Organisational forms and strategies for Data-driven Innovation: Mapping the university knowledge production and hybrid knowledge spaces in the City Region Deal

Fumi Kitagawa, University of Edinburgh, UK fumi.kitagawa@ed.ac.uk
Niki Vermeulen, University of Edinburgh, UK niki.vermeulen@ed.ac.uk
Marion Maisonobe, UMR Géographie-cités, CNRS, Paris, France,
marion.maisonobe@cnrs.fr

Introduction

The recent institutional forms of governance of city regions has resulted in debates about political rescaling through the creation of local territorial spaces and actors. In this context, investigating new organisational forms and strategies in urban settings facilitates the development of an analytical lens to better understand how various agents behave, interact, relate, and evolve with wider "institutional constellations" (Sotarauta and Pulkkinen, 2011, p. 100). Such interactions occur not just among firms, but also between "public and private research infrastructure, and the infrastructure of regional institutions" (Wolfe, 2010, p. 139). Empirical evidence on the institutional diversity behind territorial path creation and transformation is called upon, between "non-firm" organizations of different types including universities, public research institutes, and various other intermediary actors. In this context, we examine strategy development of the University of Edinburgh responding to recent localised governance of the UK's city region through so-called City Region Deals. We will show how the Edinburgh City Deal is creating new hybrid spaces for inter-organisational interaction.

Our study aims to broaden theoretical horizons by bringing together two broad streams of literature: the governance of city regions, and organisational studies of higher education institutions (HEIs). In particular, we introduce the concept of "hybrid spaces" where different institutional logics coexist and interact. Empirically, we present the case of a City Region Deal in Scotland, more specifically, the Edinburgh and South East Scotland City Region Deal (ESES-CRD). Our focus is on the Data Driven Innovation (DDI) Programme, which is part of the City Region Deal aiming to **"**help establish the region as the data capital of Europe", by drawing in inward investment, fuelling entrepreneurship and delivering inclusive economic growth**.** It attempts to realise its goals by helping organisations and individuals to connect to research and development in the generation, storage, analysis and use of various forms of data.

In addition, the programme aims to improve digital skills through working with schools, further and higher education, employers, and training providers, and to stimulate entrepreneurship.

In this paper, we ask the following key questions:

- How can we understand the influence of the City Deal's focus on data-driven innovation on the profile of the University of Edinburgh?
- How does the university position itself in the evolving local institutional constellations of a City Region Deal?
- How is inter-sectoral and inter-organisational collaboration encouraged and orchestrated, and inhibited in the context of the University of Edinburgh and the City Region Deal?

This study adopts a mixed methodology. First, to empirically investigate the positioning of Edinburgh in the identified areas of scientific knowledge production (i.e. data science, computer science), we carry out bibliometric analysis, focusing on sets of publications encompassing proceedings in our analyses. We show how Edinburgh as a city region is positioned in terms of knowledge production and collaborative patterns referring to the content of the Web of Science Core Collection (articles, reviews, letters and proceedings). This "spatial scientometric" (Frenken et al., 2009) approach allows us to demonstrate the patterns of knowledge production and collaboration across cities in the UK, positioning Edinburgh as a city region in the national scientific knowledge production landscape. Second, in order to understand the recent interactive and evolutionary nature of organisational changes set in the city region context, this study is informed by exploratory semi-structured interviews conducted between October and December 2018 exploring the alignment of interests between the local industry needs and the university academic capability and expertise related to the DDI activities. Thirdly, we place recent developments in a historic and evolutionary perspective, to show continuities and transformations in Edinburgh as an important place for knowledge interactions and development.

The rest of the paper is structured in a following way. Section 2 sets the context of this study by providing a review of literature firstly on the governance of city regions and knowledge production, and secondly on the role of HEIs in spatial development, and introduces a set of institutional theory literature. Section 3 provides the empirical contexts by giving the

background of the ESES-CRD and the scientific knowledge production in data science. Section 4 focuses on the emerging new organizational forms and strategies of the University of Edinburgh in order to respond to new opportunities and challenges, by creating new "hybrid spaces."

Literature review

As the history of the city of Edinburgh with the Enlightenment shows, place matters in the generation of knowledge (Livingstone, 2003). Today, there is a growing strand of literature asking why some cities prosper within an increasing knowledge based society while other cities do not, and how the structure of national urban systems influences development paths (Krätke, 2007). Authors analyse the roles of governance of urban and metropolitan spaces (Harrison and Hoyler, 2014), and the highly specialised institutional thickness within cities (Growe and Volgmann, 2016). At the same time, science is characterised by unequal spatial patterns: recent analyses of the global network of academic science reveal specific geographical patterns, such as polarization, while simultaneously, a global trend towards spatial deconcentration is observed (Grossetti et al., 2014; Maisonobe et al., 2016).

The rapid expansion of universities and other HEIs has been followed by growing scrutiny of their role in knowledge production and spatial development (Harrison and Turok, 2017). The rising expectations placed on universities have been met by far-reaching shifts in their internal culture, organization and leadership (Goddard el al., 2016). There is increasing engagement of academics with the external business community, civil society and different parts of government. However, the diverse pressures on universities have created many tensions and contradictions that are difficult to resolve (Grossetti et al., 2014). Is research excellence more important than economic impact and social relevance? Should universities trade autonomy for success through greater collaboration (Harrison et al., 2015; Kitagawa, 2010; Vermeulen et al., 2013)? Is concentrating research activity in the "best" institutions more productive than investing in peripheral areas (Langfeldt et al., 2015). These dilemmas all raise questions of institutional autonomy, accountability and responsive governance.

The concept of hybrid logics is a promising framework for understanding 'how universities can and do manage and exploit tensions in the missions' in their responses to the demands of social institutions and industry logics (Upton and Warshaw, 2017, p. 100). Recent organisational

studies of higher education show the emergence of "hybrid spaces" in which universities manage such different logics (Perkmann et al., 2018). Three functions of "hybrid spaces" are identified (Perkmann et al., 2018):

(a) leveraging, where dominant logic practices are drawn on to achieve minority logic objectives;
(b) hybridization, where the practices inside the space are modified to allow engagement with the minority logic; and
(c) bolstering, where the space is shielded against excessive minority logic influence and is anchored back into the wider organization.

Existing literature points out how knowledge societies are grounded in space and the ways in which certain spatial structures and sub-national policy initiatives provide advantages for the development of research and science activities. National contexts are important because academic research is embedded in territories, connected to local and national histories (Powell, 2007). In the UK, a path-dependence occurring in cities and city regions have been recognised with growing interests in historical dimensions (Simmie et al., 2008). In the following section, we focus on a case of one city region -Edinburgh- where we observe evolving dynamics of knowledge production and the formation of hybrid spaces to combine and reconcile different institutional logics and resolve tensions between public and private stakeholders in the city region.

Empirical contexts - Data Science, the City Region and the University of Edinburgh

In Autumn 2015 the UK Government announced regional Science and Innovation Audits (SIAs) to catalyse a new approach to regional economic development. SIAs enable local consortia to focus on analysing regional strengths and identify mechanisms to realise their potential (BEIS, 2016). Following the SIAs, in Scotland, City Region Deals have been developed as agreements between the UK Government, the Scottish Government, and local governments aiming to bring about long-term strategic approaches to improving city region and regional economies. Each deal aims to address the need of its city region, based on an analysis of economic strengths and weaknesses, and "comprises a programme of interventions to support positive, transformative change" (Scottish Government, 2018). As such, City Region Deals need to be analysed with spatial and temporal perspectives with a view to a multi-level policy governance structure.

In the Edinburgh and South East Scotland City Region, a consortium was formed around the identified growing strength in Data-Driven Innovation (DDI). From the incept of the DDI programme, the University of Edinburgh has been working closely with six local authorities in the southeast of Scotland as well as relevant businesses. The University of Edinburgh claims engagement with this research agenda for several decades, with historic expertise in informatics and Artificial Intelligence, and related fields of Engineering and Natural and Social Science. The performance of the School of Informatics at the University of Edinburgh, and the excellence in robotics at the University of Heriot-Watt are recognised as part of DDI academic capability. The programme is centred around the *Training, Research, Adoption, Data* and *Entrepreneurship* (TRADE) framework. With recent local political developments leading to the launch of the Edinburgh City Deal in 2018 as a 10 year programme, capabilities of the city region in digital business is emphasised.

Mapping the Edinburgh Data Science Knowledge Production

In our quantitative phase of investigation, we use geo-tagged data from the Web of Science Core Collection (articles, reviews, proceedings and letters) to understand spatial dynamics. This shows that Edinburgh is among the top 10 publishing and cited UK cities. It is the 6th UK city both in production share and in citation share. Its visibility ratio is high and is improving at the global level (since 2000, the decrease in its global share of citation has been much less important that the decrease in its global production share leading to an increase in its global impact ratio). At the national level, Edinburgh is performing well. Among the cities with an impact ratio superior to the national average, Edinburgh is the city that has experienced the smaller decrease of its impact ratio between 2000 and 2013.

Identifying the strength of Edinburgh in data science and the DDI related academic capability is not straightforward and requires careful investigation. According to Hyland and Tse, 2007, “data” is with “process”, “analyse”, “research” and ”method”, one of the top 5 frequently used words by academics in sciences, engineering and social sciences. If “working with data” were what define “a data scientist”, then most academics would be considered data scientists. In order to adopt a more specific definition or at least to distinguish between different data science skills, we must investigate within the different branches of research that are well developed in Edinburgh; e.g. informatics, health science, engineering, space science and social science.

Within these different areas, the engagement with data differs and some research is more data driven than others.

To delineate a corpus of publications that is representative of Edinburgh's DDI related academic capability, the analysis begins by selecting all academic publications signed by authors working in the Edinburgh urban area between 2015 and 2017. A lexical analysis helps us identify and map the different research areas that are specific of the city region in terms of "data science". Then we focus on the three most representative ones and analyse the position of Edinburgh in terms of collaboration, production and visibility in these research areas.

The University Organisational Forms, Challenges and Strategies

At the University of Edinburgh, the DDI programme has been constructed as an 'interdisciplinary' project spanning the traditional Colleges, Schools and groups. In order to cut across existing structures, new organisational structures as 'hybrid spaces' have been created. Four innovation hubs are located at University of Edinburgh (i.e. *Edinburgh Future Institute*; *Eastern Bush*; *Bayes Centre*; *Usher Institute*). In addition, the *Robotarium* is a collaboration with Herriot-Watt. These new structures have often led to infrastructural transformations, often located in new or newly renovated buildings. Moreover, the DDI programme aims to re-organise data-driven innovation by engaging with external stakeholders and citizens of Edinburgh, strengthening the Universities third mission of local engagement.

The embedding of DDI activities in the existing university organizational structure comes with considerable challenges. Questions remain on how are these new innovation hubs function next to existing research and education; how academics can be incentivised to participate and connect to industrial and societal needs; and how the external markets for DDI expertise can be formed and developed. Other challenges are found in the engagement of industry stakeholders and the establishment of links to the industry's sometimes 'unknown' DDI needs, demands and interests. For the university, understanding the complexities of the local skills landscape and the opportunities for linking with specific local SMEs and supply chain systems may provide further challenges. Critical questions relate to linking DDI programme to inclusive growth and social inclusion agenda and wider social impacts of the identified DDI areas. These activities would also support the development of a skills ecosystem through

developing innovative learner pathways and can lead to significant improvement of outcomes for widening participation through strategic partnerships.

Discussion and Contribution

The case of the DDI programme in the ESES City Region Deal illustrates how the university manages and exploits tensions in its missions in their responses to the demands of different logics in a city region context. One of the key questions is concerned with the ways in which the university manages academic logics along with growing logics including industry logics and demands as social institutions. To explain the balance of these logics, Perkmann et al (2018) identify three functions of "hybrid spaces": "leveraging"; "hybridization" and "bolstering". In the City Region Deal context, how the hybrid spaces are designed, governed and developed poses challenges for organisational capability and actions for the organisation as a whole as well as different sub-units. Collaboration with local intermediary organisations could pave a way for future complementary opportunities.

Based on the quantitative mapping study and a set of exploratory interview findings, we propose areas of further investigation. First, there is a theoretical gap in terms of local governance forms and the nature of hybrid spaces. In terms of organisational actions for the university, such governance forms and organisational constraints need be recognised in the design of innovation hubs and their future development. The DDI programme is still in its early days, and its development and dynamics in terms of the new modes of knowledge production, as well as industry and social engagement remains to be observed over the coming years. Understanding how the hybrid spaces evolve over time requires an innovative methodological and conceptual approach in organisational studies. This includes the micro-understanding of institutional processes as multiple logics co-evolve and new organisational drivers are being co-created with a variety of external stakeholders in the multi-scale organisational contexts of the university.

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