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Does usable research face higher obstacles within the academy?

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Julia Olmos-Peñuela, Department of Business Administration “Juan José Renau Piqueras”
(University of Valencia)
julia.olmos@uv.es

Paul Benneworth. CHEPS (University of Twente)
p.benneworth@utwente.nl

Elena Castro-Martínez
INGENIO (CSIC-UPV), (Universitat Politècnica de València)
ecastrom@ingenio.upv.es

Series Editor Contact:

Paul Benneworth, Katharina Lemmens-Krug & Franziska Eckardt
Centre for Higher Education Policy Studies
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands
T +31 53 – 4893263
F +31 53 – 4340392
E p.benneworth@utwente.nl
W www.utwente.nl/cheps

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Abstract

The recognition of academic research as a potential source of economic growth and social welfare has attracted the attention of both policy-makers and academics over the past decades. But emphasising the impact of research brings a new set of tensions to scientific governance processes, and raises the risk that academics who engage more with users be hindered in pursuing their research activities. In this paper, we seek to understand whether researchers that meaningfully engage with societal users in their research micro-practices face additional obstacles in their research, whether in terms of the acceptance of that research by academic communities and the absorption of that knowledge by users. To do this, we draw on a recent approach to knowledge production highlighting the importance of ‘openness’ of research practices in influencing the subsequent societal usability of that knowledge. Openness occurs by involving users in research practices, and we therefore ask the question of whether researchers who use open research practices do indeed suffer additional obstacles to their research. Drawing on a questionnaire of 1583 scientists working for the largest Spanish Public Research Organisation, we identify that the greatest obstacles that all researchers face are in administrative structures, which make it harder to engage with users. Less-open users tend to experience fundamental obstacles in their engagement, such as a lack of interest from users or a lack of acceptance by other academics, whilst more open researchers experience problems relating to the practices of managing technology transfer projects. We conclude by arguing that a differentiated support structure is need to assist academics with user engagement reflecting their past experience as well as the need for a rethink of how research organisations situate user engagement in their administrative structure.

Keywords: societal engagement; obstacles; openness; academic norms; research management.

1. Introduction

The recognition of academic research as a potential source of economic growth and social welfare has attracted the attention of both policy-makers and academics over the past decades. On one side, policy makers are interested in identifying and promoting the research that makes an impact on society. We see for example at the European scale that there has been a transformation in the way that research funding is organised within the framework programme, deliberately seeking to make it more impactful in society. Whilst early ‘Framework Programmes’ within Europe concentrated on creating excellence and critical mass within academic communities, since 2014, there has been a dominant emphasis on funding European research that contributes to addressing societal challenges, something that will become dominant in the Horizon Europe programme after 2020. Likewise, we see that national research councils have changed their orientation, often increasing the emphasis on more applied research, or creating funding streams particularly oriented towards creating societal impact and addressing societal challenges (Maxwell and Benneworth, 2018).

In response to this, academics have generally demonstrated a willingness to produce societal impact from research, often justified in terms of their duties to society as well as ensuring public support for their activities (Gibbons et al., 1994; Ziman, 1996). Much research has emphasised the value that engagement can bring to academic researchers, by increasing the access to resources, providing interesting new research questions and in helping to identify potential partners, collaborators and customers (Fransman, 2018). But at the same time, there is an increasing recognition that this engagement activity can also have undesirable effects, what Bozeman et al. (2013) call the ‘dark side’ of engagement. There is also resistance within academic communities to the potential limitations this increasing engagement may impose upon academic freedom by allowing other stakeholders a potential voice in what should arguably be academic decisions. Therefore, we postulate that despite an increasing policy emphasis on engagement, any potential deficit in terms of an academic shift towards embracing engagement is a consequence of potential problems that engagement brings for academic activities.

Our argument begins from the perspective of cognateness as a prerequisite of knowledge transfer; incorporating user knowledge in the research process reduces the cognitive distance between producer and user and thus facilitates its eventual use. But the Bozeman dilemma is salient here – cognateness also gives users more potential control over the direction of that research, potentially undermining the academic validity of that research performed (Hodgkinson et al., 2001; Fincham and Clark, 2009; Kieser and Leiner, 2009). We contend that incorporating external knowledge into research processes could create barriers for academics in their research activities that are not

experienced by those that do not engage with user knowledge. Defining openness as the quality of incorporating user knowledge into research processes, we specifically ask the research question of whether open researchers encounter different kinds of obstacles to engagement with users than less-open researchers.

We conceptualise this in terms of an emerging literature that highlights that research micro-practices that incorporate user knowledge ultimately make that knowledge more absorbable by user communities, a property elsewhere named as ‘openness’ (Olmos-Peñuela, et al., 2015). Using a survey of approximately 1580 scientists in Spain, we explore the obstacles scientists face in establishing relationships with external partners. We specifically ask whether those scientists more active in incorporating user knowledge into their own research micro-practice encounter more obstacles to engagement, and more frequently, than other scientists who do not incorporate external knowledge in their practices. On that basis, we argue that more consideration need be given to incentivising shifts within the norms of scientific communities using collective policy instruments rather than seeking to incentivise and regulate individual scientists to engage directly in user engagement in their scientific practices.

2. Understanding engaged scientists within autonomous scientific communities

To address our research question, we propose a heuristic to explain why policy efforts to stimulate engaged practice by researchers would fail to transform the scientific communities within which academic knowledge production is organised. There are three key elements in this model. The first is that we regard scientific practice as taking place within governance systems in which scientists and societal partners agree common subjects of interest to coordinate scientific progress, which ultimately shape norms and beliefs of what constitutes ‘good’ research. We then secondly conceptualise user engagement in a research process in terms of the property of ‘openness’; openness arises when knowledge is created making use of user knowledge (within five micro-practices). Open practices make the resultant knowledge more usable by societal partners, but at the same time make the researcher more interdependent with the user. We then argue researchers who seek to make their research more usable through these open practices may experience different kinds of obstacles in building up those external connections, that may in turn serve as a disincentive for researchers to seek to make their research more usable by societal partners.

2.1 Science as a meso governance system of individual researcher coordination

Our starting point for understanding academic behaviour is to consider it as being constituted within communities of likeminded researchers, often following disciplinary lines, with a set of common agreements about what constitutes good research practices. Scientific derives strength from these communities being remote ('epistemic') and imagined, giving individual researchers commonalities with other scientists with whom they have never met, on the basis of their mutual identification with particular research activities. The governance of these scientific communities collectively coordinates research agendas by defining both what are the legitimate class of objects for study, as well as internally prioritising which of those questions most urgently require attention (Gläser, 2012). The fundamental unit of the community are individual knowledge creators, scientists, who are proactive and interactive. They are proactive, creating knowledge which they attempt to make legitimate in the eyes of the academic community (Medawar, 1972, cited in Bell, 2014). They are interactive because members of a scientific community signal to each other how legitimate they regard newly created knowledge to be (Latour and Woolgar, 1979).

Proactive interactivity guides coordination because individual scientists plan future knowledge production activities to ensure they create knowledge that their community regards as legitimate and useful. Coordination comes through mechanisms, some of which are tangible, for example journals, learned societies, newsletter and funding programmes, that make explicit quality judgements. However, other coordination mechanisms are intangible and mediated through norms internalised by scientists on the basis of their past experiences where they individually anticipate how they will be judged, and adjust their behaviours accordingly (Knorr-Cetina, 1981; Elam and Bertilsson 2003; Maxwell and Benneworth, 2018). These mechanisms allow communities of scientists at a distance to develop collective and shared common understandings of what constitutes 'good' academic practice.

Any kind of behavioural shift within scientific communities therefore involves shifts in those underlying norms which drive those behaviours, and norms which emerge in anticipation of judgements to be made by peer communities shaped by past individual experiences of being judged (Knorr-Cetina, 1981). The corollary of this is that new norms will only emerge where the wider peer community legitimates those norms. If scientists resist these norms, and those behaviours are adjudged to be illegitimate, this will prevent the standardisation and adoption of these norms. In terms of the norms governing engagement, the dominant perspective has long been that of 'Mertonian' science: 'good' research is characterised by individual researchers proceeding without excessive outside interference, dispassionately creating new knowledge to answer urgent community research (Merton, 1973). In this

paper, therefore, we contend that any deficit in terms of researcher resistance to engaging with society can at least partly be explained in terms of a resistance effect where those norms are rejected by communities as exogenous and invalid.

One feature of research communities is that it is not just academic scientists that are members, but also societal users who have an interest in absorbing and utilising that knowledge. Kitcher (2001) describes this situation as ‘well-ordered science’: where governance arrangements ensure a balance between user demands for useful knowledge and knowledge producer (researcher) interests in high-quality knowledge. Sarewitz and Pielke Jr (2007) argue that under well-ordered science, “science that is maximally responsive to the needs and values of those may have a stake in the outcomes of the research” (2007: 9), and grounded on self-conscious deliberative processes, offers the greatest chance for the creation of societal impact. As Sarewitz and Pielke Jr (2007) note, the concept of well-ordered science is an ideal type representation in which outside interests are incorporated into the everyday practices of the scientific endeavour, namely choosing research questions, undertaking research, and disseminating that research. Well-ordered science provides the best coupling between the supply side (knowledge-circulating public creators) and the demand side (knowledge-transforming private users) of the research endeavour, where users are involved in the decisions in the everyday business of science. This ensures that research takes into account socio-economic problems and needs, working with and not against scientific governance (Gibbons et al., 1994; Ziman, 1996).

2.2 Usability of knowledge as a consequence of open research micro-practices

Literature about knowledge transfer has focused on analysing diverse aspects related to university-industry collaborations (within science-society interactions) such as the different channels used to establish collaborations with external partners (D’Este and Patel, 2007; Landry et al., 2010), individual characteristics affecting these interactions (Boardman and Ponomariov, 2009; Giuliani et al., 2010), organizational and institutional characteristics (Bekkers and Bodas-Freitas, 2008; Ponomariov and Boardman, 2008) affecting collaborations, and motivations for engaging in collaborations (Baldini et al., 2007; D’Este and Perkmann, 2011; Lam, 2011; Ramos-Vielba et al., 2016), among others (see Perkmann et al. (2013) for a review).

A recent approach to knowledge translation reflecting the behavioural turn in science studies has identified “openness” as a characteristic of conducting research by which including external knowledge in the research makes newly created knowledge more amenable to eventual translation (Olmos-Peñuela et al., 2015; Benneworth and Olmos-Peñuela, 2018). In incorporating that external knowledge into ongoing science activities, open research allows external interests, knowledge and

considerations the opportunity to become salient to the business of science. Thus, open research micro-practices may lead to the production of knowledge more cognate to users' needs (Gibbons et al., 1994; Nowotny et al., 2001; Amin and Cohendet, 2004; Isaksen and Karlsen, 2010). Even where the knowledge that is created is produced in a scientifically rigorous way, the incorporation of user knowledge increases its potential to ultimately be relevant, and hence generate an impact beyond the academic sphere. This influences the eventual knowledge resulting from those research projects, and ultimately how easy it will be for that knowledge to then be translated to external users.

Open behaviour involves a range of active practices by scientists to ensure that external user research is incorporated into research. Olmos-Peñuela et al. (2015) extend Kitcher (2001)'s list of micro-practices within which coordinating governance is exercised to cover five categories of scientific practice – defined as reframing, inspiration, planning, execution and dissemination – where openness can be observed. The key criterion here for an open practice is that through the incorporation of external knowledge it allows some kind of external actor (outside science) to make an assertion about what matters, and to codetermine the outcome of the scientific decision-making. The incorporation of the societal knowledge brings with it a signal of external interest that in turn shapes what scientists choose to do. This is not the same as 'dissemination' or 'user curiosity on science, where there is no feedback of the societal interest.

The five micro-practices of open research are defined by Olmos-Peñuela et al. (2015: 384) as:

- "Reframing: deciding a future personal research agenda of potential interesting questions, partly shaped by past research; researchers whose past research has been affected by external influences starts from a knowledge base of usable knowledge;
- Inspiration: identifying one potential question as one to which the individual can commit to do more research activity; researchers may be inspired by users or external issues for a concrete future research project idea;
- Planning: producing a tangible method and plan to answer a specific question; a researcher may include external knowledge, interests and needs as key research resources within that proposal ('pro-social' behavior, D'Este et al., 2016).
- Execution: undertaking a piece of research, gathering and analysing data to make a scientific contribution; a researcher may incorporate external knowledge in its implementation;
- Societal dissemination: presenting results in ways accessible to potential users; a researcher may arrange dissemination activities together with users in ways that allow users to provide feedback, to inspire new insights or future usable research orientations."

2.3 Obstacles to research legitimization emerging from resistance to open research practices

Although there is increasing interest in the exploitation of academic knowledge for external (non-academic) purposes, there is a growing strand of literature that highlights the problems that that exploitation brings. Bozeman et al. (2013) refer to the notion of ‘the dark side of engagement’ as a set of value failures that emerge when scientists pursuing external purposes (notably around commercialisation) experience pressures that potentially steer them excessively towards these external purposes (and often privileging private benefits). Involving external interests in scientific governance processes raises the possibility that decisions will be taken in ways that do not foreground what academic communities regard to be important (and indeed promote what academics regard as being invalid or undesirable from a Mertonian perspective). In these circumstances, there is a negative effect for science as a whole through the distortion of the governance mechanisms which steer and prioritise scientific communities (and resources) towards questions worth investigating further. Individuals who engage in open research practices risk finding the knowledge they create rejected as invalid. At the same time, we note that this effect may be disciplinarily segmented because of the relative low propensity of social sciences and humanities to commercialisation activity relative to other disciplines (Olmos Peñuela et al., 2014a; 2014b).

We see a problem here potentially arising when those practices incorporating external knowledge allow external actors the opportunity to co-determine core scientific issues. By representing a clear move away from Mertonian scientific norms and patterns, these may potentially generate resistance from scholarly communities (Hessels and Van Lente, 2008; Leisyte et al., 2008). Dasgupta and David (1994) identified that when researchers’ practices deviate from Mertonian scientific norms, they experience an increased level of obstacles to their research (what Tartari et al. (2012) identified as orientation barriers). These obstacles are related with secrecy (confidentiality issues, constraints for publishing research results), with skewing (the loss of freedom in choosing research topics and the ultimately changes in the research agenda as a result of this collaborations) and with the risk of losing scientific credibility (Lee, 1996; Gulbrandsen and Smeby, 2005; Tartari and Breschi, 2012; Ramos-Vielba et al., 2016). These represent fundamental obstacles for academics, in that they can lead to a piece of research being potentially rejected as invalid; or in the language of D’Este et al. (2012), they are ‘detering barriers’, preventing activities from taking place.

At the same time, open behaviour may potentially also bring costs associated with those additional actions. A second type of obstacles are related with transactional barriers (Tartari et al., 2012) such as the lack of institutional support or the lack of information and structures (such as transfer offices) to

establish collaborations (Siegel et al., 2004). Benneworth and Olmos-Peñuela (2018) raise the spectre of ‘closed’ academic researchers responding by simply circulating ideas within limited cliques of likeminded academics with no usability for societal stakeholders. At a time when it is clear that academics are under rising pressures to deliver against targets we can see that open research practices bring with them various kinds of additional costs. We postulate that those additional costs represent opportunity obstacles for academics, might be one explanation for the relatively low diffusion of these open practices, what D’Este et al. (2012) call ‘revealing barriers’, that are only disclosed when people undertake engaged research practices.

Our contribution to the field of Sarewitz and Pielke Jr (2007) is integrating literatures on knowledge production and the literature on knowledge transfer related to the barriers to societal engagement. On this basis, we expect there would be more resistance to research activities which gave external actors a greater codetermination role (open) than those in which the determination lay entirely in the hands of the academic actors (unidirectional). We therefore in this paper specifically explore whether academics that conduct research following an ‘open’ approach (those who create knowledge cognate with users) experience more and different kinds of obstacles in their research, and specifically in the engagement associated with that research. Thus, the key theoretical frameworks that will be used are the “openness” approach (Olmos-Peñuela et al., 2015) and the literature on societal engagement obstacles (Tartari and Breschi, 2012; Tartari et al., 2012; Ramos-Vielba et al., 2016).

2.4 Our overall model and research questions

Therefore, in this paper we specifically look at this issue of whether researchers who systematically incorporate external knowledge in their research encounter different obstacles to engagement than researchers who do not incorporate that external knowledge, specifically asking the following research question:

Do open researchers encounter different kinds of obstacles to engagement with users than less-open researchers?

Thus the aim of the study is to address the following three operational research questions:

RQ 1. Do researchers that seek to make their knowledge more accessible to society (cognate to users) experience more obstacles than scientists that follow more Mertonian norms?

RQ 2. Which kinds of obstacles are most experienced by scientists in terms of why it is hard to work with users?

RQ 3. What kinds of policy frameworks and approaches could help steer the academic system to reduce the obstacles and barriers experienced by scientists deviating from Mertonian norms?

3. Methodology

3.1. Questionnaire and sample

To answer these three research questions, we draw upon an empirical study on the Spanish National Research Council (CSIC), the largest public research organisation in Spain. We draw upon entries in a unique database derived from the IMPACTO project, a project funded by the CSIC aiming at analysing the relationships that their researchers establish with non-academic partners (D'Este et al., 2016). Specifically, the database analysed results of a questionnaire answered in 2011 by CSIC research staff with both fixed-term and permanent contracts with the right to act as principal researchers and enter into contracts and agreements with external partners. The questionnaire includes a range of questions addressing researchers' profile (position, age, gender), their research characteristics or their motivations and obstacles to establish collaborations with non-academic partners, among others. According to the CSIC Human Resources department, 4,240 researchers met this requirement in December 2010. Data collection took place between April and May 2011. The questionnaire was distributed online to this population and follow-ups were conducted by telephone. This procedure allowed us to obtain a final sample of 1,583 researchers (accounting for 37% of total population) that was proportionally distributed by fields and seniority (see Olmos-Peñuela et al. (2014a) for more details on the questionnaire and data collection). Using IMPACTO database, we focus on the two variables of interest for this study; i.e., those related to researchers' openness and those related to obstacles that researchers' face to establish collaborations with third parties.

3.2 Operationalisation

3.2.1 Openness

Regarding the operationalisation of the variable "openness", we draw upon previous work (Olmos-Peñuela et al., 2015, 2016) to finally build a binary variable named '*open scientist*' that distinguishes between open scientists and less-open scientists¹. Specifically, this variable measures whether researchers report to be open in the different research processes, namely reframing, inspiration, planning, execution and dissemination. We built a working binary variable named '*open scientists*' that

¹ For brevity's sake, we here restrict our explanation to describe the openness measure that is used in this study ('open scientist'). We highly recommend to read Olmos-Peñuela et al. (2015, 2016) for an in-depth understanding of the whole operationalisation process leading to the 'open scientist' variable and its five components.

takes the value '1' if the researcher reports being open in at least 4 of the 5 processes (22.9% of the sample), and '0' otherwise (if he/she is open in less than 4 processes). This follows Olmos-Peñuela et al. (2015) who established the threshold acknowledging that this was a partly pragmatic choice reflecting the fact that it covered a big enough group of scientists, but at the same time reflected a minority performance.

3.2.2 Scientific field

The other individual level variable that we include is the scientific field within which scientist is operating, and specifically differences between the 'soft' and 'hard' sciences (see section 2.3 for a justification). We built a binary variable named 'SSH' to distinguish between researchers belonging to the social sciences and humanities (SSH), and those belonging to fields of Science, Technology, Engineering and Mathematic (STEM). The scientific fields represented in our sample are determined by the eight fields in which the CSIC is divided, namely: Social science and humanities; Biology and biomedicine; Food science and technology; Materials science and technology; Physical science and technology; Agricultural sciences; Natural resources; Chemical science and technology. Thus, the binary variable 'SSH' takes the value of '1' if the researcher belongs to SSH fields (7.4% of the sample), and '0' otherwise (i.e., if he/she belongs to any of the other 7 scientific fields above mentioned).

3.2.3 Obstacles for collaborating with third parties

Regarding obstacles to establishing collaborations, the questionnaire identified 11 obstacles as potential obstacles for collaborating with third parties, namely:

- 1) Lack of interest in establishing relationships with non-academic or non-scientific organisations
- 2) Lack of recognition of scientific merit behind societal collaborations
- 3) Lack of time given the time demands of other activities (research and management)
- 4) Little interest of other organisations about your research
- 5) Existence of cultural differences between you and non-academic organisations
- 6) Lack of scientific and technical capacity of these entities to assimilate the results of your research
- 7) Protection of confidentiality and intellectual property rights of the results
- 8) Difficulties around negotiation and administrative procedures of the contract
- 9) Lack of institutional support for these establishing relationships with non-scientific organisations
- 10) Lack of available information to find potential users of your research
- 11) Lack of financial resources for establishing relationships with non-scientific organisations.

The questionnaire asked researchers to assess, in a 4-point scale (from '1 = not at all' to '4 = a lot'), the degree to which those 11 aspects were an obstacle to establish relationships with other entities: Table 1 presents the descriptive of the 11 obstacles items, i.e., the mean (ranging from 1 to 4) of the extent to which researchers report to have experience these obstacles for establishing collaboration with third parties. The obstacles more highly reported are the lack of financial resources and time to establish these relationships, whereas the less reported are the cultural differences between academics and non-academics and the lack of interest among researchers to participate in these relational activities.

Table 1: Distribution of the obstacles perceived by researchers for establishing collaboration with non-scientific organisations

Obstacle	Mean
Lack of interest in establishing relationships with non-academic or non-scientific organisations	1.66
Existence of cultural differences between you and non-academic organisations	1.66
Protection of confidentiality and intellectual property rights of the results	1.80
Lack of recognition of scientific merit behind societal collaborations	2.02
Lack of scientific and technical capacity of these entities to assimilate the results of your research	2.11
Difficulties around negotiation and administrative procedures of the contract	2.41
Little interest of other organisations about your research	2.59
Lack of institutional support for these establishing relationships with non-scientific organisations	2.64
Lack of available information to find potential users of your research	2.68
Lack of time given the time demands of other activities (research and management)	2.89
Lack of financial resources for establishing relationships with non-scientific organisations.	2.92

Note: values of the extent of obstacles perceived may range between 1 (not at all) and 4 (a lot).

The second step of the analysis is to reduce these 11 obstacles into multi-item scales. We do this by firstly conducting a principal component factor analysis (PCFA) on these 11 obstacles and also assessing their unidimensionality (Ahire and Devaray, 2001). From the factor analysis (with varimax rotation) we retain four factors that explained about 61.7% of the variance of the variables in the original data (Table 2 presents the four factors emerging from the exploratory obstacle factors analysis).

Table 2: Obstacle Factors resulting from the exploratory factor analysis

Obstacle item	Factor	Cronbach Alpha
Lack of interest in establishing relationships with non-academic or non-scientific organisations.	Lack of recognition	.646
Lack of recognition of scientific merit behind societal collaborations		
Lack of time given the time demands of other activities (research and management)		
Little interest of other organisations about your research	Absorption obstacles	.551
Existence of cultural differences between you and non-academic organisations		
Lack of scientific and technical capacity of these entities to assimilate the results of your research		
Protection of confidentiality and intellectual property rights of the results	Administrative burden	.540
Difficulties around negotiation and administrative procedures of the contract		
Lack of institutional support for these establishing relationships with non-scientific organisations	Institutional obstacles	.626
Lack of available information to find potential users of your research		
Lack of financial resources for establishing relationships with non-scientific organisations.		

Based on the factors obtained, we build the four continuous variables measuring each type of obstacle, what we here refer to as: (a) lack of recognition; (b) absorption obstacles; (c) administrative burden; (d) institutional obstacles. We compute each multiple-item scale (factor) through the average of the items belonging to each factor. We also compute the Cronbach alpha (α) to assess the statistical reliability of each additive factor. We obtain values of Cronbach α ranging from .54 to .64 which is acceptable for emerging construct to ensure the reliability of the multiple-item scales employed in the study (Ahire and Devaray, 2001).

4. Bivariate analysis and results

We conduct bivariate analysis to explore the extent to which open and less-open scientists perceive different obstacles to establishing relationship with external agents. Taking into account the continuous nature of the four obstacles (multi-item) factors, we assess through t-test analysis whether these differences exist. Specifically, the null hypothesis of this test is that the mean of the two groups compared (open scientists and less-open scientists) are equal. The alternative hypothesis is that there are differences between these two groups. A null hypothesis may be rejected if the p-value is lower than .05. The results of the t-test analysis that assess mean differences in obstacles between open and

less-open scientists are presented in Table 3. According to these results, there are significant differences between the mean of open scientists and less-open scientists for all the obstacles (p-value < 5%) with the exception of **institutional obstacles** (p-value > 10%). Specifically, results indicate that, compared to open scientists, less-open scientists perceived significantly more obstacles associated with the lack of scientific recognition of collaborating with third parties and with the cultural differences existing between academic and non-academic communities. Conversely, open scientist perceived significantly more administrative burden obstacles than less-open-researchers.

Table 3: T-test analysis between open and less-open scientists.

Obstacle factor	Mean (S.D) All sample	Mean (S.D) Open scientists	Mean (S.D) Less-open scientists	T test p-value
Lack of recognition	2.21 (.70)	2.00 (.62)	2.25 (.70)	.000***
Absorption obstacles	2.12 (.73)	1.91 (.64)	2.17 (.73)	.000***
Administrative burden	2.09 (.82)	2.27 (.73)	2.08 (.83)	.000***
Institutional obstacles	2.75 (.79)	2.82 (.70)	2.75 (.77)	.124

Note: *** indicates statistical significant differences at 1%.

We also conduct bivariate analysis to explore the extent to which SSH and STEM researchers perceive different obstacles both among open and less-open scientists for the establishment of relationship with non-academic agents. As for the previous bivariate analysis, the continuous nature of the four multi-item obstacles factors allows to conduct a t-test analysis to assess whether there are differences between SSH and STEM collectives. Table 4 and 5 report the results of the bivariate analysis between obstacles and scientific fields for open scientists (Table 4) and for less-open scientists (Table 5). Results in Table 4 indicate that there are no significant differences between open SSH and STEM scientists regarding the extent to which they perceive obstacles to collaborate with external partners.

Conversely, results in Table 5 indicates that less-open scientists belonging to STEM fields perceive significantly more obstacles associated to administrative burden than their counterparts for the SSH fields (p-value < 5%). No other significant differences are found between fields for the less-open scientists' collective.

Table 4: T-test analysis between SSH open scientists and STEM open scientists

Obstacle factor	Mean (S.D) SSH open scientist	Mean (S.D) STEM open scientist	T test p-value
Lack of recognition	2.03 (.56)	2.00 (.62)	.847
Absorption obstacles	1.97 (.81)	1.91 (.62)	.680
Administrative burden	2.24 (.79)	2.27 (.73)	.825
Institutional obstacles	2.76 (.58)	2.83 (.71)	.640

Table 5: T-test analysis between SSH less-open scientists and STEM less-open scientists

Obstacle factor	Mean (S.D) SSH less-open scientist	Mean (S.D) STEM less-open scientist	T test p-value
Lack of recognition	2.27 (.75)	2.24 (.69)	.760
Absorption obstacles	2.18 (.74)	2.17 (.73)	.949
Administrative burden	1.90 (.83)	2.10 (.82)	.046**
Institutional obstacles	2.75 (.77)	2.75 (.77)	.985

Note: ** indicates statistical significant differences at 5%.

5. Discussions

Our findings have a number of ramifications for scientific governance and particularly in seeking to steer academic communities to create more ‘useful’ knowledge. Our first finding is that the single obstacle that both groups of academics reports as creating the greatest problems for them were the institutional obstacles, and that the research environments within which they found themselves were not supportive. This factor contained three elements, whether a lack of institutional support to undertake activities, the lack of finances to carry out these activities and even in helping to identify potential external partners with which they sought to work. The CSIC organisation had sought to create structures and policies to support user engagement, but these were still experienced as obstacles suggesting that whatever the explicit support given at the institutional level for engagement, pressures to prioritise other activities are undermining attempts to drive engagement.

The most obvious difference in the obstacles experienced by open and less-open scientists was that open academics experienced more opportunistic obstacles whilst less-open academics experienced more fundamental obstacles. Open academics reported having much greater obstacle effects derived from the mechanics of formal technology transfer, in arranging contracts and also managing intellectual property (IP) and licenses. These are problems that originate primarily outside the knowledge community, they relate to the business models around technology transfer rather than to the nature of creating knowledge that is cognate to and absorbable by users.

Conversely, less-open academics had more problems with fundamental issues as well as working with external partners. Part of this were more obstacles referred to a lack of time, a lack of recognition and a lack of interest in working with academic partners, relating to a view that, in some way, working with external partners is less legitimate than doing more Mertonian research. A second element of this was practical problems in undertaking knowledge creation in academic-user collaborations, whether finding cultural problems in collaboration, or a lack of interest in or appreciation of that research amongst direct users. Finally, STEM less-open academics had more problems than SSH less-open academics with managing the business of engagement in terms of IP rights and contracts. These obstacles together seem to reflect a mix of an antipathy towards engagement along with a lack of experience in how to manage engagement effectively, and to indeed reflect that these less-open researchers do not have experience of working habitually with external partners.

Taken together, these findings suggest that there is a segmentation in the experiences of engagement between open and less-open researchers. All researchers find that their institutions do not do enough to actively support engagement by themselves, whether they regard engagement as desirable or not. Open researchers primarily experience problems in fitting their engagement activities into the businesses models of the two organisations within which the researchers in the knowledge community are situated, the research centre and the firm. They have less problem in finding the way to make it work in a valid way for themselves, and less problems in ensuring that it also benefits the eventual users. Less-open researchers appear to be more easily caught in situations where they do not see the value of user engagement and have greater problems in making it work more effectively, with STEM less-open researchers also having difficulties in dealing with the commercial aspects of licensing and IP. This would suggest that if one wants to increase the scale of usable knowledge created, then there is a need to find some way to break the vicious cycle within which these less-open researchers seem to find themselves trapped.

6. Conclusions

In this research paper we have sought to answer the research question of whether open researchers encountered different obstacles to engagement with users than less-open researchers. Our results suggest that the answer to this question is indeed positive, in that more open researchers experience primarily commercial obstacles to engagement, whilst less-open researchers experience issues around academic legitimacy and knowledge absorption (RQ1). Perhaps unsurprisingly, researchers that are more accustomed to following Mertonian norms have great problems in terms of establishing the validity of user engagement, and also in the practicalities of managing research that includes a substantive user participation element. By contrast, open academics experience more problems in terms of fitting their knowledge practices into commercial models, finding the correct contact and IP management deals. And all academics have problems fitting engagement into their institutions, whether finding time, resources or indeed assistance with partner findings.

A second contribution to academic debates relates to our typology of the kinds of obstacles that academics face in engaging with users (RQ2). Although it is empirically derived, our four factors seem to offer an intuitively attractive segmentation in terms of the nature to which the obstacles are internal to the researcher. One set of factors related to the lack of valuation of engagement within the immediate academic environment, and a second to practical difficulties in delivering engaged research practices. The third set related to obstacles imposed by the necessary business models to enable collective knowledge practices, and the fourth to a lack of support from the institutional environment and institutional policies for engagement.

We also thought sought to reflect on potential policy frameworks and approaches that could help to address these obstacles and have a steering effect on systems to increase the overall societal usability (RQ3). Our findings suggest an experiential effect, with more researchers with more experience in open research practices better able to handle the process of dealing with external partners and in making it acceptable to the scientific community, and in turn having problem with fitting it into the necessary commercial models, whilst less-open researchers struggle with these issues. This suggests that there are different approaches possible for these different areas, assisting less-open researchers to around the absorption questions (finding money, time and contacts to engage) as well as learning the skills to make that knowledge legitimate. Open researchers need more traditional technology transfer assistance, with contracts and licensing of IP, and as a general point, institutions need to have a better understanding of how to support engagement by their researchers (engagement in our definition being research that incorporates user research in ways that ultimately makes the knowledge more usable to researchers).

In short, the research collective can be seen as a set of subgroups of scientists with different degrees of openness towards knowledge transfer and exchange activities that demand different support policies to overcome their respective obstacles. It is possible that some of these subgroups do not want to interact with users because they consider themselves basic researchers, but the issue is that this 'self-exclusion' is not due to the fact that their organization has not made the needed effort to move them towards a more open approach. Thus, regarding policy approaches that could help steer the academic system to reduce the barriers and obstacles experienced by scientists deviating from Mertonian norms (open researchers), since actions should be mainly directed towards more institutional support and the reduction of the transaction impediments of the collaboration itself.

From this, we derive two more practical conclusions for management from this study. First, in the context of our study (CSIC), all researchers (either open or less-open) perceive institutional setting as the main obstacle for establishing collaboration with societal users. This result highlights the opportunities for scientific organisations to develop active policies contributing to reduce the perceived obstacles (e.g. favouring meetings with potential societal partners to facilitate mutual knowledge, providing effective support to collaborate with societal partner, providing specific funds for knowledge transfer and exchange as well as for developing joint projects). In short, our finding suggests that researchers demand an active involvement of their organisation for promoting knowledge transfer and exchange processes.

Second, less-open researchers perceive more obstacles related to themselves (lack of intrinsic motivation, recognition and time to address societal collaboration) and to their potential societal partners (cultural differences, lack of interest and lack of absorptive capacity) than open researchers. However, we find the opposite results when we focus on the transaction characteristics, i.e. more obstacles are experienced by researchers exhibiting an open profile, having somehow included societal partners in any stage of their research process. Those, the collective of researchers that experience more obstacles related to the transaction itself are those who have previous experience in collaborating with societal users. The managerial implication from this finding is that different types of researchers (open vs. less-open) need differentiated support policies to promote their involvement in societal collaborations. Thus, if the scientific organisation is interested in increasing the number of researchers-societal agent collaborations, it should focus its effort on improving the recognition of societal collaboration in the recruitment and promotion process, on alleviating the workload (specially, administrative duties that consumes a remarkable time of scientific tasks) and on favouring the encounter of potential societal partners interested and able to effectively collaborate with these researchers.

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7. Bibliography

- Ahire, S. L., Devaray, S., 2001. An empirical comparison of statistical construct validation approaches. *IEEE Transactions on Engineering Management*, 48(3), 319-329.
- Amin, A., Cohendet, P., 2004. *Architectures of knowledge: Firms, capabilities, and communities*. Oxford University Press., Oxford.
- Baldini, N., Grimaldi, R., Sobrero, M., 2007. To patent or not to patent? A survey of Italian inventors on motivations, incentives, and obstacles to university patenting. *Scientometrics* 70, 333-354.
- Bekkers, R., Bodas-Freitas, I.M., 2008. Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter? *Research Policy* 37, 1837-1853.
- Bell, J. 2014., *Doing Your Research Project: A guide for first-time researchers*. McGraw-Hill Education (UK).
- Benneworth, P., Olmos-Peñuela, J., 2018. Reflecting on the Tensions of Research Utilization: Understanding the Coupling of Academic and User Knowledge. *Science and Public Policy*. <https://doi.org/10.1093/scipol/scy021>.
- Boardman, P.C., Ponomariov, B.L., 2009. University researchers working with private companies. *Technovation* 29, 142-153.
- Bozeman, B., Fay, D., Slade, C. P., 2013. Research collaboration in universities and academic entrepreneurship: the-state-of-the-art. *The Journal of Technology Transfer*, 38, 1-67.
- D’Este, P., Patel, P., 2007. University–industry linkages in the UK: what are the factors underlying the variety of interactions with industry? *Research Policy* 36, 1295–1313.
- D’Este, P., Perkmann, M., 2011. Why do academics engage with industry? The entrepreneurial university and individual motivations. *Journal of Technology Transfer* 36, 316-339.

- D'Este, P., Iammarino, S., Savona, M., von Tunzelmann, N., 2012. What hampers innovation? Revealed barriers versus deterring barriers. *Research Policy*, 41(2), 482-488.
- D'Este, P., Llopis, O., Yegros Yegros, A., 2016. 'Conducting Pro-social Research: Exploring the Behavioral Antecedents to Knowledge Transfer among Scientists'. In: R., Fini and R., Grimaldi (eds) *Process Approach to Academic Entrepreneurship: Evidence from the Globe*, pp. 19–55. World Scientific Publishing, doi:10.1142/9789813220621_0002.
- Dasgupta, P., David, P.A., 1994. Toward a new economics of science. *Research Policy* 23, 487–521.
- Elam M., Bertilsson M., 2003. Consuming, Engaging and Confronting Science The Emerging Dimensions of Scientific Citizenship. *European Journal of Social Theory* 6(2), 233-251.
- Fincham, R., Clark, T., 2009. Introduction: can we bridge the rigour–relevance gap? *Journal of Management Studies*, 46(3), 510-515..
- Gibbons, M., Limoges, C., Nowotny, H., Scharzman, S., Scott, P., Trow, M., 1994. *The new production of knowledge: the dynamics of science and research in contemporary societies*. Sage London.
- Giuliani, E., Morrison, A., Pietrobelli, C., Rabellotti, R., 2010. Who are the researchers that are collaborating with industry? An analysis of the wine sectors in Chile, South Africa and Italy. *Research Policy* 39, 748-761.
- Gläser, J., 2012. How does Governance change research content? On the possibility of a sociological middle-range theory linking science policy studies to the sociology of scientific knowledge. Technical University Berlin. Technology Studies Working Papers, TUTS-WP-1-2012,(downloaded on 1 April 2012 from: http://www.ts.tu-berlin.de/vmenu/publikationen/tuts-working_papers/).
- Gulbrandsen, M., Smeby, J.-C., 2005. Industry funding and university professors' research performance. *Research Policy* 34, 932-950.
- Fransman, F., 2018. Charting a course to an emerging field of 'research engagement studies': A conceptual meta-synthesis, forthcoming in *Research for All*
- Hessels, L.K., Van Lente, H., 2008. Re-thinking new knowledge production: A literature review and a research agenda. *Research Policy* 37, 740-760.
- Hodgkinson, G. P., Herriot, P., Anderson, N., 2001. Re-aligning the stakeholders in management research: lessons from industrial, work and organizational psychology. *British Journal of Management*, 12(s1), S41-S48.
- Isaksen, A., Karlsen, J., 2010. Different modes of innovation and the challenge of connecting universities and industry: case studies of two regional industries in Norway *European Planning Studies* 18, 1993-2008.
- Kieser, A., Leiner, L., 2009. Why the rigour–relevance gap in management research is unbridgeable. *Journal of Management Studies*, 46(3), 516-533.
- Kitcher P., 2001. *Science, truth, and democracy*. Oxford: Oxford University Press.

- Knorr-Cetina, K. 1981. *The Manufacture of Knowledge: An Essay on the Constructivist and Contextual Nature of Science*. Oxford: Pergamon Press.
- Lam, A., 2011. What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'? *Research Policy* 40, 1354-1368.
- Landry, R., Saihi, M., Amara, N., Ouimet, M., 2010. Evidence on how academics manage their portfolio of knowledge transfer activities. *Research Policy* 39, 1387-1403.
- Latour, B., Woolgar, S., 1979. *Laboratory life: the social construction of scientific facts*, London: Sage.
- Lee, Y.S., 1996. 'Technology transfer' and the research university: a search for the boundaries of university-industry collaboration. *Research Policy* 25, 843-863.
- Leisyte, L., Enders, J., De Boer, H., 2008. The Freedom to Set Research Agendas—Illusion and Reality of the Research Units in the Dutch Universities. *Higher Education Policy* 21, 377-391.
- Maxwell, K., Benneworth, P., 2018. The construction of new scientific norms for solving Grand Challenges. *Palgrave Communications* 4(1), 52.
- Medawar, P. B., 1972. *The hope of progress*. London: Methuen.
- Merton, R. K., 1973. *The sociology of science: Theoretical and empirical investigations*. Chicago: University of Chicago Press.
- Nowotny, H., Scott, P., Gibbons, M., 2001. *Re-thinking science: knowledge and the public in an age of uncertainty*. SciELO Argentina.
- Olmos-Peñuela, J., Benneworth, P., Castro-Martínez, E., 2014a. Are 'STEM from Mars and SSH from Venus'? Challenging disciplinary stereotypes of research's social value. *Science and Public Policy* 41, 384-400.
- Olmos-Peñuela, J., Molas-Gallart, J., Castro-Martínez, E., 2014b. Informal collaborations between social sciences and humanities researchers and non-academic partners. *Science and Public Policy* 41, 493–506
- Olmos-Peñuela, J., Benneworth, P., Castro-Martínez, E., 2015. What stimulates researchers to make their research usable? Towards an 'openness'. *Minerva* 53, 381-410.
- Olmos-Peñuela, J., Benneworth, P., Castro-Martínez, E., 2016. Does it take two to tango? Factors related to the ease of societal uptake of scientific knowledge. *Science and Public Policy* 43(6), 751-762.
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Brostrom, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., Sobrero, M., 2013. Academic engagement and commercialisation: A review of the literature on university-industry relations. *Research Policy* 42, 423-442.
- Ponomarev, B., Boardman, P.C., 2008. The effect of informal industry contacts on the time university scientists allocate to collaborative research with industry. *The Journal of Technology Transfer* 33, 301-313.

Ramos-Vielba, I., Sánchez-Barrioluengo, M., Woolley, R., 2016. Scientific research groups' cooperation with firms and government agencies: motivations and barriers. *The Journal of Technology Transfer* 41(3), 558-585.

Sarewitz, D., Pielke Jr, R.A., 2007. The neglected heart of science policy: reconciling supply of and demand for science. *Environmental Science & Policy* 10, 5-16.

Siegel, D.S., Waldman, D.A., Atwater, L.E., Link, A.N., 2004. Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialization of university technologies. *Journal of Engineering and Technology Management* 21, 115-142.

Tartari, V., Breschi, S., 2012. Set them free: scientists' evaluations of the benefits and costs of university-industry research collaboration. *Industrial and Corporate Change* 21, 1117-1147.

Tartari, V., Salter, A., D'Este, P., 2012. Crossing the Rubicon: exploring the factors that shape academics' perceptions of the barriers to working with industry. *Cambridge Journal of Economics* 36, 655-677.

Ziman, J., 1996. 'Postacademic science': constructing knowledge with networks and norms. *Science Studies* 1, 67-80.

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