



## SYSTEMATIC LITERATURE NETWORK ANALYSIS OF THE “INNOVATION POLICY MIX” CONCEPT: EXTENDING LEADERS’ VIEWS ON ORGANIZATIONAL ENVIRONMENT

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### ABSTRACT

**Introduction/Main Objectives:** This study aims to depict the scientific landscape for the innovation policy mix (IPM) from 2012 to 2019 since its re-conceptualization by Flanagan, Uyarra, and Laranja (2011). **Background Problems:** The seminal work has broadened policy mix thinking with social issues impacting innovation. Since every organization is part of the innovation policy system, this study takes the first step to introduce IPM into management fields by identifying and discussing subsequent works in research trajectories. **Novelty:** This study shows the remarkable progress toward a mature concept through IPM’s definition, characteristics, and boundaries. As a new string of interdisciplinary social science research, some opportunities and challenges are revealed, allowing future studies to be conducted in more theoretically sounding research traditions. **Research Methods:** This study applies systematic literature network analysis (SLNA) relying on objective measures from keyword co-occurrences and co-citations networks. It includes 60 articles analyzed using open-source software, i.e., Publish or Perish, Google Scholar database, VOSviewer, and the web-based Local Citation Network. **Finding/Results:** There are three clusters in the main path of research trajectories, i.e., IPM’s conceptualization, its characteristics for evaluation and measurement, and contextualization. Future research directions are proposed to advance our understanding of the organizational environment and its impact on innovation. **Conclusion:** IPM studies have opened opportunities to test and extend theories in strategic management and organization studies, especially for leaders who make decisions in the face of dynamic and demanding environments. Moreover, contextualization in developing countries would be a worthwhile exercise by considering the institutional and cultural context.

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## 1. Introduction

The policy mix is “the interactions and interdependencies between different policies as they affect the extent to which intended policy outcomes are achieved” (Flanagan, Uyarra, & Laranja, 2011, p.72). It was adopted from economics studies to explain the stability between the internal (fiscal policies) and external (monetary policies) conditions of a country (Mundell, 1962). This concept emphasizes stability as an environmental condition to gain investment. A good mix, or stability, does not mean that the environment will not change but it is predictable and affects actors or organizations. Therefore, organizations or firms can cope with uncertainty to achieve their organizational growth and stability (Dess & Beard, 1984).

The development of this concept has been analyzed by Kern, Rogge, & Howlett (2019) using bibliometric networks. Their findings showed that the seminal work of Flanagan et al. (2011) was the most cited article (299 articles), both in innovation (2002 to 2017) and policy studies (2003 to 2017) (p. 6). Centrality in the citation networks has been triggered by the call for reconceptualizing the “policy mix” for innovation, the so-called innovation policy mix (IPM), beyond the ideal combination of policy instruments (Kern et al., 2019, p. 2). They also emphasized that policy mix, as a new string in interdisciplinary social science research, is a valuable concept for policymakers developing an innovation system (p. 13).

Increasing connections between innovation and policy studies from 2012 to 2017 (Kern et al., 2019) have opened an opportunity to investigate the response to Flanagan et al. (2011). A systematic review focusing on the seminal work as the root

article is useful, as it provides a scientific landscape about IPM. However, a critique of bibliometric studies emphasizes their failure to encompass the evolutionary aspect and the reliance on subjective criteria for classifying research contributions on pre-defined coding schemes (Strozzi, Colicchia, Creazza, & Noè, 2017). Consequently, more objective measures are needed to detect research trajectories into whether IPM is going toward a mature concept that is “well defined, with characteristics or attributes identified, boundaries demarcated, preconditions specified, and outcomes described” (Morse, Mitcham, Hupcey, & Tason, 1996).

This study focuses on the development of IPM in the literature and applies the systematic literature network analysis (SLNA) method introduced by Colicchia and Strozzi (2012). SLNA combines a systematic literature review with network analysis by extracting quantitative information from bibliographic networks to identify emerging topics and research trajectories (Colicchia & Strozzi, 2012; Strozzi et al., 2017). The questions are: (1) Which studies are seminal works in the research trajectories? (2) What has been done by previous research (from 2012 to 2019) in the main path of the research trajectories? (3) What are the future research directions? The paper is structured as follows. First, we describe the methodology used for data collection and the analysis techniques. Second, we discuss the results of the bibliometric analysis and the interpretation of the evolutionary trajectories. Third, we propose some directions for further research.

## 2. Literature Review

Reconceptualization by Flanagan et al. (2011) has broadened the policy mix thinking (Kern et al., 2019). There are dynamic interactions

between multiple actors, multi-instruments, and institutions shaping public policy. The interactions evolve over time by modifying the existing policy instruments or adding new ones (Flanagan et al., 2011, p. 710). Therefore, there are no unambiguously “good” mixes (Kern et al., 2019).

Flanagan et al. (2011) borrowed terminology from the agency theory to explain the roles of the actors in innovation policy processes. First, policy principals are the actors mobilizing government resources to achieve policy goals. Second, policy entrepreneurs are the actors who promote policy problems or solutions. Third, policy targets are the actors targeted by policy actions for behavior changes, or new actors (organizations or networks) created by policy actions to fill a perceived gap in the system. Fourth, policy implementation agents are the existing or newly created actors in receipt of resources from a policy principal to achieve a policy outcome. Finally, policy beneficiaries are the actors who benefit (or lose out) from the impacts/outcomes of the policy action. These roles are not mutually exclusive; one actor may play multiple roles simultaneously. Flanagan et al. (2011) argued that policymakers tend to deny feedback from other actors where interactions, conflicts, and resistances occur.

Flanagan et al. (2011) used a dynamic view of innovation policy processes, where interactions can occur when targeting the same actors, different actors, and different processes. There is also the possibility that the same instruments interact across dimensions (policy space, government space, geographical space, and time) as forms of influence from particular policies. In the interactions, there are potential conflicts of rationales, goals, and implementation approaches from the attributes of the actors

i.e. bounded rationality, information asymmetry, and institutions within which the actors interact (Flanagan et al., 2011).

As acknowledged in management studies, public or private organizations could play one or more roles in the interactions. As policy beneficiaries or targets, organizations are subject to public authority with a particular degree of publicness (Bozeman, 2004). As policy implementation agents, organizations may be involved through sponsorship, public-private partnerships or collaborations, and other kinds of relations (Hermans, Geerling-Eiff, Potters, & Klerkx, 2019; McGahan, Zelner, & Barney, 2013). As policy entrepreneurs, organizations are taken into account as internal or external stakeholders of the government (Bryson, Edwards, & Van Slyke, 2017; Page, Stone, Bryson, & Crosby, 2015) in promoting policy problems. In relation to policy principals, organizations may have political activities as nonmarket strategies to influence the environment (Dorobantu, Kaul, & Zelner, 2017).

Those possible roles are in line with the external control of organizations (Pfeffer & Salancik, 1978) and institutional pressures (DiMaggio & Powell, 1983), especially in strategic management and organizational studies. Moreover, in the face of increasingly dynamic and demanding environments, organizational adaptability is the main challenge for entrepreneurial, enabling, and operational leaders (Uhl-Bien & Arena, 2018) as well as strategic leaders (Samimi, Cortes, Anderson, & Herrmann, 2020). Therefore, IPM studies will potentially extend the literature on the organizational environment, especially within dynamic and demanding innovation policy processes.

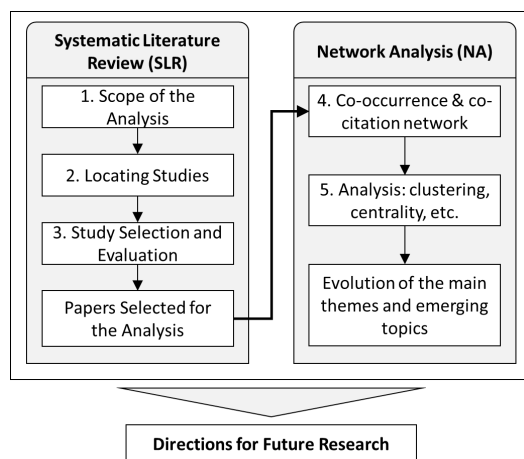
To do so, we apply SLNA that mixes quantitative and qualitative aspects in maximizing the objectivity of the analysis

and the repeatability of the results (Colicchia & Strozzi, 2012). The quantitative aspect begins with the pre-selection process to obtain local citation and keyword networks. Global citation scores are also important (Strozzi et al., 2017) to verify the representativeness of the networks. Then, the qualitative aspect is focused on the interpretation of objective measures to answer the pre-defined questions. Therefore, SLNA can eliminate any bias and error issues of literature searches (Colicchia & Strozzi, 2012) as the rationale of systematic reviews (Linnenluecke, Marrone, & Singh, 2020).

### 3. Method, Data, and Analysis

This study adopts the procedure recommended by Strozzi et al. (2017), which is shown in Figure 1 and explained in the following sub-sections.

Figure 1. Systematic Literature Network Analysis



Source: Adopted from Strozzi et al. (2017)

#### 3.1. Scope of Analysis

The first stage is determining the scope of the literature based on the objective (Colicchia & Strozzi, 2012). IPM has been studied in discussions about policymaking and implementation (Flanagan et al., 2011). It involves either private or public organizations affected by policies, political

authorities, and the creation of public values at certain levels of “publicness” and “privateness” (Bozeman & Moulton, 2011). Therefore, this study limits the scope of the literature, by citing Flanagan et al. (2011), to that published from 2012 to 2019, without specifying the fields of study.

#### 3.2. Locating Studies

This stage is determining the keywords for searching for articles in the literature (Colicchia & Strozzi, 2012; Strozzi et al., 2017). This study combines keywords in the article’s title to cope with the inconsistencies of the terms used (e.g., policy mix, policy mixes, policy mix for innovation, innovation policy mix, and innovation policy mixes) and focuses on a particular topic, as recommended by Strozzi et al. (2017). This study uses Publish or Perish (PoP) software for locating articles in the Google Scholar (GS) database (Harzing, 2007) with “policy mix” OR “policy mixes” in the title and “Flanagan et al. (2011)” OR “Flanagan et al. 2011” OR “Flanagan et al., 2011” in the contents of the articles to anticipate different styles of citations. The keyword in the title is very important “in order to select the paper [having the concept/construct of interest] as the main goal of their analysis” (Strozzi et al., 2017, p. 4). The combination will ensure comprehensive results in both conceptual and empirical studies.

#### 3.3. Study Selection and Evaluation

Locating studies (on February 20, 2020) returned 105 articles from various sources, summarized in Table 1. Then, we filtered these articles by manually selecting articles from scientific journals written in English and avoiding duplication, especially in papers before and after being published.

Table 1. Number of Articles Based on the Source

Source	N Articles
Journal (in English)*	60
Q1 Journal	51
Q2 Journal	4
No Rank Journal	5
Books/Book Chapter/Report	8
Conference Proceedings	1
Working Papers, Theses, and Dissertations	15
Unidentified, Repeated, Draft, and Non-English	21
Total	105

Notes: \* based on Scimago Journal and Country Rank (ScimagoJR) in 2018

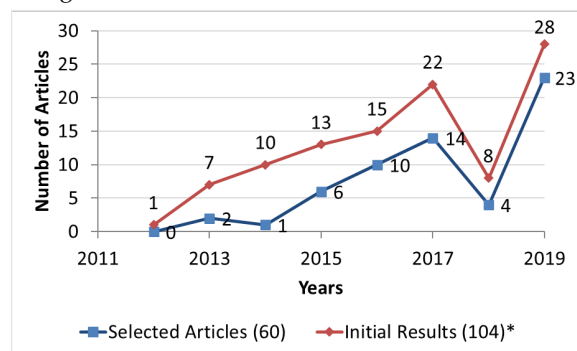
This generated 60 articles. The top three journals based on the number of articles are top tier journals (Q1) in the ScimagoJR (2018) i.e. Research Policy (27.87%), Energy and Social Sciences Research (18.03%), and Technology Forecasting and Social Change (6.56%). The list of journals and the number of articles in each tier are presented in Appendix 1.

The comparison between the initial results and the selected articles in Figure 2 shows relatively identical trends, in terms of the number of articles per year. Although significant improvements began in 2015, some duplication with theses/dissertations, working papers, and drafts between 2012 and 2015 (22 articles) indicate immediate responses to the re-conceptualization. Significant growth in 2019 also indicates that policy mix studies were still an interesting topic in scientific communities.

The use of GS has an advantage because of the scope of interdisciplinary articles (Harzing & Alakangas, 2017; Harzing & Wal, 2008). Keywords co-occurrence network is retrieved using the VOS (visualization of similarities) technique (Van Eck & Waltman, 2007, 2010) in VOSviewer software (version

1.6.11). Because of GS's limitation on citation data to retrieve citation networks (Bamel, Pandey, & Gupta, 2020), the Local Citation Network (Wölflé, 2018) is used, with the list of DOI (digital object identifier) from selected articles as input and the LCN based on the Microsoft Academic (MA) database as output. As a new service relaunched in 2015 (first launched in 2012), MA has broad coverage like GS but is more structured like Web of Service or Scopus (Harzing & Alakangas, 2017). Since being limited by the scope of this study, LCN from MA and GS are most likely identical.

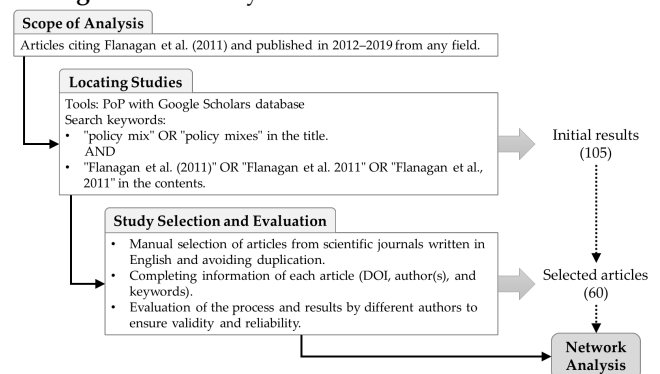
Figure 2. Number of Publication from 2012–2019



Source: obtained from the primary data.

Notes: \* one draft without publication year.

Figure 3. Summary of Article Selection Process





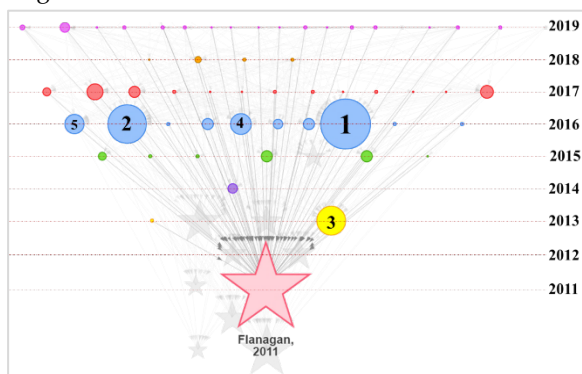
## 4. Results and Findings

LCN with Global Citation Score (GCS) and Local Citation Score (LCS) is used to identify breakthrough studies, while a keywords co-occurrence network is used to identify research trends (Strozzi et al., 2017). Those objective measures will be combined to interpret identified cluster(s) in the following sub-sections.

### 4.1. The Main Path of Research Trajectories in Local Citation Network

LCN is part of the Global Citation Network with articles as nodes and citations as ties representing the flow of knowledge within the scope of the analysis (Strozzi et al., 2017). As shown in Figure 4, all nodes (circles) are, of course, citing Flanagan et al. (2011) but not necessarily tied to each other. The top five articles based on LCS by their circle's size are (1) Rogge and Reichardt (2016), (2) Kivimaa and Kern (2016), (3) Magro and Wilson (2013), (4) Reichardt et al. (2016), and (5) Reichardt and Rogge (2016). Stars are articles suggested by MA outside the scope of analysis.

Figure 4. Local Citation Network of Selected Articles



Notes: The network was modified by adding year axis and labels for the top five biggest nodes.

Source: Obtained using Local Citation Network (Wölflé, 2018) based on the primary data.

In comparison with GCS detailed in Appendix 2, nine of the top 10 highest GCS

are also in the top 10 highest LCS, except Lanahan & Feldman (2015) and Reichardt & Rogge (2016) (10th and 13th based on GCS; 16th and 5th based on LCS).

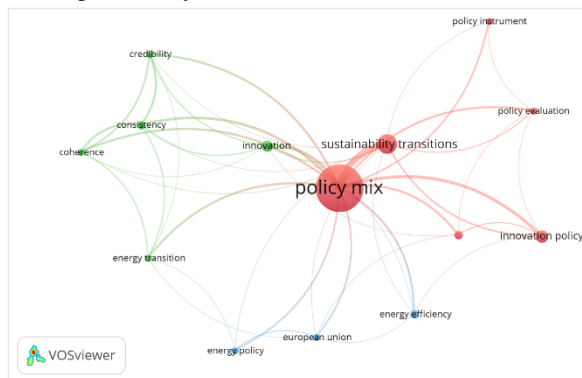
Summary of the top 10 highest GCS articles plus Reichardt & Rogge (2016) and each position in LCN are detailed in Appendix 3.

Based on the quantitative aspect, main path analysis is applied to identify the evolutionary trajectory where “a node that links many nodes and has many nodes linking to it will probably be part of the main path” (Lucio-Arias & Leydesdorff, 2008, p. 5). Since the dominant articles are already visualized in LCN (the size of the circles in Figure 4), it can be done visually. Appendix 2 (LCS) and 3 (LCN) also provide detailed information to ensure objectivity. The main path from Flanagan et al. (2011) includes Magro and Wilson (2013), Kivimaa and Kern (2016), and Rogge and Reichardt (2016). Interpretation of each cluster in the main path is discussed in the following sub-sections to answer the second question of this study.

### 4.2. Research Trends in Keywords Co-occurrence Network

Network analysis in SLNA assumes the author's keywords are adequate descriptions of the content (Strozzi et al., 2017). To ensure comprehensiveness, VOSviewer is set with minimum occurrences of keywords gradually from one to 5. The network with four minimum occurrences is selected (Figure 5) since it gives an equal number of patterned clusters with five minimum occurrences (default settings in VOSviewer).

Figure 5. Keywords Co-occurrence Networks



Source: Obtained using VOSviewer based on the primary data.

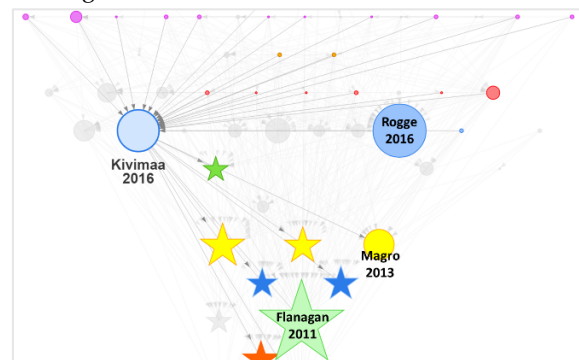
Detailed information of each cluster in Table 2 can be elaborated with Figure 2 to show indications of evolutionary trajectories. Flanagan et al. (2011) used six keywords (i.e. policy mix, policy complexity, policy interactions, policy instruments, actors, and innovation policy), and three of them were identified in the first cluster. From 2012 to 2014, two of 4 keywords in the first cluster (i.e. multi-level governance, policy evaluation) indicated new discussions. In 2016, a new issue about sustainability transitions also coincided with increasing discussions about policy mix and the formation of new clusters. Despite the decline in 2018, the number of studies increased significantly in 2019 except for the second cluster. As assumed, the spread of new keywords in three clusters also showed inter-clusters trajectories, which are discussed as follows.

#### 4.2.1. Cluster 1: Conceptualization of IPM

This cluster includes 47 articles (78.33%) as circles in Figure 6. The LCN shows seminal works in this cluster create the main path of research trajectories. The first article (Magro & Wilson, 2013) focused on IPM's definition. They discussed the complexity of multi-level governance and emphasized the importance of policy evaluation and coordination. The

complexity was explored by subsequent studies (Lanahan & Feldman, 2015; Magro, Navarro, & Zabala-Iturriagagoitia, 2014; Vitola, 2015) emphasizing the importance of coherence (top-down and bottom-up) as coordination-mix. They showed an evaluation of IPM for creating an entrepreneurial climate (Flanagan et al., 2011; Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007) is required before formulating policy as an input to existing policies and processes. However, the old definition was still used by Liu (2013) without subsequent studies in LCN.

Figure 6. Local Citation Network of Cluster 1



In 2016, “sustainability transition” emerged in two breakthrough articles (i.e. Kivimaa & Kern, 2016; Rogge & Reichardt, 2016) which provided conceptual extensions and insights from case studies in different contexts. Using the Schumpeterian perspective in innovation studies, Kivimaa & Kern (2016) (highest GCS; second-highest LCS) explained the role of IPM as motors of creative destruction emphasizing the “destruction” of old practices and the “creation” of new ones. They encouraged further studies to take the transition into account by analyzing the impact on the strategies of policy agents or targets who implement an innovation. Thus, IPM should also guarantee a successful transition, as emphasized by articles from the Energy Research & Social Science journal

**Table 2.** Occurrences of Keywords in Three Clusters

Keywords	Total occurrence <sup>a</sup>	Year							Dominant authors <sup>b</sup>
		2013	2014	2015	2016	2017	2018	2019	
<b>Cluster #1</b>									
policy mix	42 (85)	1	1	2	8	10	4	16	Rogge (9); Kern (6)
sustainability transitions	15 (32)	-	-	-	2	2	2	9	Rogge (4); Kern (3); Kivimaa (2)
innovation policy	8 (19)	1	1	-	2	1	1	2	Kern, Magro, Uyarra (2)
multi-level governance	5 (8)	1	1	1	-	1	-	1	Magro, Wilts (2)
policy evaluation	4 (9)	1	-	-	-	1	-	2	Magro, Wilson (2)
policy instrument	4 (11)	-	-	1	1	-	-	2	N/A
<b>Subtotal</b>		<b>4</b>	<b>3</b>	<b>4</b>	<b>13</b>	<b>15</b>	<b>7</b>	<b>32</b>	
<b>Cluster #2</b>									
innovation	7 (12)	-	-	2	2	2	-	1	Rogge (3); Reichardt (2)
consistency	5 (6)	-	-	-	2	1	2	-	Rogge (5); Reichardt (2)
coherence	4 (6)	-	-	-	1	1	2	-	Rogge (4)
credibility	4 (4)	-	-	-	2	-	2	-	Rogge (4); Reichardt (2)
energy transition	4 (8)	-	-	-	-	2	1	1	Rogge (2)
<b>Subtotal</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>7</b>	<b>6</b>	<b>7</b>	<b>2</b>	
<b>Cluster #3</b>									
energy efficiency	5 (11)	-	-	1	2	2	-	-	Kern, Rosenow (2)
energy policy	4 (8)	-	-	-	-	1	-	3	Lindberg (2)
European union	4 (9)	-	-	-	1	-	-	3	Lindberg (2)
<b>Subtotal</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>6</b>	
<b>Total</b>		<b>4</b>	<b>3</b>	<b>7</b>	<b>23</b>	<b>24</b>	<b>14</b>	<b>40</b>	<b>11 authors</b>

Notes: The number of authors (a) and documents of each dominant author (b) are in parentheses.

(e.g., Kern, Kivimaa, & Martiskainen, 2017; Rogge, Kern, & Howlett, 2017). Kivimaa & Kern (2016) also offered an extended definition from the previous literature, as summarized in Table 3.

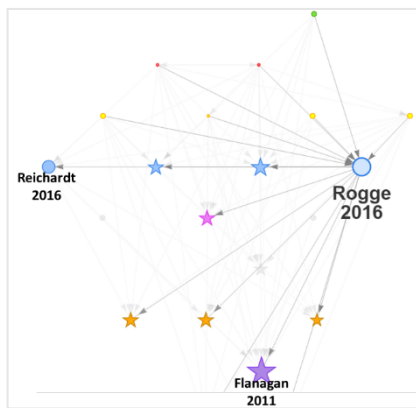
Rogge & Reichardt (2016) (highest LCS; second-highest GCS) also proposed an extension of the policy mix concept and analytical framework based on previous studies. They emphasized interaction as the main focus and explained the framework covering policy elements (instruments and strategies), policy processes, the characteristics of the policy mix, and the dimensions or context of interactions. In line with Kivimaa & Kern (2016), they extended IPM to interactions by which policies and

actors operated in the process. Focusing on re-definition, this cluster is labeled as the conceptualization of IPM.

#### 4.2.2. Cluster 2: Characteristics of IPM

This cluster includes 12 articles (20%) as circles, shown in Figure 7. The LCN shows the seminal work by Rogge & Reichardt (2016) as part of the main path. Besides extending the IPM definition, four characteristics were also proposed from accumulated qualitative case studies. It was claimed to have "a great potential for further interdisciplinary policy mix research" (Rogge et al., 2017).



**Figure 7.** Local Citation Network of Cluster 2

In subsequent studies, two survey-based studies measured firms' perceptions of the characteristics (Rogge & Dütschke, 2018; Rogge & Schleich, 2018), while five qualitative studies investigated IPM in different countries or regions (Lindberg, 2019; Ossenbrink, Finnsson, Bening, & Hoffmann, 2018; Reichardt & Rogge, 2016; Vitola, 2015). As emphasized by Rogge & Schleich (2018), further explorations in different contexts are needed.

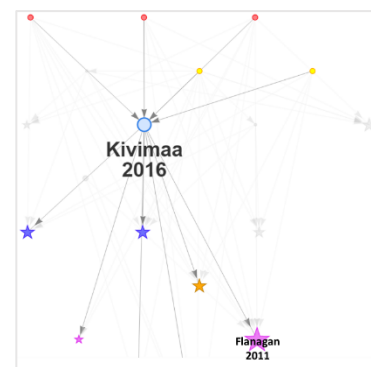
Increasing studies of firms or agencies in policy implementation based on the characteristics also provide evidence of IPM as a valuable concept for policy targets or agents. The critique of Flanagan et al. (2011), "treating policymakers as translators' theoretical rationales into action, denies agency to the actors in relation to policy change ..." (p. 711), has been responded to. Either agencies or firms are involved in the innovation process so that their perception of the characteristics would be more relevant and informative to explain the impact of IPM.

Although Meissner & Kergroach (2019) criticized the lack of IPM measurement (p. 8), Rogge & Reichardt (2016) have triggered new research directions. Besides, Meissner & Kergroach (2019) also didn't cite the subsequent works (i.e. Rogge & Dütschke, 2018; Rogge & Schleich, 2018) as attempts to operationalize IPM characteristics

highlighted in Table 3. As four of 5 keywords in this cluster used by the seminal work, this cluster is labeled as the characteristics of IPM for evaluation and measurement.

#### 4.2.3. Cluster 3: Contextualization of IPM

This cluster includes 10 articles (16.67%) and the seminal work by Kivimaa & Kern (2016) in the main path as showed in Figure 8. Most articles focus on energy policies in Europe and are also included in other clusters. To ensure sustainability in the energy sector, long-term targets should consider the institutional context of policy formulation and implementation (Kivimaa & Kern, 2016; Rogge & Reichardt, 2016).

**Figure 8.** Local Citation Network of Cluster 3

As emphasized by Meissner & Kergroach (2019), the contextualization revealed that stimulating innovation had gone beyond addressing market failures but focused on system failures from science to corporate activities in the center of innovation. Legitimacy is the challenge for the actors, not only the outcome as promised or expected through innovation but also the process (Johnstone, Stirling, & Sovacool, 2017; Lindberg, 2019; Mahzouni, 2015; Rosenow, Kern, & Rogge, 2017). The process includes designing policy, maximizing synergy, reducing conflicts, promoting coherence, and coordinating activities (Wilts & O'Brien, 2019) as described in the policy mix

**Table 3.** Conceptual Definitions of Innovation Policy Mix in Selected Articles

Article	Conceptual explanation
Liu (2013)	"The European Policy Mix experts group (2009) defines the R&D and innovation policy mix as 'the set of government policies which, by design or fortune, has direct or indirect impacts on the development of an R&D and innovation system'."
Magro & Wilson (2013) and Magro et al. (2014)	"In the light of this paper, the policy-mix for innovation is understood as the combination of rationales, domains, and instruments that are interplaying in a certain policy space or system."
Borrás & Edquist (2013)	"A definition of the innovation policy instrument mix is: <i>The specific combination of innovation-related policy instruments which interact explicitly or implicitly in influencing innovation intensities.</i> "
Kivimaa & Kern (2016)	"We do, however, extend from Borrás and Edquist in that we examine policy mixes for transitions over several policy domains, not merely 'classic' innovation policy instruments. Analyses across domains are important from the perspective of policy coherence and consistency, as sub-optimal or even perverse outcomes of policies can frequently be explained by clashing policies designed for different purposes across different policy domains."
Rogge & Reichardt (2016)	"... interaction is a central feature of the existing policy mix definitions." The characteristics are: (1) Consistency as "how well the elements of the policy mix are aligned with each other, thereby contributing to the achievement of policy objectives." (2) Coherence as "synergistic and systematic policy making and implementation processes contributing - either directly or indirectly - toward the achievement of policy objectives." (3) Credibility as "the extent to which the policy mix is believable and reliable." (4) Comprehensiveness as "how extensive and exhaustive its elements are and the degree to which its processes are based on extensive decision-making."

characteristics. Because of the importance of sensitivity to the prevailing system, this cluster is labeled the contextualization of IPM.

## 5. Discussion and Future Research Directions

IPM's research trajectories have put public policy issues in the foreground. The extended definitions (the first cluster) are the baseline to evaluate and measure IPM through the characteristics (the second cluster). Then, applying IPM to an empirical context focuses on the innovation policy process, the resulting mix, and outcomes (the third cluster). However, "no theory or policy model has yet been developed that postulates the relationship between policy

mixes and innovation performance" (Izsak, Markianidou, & Radošević, 2015, p. 790). It was confirmed in the subsequent quantitative study that still relied "on recent qualitative insights into the impact of policy mix characteristics for innovation" (Rogge & Schleich, 2018, p. 2).

Izsak et al. (2015) used the Schumpeterian growth theory and the systems of innovation literature. They argued that policy mix is a reflection of the level and nature of technology challenges. As part of an innovation system, IPM addresses market and institutional failures to enable coping with uncertainty (p. 788). Their attempt was not impactful since IPM was not clearly defined and characterized yet. As a peripheral study in the main path of the research trajectories (LCS = 0 and GCS = 12),

it is also reasonable that their critique is stationary.

The use of the Schumpeterian perspective in IPM studies (e.g., Izsak et al., 2015; Kivimaa & Kern, 2016) emphasizes the way innovation policy disturbs or changes existing patterns of resource allocation, processes, or expected outcomes through bold and creative action (Klein, Mahoney, McGahan, & Pitelis, 2010). In this sense, public policies define "the rules of the game" in response to the co-evolution and interplay between public and private interests within which organizations create and capture value (Klein et al., 2010, p. 5). As shown in the third cluster of IPM studies, public interest in renewable energy and resource efficiency through an energy-related policy has stimulated transitions in companies' activities in the sector.

In line with the creation of an entrepreneurial climate (Flanagan et al., 2011; Hekkert et al., 2007), IPM has been described as the condition of environments enabling (or hindering) innovations (e.g., Izsak et al., 2015; Rogge & Schleich, 2018). While IPM studies (except Rogge & Schleich, 2018) examine macro-level (national or regional) impacts, management studies have opportunities to engage at meso-level where organizational adaptability is one of the biggest challenges for leaders (Uhl-Bien & Arena, 2018). The challenge is not simply one of changing the existing operational system to comply with the external environment, because internal stability would then be at risk.

IPM has potentially become a valuable tool for leaders in the adaptive process. Gathering, processing, and using the information available in external environments is required to make decisions and engage with external stakeholders (Samimi et al., 2020). Using IPM, leaders have

a systematic description of the complex innovation policy processes and the others actors involved. Thus, leaders can react to new opportunities (or new threats caused by illegitimate activities) and drive the organizational transformation to cope with uncertainty and gain legitimacy.

Indeed, confronting public policy issues in strategic management and organization studies is not totally new. Pfeffer (2003) admitted that "I would be remiss if I did not address public policy concerns" and called for the examination of "the relations between the regulated and regulators using the basic concepts and hypotheses" (p. xxv) in the resource dependence theory (Pfeffer & Salancik, 1978). Peng, Sun, Pinkham, & Chen (2009) also criticized "strategy's tendency to eschew engagement with major public policy issues" (p. 75). There is no doubt that the benefit of bringing strategic management theories enables them to become more widely known, tested, and extended (Barney, 2005). Because leadership studies also use the theories (e.g., strategic leadership in Cortes & Herrmann, 2021; Samimi et al., 2020), IPM potentially extends leaders' views about the environment, allowing them to anticipate and predict changes.

Analyzing the most cited article (Rogge & Reichardt, 2016) also revealed two of 4 policy mix characteristics closely related to management studies. Credibility and comprehensiveness were defined (p. 8) by citing Newell & Goldsmith (2001) ("The Development of a Scale to Measure Perceived Corporate Credibility" in the *Journal of Business Research*) and Miller (2008) ("Decisional Comprehensiveness and Firm Performance: Toward a More Complete Understanding" in the *Journal of Behavioral Decision Making*). It confirms that IPM studies have been a new string of

interdisciplinary research (Rogge & Reichardt, 2016; Kern et al., 2019) and management studies have already been in a position to engage.

Based on the findings and discussions above, we outline several promising directions for future research. First, as emphasized in Kivimaa & Kern (2016) and Rogge & Reichardt (2016), IPM can be defined as a set of different and interacting policies to solve a problem, both elements (instruments and strategies) and policy processes, in the innovation system. It has been extended to the central issue of the interaction between the policies and actors involved in policymaking and implementation.

This definition implies that future research can explore the characteristics reflecting a good or bad mix. For example, some articles have emphasized the importance of legitimacy at the program, district, city, province, national, and regional levels (e.g., Edmondson et al., 2019; Johnstone, Stirling, & Sovacool, 2017; Lindberg, 2019; Magro et al., 2014; Rogge et al., 2017). In public policy studies, legitimacy is categorized as the substantive, procedural, political, and administrative/bureaucratic feasibility in program/policy evaluations, either before or after implementation (Park, Lee, & Chung, 2015; Wallner, 2008). Further explorations can emphasize the consistency in substantive legitimacy, coherency in procedural legitimacy, credibility in political feasibility, or comprehensiveness in administrative or bureaucratic feasibility.

In management studies, legitimacy has been acknowledged in strategic and institutional approaches (Suchman, 1995). Since it is related to public interests, moral legitimacy might be more relevant concerning "a positive normative evaluation of the organization and its activities"

(Suchman, 1995, p. 579). Evaluation of (1) outputs and consequences, (2) techniques and procedures, (3) categories and structures, and (4) leaders and representativeness would be worthwhile exercises regarding consistency, coherence, comprehensiveness, and credibility. Of course, more updated literature would be required for conducting exploratory or confirmatory studies.

Second, this study revealed that IPM is not only valuable for policymakers but also policy targets and implementation agents. It was pioneered by measuring perceived policy mix characteristics at the level of corporate innovation (Rogge & Schleich, 2018). Especially for public managers in agencies, their perception of the environment is more important than its actual existence (Meynhardt & Diefenbach, 2012). Nevertheless, the challenges for future research are still wide open in responding to Izsak et al. (2015) as emphasized earlier. Since innovation is also popular in strategic management and organization studies, in either public or private sectors, future research can apply existing theories about the organizational environment for a robust foundation in comparison and prediction.

For example, legitimacy is important for managing resource dependencies (Oliver, 1991; Suchman, 1995) in line with the resource effect of socio-technical changes in policy mix studies (Edmondson et al., 2019). As already emphasized in the resource dependence theory (Pfeffer & Salancik, 1978), organizations are subsystems of a larger social system. Answering why and how IPM drives innovation decisions and predicts the success of organizational innovation would be valuable insights to fill some gaps in the study of this interdisciplinary concept. Of course, researchers should take the publicness (or privateness) of organizations

(Bozeman & Moulton, 2011) into account based on their core purpose to create values (Moore, 1995).

Third, the extended definition above emphasizes sensitivity to the context of interaction. Future research in developing countries will be a valuable contribution since most studies were done in developed countries, especially Europe. Moreover, there are different patterns of shifting or the hybridization of public management paradigms (Wiesel & Modell, 2014) behind multi-level and multi-actor structures, such as the New Public Management (NPM) (Osborne, 1993), Digital-Era Governance (DEG) (Dunleavy, Margetts, Bastow, & Tinkler, 2006), Public Value Management (PVM) (Stoker, 2006), and New Public Governance (NPG) (S. P. Osborne, Radnor, & Nasi, 2013; Sørensen & Torfing, 2017). While the convergence is in the importance of innovation to improve performance (Meynhardt & Diefenbach, 2012; Stoker, 2006), IPM in different settings would be highly relevant for further studies.

Cultural context is also often neglected in explaining interactions between actors (Flanagan et al., 2011) as behavioral factors in policy mix problems (Bouma, Verbraak, Dietz, & Brouwer, 2019). Different cooperative mechanisms could also determine the actors' attitudes and behavior with their views of collective goals, identity, accountability, communication, and incentives shaped by cultural characteristics (Chen, Chen, & Meindl, 1998). Future research considering those effects would be a worthwhile exercise to enrich the contextualization in different domains and levels of authorities.

## 6. Conclusion

This study represents the scientific landscape from 2012 to 2019 after its re-conceptualization by Flanagan et al. (2011) guided by the main path of evolutionary trajectories. Significant progress has been discussed in three connected clusters. IPM conceptualization and characteristics are the beginning of a mature concept, while contextualization is the next step to define boundaries and preconditions (Morse et al., 1996) as proposed for future research directions. Interdisciplinary scholars have a big challenge to investigate the complexity of the innovation process based on the prevailing regulation system in different institutional contexts. Since being extended to social issues, there are some opportunities to study IPM in more theoretically sounding research traditions. By sensitively to the context, there are potential contributions to explain interactions between policies and actors (including organizations) in particular domains. By taking IPM studies seriously, future research will potentially advance our understanding of the organizational environment, innovation decisions, and outcomes within dynamic and demanding innovation policy processes.

This study also has several limitations. First, the citation data was limited to the scope of the GS database. Second, citation networks were not generated using common bibliometric tools such as HistCite or Pajek. Third, Matthew's effect, i.e., "the rich get richer" (Strozzi et al., 2017), could not be avoided by ignoring criticism or issues in unpopular articles (low GCS or LCS).

Nonetheless, this study shows that the use of LCN (Wölfle, 2018) based on the MA database can overcome the limitation to generate the networks and support the interpretation of identified clusters. Collecting DOI as a unique identifier and



comparing citation scores (GCS and LCS) of the selected articles ensured identical citation networks (even by using different tools) and the representativeness of the populations. Consequently, the networks' difference only depends on the scope of the database where the primary data are located. Future research using a more sophisticated tool, such as RStudio (Linnenluecke et al., 2020), would be a worthwhile upgrade for visualizing and mapping the results.

Although not sufficient to overcome the general limitation of bibliometric analysis, this study has identified important issues in unpopular articles, such as Izsak et al. (2015) and Meissner & Kergroach (2019), in line with the discussion and future research directions. Future research combining two or more databases would be valuable to ensure more comprehensive data. In terms of the objective measures in SLNA, adding co-authorship networks would be a worthwhile exercise to improve the comprehensiveness of the interpretation.

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**Appendix 1. List of Journals based on Tier**

<b>Tier of Journal</b>	<b>Number of Articles</b>	<b>Journals</b>
Q1 Journals	51 (85%)	Research policy (17); Energy Research and Social Science (11); Technological Forecasting and Social Change (3); Environment and Planning C: Politics and Space (2); Economics of Innovation and New Technology (2); Journal of Technology Transfer (2); Environmental Policy and Governance (2); Environment and Planning C: Government and Policy (1); Environmental Innovation and Societal Transitions (1); Building Research and Information (1); Energy Policy (1); Journal of Common Market Studies (1); Journal of Cleaner Production (1); Ecological Economics (1); Environmental Science and Policy (1); Land Use Policy (1); Policy and Society (1); Politics and Governance (1); Local Economy (1).
Q2 Journals	4 (6.67%)	Science and Public Policy (2); Review of Policy Research (1); Sustainability (1).
Unidentified journals in ScimagoJR	5 (8.33%)	Journal of Innovation Economics Management (1); Journal of Environmental Economics and Policy (1); International Review of Public Policy (1); Journal for Research and Technology Policy Evaluation (1); Management and Economics Review (1).

**Appendix 2. Top Ten Articles Based on Centrality in Local Citation Network**

Rank	Article	GCS	LCS							Cluster(s)
			2014	2015	2016	2017	2018	2019	Total	
1	Rogge & Reichardt (2016)	314	-	-	-	10	3	18	31	1 and 2
2	Kivimaa & Kern (2016)	350	-	-	2	8	2	12	24	1 and 3
3	Magro & Wilson (2013)	175	1	2	5	4	2	5	19	1
4	Reichardt et al. (2016)	100	-	-	1	4	3	5	13	1
5	Reichardt & Rogge (2016)	62	-	-	1	4	2	5	12	1 and 2
6	Kern et al. (2017)	123	-	-	-	3	2	5	10	1
7	Rogge et al. (2017)	97	-	-	-	-	2	6	8	1 and 2
8	Guerzoni & Raiteri (2015)	157	-	-	3	2	1	1	7	-
9	Howlett & del Rio (2015)	88	-	-	-	1	2	4	7	1
10	Costantini, Crespi, & Palma (2017)	78	-	-	-	3	2	2	7	1 and 3

### Appendix 3. Top Ten Articles Based on GCS and Each Position in LCN

No.	GCS	Article and LCS	Journals	Contribution
1.	350	Kivimaa and Kern (2016)  LCS=24 (Rank 2)	Research Policy (Q1)	Extending the function of innovation system from “motors of innovation” to “motors of creative destruction” based on the Schumpeterian perspective for a sustainable transition.
2.	314	Rogge and Reichardt (2016)  LCS=31 (Rank 1)	Research Policy (Q1)	Extending the policy mix concept and proposing an analytical framework for empirical studies by considering interactions between policies (consistency), interactions in the process (coherence), sustainability (credibility), and comprehensiveness of decision making in evaluating the policy mix.

No.	GCS	Article and LCS	Journals	Contribution
3.	175	Magro and Wilson (2013)  LCS=19 (Rank 3)	Research policy (Q1)	Explaining the complexity of multi-level governance and extending the policy mix concept; not only on the mix of rational, domains and instruments but also the mix of administrative levels in the policy system.
4.	157	Guerzoni and Raiteri (2015)  LCS=7 (Rank 8)	Research Policy (Q1)	Providing empirical evidence (quasi-experiments in Norway and Switzerland) that technological policy has a greater impact on innovation activities when interacting with various existing policies.

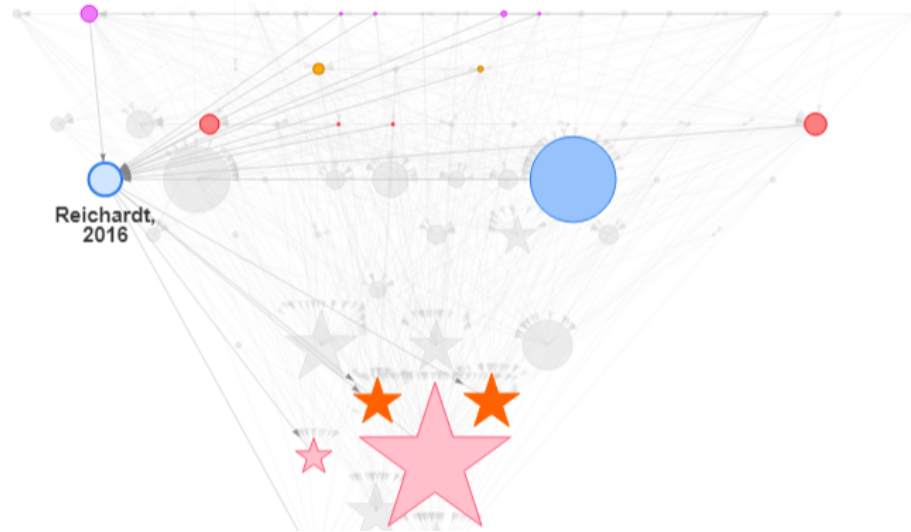


No.	GCS	Article and LCS	Journals	Contribution
5.	123	Kern et al. (2017) LCS=10 (Rank 6)	Energy Research & Social Science (Q1)	Exploring the formulation of an innovation policy mix driving innovation for energy efficiency in Finland and the United Kingdom (qualitative; interviews and secondary data). Policy systems in different countries also determine policy changes in different ways (packaging or patching).
6.	100	Reichardt et al. (2016) LCS=13 (Rank=4)	Technological Forecasting and Social Change (Q1)	Finding dynamic dependencies with recurring patterns on solving systemic problems and adjusting the policy mix driven by the support and commitment of political actors as manifestations of the credibility (qualitative; event-history analysis and interviews).

No.	GCS	Article and LCS	Journals	Contribution
7.	97	Rogge et al. (2017)  LCS=8 (Rank 7)	Energy Research & Social Science (Q1)	Providing summaries of the special issue in Volume 33 (November 2017) about the policy mix concept for energy transitions.
8.	88	Howlett and Del Rio (2015)  LCS=7 (Rank 9)	Environment and Planning C: Government and Policy (Q1)	Explaining types of policy mix based on characteristics of multi-level, multi-policy, and multi-purpose to highlight the differences of complexity vertically and horizontally in policy formulation.

No.	GCS	Article and LCS	Journals	Contribution
9.	78	Costantini et al. (2017)  LCS=7 (Rank 10)	Research policy (Q1)	Providing empirical evidence (quantitative; patent analysis; proxy; policies and R&D expenditures as independent and dependent variables) that innovation’s policy mix can increase innovation activities in energy-efficient technologies.
10.	75	Lanahan and Feldman (2015)  LCS=5 (Rank 16)	Research Policy (Q1)	Explaining the relationships between policy levels in multi-level governance between national and sub-national and providing empirical evidence (quantitative; event-history analysis with time series data) of dependencies in innovation policy for SMEs in the United States.

No.	GCS	Article and LCS	Journals	Contribution
11	62	Reichardt and Rogge (2016)  LCS=12 (Rank 5)	Environmental Innovation and Societal Transitions (Q1)	Analyzing the impact of policy mix on innovation (qualitative; interviews and policies as secondary data) from company case studies on offshore wind in Germany. The results indicate characteristics of the policy mix have been a determinant of innovation adoption by companies.



Notes: Reichardt and Rogge (2016) is added as an exception to the top ten LCS which is not in the top ten GSC.