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A Bibliometric Analysis of Mission-Oriented Policies

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Abstract

The interest in mission-oriented policies have been increased in the last few years. In this paper, a bibliometric analysis of mission-oriented policies is conducted to understand how research focuses changed over time and between the countries. To conduct the bibliometric analysis, data are gathered from the Web of Science publication database. From the data, the number of publications over time, number of publications and citations from countries, and repetitive keywords from the publications are analysed. Furthermore, a visual analysis for the same dataset is conducted using VOSviewer, to understand how the research focuses changed over time and between the countries. Findings of the bibliometric analysis suggests that research interest for the mission-oriented policies has kept increasing since the early 2000s. Also, research interest has shifted from the United States of America to Europe and China in recent years, and high numbers of co-authorships between European countries make Europe the main research hub for the mission-oriented policies.

Keywords: mission-oriented policies, innovation policies, bibliometric analysis, Web of Science

1 Introduction

The idea that governments should support the innovation process is gaining more and more interest in literature. For example, Mowery (2010) states it is critical to shift from a vision of the State as merely delivering a fix to a market failure to one in which the State creates and encourages investments and innovations. However, State's direct involvement in specific sectors or technologies causes some concerns, such as unintentionally creating monopolies in some sectors or technologies. Therefore, it is also critical that public investments should not allow their private beneficiaries to create monopolies in technical fields, and a "pro-

dissemination" attitude should be maintained, where policy should encourage dissemination and access to findings that are generated by its investments (Foray et al., 2012). Thus, governments direct participation in the innovation process requires well planned, organized, and executed policies, which brings the idea of mission-oriented policies. In her book The Entrepreneurial State, Mariana Mazzucato (2014) defines mission-oriented policies as to where State does not only act as the de-risking factor for the private investors but also the main driving force of the innovation process by taking bold risks with a pre-determined and well-established vision. This makes mission-oriented policies effective policy tools for governments' active participation in investment and innovation process. Therefore, understanding the changes in research focuses regarding mission-oriented policies are essential for effective implication of the mission-oriented policies.

The main focus of this paper is to analyse the past and current status of the mission-oriented policies and find out if the research interest in mission-oriented policies has increased over time, and if they did, how focus areas changed over time and how they differ between countries.

2 Literature Review

2.1 Mission-Oriented Policies

It is critical to shift from a vision of the State as merely delivering a fix to a market failure to one in which the State creates the market and encourages investments and innovations (Mowery, 2010). Considering the suggested market-creating approaches rather than fixing the market and the risk of the averseness of the private sector, the necessity of direct public investments and participation of the public institutions in every level of the innovation chain becomes clearer (Mazzucato, 2018a). But, it is also critical that public investments should not allow their private beneficiaries to create monopolies in technical fields, and a "pro-dissemination" attitude should be maintained, where policy should encourage dissemination and access to findings that are generated by its investments (Foray et al., 2012). Suggestions of direct public investments and market creation approach of the state brings forth the mission-oriented policies (Mazzucato, 2014), where it is not about "picking a winner", where a single company, technology or sector is chosen; it is about realizing or deciding that a transformation in society and economy must happen and taking action towards the transition by "picking the

willing" (Mazzucato, 2018a). According to Mazzucato (2017), the success of the mission-oriented policies requires:

1. Well defined missions, straight and evident goals allows monitoring to be more efficient and gives the economy a clear target to aim.

2. Since innovation is very uncertain, missions should not target one singular technology or project. Also, failures should not be punished but should be used as a learning experience.

3. By using policy tools and public institutions to target priorities, missions should create a trickle-down effect. Missions should make use of many public institutions to create a division of labor amongst them for efficient coordination and monitoring.

Foray et al. (2012) states that an R&D program that covers a broad range of technology, markets, nations, consumers, and implementations, requires a significant amount of decentralization, but to monitor and evaluate the overall performance and progress, a centralized administrative structure is needed to complement the decentralization. Thus the overall mechanism of mission-oriented policies can operate smoothly both among itself and with the outside actors. Suggestions of Foray et al. (2012) further supports the statements of Mazzucato (2017).

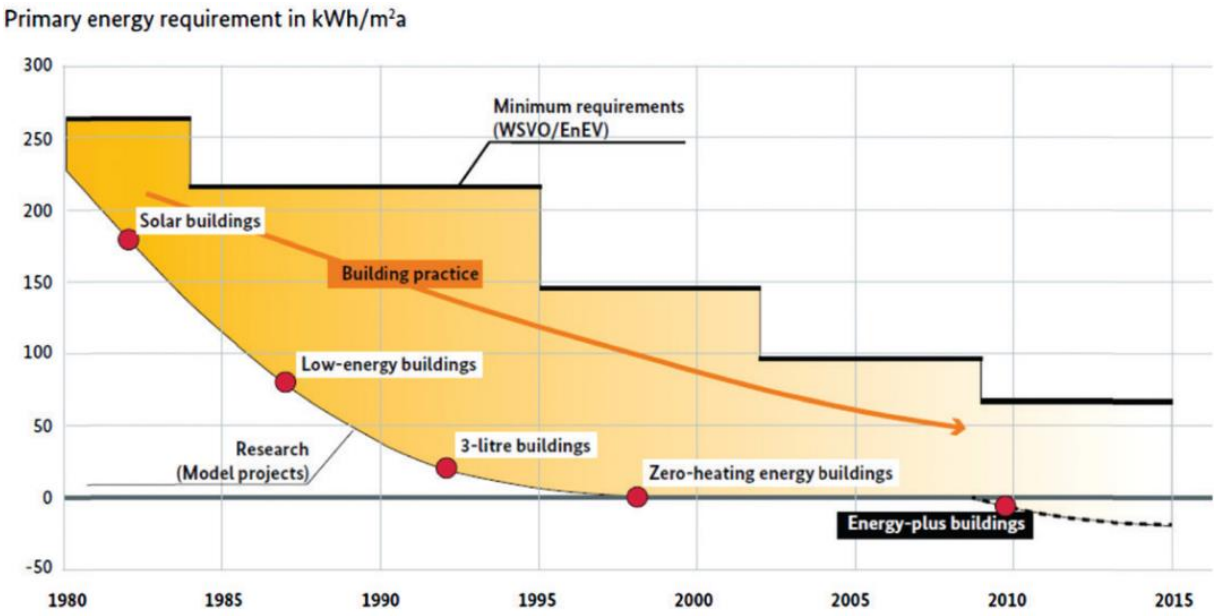
2.1.1 Mission-Oriented Policies in Developed Countries

2.1.1.1 Germany

Germany's energy saving ordinance (EnEV) provides the regulatory framework for the energy efficiencies of the new buildings and renovation of the old ones (dena, n.d.). Compliances for the regulations and usage of the incentives for constructing a new building or refurbishing the old ones were financed by the public bank, Kreditanstalt für Wiederaufbau (KfW) (Kemp & Never, 2017). The success of the program, which can be seen in *Figure 1*, is due to The success of the program was due to the high level of cooperation between policy process, experimental pilot projects and studies that facilitated feedback from those projects, and the steady tightening of the regulations (Kemp & Never, 2017). Additionally, Investors of the high-end housing market in Germany responded to the narrowing technology gap between

the low-quality housing market, even if their success is unlikely to be impacted by the regulations in the future (El-Shagi et al., 2014). This supports the idea that determinant government policy can give incentives to the private sector to innovate.

Figure 1: Primary Energy Requirement in kWh/m^{2}a



Note: Retrieved from "Green transition, industrial policy, and economic development" by R. Kemp, B. Never, 2017, *Oxford Review of Economic Policy,* 33(1), pp. 66-84

2.1.1.2 USA

Unites States of America is a good example of how direct government support and investments to the technologies can effectively create new technologies and support the private innovation as well. So that, Many students from the United States Defense Department's vast post-war R&D projects contend that they have essentially operated as a covert "industrial strategy," producing technical advancements that have enabled the development of leading US computer hardware, aerospace, electronics, and other high-tech firms (Foray et al., 2012). One good example can be given from Steve Jobs' Apple's, where it's huge success was built on the State investments that push the breakthrough technologies which made Ipad and iPhone so unique, such as GPS, communication technologies, touchscreens, and the Internet (Mazzucato, 2014), which were all creations of USA's military investments.

Space exploration is an area that has been fuelled by mission-oriented policies in USA. For example, the Apollo "Man on the Moon" mission is an excellent example of a mission-oriented policy; to put a man on the moon, innovation and investments in many sectors were required, such as electronics, communications, food, medicine, aerospace, biology, materials and many more (Mazzucato, 2018b). With the governments direct investment in private innovations to achieve a goal rather than picking winners or specific technologies, man was on the moon in 1969. Another perfect example of a mission-oriented policy is NASA's current Artemis program, the new program aims to send new man and first to the moon, lay the foundations of lunar exploration and prepare for the future Mars missions with astronauts (NASA, 2020). In their published program overview NASA, (2020) states " …,with private companies hard at work on innovations that will help establish a sustainable human presence at the Moon.", more than 50 years later NASA turns its face to the private innovators again to achieve their goals. So that, in April 2021 NASA chose SpaceX a private space exploration company to carry the next two astronauts to the moon and awarded them for a total of $2.89 Billion (Brown, 2021).

Mission-oriented policies are nothing new for USA, they have been implementing them for decades without calling them mission-oriented policies, and it can be argued that the direct government participation in many sectors and technologies is the reason why many technological leaps in the past happened in USA.

2.1.2 Mission-Oriented Policies in Developing Countries

2.1.2.1 *China*

In 2001, the Chinese government introduced the Energy Conservation Law, which aimed to promote energy saving and efficiency by the newly introduced mandatory and voluntary policies; before the programme, there was hardly any private investment in energy efficiency (Kemp & Never, 2017). Green economy investments in China are driven by the Chinese Development Bank (Sanderson & Forsythe, 2012), by using "state signalling", in which the central state gives local governments guidelines and targets while keeping policy goals broad for local governments to let them adjust to the policies and incentives (Harrison & Kostka, 2014). Recent massive solar power advances in China are fuelled by the investments

of the China Development Bank (CDB), where the state actively partakes in high-risked investments (Mazzucato, 2014).

2.1.2.2 Brazil

The technology fund that has been created by the Brazilian Development Bank (BNDES) to fund selected technologies in Brazil is an excellent example of mission-oriented investments (Mazzucato, 2018a). In 2010, the Brazilian State investment bank (BNDES) earned a 21.2% return from its investments compared to its fellow organizations such as International Bank for Reconstruction and Development (IBRD), where the return on equity was -2.3% (Mazzucato, 2014). State investment banks in developing countries like Brazil and China are proving themselves as vital not only as a countercyclical lending source but also active providers of investments in the new and capital intensive low-carbon technologies (Mazzucato, 2014).

Studying the past examples of mission-oriented policies from countries, their success and their failure can help understanding how mission-oriented policies work, and that knowledge can be further used for creating and implementing new mission-oriented policies. Additionally, examples from countries shows that there is not any singular framework for mission-oriented policies that can work on every country and even technology. Which indicates when it comes to creating and implementing new mission-oriented policies, for every country and technology focus there needs to be unique, well-tailored mission-oriented policies.

2.2 Innovation as a Mission-Oriented Policy

Innovation is the only way for the most developed countries to secure sustainable long-run productivity growth (Bloom et al., 2019). Innovation being a very hot topic, brings disagreements in literature, where many scholars ideas of innovation, how innovation occurs, who innovates, and how to use policy tools differs from each other. For example, some scholars support the idea that small firms tend to be more receptive to initiatives that promote innovation and other forms of business assistance policies than larger firms (Criscuolo et al., 2019). Some suggest that instead of giving handouts to small firms and hoping that they will innovate and grow, it is much more beneficial to give contracts to ambitious and young firms to commission the technologies that require them to innovate (Mazzucato, 2014). Additionally,

some studies aim to measure and rank the availability and implacability of the policy tools. Such as the works of Bloom et al. (2019), in which they analysed and ranked the available policy tools for boosting innovation, from which they gathered their findings and compiled them in a table. As shown in *Table 1,* mission-oriented policies ranked below average compared to other policy tools. However, Bloom et al. (2019) further suggested that solving the market failures that have been emerged from carbon emissions requires new technologies to decarbonize the world, and mission-oriented policies may generate the most valuable innovations to fight climate change.

***Table 1*:** Innovation Policy Toolkit

Innovation Policy Toolkit

Policy	*Quality of evidence (1)*	*Conclusiveness of evidence (2)*	*Net benefit (3)*	*Time frame (4)*	*Effect on inequality (5)*
Direct R&D grants	Medium	Medium	💡💡	Medium run	↑
R&D tax credits	High	High	💡💡💡	Short run	↑
Patent box	Medium	Medium	Negative	NA	↑
Skilled immigration	High	High	💡💡💡	Short to medium run	↓
Universities: incentives	Medium	Low	💡	Medium run	↑
Universities: STEM supply	Medium	Medium	💡💡	Long run	↓
Trade and competition	High	Medium	💡💡💡	Medium run	↑
Intellectual property reform	Medium	Low	Unknown	Medium run	Unknown
Mission-oriented policies	Low	Low	💡	Medium run	Unknown

Note: Retrieved from "A toolkit of policies to promote innovation" by N. Bloom, J. Van Reenen, H. Williams, 2019, *Journal of Economic Perspectives,* 33(3), pp.163-184.

2.2.1 Innovation in Low-Carbon Technologies

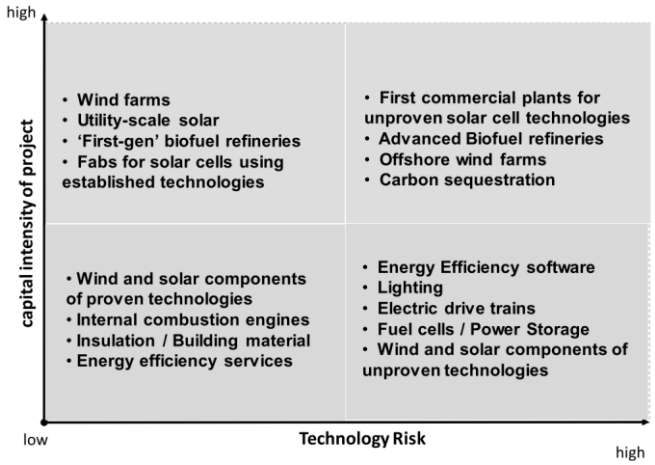
The necessity of innovation in low-carbon technologies to fight against climate change is evident. Although policymakers have drastically increased their funding for low-carbon innovation, the scale of that support is still insufficient to match the magnitude of the carbon emissions and climate change (McDowall & Ekins, 2014). Therefore, to speed up the low-carbon transition, Growing the share of taxation generated from environmental revenues, more innovation-oriented environmental policy, and green public procurement for innovation are all examples of cross-cutting, 'horizontal' steps that are needed to green the path of innovation across the economy (McDowall & Ekins, 2014). However, there is a general belief amongst some scholars that carbon taxes can discourage further researchers in non-green sectors and also reduce emissions, but the best policy to promote low-carbon transition requires

encouragement of developments in low-carbon technologies as well (Acemoglu et al., 2014). To encourage the private sector, the state must assure that companies and entrepreneurs in the green sectors are confident that their work will be funded, from fundamental research to applied research to solve real-world problems (Lamperti et al., 2019). To finalize, low-carbon technology, like all technological revolutions, necessitates a brave government to lead the way, as it did with the previous technological revolutions such as the Internet, biotech, and nanotech (Mazzucato, 2014).

2.2.1.1 Innovation in Low-Carbon Technologies and Role of the Private and Public Sector

Banks and venture capitalists become so more risk-averse that venture capitalists aim for cashing out from their investment by initial public offerings (IPO) within three years (Lazonick & Tulum, 2011). considering that it usually takes 15-20 years for significant innovations to develop, the private sector in the current market structure is more focused on short-term advancements in existing technologies rather than the new ones (Mazzucato & Perez, 2014). Ghosh and Nanda (2010) further suggest risk averseness of the private sector; in their study, they examine the position of venture capitalists and other private participants in clean technology investments and divide the clean energy into sub-sectors considering technological risk and capital intensity of the clean technologies. Through their research, Ghosh and Nanda (2010) visualized their findings and suggested that capital intensive and high risky low-carbon technologies on the upper right corner of *Figure 2* are only being funded by the public sector, where venture capitalists are funding the safer and less capital intensive low-carbon technologies on the bottom part of the *Figure 2*.

Figure 2: Clean Energy Investment Capital Intensity and Risk Factors



Note: Retrieved from "Venture Capital Investment in the Clean Energy Sector" by S. Ghosh, R. Nanda, 2010

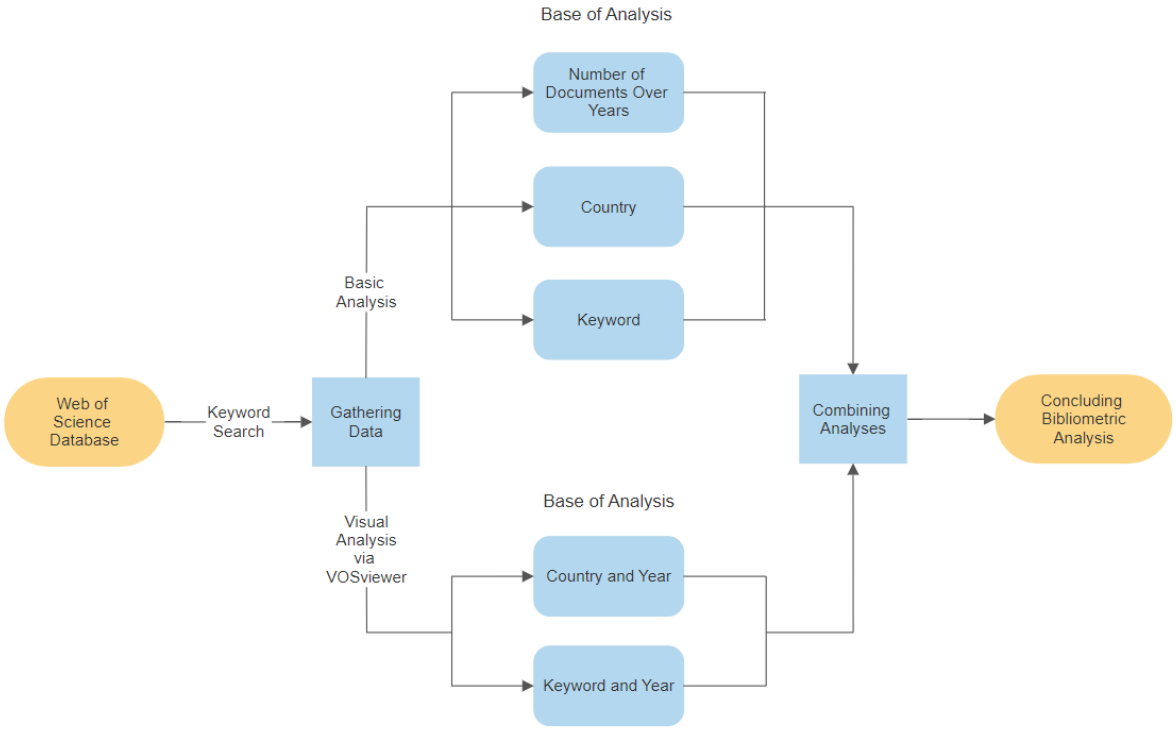
Information spillovers are the primary market failure that economists use to justify government interference in innovation. If one company discovers something genuinely creative, this knowledge can spill over to other companies, allowing them to either replicate or benefit from the original research without paying the total cost of R&D (Bloom et al., 2019). But in the case of low-carbon technologies, considering how risk-averse is the private sector, governments are the only agents that can push the low-carbon transition with continuous funding in the radical and disruptive technologies (Mazzucato, 2014). Therefore, State should not just act as the de-risking factor for the private investors; it should lead the way for innovation and change with a pre-determined well-established vision (Mazzucato, 2014).

3 Data

To conduct a reliable bibliometric analysis, the Web of Science publication database is used as the source for the research data. To filter the documents that are related to mission-oriented policies, a keyword search for the topics of the publications conducted. Since mission-oriented policies sometimes referred to as mission-innovation or mission-technology or mission-technology or mission policies following keywords are used. "mission-oriented" or "mission policy" or "mission innovation" or "mission technology" or "mission oriented policy" or "mission oriented innovation" or "mission-oriented technology". During the filtering process, "or" is used rather than the "and" since it is aimed to gather documents that include at least one of the keywords. Total of 517 publications were found from 59 different countries and 13 different document types.

4 Methodology

Figure 3: Visual Representation of Methodological Process



All methodological process of the paper is visualized and can be seen in *Figure 3* and the details of the process are as follows: First, to analyse the collected data from the Web of Science publication database, VOSviewer software is used to construct network maps. To understand how the research interest of researchers changes over time, a keyword co-occurrence map is created from the keywords that are used by researchers in their work. In the process of creating the keyword co-occurrence map, full counting method is used, and 11139 keywords were found. To eliminate irrelevant keywords, only keywords that occurred more than ten times were chosen, and 245 keywords met the threshold. From the keywords that occurred more than ten times only, the most relevant 60% keywords chosen regarding their VOSviewer relevance score, and 147 keywords met the criteria.

Furthermore, to understand how research interest differs in countries, citation analysis for the countries conducted using VOSviewer software. In which, number of publications and citations of countries are analysed with their linkage with other countries as well. From 59 countries, countries with a minimum of four documents and five citations were chosen, and 23 out of 59 countries met the threshold. After analysing the data and data patterns of keyword co-

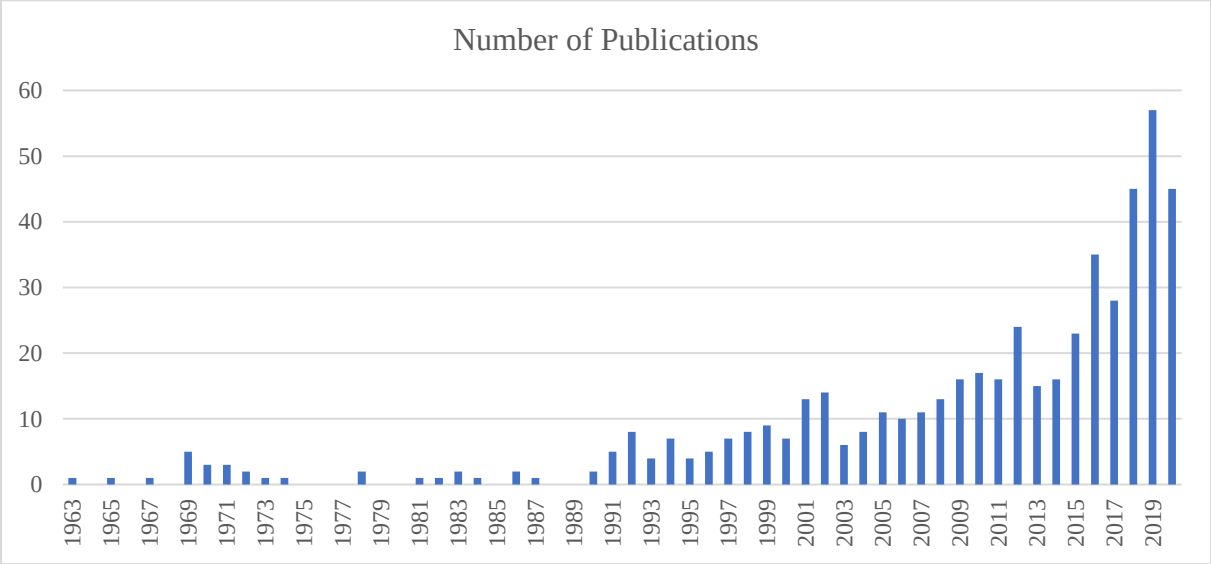
occurrence map and citation analysis of countries, the research aims to understand how research interest areas changed over time and where the future for mission-oriented policies lay.

5 Findings

5.1 Number of Documents Over Years Analysis

Analysing the changes in the numbers of publications over time can be helpful to understand how research interests have changed throughout the years. Between the years 1963 and 2020, 517 different publications have been written. From those publications, more than 80% of them have been written between 2000 and 2020. Additionally, as shown in *Figure 4*, increases in the number of publications in recent years show an increase in the interest in the research area.

Figure 4: Number of Publications per Year



5.2 Country Analysis

Analysing how many publications have been published in different countries can be used to understand the geographic differences in research interest regarding mission-oriented policies. To carry out a more reliable analysis, countries with a minimum of four publications and five citations were chosen, and only 23 countries have met the requirements. The number of publications and citations of countries can be seen in *Table 2*. Looking at *Table 2*, the United States of America has the lead in both numbers of documents and citations. However, to

understand the quality of the publications rather than the quantity, the number of citations per document can be analysed. In *Table 3*, Citations per publication for the countries with at least ten publications can be seen. Even though the United States of America has the highest number of publications and citations, data paints a different picture when it comes to citations per publication. In which the top 6 countries are EU countries. This suggests Europe is leading the research in mission-oriented policies.

Table 2: Number of Publications and Citations of Countries

Country	Publications	Citations	Country	Publications	Citations
USA	171	1558	Brazil	14	106
England	35	1235	Canada	8	88
France	30	571	Scotland	5	84
Sweden	14	547	Norway	5	81
Germany	27	507	South Korea	15	55
South Africa	5	395	Belgium	9	44
Netherlands	19	344	Australia	6	43
China	68	269	Austria	5	27
Italy	18	260	Taiwan	14	22
Spain	9	182	Portugal	5	10
India	14	143	Iran	5	8
Denmark	9	134			

Table 3: Number of Citations per Publication

Country	Number of Citations per Publication
Sweden	39,07
England	35,29
France	19,03
Germany	18,78
Netherlands	18,11
Italy	14,44
India	10,21
USA	9,11
Brazil	7,57
China	3,96

5.3 Keyword Analysis

In *Table 4,* most occurred 40 keywords are listed. Inspecting the most occurred keywords can give a general idea about the research focus of mission-oriented policies. Combining the findings from the literature review and the number of keywords such as "Research", "Problem", "Environment", "Innovation", it can be said that focus areas of mission-oriented policies are using innovation and research as the primary tool for solving more significant problems, such as environmental problems and climate change.

Table 4: Top 40 Keywords

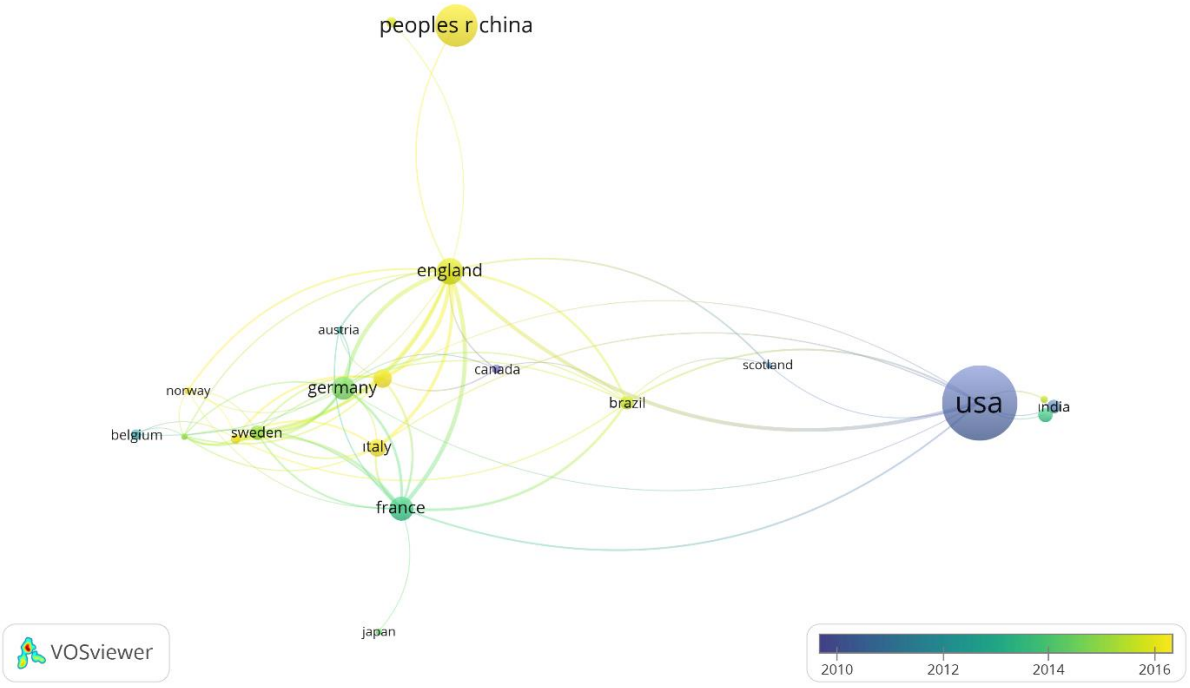
Rank	Keyword	Occurrences	Rank	Keyword	Occurrences
1	Research	226	21	University	65
2	Network	170	22	Requirement	63
3	Problem	144	23	Solution	63
4	Study	130	24	Node	61
5	Policy	118	25	Number	56
6	Performance	117	26	Country	55
7	Science	113	27	Vehicle	54
8	Environment	103	28	Technique	54
9	Innovation	97	29	Platform	52
10	Program	97	30	Set	51
11	Challenge	88	31	Protocol	50
12	Organization	86	32	Architecture	49
13	Sensor	81	33	Year	49
14	Communication	74	34	Simulation	48
15	Task	72	35	Practice	48
16	Article	70	36	Team	48
17	Control	69	37	Knowledge	48
18	Operation	68	38	Value	47
19	Capability	67	39	Sector	46
20	Algorithm	66	40	Innovation policy	45

5.4 Visual Analysis of Literature Using VOSviewer

Using a visual analysis tool such as VOSviewer makes it possible to analyse the data with two different angles simultaneously by constructing network maps. In this research, VOSviewer is used to investigate whether countries research interests changed overtime or not. Additionally, using keyword and year analysis in VOSviewer, it is examined that whether there are any changes in research focus areas or not.

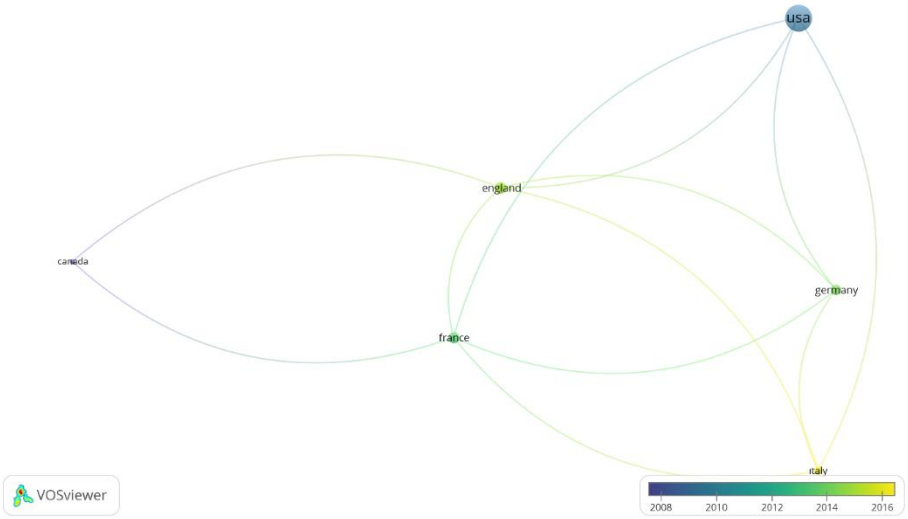
5.4.1 Co-Authorship Analysis

Figure 5: Network Visualization map of Co-Authorships Between Countries



In *Figure 5*, the size of the countries increases with their numbers of publications, colors represent the general time frame of those publications and lines that connect countries represents the co-authorships between countries. Their colors represent the time frame of those publications co-authorships. Looking at *Figure 5*, even though the USA has the most publications, their research interests in mission-oriented policies decreased over time and shifted to Europe and China. Again, from *Figure 5*, most co-authorships occurred between EU countries, and most of their co-authorships occurred in recent years. Lines, country bubbles and colors in *Figure 6* represent the same variables as the one in *Figure 5* and in *Figure 6* only G7 countries are examined except Japan, because it did not meet the requirements of the analysis. Findings of the *Figure 6* do not differ from the findings of the *Figure 5* except for China, and the transition from USA to Europe can be seen again clearly.

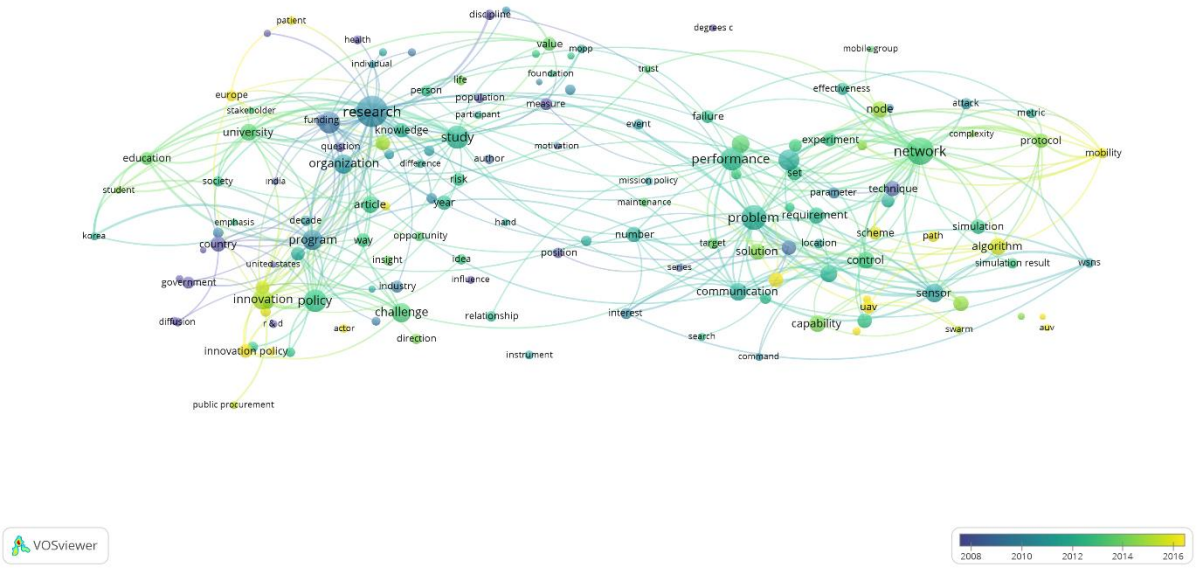
Figure 6: Network Visualization map of Co-Authorships Between G7 Countries (except Japan)



Thus, for the changes in research interests of countries, USA was the starting for the research in mission-oriented policies. However, that interest shifted towards China and especially Europe over time. Considering the high number of co-authorships in Europe, it can be said that Europe is the main hub for the current research in mission-oriented policies.

5.4.2 Keyword Co-Occurrence Analysis

Figure 7: Network Visualization map of Keyword Co-Occurrence



Just like in *Figure 5* and *Figure 6*, in *Figure 7*, sizes represent the number of occurrences, colors represents years, and lines represent the usage of the corresponding keywords together. Looking at the *Figure 7*, it can be seen that how new interest areas emerged in mission-oriented policy research. Especially one keyword in *Figure 7* stands out, which is "innovation policy". Backtracking the "innovation policy" keyword and its co-occurrences, it can be seen how researchers focussed on "policy" and "innovation" separately with the keyword "r&d" in the middle of them. Which suggests research in mission-oriented policies shifted towards innovation policies as a whole, rather than looking at innovation, policy, and R&D separately.

6 Discussion

Considering all the analyses that are carried out in the paper, some points can be made. Firstly, continuous increases in the number of publications over time indicate the increases in research interest for mission-oriented policies. Secondly, comparing countries interests in mission-oriented policy research, the research focuses has shifted towards Europe and China from the United States of America, which is further supported by the higher numbers of publications, co-authorships and most importantly, citation per publications in European countries. When it comes to research focuses, mission-oriented policies are still focused on innovation and innovation policies. However, what has changed is how to use these tools or the problems that are aimed to be solved with mission-oriented policies, such as environmental problems and climate change. Additionally, past, and current examples from countries' intentional or unintentional mission-oriented policies can pave the way for the successful future policies and their implications. Even with the research interest increase and recent implementation of mission-oriented policies, one can not come up with an "one fits all" policy framework for countries. Which justifies the future research needs of mission-oriented policies regarding different country classifications and even specific country case studies.

7 Conclusion

The idea that governments should actively participate in the innovation process is gaining momentum around the world. The increasing popularity of the idea draws attention to mission-oriented policies, in which governments lead the innovation process by actively taking risks in selected sectors or technologies with clear and determined plans. Thus, it is essential

for their implication to understand how mission-oriented policies, their research focuses and overall interests in them changed over time. In this paper, a bibliometric analysis is conducted to achieve that goal. Starting with a keyword search from the Web of Science publication database, the data for the research are collected. Then using simple analysis tools and VOSviewer visual analysis tools, analyses are conducted and discussed. The findings of the bibliometric analysis suggest that overall academic interest in mission-oriented policies has increased significantly. Furthermore, looking at the countries and their co-work in mission-oriented policies, the research focus has shifted from the USA to Europe and China. The number of co-authorship between European countries and their high numbers of citations per publication numbers suggests that Europe is leading the research in mission-oriented policies. With the review of the literature and keyword analysis, it seems like the latest focus areas of the mission-oriented policies has shifted from using mission-oriented policies to boost innovation in singular technology or sector to using them as an effective tool to overcome drastic problems such as climate change by creating new markets around problems and promoting innovation. When it comes to real policy implications of the mission-oriented policies, past examples can be very insightful for creating and implementing new mission-oriented policies. However, each problem and each country will require unique policies to fit their social and economic structure, which implies further research of mission-oriented policies not just as a whole, but also regarding different country classifications and specific case studies for countries. Thus, to tackle the various social problems of our world such as inequality, climate change, sustainability, and many more, the continuation and evolution of research in mission-oriented policies is essential for our future.

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