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**Increasing University Entrepreneurialism: Qualitative Insights from the Technology Transfer Office**

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# Increasing University Entrepreneurialism: Qualitative Insights from the Technology Transfer Office

## Abstract

**Purpose.** Successful promotion of academic entrepreneurship is a determining factor in the pursuit of university entrepreneurialism. This paper aims to illustrate how qualitative data on the performance of the technology transfer office (TTO), based on access to intellectual capital (IC) indicators, can be transformed into a metric to provide insights that assist in strategy development for a university moving toward a more entrepreneurial configuration.

**Design/methodology.** The TTO performance metric takes the form of a self-assessment of access to IC indicators, which are determinants of effectiveness. This study involves the use of the metric through the completion of an online survey and follow-up interviews, to collect and analyse the data.

**Findings.** The performance of 34 TTOs in continental Europe and the UK are measured, and insights into the success of promoting academic entrepreneurship were gained. The qualitative data are studied in detail to illustrate how the university can strategically leverage IC to enhance academic entrepreneurship.

**Research implications** This study recommends that the university align the mission statement and organisational structure of the TTO, to enable access to IC. This in turn may result in increased academic entrepreneurship activities which will drive the university towards increased entrepreneurialism.

**Practical implications.** The interpretation of the qualitative data relating to the performance of the TTO, and which factors influence it, aids in understanding the performance of the entrepreneurial university and illustrates which strategic interventions can be made.

**Originality.** Understanding the link between IC, academic entrepreneurship (as encapsulated in the performance of the TTO) and the characteristics of the entrepreneurial university is particularly useful for university management decisions.

## Keywords

Academic Entrepreneurship; Entrepreneurial University; Intellectual Capital; Technology Transfer Office, Performance Measurement

## 1. Introduction

The role of a university has expanded from teaching (first mission), to research (second mission) towards entrepreneurship (third mission) (Redford and Fayolle, 2014). The activities associated with the university third mission include (non-exhaustively) technology transfer and innovation, continuing education, social engagement and, economic and social development (Guan and Zhao, 2013). Some of these activities, namely, technology transfer, innovation, commercialisation and entrepreneurial endeavour, are known collectively as ‘academic entrepreneurship’ activities (Rothaermel et al., 2007; Siegel and Wright, 2015). There has been an emergence of ‘entrepreneurial universities’ (Guerrero et al., 2015; Guerrero et al., 2016) within which, academics, in the pursuit of increasing entrepreneurialism, engage in academic entrepreneurship.

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3 Audretsch et al., (2005) define entrepreneurship as involving the recognition and pursuit of  
4 opportunities. In this pursuit, entrepreneurial universities have often opted to establish  
5 technology transfer offices (TTOs) or similar intermediary units (Hsu et al., 2015). The TTO is  
6 the catalyst of the technology transfer process from university research to commercial  
7 application and enables the transfer of implicit knowledge, codified or non-codified know-how,  
8 and technology to create wealth and to increase economic development (Tahvanainen and  
9 Hermans, 2011). Therefore, the performance of the TTO influences the promotion of academic  
10 entrepreneurship and the entrepreneurial configuration of the university.  
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14 Entrepreneurial universities have emerged as central economic actors playing an active role in  
15 promoting teaching, innovation, knowledge transfer, and entrepreneurship (Urbano and  
16 Guerrero, 2013). Over the last 30 years it has been observed that some significant changes in the  
17 structure and mission of TTOs have occurred (Siegel and Wright, 2015), paralleled by the  
18 emergence of TTO performance measures. Such measures generally reflect the *efficiency* of the  
19 TTO i.e. their ability to convert inputs into outputs (Thursby and Kemp 2002; Thursby and  
20 Thursby 2002; Siegel et al., 2003; Chapple et al., 2005; Schoen et al., 2014) and typically rely  
21 upon tangible performance metrics such as patents, licenses and spin-off company creation and  
22 other proxies for Return on Investment (ROI). Similarly, the volume of output on such measures  
23 themselves are often used as proxies for how entrepreneurial a university is deemed to be.  
24 However, these tangible, output-based metrics do not measure the full extent of academic  
25 entrepreneurship and have been criticised for inadequately capturing the full extent of TTO  
26 *potential* and *capability* (Guerrero et al., 2015). We suggest the metric developed by Secundo et  
27 al., (2016) that additionally captures the TTO's access to intellectual capital (IC) is a more  
28 comprehensive measure of TTO performance. IC is described as intellectual material that has  
29 been formalized, captured and leveraged to produce higher valued assets (Schiuma, 2009) and  
30 constitutes the largest proportion of the universities' assets (Bercovitz and Feldman, 2006;  
31 Rothaermel et al., 2007; Secundo et al., 2015).  
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36 By incorporating the intangible, non-monetary and knowledge asset-based components of  
37 academic entrepreneurship, into a measure of TTO performance, we can also use the metric as a  
38 management tool to assess not only the current state of academic entrepreneurship, but also of  
39 entrepreneurial potential (Dumay and Garanina, 2013; Guthrie et al., 2012) in a particular  
40 university TTO. In adopting this metric, this paper seeks to address the following question:  
41 "How can insights, derived from the performance of the TTO, aid the university in the pursuit of  
42 entrepreneurialism?"  
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45 Building upon Secundo et al. (2016; 2017a), we employ the TTO performance metric in an  
46 online, self-assessment survey. We sent the survey to university TTOs or similar intermediary  
47 units in continental Europe and the UK. Following completion of the survey, certain TTOs  
48 agreed to participate in follow-up interviews to collect additional information and analyse the  
49 data. In total 34 TTOs were interviewed, and together, the empirical data enabled us to  
50 investigate the influences organisational structure, TTO mission, and IC assets have on academic  
51 entrepreneurship. These 34 participating TTO are studied in detail to illustrate the applicability  
52 of the performance data in deriving insights into university entrepreneurialism.  
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In the next section, we discuss extant literature on the entrepreneurial university, the performance of the TTO, and the performance metric used in this study. This is followed by the methodology, findings, and a discussion of the results. The paper concludes with recommendations, implications for theory and practice, and suggestions for future work.

## 2. Literature Review

For contextual background, this section discusses the literature on the entrepreneurial university and academic entrepreneurship, then the specific role of the TTO in entrepreneurial universities. Our key focus however, is a critical review of the commonly cited metrics for assessing the performance of TTOs. Finally, the performance metric framework used in this study will be discussed in terms of how IC can be incorporated to illustrate how such a metric can be applied to better understand potential underlying factors of success in the entrepreneurial university.

### *2.1 The Emergence of the Entrepreneurial University and Academic Entrepreneurship*

There is no consensus on the exact definition of an ‘entrepreneurial university’. The term “entrepreneurial university” (Etzkowitz, 1983) has been adopted by academics and policy makers to describe universities that effectively deliver on their “third mission” (Clark, 1998, Lambert, 2003). Sometimes third mission refers to all the activities not included as first or second mission or in other cases “any activity that universities perform in relation to ‘external environments’” (E3M, 2010, p. 15). Generally, third mission activities comprise three dimensions performed by universities in relation to external environments: technology transfer and innovation, continuing education and social engagement (E3M, 2010). A growing body of literature relating to entrepreneurial universities and academic entrepreneurship equates these developments to the commercialization of science. Other work on university-industry links also emphasises the role of university in regional systems of innovation as the primary driver of economic development (Bercovitz and Feldman, 2006; Guan and Zhao, 2013). Other authors have defined it as an institution that transforms itself to become more adaptive organisationally through collective entrepreneurial action (Clark, 1998). Hsu et al. (2015) remarked the transfer of university technology to industry was achieved through a multitude of mechanisms including launching technology-oriented start-ups, and providing collaborative research, contract research, consulting services, technology licensing, graduate education, advanced training for enterprise staff, exchange of research staff, and other forms of formal or informal information transfer. Etzkowitz (1983; 2003) observed that these universities utilise third mission activities as means to attract diversified funding sources. We choose to use the definition of Guerrero and Urbano (2012) which states that an entrepreneurial university is a natural incubator, providing support structures for researchers and students to initiate new ventures: intellectual, commercial and conjoint. As such, universities that strive to be more entrepreneurial are:

- characterised by the transformation of their organisational structures to respond better and adapt to the external environment,
- oriented toward innovation and the development of an entrepreneurial culture and,
- have a new managerial ethos in governance, leadership, and planning (Etzkowitz, 2003).

In parallel with the evolving literatures on the entrepreneurial university, the study of academic entrepreneurship has also received increasing attention (e.g., Chrisman et al., 1995; Harmon et

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2  
3 al., 1997; McMillan et al., 2000; Zucker et al., 2002). The trend toward universities acting as a  
4 catalyst for entrepreneurial activity is at the heart of the academic entrepreneurship phenomenon  
5 (Chrisman et al., 1995; Shane, 2004).  
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8 Wood (2011) provides a holistic definition of academic entrepreneurship, moving from the  
9 premise that academic entrepreneurship is not a single event, but rather a continuous process  
10 comprised of a series of events (Friedman & Silberman, 2003). He proposes a process based  
11 model of academic entrepreneurship, composed by the following stages:  
12

- 13 a) Innovation disclosure and intellectual property (IP) protection stage;
- 14 b) Awareness and securing industry partnerships stage;
- 15 c) Commercialization mechanism selection stage realised through the use of technology  
16 licensing agreements or the launch of a completely new business, typically called a ‘spin-  
17 off’ and;
- 18 d) The commercialization stage during which the university and its industry partners have  
19 decided to attempt commercialization of the innovation via license agreement or creation  
20 of a spin-off.  
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24 This view has been further explored by Etzkowitz (2016) who supported the idea that academic  
25 entrepreneurship enhances “the research university by joining a reverse linear dynamic moving  
26 from problems in industry and society, seeking solutions in academia, to the classic forward  
27 linear model, producing serendipitous innovations from the meandering stream of basic  
28 research” (Etzkowitz, 2016, pag 22-23).  
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31 Siegel and Wright (2015) argue that academic entrepreneurship needs a rethink, given the  
32 changing role and purpose of universities. In the initial phases of undertaking academic  
33 entrepreneurship, there was a strong focus on technology transfer, and specifically, patents and  
34 licensing. Entrepreneurial activities related to commercialisation such as spin-off company  
35 creation were given very little attention. However, the emerging perspectives of academic  
36 entrepreneurship include a wider social and economic benefit to the university ecosystem  
37 overcoming the traditional goal of economic revenue (Kalar & Antoncic, 2015). Now the  
38 creation of students and alumni start-ups, entrepreneurially equipped students, and job creation in  
39 the local region or state also become a priority (Gur et al., 2016). This shift reflects policy  
40 developments that focus on the need for universities’ knowledge transfer to make a wider  
41 contribution to society which has in turn induced a focus on more indirect aspects of academic  
42 entrepreneurship, such as social ventures and commercial start-ups launched by students and  
43 alumni, as well as the transfer of knowledge to existing local businesses (Siegel and Wright,  
44 2015).  
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48 A key facilitator of academic entrepreneurship is the technology transfer office (TTO) that  
49 assists universities in the commercialization of scientific research by:  
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- 51 - assessing the commercial viability of new technologies,
- 52 - managing and protecting IP,
- 53 - fostering research partnerships with the business sector, and
- 54 - supporting the creation of university spin-offs (González-Pernía et al., 2013).  
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There are many different types of universities and each university has a different managerial approach to the management of intangibles and IC, as well as IP, depending on the national law and internal policies of the university (Secundo et al., 2015). For this reason, there is also a diversity of governance models of technology transfer processes. Schoen et al. (2014) categorise TTO along four structural dimensions: the degree of discipline specialisation, the degree of task specialisation, the level of autonomy, and the degree of exclusivity. Thus, depending on the extent to which the TTO engages in academic entrepreneurship, the TTO will take different structural configurations to complement the activities it is involved in. The performance of the TTO is paramount not only to the success of promoting academic entrepreneurship but also to facilitate increasing entrepreneurialism within the university.

### 2.2 The Evolution of TTO performance metrics

The range of activities TTOs are involved in is ever-expanding. This is because the university defines the mission statement of its TTO, sets the TTO's objectives, assigns the funds for TTO activities and defines the TTO's organisational relationships with other university structures i.e. defining governance structures (Huyghe et al., 2014). As the mission and vision of each university differs and the scope of academic entrepreneurship increases, the activities the TTO pursues, or deems important, will differ across universities. As a result, the selection of appropriate performance metrics is critically important. In *academic* studies, TTO performance tends to be viewed through different lenses: successful technology transfer, commercialization of IC, or promoting academic entrepreneurship (Carayannis et al., 2014). As such, TTO performance metrics to date, encompass a broad range of indicators, both qualitative and quantitative. These can be grouped into :

- 1) input/expenditure/resources
- 2) mid-term/activities/cultural changes
- 3) outcomes/long-term/economic impacts (Carayannis et al., 2014).

There is, however, dissatisfaction among technology transfer *professionals* due to the over-simplified metrics applied to their efforts e.g. the concept return on investment (ROI) measures only short-term benefits (Faulkner, 1996). Considering the need for universities to make a wider contribution to society as articulated above, it is clear that TTO performance metrics need a rethink to encompass the greater scope of activity that is undertaken today.

A TTO's performance is measured by both its efficiency and effectiveness in a range of activities. Effectiveness relates to the success at achieving a desired result, and efficiency to the conversion ratio of inputs to outputs. However, current methods overwhelmingly focus on measuring TTO performance on efficiency measures, not effectiveness. Furthermore, the efficiency measures are predominantly based on the highly criticised return on investment (ROI) metric. Nevertheless, several studies have focussed on the relationships between the resources and capabilities of TTOs, governance structures, attitudes and organisational culture promoting academic entrepreneurship (Feldman et al., 2002; Di Gregorio and Shane, 2003; Lockett and Wright, 2005; Markman et al., 2005; González-Pernía et al., 2013). These determinants include:

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- *The team composition of TTOs* (Muscio, 2010). The skills and experience of the TTO staff are critical for the successful promotion of academic entrepreneurship.
- *The structure of the TTO* (Brescia, 2016). TTOs are organised in a variety of ways such as an internalised (to the university) centralised office, an internalised but decentralised office, an externalised non-profit research foundation, or an externalised for-profit venture specialisation.
- *The mission statement* (Fitzgerald and Cunningham, 2016). Mission statements have three core purposes: a guide to decision making, as a communication tool, and as a tool in directing the formulation and implementation of strategic planning. It is essential that the TTO mission statement be clear and consistent with the goals of the university.
- *Faculty's views on the merits of commercialisation and their role in the process* (Sideri and Panagopoulos, 2016). Clarity over the importance of academic entrepreneurship and the role researchers play helps to ensure academic input, collaboration and support.
- *The extent of collaboration with industry* (Villani et al., 2017). University-industry links are crucial for identifying commercialisation partners, sources of funding, development support and aligning research with industry needs.

Even though a single definition of an entrepreneurial university is lacking, several criteria for assessing such an organisation exist. These include involvement in large-scale science projects, contracted research, consulting, patenting/licensing, generation of spin-off companies, external teaching, university-industry collaboration, as well as new product development and distribution (Kirby et al., 2011). Given the lack of consensus on the definition of an entrepreneurial university, there is a significant gap in the university sector in both the measurement of entrepreneurial activities within the university, as well as the reporting and disclosure of measures to the university's external environment. To bridge this gap, Secundo et al., (2015) suggest using IC as a performance measure. Secundo et al., (2016; 2017a) developed of a metric which would overcome the shortcomings and weaknesses of current methods and incorporate the greater scope of academic entrepreneurship by looking toward intellectual capital (IC) and intangible indicators to measure the aforementioned determinants. Since this paper seeks to apply Secundo et al's metric, the next section will recap the metric in detail.

### 2.3 The IC-based TTO Performance Metric

IC is already widely adopted by industry in assessing performance, so Secundo et al., (2017b) have argued in favour of also using IC as a performance measure for entrepreneurial universities because:

- (i) IC can represent the potential of the entrepreneurial university to achieve its stated main mission and performance objectives.
- (ii) The identification of IC can improve the value creation process, moving the university towards being more entrepreneurial.
- (iii) IC enhances transparency which is needed to ensure successful university-industry cooperation, because IC provides a means by which industry can assess the potential/ability of a university to be entrepreneurial and create linkages which could be of mutual benefit to both parties.



To this, we add that, depending on the university's profile, mission and vision, the weight, role, and meaning of IC will differ which makes it the perfect tool to assess the level of entrepreneurial activity in the university.

IC can be classified into human, structural and relational capital (Carayannis et al., 2014; Secundo et al, 2015). In the context of the TTO, human capital (HC) relates to the expertise, knowledge, and experiences of the staff, as well as the access the TTO has to the expertise, knowledge, and experiences of the researchers, professors, technical staff, PhD students and administrative staff. Structural capital (SC) consists of the research infrastructure, the research and education processes and routines, the university culture and the governance principles. These influence the quality of research and therefore innovation disclosures, as well as the authority the TTO has to commercialise the innovation. It furthermore captures the enabling environment the university creates, through policies and mission statement to allow the TTO to operate. Relational capital (RC) captures the university's internal and external relations with public and private partners and collaborations with national and international research centres. These networks and industry links are utilised by the TTO during the commercialisation process. Looking at the tripartite classification of IC into HC, SC and RC, therefore, encompasses the determinants of the success of academic entrepreneurship mentioned above (team composition, structure, collaboration with industry, faculty education, and mission statement). The characteristics of an entrepreneurial university (as per the definition in section 2.1 above) are primarily driven by these determinants of the success of academic entrepreneurship. The table below shows the alignment of these (Table 1).

*Table 1: Alignment between Determinants of Academic Entrepreneurship, Characteristics of Entrepreneurial Universities and Intellectual Capital (IC) Indicators*

<b>Intellectual Capital (IC) indicator</b>	<b>Academic Entrepreneurship determinant</b>	<b>Entrepreneurial University characteristic</b>
Human Capital (HC)	Team Composition	New managerial ethos in governance, leadership, and planning
Structural Capital (SC)	Structure, Faculty Education, Mission Statement	Organisational structures which respond better and adapt to the external environment
Relational Capital (RC)	Collaboration with industry	Orientation toward innovation and the development of an entrepreneurial culture

Table 1 shows how we can use the TTO as a unit of measurement of the entrepreneurial characteristics of a university, as universities primarily act through their TTO's in engaging in entrepreneurial activities. Furthermore, Table 1 shows how we can use intellectual capital indicators to assess how successfully a TTO is engaging in academic entrepreneurship.

Secundo et al's., (2016; 2017a) metric of TTO performance captures the relative presence (5) to absence (0) of several intangible indicators in the areas of human resources, IP strategy and policy, university-industry links, networks, technology, and organisation design and structure.

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3 The ‘human resources’ aspect of the TTO identifies their skills sets. ‘IP strategy and policy’  
4 focus on the institutional support given to academic entrepreneurship. ‘University-industry’  
5 links indicate the TTO’s self-perception of their understanding of the needs of industry, whereas  
6 ‘networks’ indicate the extent of actual interaction between the parties involved. ‘Technology’  
7 emphasises the importance of the stage of development of the disclosed technology, as well as  
8 the academic merit of the discloser. Finally, ‘organisation design and structure’ looks at the TTO  
9 features (e.g. size, age) and surrounding support functions (e.g. presence of a medical school,  
10 business school) – see Appendix 1. As substantiated by the discussion above, these areas align  
11 with the tripartite classification of IC:  
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- 14 - Human Capital – Human Resources, Technology
  - 15 - Structural Capital – IP strategy and policy, Organisation design and structure
  - 16 - Relational Capital – University-industry links, Networks
- 17  
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19 Using these non-monetary and intangible indicators, the metric calculates an average score for  
20 the performance of academic entrepreneurship and shows the access the TTO *perceives* it has to  
21 IC. The performance metric therefore determines the access the TTO has to 5 HC indicators, 13  
22 SC indicators and 6 RC indicators which show to influence the performance of the TTO. For  
23 universities seeking to increase academic entrepreneurship, these thematic areas are within the  
24 realm of influence of the university. What this means, practically, is that the university can  
25 strategically intervene to improve the performance of its TTO by leveraging IC and developing  
26 the necessary policies to create an enabling environment for the TTO, resulting in increased  
27 academic entrepreneurship. Furthermore, specific indicators within these thematic areas  
28 influence the characteristics of an entrepreneurial university (Table 1), and as such, by  
29 investigating these indicators in detail the university may gain insights into driving its pursuit of  
30 entrepreneurialism.  
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### 34 **3. Methodology**

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36 To recap, the aim of this paper is to illustrate how an IC-based TTO performance metric, could  
37 be applied so as to support a university’s entrepreneurial efforts. Methodologically, we have  
38 taken the Secundo et al (2016; 2017a) performance metric which highlighted 6 thematic areas  
39 which influence the performance of TTOs and identified proxy indicators for each of these. We  
40 then embodied these within a survey instrument using Dillman’s (2007) tailored design method.  
41 This method is a set of procedures for conducting successful, self-administrated surveys that  
42 produce both high-quality information and high response rates. All the indicators were measured  
43 through adequately modified scales previously tested and used by other researchers. The  
44 indicators, as embodied in their corresponding IC classifications, were rewritten as a statement,  
45 and respondents were asked to indicate the level of their agreement with 24 statements on a five-  
46 point Likert scale, ranging from “strongly disagree” to “strongly agree” (Kalar & Antoncic,  
47 2015).  
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#### 51 *3.2 Data Collection*

52 All surveys were administrated electronically to the email addresses of TTO staff. Data on TTOs  
53 and their staff were collected using the websites of individual universities. To allow the cross-  
54 cultural generalisation of our findings, we sent the survey to 116 TTOs in the UK and 118 TTOs  
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in continental Europe. The responses, on the five-point Likert scale, were weighted to determine the performance of the TTO and visualised to illustrate the TTO's access to university IC. The survey had a response rate of 23%, and all respondents were contacted for follow-up interviews. 34 TTOs agreed to be interviewed.

### 3.3 Data Analysis

The characteristics of the 34 university TTOs who participated in the survey and follow-up interviews were summarised. Given the university's ability to configure the organisational structure of the TTO, the organisational structure of each TTO (internal, external and mixed) was investigated during the interview phase. Furthermore, given that the university determines the mission statement of the TTO, each interviewed TTO was also asked what their mission statement is, and it was broadly grouped into commercial, impact focussed or relationship-building.

Following the alignment between IC, academic entrepreneurship determinants and characteristics of the entrepreneurial university (as described in Table 1) the responses to the statements in the survey which captured these were examined in detail. Table 2 below shows which statements were examined. The structure of the TTO and mission statement were evaluated during the interview phase.

Table 2: Statements from the survey which were investigated in detail and compared

Intellectual Capital Category	Indicator
Human Capital	Staff experience Staff expertise
Structural Capital	Faculty involvement Faculty education on IP
Relational Capital	TTO understands the needs of industry Industry education on knowledge and technology transfer

## 4. Findings and Discussions

The characteristics of the 34 university TTOs (Table 3) and survey data are given below with a brief explanation and discussion of the results. The three over-arching organisational structures observed are also outlined. A succinct description of the three thematic areas covering the mission statements is also given. The survey data which best captures the characteristics of the entrepreneurial university (as highlighted in Table 2) are also studied in detail.

The survey data was used to determine the efficiency of each TTO as per the method described in Secundo et al., (2016), and are given in Table 3 below. For the purpose of anonymity of the data, only the countries in which the university TTOs are located are given. The figure in brackets is the current Global Innovation Index rating for the country (which aims to capture the multi-dimensional facets of innovation) (Cornell University et al., 2018). The remainder of Table 3 gives the organizational structure, and the mission statement of the TTO, as captured during the interview phase. It is important to note that 3 TTOs did not have a clearly defined mission statement.

Table 3: Characteristics of 34 university TTOs

	<b>Country</b>	<b>Efficiency Score</b>	<b>Organizational Structure</b>	<b>Mission</b>
1	UK (4)	64.97	External	Commercial
2	UK (4)	66.49	External	Commercial
3	France (16)	58.92	External	Not defined
4	Germany (9)	36.96	External	Not defined
5	Germany (9)	47.88	External	Not defined
6	Austria (21)	38.69	Internal	Commercial
7	Belgium (25)	45.76	Internal	Commercial
8	Belgium (25)	58.46	Internal	Commercial
9	Denmark (8)	55.59	Internal	Commercial
10	Spain (28)	47.82	Internal	Commercial
11	UK (4)	53.81	Internal	Commercial
12	Czech Republic (27)	52.65	Internal	Impact
13	Greece (42)	40.59	Internal	Impact
14	Italy (31)	40.67	Internal	Impact
15	Romania (49)	50.29	Internal	Impact
16	UK (4)	48.47	Internal	Impact
17	UK (4)	48.96	Internal	Impact
18	Belgium (25)	58.48	Internal	Relationships
19	Czech Republic (27)	46.89	Internal	Relationships
20	Czech Republic (27)	48.27	Internal	Relationships
21	Czech Republic (27)	52.25	Internal	Relationships
22	Czech Republic (27)	56.72	Internal	Relationships
23	Estonia (24)	57.89	Internal	Relationships
24	Germany (9)	46.78	Internal	Relationships
25	Netherlands (2)	54.07	Internal	Relationships
26	Poland (39)	51	Internal	Relationships
27	UK (4)	50.06	Internal	Relationships
28	UK (4)	57.14	Internal	Relationships
29	Netherlands (2)	54.1	Mixed	Commercial
30	Sweden (3)	63.62	Mixed	Commercial
31	Switzerland (1)	65.12	Mixed	Commercial
32	Belgium (25)	56.62	Mixed	Relationships
33	Bulgaria (37)	54.79	Mixed	Relationships
34	UK (4)	52.35	Mixed	Relationships

The efficiency scores can range from 15,57 (Awareness stage) to 77,85 (Sustained stage). The majority of the university TTOs in the sample are between the Managed (36,34 – 57,09) and Integrated (57,10 – 77,84) stages (Secundo et al., 2016). All scores above 50 are given in green, and all scores above 60 are given in blue to indicate the higher performing TTOs in our sample.

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4 The governance and organisational structure of the TTO in relation to the wider university is  
5 likely to affect the ability of the TTO to access to IC. Brescia et al., (2016) present three  
6 knowledge transfer organisational models (internal, external, and mixed):  
7

- 8  
9 1) An internalised structure is when a TTO is viewed equivalently to a department or office  
10 within the university but functions independently from other departments. These internal  
11 offices have a low degree of autonomy and report at various levels within the university.
- 12 2) An externalised structure is where a TTO company is established physically outside of,  
13 but wholly owned by, the university. These external offices have a high degree of  
14 autonomy, often being governed solely by an external board.
- 15 3) The mixed structure is where the TTO is held internally as a central office, but supported  
16 by other offices (marketing, legal) or IP scouts (faculty level technology transfer officers)  
17 or an external office (business incubator or holding company) or variations thereof. Due  
18 to the variety of offices involved in this hybrid structure, the autonomy of the TTO  
19 varies, but most often the central TTO has autonomy from other offices but reports  
20 internally.  
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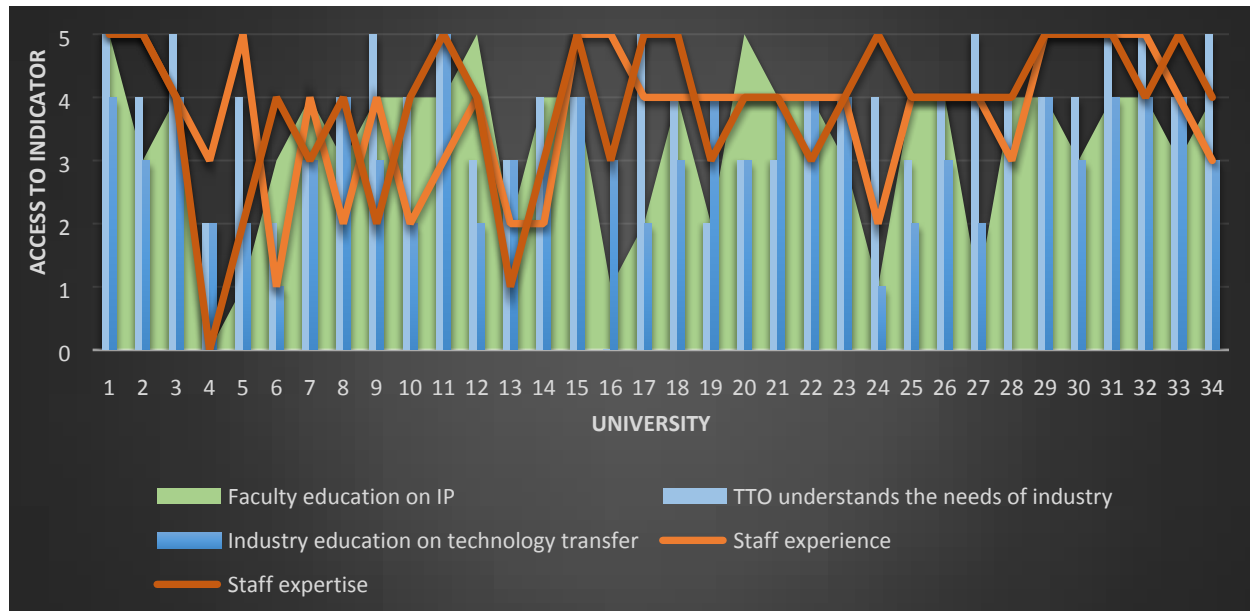
24 Table 3 shows the following complement of organisational structures: 6 Mixed; 24 Internal; 5  
25 External. Based on the efficiency scores of the TTOs it seems the mixed organisational structure  
26 is the most favourable.  
27

28 The mission statement of the TTO should influence which aspects of academic entrepreneurship  
29 the TTO most actively engages in (Libecap et al., 2005). As such, when the university leadership  
30 prioritises certain activities, the mission statement of the TTO should reflect this. Ideally, the  
31 mission statement of the TTO should then also influence the development and leveraging of  
32 appropriate IC so that TTOs can fulfil these missions. Table 3 shows the following complement  
33 of mission statements: 11 Commercially focussed; 14 focussed on relationship building; 6  
34 focussed on impact; and 3 that are undefined. Based on the efficiency scores of the TTO it seems  
35 the combination of a mixed organizational structure with a commercial or relationship focussed  
36 mission statement results in greater success in academic entrepreneurship. Furthermore, the  
37 combination of an internal organizational structure with an impact focussed mission statement  
38 seems to be a more favourable combination.  
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42 We therefore advocate that the university organisational structure in relation to the TTO, and the  
43 TTO mission statement should be aligned to facilitate enhanced access to IC, in the appropriate  
44 balance of its sub-components. This is more likely (than where these elements are mis-aligned)  
45 to give rise to an efficient and effective TTO which promotes academic entrepreneurship and the  
46 universities' pursuit of entrepreneurialism. Our findings should, however, be interpreted with  
47 caution due to the small sample size.  
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50 The survey data for the 34 TTOs, focussing on the statements in Table 2 are given in figure 1  
51 below.  
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Figure 1: Survey data on entrepreneurial characteristics



Some of the determinants of success mentioned earlier include the team composition of TTOs (Muscio, 2010) which forms part of human capital (indicated by Staff experience and expertise, the orange lines in figure 1 above). Surprisingly, even the best performing TTOs in our sample have comparatively low access to HC. This suggests, university leadership may intervene to improve both the skills of the TTO staff and their ability to access and leverage, the skills of faculty and other staff across the university. The faculty's views on the merits of commercialisation and their role in the process (Sideri and Panagopoulos, 2016) can be influenced by education in entrepreneurship (indicator 3, the green area in figure 1 above), which the university might seek to provide as standard provision within compulsory, introductory, staff induction sessions or other staff training and development as ongoing provision. Another determinant, the extent of collaboration with industry (Villani et al., 2017), is encapsulated in relational capital (indicators 4 and 5, the blue columns in figure 1 above). There seems to be a clear positive relationship between access to RC and TTO performance, which supports the work by Villani et al. (2017).

## 5. Conclusion and Recommendations

This research builds on previous work and utilises the TTO as a unit of observation for academic entrepreneurship within the entrepreneurial university. Research on the performance of entrepreneurial universities is very limited, and this study represents an early attempt to apply a hitherto, conceptual performance measure based on the broader notion of intellectual capital. We acknowledge the limitation of our findings given they are founded on the examination of 34 universities however, future work will seek to expand that dataset to universities beyond Europe and the UK. Nevertheless, this paper has illustrated how a TTO performance metric, based on access to IC can be used to gain insights into how the TTO might more effectively aid university entrepreneurialism. However, the performance of the TTO is not just an empirical issue, but also

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3 has ramifications for university management and university policy in relation to the purpose of  
4 modern universities (Anderson et al., 2007).  
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7 The findings have shown how access to IC can influence the performance of the TTO. The  
8 measure of IC used here captures multiple (both tangible and intangible) resources, which can  
9 affect the effectiveness of the TTO in pursuing academic entrepreneurship. Two other factors  
10 within the control of senior university governing bodies, namely organisational structure and  
11 mission statement were also shown to have an impact upon the TTO performance. The  
12 organisational structure of the TTO and its mission statement are closely linked, and together,  
13 they influence how well the TTO is able to access and leverage IC to enhance the entrepreneurial  
14 efforts of academics and the university more broadly. Given that the TTO is responsible for  
15 academic entrepreneurship, and the university seeks to pursue entrepreneurialism, senior  
16 university bodies (e.g. university councils) may then strategically intervene to align the TTO  
17 mission, and position in relation to the rest of the university structure, accordingly. As stated  
18 before, entrepreneurialism is the spirit or state of acting in an entrepreneurial manner. Therefore,  
19 the university can gain insights from the performance of the TTO and leverage IC as a means to  
20 pursue this.  
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24 This paper opens up a new perspective for studying the performance of the TTO of  
25 entrepreneurial universities based on IC. In resonance with the literature review above which  
26 indicated that narrow measures of university entrepreneurship based on patents and other forms  
27 of tangible intellectual property (IP) fail to adequately capture the range of activities in which  
28 entrepreneurial universities are active, we advocate, on the early evidence provided in this study,  
29 that universities should seek to broaden their IP policies (which typically govern academic  
30 entrepreneurial efforts) to incorporate the notion of intellectual capital (IC). Alongside the IC  
31 policy, the university should seek to place the TTO within an organisational structure that  
32 enables it to gain maximum access to IC (in whichever balance of its subcomponents – HC, RC  
33 and SC, as is necessary to achieve this). Similarly, the anticipated IC policy would align the  
34 organisational structure of the TTO with the mission statement for academic entrepreneurship the  
35 university holds. As one might expect, a TTO with a relationship-building mission statement  
36 would need an organisational structure which supports networking and university-industry  
37 linkage activities, and access to the RC of the university to enable the achievement of this  
38 mission. Therefore, the IC policy would enable access to RC but also inform how the SC of the  
39 entrepreneurial university may be restructured to promote academic entrepreneurship.  
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44 The scope of the IP policy could also be enhanced to become an IC policy by, for example  
45 creating incentives for a range of both academic, and professional services staff to work with  
46 TTO, in terms of marketing support, legal support, or independent external expert advice. This  
47 will enable greater access to HC which is improves the performance of the TTO. Similarly,  
48 creating structures for staff to share their networks more effectively with the TTO (if TTO is  
49 searching for contacts with specific industry partners) would enable to the TTO to access more  
50 RC and in this way, potentially more successful academic entrepreneurship.  
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53 The 5 TTO performance indicators (as detailed in Table 2 above) which were specifically  
54 investigated as proxies for entrepreneurial characteristics in universities show a positive  
55 relationship with TTO performance. Better performing TTOs seem to have greater access to  
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these indicators. Future work will further explore these proxy indicators to determine how universities may position themselves, and their TTO as the main body for academic entrepreneurship, strategically to enhance entrepreneurial activity. However, these findings are a good indication of the appropriateness of using the TTO as a unit of observation in assessing entrepreneurialism within the university.

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**Appendix 1: Self-assessment tool created by Secundo et al., 2016.**

IC	Likert scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Survey Weight
HC	<b>Human resource</b>						
	At least one staff member has the expertise to manage the licensing portfolio as a set of options					4	80%
	TTO has sufficient number of staff					3.9	78%
	At least one staff member has marketing experience					3.6	72%
HC	<b>Technology</b>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
	Most technologies disclosed to TTO is not at an early stage					2.7	54%
	Most faculty members who disclose are Professors					1.65	33%
SC	<b>IP Strategy and policy</b>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
	A clear, transparent and consistent vision for technology transfer, with strategic goals and priorities.					4.15	83%
	Frequent and reciprocated involvement with faculty					3.85	77%
	Sufficient resource allocation to TTO					3.75	75%
	Provide education to overcome informational and cultural barriers between TTO and Faculty					3.25	65%
	Incentives for faculty to disclose					3.2	64%
	Royalty shares for faculty					3.05	61%
	Incentives for TTO staff					2.75	55%
SC	<b>Organization design and structure</b>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
	A business incubator is available for faculty					3.35	67%
	TTO has been established for 10 years or more					2.8	56%
	TTO has a decentralized management style					2.65	53%
	University has a medical school					2.55	51%
	TTO is positioned externally to the University					2.5	50%
	University is publicly owned					1.95	39%
RC	<b>Networking</b>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
	TTO has personal relationships with faculty					3.95	79%
	Formal and/or informal networking between faculty and TTO					3.5	70%
	TTO facilitates formal and/or informal networking between scientists					3.1	62%
RC	<b>University-Industry links</b>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
	TTO understands the needs of industry					4.45	89%
	TTO facilitates formal and/or informal networking between faculty and industry					4	80%
	Provide education to overcome informational and cultural barriers between TTO and industry					3.2	64%

Table 1: Alignment between Determinants of Academic Entrepreneurship, Characteristics of Entrepreneurial Universities and Intellectual Capital (IC) Indicators

Intellectual Capital (IC) indicator	Academic Entrepreneurship determinant	Entrepreneurial University characteristic
Human Capital (HC)	Team Composition	New managerial ethos in governance, leadership, and planning
Structural Capital (SC)	Structure, Faculty Education, Mission Statement	Organisational structures which respond better and adapt to the external environment
Relational Capital (RC)	Collaboration with industry	Orientation toward innovation and the development of an entrepreneurial culture

Table 2: Statements from the survey which were investigated in detail and compared

Intellectual Capital Category	Indicator
Human Capital	Staff experience Staff expertise
Structural Capital	Faculty involvement Faculty education on IP
Relational Capital	TTO understands the needs of industry Industry education on knowledge and technology transfer

Table 3: Characteristics of 34 university TTOs

	Country	Efficiency Score	Organizational Structure	Mission
1	UK (4)	64.97	External	Commercial
2	UK (4)	66.49	External	Commercial
3	France (16)	58.92	External	Not defined
4	Germany (9)	36.96	External	Not defined
5	Germany (9)	47.88	External	Not defined
6	Austria (21)	38.69	Internal	Commercial
7	Belgium (25)	45.76	Internal	Commercial
8	Belgium (25)	58.46	Internal	Commercial
9	Denmark (8)	55.59	Internal	Commercial
10	Spain (28)	47.82	Internal	Commercial
11	UK (4)	53.81	Internal	Commercial
12	Czech Republic (27)	52.65	Internal	Impact
13	Greece (42)	40.59	Internal	Impact
14	Italy (31)	40.67	Internal	Impact
15	Romania (49)	50.29	Internal	Impact
16	UK (4)	48.47	Internal	Impact
17	UK (4)	48.96	Internal	Impact
18	Belgium (25)	58.48	Internal	Relationships

19	Czech Republic (27)	46.89	Internal	Relationships
20	Czech Republic (27)	48.27	Internal	Relationships
21	Czech Republic (27)	52.25	Internal	Relationships
22	Czech Republic (27)	56.72	Internal	Relationships
23	Estonia (24)	57.89	Internal	Relationships
24	Germany (9)	46.78	Internal	Relationships
25	Netherlands (2)	54.07	Internal	Relationships
26	Poland (39)	51	Internal	Relationships
27	UK (4)	50.06	Internal	Relationships
28	UK (4)	57.14	Internal	Relationships
29	Netherlands (2)	54.1	Mixed	Commercial
30	Sweden (3)	63.62	Mixed	Commercial
31	Switzerland (1)	65.12	Mixed	Commercial
32	Belgium (25)	56.62	Mixed	Relationships
33	Bulgaria (37)	54.79	Mixed	Relationships
34	UK (4)	52.35	Mixed	Relationships

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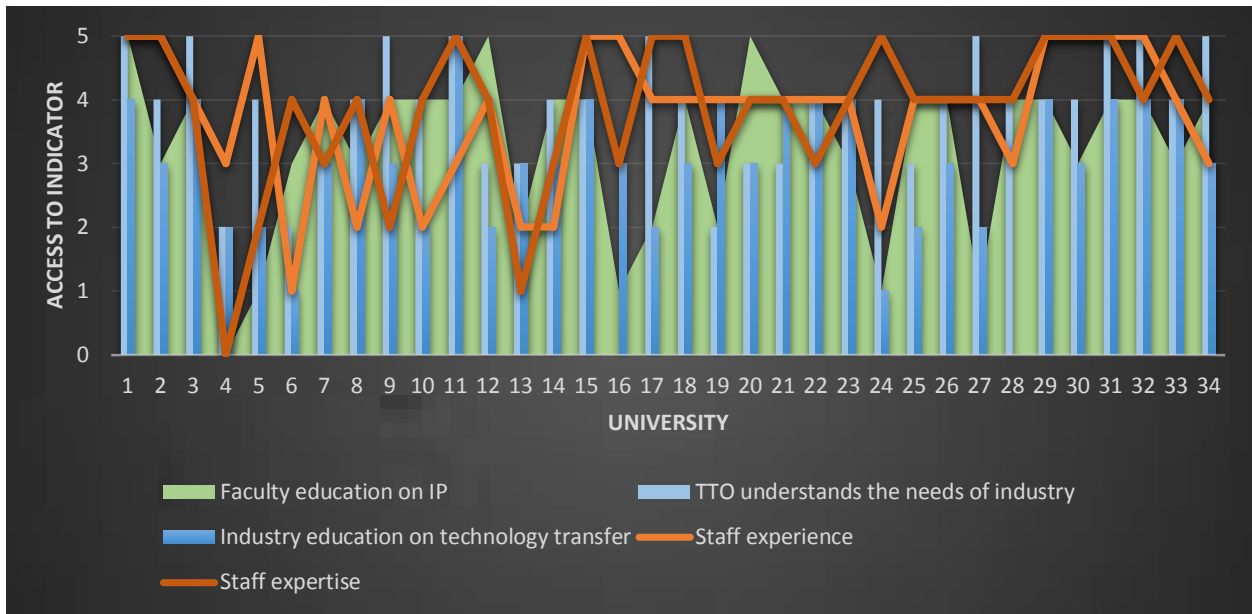
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Measuring Business Excellence

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Figure 1: Survey data on entrepreneurial characteristics



Business Excellence