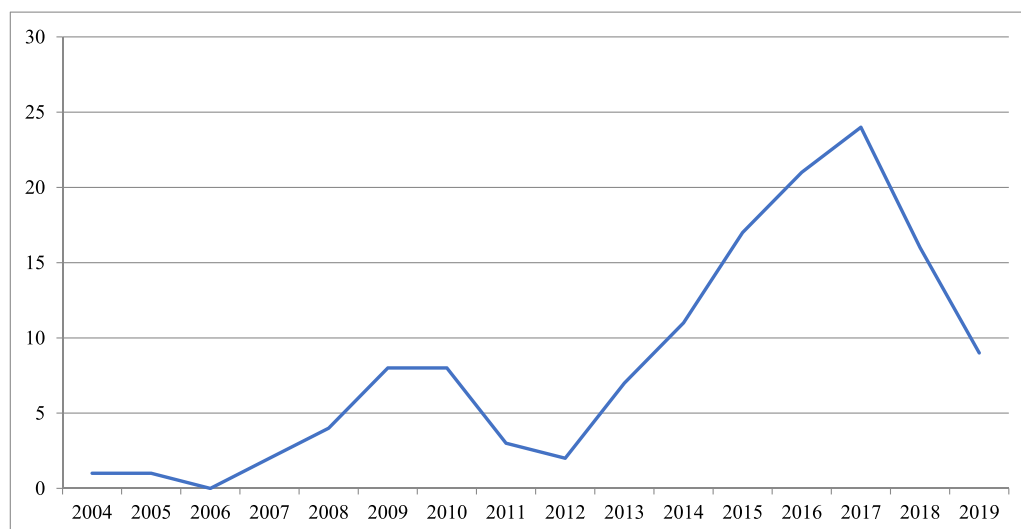


Fig. 2. Publication trend for TM from January 2004 to May 2019.

Source: Authors' elaboration

**Table 3**

Descriptive analysis of papers reviewed.

Source: Authors' elaboration.

Codes	Geographical area	Methodology	Results	Analysis period
A	5 (3,40%)	38 (28,35%)	83 (61,94%)	12 (8,95%)
B	93 (63,26%)	37 (27,61%)	38 (28,35%)	17 (12,68%)
C	4 (2,72%)	39 (29,10%)	13 (9,70%)	38 (28,35%)
D	3 (2,04%)	N / A	N / A	44 (32,83%)
E	5 (3,40%)	20 (14,92%)	N / A	23 (17,16%)
F	9 (6,12%)	N / A	N / A	N / A
G	5 (3,40%)	N / A	N / A	N / A
H	3 (2,04%)	N / A	N / A	N / A
I	N / A	N / A	N / A	N / A
L	20 (13,60%)	N / A	N / A	N / A
*Multiple	(13)	N / A	N / A	N / A
<b>Total</b>	<b>147</b>	<b>134</b>	<b>134</b>	<b>134</b>

\*Multiple: some articles consider two or more geographical areas

\*Multiple: some articles consider two or more geographical areas.

### 3.2. The entrepreneurial shift in higher education

The increasing need to produce, transfer, and commercially exploit viable research findings has progressively led universities to rethink and adjust their role (Goethner and Wyrwich, 2019) within the local, national, and international contexts they belong to. This turnaround within higher education was first investigated by Etzkowitz (1983), who first coined the term 'entrepreneurial university' to describe universities as institutions that have become crucial for regional economic development. Many and various studies have since highlighted that the entrepreneurial university is a model of the TM which prioritizes a set of activities, based on the combination of academic and business imperatives, by broadening both the inputs to academic knowledge and its use in an economic and societal context (Clark, 1998a, 1998b; Etzkowitz, 2003b; Rothaermel et al., 2007; Etzkowitz et al., 2008; Vorley and Nelles, 2009; Trencher et al., 2014; Foss and Gibson, 2015). Furthermore, these activities rely on research and a new management paradigm for the provision of universities' tasks (Unger and Polt, 2017).

From a historical point of view, the transition from research university to entrepreneurial university originated in the USA in the late 19th century (Etzkowitz, 2004; Riviezzo and Napolitano, 2010). The Massachusetts Institute of Technology (MIT) and Stanford University are early archetypes of HEIs, and they were the first institutions to expand their traditional missions of teaching and performing research, the first movers to include more applied research with commercial relevance into their programmes. Furthermore, they also started to transfer knowledge to the non-academic environment, as well as providing support to industry (Etzkowitz, 2000, 2003; Goethner and Wyrwich, 2019).

The entrepreneurial university is, still today, an idea with far more resonance in the USA than in Europe. US universities are, and have traditionally been based on private funds and corporate contracts providing a substantial part of their income (Blenker and Dreisler, 2006). Consequently, these universities have a more automatic, and natural, orientation to the market while European universities are still predominantly State financed (O'Reilly et al., 2019). Moreover, the entrepreneurial university emerged 'bottom up' in the USA, unlike in Europe, where the introduction of academic entrepreneurship is a more recent, 'top down', phenomenon (Etzkowitz, 2004).

The literature has investigated the drivers that boost the move towards entrepreneurial approaches. According to many studies, the evolutionary process leading to the entrepreneurial university has been strongly affected by the limited amount of funds that universities receive from national governments, resulting in funding gaps (Chrisman et al., 1995; Slaughter and Leslie, 1997; Riviezzo and

Napolitano, 2010; Sam and van der Sijde, 2014; Muscio et al., 2017; Paoloni et al., 2019). Furthermore, cutbacks in research funding systems have recently increased competition between universities. Indeed, nowadays, universities seem to be under constant pressure to improve their results, even in economic terms (Paoloni et al., 2019), and to cope with global development (Sam and van der Sijde, 2014). Thus, the entrepreneurial culture is often seen, by universities, as a new way of bringing in much needed resources, such as funds, collaborations and access to facilities, from different sources (Mariani et al., 2018).

Along with the pressure imposed by the changing economic environment, the literature has also identified further drivers of the entrepreneurial shift in higher education (Philpott et al., 2011). For example, Riviezzo and Napolitano (2010) focus on the internal operating conditions of the university that affect the pace and direction of knowledge flow. The development of the techno-sciences and the growing interest of industries in university laboratories have also contributed to the shift towards academic entrepreneurship (Etzkowitz, 2001; Azagra-Caro et al., 2006). Changes in both national and international legislation on Intellectual Property Rights (IPRs) have also played a key role in enhancing the growing interest in entrepreneurial initiatives within higher education (Powers, 2004).

Many studies agree that the development of an entrepreneurial mindset is the main mechanism through which academia can effectively participate in economic development (Fairweather, 1990; Liu and Dubinsky, 2000; Hagen, 2002; Brennan and McGowan, 2006). In recent years, this entrepreneurial turn has also been positively fostered by both national and local governments, which have introduced measures to promote the transformation of scientific knowledge into innovative and practical goods (Organization for Economic Cooperation and Development (OECD) 2003; Lockett et al., 2005; Link and Scott, 2010). For instance, the Bayh-Dole Act of 1980 is probably the best-known piece of legislation enacted by the USA for that purpose (Dornbusch et al., 2013; Goethner and Wyrwich, 2019). At the same time, scholars have gradually started both individual and collective initiatives to obtain resources for supporting original, investigative research (Riviezzo and Napolitano, 2010).

On the other hand, several studies criticise the nature of the changes in the political economy that have encouraged and fostered the trend towards academic entrepreneurialism (Robertson and Kitigawa 2009; Vernon 2010; Thrift 2011; Shore and McLauchlan, 2012). This current in the literature seeks to warn about the impact of increased State disinvestment in tertiary education. In particular, the authors disapprove of the fact that policy makers are gradually tending to view higher education and research as a personal, private investment rather

than as a public good (Robertson and Kitigawa 2009; Vernon 2010; Thrift 2011; Shore and McLauchlan, 2012).

### 3.2.1. The definition of the entrepreneurial university

The entrepreneurial university has attracted considerable attention from scholars and policy makers (e.g. Clark, 1998a; Etzkowitz and Leydesdorff, 2000; Gibb, 2005; Kirby, 2006; O'Shea et al., 2007; Rothaermel et al., 2007; Nelles and Vorley, 2010a; Guerrero and Urbano, 2012). As noted by Salamzadeh et al. (2016), some studies have stated that the entrepreneurial university is a universal phenomenon with an isomorphic developmental path. For example, Dill (1999) referred to an entrepreneurial university as 'university technology transfer' and Ropke and Xia (1998) consider the entrepreneurial university to be an 'entrepreneur organisation'. Jacob et al. (2003) describe the entrepreneurial university as that which has "developed a comprehensive internal system for the commercialisation and commodification of its knowledge", and Kirby (2006), states that the entrepreneurial university is a natural incubator, which fulfils its missions of teaching, research, and entrepreneurial activities.

According to Günther and Wagner (2008) the entrepreneurial university consists of direct and indirect mechanisms to link academia to businesses. Technology transfer facilities, such as technology transfer offices (TTOs), incubators, and university-based science parks, are set up in order to patent and license new technology, or to create firms. However, several studies consider the entrepreneurial university to be any innovative activity that occurs outside of the traditional missions of teaching and research. Whereas others assert that the entrepreneurial university relies on the initiative and risk-taking of individuals and groups to achieve maximum political and financial gains in the marketplace (Middlehurst, 1993; Clark, 1998a; Huyghe and Knockaert, 2014) and that it represents a means of earning economic benefits in order to protect academic freedom and engage in further research (Berkowitz and Feldman 2008).

More recently, Vorley and Nelles (2010), and Hellström et al. (2013) have investigated the phenomenon of the entrepreneurial university by interpreting two concepts: (i) academic entrepreneurship; (ii) and university entrepreneurship. The former is the pursuit of an entrepreneurial opportunity, led by an individual or an academic faculty team, and based upon, or relating to, their own research, with specific outcomes sought. However the latter, university entrepreneurship, is the pursuit of an entrepreneurial opportunity led by the institution and, in this case, the opportunity is based upon, or relates to, the research carried out by an individual or by academic staff. Lastly, Woollard (2010) sees university entrepreneurship as an organizational process driven by systemic, significant and sustained (3S) entrepreneurial behaviour, designed to achieve desired organizational outcomes.

Along with the overly fragmented definition of the entrepreneurial university as a model of university TM (Nelles and Vorley, 2010a), the literature has also suggested synonyms and new models of contemporary universities based on the prioritization of economic activities. For instance, Clark (2001) coined the term 'innovative universities' and Slaughter and Leslie (1997) assert that the model of 'academic capitalism' is based on resources deployed in the market and/or market-like behaviour of universities and its professoriate. The term 'enterprise university' was introduced by Marginson and Considine (2000), and describes a situation wherein collegiate governance is replaced by a new culture of executive management. This model is characterised by the shift from democratic to centralised decision-making so here, the enterprise culture is seen as a response to a decline in public funding (Vorley and Nelles, 2009).

In line with the previous models, there is also the 'corporate university', a term coined by Aronowitz (2000). This model is exclusively grounded on profit, on fund raising and on private partnerships. It implies that the university is totally exposed to market forces which may take priority over teaching and research. As a result, there is limited/restricted academic freedom and the commodification of university products and services plays a dominant role.

However, as noted by Vorley and Nelles (2009), the above-mentioned models are synonymous of the heterogeneous concept of the entrepreneurial university (Abreu et al., 2016). They all identify, and describe, different aspects of the same broad phenomenon, namely, the entrepreneurial turn in higher education.

### 3.2.2. The paths taken by the entrepreneurial university: constraints and potentials

The literature has also suggested some pathways and potentials for the development of the entrepreneurial university and has emphasised those theoretical and practical constraints which may, or should be, taken into account by academia and policy makers when designing the entrepreneurial university. For instance, Clark (1998a) attempted to identify and explain the processes and methods by which an entrepreneurial university can be created. The author carried out a series of case studies in order to derive, inductively, the five pathways of transformation that can be followed when designing entrepreneurial universities: (i) a strengthened steering core; (ii) an expanded developmental periphery; (iii) a diversified funding base; (iv) a stimulated academic heartland; and, (v) an integrated entrepreneurial culture (Woollard, 2010).

More recently, Etzkowitz (2013) described four stages in the transformation towards the entrepreneurial university. In the first stage, the university identifies its ability to establish priorities and to formulate a strategic view of its direction. Next, it acquires financial resources from various sources. Subsequently, academia begins to play an active role in commercializing the intellectual property arising from research performed by its staff. In the final stage, the university focuses on its engagement with stakeholders in order to participate in the development of the regional innovation environment. It is clear that the four stages may take place in any sequence or, even virtually, simultaneously (O'Reilly et al., 2019).

Drawing on the literature both on the entrepreneurial university (Etzkowitz et al., 2000) and on corporate entrepreneurship (Burns, 2005), Vorley and Nelles (2008, 2012), by introducing the concept of 'entrepreneurial architecture' (EA), have suggested a different pathway to achieving the entrepreneurial university. EA is considered to be a lens through which the expanded mission of the university can be understood (Nelles and Vorley, 2010a). Indeed, EA serves to analyse the ways in which the TM reinforces a university's core activities, including teaching and research. Nelles and Vorley (2010b) intend EA to be used as both a theoretical bridge and as a practical approach which combines the endogenous – and mutable – determinants of the entrepreneurial university. In other words, EA provides a means of developing a more comprehensive, broader, understanding of the nature of entrepreneurial transformations in universities.

EA refers to the five categories of internal factors that interact to shape entrepreneurial agendas within universities: (i) structures (entrepreneurial infrastructures such as TTOs, incubators, tech parks, business portals); (ii) strategies (institutional goals elaborated when planning documents, formal incentive structures); (iii) systems (networks of communication and the configuration of linkages between structures and departments); (iv) leadership (qualification and orientation of key leaders, administrators, board of directors, department heads, "star scientists" involved in the TM); and, (v) culture (institutional, departmental and individual attitudes and norms within the TM (Nelles and Vorley, 2010a).

Building upon this current within the literature, Martin et al. (2019) argued that EA structures and systems are housed in central bodies – in liaison, knowledge exchange, business engagement, or in knowledge transfer offices (see Section 3.3.) - which have a unique perspective when working across diverse faculties and various types of personnel. Moreover, these central bodies are both components and intermediaries within the entrepreneurial university ecosystem, supporting knowledge application through practical knowledge and social capital (Hayter, 2016). Furthermore, EA serves as a multifocal approach which requires development and coordination throughout, and between, the five categories of



internal factors and, also, the integration of the entrepreneurial mission into both teaching and research (Vorley and Nelles, 2008, 2012; Pinheiro et al., 2015a).

EA has been acknowledged as being a flexible and pragmatic approach, which can be applied by universities in order to adapt their entrepreneurial pathway through a dynamic process of organisational change (Vorley and Nelles, 2009). On the other hand, few contributions have attempted to establish a theoretical approach to conceptualizing how universities can respond effectively to entrepreneurial imperatives. Indeed, there is a felt need to present a more theoretically grounded framework so as to inform policy design, to understand the broader implications of increasing socio-economic engagement and, to structure institutional responses (Nelles and Vorley, 2010a). Furthermore, several studies have argued that both the determinants of academic entrepreneurship and, also, what precisely influences academics' roles, motivations and perceptions of entrepreneurship are under-researched topics (Göktepe-Hulten and Mahagaonkar, 2010; Clarysse et al., 2011). There has been no in-depth debate on the effects that the changes in university governance, which take place in order to accommodate academic engagement in entrepreneurial activities, are having on teaching and research (Muscio et al., 2017).

One body of the literature has provided evidence that the ideals, and the development, of an entrepreneurial culture within a university have not yet been widely embraced by the majority of academic staff (Etzkowitz, 2003b; Woollard et al., 2007; Sá et al., 2018). For example, Philpott et al. (2011) asserted that while some academics seem to appreciate the entrepreneurial turn of the university, others do not regard it as a positive transformation. More precisely, Lam (2010) suggested a typology of scholars placed on a continuum between two polar types. On the one hand, the 'old school' traditionalists, who adhere to basic science and resist approaching entrepreneurial activities and relationships and, on the other, the author identified a 'new school' of entrepreneurial academics, those who participate both in the area of science and of business.

Various studies have taken a pessimistic view of the involvement of both universities, as institutions, and scholars in entrepreneurial activities (Naidoo, 2005; Nedeva, 2007; Wang et al., 2016; Muscio et al., 2017). Indeed, entrepreneurial initiatives may distract academics from their traditional missions by prioritising commercial imperatives and applied research to the detriment of fundamental / basic research. Moreover, the entrepreneurial perspective may clash with academic values and culture, because the engagement of scholars in entrepreneurial initiatives can generate conflicts of interests (Etzkowitz, 1998; Lukannen, 2003; Gulbrandsen and Smeby, 2005; Montesinos et al., 2008; Lam, 2010; Tartari and Breschi, 2012) and even lead to individual crises of identity (García-Aracil and Palomares-Montero, 2012; de la Torre et al., 2017).

Also, the escalating commercialisation of academic science could increase corporate disclosure constraints, intensify pressures on researchers' traditional teaching and research roles and restrict the free circulation of ideas within academia (Brooks and Randazzese, 1999; Geuna and Nesta, 2003; Breschi et al., 2007). As a result, an elite set of archetypal university-run science and technology enterprises has produced a small number of successful hard activities which, in turn, have become high profile and created somewhat of an entrepreneurial mythology (Wang and Zhou, 2009; Maes et al., 2011).

In the light of these constraints, some studies have empirically investigated the relationship between entrepreneurially orientated activities, teaching, and research performance. For instance, both García-Aracil and Palomares-Montero (2012) and de la Torre et al. (2017) have suggested that there is a negative relationship between teaching and entrepreneurial activities but a positive relationship between research and entrepreneurial initiatives. Conversely, the predominant literature states that there is little empirical evidence that the narrow entrepreneurial focus of the TM and the rise of university-industry links has negatively affected teaching and research (Ziman, 1991; Geuna, 1999; Behrens and Gray, 2001; Yusuf, 2007; Wang et al., 2016). For example, the work of D'Este et al. (2013) shows that universities can

achieve high academic excellence with either high or low levels of engagement with business; likewise, departments that are heavily orientated towards business collaborations can display different levels of scientific excellence. A wide range of empirical studies have asserted that the involvement of universities in business activities can have a positive impact on both the university as an institution, and on the performances of scholars in terms of research. More specifically, scholars may increase their flexibility and autonomy and universities' traditional norms may be strengthened by engaging in business initiatives (Martin and Etzkowitz, 2000; Dutrenit et al., 2010; Perkmann and Schildt, 2015; Degl'Innocenti et al., 2019).

The literature has also analysed the relationship between entrepreneurial activities, teaching and research, highlighting some important constraints. In particular, Sam and van der Sijde (2014) argued that performing entrepreneurial activities does not automatically transform a university into an entrepreneurial institution. This happens only when the entrepreneurial activities create added value for education and research and vice versa. Indeed, as suggested by Günther and Wagner (2008), the entrepreneurial university is a manifold institution with direct and indirect mechanisms. The former concern the transfer of knowledge from research to industry, while the latter concern support for business initiatives through entrepreneurship education. However, the existing literature usually deals separately with one or other of these linking mechanisms.

It has also been highlighted that the pathway of the entrepreneurial university can be slowed down by the innate nature of universities, which are large, impersonal, hierarchical organizations. Universities are based on rules, procedures and controls, require several levels of approval (Kirby, 2006) and may lack any systemic coordination of entrepreneurial activities (Woollard et al., 2007). Moreover, the entrepreneurial pathway is even more constrained because of the widespread top-down push towards the ideal of the entrepreneurial university. Indeed, Philpott et al. (2011) confirmed an earlier study by Burgelmans (1983) and showed that the top-down push reduces overall entrepreneurial activity throughout the university.

Furthermore, some studies have pointed out that the lack of entrepreneurial experience and insufficient talent, can hinder the emergence of the entrepreneurial university (Kirby, 2006; Ca, 2009; Philpott et al., 2011). Along with this weak business innovation environment, universities may also not pay enough attention to their reputation and brand something which would increase their ability to be more successful within a competitive global market (Drori et al., 2013). In particular, the reputations of universities in research and teaching have become increasingly important as a part of marketing both academia itself and any entrepreneurial-orientated activities (Salamzadeh et al., 2016; Veugelers, 2016).

The literature has also emphasised that the development of an entrepreneurial culture within academia plays a crucial role in developing the entrepreneurial university. Indeed, the entrepreneurial shift not only requires changes in infrastructure, but also needs a unified culture throughout academia and amongst academic staff. The University, as an institution, is usually not aware either of the importance of communicating its entrepreneurial initiatives to staff, by means of departmental strategies, or of the need to nurture a shared culture of entrepreneurship. At the same time, academic staff often lack personal experience within the business environment and have little understanding of how the industrial community behaves. Consequently, scholars may regard "being entrepreneurial" as running the risk of debilitating its two traditional missions of teaching and research (Jacob et al., 2003; Siegel et al., 2007; Ca, 2009; Philpott et al., 2011; de la Torre et al., 2018; Sá et al., 2018; Martin et al., 2019).

Drawing on the constraints that emerged from the SLR, Table 4 displays a selection of measures which could support the design and the management of the entrepreneurial university as a model of the TM of university.

More recently, it has been argued that some entrepreneurial universities have adopted quasi-firm structures and behaviours. To this end, they have introduced new management mechanisms and structures, namely Knowledge Transfer Offices (KTOs) or Technology

**Table 4**

Measures to support the design and the management of the entrepreneurial university .

**Source:** Authors' elaboration. (Gilman and Serbanica, 2015; Guerrero et al., 2015; El Hadidi and Kirby, 2015a; El Hadidi and Kirby, 2015b)

Domains and Measures	Sources
<b>Management</b> <ul style="list-style-type: none"> <li>• The adoption of a 'one size fits all' approach can be avoided. The shift towards the entrepreneurial ideal varies depending on the background and strengths of the individual university</li> <li>• University management could understand, adapt and respond to specific institutional contexts rather than simply emulate the approaches of other institutions</li> <li>• A bottom-up approach may be more conducive to fostering academic entrepreneurship</li> <li>• University staff could adopt the multifocal approach of the entrepreneurial university and its embeddedness, mutual dependency, and impact of, with, and within, teaching and research</li> <li>• Understanding how internationalization (as an input) can affect the entrepreneurial university (as an output) and could advance the conceptualization and process of the entrepreneurial university</li> <li>• A review of trends towards entrepreneurial universities in developing countries needs to be conducted to achieve better understanding these issues</li> </ul>	Clark (2001); Günther and Wagner (2008); Nelles and Vorley (2010b); Philpott et al. (2011); Sam and van der Sijde (2014); Guerrero et al. (2015); Minola et al. (2016)
<b>Activities</b> <ul style="list-style-type: none"> <li>• Entrepreneurial activities can be placed on a continuum, which encompasses harder activities to softer activities: the creation of a technology park; spin-off firm formation; patenting and licensing; contract research; industry training courses; consulting; grantsmanship; publishing academic results; producing highly qualified graduates</li> <li>• The conventional set of licensing and spinout activities could be broadened, by considering 'problem-solving activities' including consultancy, contract research and joint research with external organisations; participation in research consortia, providing informal advice, prototyping and testing for external organisations and hosting personnel from external organisations and secondments</li> <li>• Informal contacts between people play a strategic role in the entrepreneurial university. The mobility of students and researchers between academia and industry is crucial, because industry often finds it difficult to codify science-based knowledge</li> </ul>	Clark (1998a); Klofsten and Jones-Evans (2000); Philpott et al. (2011); Gilman and Serbanica (2015); Abreu et al. (2016); Veugelers (2016); Sá et al. (2018)
<b>Promotion</b> <ul style="list-style-type: none"> <li>• A conceptual model for reinforcing the reputation/brand of the entrepreneurial university could either facilitate academia when entering new markets, or help it achieve its targets, or improve the level of socio-economic development</li> <li>• The University could setup training programs for the academic community to promote the ideal, and ideas, behind the entrepreneurial university</li> <li>• The more universities promote academic entrepreneurship, the greater will be the incentives for researchers to engage in entrepreneurial activities</li> <li>• The presence of role models that exemplify a type of academic entrepreneurship, leads to stronger intentions among researchers to imitate the same mechanism</li> </ul>	Berkowitz and Feldman (2008); Philpott et al. (2011); Huyghe and Knockaert (2014); Salamzadeh et al. (2016)
<b>Government support</b> <ul style="list-style-type: none"> <li>• In accordance with the Triple Helix Model (THM), the government could consider creating a permanent national university-industry-government forum, in which members can explore areas of mutual interest and benefit, together with opportunities for collaboration</li> <li>• Support is needed to ensure that both industry and academia are aware of the existing measures and mechanisms for collaboration</li> <li>• Along with the efforts of the academic staff, a strong political influence may be crucial before any market-orientation would emerge within academia</li> </ul>	Etzkowitz and Leydesdorff (2000); Blenker and Dreisler (2006); El Hadidi and Kirby (2015a); El Hadidi and Kirby (2015b)

Transfer Offices (TTOs). These bodies are in charge of managing knowledge transfer (KT), one of the most important functions of the TM. KTOs especially focus on the commercialisation of knowledge, patenting and licensing, the creation of spin-offs, and the promotion of entrepreneurship education and culture amongst students and scholars (e.g. Etzkowitz, 2003a; Gibb, 2007; Laredo, 2007; Riviezzo and Napolitano, 2010; Ernø-Kjølhed and Hansson, 2011; Trencher et al., 2014; Civera and Meoli, 2018; Bacs et al., 2019).

### 3.3. Knowledge transfer as a function of the Third Mission

The TM promotes the active engagement of universities in KT activities, which are an important source of innovation and an engine of economic development for regions (Perkmann and Walsh, 2008;

Audretsch, 2014). They do this by creating new knowledge from research, nurturing specialized human capital and by transferring technology from academia to industry (Markuerkiaga et al., 2016). KT is a function of the TM and includes the commercialization of academic knowledge, patent activity, the linkage between industry and universities, license agreements and the creation of spin-offs (Audretsch, 2014; Trencher et al., 2014; Yuan et al., 2016; O'Reilly et al., 2019). In other words, KT is the application of knowledge into a business or community organisation, which leads to innovation that improves its own ability to operate in terms of profit or efficiency (Howlett, 2010). On the other hand, KT has different meanings in different contexts (Howlett, 2010) and can include multiple ways in which academic knowledge can be exploited by firms and other organizations (OECD, 2013).

The literature states that the policy agenda has traditionally been supportive of KT activities (de la Torre et al., 2018). However, targeted policies are not enough to promote KT because it also needs university skills to intuit, and to seize, business opportunities and to transform its capabilities in order to meet the demands of the innovation system (Cohen and Levinthal, 1990; Augier and Teece, 2008; O'Reilly et al., 2019). Initially, these abilities were often mainly based on individual researchers and shaped by personal relationships between academics and companies. There were very few dedicated structures to foster the links between university staff and industries (Geuna and Muscio, 2009; Brescia et al., 2016).

Later on, along with the key role of personal relationships, some entrepreneurial universities began to adopt quasi-firm structures and behaviours and they introduced new management mechanisms and structures, namely KTOs, which are responsible for managing most of the TM activities (e.g. Etzkowitz, 2003a; Gibb, 2007; Ernø-Kjølhede and Hansson, 2011).

### 3.3.1. Knowledge transfer offices

The works of O'Gorman et al. (2008) and Aragonés-Beltrán et al. (2017) both emphasized the fact that university KTOs represent the institutionalization of the TM because they seek to be the service responsible for the management of most TM activities. Moreover, it is mainly up to KTOs to define both the actions and the resources which are allocated to achieve TM targets. In particular, KTOs are in charge of supporting the creation of spin-offs and of identifying, managing, and marketing patents and licences through the protection of the IPRs. Furthermore, KTOs facilitate interaction between research units and companies, which may result in consultancy contracts and, more generally, in the promotion and dissemination of entrepreneurship education and culture amongst students and academic staff (Laredo, 2007; Riviezzo and Napolitano, 2010; Civera and Meoli, 2018; Backs et al., 2019).

As regards the management of KTOs, one section of the literature has developed organizational models and tools to support decision-making and to improve the effectiveness of KTO activities. For example, the work of Brescia et al. (2016) investigated three main organizational models of KTOs which included (i) internal, (ii) external and (iii) mixed models, as well as six configurations of these models. The authors stated that the most widely adopted model is the internal model, which is suitable for large KTOs and large universities. Whereas, external and collaborative configurations are more often found in smaller universities, which can benefit from pooling resources in a shared KTO. Aragonés-Beltrán et al. (2017) suggested an alternative approach to the strategic planning process of KT activities. They introduced a rigorous decision-making tool which supports KTO managers when analysing both the effectiveness of KTO activities and their degree of alignment with the objectives of the university. More recently, Backs et al. (2019) modelled an agent-based simulation for evaluating measures that can be employed by KTOs in order to stimulate patenting and the formation of spin-offs which rely on such patents.

Notwithstanding this, there are still research gaps and practical constraints that universities and policy makers may consider adopting in order to design and manage KTOs in a more efficient way. For instance, Di Berardino and Corsi (2018) criticised the works of Etzkowitz and Leydesdorff (1999), Bozeman (2000), and Link et al. (2007), because the TM is closely associated with KT functions to further strengthen the entrepreneurial university and its economic interests. This approach limits the decision-making and operational spectrum that university strategies and policies could implement. Several studies have emphasised the fact that universities are able to extend KTOs into other areas of academia, because the development of the TM is more than just a structural change since it involves social convention(s) and legal rights as well as economic interests (Bercovitz and Feldmann, 2006; Nelles and Vorley, 2010a; Brescia et al., 2016).

In line with this current in the literature, a large number of studies have observed that universities have often established KTOs so as to

further academic patenting and the creation of spin-offs. Despite the fact that only a very few blockbuster patents and spin-offs do turn out to be worth millions of dollars, the complex mechanisms of KT have usually been interpreted adopting a narrow economic focus. On the contrary, KTO organization and strategies may reflect both the more general goals and the distinguishing characteristics of the academic institution and of its external environment (Lach and Schankerman, 2008; Valdivia, 2013; Veugelers, 2016; Backs et al., 2019; Giuri et al., 2019).

There is also, at times, a noticeable lack of interaction between KTOs and their external stakeholders, which weakens the development and the impact of KT activities. Academia, policy makers and industries, may work together in a system of innovation to design programmes which require long-term gestation and evaluation periods, and cannot exclusively depend on universities (Maculan and Carvalho de Mello, 2009; Min and Kim, 2014; Singh et al., 2015). Moreover, there is limited evidence about KTO organizational models. However, the development of decisional aids, designed to support KTO management, is still an under-researched area (Brescia et al., 2016; Backs et al., 2019). Overall, there is a lack of understanding regarding the strategic orientation of universities within KT, and there is, so far, no multifocal approach to KT which combines economic and non-economic activities (Chau et al., 2017; Giuri et al., 2019).

### 3.3.2. Entrepreneurship education

KTOs also facilitate interaction between academia and industries by promoting the diffusion of entrepreneurship education and culture amongst students and university staff. Thus, within a TM, entrepreneurship education is strictly linked to local developments, especially in terms of contributing to developing human capital (Arbo and Benneworth, 2007; Jäger and Kopper, 2013; Šmídová et al., 2017). To this end, a TM may be extended beyond "traditional" economic activities, so as to strengthen the inclusion of both lifelong learning and entrepreneurship as a skill which can be taught, inspired and stimulated (Laredo 2007; Franzoni and Lissoni, 2009; Fini et al., 2011; Bae et al., 2014; de la Torre et al., 2017).

In recent years, European universities have increasingly begun to invest in entrepreneurship education programmes (O'Connor, 2013). The works of Günther and Wagner (2008), Preece et al. (2011), Mora et al. (2015), and Goethner and Wyrwich (2019), observe that entrepreneurship education could be regarded as a highly integrative discipline which could establish broader interdisciplinary courses and network ties. In particular, entrepreneurship education is able to combine KT, basic research, practical applications, interaction with the local communities and professional training (Popescu et al., 2015).

Furthermore, some of the literature states that universities may carry out multiple tasks in order to provide the learning initiatives required; to ensure their graduates acquire the skills they will need to thrive in their future jobs; to address entrepreneurial challenges; and, to be aware of the ties between science and society (Kolvereid and Moen, 1997; Philpott et al., 2011; Predazzi, 2012; Gokhberg et al., 2014; Fayolle and Gailly, 2015; Jaekel et al., 2015). Wright et al. (2009) noted that business schools offer strategic support through two channels. The first relates to the provision of courses and seminars on financial planning and accounting, classes on writing a business plan, marketing new products and negotiating with potential investors. The second channel refers to the direct involvement of school faculties in the generation and the development of entrepreneurial ideas.

Despite the current emphasis on hard entrepreneurial activities, such as patenting or the creation of spin-offs, softer activities and soft skills also play a crucial role in entrepreneurship education and TM activities. Thus, universities may focus more on practice-orientated entrepreneurial courses and collateral activities, such as projects and trainings, to involve students, university staff and industries. Furthermore, in order to ensure the potential for success of the interaction between employers and graduates, it is important to define the opportunities which can derive from the interaction between universities, companies and local communities (Philpott et al., 2011;

Popescu et al., 2015; Passaro et al., 2018).

Based on the constraints revealed by the SLR, Table 5 displays a selection of measures which could support the design and management of KTOs and their related activities, especially as regards improvements in entrepreneurship education.

### 3.4. The engagement of academics and stakeholders in Third Mission activities

It is widely acknowledged that academia is already introducing the commercialisation of knowledge in various ways. At the same time, universities are also increasingly coming under pressure to go beyond this function and are being encouraged to contribute to the development of the communities they belong to. Consequently, establishing deeper engagement with academics and external stakeholders has become a key concern for universities in order to achieve their TM activities (Mora et al., 2015; Secundo et al., 2015; Cesaroni and Piccaluga, 2016; Secundo et al., 2016; Taheri and van Geenhuizen, 2016; Pinheiro et al., 2017).

It has been emphasised that community engagement is a broad term because it is not clear what may be covered, what its outcomes may be, or even how universities might set about it (Barker, 2015). On the other hand, community engagement could be seen as a two-way process between universities and their wider constituencies, with opportunities for mutual lifelong learning (Preece et al., 2011). From a practical point of view, universities work to maintain a continuous dialogue with groups of interest and to develop participatory mechanisms to offer a bridge between their activities and the needs and expectations of external actors (Pinheiro et al., 2015a, 2015b).

However, participatory approaches and collaborative endeavours for the TM offer important challenges to universities. In fact, engagement in TM initiatives requires both the efforts of internal stakeholders, including scholars, students, alumni, administration and university staff, and the collective involvement of non-academic partners, such as industry, government, local communities, intermediary organizations and citizens. Furthermore, to deliver a socio-economic value, all the internal and external stakeholders should be able to put together their tangible and intangible assets, competences, and specificities (Disterheft et al., 2015; Bramwell and Wolfe, 2005).

#### 3.4.1. Academics and non-Teaching staff

In its role as a knowledge-based body and cultural repository, a university will engage with external stakeholders by encouraging its staff to take active part in TM activities (Gregersen et al., 2009). Nevertheless, along with the increasing pressure to conduct research and teaching, there is also a lack of understanding about the consequences of engagement in non-traditional academic missions. Moreover, there is little perceived recognition for TM activities. Overall, the determinants of the intentions of academics to engage in the TM still remain under-researched (Perkmann et al., 2013; Huyghe and Knockaert, 2014; Pugh, 2017).

From a general point of view, the literature asserts that the intention of scholars to engage, or not, in TM activities may be influenced by three determinants which include (i) the institutional conditions; (ii) the incentive systems already in place; and (iii) the individual perceptions and personal values of academic staff (Owen-Smith and Powell, 2001).

As regards (i) the institutional conditions, the rules for academic career progress and opportunities are one of the major constraints reducing wider engagement of university staff both with companies and with society at large. It is easy to discern that assessment and careers advancement are almost exclusively based on academic performance in teaching and research. Thus, engaging scholars in TM activities is usually seen as either unnecessary, or even problematic, because it impedes “traditional” academic work (Göransson et al., 2009; Philpott et al., 2011; Predazzi, 2012; Shore and McLauchlan, 2012).

In line with these studies, further work has investigated the degree, target and mode of engagement of academics with external actors, and has suggested that scholars are rarely active in the TM because universities are not willing to assess and support the TM in any substantial

way. For instance, drawing on data collected for The Changing Academic Profession Project, Sá et al. (2018) established, empirically, that Portuguese researchers are not particularly engaged in KT and TM activities, when these are compared to other outputs, such as scientific publications and participation in conferences. The study confirmed the previous findings referring to all 19 countries that took part in the project: Argentina, Australia, Brazil, Canada, China, Finland, Germany, Hong Kong, Italy, Japan, the Republic of Korea, Malaysia, Mexico, The Netherlands, Norway, Portugal, South Africa, the UK and the USA.

Mejgaard and Ryan (2017) confirmed the earlier findings of research conducted by Perkmann et al. (2015). The authors distinguished between scholars as innovators and as public sector advisors. The former are those researchers who work closely with industry and perform well in terms of publication productivity. The latter, public sector advisors who engage with public authorities to deliver research-based knowledge, perform below average as regards publication productivity. amongst other studies, the work of Abreu et al. (2016) could be cited here, as they suggest there is a relation between the institutional focus of the university and the degree of academics’ engagement in TM activities. The authors introduce a distinction between scholars at teaching-led institutions and academics at research-intensive universities. The former category shows higher rates of local and regional engagement, while the latter are more active at national and international levels.

Turning to (ii) incentive systems, universities of both developed and developing countries find it difficult to design and implement appropriate incentives to encourage scholars to engage in both the social and commercial. For example, Benneworth et al. (2015), Veugelers (2016), and De La Torre et al. (2018), have stated that the true potential of the TM has yet to be achieved, because of weak incentives for academics. This is mainly due to the fact that universities rarely provide researchers with sufficient incentives to disclose their inventions and to become actively involved in TM activities. Furthermore, the prevailing selection and incentive systems for university staff do not encourage either the adoption of community-engaged practices or the impact of scholars’ work on society at large (Gunasekara, 2006; Balbachevsky, 2008; Saltmarsh et al., 2009; Hill and Williamson Hill, 2010).

In line with this current in the literature, an empirical study by Huyghe and Knockaert (2014) illustrates that researchers working at universities which explicitly reward staff for TM outputs, show higher levels of intention to become engaged in TM activities, such as spin-off creation and licensing. This implies that it is crucial to create, at both the national and the local university system level, an incentive plan for academics who promote and collaborate to ensure the success of TM activities (Markman et al., 2004; Debackere and Veugelers, 2005; Link et al., 2007; Paoloni et al., 2019).

Thus, according to the mainstream literature, the often claimed stronger orientation towards the TM should be based on improved financial and non-financial incentives for university staff. However, a growing body of the literature has also stressed the importance of individual perceptions and of the personal values of the academic staff involved. Indeed, any support for scholars’ engagement in TM activities should not only be considered in terms of financial and non-financial rewards, but also in relation to societal and scientific appreciation. Cultural barriers, social norms, personal values and beliefs all influence the engagement of researchers in TM initiatives. However, many academics and non-teaching staff have not yet matured an all-encompassing understanding and appreciation of the benefits deriving from the dissemination of scientific and non-scientific outputs into the wider community (Göransson et al., 2009; Howlett, 2010; Bonaccorsi et al., 2014; De La Torre et al., 2018; Sá et al., 2018).

#### 3.4.2. External stakeholders

The TM of a university has been described as the antecedent to the Triple Helix Model (THM) (e.g. Etzkowitz and Leydesdorff, 2000; Leydesdorff, 2012; Ranga and Etzkowitz, 2013), where universities act as intermediary organisations to engage with external stakeholders, in

**Table 5**

Measures to support the design and the management of KTOs and related activities.

**Source:** Authors' elaboration. (Johansson et al., 2005; Landry et al., 2007; Laredo and Mustar, 2000; Powers and McDougall, 2005; D'Este and Perkmann, 2011)

Domains and Measures	Sources
<b>Knowledge transfer to industry</b> <ul style="list-style-type: none"> <li>• Business initiatives are more likely to be successful when there are already long-lasting collaborations with large firms/users in place from an early stage of the commercialization</li> <li>• The focus on research projects based on market needs may increase KT</li> <li>• Foresight studies on dynamics and shifts in technology and markets may improve KT</li> <li>• Research teams can benefit from the creativity and innovative power of large firms/users and, at the same time, be able to respond to their needs</li> <li>• Universities could provide training for university staff in the commercialization of knowledge</li> <li>• Universities can enhance joint collaboration with industry by establishing living labs (LLs)</li> <li>• Publication is not truly effective for achieving KT, particularly in Small and Medium Sized Enterprises (SMEs), because they find it difficult and costly to access and codify knowledge. Thus, academic publications could offer simplified versions of papers and make them available via open access</li> </ul>	Laredo and Mustar (2000); Laredo (2001); Powers and McDougall (2005); Landry et al. (2007); Laredo, (2007); Wang and Zhou (2009); Howlett (2010); D'Este and Perkmann (2011); Taheri and van Geenhuizen (2016)
<b>Academic spin-offs creation and patenting</b> <ul style="list-style-type: none"> <li>• A supportive institutional context is a core element for enhancing the formation of spin-offs for students</li> <li>• Establishing activity-based relationships with stakeholders who are integrated, formally and informally, within the university is also important</li> <li>• The prestige of the university supports the creation of spin-offs that are likely to survive and grow by virtue of the strong ties with parent institutions</li> <li>• The establishment and management of university venture capital and private equity funds could be further investigated in order to better understand how to foster the formation and growth of spin-offs</li> </ul>	Johansson et al. (2005); Riviezzo and Napolitano (2010); Croce et al. (2013); Markuerkiaga et al. (2016)
<b>Incentives to and from KTOs</b> <ul style="list-style-type: none"> <li>• Future incentive systems may be able to avoid a one-size-fits-all policy</li> <li>• Monetary or non-monetary incentives make a difference when planning KTOs measures</li> <li>• Each type of incentive should be fine-tuned according to the unique situation of each department</li> </ul>	Backs et al. (2019)
<b>Entrepreneurship education</b> <ul style="list-style-type: none"> <li>• KTOs could offer educational programmes which are based on operational approaches</li> <li>• New approaches could focus on the early stages of entrepreneurship and include lean start-up workshops, spin-off programmes, business plan competitions (BPC), mentor and incubator meetings, pitch sessions, design thinking</li> <li>• Entrepreneurship education could support both students and university staff to think as entrepreneurs do, by stimulating individual motivation, creativity, risk-taking propensity, and the need for achievement and autonomy. To this end, students and university staff could be involved in start-up weekends, demo days, pitch events, hackathons, prize challenges</li> <li>• Entrepreneurship education could be intended as an interdisciplinary lifelong process, which fosters the collaboration between business schools, SSHs faculties, technical faculties, and research institutes</li> <li>• The cross-fertilisation of ideas would be facilitated by the involvement of entrepreneurial actors and the establishment of LLs, fab labs and co-working spaces</li> <li>• Entrepreneurship education could valorise basic research which provides graduates with the skills necessary for complex problem solving and for speeding up in the rate of innovation</li> <li>• To fully serve the TM, entrepreneurship education could be interrelated with teaching and research</li> </ul>	Kolvareid and Moen (1997); Günther and Wagner (2008); Ca (2009); Philpott et al. (2011); Preece et al. (2011); Fayolle and Gailly (2015); Passaro et al. (2018); Goethner and Wyrwich (2019)

order to innovate and to develop a knowledge-based society. The THM of the intertwined university-industry-government relationship highlights the importance of both systemic coordination between these actors and their dynamics (e.g. Leydesdorff and Etzkowitz, 2001; Nakwa and Zawdie, 2016).

However, various studies have stressed that helix actors are well-known for their inability to engage and to be aligned through common interests (Huggins et al., 2012; Serbanica et al., 2015; Rossi and Rosli, 2015; Chau et al., 2017). There is also a widespread lack of any articulate policy framework for creating an environment that would enable universities to successfully engage with external stakeholders in

both public and private sectors (Benneworth, 2013; Pinheiro et al., 2017). Furthermore, the absence of an approach for the co-generation of knowledge between universities and its stakeholders is clearly revealed, as is the lack of both appreciation of, and coordinated attention to, the role of universities in their regions (Pinheiro et al., 2017; Pugh, 2017).

Turning to the specific external stakeholders, SMEs usually have a weak cooperation culture with academia, often because companies only perceive universities in their role as teaching providers, and not as potential technology partners (De La Torre et al., 2018). Even governments often do not appreciate the multitude of practical roles universities could play over and above the normative definitions of the TM and THM

**Table 6**

Measures to support the engagement of university staff and stakeholders in TM activities .

Source: Authors' elaboration.

Domains and Measures	Sources
<b>Engagement of academics and non-teaching staff</b> <ul style="list-style-type: none"> <li>• Universities could assess and reward the performance of staff units who contribute to the success of TM initiatives</li> <li>• To actively engage scholar and personnel in TM initiatives, universities could take into account the multifaceted characteristics of disciplinary, institutional fields and individual academic profiles, by organizing group meetings, focus groups and one to one meetings at department level</li> <li>• Universities could focus more on micro-practices to engage academics, rather than imitate the strong leadership myths which dominate contemporary discourse</li> <li>• Further research could be conducted on the effects of existing incentive policies adopted in order to engage academics and non-teaching staff in TM activities</li> </ul>	Benneworth et al. (2015); Pinheiro et al. (2015); Meoli et al. (2018); Paoloni et al. (2019)
<b>Engagement of external stakeholders</b> <ul style="list-style-type: none"> <li>• Universities may recognize the role of dedicated internal organizations, such as KTOs, and provide training for staff able to act as value-added intermediaries in engagements with external stakeholders</li> <li>• Communities could be invited to identify their learning needs to ensure that the service(s) provided by universities is suitable and so useful</li> <li>• Universities could strengthen their involvement with autonomous organizations in order to bridge the cognitive, institutional and cultural distance that hinders cooperation with business actors</li> <li>• Universities could produce leaflets, brochures and media communications, via television and radio, for different targeted groups of interest and society at large</li> <li>• Further exploration of the potentials of ICT could provide added value to foster communication between a university and its stakeholders</li> </ul>	Ca (2009); Preece et al. (2011); Smith (2013); Venditti et al. (2013); Bonaccorsi et al. (2014); Balduzzi and Rostan (2016); Suomi et al. (2019)
<b>Policy makers</b> <ul style="list-style-type: none"> <li>• Policy interventions should abandon the one-size-fits-all approach</li> <li>• Governments should introduce regional development centres which would function as supporting structures for TM activities, places where academics and stakeholders will be able to build partnerships, learn, create and exchange knowledge at both the local and the international level</li> <li>• Policy makers should consider the disciplinary differences between departments and also any diversity in regional inequalities in growth levels, by organizing group meetings and focus groups with representatives of universities, companies, associations and other public bodies</li> <li>• Policy makers should introduce incentive systems to engage academics by focusing on place-based sustainability needs</li> <li>• Governments should prepare society for more intense interaction with universities by further encouraging donations and patronage and by transforming the production base</li> </ul>	Ca (2009); Bonaccorsi et al. (2014); Trencher et al. (2014); Mora et al. (2015); Balduzzi and Rostan (2016); De La Torre et al. (2018); Di Berardino and Corsi (2018); Sá et al. (2018)

(Pugh, 2017). Furthermore, there is no adequate interaction between universities and specialised and/or autonomous organizations, which would be able to organize settings where stakeholders can engage, learn, create and exchange knowledge (Balduzzi and Rostan, 2016). amongst the major constraints to the engagement of these external stakeholders in TM activities is the lack of attention paid either to strategies adopted by scholars and universities in order to communicate at different levels or to various groups of interest (Predazzi, 2012; Rolfo and Finardi, 2014; Koryakina et al., 2015). On the one hand, academics have emerged as the apostles of a new age of knowledge and culture (Smith, 2013). On the other, they usually adopt cryptic language, priorities, knowledge dissemination needs or timings which could lead to mistrust when engaging with external stakeholders (Predazzi, 2012; De La Torre et al., 2018). As a result, society at large tends to be unreceptive to the efforts made by university staff and this, in its turn, ends up discouraging academics to deliver TM initiatives and to engage with stakeholders (Predazzi, 2012).

Based on these studies, others have argued that scholars may be aware of their important role in reaching out to, and engaging, different groups of stakeholders both internally, their peers, students and university administrators, and externally. Scholars should learn not only to communicate scientific outputs to academic units, but also how to clarify the reasons for doing so to non-academics. To this end, the new media could offer a powerful tool for engaging both specific stakeholders and society at large. At the same time, resources and programs could be dedicated to

stimulating and to supporting scholars when they make an effort to develop specific communication skills (Predazzi, 2012; Smith, 2013; Callagher et al., 2015; Koryakina et al., 2015; Giuri et al., 2019).

Drawing on the constraints identified through the SLR, Table 6 displays a selection of measures that could be adopted to encourage and support the engagement of academics, non-teaching staff and external stakeholders in TM activities.

### 3.5. The evaluation of the Third Mission and its impact

The assumption that universities are able to contribute to the social, economic and cultural development of the regions in which they operate, is widely accepted (Agasisti et al., 2019). However, the general trend to reduce State funding to universities has placed greater pressure on academia not only to use resources more efficiently but also to offer measurable results. Thus, along with creating value, universities also face the challenge of demonstrating efficient budget spending to its stakeholder portfolio, including government, citizens, students, companies and financiers (Aragonés-Beltrán et al., 2017; De La Torre et al., 2017; Mariani et al., 2018).

In this context, performance criteria for measuring the TM have become crucial, because of the increasing demands for transparency and accountability as regards the socio-economic impact of academia (De La Torre et al., 2015; Secundo et al., 2017b; Urdari et al., 2017). Clearly, there are two strategic reasons to measure the performance of

the TM and its impact. First, to stimulate dialogue within universities and with the society at large (Taylor and Massy, 1996; Dolence and Norris, 1999). Second, to offer an incentive to universities to consider their contribution to the community as a core activity alongside their traditional missions of teaching and research (Urdari et al., 2017).

Nevertheless, many studies argue that the debate about both the suitability of the existing criteria for assessing TM performance, and the development of new indicators, is still wide open and there is a need for further research (Siegfried et al., 2007; Ramos-Vielba et al., 2010; Rasmussen and Borch, 2010; Secundo et al., 2017b). In particular, there is a lack of any cohesive methodology for the evaluation of a TM and its impact on external stakeholders. While some assessment instruments and techniques are relatively advanced as regards the first and second missions, the evaluation of TMs still lags behind because measurement systems are inadequate, under or undeveloped and usually fail to assess the successes of a university in carrying out TM initiatives (Montesinos et al., 2008; Ramachandra and Mansor, 2014; Vargiu, 2014; De La Torre et al., 2017; Manatos et al., 2017; Secundo et al., 2017b; Urdari et al., 2017).

TM performances and their impacts have proved difficult to measure. But the comparison between universities involved in TM activities is even more complex and problematic (Molas-Gallart et al., 2002; Rosli and Rossi, 2016; O'Reilly et al., 2019). Secundo et al. (2017b) observed that several reasons could explain the marginal status of TM indicators when compared to those of research and teaching.

First, the TM of universities is still developing, evolving, and every paradigm change requires a certain time to make its effects felt (Secundo et al., 2017a, 2017b).

Second, the variety of TM activities and the heterogeneity of the institutional profiles of universities make it difficult to assess and compare them. Furthermore, this diversity in university characteristics itself results in different profiles in terms of TM strategies, outcomes and impact (De La Torre et al., 2015, 2017; Secundo et al., 2017b; Giuri et al., 2019).

Third, indicators for measuring TM are neither easy to define nor to establish because the stream of TM activities and the exchange of tacit knowledge usually consists of intangible assets, such as the value of transferred knowledge, or the soft skills acquired by students. Furthermore, the nature of universities interactions with their external environment is not clearly defined, thus quantifying it is a very complex task (Secundo et al., 2017a, 2017b; Urdari et al., 2017).

Fourth, TM performance and its impact are difficult to measure because both universities and governments lack specific information and data on the TM. Furthermore, existing official policy documents on the TM are often mere statements of principle. This means that they are articulated so broadly as to give rise to different interpretations at the point of implementation (Vargiu, 2014; Barker, 2015; Secundo et al., 2017b).

From a general point of view, Mariani et al. (2018) noted that most academic studies of the TM have only explored the performance measures of the entrepreneurial university (e.g. Chiesa and Piccaluga, 2000; O'Shea et al., 2005; Agasisti et al., 2019). On the other hand, a growing body of the literature has suggested that these entrepreneurial indicators are not sufficient because they are expressed in terms of countable properties and only refer to a narrow set of TM outputs, such as spin-off creation rate, or the number of patents or licensing agreements. Countable properties may distract attention from other, more qualitative indicators which could shed light upon the effectiveness and quality of TM practices. Consequently, using only economic-based indicators tends to underestimate the wide variety of channels through which the TM produces outcomes, and does not reflect either all the efforts made or their impact on society at large (Ramos-Vielba et al., 2010; Schmoch, 2014; Vargiu, 2014; Singh et al., 2015; Meoli et al., 2018; Giuri et al., 2019).

Other studies of TM performance and impact, Venditti et al. (2013) have observed that the indicators introduced by Molas-Gallart et al. (2002), Spaapen et al. (2007) and E3M (European Indicators and Ranking Methodology for University Third Mission) do not take various activities and results into account, especially those in 'soft' disciplines, such as SSHs. In the words of these authors, SSHs are neglected because they have less chance of

making an impact. Indeed, SSHs display a reduced capacity to produce 'valid' knowledge which can be 'valorised' on the market.

However, Montesinos et al. (2008) go beyond measuring teaching and research performances and introduce new indicators to evaluate TM initiatives. The authors suggested that TM has at least three dimensions: (i) a non-profit - social - approach; (ii) an entrepreneur focus; and (iii) an innovative approximation. As regards (i) the non-profit - social - approach, this could be tied to indicators on social services. Academia is committed to society and organises services at little or no cost to the final service user. Drawing on a previous work by Padfield (2004), social services could take the form of non-academic dissemination, media communication, volunteer contributions to the community (labour, expertise, educational outreach), social networking or contributions to public policy. This dimension also includes the following indicators: services for retired senior personnel, summer schools for the children of employees, courses offered to academic staff on didactics, and cultural activities, such as art exhibitions and film forums, etc.

As regards the entrepreneur focus (ii), universities should try to diversify their incomes and generate sources of funding by developing services offered to society, industry, other institutions, and/or former students. From the KT standpoint, this dimension includes indicators like consultancy for industry, patent registration, the commercialisation of intellectual property, advisory work and contracts, shared development of research, problem-solving agendas or even contract and collaborative research. From the continuing education point of view, the indicators are: lifelong learning/teaching activities, curriculum alignment to society's needs, open and distance learning (ODL), the commercialisation of facilities and the organization of conferences. From an employment perspective, the entrepreneur dimension can be assessed on the basis of staff mobility (flow and exchange), student placements, former student employee links, and training for company creation and self-employment. International activities can also be evaluated, especially student and teacher exchanges, and doctoral and continuing education training in developing countries.

The third dimension (iii) concerns an innovative approximation which is based on the innovative TM services that research units transmit to society that go beyond traditional KT. This dimension examines the following indicators: the search for seed or venture capital, business networking, company creation for patent exploitation, consultation services for governments, joint ventures with industrial sectors, conferences for research, development and innovation in specific industries, and innovation and networking with entrepreneurs.

Unlike previous studies, De La Torre et al. (2015) proposed an alternative evaluation method and considered data on KT as a function of the TM. The authors applied a bootstrap data envelopment analysis (DEA) and multidimensional scaling analysis (MDS), and they performed a DEAMDS analysis. This method could offer an alternative for institutional evaluation, one which respects and supports the diversity of universities.<sup>1</sup> However, Urdari et al. (2017) consider technology commercialization, entrepreneurial activities, and contracts with non-academic clients, to be the most important

<sup>1</sup> The authors offered a multidimensional descriptive classification of universities into typologies, while analysing the relation between their institutional factors (characteristics) and their (technical) efficiency performance from a descriptive perspective. To do so, they applied bootstrap data envelopment analysis (DEA) and multidimensional scaling analysis (MDS), performing a so-called DEAMDS analysis on data on the Spanish university system and, unlike previous studies, they included data on an important dimension of the TM of universities (knowledge transfer KT) in their characterization. The paper identified six types of (homogeneous) universities. Results indicated that to be fairly efficient, universities could focus on teaching, KT, or on overall efficiency but always have to perform quite well in research. Their results confirmed the importance of the TM as a source of institutional diversity in higher education. According to the authors, this approach could be used to address an alternative evaluation methodology for higher education institutions with formative purposes, evaluating universities according to their unique characteristics for the improvement of higher education systems.

indicators for a TM from a business point of view, while student placement and learning activities are adopted as main indicators of the TM for students. The work of Schmid et al. (2018) proposed a set of indicators of transition across three university missions. The authors describe the TM as an Economic Development Mission which includes the following markers: (i) patenting activity; (ii) pro-active IP management; (iii) technology transfer (licensing, joint patenting, etc.); (iv) partnerships with firms; (v) start-up and spin-off companies; (vi) infrastructure and support for innovation; and (vii) regional boundary-spanning functions (networks, brokerage and liaison, events).

Recently, there has been growing interest in assessing university performances, when pursuing the TM, in terms of the creation of Intellectual Capital (IC) (e.g. Kapetanidou and Lee, 2017; Secundo et al., 2017a; Mariani, 2017; Di Berardino and Corsi, 2018; Mariani et al., 2018; Secundo et al., 2018). For instance, Secundo et al. (2017b) suggested a conceptual framework, based on IC approaches, for systematically measuring and analysing TM activities. This approach starts from the assumption that each of the TM goals is, by its nature, closely linked to one of the three elements of IC: human capital, structural capital and relational capital. The authors proposed an approach which is focused on three interrelated areas: (i) research: technology transfer and innovation including the management of intellectual property, spin-off creation, and R&D network development; (ii) teaching: lifelong learning and continuing education which are based on education for entrepreneurial competences, talent attraction and incubation; and (iii) social engagement: which is meant in terms of embeddedness in regional and international communities, and in networks for development. Thus, Secundo et al. (2017b) offer an IC perspective which tends to comprehensively capture those factors which are related to the enactment of TM activities: namely, human, structural and relational capital. This approach would seem to be innovative, because it addresses both the need to reveal results and to provide the necessary information about the enablers and the resources required to meet the intended outcomes of the TM.

Subsequently, drawing on the work Secundo et al. (2017b), empirical research carried out by Di Berardino and Corsi (2018) focused on a sample of 71 Italian universities and revealed that quality evaluation reports can provide useful information about the contribution of IC components to TM performance. Indeed, structural capital could be particularly important for the development of those TM activities that create value in the university's own region. More recently, Mariani et al. (2018) introduced a new tool to measure the impact of KT investments on the local community. Their study argues that KT investments positively impact the local community through the spin-off system, both in economic terms and in IC.

On the basis of the constraints identified by the SLR, Table 7 displays some measures that could be useful for developing new indicators to evaluate the TM and its impacts, by considering the interrelations between teaching, research and the TM, as well as the heterogeneity of both universities and socio-economic contexts.

### 3.6. The strategic orientation of the Third Mission

Universities seem to be at a crossroads in teaching, research and the TM. Indeed, the dynamics of knowledge production are changing, as is the way society stands regarding expectations and values (Bortagaray, 2009). Academia is playing a crucial and complex role in enriching society, going beyond the mere definition of performance indicators for tangible assets (Brown, 2016). Besides teaching and research at the highest level, universities will collaborate with their stakeholders to foster innovation and to contribute to the development of human capital and the welfare of local and international community (Gregersen et al., 2009; Mariani et al., 2018).

However, incorporating the TM is posing important challenges for the strategic orientation of universities (D'Este et al., 2013). In fact, there are considerable gaps, as well as external and internal barriers, with respect to the governance and management of TM (Rolfo and

Finardi, 2014; Koryakina et al., 2015). This comes at a time when universities are already facing extensive pressure to transform every aspect of their institutional existence and raises questions about whether the TM can ever truly be a strategic objective for academia (Benneworth et al., 2017).

The evolving concept of TM may require universities to shift from an administrative to a strategic focus for the TM (Secundo et al., 2018). Furthermore, a growing body of the literature has expressed concern regarding the "one size-fits-all" approach to how the TM can best be performed, managed, and be applied to all countries or universities with homogeneous capacities. Indeed, universities and policy makers may yet recognize the importance of avoiding generalizations, which are enounced irrespective of the institutional and local context (Göransson et al., 2009; De La Torre et al., 2015; Benneworth et al., 2016; Kitagawa et al., 2016; Sánchez-Barrioluengo and Benneworth, 2019; Giuri et al., 2019).

The challenge has been, and remains, promoting diversity in the appropriation and implementation of TM activities, rather than presenting another prescription for best practice (Vorley and Nelles, 2009; Giuri et al., 2019). Despite further nurturing the "star player syndrome" (Shore and McLauchlan, 2012) a university may tailor institutional approaches to fit its own identity, culture and specific ecosystem (Nelles and Vorley, 2010c; Giuri et al., 2019). Nonetheless, interesting approaches can be observed, and mutual learning can be fruitful to maximise the impact of the TM (Göransson et al., 2009).

To this end, universities could pay more attention to the strategic orientation of the TM by defining programmes, policies and instruments (Franzoni and Lissoni, 2009; Passaro et al., 2018) which consider some of the key features that have been highlighted in the literature, including (i) the interdependencies between the three missions of the university; (ii) the local embeddedness of the university; (iii) the heterogeneity of TM activities; (iv) and the role of the SSHs in the potential development of the TM.

As regards (i) the interdependencies between teaching, research and the TM, some studies have stated that universities risk becoming overloaded (Ca, 2009; Benneworth et al., 2015) thus creating tensions between TM activities and the other two missions (Pinheiro et al., 2012). Furthermore, researchers have yet to agree on whether the TM is a mission in itself with a set of functions that are distinct from teaching and research (Vorley and Nelles, 2008). Consequently, the TM risks being regarded as a desirable, but not as an essential, task for university staff (Benneworth et al., 2015).

Nevertheless, there has been a gradual, but steady, move towards infusing TM related activities into teaching and research (Pinheiro et al., 2015b). Drawing on the metaphor of the stool, coined by Schuetze (2010), Vargiu (2014) highlights that the three missions are mutually constitutive, because education, research and service to society are three legs of the same length and strength. More recently, a range of studies has argued that the three missions co-exist, complement and synergise each other (Nelles and Vorley, 2010c; Muscio et al., 2012; Sam and van der Sijde, 2014; Trencher et al., 2014; Secundo et al., 2018). Indeed, there is increasing evidence that the TM has the capacity to stimulate, enhance and consolidate specialism in teaching and research, as well as related areas (Nelles and Vorley, 2010c).

To this end, it is crucial for universities, policy makers and society, to achieve the right alignment between the three missions (Göransson et al., 2009; Gregersen et al., 2009; Philpott et al., 2011; El Hadidi and Kirby, 2015a; Wang et al., 2016; Mejgaard and Ryan, 2017). In particular, there is a need to find a balance both between TM activities aimed at industry demands and broader societal considerations, as well as finding a balance between the allocation of financial and other resources to the three missions (Gregersen et al., 2009). Furthermore, the degree, target, and mode of involvement of university staff with external stakeholders should also be considered in the light of any high-performance expectations concerning teaching and research (Mejgaard and Ryan, 2017).



**Table 7**

Measures to support the development of TM indicators .

Source: Authors' elaboration.

Domains and Measures	Sources
<b>Data collection</b> <ul style="list-style-type: none"> <li>• A governmental request to universities for comprehensive data on the TM for evidence-based policymaking and the production of comprehensive administrative data sets could extend the scope of universities when measuring their activities</li> <li>• Further collection and elaboration of data is needed to develop criteria and forms of evaluation able to grasp the complexity of academic work and the wide variety of experiences and practices</li> <li>• Databases should include information on continuing education and societal engagement so as to reach a more encompassing understanding of the TM and its contribution to university performances and, also to fully support its development</li> <li>• To avoid the risk of overloading faculties and administrations with organizational burdens, governments and universities should invest in dedicated personnel, self-assessment tools, and the creation of specific inventories for TM activities</li> </ul>	Bonaccorsi and Daraio (2008); Vargiu (2014); De La Torre et al. (2015); Secundo et al. (2017b); Mariani et al. (2018)
<b>Context</b> <ul style="list-style-type: none"> <li>• A one-size-fits-all model for the evaluation of TM performance and its impact cannot be applied in all countries</li> <li>• TM activities should be evaluated according to the characteristics of the university and the area where the institution operates</li> </ul>	Gregersen et al. (2009); Kapetaniou and Lee (2017)
<b>TM indicators</b> <ul style="list-style-type: none"> <li>• Governments and universities should work together on the elaboration of extensive, comparable, and reliable indicators for TM as a field of data development, in order to encourage regional development, competitiveness and social cohesion</li> <li>• Different mixes of TM activities should involve different indicators, such as medical schools, technical universities, or SSHs schools</li> <li>• TM indicators should go beyond the specific aspects of the financial returns to a given intellectual property portfolio and seek to consider wider social and economic benefits such as the diffusion of knowledge, the creation of the intangible assets that are behind the new venture process and, also, the contribution made to employment for social, cultural and economic development</li> <li>• TM indicators for comparison, metrics for resource allocation and benchmarking activities, should take into account the sources of university diversity, the external context, the heterogeneity of TM activities and the link between research, teaching and TM</li> <li>• TM indicators should consider and promote practices and experiences that tend towards the sharing and co-production of socially and culturally relevant knowledge</li> </ul>	Montesinos et al. (2008); Gregersen et al. (2009); Secundo and Elia (2014); Vargiu (2014); De La Torre et al. (2015); Secundo et al. (2017b); De La Torre et al. (2018); Di Berardino and Corsi (2018); Mariani et al. (2018)

With respect to (ii) the local embeddedness of academia, if universities engage in TM initiatives this implies that the generation, accumulation and dissemination of knowledge, are focused more on the surrounding environment (Jäger and Kopper, 2014). However, the physical presence of universities in a given region is a necessary, but not a sufficient, condition for social, economic and cultural development to occur (Pinheiro et al., 2012). In fact, the local context influences both the university's adaptation to changing external demands and circumstances and, the university's ability to negotiate solutions (Göransson et al., 2009; Koryakina et al., 2015; Lebeau and Cochrane, 2015; Kapetaniou and Lee, 2017).

The degree of structural embeddedness of universities in their local environment and their connection with local social issues also needs to be understood in order to identify effective strategies and logics for action (Lebeau and Cochrane, 2015; Schmid et al., 2018). To this end, Piirainen et al. (2016) suggest that innovation system foresight (ISF) could significantly contribute to the TM by creating an active dialogue between universities, enterprises and society regarding knowledge sharing and negotiation. Moreover, a university can contextualize the TM, teaching, and research, by acquiring information about production, and social and economic needs, by letting the "outside" know what the capacities of the "inside" are as well as by linking the forces of the society and demand, and, by finding a common ground for research and teaching (Bortagaray, 2009).

A further key aspect in the strategic orientation of the TM is (iii) the heterogeneity of TM initiatives and their overlap with teaching and

research, which makes it difficult to circumscribe the activities that fall under the umbrella of the TM (Calcagnini et al., 2016; De La Torre et al., 2017). As well as the TM performance indicators reviewed in Section 3.5., some studies have agreed that TM activities comprise at least three dimensions, which are performed by universities in relation to external environments. These dimensions are: academic KT and innovation; university continuing education; and, social engagement in local communities (E3M, 2010; Vargiu, 2014; Mariani et al., 2018).

Molas-Gallart et al. (2002) identified four dimensions of the TM: knowledge capabilities (technology commercialization, entrepreneurial activities, advisory works and contracts); facilities (entrepreneurial activities, commercialization of facilities); research (entrepreneurial activities, contract research, collaboration in academic research); teaching (student placements, learning activities); communication (social networking, non-academic dissemination). Furthermore, as noted by Laredo (2007), Schoen et al. (2006) proposed gathering TM activities around eight dimensions, four economic and four societal. The economic dimensions are: human resources, intellectual property, spin-offs, and contracts with industry. Whereas the societal dimensions include: contracts with public bodies, participation in policy making, involvement in social and cultural life, and public understanding of science.

Lastly, turning to (iv), the role of the SSHs in the strategic orientation of the TM, it has been stated that KT and commercialisation are too narrow and not particularly important for SSHs-based universities (Staniškis, 2016). Apart from those TM activities in SSHs that have focused almost exclusively on the creative sector (Moreton, 2018),

SSHs have traditionally been related to the potential development of the teaching mission (De La Torre et al., 2017). As observed by Trencher et al. (2014), some scholars have described neglect of the SSHs at the expense of the revenue generating fields of applied sciences (Slaughter and Rhoades 2004; Canaan and Shumar 2008). Moreover, the absence of a unified culture regarding the TM, along with a clear divide in TM support between the SSHs and science–technology based disciplines, has fostered a schizophrenic divide between disciplines (Philpott et al., 2011).

On the other hand, promoting diversification of the TM means it is no longer the exclusive domain of science–technology based disciplines. The TM has recently become more inclusive, acknowledging both SSHs and the Arts, and connecting them through resolving and researching common challenges (Bortagaray, 2009; Nelles and Vorley, 2010c). A range of studies have highlighted that the TM in the SSHs may also play a paramount role in the contribution of universities to socio-economic development, employment, and the quality of life. For instance, despite the fact that the contribution of the SSHs has been made mainly through books and reports, SSHs could also support the dissemination of academic knowledge and the visibility of the university by maximising the impact of emerging digital technologies (De La Torre et al., 2018).

An empirical study by Di Berardino and Corsi (2018) has confirmed the important contribution of the SSHs to the TM in tourist areas, where industrialization is usually less developed. Moreover, research quality and the TM in the SSHs, attract innovative start-ups (Calcagnini et al., 2016). Looking towards future global challenges, the increasing spread of new technologies derived from a combination of disciplines, including the SSHs, is also to be expected. These innovative technologies might include new and sustainable forms of transport and housing, new modes of city planning, innovations in both work organization and job creation. The emerging innovation-based SSH ways of developing services and products could have a major impact, especially on the environment and on the lives of poor people (Cooper, 2017).

### 3.6.1. The emerging function of co-creation for sustainability

Initial discussions about the TM of universities mainly focused on the market-orientated behaviours of academia. However, the emergence of a global entrepreneurial approach, and the commercialisation of KT, do not constitute the final chapter in the ever-evolving model of the university (Hellström et al., 2013; Trencher et al., 2014; Staniškis, 2016; Neary and Osborne, 2018). While attempting to turn universities into quasi-economic development agencies appears to resemble a reductionist policy objective (Brown, 2016), more recently the TM has also been linked to activities which aim to promote sustainability (Goddard and Vallance, 2013; Trencher et al., 2014; Appe and Barragán, 2017) and social justice orientation, particularly with reference to race, class and gender (Cooper, 2017).

Along with the global economic crisis, and increasing pressure on natural resources and the environment, official statements are increasingly recognising the role of the university in sustainable development and are demanding active policies from them (Lozano et al., 2015). The literature shows that a university culture of sustainability has also been created and embedded in management (Adams et al., 2018) and it can be linked to the TM of universities. This culture is based on an active role for economic and cultural growth (Secundo et al., 2016).

Drawing on the Quadruple Helix Model (QHM) (e.g. Carayannis and Campbell, 2009; Yawson, 2009) universities collaborate with industry, government and civil society, to create societal transformations with the goal of materialising sustainable development in a specific location, region or societal sub-sector (Trencher et al., 2014). In other words, the university function of co-creation for sustainability is evolving. The missions of teaching, research and the TM are potentially able to co-exist with co-creation and can complement the first three missions at a sustainable university. Consequently, the TM of a university and co-creation might not longer be viewed in isolation and co-creation might not become the sole focus for a given university (Staniškis, 2016). At

the same time, academia's stakeholders are increasingly interested in how the transformative university can create value for society and, in particular, for their region (Secundo et al., 2016; Staniškis, 2016).

Despite the fact that the literature on university–industry collaborations has generally sampled universities in developed countries and few studies have focused on emerging countries (Wang et al., 2016), there are some interesting examples where co-creative partnerships for sustainability have been implemented in developing countries (Staniškis, 2016). For instance, recently, an increasing number of works (Ramachandra and Mansor, 2014; de Francisco et al., 2017; Kriel, 2017; Kruss and Gastrow, 2017) have taken emerging countries as case studies. The authors have highlighted the vision of those universities that have engaged with the local community in order to address social and environmental issues in a sustainable way. Moreover, it has also been suggested that universities should be challenged to consider whether, and how, a transformative framework of innovation for inclusive development could offer an expanded understanding of their own TMs (Kruss and Gastrow, 2017).

Drawing on the constraints that emerged from the SLR, Table 8 displays a selection of measures that could be adopted to support the strategic orientation of the TM, considering the following interlinked domains: interdependencies between teaching, research and the TM; local embeddedness and activities of the university; co-creation for sustainability and the role of SSHs.

## Conclusions and future avenues for research

The purpose of this SLR is to offer a comprehensive review of the current research on the TM of universities and to investigate both the potential and constraints of the recurring themes found in the TM. On the basis of the SLR, this paper also offers an innovative framework of measures which could support both scholars and policy makers by advancing the state of knowledge and so improving TM enactment. Despite the fact that there is widespread recognition, in universities, governments, industries and in society, that the TM is becoming increasingly important, the concept of TM remains nebulous and ambiguous. Indeed, it has been defined in many diverse ways and encompasses a wide array of models, dimensions, functions and activities, all of which fuel wide-ranging debates between scholars and policy makers. In other words, the TM is currently both the most crucial mission and that which most requires innovation in the organization of universities.

This fragmentation can be misleading when it is addressed with a narrow perspective, one which ignores some fundamental aspects, such as: the wide array of rationales driving the shift towards the TM; the synergies between the various functions of the TM; the incorporation of the TM within the traditional university missions of teaching and research; and the perceived legitimacy and contribution of all three missions by both university staff and external stakeholders. Thus, an SLR can provide a useful analysis in order to exhaustively investigate the complexity, multidisciplinary and heterogeneity of the TM, which is still an evolving phenomenon. However, like all the transformational changes taking place in any country and any organization, the TM of the university cannot be created overnight.

Through analysis of 134 peer-reviewed journal articles downloaded from the Elsevier's Scopus Electronic Database, this paper has identified the recurring themes of the TM, and revealed how they are interconnected and what their challenges are. The growing body of research and increased attention paid to the TM are, no doubt, reflected in the increasing pressure governments are putting on universities to add a TM, labelled as a “contribution to society”, into their programme Syllabi, even while public funding for education is steadily being cut. At the same time, academia is facing demands for transparency, efficiency and accountability regarding the socio-economic impact of its activities. Furthermore, universities are now being required to demonstrate their legitimacy to external stakeholders, including industry and society at large. This means that the university and the production and

**Table 8**  
Measures to support the strategic orientation of the TM.  
Source: Authors' elaboration.

Domains and Measures	Sources
<p><b>The TM and its interdependencies with teaching and research</b></p> <ul style="list-style-type: none"> <li>• Policy makers should avoid isomorphism, namely the tendency to emulate ‘world class’ universities</li> <li>• Policy intervention should take into account all three missions of university simultaneously</li> <li>• Coping with multiple missions requires a focused strategy based on leadership at both departmental and university levels</li> <li>• The University should analyse both the development of its internal faculty evaluation process and the perceived legitimacy of all three missions</li> <li>• University should consider what it sees itself as and how it acts in order to survive, compete, and be legitimate</li> </ul>	<p>Vorley and Nelles (2009); D’Este et al. (2013); Hellström et al. (2013); Veugelers (2013); Loi and Di Guardo (2015); Urdari et al. (2017)</p>
<p><b>Local embeddedness of the university</b></p> <ul style="list-style-type: none"> <li>• Universities should understand their role within the wider innovation system so as to fulfil their potential for economic development</li> <li>• Universities, governments, companies and communities, should focus on long-term investments in all the complementary dimensions of the TM</li> <li>• Universities should design structures and teaching styles, provide funds, and develop research capacities on the basis of demand from the local context</li> <li>• Government should play a constructive role in creating an economic, financial and legal environment to improve the performances of the TM</li> <li>• Universities, industry and local government should design new forms of participative governance of research, teaching, and the TM, with appropriate attention being paid to students and university staff</li> </ul>	<p>Laredo (2007); Hellström et al. (2013); Mora et al. (2015); Piirainen et al. (2016); Kapetaniou and Lee (2017); Martin et al. (2019)</p>
<p><b>TM activities</b></p> <ul style="list-style-type: none"> <li>• Universities could map the activities that faculty members and research groups are already carrying out and determine under what circumstances these activities can thrive</li> <li>• Understanding the patterns and degree of interrelations between existing TM activities could be a useful starting point for the strategic prioritization of time and resources</li> <li>• Universities should include among their strategic objectives the development, coordination or reinforcement of those structures dedicated to providing logistical support to university staff engaged in TM activities</li> <li>• Policy makers should encourage universities to focus on TM activities that have an impact on the surrounding environment, rather than simply engaging in many activities with limited impacts</li> <li>• TM activities can be improved by attracting external stakeholders’ expertise and financial resources</li> </ul>	<p>Hellström et al. (2013); Kohtamäki (2015); Rosli and Rossi (2016); Mejlgaard and Ryan (2017); De La Torre et al. (2018)</p>
<p><b>Co-creation for sustainability and SSHs</b></p> <ul style="list-style-type: none"> <li>• Both the Triple and Quadruple Helix Models should receive more attention in order to create closer links between stakeholders and to promote innovation, as well as when addressing social and environmental challenges</li> <li>• Understanding how universities interact with marginalised actors and communities in informal settings could add another dimension to the debate on co-creation, i.e. on inclusive development, as part of TM innovation and engagement</li> <li>• Outreach and service activities could be useful when meeting the needs of external stakeholders and, also, for supporting the co-creation of sustainable paths</li> <li>• Strategies and processes within the university should be developed in a holistic manner, in order to plan TM activities for the purpose of collective value creation</li> <li>• Regarding the SSHs, it is unrealistic to expect dramatic increases in third party funding and a major impact on society at large, unless there is a drastic reorientation of the TM in the SSHs</li> </ul>	<p>Bonaccorsi et al. (2014); Trencher et al. (2014); Kruss and Gastrow (2017); Di Bernardino and Corsi (2018); Neary and Osborne (2018)</p>

dissemination of knowledge are currently perceived as being at a crossroad.

There is considerable concern regarding the “one size-fits-all” approach to how the TM can best be performed, managed, measured and applied to countries, or universities, with homogeneous characteristics. Despite nurturing the “star player syndrome”, the role and the contribution of universities may already be embedded in their territory and further promoted by the active engagement of local stakeholders. The diverse institutional and historical characteristics of universities, in combination with the unique aspects of each socio-economic context, result in differing degrees of TM engagement even within the same university and the same department. Consequently, universities may

need to tailor their functions, strategies, and management, and even to prioritize some specialisations. To this end, human, physical and financial resources should be increased and allocated more efficiently, even while preserving the quality of teaching and research and avoiding any overload upon university staff at the expense of student activities.

This SLR does have some limitations, including the level of accuracy. To tackle this, the analysis started broadly and then focused on the recurring themes of the TM, revealing their interconnections as undeniable dimensions of the TM, which is a highly complex and still evolving phenomenon. The themes selected were: the entrepreneurial university; KT as a function of the TM - in particular KTOs and entrepreneurship education; the engagement of university staff and

external stakeholders in TM activities; the evaluation of the TM and its impact; the strategic orientation of the university and the emerging function of co-creation for sustainability. Although some dimensions might have been missed, this analysis of the potentials, constraints and challenges posed by these themes reveals a reasonable level of consistency in the papers used for this study.

This paper proposes themes which require further investigation in order to advance both the understanding and the enactment of the TM as well as its contribution to society at large. Some unsolved challenges or promising areas, which require further research could be the following.

- i *The entrepreneurial university as a model of the TM of university.* Despite the widespread “star player syndrome” and the one-size-fits-all approach, further research could investigate the rationales, practices, effects and impact of a bottom-up approach focused on the specialisations of the university and of its territory. Then, according to the theoretical frameworks of the THM and the QHM, future analysis could explore mutual interests, opportunities and new forms of collaboration between the university and its stakeholders also in the light of social and economic linkages that universities can nurture and activate at different levels. In particular, at the European level, one of the most recent and innovative forms of participative governance, the Smart Specialisation Strategy (S3) could be further analysed. It is clear that the progressive definition of the TM has also been guided by the Europe 2020 strategy that refers to S3, which seeks to promote intelligent, sustainable and inclusive growth in Europe and its regions. In this context, universities and regional governments should continuously gather data on research, on companies and on market opportunities at both the local, national and European level. This would translate into a continuous process of entrepreneurial discovery and exploration of the activities, the capacities and the needs of any regional actors involved (Ciampi Stancova and Cavicchi, 2017).
- ii *Knowledge Transfer and entrepreneurship education as functions of the TM of university.* Future research could go beyond the commercialisation of knowledge and look at spin-off creation and patenting. The role of KTOs could be examined in the light of current economic, societal, technological and environmental challenges. Further analysis could be done on the elaboration and testing of new entrepreneurship educational programmes that would be based on operational and interdisciplinary approaches and would involve university staff, students and external stakeholders too. In particular, the SSHs approach to business challenges deserves further attention because it can contribute to forecast the complexity of current economic, social and environmental issues, as well as being able to generate intelligent, collaborative strategies. Furthermore, emerging innovative SSH ways of developing services and products could have a major impact, especially on the environment and on the lives of poor people.
- iii *Engagement of academics and external stakeholders.* The TM should not penalise academics, who are already involved in teaching and research, nor should it become mandatory. Thus, future research could shift from focusing solely on strong leadership stories, to micro-practices, so as to actively engage more academics in TM activities. Further investigation could be conducted on existing policies which assess and reward scholars and non-teaching personnel who already contribute to the success of TM initiatives. Turning to the engagement of external stakeholders, there are two main challenges: firstly, developing new forms and channels to disseminate scientific outputs to non-academic audiences and, also

understanding the potential of ICT to promote effective dissemination. Secondly, the gap between university and external stakeholders could also benefit from research both on new spaces and on patterns to enhance collaboration and innovation. Living Labs, in particular, deserve attention as they offer real or virtual environments wherein to share mutual interests and opportunities and to help bridge the gap between university and society in general.

- iv *Evaluation of TM activities.* Looking at the future, a one-size-fits-all model for the evaluation of TM performance and its impact cannot be applied in all countries and universities. Indeed, the wide array of TM activities should be evaluated according to the characteristics and specialisations of each university and to the specific socio-economic environment in which the institution operates. However, even though there is a need to introduce new assessment mechanisms and performance indicators, very little comprehensive data on the TM is currently available. Thus, further academic research should be supported by governments to gather and elaborate data in order to develop criteria and forms of evaluation that are able to grasp both the complexity of the TM, and the heterogeneity of experiences and practices. Data collection should also include information on continuing education, entrepreneurship education and societal engagement, along the different dimensions of innovation and not limited to technological one.
- v *Strategic orientation of TM.* Policy makers should avoid isomorphism, or rather, the tendency to emulate “world class” universities. However, interesting approaches should all be observed and considered, and mutual learning could be fruitful in the attempt to maximise the impact of the TM. Future research and policy interventions should consider all three missions of the university simultaneously, exploring synergies, interdependencies, opportunities, priorities and values. Further work is also required on the strategic orientation of the TM towards the co-creation of collaborative approaches and solutions to forecast and address the challenges of sustainability in both developed and developing countries. Moreover, the potential of SSHs to contribute to the evolution of the TM and its impact should also be investigated. In particular, the TM in the SSHs could play a paramount role in the forecasting of emerging societal, technological and environmental changes as well as in the contribution of universities to socio-economic development, employment and the quality of life. Indeed, the SSHs could support the dissemination of academic knowledge and the visibility of the university by maximising the impact of emerging digital technologies. SSHs can also contribute to the TM in tourist areas, where industrialization is usually less developed. To this end, applied research thorough real case studies, surveys with diverse groups, in-depth qualitative interviews with scholars, students, university staff and stakeholders, including entrepreneurs, citizens and policy makers could and should also be conducted.

#### Author contributions

Lorenzo Compagnucci conceived the research framework. Material preparation, data collection and analysis were performed by Lorenzo Compagnucci. The original draft of the paper was written by Lorenzo Compagnucci. Francesca Spigarelli and Lorenzo Compagnucci jointly reviewed and edited the final manuscript.

#### Funding

This work was financed by the University of Macerata - Department of Law, Piaggia dell'Università 2, 62100 Macerata (Italy).

#### Appendix

Table A, Table B

**Table A**

. List of the 134 peer-reviewed journal articles on which the SLR is based.

Source	Title	Journal
Abreu et al. (2016)	Entrepreneurial practices in research-intensive and teaching-led universities	Small Business Economics
Agasisti et al. (2019)	Research, knowledge transfer, and innovation: The effect of Italian universities' efficiency on local economic development 2006 – 2012	Journal of Regional Science
Ahola (2005)	Global and local priorities in higher education policies: A headache at the national level?	Tertiary Education and Management
Albulescu et al. (2014)	The third mission of universities and some implications	UPB Scientific Bulletin, Series D: Mechanical Engineering
Aragónés-Beltrán et al. (2017)	An in-depth analysis of a TTO's objectives alignment within the university strategy: An ANP-based approach	Journal of Engineering and Technology Management
Backs et al. (2019)	Stimulating academic patenting in a university ecosystem: An agent-based simulation approach	Journal of Technology Transfer
Balduzzi and Rostan (2016)	Organizing the 'productive transformation of knowledge': linking university and industry in traditional manufacturing areas	Tertiary Education and Management
Barker (2015)	The challenging Australian policy context for university engagement	Journal of Higher Education Policy and Management
Benneworth et al. (2015)	Between good intentions and urgent stakeholder pressures: Institutionalizing the universities' third mission in the Swedish context	European Journal of Higher Education
Benneworth et al. (2016)	One size does not fit all! New perspectives on the university in the social knowledge economy	Science and Public Policy
Benneworth et al. (2017)	Between rigour and regional relevance? Conceptualising tensions in university engagement for socio-economic development	Higher Education Policy
Bonaccorsi and Daraio (2008)	The differentiation of the strategic profile of higher education institutions. New positioning indicators based on microdata	Scientometrics
Bonaccorsi et al. (2014)	Participation and commitment in third-party research funding: Evidence from Italian universities	Journal of Technology Transfer
Bortagaray (2009)	Bridging university and society in Uruguay: Perceptions and expectations	Science and Public Policy
Brescia et al. (2016)	Organizational structures of Knowledge Transfer Offices: an analysis of the world's top-ranked universities	Journal of Technology Transfer
Brown (2016)	Mission impossible? Entrepreneurial universities and peripheral regional innovation systems	Industry and Innovation
Brusca et al. (2018)	The challenge of sustainability and integrated reporting at universities: A case study	Journal of Cleaner Production
Ca (2009)	Reaching out to society: Vietnamese universities in transition	Science and Public Policy
Calcagnini et al. (2016)	The role of universities in the location of innovative start-ups	Journal of Technology Transfer
Callagher et al. (2015)	Exploring societal responses towards managerial prerogative in entrepreneurial universities	International Journal of Learning and Change
Cesaroni and Piccaluga (2016)	The activities of university knowledge transfer offices: towards the TM in Italy	Journal of Technology Transfer
Chantler (2016)	The ivory tower revisited	Discourse
Chapman et al. (2011)	University enterprise: The growth and impact of university-related companies in London	Industry and Higher Education
Chau et al. (2017)	Aligning university–industry interactions: The role of boundary spanning in intellectual capital transfer	Technological Forecasting and Social Change
Civera and Meoli (2018)	Does university prestige foster the initial growth of academic spin-offs?	Economia e Politica Industriale
Cooper (2009)	University-civil society (u-cs) research relationships: The importance of a 'fourth helix' alongside the 'triple helix' of university-industry-government (u-i-g) relations	South African Review of Sociology
Cooper (2017)	Concepts of "Applied and Public Sociology": Arguments for a bigger theoretical picture around the idea of a "University Third Mission"	Journal of Applied Social Science
Croce et al. (2013)	Venture capital enters academia: An analysis of university-managed funds	Journal of Technology Transfer
D'Este et al. (2013)	The pursuit of academic excellence and business engagement: Is it irreconcilable?	Scientometrics
De Francisco et al. (2017)	Evaluating impacts of university cooperation for development from the voice of the south	Revista de Economía Mundial
Degl'Innocenti et al. (2019)	The interconnections of academic research and universities' "third mission": Evidence from the UK	Research Policy
De Jong et al. (2014)	Understanding societal impact through productive interactions: ICT research as a case	Research Evaluation
De La Torre et al. (2015)	Defining typologies of universities through a DEA-MDS analysis: An institutional characterization for formative evaluation purposes	Research Evaluation
De La Torre et al. (2017)	The relevance of knowledge transfer for universities' efficiency scores: An empirical approximation on the Spanish public higher education system	Research Evaluation
De La Torre et al. (2018)	The policy approach for the third mission of universities: The Spanish case (1983–2018)	Regional and Sectoral Economic Studies
Di Berardino and Corsi (2018)	A quality evaluation approach to disclosing TM activities and intellectual capital in Italian universities	Journal of Intellectual Capital
Fontana et al. (2018)	Reformism and evaluation in the field of social and political sciences. Consequences for the academic community, projects, people	Italian Journal of Sociology of Education
Forleo and Palmieri (2017)	University value for sustainability: What do stakeholders perceive? An Italian case study	Rivista di Studi sulla Sostenibilità
Gaus and Raith (2016)	Commercial transfer – A business model innovation for the entrepreneurial university	Industry and Higher Education
Giuri et al. (2019)	The strategic orientation of universities in knowledge transfer activities	Technological Forecasting and Social Change
Giusepponi and Tavoletti (2018)	Vision and Mission Statements in Italian Universities: Results of an Empirical Investigation on Strategic Orientation	Journal of the Knowledge Economy
Goethner and Wyrwich (2019)	Cross-faculty proximity and academic entrepreneurship: The role of business schools	Journal of Technology Transfer
Göransson et al. (2009)	New activities of universities in transfer and extension: Multiple requirements and manifold solutions	Science and Public Policy
Gregersen et al. (2009)	Linking between Danish universities and society	Science and Public Policy
Guenther and Wagner (2008)	Getting out of the ivory tower – new perspectives on the entrepreneurial university	European Journal of International Management
El Hadidi and Kirby (2015a)	The attitude of Egyptian SET academics towards innovation: Universities and innovation in a factor-driven economy	Industry and Higher Education

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Table A (continued)

Source	Title	Journal
El Hadidi and Kirby (2016)	Universities and innovation in a factor-driven economy: The performance of universities in Egypt	Industry and Higher Education
Hellström et al. (2013)	Organizing for the third mission: Structural Conditions for outreach and relevance at two Swedish HEIs	Industry and Higher Education
Howlett (2010)	Knowledge transfer between UK universities and business	Smart Innovation, Systems and Technologies
Huyghe and Knockaert, 2014	The influence of organizational culture and climate on entrepreneurial intentions amongst research scientists	Journal of Technology Transfer
Jaeger and Kopper (2014)	Third mission potential in higher education: Measuring the regional focus of different types of HEIs	Signal, Image and Video Processing
Jones et al. (2017)	Doing well by doing good: A study of university-industry interactions, innovativeness and firm performance in sustainability-orientated Australian SMEs	Technological Forecasting and Social Change
Junior and Odei (2018)	The influence of public support on university-industry-government collaboration: The case of the Czech Republic, Slovakia, Hungary and Romania	Statistika
Kapetaniou and Lee (2017)	A framework for assessing the performance of universities: The case of Cyprus	Technological Forecasting and Social Change
Kitagawa et al. (2016)	Third mission as institutional strategies: Between isomorphic forces and heterogeneous pathways	Science and Public Policy
Knockaert et al. (2015)	Growth intentions amongst research scientists: A cognitive style perspective	Technovation
Kohtamäki (2015)	Does structural development matter? The third mission through teaching and R&D at Finnish universities of applied sciences	European Journal of Higher Education
Koryakina et al., 2015	Third mission activities: University managers' perceptions on existing barriers	European Journal of Higher Education
Kotosz (2015)	How to measure the local economic impact of universities? Methodological overview	Regional Statistics
Kriel (2017)	Engaging with homelessness in the City of Tshwane: Ethical and practical considerations	Development Southern Africa
Kruss and Gastrow (2017)	Universities and innovation in informal settings: Evidence from case studies in South Africa	Science and Public Policy
Laredo (2007)	Revisiting the third mission of universities: Toward a renewed categorization of university activities?	Higher Education Policy
Lebeau and Cochrane (2015)	Rethinking the 'Third Mission': UK universities and regional engagement in challenging times	European Journal of Higher Education
Loi and Di Guardo (2015)	The third mission of universities: An investigation of the espoused	Science and Public Policy
Maculan and Carvalho de Mello (2009)	University start-ups for breaking lock-ins of the Brazilian economy	Science and Public Policy
Mariani et al. (2018)	Academic spinoffs as a value driver for intellectual capital: the case of the University of Pisa	Journal of Intellectual Capital
Martin et al. (2019)	Entrepreneurial architecture in UK universities: Still a work in progress?	International Journal of Entrepreneurial Behaviour and Research
Manatos et al. (2017)	The European standards and guidelines for internal quality	TQM Journal
Markuerkiaga et al. (2016)	Factors fostering students' spin-off firm formation: An empirical comparative study of universities from North and South Europe	Journal of Management Development
Meissner and Shmatko (2017)	A "Keep open": the potential of gatekeepers for the aligning universities to the new Knowledge Triangle	Technological Forecasting and Social Change
Mejlgaard and Ryan (2017)	Patterns of third mission engagement amongst scientists and engineers	Research Evaluation
Meoli et al. (2018)	The effects of public policies in fostering university spinoffs in Italy	Economics of Innovation and New Technology
Minola et al. (2016)	Students climbing the entrepreneurial ladder: Does university internationalization pay off?	Small Business Economics
Montesinos et al. (2008)	Third mission ranking for world class universities: Beyond teaching and research	Higher Education in Europe
Mora et al. (2015)	Higher education in Albania: developing third mission activities	Tertiary Education and Management
Moreton (2018)	Contributing to the creative economy imaginary: universities and the creative sector	Cultural Trends
Muscio et al. (2017)	The complex relationship between academic engagement and research output: Evidence from Italy	Science and Public Policy
Nakwa and Zawdie (2016)	The 'third mission' and 'triple helix mission' of universities as evolutionary processes in the development of the network of knowledge production: Reflections on SME experiences in Thailand	Science and Public Policy
Neary and Osborne (2018)	University engagement in achieving sustainable development goals: A synthesis of case studies from the SUEUAA study	Australian Journal of Adult Learning
Nelles and Vorley (2010a)	Constructing an entrepreneurial architecture: An emergent framework for studying the contemporary university beyond the entrepreneurial turn	Innovative Higher Education
Nelles and Vorley (2010b)	Entrepreneurial by design: Theorizing the entrepreneurial transformation of contemporary universities	Industry and Higher Education
Nelles and Vorley (2010c)	From policy to practice: engaging and embedding the third mission in contemporary universities	International Journal of Sociology and Social Policy
O'Reilly (2019)	Dynamic capabilities and the entrepreneurial university: A perspective on the knowledge transfer capabilities of universities	Journal of Small Business and Entrepreneurship
Paoloni et al. (2019)	Relational capital and knowledge transfer in universities	Business Process Management Journal
Passaro et al. (2018)	The impact of higher education on entrepreneurial intention and human capital	Journal of Intellectual Capital
Philpott et al. (2011)	The entrepreneurial university: Examining the underlying academic tensions	Technovation
Pinheiro et al. (2015a)	One and two equals three? The third mission of higher education institutions	European Journal of Higher Education
Pinheiro et al. (2015b)	The institutionalization of universities' third mission: Introduction to the special issue	European Journal of Higher Education
Pinheiro et al. (2017)	Universities' third mission: Global discourses and national imperatives	Higher Education Policy
Piirainen et al. (2016)	Foresight and the third mission of universities: The case for innovation system foresight	Foresight
Popescu et al. (2015)	Romanian higher education challenges: "Opening" universities to the local community and the business environment	Quality - Access to Success
Predazzi (2012)	The third mission of the university	Rendiconti Lincei
Preece et al. (2011)	Nurturing lifelong learning in communities through the National University of Lesotho: Prospects and challenges	International Journal of Lifelong Education

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Table A (continued)

Source	Title	Journal
Pugh (2017)	Universities and economic development in lagging regions: 'Triple helix' policy in Wales	Regional Studies
Ramachandra and Mansor (2014)	Sustainability of community engagement – in the hands of stakeholders?	Education and Training
Ramos-Vielba et al. (2010)	Measuring university-industry collaboration in a regional innovation system	Scientometrics
Ricci and Civitillo (2017)	Accountability and third mission in Italian universities	International Journal of Managerial and Financial Accounting
Riviezzo and Napolitano (2010)	Italian Universities and the third mission: A longitudinal analysis of organizational and educational evolution towards the 'Entrepreneurial University'	Industry and Higher Education
Rolfo and Finardi (2014)	University third mission in Italy: Organization, faculty attitude and academic specialization	Journal of Technology Transfer
Rosli and Rossi (2016)	Third-mission policy goals and incentives from performance-based funding: Are they aligned?	Research Evaluation
Sá et al. (2018)	The university entrepreneurial mission: Portuguese academics' self-perspective of their role in knowledge transfer	Journal of Further and Higher Education
Salamzadeh et al. (2016)	Entrepreneurial universities and branding: A conceptual model proposal	World Review of Science, Technology and Sustainable Development
Sam and van der Sijde (2014)	Understanding the concept of the entrepreneurial university from the perspective of higher education models	Higher Education
Sánchez-Barrioluengo and Benneworth (2019)	Is the entrepreneurial university also regionally engaged? Analysing the influence of university's structural configuration on third mission performance	Technological Forecasting and Social Change
Schmid et al. (2018)	Plans versus experiences in transitioning transnational education into research and economic development: A case study	Science and Public Policy
Schmoch (2014)	Knowledge transfer from German universities into the service sector as reflected by service marks	Research Evaluation
Secundo and Elia (2014)	A performance measurement system for academic entrepreneurship: A case study	Measuring Business Excellence
Secundo et al. (2017b)	An Intellectual Capital framework to measure universities third mission activities	Technological Forecasting and Social Change
Secundo et al. (2017a)	Mobilising intellectual capital to improve European universities' competitiveness: The technology transfer offices' role	Journal of Intellectual Capital
Secundo et al. (2018)	Intellectual capital management in the fourth stage of IC research: A critical case study in university settings	Journal of Intellectual Capital
Shore and McLauchlan (2012)	'Third Mission' activities, commercialisation and academic entrepreneurs	Social Anthropology
Siboni et al. (2013)	Italian state university contemporary performance plans: An intellectual capital focus?	Journal of Intellectual Capital
Singh et al. (2015)	The role of universities in the national innovation systems of China and the East Asian NIEs: An exploratory analysis of publications and patenting data	Industry and Higher Education
Šmídová et al. (2017)	Regional development: Lifelong learning as a priority in Norway and the Czech Republic?	Higher Education Policy
Smith (2013)	Academics, the 'cultural third mission' and the BBC: Forgotten histories of knowledge creation, transformation and impact	Studies in Higher Education
Staniškis (2016)	Sustainable university: Beyond the third mission	Environmental Research, Engineering and Management
Suomi et al. (2019)	Revisiting "the shotgun wedding of industry and academia"—empirical evidence from Finland	International Review on Public and Nonprofit Marketing
Taheri and van Geenhuizen (2016)	Teams' boundary-spanning capacity at university: Performance of technology projects in commercialization	Technological Forecasting and Social Change
Trencher et al. (2014)	Beyond the third mission: Exploring the emerging university function of co-creation for sustainability	Science and Public Policy
Unger and Polt (2017)	The knowledge triangle between research, education and innovation. A conceptual discussion	Foresight and STI Governance
Urdari et al. (2017)	Assessing the legitimacy of HEIs' contributions to society: The perspective of international rankings	Sustainability Accounting, Management and Policy Journal
Vakkuri (2004)	Institutional change of universities as a problem of evolving boundaries	Higher Education Policy
Van Der Steen and Enders (2008)	Universities in evolutionary systems of innovation	Creativity and Innovation Management
Vargiu (2014)	Indicators for the evaluation of public engagement of higher education institutions	Journal of the Knowledge Economy
Venditti et al. (2013)	Disclosure of university research to third parties: A non-market perspective on an Italian university	Science and Public Policy
Veugelers (2016)	The embodiment of knowledge: Universities as engines of growth	Oxford Review of Economic Policy
Villa Encisoet al. (2017)	Analysis of university management of emerging technologies and recommendations for developing countries	Turkish Online Journal of Educational Technology
Vorley and Nelles (2009)	Building entrepreneurial architectures: A conceptual interpretation of the third mission	Policy Futures in Education
Vorley and Nelles (2010)	Gone corporate? The changing face of entrepreneurship in contemporary universities	International Journal of Entrepreneurial Venturing
Wang and Zhou (2009)	University-owned enterprises as entry point to the knowledge economy in China	Science and Public Policy
Wang et al. (2013)	Have Chinese universities embraced their third mission? New insights from a business perspective	Scientometrics
Wang et al. (2016)	Does teaching benefit from university-industry collaboration? Investigating the role of academic commercialization and engagement	Scientometrics
Woollard et al. (2007)	Academic enterprise and regional economic growth: Towards an enterprising university	Industry and Higher Education
Woollard (2010)	Towards a theory of university entrepreneurship: Developing a theoretical model	Industry and Higher Education

**Table B**  
 Descriptive statistics on journal publishing TM articles to May 2019.

Journal	Number of papers
Science and Public Policy	15
Industry and Higher Education	10
Journal of Technology Transfer	9
Technological Forecasting and Social Change	8
Journal of Intellectual Capital	6
European Journal of Higher Education	6
Research Evaluation	6
Higher Education Policy	5
Scientometrics	5
Tertiary Education and Management	3
Small Business Economics	2
Technovation	2
Journal of the Knowledge Economy	2
Journal of Further and Higher Education	1
Research Policy	1
Journal of Cleaner Production	1
International Journal of Entrepreneurial Behaviour and Research	1
Economia e Politica Industriale	1
Italian Journal of Sociology of Education	1
Regional Studies	1
Journal of Engineering and Technology Management	1
Turkish Online Journal of Educational Technology	1
Revista de Economia Mundial	1
Sustainability Accounting, Management and Policy Journal	1
Rivista di Studi sulla Sostenibilità	1
Foresight and STI Governance	1
TQM Journal	1
Journal of Management Development	1
Foresight	1
Discourse	1
Industry and Innovation	1
World Review of Science, Technology and Sustainable Development	1
International Review on Public and Nonprofit Marketing	1
Oxford Review of Economic Policy	1

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Table B (continued)

Environmental Research, Engineering and Management	1
Journal of Higher Education Policy and Management	1
International Journal of Learning and Change	1
Regional Statistics	1
Quality – Access to Success	1
Higher Education	1
Signal, Image and Video Processing	1
UPB Scientific Bulletin, Series D: Mechanical Engineering	1
Measuring Business Excellence	1
Education and Training	1
Studies in Higher Education	1
Rendiconti Lincei	1
Social Anthropology	1
International Journal of Lifelong Education	1
Smart Innovation, Systems and Technologies	1
Innovative Higher Education	1
International Journal of Entrepreneurial Venturing	1
Policy Futures in Education	1
Higher Education in Europe	1
Creativity and Innovation Management	1
European Journal of International Management	1
Business Process Management Journal	1
Journal of Regional Science	1
Australian Journal of Adult Learning	1
Cultural Trends	1
Journal of Small Business and Entrepreneurship	1
Statistika	1
International Journal of Sociology and Social Policy	1
Economics of Innovation and New Technology	1
Regional and Sectoral Economic Studies	1
Development Southern Africa	1
International Journal of Managerial and Financial Accounting	1
Journal of Applied Social Science	1
South African Review of Sociology	1
<b>Total</b>	<b>134</b>

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