RESEARCH ARTICLE

Who influences policy labs in the European Union? A social network approach

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ABSTRACT

The growing importance of public innovation has been manifested through the creation of policy labs: spaces for policy experimentation and innovation that work for or within a government entity. The rise of this phenomenon in Europe was evidenced by the creation of a policy lab by the European Commission (EC) in 2016 and the publication by the EC of a report identifying policy labs and their influencers in Europe. Public innovation is increasingly based on national and international networks, giving rise to complex ecosystems involving participation by multiple actors from countries with different administrative approaches. Our study uses social network analysis of these labs' Twitter profile data to map the European Union's (EU) public innovation ecosystem and identify the major influencers. Policy labs and their influencers are analyzed by administration style by using a large geographical database. The results reveal a complex global network of influencers and a strong predominance of the Anglo-Saxon administration style. From an EU perspective, our systematic analysis of influence is particularly important in the post-Brexit context, helping to foster a genuine public innovation ecosystem that is both autonomous and interconnected with the aim of facing challenges such as the Sustainable Development Agenda and COVID-19 crisis recovery.

1. INTRODUCTION

Public sector innovation has become one of the most promising topics in public governance in recent decades (Moore, 2005) and this has led to its being institutionalized (Hjelmar, 2019). The speed with which social and technological changes occur, the complexity of social problems and a globalized world—thanks to trade, social networks, and information flows—have pushed governments to adopt various solutions to promote public innovation (OECD, 2019) and, thus, address common challenges more creatively, more effectively, and with greater social legitimacy. As Hartley (2005) pointed out, public innovation is a process of change that produces durable and significant transformation in how an organization operates. This happens not just by creating original ideas but also as the result of applying existing ideas to new institutional contexts (Gieske, George et al., 2020; Moore, 2005). Efforts to advance public innovation have been made at various levels of government administration, from local to supranational levels.

Innovation labs, innovation networks, innovation schemes, and prizes are some examples of the institutionalization of public innovation (OECD, 2017). In the present article, we focus on innovation labs or policy labs in Europe, whose mission it is to use innovative and participatory

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methodologies in designing public policies (Hjelmar, 2019; Lewis, McGann & Blomkamp, 2020; Romero-Frías & Arroyo-Machado, 2018; Tõnurist, Kattel, & Lember, 2017). Labs are attempts to institutionalize and promote the transformation of public organizations from the inside out, in order to respond to citizens' demands for openness and participation. At the same time, they seek to activate an approach in which smart citizens and employees foster collective intelligence. Policy labs place citizens at the center of their innovation processes in open, experimental ways to promote more proactive institutions that seek to recover the political initiative and increase people's confidence in them. Concepts such as coproduction, citizen participation in innovation processes, experimentation, and managing through networks all fit within the New Public Governance paradigm (Pollitt & Bouckaert, 2011; Torfing, Andersen et al., 2020). This new theoretical approach takes into account sociology and network theory and acknowledges the increasing uncertainty affecting public management in the 21st century (Osborne, 2010), a political scenario that policy labs are seeking to address in the public sector.

Policy labs are generally identified by a range of names: government labs or govlabs, public sector innovation (PSI) labs (McGann, Blomkamp, & Lewis, 2018), innovation labs (Tõnurist et al., 2017), or policy labs (Fuller & Lochard, 2016), among others. Throughout this study, we will use the term *policy lab* (or simply, *labs*), as this was used by the European Commission (EC) when creating its own lab in 2016.

To understand the global outreach of policy labs in Europe and around the world, it is necessary to adopt various means of classifying public administration according to their characteristics. As stated, policy labs meet governments' needs to reorganize their innovation processes, taking into account two main ideas: technological change and user- and citizen-centric governance and management. Based on an analysis of the literature, Voorberg, Bekkers, and Tummers (2011) identified the following drivers of the innovation environment: the social and political complexity of the public organization environment; the characteristics and degree of the legal culture in a country; the type of governance and state tradition in the country; and the allocation of resources, resource dependency, and the quality of relationships within the networks among the stakeholders involved. Both the legal culture and the type of governance and state tradition seem to be relevant drivers to understand the nature of policy labs. For example, innovation in the public sector is dependent on the capacity to embark on a process of "trial and error," experimentation, collaboration, and availability of resources. Dwivedi (2005, p. 20) refers to administrative culture as "the modal pattern of values, beliefs, attitudes, and predispositions that characterize and identify any given administrative system." This idea, also referred to as *Administration Style*, is used in this study to classify labs according to their different national traditions. Administration Style has been used to explain the evolution of public sector reforms (Bonsón & Bednárová, 2018), including aspects such as transparency, accountability, and e-participation (Pina, Torres, & Royo, 2007; Royo, Yetano, & Acerete, 2014). According to these authors, the dissemination of public sector management innovations is influenced by their organizational and administrative culture, historical background, and legal structure. Therefore, this can be a useful theoretical approach to understand the creation and popularization of policy labs and their influencers across countries.

In EU countries, four broad styles of public management may be distinguished, as follows (Torres, 2004):

- Anglo-Saxon (AS, including Ireland and the United Kingdom): emphasis on efficiency, effectiveness, and value for money in public administration; more likely to introduce market mechanisms, notions of competitiveness, and attempts to make public services more responsive to their users or customers; adaption of private sector experience to the public sector.

- Germanic (GE, including Austria and Germany): Weberian approach, involving a complex federal system; administrative practice marked by an overriding legalistic philosophy within the constitutional framework; strong hierarchy with detailed regulations.
- Nordic (NO, including Denmark, the Netherlands, Finland, Sweden, and Norway): a mixture of the AS and Germanic types; public administration model that seeks efficiency and effectiveness through the satisfaction of citizens' needs; strong tradition of negotiation and consultation.
- Southern EU countries (SO, including Belgium, France, Greece, Italy, Luxembourg, Portugal, and Spain): influenced by the French legal model focused on administrative law; definition by central government of overarching state rules for field services and a unitary treasury system.

This classification focuses mainly on Western Europe, which may *a priori* present limitations due to the enlargement of the EU with countries that have postsocialist administration traditions (Painter & Peters, 2010). However, the EU report upon which this research is based does not identify policy labs from these countries and therefore its scope fits the aforementioned classification (i.e., mainly focused on Western European tradition).

Public innovation practice in Europe and around the world is made up of globalizing instruments, such as conferences and networks, giving rise to a complex and interconnected public innovation ecosystem. Policy labs are one of the most novel and relevant entities in this ecosystem. Due to their institutional nature and goals, most of them have active profiles on social media, where they communicate and build networks with other actors.

Our main objective is to explore this global ecosystem by analyzing structural relations on the Twitter profiles of European labs to obtain a better understanding of public innovation communities and the extent to which they are connected to the different public administration styles. This can provide insights on how different management and innovation cultures relate to each other in a field that, unlike competitive political processes such as electoral campaigns, is built on cooperative dynamics (Sørensen & Torfing, 2011). In addition, Dawes and Gharawi (2018) pointed out the lack of empirical research into Transnational Public Sector Knowledge Networks, in which governments engage to share knowledge and information. This study helps to fill this research gap in relation to policy labs, which are an example of this type of network, as well as verifying the effectiveness of new media as a means of unveiling new actors and potential partners.

Based on this general goal, our research questions are the following:

RQ1: What kind of network exists between European policy labs and their potential influencers (their followed profiles or friends)?
RQ2: What is the profile of European policy lab influencers on Twitter? Does social network analysis (SNA) validate the identification by experts of influencers in the EC-commissioned report?
RQ3: How are policy lab influencers distributed geographically and according to their public administration style?

2. POLICY LABS IN EUROPE

In 2016 the EC founded its own policy lab[1], defined as a "a space designed to foster creativity and engagement, and to develop interactions, processes and tools able to bring innovation

[1] https://blogs.ec.europa.eu/eupolicylab/.

into European policy-making"[2]. It was conceived of as both a physical and conceptual space where solutions are delivered through testing, experimenting, codesigning and visual thinking, using participatory methods that integrate all the stakeholders' views. In June 2016, the EC Joint Research Centre, on which the lab depends, commissioned and published a report entitled "Public Policy Labs in European Union Member States." This was prepared by Conseil & Recherche and the 27e Région (Fuller & Lochard, 2016) and their main goal was to map the policy labs operating in the EU at that time—64 laboratories in 13 countries—and their principal topics of interest. To the best of our knowledge, this report has not yet been replaced or updated.

So far, research into policy labs in Europe has been scant, although recently there has been a growing number of studies on policy design and labs (Olejniczak, Borkowska-Waszak et al., 2020; van Buuren, Lewis et al., 2020). To our knowledge, some studies have analyzed European labs in a wider context. For example, Olejniczak, Newcomer, and Borkowska-Waszak (2016) analyzed 20 labs around the world, including Europe, through a literature review and analysis of policy evaluation practices, to determine their value and impact. Tõnurist et al. (2017) analyzed 35 public innovation laboratories around the world to determine their main characteristics and the reasons for their creation. Their methodology focused on empirical analysis by triangulating data from in-depth interviews, document analysis and a survey of i-labs. McGann et al. (2018) tried to understand the role of public sector innovation labs in policy systems by analyzing publicly available information of a sample of 20 labs worldwide. Focusing solely on the European context, Romero-Frías and Arroyo-Machado (2018) used network analysis to reveal the structure of relationships between the 42 of the 64 labs in the EC report that have a presence on Twitter, conducting a content analysis of the labs' Twitter publications to identify their topics of interest. More recently, Olejniczak et al. (2020) analyzed the functions, structures, and processes of 20 policy labs from all around the world, including Europe.

The EC report mapped the main European policy labs and offered a selection made by the report's authors of the so-called "influencers" of these policy labs. Table 1 shows a list of 13 influencers that are defined as "entities that both advocate and propel the creation of Policy Labs, but are not in and of themselves attached to a specific government organization." Influencers play a role in advocating the creation of policy labs and providing experience, resources, and networking, as well as functioning as central nodes in the policy lab manager network.

3. SOCIAL NETWORK ANALYSIS AND INFLUENCER IDENTIFICATION

Social network analysis is based on network theory, which enables us to understand and model complex systems (Lewis, 2008). Different types of graph reflect real-world behavior through individual participants (nodes), and the implicit or explicit relationships between them (edges), whether or not directionality exists in the relationship. Given its popularity and openness to data collection, Twitter is one such complex system in which we can observe relationships through various indicators: number of friend/follower connections, retweets, and mentions (Del-Fresno-García, 2014). These relations can be analyzed from two general perspectives by focusing on social relations between individuals through established follow-up connections (taking account of the double, bidirectional follower/friend perspective) and the information network based on tweet-produced interaction (Myers, Sharma et al., 2014). The objective is to describe a given community's underlying network and analyze the existing

[2] https://blogs.ec.europa.eu/eupolicylab/about-us/.

Table 1. Twitter profiles of influencers identified in the EC Report

Policy lab [Twitter user]	Country	Twitter profile setup date	Tweets	Followers (# profiles following this profile)	Friends (# profiles followed by this profile)
Demos Helsinki [DemosHelsinki]	Finland	2014	2,638	8,482	2,453
EU Forum Alpbach [forumalpbach]	Austria	2009	4,311	7,056	565
iMinds [imec_int]	Belgium	2007	9,193	18,225	2,322
FutureGov [FutureGov]	UK	2008	10,967	22,839	7,210
Governance International [govint_org]	UK	2011	3,586	1,821	2,041
iNetwork [theinetwork]	UK	2010	7,057	1,989	2,202
La 27e Région [La27eregion]	France	2009	4,331	7,901	1,877
Laboratorio per l'innovazione [LabInnovazione]	Italy	2015	42	32	103
LabGov [LabGov]	Italy	2013	5,454	2,977	1,004
Localis [Localis]	UK	2008	4,276	3,353	569
Nesta [nesta_uk]	UK	2008	16,751	103,364	1,225
OECD Observatory for Pub. Serv. Inno. [OPSIgov]	France	2015	1,681	4,161	4,999
Publieke Waarden [Publiekewaarden]	Netherlands	2011	37,180	7,740	3,164

clusters and a range of indicators and statistics. Influence is one of the issues that can be researched through social network analysis.

Influencers have largely been analyzed in marketing studies, particularly in relation to social media (Casaló, Flavián, & Ibáñez-Sánchez, 2017; Hsu, Chuan-Chuan Lin, & Chiang, 2013; Uzunoğlu & Kip, 2014; Zhang & Caverlee, 2019), where digital influencers have a wider reach among their online social contacts than in traditional offline communication (Lyons & Henderson, 2005). This is how brands seek to design effective campaigns by using influencers as a reference group to influence their audience. The identification of relevant influencers has become a popular research topic in business (Kim & Tran, 2013; Liu, Jiang et al., 2015; Zhu, 2013). Numerous studies try to identify influencers on social media platforms, given their increasing importance as a part of companies' marketing strategies (Nip & Fu, 2016; Sun, Wang et al., 2016).

Shmargad (2018) studied Twitter influencers in politics using retweets as the best indicator of a given user's influence, as they capture other users' willingness to engage with others' messages. Centrality has also been studied in the specific case of social media platforms, concluding that a relationship exists between an individual's position in a group and their behavior (Klein, Ahlf, & Sharma, 2015). In politics, influence has mainly been studied in relation to electoral competition (Shmargad & Sanchez, 2020), although generally these studies focus on a particular event involving a surge in social media communication and not on the network of relations between institutions (policy labs in our case), where the act of following another profile can involve recognition in a process of accumulation of social capital (Bourdieu, 1986).

Our study explores the nature of the global public innovation ecosystem taking as its starting point the influencers of European policy labs, defined in the EC report as entities that advocate the creation of policy labs. This influence at an institutional level will be analyzed by following the different relationships in a given policy lab's Twitter network.

4. METHODOLOGY

4.1. Sample and Research Design

Our initial sample consisted of 64 policy labs and 13 "influencers," identified in the EC-commissioned "Public Policy Labs in European Member States" report. This report has been taken as a starting point to explore this public innovation ecosystem, given the relevance of the EU and the importance of the expert reports they commission in terms of agenda-setting and as foundations for future regulatory decisions.

We identified some problematic policy lab Twitter profiles that have associated Twitter accounts that may not be exclusively dedicated to lab activity. Labs with descriptions suggesting they are primarily or exclusively used by the policy lab were included. Similarly, we have included labs with a wider scope if their profiles or tweet content refer to innovation activities covered by the abovementioned definition (i.e., CityofOdense and AlpesMaritimes). In some cases, we have found that accounts have been redirected (e.g., UKTIIdeasLab is now redirected to TradeDesignLab—we have included the latter in the present study). Another case was the UNHCR policy lab, which links globally to the United Nations but was located in the online Refugee Aid Initiative in Greece report (UNHCRInnovation).

Initial profile identification and data collection took place in spring 2018, finding that 42 of the 64 labs had a presence on Twitter. A second survey was conducted in September 2019 to determine any subsequent changes. In this, we found that MindLabDK, one of the most prominent European policy labs according to Romero-Frías and Arroyo-Machado (2018), had

disappeared following cessation of activities at the end of 2018. Furthermore, PFI Region Sjælland (PFI_regsj) and Trade Design Lab (TradeDesignLab) no longer existed.

At that point, the 39 policy labs included in the EC report (plus the EC's own lab) were distributed geographically as follows (from highest to lowest number): 13 in the United Kingdom, eight in France, three each in Denmark, Spain, and the Netherlands, two each in Italy and Sweden, and 1 each in Finland, Greece, Ireland, and Portugal, plus the EU lab.

4.2. Data Processing

We collected information on Twitter related to the labs in the sample (42 in 2018 and 39 in 2019) and to the so-called "influencers"; this including followers, friends, number of tweets, description, lists, profile set-up date, location, and language.

The data gathered (profiles and interconnections) were collected through scripts programmed in python using the Tweepy and Twython libraries. We also used R[3] to treat some data. In our study we used the locations found in the free field offered to Twitter users. Having collected the locations, we searched OpenStreetMap API to geolocalize the accounts. Finally, we created heat maps using R to indicate the presence of accounts worldwide.

We analyzed the policy lab network by visualizing the connections between labs with the Gephi3 tool (Bastian, Heymann, & Jacomy, 2009). The graph obtained shows how the sample labs related to each other and which network nodes were the most relevant. We conducted this analysis on a global scale, taking account of the network as a whole and paying attention to each node or lab at local level. At a global level, we calculated the diameter, maximum eccentricity (greatest distance) between all node pairs, and the mean distance between all of them. For each node the degree of entry (indegree) and exit (outdegree) have been taken into account; these are equivalent to account followers and friends, respectively. Likewise, eigenvector centrality has been calculated (Bonacich, 1972). This is determined by using an iterative process that takes account of the degree of entry and exit of a node and the quality of these connections. We also calculated descriptive statistics for the mean and standard deviation (SD) from follower and friend data.

In total, 41,058 friends (outdegree) and 843,701 followers (indegree) of policy labs have been downloaded; of these, 36,338 friends (potential policy lab influencers) and 786,453 followers are unique. These figures indicate that policy labs attract much more attention from third parties than they pay to others by following their accounts.

The profile geolocation process revealed that 510,715 Twitter accounts provided locations, of which 110,156 were unique. Because this is not a standardized field on Twitter, the specific country to which each account belonged had to be identified using the OpenStreetMap API. Some 73,769 unique locations were correctly identified, giving 487,232 different Twitter accounts associated with a specific country. Thus, 77.14% of initial friends and 58.38% of followers were assigned a location.

4.3. Public Administration Style Differences

Excluding the EU Policy Lab, which is located at Europe level, the remaining 38 laboratories with a presence on Twitter are distributed by administration style as follows:

- Anglo-Saxon (AS) (14): United Kingdom (13) and Ireland (1)

[3] R Scripts for data processing are available at GitHub (https://doi.org/10.5281/zenodo.7590866).

- Nordic (NO) (9): Denmark (3), Netherlands (3), Sweden (2), and Finland (1)
- Southern Europe (SO) (15): France (8), Spain (3), Italy (2), Greece (1), and Portugal (1)

There is no Germanic policy lab in the sample. All geolocalized Twitter accounts in Europe were classified by administration style and then visualized through a Sankey diagram to analyze the location of influencers and the subsequent patterns of policy labs. We grouped policy labs by administration style and influencers by country. To improve the visualization, countries representing less than 0.2% of total influencer connections were eliminated. We then established the follow-up flows between administration styles and influencers using percentages of influencers over the total instead of absolute values.

4.4. Content Analysis

We conducted a content analysis of Twitter profiles to classify the top policy lab influencers identified in our analysis by influencer type and country of origin (Holsti, 1969). Our profile sample is based on the top 100 influencers of all European policy labs and on the top 50 labs in each of the three administration styles identified in the study sample. We ranked influencers by indegree and eigenvector centrality.

An initial taxonomy was explained to two independent research assistants who were asked to classify part of the sample to test the classification scheme. After sharing results, some adjustments were agreed which led to the establishment of the following influencer types: Academia; Business; Expert (female/male); Government institutions; Media; Networks and international organizations; Nonprofit organizations; and Others (including conferences, events, and internet services). We also recorded country profiles. The three researchers then coded the influencers separately and shared their results, reaching a consensus in the few cases on which they initially disagreed.

Finally, to respond to our research questions, we used a contingency table and correspondence analysis to assess differences between administration styles and influencer type.

5. RESULTS

5.1. European Policy Lab and Influencer Network

To answer RQ1, "What kind of network exists between European policy labs and their potential influencers (their followed profiles or friends)?," Figure 1 shows the network of policy labs and influencers; that is, all outdegree connections (friends). In some cases this relation is reciprocal. From the labs' perspective, this is reflected by the directions and colors of the edges, with blue for outdegree connections and red for indegree connections. Policy labs are represented by blue circles and influencers by red circles. The size of each node is calculated from the indegree, except for those labs that have been shown as equivalent in size to indegree 7 to give a homogeneous representation that allows the reader to focus on the influencers—the object of our study. All lab names have been included together with all influencer names with indegree 7 or higher. Edge thickness has no specific meaning. To properly visualize the network, only profiles with indegree 2 and belonging to the main component have been taken into account. The network in Figure 1 consists of 3,096 nodes, including labs and influencers, and 13,785 edges.

Figure 1 identifies two main clusters by size, corresponding mainly to British entities in the upper part and French entities in the lower part. The United Kingdom cluster comprises UK labs and the Irish lab (DCCStudio), and is next to the center of the network in closer

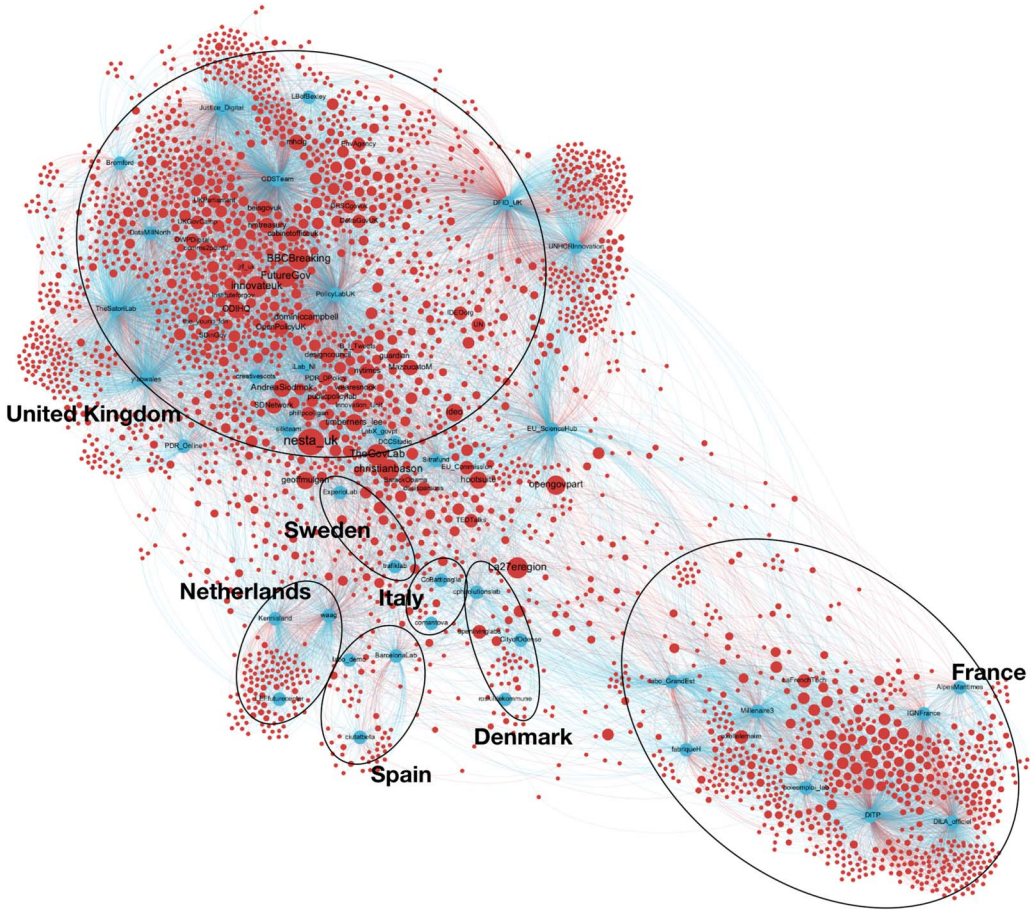

Figure 1. Network of policy labs and main influencers.

connection with other countries. This cluster includes the most relevant influencers, as indicated by labels on the map. nesta_uk and FutureGov are two of the most prominent influencers, as recognized by the EC report and confirmed by their position on the map. Clearly, nesta_uk holds a more central position in the European ecosystem than FutureGov, which is more central to the British cluster.

Note that PolicyLabUK stands at the core of the British ecosystem—as would be expected given its central role within the UK government's Cabinet Office—which implies that it is situated at a very high level in the administration. Influencers detected in this cluster include British government units and departments, such as innovateuk, the UK's innovation agency funding ideas in science and technology; cabinetofficeuk, the Prime Minister's office; UKParliament; hmtreasury, the UK Government's economic and finance ministry; beisgovuk, the UK Department for Business, Energy and Industrial Strategy; and mhclg, UK Ministry of Housing, Communities and Local Government. This shows affiliations to departments that can act as clients, users, funders, or regulators of lab activities, among other roles.

From the nonprofit sector, the Open Data Institute (ODIHQ) is identified as an important influencer in its work with companies and governments to build an open, trustworthy data ecosystem. The same stands for designcouncil, an institution focused on design at all levels, from grassroots to government, developing training programs and research.

Within the same cluster, we find labs of importance in the UK's devolved regions: iLab_NI, the public innovation laboratory of Northern Ireland, which was set up in 2014 in the government's Finance Department to innovate in developing public services; ylabwales, a Public Services Innovation Lab for Wales, which emerged from a partnership between Nesta and the University of Wales at Cardiff; or creativescots, a public body that supports the arts, screen, and creative industries in Scotland. It also includes Irish profiles, such as DubCityCouncil and DCCStudio.

The present study reveals the importance of significant individuals as influencers, given the greater mobility of people across countries and organizations. Within the Anglo-Saxon cluster, the most significant individuals are Dominic Campbell, CEO of FutureGov, and Andrea Siodmok, Deputy Director at the Cabinet Office responsible for Policy Innovation across the UK Government through Policy Lab, the Open Innovation Team, and SKYrooms innovation spaces. The latter was also connected to designcouncil, an organization committed to improving life through design and collaboration across institutions. Not directly linked to labs, we also found the economist Mariana Mazzucato (MazzucatoM), an economist and Director of the Institute for Innovation and Public Purpose at University College London; Tim Berners-Lee (timberners_lee), the inventor of the World Wide Web; and Philip Colligan, from the Raspberry Pi Foundation. The last two are involved in the digital world. Close to the center of the network we find Christian Bason, ex CEO of Mindlab, the Danish policy lab, and Geoff Mulgan, Chief Executive of Nesta, the most influential and connected influencer of the other European Labs.

Influencers from the United States are found in near central network positions in this area. They are the most relevant from countries outside Europe. Central positions are indicative of shared connections with labs from other European countries, as seen in Figure 2. Two

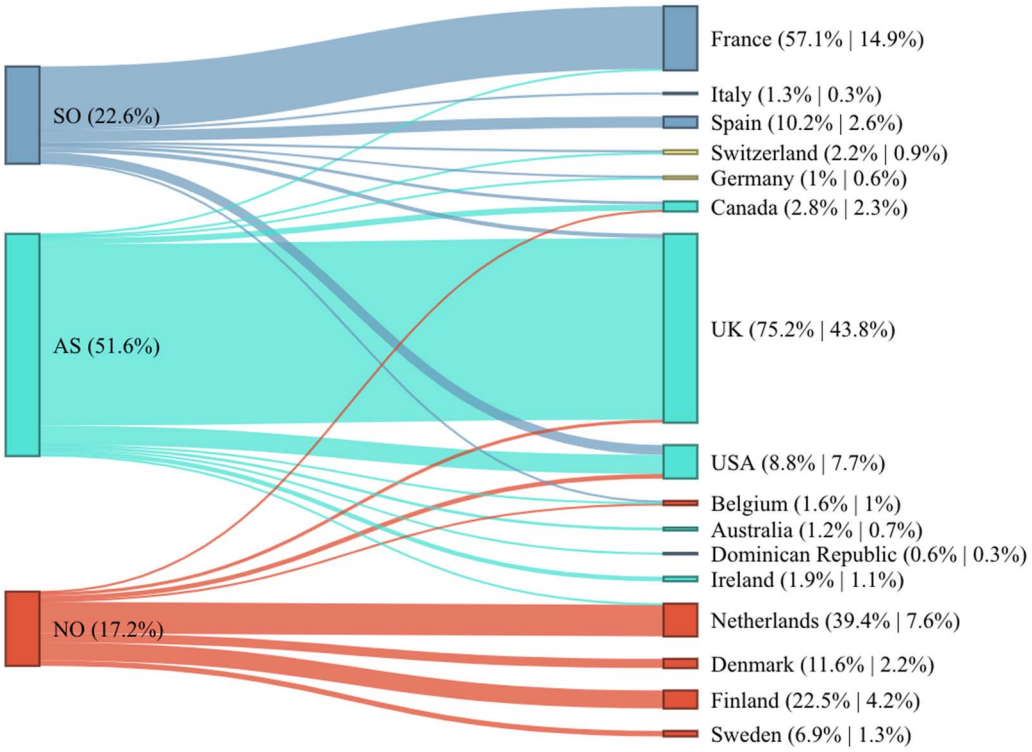

Figure 2. Sankey diagram showing influencers' countries by administration style. Southern Europe (SO); Anglo-Saxon (AS); Nordic (NO).

academic labs with high social impact are TheGovLab, a lab belonging to New York University, and the Parsons Design for Social Innovation and Sustainability Lab (desisparsons), an action research laboratory at The New School in New York.

Globally, we can conclude that the Anglo-Saxon cluster includes the more influential profiles. Outside of this, other national clusters can be observed. The biggest is the French cluster, which remains relatively isolated from another cluster made up of various Southern European and Nordic countries.

The United Nations (UN) and the EC (EU_Commission) are both intergovernmental organizations that are placed in central positions. The 27e Région (La27eregion) is the most influential French influencer, as can be seen by its position closer to other European labs and not at the core of French institutions. It is a public transformation lab for the design of public policies. openlivinglabs is the Twitter profile of the European Network of Living Labs (ENoLL), an influential actor in social innovation and cocreation practices across private and public organizations.

Figure 1 shows how network analysis can be an effective approach to reveal the complex ecosystem built around European policy labs. As we will examine below, this ecosystem goes beyond the actor identified in the EC report taken as the starting point for this research.

5.2. Influencers Identified on Twitter

Our RQ2 refers to the profile of influencers on Twitter and whether or not they match those in the EC report. To answer this, we started with the 39 policy labs with a presence on Twitter (including the EU Policy Lab). These labs have mean figures of 21,633.4 followers (SD ± 57,345.6), 1,052.8 friend accounts (SD ± 1,064.6), and 7,100.67 published tweets (SD ± 10,218.73). To focus on the most important influencers, we considered profiles followed by policy labs with a higher indegree—that is, those profiles followed by a larger number of labs. We used indegree 6, including 106 profiles, to examine influencers. This increased the initial number of 51 profiles (indegree 7), which have been named in Figure 1. The researchers classified these profiles by country and organization type.

The data show that a majority of profiles (57%) are located in the United Kingdom, followed by France (16%) and the United States (12%). Some 5% have a European reach and another 5% a global reach. The other countries in the sample with 1% or 2% are Australia, Canada, Denmark, Ireland, and Germany. Of the 106 profiles, all use English in their descriptions, except the French accounts.

The distribution by profile type is government institutions (32%), experts (20%; of which only 29% are women), and nonprofit organizations (18%). We found a lower presence for business (8%), the media (7%), networks and international organizations (6%), academia (3%), and others (8%), which included heterogeneous profiles such as conferences, events, and internet services.

Of the 106 most-followed profiles, only three are influencers identified in the EC report: Nesta, FutureGov, and La 27e Région—although this rises to five if we incorporate people directly linked to organizations as indicated above. Table 2 shows descriptive data for the Twitter profiles of the 15 main influencers detected. The table also shows the evolution of rank-order positions over 1 year to determine their stability in time. Indegree was quite stable with a slight general fall, but eigenvector centrality provides more information. Christian Bason, former CEO of Mindlab, lost influence, probably due to the closure of the lab, which no longer appears in the list because its Twitter profile was removed. Hootsuite has a very low

Table 2. Most relevant influencers according to Twitter

Influencers [Twitter user]	Country	Year Twitter profile set up	Tweets	Followers	Friends	Indegree 2019 | 2018	Eigenvector 2019 | 2018
Nesta* [nesta_uk]	UK	2008	16,750	103,349	1,225	14|15	0.75|0.83
Innovate UK*** [innovateuk]	UK	2009	54,076	116,842	32,678	11|11	1|0.65
FutureGov* [FutureGov]	UK	2008	10,967	22,838	7,211	11|12	0.86|0.69
Christian Bason** [christianbason]	Denmark	2009	10,143	7,691	2,049	11|12	0.82|1
BBC Breaking News*** [BBCBreaking]	UK	2007	35,897	40,536,397	3	11|9	0.74|0.2
The GovLab*** [TheGovLab]	USA	2012	7,300	19,377	1,314	11|13	0.63|0.8
La 27e Région* [La27eregion]	France	2009	4,330	7,897	1,877	11|12	0.61|0.69
Open Gov Partnership*** [opengovpart]	USA	2011	27,007	61,493	2,590	10|12	0.91|0.73
Tim Berners-Lee*** [timberners_lee]	UK	2009	976	332,661	553	9|9	0.89|0.55
Dominic Campbell** [dominiccampbell]	UK	2007	163,912	21,097	10,255	9|11	0.82|0.85
Andrea Siodmok** [AndreaSiodmok]	UK	2011	10,508	7,397	7,941	9|11	0.8|0.89
Open Data Institute*** [ODIHQ]	UK	2012	14,451	55,518	1,278	9|9	0.61|0.44
IDEO*** [ideo]	USA	2009	8,840	365,349	5,258	9|10	0.61|0.85
Geoff Mulgan** [geoffmulgan]	UK	2009	2,226	17,229	514	9|10	0.61|0.8
Hootsuite*** [hootsuite]	Canada	2008	69,320	7,854,577	1,493,067	9|9	0.16|0.09

Data collected in July 2018 and September 2019.

* Influencers included in the report.

** People linked to the influencers in the report.

*** Influencers detected through policy labs' Twitter friends.

Table 3. Descriptive indicator by policy lab administration style

	Tweets		Followers		Friends	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Anglo-Saxon	7,605.4	±9,042.5	42,163.2	±92,262.7	1,457.3	±1174.5
Nordic	3,740.3	±7,547.5	7,653.3	±13,486.6	742.4	±670.6
Southern Europe	8,009.8	±12,651.3	10,099.8	±14,789.8	634	±541.4
All policy labs	6,849.6	±10,233.3	21,333.3	±58,084.5	963	±917.1

eigenvector, indicative of the fact that, despite being followed by many policy labs, its importance in the community is nil as it does not belong to this group. Its presence is probably explained by the policy of promoting account-following among Twitter users, which could happen if labs use the tool to manage social networks. The majority have been active for 10 or more years.

To refine our analysis of influencers, in the next section we will segment influencers according to the public administration styles of the labs.

5.3. Policy Labs and Influencers' Public Administration Style

RQ3 focuses on the distribution of policy labs and influencers in relation to their public administration style. According to their administration style, of the 38 policy labs in the sample (excluding the EU Policy Lab), 14 are AS, nine NO and 15 SO. Table 3 shows descriptive indicators of tweets, followers, and friends (mean and SD), of the policy labs classified by administration style. Mean figures for publications relating to AS and SO labs are significantly higher than those of NO labs. The AS labs have more followers (mean = 42,163.2) than either of the other two.

Table 4 shows the number of influencers (column 1) in the present study by public administration style and details those that we have geolocalized (column 2). To limit the total number of countries and facilitate data visualization, we have selected only those countries with at least 0.2% of all geolocalized influencers, hence eliminating some Twitter profiles (column 3).

We used a Sankey diagram (Figure 2) to explore the worldwide distribution of influencers and determine which public administration style they belonged to and which labs followed them. Some 92.1% of all connections from the AS administration style are included in the graph. This means that 7.9% of the connections correspond to influencers in countries that

Table 4. Influencers included in the analysis

		Geolocalized influencers	
	Total influencers (friends)	*All*	*In countries with more than 0.2% of total connections*
Anglo-Saxon	18,175	14,398	13,263
Nordic	6,428	4,767	4,430
Southern European	8,431	6,545	5,803
All policy labs	36,338	28,032	23,122

are below the 0.2% limit of total connections. In the SO group, this amounts to 88.7%, which indicates a higher number of connections missing in the graph given that they follow accounts in underrepresented countries. In the sample, 51.6% of all influencers are followed by AS policy labs, 22.6% by SO labs, and 17.2% by NO labs.

The right-hand side of the graph indicates the countries where the influencers are located: The first number is the percentage of total influencers of the administration style to which the country belongs; the second, the percentage of influencers of a country over the total number of influencers in the sample. For instance, 57.1% of all influencers of SO policy labs are French and this represents 14.9% of all influencers in the sample.

Table 5 shows the percentage of influencers by country and administration style. The top three (United Kingdom, 43.83%; France, 14.86%; Netherlands, 7.6%) correspond to countries from the three administration styles of the policy labs in the sample. The fourth position is held by a non-European country (United States, 7.54%). There are only two Germanic administration style countries (Switzerland, 0.86%; Germany, 0.62%), with very low representation. The majority of influencers are AS (60.79%), followed by SO (20.94%), NO (16.65%), and Germanic (1.62%).

Table 5. Influencers by country and administration style

Country	Administration style	Influencers (%)
United Kingdom	Anglo-Saxon	43.83
France	Southern European	14.86
Netherlands	Nordic	7.6
United States	Anglo-Saxon	7.54
Finland	Nordic	4.17
Spain	Southern European	2.59
Canada	Anglo-Saxon	2.32
Denmark	Nordic	2.15
Sweden	Nordic	1.27
Ireland	Anglo-Saxon	1.1
Belgium	Southern European	1
Switzerland	Germanic	0.86
Australia	Anglo-Saxon	0.67
Germany	Germanic	0.62
Italy	Southern European	0.33
Dominican Republic	Southern European	0.32
Total		91.23

Some 8.77% correspond to countries with less than 0.2% of all influencers and therefore are not included in the sample.

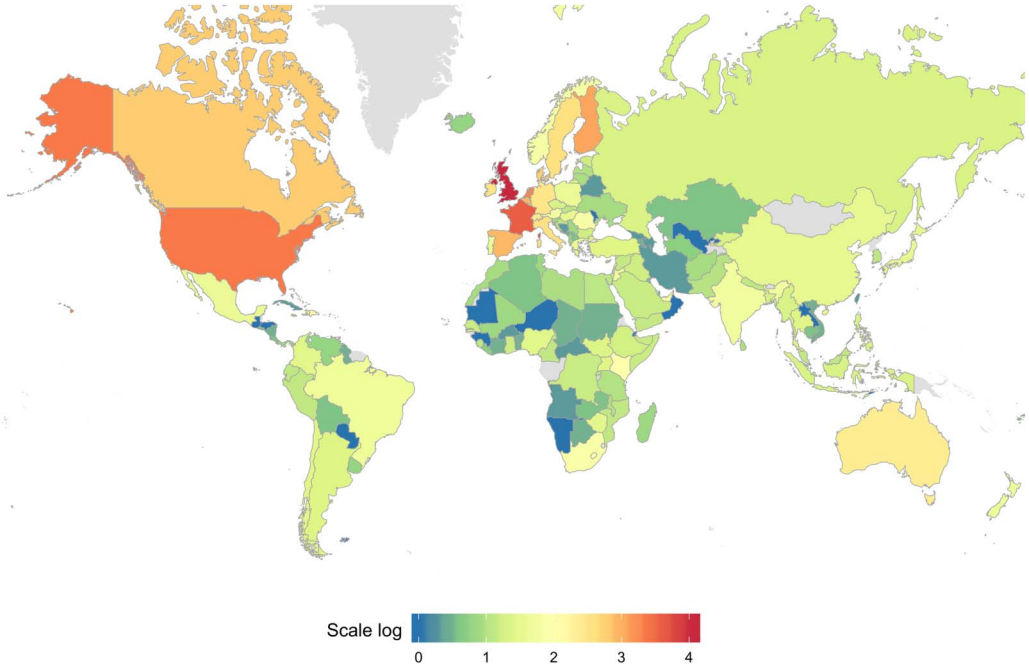

Figure 3. Geographic distribution of influencers around the world.

Figure 3 shows the worldwide distribution of influencers (friends). There are of 28,032 unique influencers in 170 countries; due to the wide range of values, this figure is presented using a base 10 logarithmic scale. The results show that from a European perspective the reference organizations are located almost exclusively in the Western world: Europe and North America.

6. DISCUSSION AND CONCLUSIONS

This study uses Twitter to explore the public innovation ecosystem of European policy labs to gain a better understanding of public innovation communities and the extent to which they are connected to the different public administration styles. As the OECD (2019, p. 13) indicates, the need and the potential for innovation in the public sector is greater than ever, due to a redefinition of the relationship between governments and their constituents using instruments such as internal innovation labs (Mergel, Gong, & Bertot, 2018). We took as our starting point a report commissioned by the EC to identify 64 laboratories and their main influencers. Given the linguistic and national diversity and the different administrative styles within the EU, SNA helps to shed light on this complex innovation ecosystem.

Figure 1 confirms the existence of national ecosystems integrated in a global network, in which actors corresponding to the AS sphere, particularly the United Kingdom, have a special influence. The highest number of all the influencers detected is from the United Kingdom (43.8%). Together with 7.7% from the United States, this means that more than 50% of the influencers detected correspond to entities from countries with an AS administration style. Focusing on the top 106, the figure rises to 69% for these two countries. The AS style is marked by greater adoption of private sector practices, which constitute the breeding ground for innovation laboratories, favoring the adoption of policy labs and institutions linked to public innovation. This is confirmed by the influence in terms of both number and relevance of the

AS profiles in our study. In addition, despite the fact that actors in the network tend to follow profiles from their own country and culture, the largest number of followings outside their environment are with entities from countries with an AS administrative style. Given that influencers act as important connectors to generate and disseminate innovations, there is a resulting globalization of AS administrative practices through the proliferation of policy labs. As shown by previous studies applied to the municipal sphere and topics, such as e-government and public innovation (Bolívar, 2018; Bonsón & Bednárová, 2018), administrative style can explain differences between countries. This strong predominance of AS influencers reinforces our earlier view and could be explained by the fact that public innovation delivered by policy labs is more closely aligned to features of administration style, such as openness to public sector reforms, high transparency, and citizen engagement (Torres, 2004).

The influence ecosystem revealed by SNA using Twitter data is different and more complex than the results of the EC report, confirming the validity of this method to supplement opinions offered solely by experts. Another important difference is the percentage of AS influencers: 38% in the EC report and 61% according to Twitter. This strong influence, exerted especially by the United Kingdom, needs to be considered in relation to the consequences of Brexit. It means that most policy lab influencers and, by extension, public innovation influencers as a whole, are currently outside the EU.

The network in Figure 1 shows how some institutional profiles such as those of the UN and the EC are located in very central positions, connecting the two main clusters (United Kingdom and France) and other smaller clusters such as those of southern countries (Spain and Italy) and northern countries (Netherlands, Denmark, and Sweden). The network offers opportunities to develop a more powerful and interconnected network of policy labs that boost public innovation in the EU. If the intention is for public innovation through policy labs to be based on collaboration, more institutional efforts are needed to coordinate and exchange best practices and projects across different countries and administrative styles.

Only three influencers (Nesta, FutureGov, and La 27e Région) out of 13 are identified as "big nodes" in the network. However, within the top 15 influencers we did identify related profiles of individuals (e.g., Geoff Mulgan and Dominic Campbell). The presence of experts is very significant among top influencers: 21 out of 106 (20%). A certain degree of mobility of experts across countries and organizations has also been observed. For instance, after the closure of the Danish Mindlab, former CEO Christian Bason occupied a highly relevant position with the Design Center project, and Jesper Christiansen moved from MindLab to Nesta. This indicates that influence should be understood not only at an institutional level, but also based on personal relations within a dynamic and changing ecosystem. Policy lab practices may foster an emulation effect (Tõnurist et al., 2017), which also contributes to the flow and exchange of people. Finally, in relation to the experts a gender bias clearly exists, as only 29% are women.

Digital culture is quite strongly connected to policy lab influencers, as illustrated by the significant position within the network of Tim Berners-Lee, the creator of the World Wide Web, and by the types of activity conducted by organizations such as Nesta. Digital culture and innovation practices have grown in parallel in recent decades. The online presence of laboratories is undoubtedly important given their interest in promoting participation and innovation in the development of public policies, including the adoption of tools and strategies typical of Web 2.0 (Nam, 2012). In fact, one of the policy recommendations is the importance of generating an open digital communication policy that maximizes the impact of the entity's actions, both nationally and internationally.

At a national level, regardless of the level of decentralization, there is a clear imbalance in the development of policy labs in Europe. A more proactive policy is needed in the field of public innovation to institutionalize venues and spaces for innovation. At the EU level, the EC has an opportunity to promote and lead an ecosystem, coordinating national efforts to develop a model that is compatible with the various administrative cultures of the member states. In this sense, the EC should also review methodologies such as SNA for the identification of communities. This study could offer exploratory methods to expand the identification process by using hybrid approaches based on network and content analysis.

Finally, it should be noted that as can be seen in Figure 3, from a European perspective, influencers are located almost exclusively in Europe and North America. This shows that there are opportunities to open the focus to other regions, such as South America, which has a vibrant innovation ecosystem, thereby fostering international cooperation to learn from initiatives in other countries and transfer good practices developed in Europe.

6.1. Limitations and Future Research

We should acknowledge some limitations of the present study. Our study focused on the EC report on policy labs, which in itself contained the aforementioned limitations in terms of its identification of policy labs and their representativeness. The report was an adequate starting point to initiate this line of research, but recognizing these limitations should help us understand some of the results—for example, the clear bias towards a strong AS presence and a weak Germanic presence. The use of English as the lingua franca of international communications is also a factor that needs to be considered when interpreting the results. Furthermore, the use of visualization techniques to balance the relevance of information and its comprehension has led us to take decisions that might differ in other cases.

As we have explained in our results in relation to RQ3, given that only countries with at least 0.2% of total influencers were included in this analysis, the opportunity exists to explore influencers on a smaller scale in specific countries. For instance, 11.34% of potential influencers with the SO administration style were excluded from more detailed analysis. The aggregated distribution of some of these influencers is shown in the map in Figure 3. This opens up opportunities for future research aimed at discovering influencers in linguistic areas of influence, for example of Spanish in Latin America. In addition, the methodology used in this paper could be adapted to discover new policy labs or influencers at EU level or in countries such as Australia or the Dominican Republic, which already have a strong presence in our sample.

To conclude, SNA seems to be an appropriate methodology to decipher the intricacies of public innovation ecosystems, given that they are network-like models of public governance (Scupola & Zanfei, 2016). Similarly, in our view it is an adequate approach to address the lack of knowledge regarding Transnational Public Sector Knowledge Networks (Dawes & Gharawi, 2018). The results of this study show the promising applications of this method to advance knowledge of emergent topics such as public innovation, which potentially involves participation by all citizens and organizations.

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AUTHOR CONTRIBUTIONS

Esteban Romero-Frías: Conceptualization, Methodology, Project administration, Supervision, Writing—original draft, Writing—review & editing. Daniel Torres-Salinas: Funding acquisition, Resources, Validation, Writing—review & editing. Wenceslao Arroyo-Machado: Data curation, Formal analysis, Investigation, Software, Visualization.

COMPETING INTERESTS

The authors have no competing interests.

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DATA AVAILABILITY

R Scripts for data processing and Twitter data (user IDs) are available at https://doi.org/10.5281/zenodo.7590866.

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