



PAPER

Early Draft – Please, do not quote or share!

Title: Fighting the Elements! The Role of PhD holders in Industrial Districts¹

Authors and e-mails of them:

Francisco Javier Ortega-Colomer¹, Javier.Ortega@uv.es

José-Vicente Tomás-Miquel², jotomi@doe.upv.es

Josep Capó-Vicedo², pepcapo@doe.upv.es

Department:

¹Departamento de Dirección de Empresas ‘Juan José Renau Piqueras’

²Departamento de Organización de Empresas,

University:

¹Universitat de València, Valencia, Spain

²Universitat Politècnica de València, Campus de Alcoy

Subject area: S12 – Clusters and sustainability in times of COVID-19.

Abstract:

Currently, not all PhD holders can develop their professional career in academic organisations, so they end up working in non-academic organisations or become entrepreneurs. Although this phenomenon was initially analysed in territories with high-technology companies, where the skills of PhD holders were more in demand, it is now also the object of study in other territories with a higher presence of companies belonging to low-tech industries. This paper focuses qualitatively on the roles’ perceptions of PhD holders and their employers in non-academic organizations in the Textile Valencian industrial district (ID). The results aim to inspire a more informed and critical dialogue about the role of PhD holders in non-academic organisations within low-tech industries belonging to a cluster. An emphasis on their contribution to more sustainable region is put in this paper, to reveal the key competences, research orientation and contributions of this highly skilled personnel.

Keywords: *PhD holders; dynamic capabilities; low-tech industries; qualitative study; industrial district; cluster.*

JEL codes: R11, Q01, J24.

¹ Agradecimientos: los autores agradecen el apoyo financiero del Ministerio de Ciencia e Innovación a través del proyecto PID2021-126516NB-I00.

1 Introduction

Not all PhD holders are working at academic organisations due to different reasons. On the one hand, constraints on public expenditure may be one important factor (Martin & Etzkowitz, 2001) but on the other hand, PhD holder's perception about her future could also be decisive (Kuoppakangas et al., 2020). Despite of representing an increasing proportion of the total workforce (Aanerud et al., 2007; Cyranoski et al., 2011; Skovgaard-Pedersen, 2015), PhD holders' role outside academia is easily lost and has not been enough studied. By studying this population of highly skilled workers we can better understand their visible/invisible contribution towards more sustainable clusters in regions. For instance, previous work has shown how they facilitate sustainable transitions through the translation of scientific knowledge into innovation (Telling & Serapioni, 2019).

A significant number of studies of university contributions to society have been published in the past decades (Gjelsvik, 2017; Power & Malmberg, 2008; Stephan et al., 2016). However, most of those studies have focused on formal mechanisms (Bazeley, 1999; Dietz & Bozeman, 2005) of knowledge transfer, including patents, licenses, royalty agreements (Bozeman, 2000; Breznitz & Feldman, 2012) and more recently also start-up creation by PhD graduates (Muscio et al., 2021). Therefore, other forms of contribution by PhD holders who are actively participating as knowledge workers in their respective contexts are neglected, despite being also indirect outputs of what universities are offering as their response to societal needs (Benneworth et al., 2009). Moreover, without knowing the types of contributions of PhD holders to society and applicability of PhD education to societal and industrial needs, new initiatives of research and innovation policies aiming at strengthening the knowledge economies are hard to implement. Our approach aims to better understand the micro reality of the

knowledge workers focusing by highlighting the high diversity of contributions that PhD holders can generate for the pursuit of getting more sustainable clusters. So, the aim of the paper is to explore inductively the different types of contributions that PhD holders have been bringing to clusters in terms of sustainability. To do that, we explore not only actual but also potential contributions, not only formal but also informal channels, not only most-intended outcomes but also unintended consequences, and, in terms of their impact, we distinguish between conceptual, symbolic, or instrumental impacts of PhD holders, to face the challenges of sustainability. We acknowledge there is an important obstacle to obtain a comprehensive picture of the socio economic and cultural contributions of PhD holders due to their heterogeneity in terms of their level of expertise, their specific research domains, their individual and social features and their workplaces (Auriol, 2010). This article also acknowledges the different cultures contexts and disciplinary realities of PhD holders (Haapakorpi, 2015; Porter & Rafols, 2009). That is why their research orientation is taken into account, to distinguish between those whose research is more oriented towards an understanding of the phenomena under study and those that are more inspired towards the use of the knowledge generated (Stokes, 1997). Moreover, PhD holders are increasingly not working formally as academics at higher education institutions, but at other knowledge organisations (Herrera & Nieto, 2016), such as consultancy firms, technology institutes, among others, which entails more difficulties to track them. Since academic organisations cannot absorb the total amount of PhD graduates that universities are producing, and the policies on educating PhD holders often emphasise their role for national prosperity, the majority of PhD holders are to find their positions in new research-based (but non-academic) organisations (Powell, 2015), who do not have tradition or policies in employing PhD holders.

In regional innovation studies, it is stated that contexts with a pre-eminence of high-tech firms are supposedly more likely to show better performances in terms of science-based innovative products (Hartog et al., 2012). The firms operating in this kind of context are the commonly suspected to employ PhD holders, contributing to the culture and socio-economic performance of firms with their research skills. On the other hand, low-tech firms are said to use other sources for innovating rather than scientific knowledge: providers/clients exchange of information, machinery acquisition, marketing strategies, new raw materials, new markets, among others (Hirsch-Kreinsen, 2008). In this case, the readiness to employ PhD holders is not as evident than in high-tech environments. However, there are still few documented cases that encourage to also study this context in greater detail (Skovgaard-Pedersen, 2015). Then, the question that arise is: in which ways are PhD holders contributing, as agents of change, towards more sustainable clusters beyond high-tech environments? The paper explores this guiding question as follows. Section 2 presents the theoretical framework. Sections 3 describes the methods and section 4 present the analysis and result of our empirical study, which is still in progress. Finally, section 5 discusses the results and its implications for science policymakers.

2 Theoretical background

2.1 Industrial district as a socio-economic reality

In the cluster and industrial districts literature, it is pointed the importance of the existence of a pool of high skilled labour force as one of the three main externalities that characterised agglomeration economies, since Alfred Marshall's times. However, the way in which those highly skilled people interact and contribute in their respective context remains unexplored, even in thorough studies about how productive activity is organised in the textile industry (Puig & Marques, 2010). Up to this point, the

hegemonic quantitative approach in cluster literature has not allowed to show the actual interactions between PhD holders in their clusters (Ortega-Colomer et al., 2016). For instance, this seems to still happen in official reports about clusters, where the approach adopted is ‘deliberately based on the measurement of the revealed effects of clusters’ (Commission, 2008, p. 18) and assumes that ‘the interactions [in and between clusters] are meaningful’ despite differences in type and intensity. The common limitation of this approach is that it neglects the quality of relationships between many heterogeneous actors with different motivations or logics (mainly based on science and market rewards). Therefore, approaches that bear in mind more details about the interactions among actors is needed (Molina et al., 2018). This paper analyses the narratives collected from both PhD holders and their employers on how they contribute to their local context, in terms of sustainability. Here, as informal and unstructured interactions are also included, our analysis will enrich the already known local system of innovation dynamics (Breschi & Lissoni, 2001).

2.2 Innovation in Low-Tech Sectors

While the European Union (EU) has been evolving towards a knowledge-based society, it has been increasingly crucial to putting into practice for regions their competence to generate, use, diffuse and absorb new knowledge for economic success and societal development. Since conventional wisdom has assumed that the so-called high-tech industries, research-intensive and science-based industries were the key drivers of future economic prosperity, there has been also a some more critical view. Where those industries were seen as the main source of highly sophisticated products, they could be located elsewhere as easily as governments promoted at policy circles. Then, high-cost industrialised countries were claimed concentrate their efforts on

promoting these industries. However, they forgot that the most present industries in Europe were part of the so-called low- and medium-tech (LMT) industries.

We can also see this different view on what innovation is where we compare the seminal works, from 1980s on, where they focused on the most successful environments, such as Oxford, Cambridge, Silicon Valley, etc. However, a more critical stream of research has turned this hegemonic towards an alternative sight, where innovation depends also on low-tech industries (Hirsch-Kreinsen, 2008). During the 2000s a European research project on the innovativeness of industrial ‘low-tech’ sectors (Hirsch-Kreinsen et al., 2006, p. 4) concluded that

“the performance of LMT sectors is severely misrepresented by most current indicators and that they contribute very significantly to innovation and growth in advanced economies. LMT firms often face special problems, however, and their efficiency could be further improved through the implementation of appropriately targeted policies”.

Therefore, a re-examination of these LMT industries would further enhance their value in terms of employment, the role of integration in local and regional economies in an increasingly important period of globalization, and the symbiotic relationships between LMT and business and high-tech sectors.

In addition, here it is crucial the concept of dynamic capabilities as the conditions on which the innovation capacity of a company depends, by stressing “exploiting existing internal and external firm-specific competences to address changing environments” (Teece et al., 1997, p. 510). Therefore, the knowledge base of companies in low-tech contexts should be investigated taking into account their "accumulated internal knowledge" (Hirsch-Kreinsen et al., 2006, p. 11), since they are more combiners of existing codified knowledge with practical knowledge, than basic innovators. This has

implications for the organisational learning practices as they are more centred in benchmarking that in turn puts a stress on observing, obtaining information, analysing and transform technologies from other contexts. This is the case in the study conducted by (Boschma & ter Wal, 2007) where Boschma and Wal's (2007) study the authors highlighted the relevance emphasizes the importance of building networks to facilitate knowledge transfer and highlights the importance of building non-local ties to improve overall business firm performance (Schmierl & Köhler, 2005).

2.3 The importance of human capital in industrial districts

To achieve sustainable economic growth, it is necessary to give a voice to the managers of both higher education and scientific research, since every post-industrial society needs highly qualified personnel in line with what a knowledge-based economy requires. This is also crucial in localized industrial districts, where one of their main characteristics is precisely the presence of specialized workers on a particular industry. The fact of obtaining a doctorate degree has become increasingly important, given the current highly complex challenges of society, such as climate change, the scarcity of mineral resources, social inequalities between regions, etc. According to Auriol (2010), those Phd holders who have been accumulating skills and human capital throughout their training seem to be one of the key actors behind the creation of economic growth based on knowledge. There is a need for understanding of the personal value of having a Ph.D. level around its social and cultural impacts. Therefore, it is conceivable that this is also a latent demand, in localized clusters. To do this, a tentative proposal is to study in depth complex areas such as the direct socioeconomic impact on their respective jobs, as well as the expected and real 'added value' at the time of their hiring, not only in the short term, but even for a future wider. In this article, we do not focus on those fields of study, but rather we concentrate our efforts to understand different types of profiles that

have impacted in a heterogeneous way to its labor context. In the following section, we develop the rationale and methods to accomplish this goal.

3 Approach

The interpretivist approach explores ‘events by discovering the meaning human being attribute to their behaviour and the external world’ (Della Porta & Keating, 2008, p. 26). Thus, by putting the focus on meanings, we seek to explicitly considering contextual variables instead of trying to decontextualise (Cooke, 2018). We also use techniques typically applied such as the analysis of texts and discourses (della Porta & Keating, 2008). In that regard, the use of qualitative methodology is dominant throughout this work, since aims to describe a given phenomenon, which is the value of PhD holders’ labour market, but from a novel perspective, by looking out an environment where most firms belong to low-tech industries. “According to OECD categories, the industrial sectors can be classified as follows: High-technology sectors (“high-tech”) with a R&D intensity or more than 5%, sectors with complex technology (“medium-high-tech”) with a R&D intensity between 3% and 5%. Industries which are not research-intensive (“medium-low-tech” and “low-tech”) have a R&D intensity below 3 percent” (Hirsch-Kreinsen, 2008, p. 11). This allows us to select the case-study method as the most appropriate for the objectives posed. To do such a task we have interviewed 25 key informants: 15 PhD holders and 10 business managers and members of the TMTs. With this matching information, we illustrate the two sides of the same coin. On the one hand, we explore how PhD holders’ role is considered in this specific context, and, on the other hand, we also gather information on how they consider their contribution as beneficial to their immediate local context. For that purpose, we selected a group of 15 PhD holders from a list of 70 found through two main channels: personal contacts and university administrators and professors. The interviews were semi-structured, given the

nature of the problem. Then, we prepared a battery of questions, divided into three sections, that was adapted when necessary to the specific context of each interview. Once the interviews were conducted, a reflective analysis was carried out to interpret the different voices that intervene in the discourse around the role of PhD holders in non-academic organisations.

4 Preliminary Findings

4.1 PhD holders' perception about their role in industrial districts

From the interviews we have found a consensus: PhD holders in low-tech firms' context are not totally exploiting their skills, and hence, a process to absorb their knowledge is required and is even acknowledged by employers. There is a bad perception of the political and social context, which does not appreciate the scientific knowledge, so PhD holders sometimes feel like they are strangers and pioneers in this new situation. As in several firms the scientific knowledge (most times with an analytical knowledge base) cannot be absorbed by low-skilled workers, the manager usually prefers to import the machinery as a way to innovate, and not by incorporating a highly skilled worker who could develop a better fitted solution to the textile firm. So, this means that the dependency from exports is limiting the possible potential ways to compete in the international landscape, from an endogenous-like development. This is present in almost all the interviews conducted and it seems to be the key problem of this kind of territorial contexts. Moreover, the situation can become worse as years pass, since there is no evolution in the inner skills of the company, which was one of the key successes of the Italian industrial district model. Becattini (2002) showed us how the industrial district's inhabitants were very conscious about their learning aspirations, as a way of developing their personal traits, and not only for the economic performance. Thus, one of the main lessons we have learned from this case-study is that to break a

misconception about highly skilled workers' contribution is to learn about how they are actually contributing to other contexts, and what the regional managers can do to adopt those benchmarking practices into their plans.

4.2 Employers' perception about the role of PhD holders in industrial district

One of the issues that mostly concern in the knowledge transfer studies and innovation management literature is the role of non-STEMs (Science, Technology, Engineering and Mathematics) PhD holders in society. While PhD holders from STEMs are called to have a prominent role, for instance, in the full robotisation and automation of the production lines, they are underrepresented in the decision-making bodies, so as the sensitiveness to build co-programmes jointly with the user of those programmes is still a task to be done. In the interviews conducted, most of PhD holders highlighted the lack of understanding from political bodies in certain complex issues, such as environmental issues, corruption, economics as an evolutionary process, the importance of language. These four themes were discussed not only with them, but also with the employers and the high contrast between their perception was always present. While politicians were not fully worried about potential environmental hazards that the process, for instance, of creating a new Technology Park in a Valencian County would encounter, most of PhD were emphasizing the lack of rigor in the Environmental Analysis' reports from political bodies. The main problem found was that such an infrastructure, the Technology Park, was being planned to be built on a reservoir of an aquifer. While PhD holders were searching for environmental-friendly solutions, politicians and some industrialists were focusing only on their vested economic interests. So, the public interest was out of place. Meanwhile, the promise of creating jobs and bring prosperity to the region was spread with a misleading message to the population of that textile area. Hence, this is an example where PhD can contribute with their rigorous knowledge

to tackle sensitive regional problems. However, the barriers to implement and use this scientific knowledge comes from a problem of agency.

In the textile area studied, the presence of higher education institutions is limited to four organisations (taking a radio of 50 Kilometres from Alcoy, the industrial district core). Despite this, the role of higher education institutions has been crucial since the inception of the Industrial Revolution (Ortega-colomer, 2013). The problem discussed with the interviewees at this stage was the lack of capacity from higher education institutions to hire highly skilled workers. Consequently, other kind of organisations are called to play a role while the university is not functional in that regard. The new employers of PhD holders are, for instance, technology institutes, industrial firms with (or without) R&D projects and consultancy firms. Here, we found another mismatching between the employer profile and the PhD holders' responses. While PhD holders who worked in non-university sector felt that they were not using the analytical skilled, that characterise a researcher, the employers argued that the lack of contextual knowledge, from the PhD holders' side impede to find joint solutions that solve the industrial problems. In other words, the employer was finding an adaptation from PhD holders to the context of the sector in terms of habits and routines embedded in the firm and their immediate network of collaborators. Here, we think there is no black or white-like solutions, and the answer could be to plan more open space to debate, maybe out of the comfort area of employers (their factory), to avoid certain conflicting interests. In parallel with this, from PhD holders' side, one can suggest them to strive to incorporate more entrepreneurial spirit in their routines, to anticipate to the abovementioned problems of incoordination, in terms of employability and the purpose and sense of each task. That means, they should adopt a more project-based attitude to better offer their value-added solutions to employers. Thus, a possible understanding between them could

consider as a win-win strategy: The employer wins a highly skilled worker who provides the scientific method within the firm culture, and to the rest of local actors, while the PhD holders can start to avoid statements like "the employer is the enemy who did not hire me, or if so, makes me think not as a scientist, but as another low-skilled workers who does not think".

4.3 Unbalance between labour markets industrial districts and PhD holders towards more sustainable regions

Another theme discussed in the fieldwork conducted was referred to the creation of more sustainable regions. After several decades where the shortcomings of the industrialisation of society have been more than criticised, we are still waiting for political decisions that limit the action of several industrial sectors that, in fact, are the most contributors to the pollution in the atmosphere. Thus, the role of PhD, as a reflexive agent and an evidence-based decision-maker, can get feasible answers to the main problems of society, though they are not always popular. Those problems are, indeed, reflected within the European Programme "Horizon 2020" as six axes to be tackled, and recently within the European Green Deal (European Commission, 2019). Here, the conflict may again seem to be the existing vested interests among hegemonic actors that were created by the former generations.

From PhD holders' side, the main insight and lesson to put into practice, according to the interviews, is to encourage them to be more active in the public life of the industrial district, instead of remaining in a bunker of truth, that their status of scientist is providing. The more a consensus can be reached and the more a joint plan can be drawn, a better regional political landscape we will witness in the coming years.

5 Discussion

This work in progress explores the perception of the role of PhD holders in industrial districts by themselves and by their employers. The relevance of this topic is given by the need to transform the current economic structure into a more sustainable one. Spanish industrial districts are characterized by a set of small and medium-sized firms belonging to traditional industries, such as textiles, ceramic or shoes, which are very polluting industries. The usual employer of PhD holders has been the local universities, but not those firms located in industrial district. In this regard, the article has explored how this mass of PhD holders is being absorbed by heterogeneous actors in industrial districts and which are their consequences in terms of their contributions to the coming challenges and paradoxes to be tackled.

The identification of both narratives, PhD holders and their employers, can shed light on the transformation needed for an industrial district that has to compete in the international landscape. This is even more important if we aim to tackle the societal challenges, like the Sustainable Development Goals (United Nations, 2015). The contribution, for instance, of creating an observatory of PhD holders would add a mean to assess the current and future efforts in terms of public policies addressed to the economic development and employment. In parallel to this, the generation of open public spaces for debating common local problems could empower a local network of experts and citizens by sharing common concerns and by undertaking co-solutions. This way, the district-effect may be enhanced and probably, more and better future scenarios could be drawn. Some initiatives (for instance, in the Basque Country) show the creation of Knowledge Clusters are a possible path to follow. Another example would be the Science Shops in Denmark. However, how to balance a governance structure

among local/global actors within this cluster is still an open question to answer in a cooperative way.

The diversity of career paths for PhD holders needs to be settled within a framework that is in between the public policy sphere, the industrial and economic development, and the science-society interactions literature. This article, still in progress, attempts to converge different streams of literature. Further research on this topic deserves much more attention by including more voices, more examples of public policy initiatives and above all, more participation in the political economy debates. The aim of this long-run debate is to tackle a paradox we are living today: firms with a low capacity to innovate cannot compete internationally, while highly skilled workers are looking for a job at the height of their status, or even worst, those workers are not embedded in the territory and thus, not contributing accordingly, despite the public investment of their education and early research career development.

REFERENCES

- Aanerud, R., Morrison, E., Homer, L., Rudd, E., Nerad, M., & Cerny, J. (2007). Widening the Lens on Gender and Tenure: Looking Beyond the Academic Labor Market. *NWSA Journal*, *19*(3), 105–123.
- Auriol, L. (2010). *Careers of Doctorate Holders: Employment and Mobility Patterns*.
- Bazeley, P. (1999). Continuing Research by PhD Graduates. *Higher Education Quarterly*, *53*(4), 333–352. <https://doi.org/10.1111/1468-2273.00135>
- Benneworth, P., Coenen, L., Moodysson, J., & Asheim, B. (2009). *European Planning Studies Exploring the Multiple Roles of Lund University in Strengthening Scania's Regional Innovation System: Towards Institutional Learning?* <https://doi.org/10.1080/09654310903230582>
- Boschma, R. A., & ter Wal, A. L. J. (2007). Knowledge Networks and Innovative Performance in an Industrial District: The Case of a Footwear District in the South of Italy. *Industry and Innovation*, *14*(2), 177–199. <https://doi.org/10.1080/13662710701253441>
- Bozeman, B. (2000). Technology transfer and public policy: A review of research and theory. *Research Policy*, *29*(4–5), 627–655. [https://doi.org/10.1016/S0048-7333\(99\)00093-1](https://doi.org/10.1016/S0048-7333(99)00093-1)
- Breschi, S., & Lissoni, F. (2001). Knowledge Spillovers and Local Innovation Systems: A Critical Survey. *Industrial and Corporate Change*, *10*(4), 975–1005. <https://doi.org/10.1093/icc/10.4.975>
- Breznitz, S. M., & Feldman, M. P. (2012). The engaged university. *Journal of Technology Transfer*, *37*(2), 139–157. <https://doi.org/10.1007/S10961-010-9183-6/FIGURES/2>

- Commission, E. (2008). *The Concept of Clusters and Cluster Policies and Their Role for Competitiveness and Innovation: Main Statistical Results and Lessons Learned*. Europe INNOVA / PRO INNO Euro paper N°9.
<https://op.europa.eu/en/publication-detail/-/publication/c15445bd-8203-4d15-b907-56ea17a9876e>
- Cyranoski, D., Gilbert, N., Ledford, H., Nayar, A., & Yahia, M. (2011). Education: The PhD factory. *Nature*, 472(7343), 276–279. <https://doi.org/10.1038/472276A>
- Dietz, J. S., & Bozeman, B. (2005). Academic careers, patents, and productivity: Industry experience as scientific and technical human capital. *Research Policy*, 34(3), 349–367. <https://doi.org/10.1016/J.RESPOL.2005.01.008>
- Gjelsvik, M. (2017). Economic Transformations of Regions: The Role of Banks. *Strategic Change*, 26(1), 35–51. <https://doi.org/10.1002/jsc.2107>
- Haapakorpi, A. (2015). Doctorate holders outside the academy in Finland: Academic engagement and industry-specific competence.
[Http://Dx.Doi.Org/10.1080/13639080.2015.1119257](http://Dx.Doi.Org/10.1080/13639080.2015.1119257), 30(1), 53–68.
<https://doi.org/10.1080/13639080.2015.1119257>
- Hartog, M., Boschma, R., & Sotarauta, M. (2012). The Impact of Related Variety on Regional Employment Growth in Finland 1993–2006: High-Tech versus Medium/Low-Tech. [Http://Dx.Doi.Org/10.1080/13662716.2012.718874](http://Dx.Doi.Org/10.1080/13662716.2012.718874), 19(6), 459–476. <https://doi.org/10.1080/13662716.2012.718874>
- Herrera, L., & Nieto, M. (2016). PhD careers in Spanish industry: Job determinants in manufacturing versus non-manufacturing firms. *Technological Forecasting and Social Change*, 113, 341–351.
<https://doi.org/10.1016/J.TECHFORE.2015.09.019>

- Hirsch-Kreinsen, H. (2008). "Low -Technology": A Forgotten Sector in Innovation Policy. *Journal of Technology Management & Innovation*, 3(3), 11–20.
<https://doi.org/10.4067/S0718-27242008000100002>
- Hirsch-Kreinsen, H., Jacobson, D., & Robertson, P. L. (2006). 'Low-tech' Industries: Innovativeness and Development Perspectives—A Summary of a European Research Project. *Prometheus*, 24(1), 3–21.
<https://doi.org/10.1080/08109020600563762>
- Kuoppakangas, P., Suomi, K., Pekkola, E., Kivistö, J., Kallio, T., & Stenvall, J. (2020). Theoretical, practical and hybrid ex-academics: Career transfer stories: *Https://Doi.Org/10.1177/1474904120915026*, 20(1), 14–41.
<https://doi.org/10.1177/1474904120915026>
- Martin, B. R., & Etzkowitz, H. (2001). *The Origin and Evolution of the University Species*.
- Molina, J. L., Martínez-Cháfer, L., Molina-Morales, F. X., & Lubbers, M. J. (2018). Industrial districts and migrant enclaves: A model of interaction. *European Planning Studies*, 26(6), 1160–1180.
<https://doi.org/10.1080/09654313.2018.1455808>
- Muscio, A., Shibayama, S., & Ramaciotti, L. (2021). Universities and start-up creation by Ph.D. graduates: The role of scientific and social capital of academic laboratories. *Journal of Technology Transfer*, 1–29.
<https://doi.org/10.1007/S10961-020-09841-2/TABLES/7>
- Ortega-Colomer, F. J., Molina-Morales, F. X., & Lucio, I. F. de. (2016). Discussing the Concepts of Cluster and Industrial District. *Journal of Technology Management*

& *Innovation*, 11(2), 139–147. <https://doi.org/10.4067/S0718-27242016000200014>

Porter, A. L., & Rafols, I. (2009). Is science becoming more interdisciplinary? Measuring and mapping six research fields over time. *Scientometrics* 2009 81:3, 81(3), 719–745. <https://doi.org/10.1007/S11192-008-2197-2>

Powell, K. (2015). The future of the postdoc. *Nature*, 520(7546), 144–147. <https://doi.org/10.1038/520144A>

Power, D., & Malmberg, A. (2008). The contribution of universities to innovation and economic development: In what sense a regional problem? *Cambridge Journal of Regions, Economy and Society*, 1(2), 233–245. <https://doi.org/10.1093/CJRES/RSN006>

Puig, F., & Marques, H. (2010). Territory, specialization and globalization in European manufacturing. *Territory, Specialization and Globalization in European Manufacturing*, 1–182. <https://doi.org/10.4324/9780203844809/TERRITORY-SPECIALIZATION-GLOBALIZATION-EUROPEAN-MANUFACTURING-HELENA-MARQUES-FRANCISCO-PUIG>

Schmierl, K., & Köhler, H. D. (2005). Organisational learning: Knowledge management and training in low-tech and medium low-tech companies. *Perspectives on Economic Political and Social Integration. Journal for Mental Changes*, 11, 171–221.

Skovgaard-Pedersen, H. (2015). *Empirical Essays on the Labor Market Outcomes of PhD Graduates Politica*.

Stephan, P. E., Sumell, A. J., Black, G. C., & Adams, J. D. (2016). Doctoral Education and Economic Development: The Flow of New Ph.D.s to Industry:

[Http://Dx.Doi.Org/10.1177/0891242403262019](http://dx.doi.org/10.1177/0891242403262019), 18(2), 151–167.

<https://doi.org/10.1177/0891242403262019>

Stokes, D. E. (1997). *Pasteur's Quadrant: Basic science and technological innovation*.

The Brookings Institution.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic

management. *Strategic Management Journal*, 18(7), 509–533.

[https://doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509::AID-](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)

[SMJ882>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)

Telling, K., & Serapioni, M. (2019). The rise and change of the competence strategy:

Reflections on twenty-five years of skills policies in the EU:

[Https://Doi.Org/10.1177/1474904119840558](https://doi.org/10.1177/1474904119840558), 18(4), 387–406.

<https://doi.org/10.1177/1474904119840558>

United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable*

Development | Department of Economic and Social Affairs.

<https://sdgs.un.org/2030agenda>