6 National policies for Artificial Intelligence: What about diffusion?

Despite projected gains, the broad diffusion of artificial intelligence (AI) is not automatic, particularly for small and medium-sized firms (SMEs) that face barriers in adoption. This chapter looks at the attention policy makers have been given to SMEs and entrepreneurs in their newly designed AI policy agenda. It looks at the directionality and composition of national AI policy mixes, and aims to identify patterns in public policies and instruments. Through an exploratory text-as-data analysis, this chapter presents the various characteristics of AI policies in place, in particular those targeted towards SMEs and entrepreneurs. The report provides selected country cases illustrating the networks and clusters of governance institutions involved in national AI policies.

In Brief

Highlights

- **Artificial intelligence has emerged as a topic of policy interest**, and most countries have recently launched their national AI strategies in order to articulate public action in the area.
- **A stronger policy emphasis is generally placed on AI innovation development (supply-side) than AI adoption (demand-side),** e.g. increasing the number of AI researchers and skilled graduates, increasing national AI research capacity, and fostering national competitiveness in AI with global ambitions.
- **SMEs are rarely directly targeted by national AI strategies and policy initiatives**. But when targeted, measures aim at a mix of SMEs, start-ups, entrepreneurs, and research institutions, with a focus on innovative firms, on the supply side, and a focus on the general SME population, on the demand-side.
- **However, most national AI strategies place priority on addressing issues that SMEs face in the AI transition**, suggesting that the SME policy agenda is mainstreamed into the AI policy agenda.
- **Policies aim to ensure that new AI technologies can be applied to industrial processes**. The manufacturing industry is seen as one of the sectors that could benefit the most of AI solutions, automation and enhanced predictive capacity.
- **Cybersecurity** is an important recurrent theme in AI policy initiatives.
- **In terms of instrumentalisation, the AI policy mix**, i.e. the composition of the AI policy portfolio, **is dominated by governance arrangements**, also reflecting the novelty of the area.
- **However, AI policies geared towards SMEs are more likely to be direct financial support or collaborative infrastructure, platforms, and experimentation labs and testbeds**. Indeed, financing AI innovation is a major issue, as traditional obstacles to finance innovation and obstacles faced by SMEs to access finance compound. Infrastructure particularly matters for SMES to engage in co-operation and access networks, where knowledge transfer and partnerships take place.
- **AI policy responsibilities tend to be distributed across multiple policy areas and levels of governance**, reflecting both the growing complexity and interweaving of innovation policy arrangements and the pervasive nature of AI. This may exacerbate the issues of policy co-ordination and coherence.
- **AI policies for SMEs often fall under the authority of institutions in charge of STI and industry policy**, less often under those in charge of economic development. Through a selection of country cases and an exploratory text-as-data analysis of the EC/OECD STI Policy Compass, the report highlights very large country differences in AI/SMEE governance settings.
- **Going forward**, future policy mapping exercise of this kind should consider complementing policy information with other sources, in order to bridge the knowledge gap across different policy domains (e.g. broadband policies, data protection policies) and different levels of governance (subnational programmes).

Introduction

Driven by the growth in computing power and greater data availability and algorithm efficiency, "Artificial Intelligence" (AI) has gained prominence in recent years. In particular, "machine learning" has seen spectacular progress since the early 2010s, following a paradigm shift in the discipline which has enabled AI models to self-improve and has greatly broadened the scope of applications (OECD, 2019[1]). The main business applications of new generation AI relate to automation, image/face recognition, natural language processing, data analytics and predictive capacity.

AI adoption can have many benefits for small and medium-sized firms (SMEs), including increased cost efficiency and productivity gains, increased ability to manage risks and address complex challenges, increased prediction and decision-making capacity and increased innovation opportunities (Cockburn, Henderson and Stern, 2018[2]) (see Chapter 5 for a detailed discussion on AI implications for SMEs and barriers to adoption [CFE/SME(2020)5/CHAP7]) For example, SMEs involved in retail trade and e-commerce can use AI to personalise offerings and suggestions to customers. Those that engage in customer support can use AI-supported chatbots to interact with customers 24/7 with no human presence. AI can also help business owners with forecasting their sales and market trends. A manufacturing SME could use AI to improve production operations and maintenance, for instance by identifying the combination of tools and robots that can assemble a device most efficiently, with real-time feedback about performance, allowing for further optimisation (OECD, 2017[3]).

AI can also substantially improve SME business environment, by enhancing the efficiency of public administration, courts and tax authorities, reducing red tape, securing digital infrastructure, improving SME access to finance, easing skills management and job matching, or reducing the costs of experimentation and innovation. At the same time, algorithms increase the risk of tacit collusion on product and labour markets, and of (likely large) firms sustaining profits and prices above a fair competitive level, at the detriment of smaller businesses.

Despite projected gains, the diffusion of AI innovation is not automatic. Evidence suggest different degrees of AI diffusion across countries, sectors and firm sizes (see Chapter 5), with concerns that most of the AI benefits could be reaped by first adopters, while laggards have low or no benefits at all (Brynjolfsson and McElheran, 2016[4]). There are also converging evidence of an SME gap in using data analytics or implementing AI solutions.

SMEs face a number of barriers in adoption. The AI transition requires them to engage in a process of transformation that can be lengthy and costly, and for which most of them lack awareness, skills and the culture of data required. A transformation that also depends both on their absorptive capacities of new knowledge and on various market and policy incentives (Brynjolfsson, Rock and Syverson, 2017[5]; Berlingieri et al., 2020[6]; Andrews, Nicoletti and Timiliotis, 2018[7]) (Box 6.1). In addition, the deployment of AI solutions will have a cost. Generally, effective use of AI depends on investments in data and skills (OECD, 2019[1]; Berlingieri et al., 2020[6]; Andrews, Nicoletti and Timiliotis, 2018[7]), but also on the use of complementary technologies, such as the Internet of Things (IoT), high-speed broadband, sensors, or computing storage, etc. These complementary investments add to the high sunk costs SMEs would have to incur for training AI models. The financial issue is not trivial as little evidence exists on what returns on investment businesses could expect from AI, nor when they could expect reaping these benefits. It would take time to build a sufficient stock of AI subfields before seeing effect (Brynjolfsson, Rock and Syverson, 2017[5]).

In fact, AI is unlikely to translate into aggregate productivity growth soon, until sufficient AI innovation has been undertaken and until adoption has been mainstreamed, along with the spread of adequate skillset, (Brynjolfsson, Rock and Syverson, 2017[5]), what has emerged as an "aggregate productivity paradox".

A literature review on barriers to AI adoption by SMEs has helped identify several areas where policy attention could be given, if governments are to ensure SMEs can participate in the AI transition (see Chapter 5).

- **Data is the key**. Governments have a role to play in supporting SMEs in building a culture of data and improving digital risk management practices.
- **The human factor is critical**. Raising awareness among SME managers and workers on AI benefits, and the conditions of a trustworthy transition, is required. National and local governments should also co-ordinate action for reskilling SME managers and workers, and ensuring a participatory approach in redesigning work processes and training AI models.
- **The issue of financing should be addressed**, first by building more evidence on the return on investment of AI business applications, in order to inform SME managers and business owners, but also investors and financial institutions, and by identifying mechanisms for bridging the financing gap until AI can deliver its full promises.
- **Regulators and policy makers should ensure the well functioning of knowledge markets** that provide cloud solutions embedding AI technologies, as well as the transfer of knowledge that could enable SMEs scale up capacity before being eventually able to develop their own AI solutions.
- **Adopting a differentiated industrial approach of the AI transition(s),** through sectoral studies and business use cases, could help inform relevant stakeholders and account for the low transferability of AI knowledge across environments.
- **Supporting mutual learning in terms of capacity building and knowledge sharing**, through platforms such as the OECD Digital for SMEs Initiative and the OECD.AI Policy Observatory, could help better understand the role large firms, business associations, chambers of commerce, academia, national and local governments, international organisations, and SMEs as well, could play to advance on these different agenda.

What is the place of SMEs and entrepreneurs in AI ecosystems and what role can public policy play to ensure SMEs are able to participate in the AI revolution? SMEs are actors of the digital transformation in two ways, namely as *producers* and/or as *adopters* of AI tools (Box 6.1). This chapter looks at the attention given to SMEs and entrepreneurs in national AI innovation policy mixes across various countries. It looks at what major policy initiatives have been implemented to support AI development and diffusion in the SME sector and aims to identify patterns in these public policies and instruments. The report builds on information contained in the European Commission/OECD Science, Technology and Innovation Policy (STIP) Compass (European Commission/OECD, 2020[8]) database (henceforth the Compass), which is the largest international repository on national STI policies. The report explores two methods for navigating the database, and presents various characteristics of AI policies in place, in particular those that target SMEs and entrepreneurs. The analysis focuses on the following questions:

- How are national innovation policy mixes shaped for AI innovation and diffusion? What attention is given to SMEs and entrepreneurs? Are national policy mixes targeted alongside other groups?
- Do policy initiatives tend to support the development and diffusion of complementary technologies besides AI? If so, which ones and how? Have some countries a sector-specific approach?
- What policy instruments are used to support AI innovation and AI diffusion? To which extent do these instruments address the specific barriers faced by smaller businesses?
- What role do various public and private organisations play in AI governance? How are SMEs and entrepreneurs engaged in AI policy governance?

Box 6.1. Innovation and innovation policies: Some theoretical insights

Innovation is a broad concept and encompasses a wide range of activities. Taking into account that it is not specific to the business sector and could be undertaken in the public administration, the OECD/Eurostat Oslo Manual defines innovation as: "*a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)*" (OECD/Eurostat, 2018[9]).

By innovating, the firm seeks new opportunities and competitive advantage, and aims to generate more profits, through increased sales, greater brand awareness, new customer base or higher market shares (i.e. product innovation), or through greater cost efficiency and improved productivity (i.e. business process innovation). (Schumpeter, 1934[10]) described the disruption of existing economic activities brought by these innovations, and the subsequent re-organisation of markets, as "creative destruction".

Innovations derive from an accumulation of knowledge and information that constitutes the firm's knowledge-based capital. R&D, for instance, is one of the activities that can generate innovations, or through which useful knowledge for innovation can be acquired. Technology is a key innovation asset and its deployment is a major driver of changes in business products and processes and the apparition of new industries.

Innovation diffusion encompasses both the process by which ideas underpinning product and business process innovations spread (*innovation knowledge diffusion*), and the adoption of such products or processes by other firms (*innovation output diffusion*) (OECD/Eurostat, 2018[9]).

Firms can source knowledge within their organisational boundaries, as well as from outside, including from their customers, investors, suppliers, etc. (Enkel, 2010[11]) or from knowledge markets (Hayek, 1945[12]). In fact, firms almost never innovate in isolation (DeBresson, 1996[13]), and networks of innovation involving multiple actors are the rule rather than the exception.

The scope and nature of innovation diffusion remain deeply conditioned by the firm's absorptive capacity, and the incentives -and barriers – existing in its business environment. The firm's absorptive capacity depends on structural aspects, such as its size and its sector of activity, but also on its (financial, human and knowledge-based) capital endowment and its ability to access strategic resources (OECD, 2019[14]). The business environment is defined by institutional and regulatory settings, competition and market conditions, and the available infrastructure. Agglomeration is also an important enabling factor of innovation diffusion (Audretsch and Feldman, 1996[15]).

A range of market, system and government failures provide the rationale for governments to intervene in support of innovation and technology diffusion (OECD, 2015[16]; OECD, 2016[17]). However, the diversity of innovation actors, learning processes, linkages, knowledge bases, institutions and organisations engaged in knowledge transfers increases the complexity of policy making. In fact, intervention in the field can take many different forms, as it targets the various existing forms of innovation, the various actors engaged in knowledge flows, the various diffusion channels and mechanisms at play, or the various enabling conditions that help the firm scale up its capacity to innovate or provide it the incentives to do so.

This complexity advocates for adopting a "policy mix" approach in the design and evaluation of innovation diffusion policies, i.e. an approach that takes into account the composition and balance between policies, and their complementarities or trade-offs.

Source: Abridged from Kergroach (2020[18]), "Benchmarking national innovation policy mixes for technology diffusion".

Data sources and methodology

Data sources

This work builds on desk research and on text-as-data analysis of information contained in the Compass (European Commission/OECD, 2020[8]). The Compass gathers government responses to a biennial policy survey on national STI policies. Data from the Compass, edition 2020, was downloaded using the dedicated query builder (https://stip.oecd.org/stip/query-builder) in March 2020 (see Box 6.2) for more information).

Box 6.2. The EC/OECD STI Policy Compass

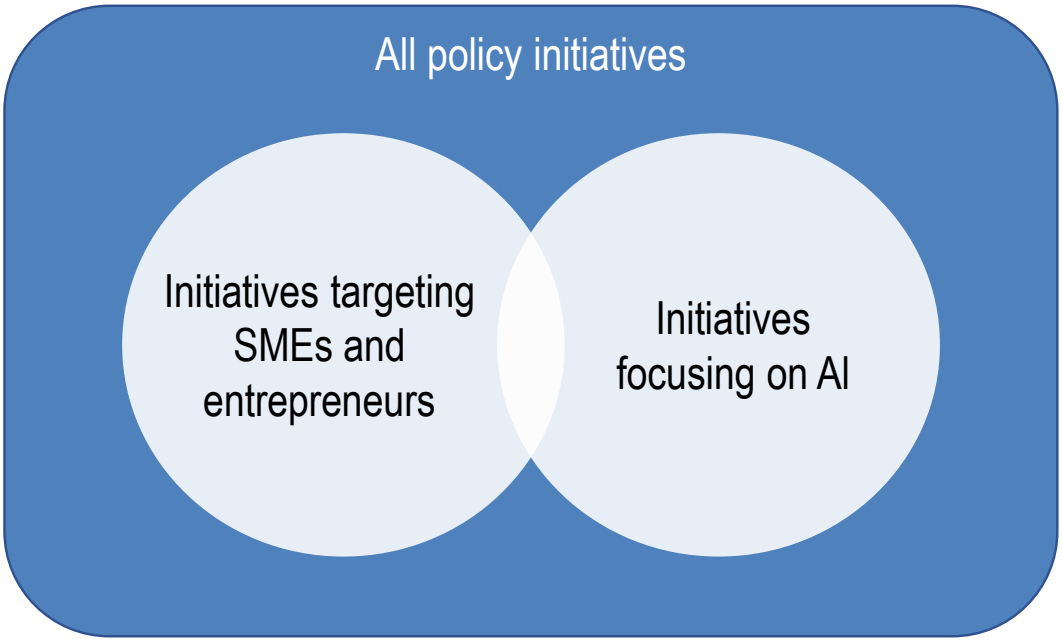
The Compass contains country responses to a biennial survey on major national science, technology and innovation policy initiatives. The database was first published in 2017, with earlier pilot versions back to 2012. Respondents are government representatives to the OECD Committee for Scientific and Technological Policy and to the European Research and Innovation Committee (ERAC). The 2020 edition of the database allows for multiple respondents by country, via national contact points (NCPs) – see (OECD, 2019[19]). Policy initiatives are reported at the country level, reflecting government views on the major components of their policy mix for STI (Meissner and Kergroach, 2019[20]). The latest edition of the database is structured as follows (OECD, 2019[19]):[1]

- There are 5 685 observations (policy initiatives).
- 67 geographical entities are covered (see Annex 6.A).
- Several fields are free text (name in English, background, objective(s), description, responsible organisation(s)).
- Other fields are multiple-choice and base themselves on pre-existing taxonomies (yearly budget range, theme area(s), theme(s), policy instrument name, etc.).
- The database also includes information about the start year and the end year of each initiative.
- Two True/False fields indicate whether the initiative is a structural reform and whether it has been or is currently evaluated.
- The share of incomplete information (i.e. initiatives with at least one mandatory field[2] left empty) is 39% (OECD, 2020[21]).

Identifying national AI policies for SMEs

The Compass covers a broad range of STI policy initiatives and instruments. Some initiatives are reported as “national AI policies”, some are specifically designed for targeting SMEs and entrepreneurs, and some present both characteristics. Several methods can be used in order to identify the relevant initiatives for this work in the Compass. The composition of the Compass is represented in stylised form below, with the intersection between the two subsets, namely initiatives targeting SMEs and entrepreneurs and initiatives focusing on AI (Figure 6.1).

Figure 6.1. Subsets of Compass initiatives



Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Using the original Compass taxonomies

STIP survey respondents are required to report their policy mapping along different dimensions. These dimensions include:

- "Target group(s)", which are defined as "direct beneficiaries" – e.g. "Industry associations" or "Established researchers"; and
- "Theme(s)", which are pre-defined policy topics – e.g. "STI human resources strategies" or "Digital transformation of firms" (DSTI/STP(2019)17).

For each observation in the database could correspond to one or more "Target group(s)" and one or more "Theme(s)". These two fields provide the most basic way of selecting specific initiatives.

In practice, along the Compass taxonomies, three "Target group(s)" can be singled out as pertaining to the SME sector:

- Micro-enterprises.
- SMEs.
- Entrepreneurs.

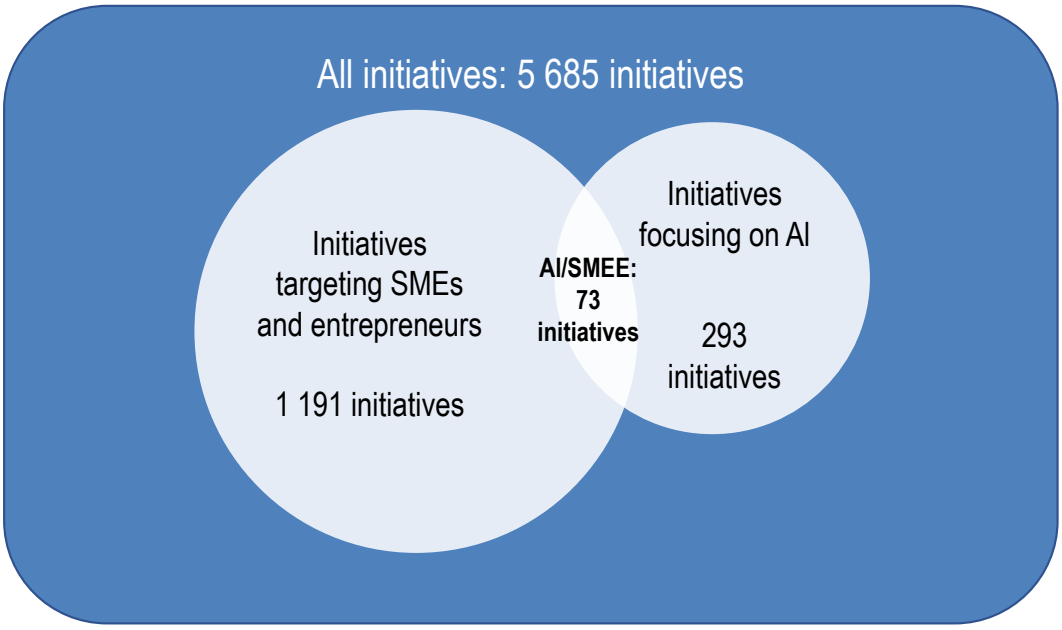
Policy initiatives that list at least one of these three groups as a "Target group(s)" can be deemed to be targeted to the SME sector as well as entrepreneurs. It should be noted that in practice, countries may also include SME-relevant initiatives under the dimension "Firms of any size". While the present report does not consider these initiatives, future analysis could investigate to which extend adding these initiatives could alter the results and findings.

Secondly, "Artificial Intelligence (AI)" constitutes one of the pre-existing themes available to respondents. This input corresponds to responses to the following question: *What strategies (or plans, roadmaps) and other types of policy initiatives, if any, make up your national AI policy?*[3] Any initiative that contains "Artificial Intelligence (AI)" as one of its topics of relevance can be considered as AI-targeted.

Figure 6.2 illustrates the size of the two subsets of policy initiatives that are of interest here, based on the two filters applied to the full dataset. Of the 5 685 policy initiatives that are reported in the Compass:

- **1 191 initiatives** or 20.95% of all initiatives are targeted at SMEs, micro-enterprises or entrepreneurs (SMEE).
- **293 initiatives** or 5.15% of all initiatives form part of "national AI policies" (AI).
- **73 initiatives** or 1.28% of all initiatives satisfy both conditions (AI/SMEE).

Figure 6.2. Number of initiatives by subgroup, based on STIP Compass taxonomies



Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Using the Compass taxonomies may, however, have some limitations. Indeed, respondents tend to specify many target groups for a single policy initiative (3.47 target groups per initiative are specified on average, including initiatives that are not targeted – for country-specific figures see Annex Table 6.A.2). This may suggest either a high segmentation of the policy initiatives, or a high degree of disaggregation in the taxonomies, or a misinterpretation of the definition of the target group, e.g. when a large number of target groups might question the very idea of target, etc. While some explanations may have little impact on the selection of initiatives (high degree of disaggregation), others could be problematic (misunderstanding). Ultimately, from a user perspective, it remains difficult to sort out what the explanations could be and address any possible issue of selection.

Moreover, policies that are generally related to emerging technologies or general-purpose technologies can be considered by respondents as belonging to "national AI policies", even though AI is not explicitly stated. This could reflect horizontality in policy making and the predominance of high-level policy initiatives that are not technology-specific, but it also makes interpretation and further analysis difficult. Likewise, SMEs and entrepreneurs are sometimes listed in the target groups but are not mentioned in any of the other fields, including its description and objective (this is the case for 244 initiatives, i.e. almost one-fifth of all initiatives found using this method). This discrepancy between the taxonomies and the descriptive fields does not allow quality control, i.e. to confirm or infirm whether an initiative is relevant to a selection,

adding to the complexity of the analysis if information should be tracked back into national documentation and other repositories.

Conversely, SMEs and entrepreneurs can be mentioned in one of the textual fields, but may not be included in the target groups. This, again, raises the question about how definitions and taxonomies are used.

For these reasons, it may be interesting to explore another method for filtering the database, which broadens the search to the full range of fields.

Identifying policies using keywords

The fact that most fields in the database are free text allows for filtering by keywords. This approach has already been used in the past to explore the composition of national innovation policy mixes for technology transfer and public research commercialisation by universities and public research institutes (Kergroach, Meissner and Vonortas, 2017[22]) and technology upgrading through global value chains (Kergroach, 2019[23]), based on earlier versions of the Compass. These early explorations showed that keywords analysis could broaden the range of policy initiatives that may be relevant for analysing a policy mix, with ultimately different interpretations on how the national mixes could be composed and balanced.

In practice, if at least one field associated with a policy initiative contains a given keyword, then the initiative is considered relevant to the keyword. Using only one keyword such as “artificial intelligence” would be limiting, as there is a full lexical field surrounding the concept, and respondents may choose to refer to different subfields of AI. This is why it is useful to create a list of keywords covering a wider range of the lexical fields, including keywords pertaining to AI techniques (e.g. “neural network”) and AI applications (e.g. “computer vision”). A similar list of keywords was used in a recent study of private equity investments in AI (OECD, 2018[24]).[4] If at least one keyword in this list is found in at least one field, then the initiative is deemed to be relevant to AI. The keywords used for the selection of initiatives are listed in Table 6.1, with their frequency of occurrence in the full STIP dataset. The search is conducted on all fields except “Theme(s)” and “Target group(s)”, in order to avoid reproducing the original taxonomies (described above).

Table 6.1. List of AI and SME&E keywords

In descending order of frequency, keywords above the double line are used in the final search

AI keywords	Frequency of occurrence	SME&E keywords	Frequency of occurrence
artificial intelligence	200	smes*	310
ai*	97	entrepreneurship	280
big data	22	entrepreneur	196
robotics	16	sme*	119
automation	12	start-up	107
automated	12	startup	24
data infrastructure	8	medium-sized	21
internet of things	6	medium-sized	21
machine learning	4	small business	18
iot*	3	small enterprise	11
natural language processing	2	small and medium	8
autonomous vehicle	1	medium enterprise	6
natural language recognition	0	self-employed	3
visual recognition	0	small companies	2
machine-based	0	medium firm	2
neural network	0	microenterprise	1
nlp*	0	small firm	1
computer vision	0	mittelstand	0

AI keywords	Frequency of occurrence	SME&E keywords	Frequency of occurrence
deep learning	0	micro-firm	0
ml*	0	micro-enterprise	0
		family business	0

Note: *Abbreviations (such as "ai") are isolated to make sure that words containing the same sequence of characters (e.g. "brain") are not matched. Keywords are tested individually to see how many observations they are found in and whether these observations are relevant. The list of AI keywords was consolidated based on definitions provided in OECD (2019[1]), *Artificial Intelligence in Society,* OECD Publishing, Paris, https://dx.doi.org/10.1787/eedfee77-en. Redundant keywords (i.e. keywords that find no new initiatives – with 0 as their frequency) are removed from the final list of keywords. Once this has been done, the filtering can be conducted using the full list. The filtering is not case-sensitive, and it identifies the above patterns even when they are part of a larger word. All procedures were conducted using Python and regular expressions (regex).
Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

The keywords approach to the Compass data yields 383 initiatives related to AI. Of these 383 policy initiatives, 233, or 60.8%, have been identified by default using the in-built taxonomy. The remaining 150 initiatives can only be identified using this method. The initiatives that are only identified using keywords search correspond to cases where the respondent mentions one of the AI keywords in the text fields, but does not list the initiative as belonging to the country's "national AI policy".

A manual verification of the 383 initiatives found that using this search method shows that 310 initiatives (80.9% of the total) indeed concern AI. Meanwhile, less than 50% of the 60 initiatives that were listed as part of a country's "national AI policy" (along the original Compass taxonomy) but not containing any of the keywords, proved to be relevant. This suggests that using keywords is another effective way to explore the Compass and can increase accuracy.

The very same method can be used to identify measures concerning SMEs and entrepreneurs. In order to do this, a similar list of keywords drawn from the lexical field of small firms and entrepreneurship can be designed (Table 6.1). Two preliminary observations can be made:

- The lexical field of SMEs and entrepreneurship is much more restricted than that of AI. This is probably because there is some disagreement on what exactly AI is, and so there is a rich set of expressions to describe this technology and its numerous applications, as opposed to SMEs and entrepreneurs, which are relatively more common target groups for policy makers.
- The vast majority of relevant initiatives can be identified using just "entrepreneurship" and "smes" (2 104 initiatives, i.e. 94.1% of the total using the full list of keywords).

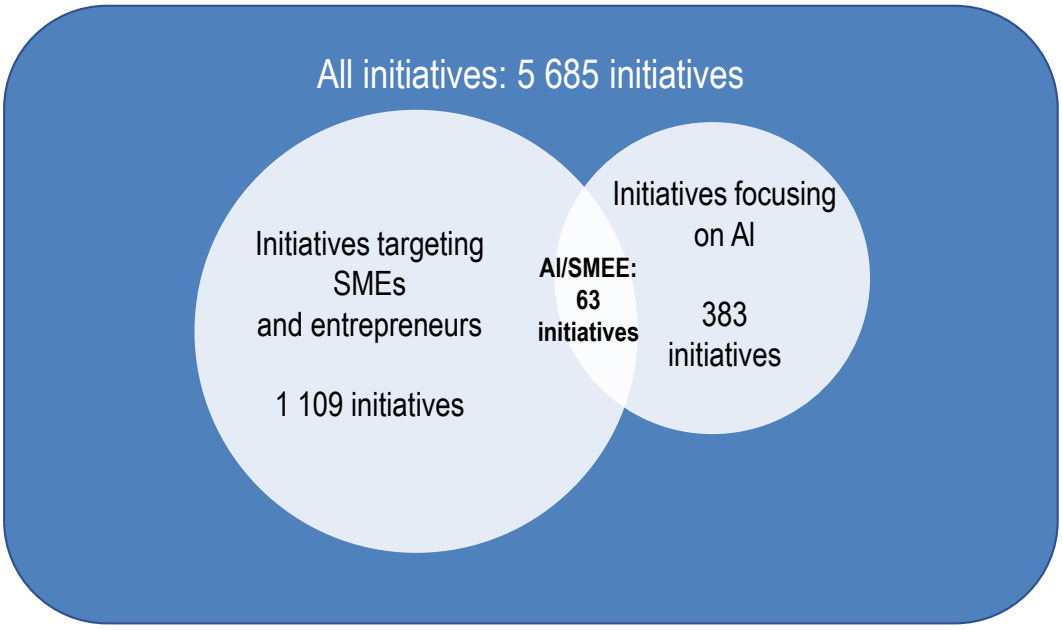
Gap and similarities between methods

Using the keywords approach yields the following results (Figure 6.3):

- **1 109 initiatives** or 39.3% of all initiatives are found to target SMEs and entrepreneurs (SMEE).
- **383 initiatives** or 6.7% of all initiatives have a particular focus on AI (AI).
- **63 initiatives** or 3.5% of all initiatives satisfy both conditions (AI/SMEE).

This is considerably more than the initiatives found using the original Compass taxonomies and consistent with prior exercises comparing the two methods of exploration (Kergroach, Meissner and Vonortas, 2017[22]; Kergroach, 2019[23]).

Figure 6.3. Number of initiatives by subgroup, using a keywords approach



Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

When comparing the subset of AI/SMEE policy initiatives as identified through the Compass taxonomies, and the subset of the same AI/SMEE policy initiatives as identified by keyword search, it appears that only 56 initiatives are common to the two methods. This means that while the two subsets overlap overall, they may be also quite different in some areas. Thus, the keyword-based selection is not a simple addition to - or subset of- the taxonomy-based selection. In essence, a number of policy initiatives that have "Artificial Intelligence" in their themes and "SMEs" or "Entrepreneurs" in their target groups make no other mention of these in the other fields. Several phenomena could explain this:

- **Misreporting**: respondents may select the wrong target groups/themes; in particular under- or over-reporting. Due to incomplete information, respondents may list too few or many target groups/themes for a given initiative.
- **Gap between policy developments and the design of the taxonomies**: some categories may become outdated, too broad or too narrow, especially in the field of emerging technologies. The keywords approach may be more flexible and make it possible to cover the full range of AI policies.

Characteristics of AI/SMEE policy initiatives

The keywords-based filtering of policy initiatives produces 63 policy initiatives (henceforth AI/SMEE initiatives) from 30 geographical entities (Annex Table 6.A.3).[5]

A quick glance at the initiatives shows strong heterogeneity between countries. The European Union and Turkey, for instance, respectively have eight and seven AI initiatives targeting SMEs and entrepreneurs, but around half of the geographical entities at hand only have one such initiative in place. There is also strong heterogeneity in policy objectives and instruments.

The subset of AI/SMEE policies includes:

- High-level national strategies on AI (e.g. *Malta's National AI Strategy*).
- Large-scale AI research programmes (*AI R&D Framework and Activities of the Israeli Innovation Authority*).
- Platforms helping SMEs to reap the benefits of digitalisation, with a focus on AI and other technologies (e.g. *Digital Catapult – United Kingdom*).

This section starts by introducing broad features of the national AI/SMEE policy initiatives in place, and then analyses them more into details along several dimensions, trying to situate them within the broader picture of national AI policy landscape:

- Target groups: What is the place given to SMEs and entrepreneurs?
- Technological focus: What complementary technologies, if any, appear alongside AI in these initiatives?
- Policy instruments: What tools do policy makers use?
- Responsible organisations: What are the institutions in charge of AI policy implementation and what do institutional arrangements say about national AI/SMEE policy?

General orientation and strategies

AI innovation and AI diffusion

Two policy approaches reflect the two faces of digital transformation, whereby SMEs *participate in* digital innovation production on the one hand, and adopt and *benefit from* digital innovation diffusion on the other hand (OECD, 2019[25]). The two approaches can be complementary as they both contribute to foster the emergence of an *AI ecosystem* from which SMEs could benefit significantly as they gain competitiveness and productivity.

These two main policy orientations shape AI/SMEE policy initiatives, when policy makers aim to:

- Foster AI development. As part of this objective, measures often provide funding for research and target innovative SMEs, start-ups, entrepreneurs, often alongside research institutions and other innovation actors. These groups are targeted as *producers* of AI solutions, and initiatives are *research, S&T and innovation policies*.
- Promote technology diffusion and the adoption of AI solutions among SMEs. These initiatives focus on increasing demand for AI services in the general SME population. In this case, SMEs and entrepreneurs are targeted as potential *adopters* of AI, and initiatives fall within the policy area of *technology diffusion*.

A stronger policy emphasis is generally placed on AI development (supply-side) than AI adoption (demand-side) in national innovation policy mixes. A first observation is that, as per the number of related measures in place, a larger number of countries are implementing supply-oriented initiatives in order to support innovative and high-growth SMEs developing AI, as opposed to supporting the adoption of AI tools among the general SME population. And it comes as no surprise that these two subsets of initiatives have different target groups, rationales and strategic objectives, and use different policy instruments.

The frame of national AI strategies

Artificial Intelligence for many governments is an emerging policy priority and national AI strategies are being devised to articulate public action in the area. National Strategies or Agendas serve as plans that develop the government's vision regarding the (in this case) contribution of AI to the

nation's social and economic development. National Strategies are a policy tool that sets priorities for public investment and policy intervention, and identifies the focal points of government legislation. They also provide a framework for co-ordinating policy action towards this shared vision. An increasing number of countries are being implemented their national AI strategy across ministries and government agencies, with different focuses on different opportunities and challenges.

Out of the forty OECD and non-OECD countries reviewed in the OECD AI Observatory, 26 countries have a national strategy dedicated to AI in place. Of the remaining, eleven countries have plans to develop such a strategy in the near future, including Austria, Hungary, Israel and Spain. Finally, three countries touch upon AI policy challenges in their national digital strategy, i.e. Australia, the Slovak Republic and Switzerland.

There are cross-country commonalities on the policy areas of intervention and policy ambitions of these strategies, e.g. the shared aim to increase the number of AI researchers and skilled graduates, strengthening national AI research capacity, and translating AI research into public and private sector applications. Countries also share a mutual goal of fostering national competitiveness in AI, with many of them aiming to be a global leader in AI development and adoption. However, national agendas also reflect differences in legal systems, economic capabilities, digital capabilities and cultures (OECD, 2019[25])

Most initiatives aim to embrace the horizontal and generic nature of AI, by actively involving multiple stakeholders from public research, industry and government institutions, having mixed public-private funding models and seeking international co-operation on AI.

The public budgetary investment on AI varies radically across countries, ranging from over USD 500 million – Japan, Korea and the United Kingdom- **to less than USD 1 million** -Australia, Estonia, Greece, Lithuania and Portugal-, also reflecting differences in financial capacity and size. Several states have not disclosed the budget for their National Strategies.

Most National AI strategies were launched in 2019 or 2020 and are short term with an end date in the next few years.

According to the OECD AI Observatory again, SMEs are rarely directly targeted by these strategies, which rather aim at national governments, firms of any size and public research institutions. Whilst firms of any size were identified to be the target group in 56 national AI strategies, SMEs were only an explicit target for 18countries.

SMEs are featured in national AI strategies to a varying extent, depending on whether those are focused on the supply-side and supporting AI invention and innovation, or the demand-side and accelerating AI innovation diffusion. SMEs are referred to in Finland, in terms of their incorporation into broader AI R&D plans.

Below are the countries where national strategies have underlined SME innovation diffusion as a priority and that assist SMEs with AI and data-driven business development as a strategic focus:

- Artificial Intelligence Mission Austria 2030 (Austria)
- National Artificial Intelligence Strategy of the Czech Republic (Czech Republic)
- Denmark's National Strategy for Artificial Intelligence (Denmark)
- Artifical Intelligence Strategy Germany (Germany)
- National Artificial Intelligence Strategy (Italy)
- Malta's National AI Strategy (Malta)
- National Strategy for Artificial Intelligence (Norway)
- Strategic Action Plan on Artificial Intelligence (Netherlands)
- National Strategy for Artificial Intelligence – AI Portugal 2030 (Portugal)
- DigitalWallonia4AI (Belgium – Wallonia – regional government)

When the national AI strategy is managed by the Ministry of Economy, there tend to be a greater policy focus on SME adoption. There is a difference among countries of what department or governmental ministry is responsible for implementing the national AI strategy. Whilst policy implementation falls under the Ministerial portfolios for science, technology and innovation in some countries, it is under that of economy or education, or administrated by the Ministry in charge of the digitalisation agenda in others. For instance, the Polish Artificial Intelligence Development Policy falls under the responsibility of the Ministry of Digitalisation

However, most national AI strategies place priority on five main themes, which reflect the barriers SMEs face in the AI transition, and suggest that the SME policy agenda is mainstreamed into the AI policy agenda: i) creating the enabling conditions to AI innovation and diffusion, such as AI research capabilities and skills development, ii) improving demand and diffusion conditions; iii) sector-approaches in related and supporting industries; iv) firm strategy, structure and competition; and v) improving the governance and co-ordination of national AI policy. Several AI strategies set specific actions to strengthen AI research capabilities reflecting the centrality of AI R&D, but many also aim to support private sector adoption of AI and develop standards for the ethical use of AI. Likewise, responsible data-access and sharing regulations, infrastructure investments, and measures to ensure that AI contribute to sustainable and inclusive growth are priorities. In fact, there is a growing focus given by governments on ethics and human rights in the context of AI (OECD, 2019[25]).

In addition, some countries such as Luxembourg and Latvia are focusing on building the framework conditions for AI diffusion among the SME sector, e.g by focusing on government adoption of AI and how this can benefit SMEs through alleviated administrative burden or improved public service delivery, or through larger plans to develop AI skills, such as Australia.

Targeted policy approaches[6]

Target populations

Similarly as for the national AI strategies, the majority of AI policy initiatives do not specifically target SMEs and entrepreneurs. The keywords method used to identify policy initiatives in the Compass database shows that of the 383 policy initiatives which mention AI and/or related keywords, only 63 (16.4%) refer to SMEs and entrepreneurs. Other target groups for AI policies may include higher education institutions, large firms, the public sector, or students, for example.

Within AI/SMEE policy, three types of policy initiatives can be distinguished: those that focus exclusively on SMEs and entrepreneurs, those that target a wide range of actors with the aim to foster agglomeration and collaboration (e.g. cluster policies), and finally those that target firms regardless of size, but have preferential conditions for SMEs. This section looks at these aspects.

On the supply-side, AI innovation initiatives often target a mix of SMEs, start-ups, entrepreneurs, and research institutions, with a focus on innovative firms and an aim to foster collaboration. Firms never innovate in isolation, and innovative firms are embedded within knowledge networks and markets, which comprise various organisations, institutions and intermediaries. Actors involved in these networks include businesses of various sizes, universities, public research institutes , governments, public administrations, individuals and non-governmental-organisations (OECD, 2013[26]). Moreover, actors of innovation exhibit high geographic concentration and interconnectedness, often forming “clusters” (Porter, 1998[27]), being through market processes or being policy-led.

Target groups include:

- **All firms, but with a specific emphasis on SMEs** and/or **start-ups** or with an aim of fostering **partnerships with large firms and research institutions**. For example, under Australia's *Cooperative Research Centers Program*, research projects must involve at least two firms (of which one must be an SME) as well as a research organisation. Canada's *Innovation Superclusters Initiative*, supports partnerships between large firms, SMEs and industry-relevant research institutions. Both initiatives contain a specific round or focus on AI innovation. For its part, the *High Performance Computer RIVR-VEGA infrastructure*, implemented in Slovenia, is accessible to researchers and to all Slovenian firms, with emphasis on SMEs.
- **Start-ups** exclusively, e.g. the *Digital Tech Fund* seed fund, launched by the Luxembourg's Ministry of the Economy and a group of private investors, supports innovative start-ups in the field of ICT, including IoT and Big Data. To be eligible, start-ups must be less than seven years old, and must preferably already have developed functional prototypes.
- **Entrepreneurs and firms regardless of size**. These include the AI R&D Framework and Activities of the Israeli Innovation Authority, International Partnerships in Sciences and Technology (Portugal) and the Brussels Region Artificial Intelligence Policy (Belgium – Brussels – regional government).
- **SMEs exclusively** in a few countries, such as *The SME Development Support Program (KOBIGEL) - Digitalisation in Manufacturing Industry* (Turkey).

Other less common target groups include students, spinoffs, and professionals. In general, initiatives aiming to foster AI innovation have a tendency to support firms rather than individuals, especially through . partnerships between public research institutions and privately-owned businesses.

By contrast, on the demand-side, AI adoption initiatives focus on the general SME population, with attention to manufacturing SMEs in particular. Concerns have been raised about technology diffusion initiatives that would target predictable early adopters, including multinationals, high-technology start-ups, and firms involved in the development of technology (OECD, 2017[3]). Instead, policy makers should make sure that these new technologies reach the SME population as whole (OECD, 2017[3]). In line with this policy recommendation, measures targeting demand for AI solutions among SMEs and entrepreneurs do tend to focus on the bulk of the SME population. Initiatives focusing on diffusion either target SMEs directly or target the private sector as a whole, with preferential conditions for SMEs. In general, several trends can be identified:

- Programmes such as *Finland Fit for Digital*, *Platform Industry 4.0* (Germany) and Italy's *Tax credit on training 4.0* aim to support digital transformation in **large and small firms alike**, but have special provisions or preferential conditions for SMEs. *Finland Fit for Digital* is a broad programme which aims to accelerate the digital transformation of firms, and focuses *inter alia* on the digital readiness of industrial SMEs. *Platform Industry 4.0* encourages all firms in Germany to gain awareness of Industry 4.0 tools, with specific emphasis on SMEs. Finally, all firms are eligible to the Italian *Tax credit on training 4.0*, but SMEs benefit from preferential rates of 50% for micro-enterprises and small firms and 40% for medium-sized firms, as opposed to 30% for large firms.
- Secondly, there is a clear emphasis on enhancing AI diffusion to **manufacturing SMEs**. The *Digital Turkey Roadmap* supports SMEs in the manufacturing industry, which face technical and financial difficulties in engaging in digital transformation. The United Kingdom's *Digital Catapult* has a sectoral focus on manufacturing and the creative industries, with specific support to SMEs in these sectors.

In addition, two initiatives foster, or plan to foster, adoption of AI tools within public sector organisations and SMEs simultaneously. This is the case of the *Support program for emerging technologies based on 5G* (*Italy*) and the *Digital Innovation Hubs* (European Union).

Focus on technology complementarity

There is often a focus given to technology complementarity in national AI policies alongside the AI technology itself, whether on the AI innovation side or on the AI diffusion side. Innovation policy often concentrates on several technologies simultaneously, recognising that transdisciplinary R&D can be highly beneficial and that new technologies can converge, creating new uses and applications. On the adoption side, different technologies often rely on the same infrastructure; for example, access to 5G infrastructure can facilitate access to AI, IoT or blockchain, enabling better connectivity and faster data transactions. For its part, blockchain can help to ensure data reliability and traceability. High-speed internet and high-performance computing are also crucial, both for AI development and for AI adoption (e.g. through cloud computing).

A striking feature of AI/SMEE policy initiatives is the emphasis given to fostering supply in a wide array of technologies. Technology convergence between different fields requires R&D to overcome traditionally mono-disciplinary arrangements (OECD, 2019[28]), and support innovation in software as well as hardware and infrastructure. This is the case for very broad-based innovation frameworks such as Luxembourg's *Digital Tech Fund*, which provides co-investment in innovative ventures in areas such as cybersecurity, FinTech, Big Data, Digital Health, media and the next-generation communication networks, digital learning, IoT or satellite telecommunications and services. Some policy initiatives jointly target two technologies at once, for instance *Financing of Artificial Intelligence and Blockchain Technologies* (European Commission). Others are centred on the opportunities offered by new networks, such as Italy's *Support Program for Emerging Technologies based on 5G*, which supports the development of IoT alongside AI and blockchain. Korea's *Smart Media Technology R&BD Support Program* supports "digital technologies including the Internet of Things (IoT), cloud technologies, big data, artificial intelligence, augmented reality, and virtual reality."

AI/SMEE diffusion policies exhibit similar characteristics, with a tendency to support the diffusion of multiple technologies, rather than focusing just on AI. This includes IoT, 5G, blockchain, photonics, synthetic biology, robotics, additive manufacturing (*Finland Fit for Digital)* immersive technologies (*Digital Catapult*), and robotics (*Digital Turkey Roadmap*).

Most AI/SMEE innovation measures aim to spur the development of AI software, often through investment in R&D. In this respect, France's *Ambition Seed Angels Fund* is an exception in that it also targets the production of (1) hardware (e.g. connected objects, robotics, etc.) and (2) new services/uses (e.g. mobile applications, platforms, collaborative models).

In addition, some subfields of AI receive special attention from policy makers, such as language technologies. Indeed, machine translation can bring significant gains to e-commerce, by reducing barriers between national markets at a lower cost. This issue is particularly acute for SMEs, which have more difficulty accessing translation services and engaging in e-commerce internationally. Language technologies are also crucial for interactive dialogue systems and personal assistants (European Commission, 2018[29]). In line with this, the *AI R&D Framework and Activities of the Israel Innovation Authority*, specifically cites the absence of commercial Hebrew-language natural language processing (NLP) tools as a reason to support the industry. Spain has a dedicated national plan (*National Plan for the Advancement of Language Technologies)*, while the Greek *Artificial Intelligence Center of Excellence* supports research in AI, with an emphasis on document intelligence.

Cybersecurity emerges as an important related topic for AI policy makers. When adopting new technologies, SMEs face a number challenges related to digital risk management. Generally, SMEs lack the know-how that is necessary to ensure digital security and data protection (see Chapter 2) and AI may bring risks of its own (see Chapter 5). In particular, SMEs which are users of AI software-as-a-service (SaaS) may face issues maintaining ownership over their data and managing related digital risks. For instance, businesses which use SaaS tend to be responsible for managing their identity and access, and

they must also protect data which is stored offline (McAfee, 2020[30]; AWS, 2020[31]). The frequent references to cybersecurity in AI/SMEE initiatives show a policy concern for making sure SMEs engage in technology adoption without becoming vulnerable to cyber-attacks or digital security risks:

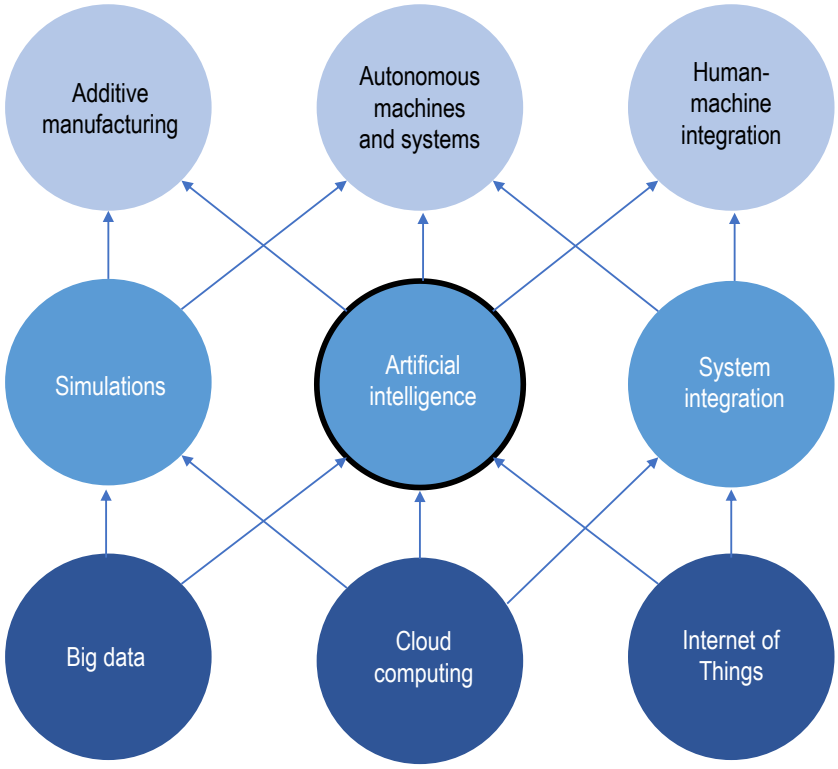
- *The SME Development Support Program (KOBIGEL) - Digitalisation in Manufacturing Industry* (Turkey). Under this programme, SMEs can apply for support in the form of grants and subsidised loans. Eligible projects include use of big data, internet of things, intelligent sensor technologies, autonomous robot technologies, AI and cybersecurity.
- *Digital Innovation Hubs* (European Union): As part of *Digital Europe Programme*, the European Commission and member states plan to invest in European Digital Innovation Hubs. In particular, emphasis will be placed on supporting uptake of cybersecurity among other themes.
- *Tax credit on training 4.0* (Italy): Firms whose staff receive training on selected themes are eligible for subsidies on labour costs. Cybersecurity is one of the theme among others: co-operative robots, additive manufacturing, augmented reality, simulation, digital integration, industrial internet, cloud, and big data/analytics.
- As part of Germany's *Platform Industry 4.0*, implicated stakeholders aim to issue recommendations of the "security of networked systems". Generally, the platform aims to increase awareness of Industry 4.0 themes among firms, with emphasis on SMEs.

Focus on the manufacturing sector and Industry 4.0

A particular field of interest for policy makers is ensuring that new AI technologies can be applied to industrial processes. The term "Industry 4.0" refers to the application of transformative digital technologies to industrial production, with a view to developing new processes or making existing processes more efficient. A variety of technologies form part of this "fourth industrial revolution", including technologies which permit autonomous and intelligent systems (AI, and in particular machine learning and data science), but also the sensors which IoT is built on and the tools related to new-age robotics (OECD, 2017[3]). AI is central to the functioning of other technologies such as additive manufacturing, autonomous machines, and human-machine integration (Figure 6.4).

The manufacturing industry is seen as one of the sectors that could benefit the most of the implementation of AI solutions, thanks to the automation of processes and enhanced predictive capacity. AI tools can help optimise operations in smart factories, improving quality and safety control, increasing capacity for just-in-time production with greater reactivity to end-use market variations and better planning capability (e.g. peaks of demand), reducing costs, e.g. regarding intermediaries or energy consumption, and reducing the delays of sourcing and delivering, improving stock and asset management through predictive maintenance, and reducing the risks of incidents and costs associated with production disruption and routine maintenance (European Commission, 2020[32]) (see Chapter 5 on AI implications on business practices).

Figure 6.4. Technology convergence and digital transformation in the industrial sector



Note: The technologies at the bottom enable those at the top.
Source: OECD (2017[3]), *The Next Production Revolution: Implications for Governments and Business*, OECD Publishing, Paris, https://doi.org/10.1787/9789264271036-en.

The industrial transition is deeply needed for restoring productivity growth and shedding the foundations of a post-COVID recovery. There are significant lags in industrial upgrading, especially among traditional manufacturing SMEs, or in low-tech sectors, which translates into lower value added and productivity levels for these segments of the business population (OECD, 2017[3]). Moreover, the gap in labour productivity growth between frontier firms and laggards is particularly acute in the manufacturing sector, where size is positively correlated with productivity (OECD, 2017[3]; Berlingieri et al., 2020[6])

The industrial transition of countries and places will largely depend on the adoption of advanced technologies by manufacturing SMEs, which in turn requires technology infrastructure, accessible data, sufficient skills, and heightened awareness of available tools (Hutschenreiter, Weber and Rammer, 2019[33]). Enabling technologies include Industry 4.0 technologies and advanced manufacturing tools (e.g. use of sensors, robotics, additive manufacturing or automation, and IoT).

There are strong links between new industrial policies and AI diffusion policies (OECD, 2016[17]) Italy's *Tax credit on training 4.0*, *Platform Industry 4.0* (Germany) and *Industry 4.0 Testlab for Australia Pilot Program* are specifically dedicated to these themes. Manufacturing and Industry 4.0 themes are also present in several national plans, including the following:

- The *National Smart Specialisation* document (Poland) sets priorities for national research, development and innovation. The "smart specialisations" that are listed as priorities include innovative industrial technologies and processes, which include sensors, networks of smart sensors, automation and robotics.

- *Tübitak Smart Manufacturing Systems Technology Roadmap* (Turkey) contains several strategic objectives for technology development, including Industry 4.0 networks, IoT software and hardware, sensors, robotics and additive manufacturing.
- The EU, in particular, has been active in helping relevant sectors transition to a new, smart industrial system which exploits digital technology, through its ICT Innovation for Manufacturing SMEs (I4MS) and Smart Anything Everywhere (SAE) programmes (European Commission, 2020[32]).

Main policy instruments in use

Two dimensions of AI/SMEE policy initiatives have been explored so far, namely their target populations and their technology or sectoral focus. Now that the "who" and the "what" are clear, it is time to turn to the "how": namely, what tools are used by governments to encourage the development and adoption of AI? This section focuses on the policy instruments used by policy makers to spur AI innovation and increase AI diffusion among SMEs and entrepreneurs.

The Compass uses a taxonomy of policy instruments, which are grouped into categories, and that relies on former theoretical and operational attempts to map and classify policy information (European Commission/OECD, 2020[8]) (see Annex Table 6.A.1). Table 6.2 shows how different types of policy instruments are mobilised in different subsets of policies initiatives.

Table 6.2. Policy instruments in use for STI policies, AI policies and AI/SMEE policies

By subset of policy initiatives

	Full Compass (except AI)	AI (except SMEE)	AI.SMEE
Governance	2 076 (36.1%)	198 (51.3%)	31 (39.7%)
Direct financial support	2 020 (35.1%)	81 (21.0%)	21 (26.9%)
Collaborative infrastructures (soft and physical)	820 (14.3%)	62 (16.1%)	15 (19.2%)
Guidance, regulation and incentives	661 (11.5%)	41 (10.6%)	9 (11.5%)
Indirect financial support	171 (3.0%)	4 (1.0%)	2 (2.6%)
Total	**5 748 (100%)**	**386 (100%)**	**63 (100%)**

Note: The three sets are disjoint, i.e. they do not overlap. The "Full Compass" group contains all policy initiatives except AI policy initiatives. Meanwhile, the AI group contains the 383 AI policy initiatives identified with keywords above, except for the 63 initiatives relevant to SMEs and entrepreneurs. Finally, the supply-side and demand-side groups contain the policy initiatives analysed in detail here. The totals shown here are superior to the total number of initiatives because initiatives listing two policy instrument categories were counted once in each category. Nonetheless, a large majority of initiatives fall under one policy instrument category (91.6% of the Full Compass except AI.SMEE, 83.7% of AI policies not targeted at SMEs and entrepreneurs, 85.7% of supply-side policies, and 77.8% of demand-side policies).
Source: Own elaboration based on policy information drawn from (European Commission/OECD, 2020[8]) and methodology from (Meissner and Kergroach, 2019[20]).

Setting the foundations of AI policy governance

In the AI policy area, the predominance of governance arrangements in the instrument mix is striking, reflecting the relative youth of this policy field. The implementation of national innovation policies, apart from those aiming to support AI innovation, tends to give an even importance to governance arrangements and direct financial support to actors, e.g. through grants, subsidies, loans and guarantees, or equity funding (Table 6.2). These two categories of instruments account for 36% and 35% of the policy portfolio respectively across countries. Past research has shown that this balance could however vary substantially across countries depending on their public research orientation, the degree of maturity of their

STI systems, their comparative advantages on international markets, or business absorptive capacities, (Kergroach, Meissner and Vonortas, 2017[22]; Kergroach, 2019[23]).

As it turns to absorptive capacity, SMEs crucially depend on accessing human capital and skills (OECD, 2019[14]). Yet SMEs face specific size-related barriers in developing and/or accessing innovation-related skills (OECD, 2019[14]; Zhou, Kautonen and Wei, 2015[34]). This is due to the fact that SMEs have a harder time dealing with information asymmetry on labour markets and identifying talent, and attracting and retaining skilled employees, partly because they often have less appealing remuneration and working conditions (OECD, 2019[14]). They may also be reluctant to invest in reskilling if they cannot ensure they can retain their employees once they have undergone training. AI is no different. While many SMEs may access AI through cloud-based software, which means that technical in-house skills may play a smaller role, efficiently using AI requires managers and day-to-day users to understand what the technology can or cannot do and to assess potentials as well as risks. This has led experts to argue that using complex AI algorithms requires non-technical skills (Luca, Kleinberg and Mullainat, 2016[35]; Beane, 2019[36]).

AI skills development is often addressed within the wider framework of the digital skills agenda, whereas relatively few AI initiatives are specifically devoted to upgrading skills. One exception is Italy's *Tax Credit on Training 4.0*, which provides subsidies on labour costs for employees that receive training on Industry 4.0 themes. In detail, 24 AI/SMEE initiatives put emphasis on skills and fall under the category of "National strategies, agendas, and plans". This includes several of the national strategies that were analysed above. Apart from national strategies, these initiatives also frequently consist of high-level digitalisation frameworks that have provisions on AI and the transformation of firms, in particular in the manufacturing sector. As shown above, these initiatives are frequently non-population targeted but cover a wide array of digital technologies. They also have a clear focus on enhancing skills, including through training and other forms of non-financial support.

- *The Digital Turkey Roadmap* aims to encourage the uptake of new technologies in the manufacturing sector, with a specific focus on AI, sensors and robotics. The levers it will mobilise to spur adoption are diverse, and include setting up data infrastructure and telecommunication services for SMEs. The programme also has a focus on skills and finance, with technical and financial aid to be offered to manufacturing SMEs that struggle with digital transformation. It also aims to launch new programmes in technical colleges and universities in order to tackle the lack of digital skills in the manufacturing sector.
- *Finland Fit for Digital Program* is a wider digitalisation framework which is to be launched during the current government's term (2019-2023), with emphasis on sustainable manufacturing and the digital readiness of industrial SMEs. It aims to modernise public support services and structures for digital transformation, including through digital innovation hubs (DIH).
- The European network of *Digital Innovation Hubs* is a network of one-stop-shops for SMEs requiring support for digitalisation. The programme, which was announced in 2016 as part of the *Digitising European Industry* initiative, places emphasis on specialisation of DIHs with respect to local/territorial needs (Rissola and Sörvik, 2018[37]). DIHs can provide test beds for technologies, advice on financing options, and networking and training opportunities. The EU's role is to provide funding and to encourage co-operation between DIHs in different regions so that beneficiaries are informed about services not provided in their regional DIH. As part of the *Digital Europe Programme*, an expansion of existing DIHs' offer is foreseen to include AI and other technologies.

AI policies towards SMEs are more likely than other AI policy initiatives to be direct financial support or collaborative infrastructure, and less likely to be governance mechanisms. Table 6.2 shows that AI policies are more often governance-oriented, e.g. including formal consultation of stakeholders or experts, national strategies, agenda and plans, or governance/co-ordination bodies and structures. Conversely, while governance arrangements remain important in the mix of AI policies towards SMEs, direct financial support – more than one-quarter of all instruments – and collaborative infrastructures

– almost 20% of all policy instruments have gained prominence. Direct financial support includes in particular grants for public research, equity financing for start-ups and innovative ventures, loans and credits for innovation, or innovation vouchers for knowledge transfer, while collaborative infrastructures include support to research infrastructure, networking and collaborative platforms, as well as information services and providing access to datasets. These different categories of policy instruments are analysed in more detail below.

More of direct financial support for SMEs

Innovation is an area where financing is potentially more difficult to find. High uncertainty about outcome and high investment costs, on the one hand, and the indivisibility of research results and the existence of externalities that increase the risk of misappropriation of innovation benefits, on the other hand, may lead to an underinvestment in knowledge production (Arrow, 1962[38]). Back in the 1960s, this market failure gave a strong rationale for public funding of R&D (Stoneman, 1987[39]). In addition to suboptimal investments, external sources of debt and equity finance are relatively more expensive for R&D and innovation than for ordinary investment (Hall, 2009[40]).

Moreover, SMEs and entrepreneurs face specific hurdles in accessing finance (OECD, 2020[41]; OECD, 2019[14]), as highlighted in the G20/OECD High-Level Principles on SME Financing (G20/OECD, 2015[42]). In particular, young firms and start-ups face strong barriers when it comes to financing investments, partly because they have more difficulty signalling quality to investors (Hall, 2009[40]). The fact that innovative and R&D-intensive SMEs rely extensively on intangible assets (e.g. software, intellectual property) creates an additional barrier, because banks and their regulatory environments often continue to require tangible assets as collateral (Brassell and Boschmans, 2019[43]). These constraints can have a negative effect on SME investment and innovation capacity (OECD, 2019[14]). In fact, recent studies have shown that there is a strong link between financial constraints and firm-level productivity, with stronger impacts in R&D-intensive and innovative sectors – such as the technology industry (Ferrando and Ruggieri, 2015[44]; Altomonte et al., 2016[45]).

Financing AI innovation is no exception. SMEs incur high sunk costs for training and maintaining AI systems. This combines with the need for investing in new business processes, skillset and complementary technologies in order to implement AI, whereas the transformation may not deliver immediate benefits, future productivity gains are difficult to anticipate, and the return on investment is difficult to assess, and therefore the investments to finance (see Chapter 5).

A large number of AI policy initiatives aim to address the financing gap with direct financial support of the supply side. Several initiatives involve or encourage private equity investments in AI start-ups. Private equity volumes invested in AI have increased steadily in past years, showing mounting interest in the technology and its commercial applications (OECD, 2018[24]). It has been estimated that AI start-ups attracted around 12% of all worldwide private equity investments in the first half of 2018, up from just 3% in 2011. However, venture capital investments in AI, as in other technological areas, are highly concentrated in the United States and in China (People's Republic of). In other countries, as the private equity market remains small relative to GDP, many governments have deployed publicly-backed equity support to innovative firms, often in the form of co-investment and funds of funds:

- *Financing of Artificial Intelligence and Blockchain Technologies* (European Union) is a call for tender aiming to develop and operate an investment support programme. This equity instrument is due to complement the *EU Artificial Intelligence and Blockchain Investment Fund*, which aims to provide equity financing to innovative SMEs, start-ups and small mid-caps in early and growth stages that develop AI and blockchain-based services and products. The investment support programme will foster investments at the national level by involving national development banks (such as Bpifrance) and incentivising private sector investments.

- Luxembourg's *Digital Tech Fund* is jointly funded by the state and by private actors, with a total budget of approximately EUR 20 million. The Fund focuses primarily on venture capital investments in start-ups active in ICT and related fields, including cybersecurity, Fintech, Big Data, Digital Health, media and the next-generation communication networks, digital learning, IoT or satellite telecommunications and services.
- *Ambition Seed Angels Fund* (France) is different in that it targets business angel investments. In practice, the fund invests in firms at the start-up stage alongside business angels, pledging up to 100% of the amount invested by the business angel (match funding).

Though, financial support is also highly relevant to technology diffusion and adoption. Empirical analysis suggests that more favourable financial conditions for SMEs is associated with higher catch-up rates for laggards in digital and skill-intensive industries, which could mean that relaxing financial constraints could increase technology adoption (OECD, 2020[41]; Berlingieri et al., 2020[6]). Direct financial support in the form of public grants and loans has shown to play an important signalling role for private investors, often facilitating recipients' access to private financiers (European Commission, 2017[46]; Hall, 2009[40]) In addition, well-developed private equity markets are positively correlated to the speed of technological diffusion (Andrews, Nicoletti and Timiliotis, 2018[7]).

Several AI diffusion initiatives offer financial support for AI adoption, in the form of indirect tax incentives (Italy's *Tax Credit on Training 4.0*) or direct subsidies :

- The EU *cascade funding*, also known as *Financial Support for Third Parties (FSTP)*, is a scheme under which SMEs are eligible for funding as third parties of existing projects, for example (*AI4EU*). It forms part of the wider Horizon 2020 framework. Open calls take place regularly, and support can take the form of direct financial support, vouchers for support services or opportunities to use testing facilities. In particular, emphasis is placed on enabling SMEs to test new technologies which are Horizon 2020 priorities, such as robotics, Industry 4.0, next-generation Internet, or advanced computing.
- The Czech Republic is developing specific support grants and investment programmes for SMEs, start-ups and spinoffs with innovative services and business models (OECD, 2020[47]).

More of collaborative infrastructure

Innovation and technology diffuse along and within a great variety of knowledge networks and markets, the diffusion channels differing according to the type of knowledge transferred, and the actors engaged in the transfer. Knowledge networks and markets encompass a set of systems, institutions, infrastructure, agreements, organisations and intermediaries (see (OECD, 2013[26]) for more elaboration).

Market and system failures prevent the proper deployment of innovation networks, providing rationale for public intervention. While a network tends to benefit all of its members, the cost of constructing and running it traditionally falls on the organisations promoting it (OECD, 2001[48]). Private benefits from running the network may not cover the private costs some members have to incur for this, even though there are high social benefits (OECD, 2001[48]). In addition, systemic failures may arise from mismatches between different actors in the system (OECD, 1999[49]), e.g. due to weak links or lack of networking facilities. This is why knowledge networks which are essential for knowledge production are partially based on formal policy-led, linkages (OECD, 2013[26])

Infrastructure, including soft infrastructure without physical premises, particularly matter for co-operation and accessing these networks, and the knowledge and partners they gather. The Compass groups under the category of "collaborative infrastructure" policy initiatives dedicated to support research infrastructure, networking and collaborative platforms and the provision of information services and access to datasets. Around 20% of AI/SMEE policy instruments fall under this category. Several types

of “hard” and “soft” collaborative infrastructure have been set up, both for AI innovation and AI diffusion (see Table 6.3).

Table 6.3. Types of collaborative infrastructure for AI innovation and diffusion

Type of collaborative infrastructure	Country examples
High-level networks and AI coalitions	AI Coalition of the Netherlands, AI4EU (European Commission), AI Forum (New Zealand), European Open Science Cloud (European Commission)
Cluster policies and AI research partnerships	Innovation Superclusters Initiative (Canada), Artificial Intelligence Center of Excellence (Greece), Artificial Intelligence and Intelligent Systems National Laboratory (Italy), International Partnerships in Science and Technology (Portugal), Co-Location Sites (Sweden),
Transfer offices and test beds	Digital Catapult (United Kingdom), Platform Industry 4.0 (Germany), Industry 4.0 Testlab for Australia Pilot Program.

Source: Based on policy information drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

High-level AI coalitions or networks have been established, including for example the *AI Coalition of the Netherlands.* This network of more than 65 parties is a large public-private partnership including large firms and SMEs, and supporting AI innovation in the Netherlands. It aims *inter alia* to test several AI applications, to promote ethical guidelines for AI development, and to increase data sharing. *AI4EU*, for its part, combines hard and soft infrastructure. It offers an on-demand AI platform with AI tools and computing power available to SMEs and entrepreneurs, but also an ecosystem that favours collaboration between different stakeholders (scientists, entrepreneurs, SMEs, industries, funding organisations and citizens). The *European Open Science Cloud* aims to integrate existing data and high-performance computing networks, with the aim to spur R&D and innovation based on data, especially among start-ups and SMEs.

Other collaborative infrastructure are specifically focused on AI innovation and aim to increase formal linkages between actors. These include various forms of cluster policies, international research partnerships, national research centres and Centres of Excellence, and co-creation platforms. The latter initiatives specifically aims to support technology transfer from research to entrepreneurship.

- Various forms of cluster policies. Canada has invested CAD 950 million in five regional Innovation Superclusters, one of which focuses on accelerating the application of AI for supply chains (SCALE.AI). The *Innovation Superclusters Initiative* invites industry-led consortia to invest in regional innovation ecosystems and supports partnerships between large firms, SMEs and industry-relevant research institutions (OECD, 2020[47]). Germany’s AI Strategy includes support for SMEs and start-ups through regional AI clusters that foster science-industry collaboration.
- International research partnerships (e.g. Portugal’s *International Partnerships in Science and Technology*) and
- National research centres and Centres of Excellence such as the *Artificial Intelligence and Intelligent Systems National Laboratory* (Italy), or *AI trainers in Mittelstand 4.0 Excellence Centres* (Germany).
- Co-creation platforms: Denmark’s *National AI Strategy* plans a digital hub for public-private partnerships on AI. Portugal has established *Digital Innovation Hubs* on production technologies, manufacturing and agriculture, as well as collaborative laboratories (CoLabs). The United Arab Emirates’ *Dubai Future Accelerators* facilitate collaboration between government entities, private sector organisations and start-ups, scale-ups and innovative SMEs to co-create solutions to global challenges.

Finally, some AI/SMEE initiatives offer places and resources to specifically increase awareness and uptake among SMEs or provide controlled environments for the testing and experimentation of AI systems by SMEs (Lithuania, New Zealand, United Arab Emirates, United Kingdom, United States) (OECD, 2020[47]).

- The *Industry 4.0 Testlab for Australia Pilot Programme* funds six testlabs in Australian universities. The testlabs provide opportunities for SMEs to learn about Industry 4.0 applications and digitalisation in the manufacturing sector and have been shaped by close collaboration between Australia and Germany on Industry 4.0 issues (Prime Minister's Industry 4.0 Taskforce, Swinburne University of Technology, 2017[50]).
- Finland's AI accelerator, initiated by the Ministry of Economy and Employment with Finland's association of technology, aims to spur AI use in SMEs.
- Germany's *Platform Industry 4.0* brings together different Industry 4.0 stakeholders, aims to develop common recommendations and raise awareness of new tools among SMEs. A Transfer Network was established in 2017 to help the diffusion of Industry 4.0 applications.
- Hungary has established the *AI in practice* self-service online platform, where developers can showcase technologies and local case studies to foster collaboration and awareness.
- Korea's *AI Open Innovation Hub* provides SMEs and start-ups with data, algorithms and high-performance computing resources to allow them to innovate with AI.
- The UK's *Digital Catapult*, for instance, acts as an interface between the digital sector (producers) and the wider UK economy (potential adopters).
- The European Commission's AI4EU project is an AI-on-demand platform that aims to help EU SMEs adopt AI.
- The United Arab Emirates' *Dubai AI lab*, a partnership between different parts of government, IBM and other partners, provides essential tools and go-to-market support to implement AI services and applications in different areas.

Responsible institutions: networks and clusters of policy initiatives

Innovation policy arrangements have become increasingly complex, interweaving a growing number of institutions across multiple policy domains, and raising the issue of co-ordination. Given that innovation is a cross-cutting theme and that a wide array of actors are involved in knowledge transfers, innovation policy competences tend to be distributed across a high number of organisations and policy areas, including economic affairs, tax, science, education, immigration and enterprise (Edler and Fagerberg, 2017[51]; OECD, 2015[16]). Innovation is also characterised by multiple levels of governance: subnational and supranational levels of STI policy making have gained importance with globalisation on the one hand, and with regionalisation and decentralisation on the other (OECD, 2015[16]). As public intervention spreads across ministries, departments, agencies, dedicated organisations, regions and international bodies, issues of co-ordination may arise (e.g. inconsistency or redundancies), creating the potential for inefficient spending, lower quality of service, and contradictory objectives (OECD, 2015[16]). While policy co-ordination and integration is one of the oldest challenges for governments, there is evidence that the proliferation of independent or quasi-independent agencies may have exacerbated this issue (Peters, 2018[52]). For instance, research in the field of AI has existed for several decades, but the holistic focus on AI as a general-purpose technology is relatively recent, as shown by the proliferation of national strategies on AI in recent years (see chapter 6 on AI and SMEs, and (Paunov, Planes-Satorra and Ravelli, 2019[53])).

Several solutions to address a lack of policy co-ordination exist, including effective policy monitoring and evaluation, ensuring policy co-ordination via the centre of government (CoG) (OECD, 2019[54])**, or setting up dedicated co-ordination mechanisms.** Generally, different forms of

consultation and dialogue are often highly effective in ensuring policy coherence (OECD, 2015[16]). In some cases, similar or identical instruments across different levels of governance (e.g. identical R&D funding at federal and regional level) may actually not be redundant, as they may have different target groups, territorial scopes, or approaches (OECD, 2015[16]). National strategies, plans and roadmaps also play a role in co-ordinating policy action. In the field of AI, a number of overarching federal/national instruments have been put in place, such as national strategies (e.g. *Malta's National AI Strategy*) and "AI coalitions" (e.g. the *AI Coalition of the Netherlands*).

The distribution of AI policy responsibilities and action across policy areas and levels of governance is likely to be even higher than for innovation policy generally. Based on the policy information provided in the Compass, on average, countries for which data is available have approximately six AI policy initiatives in place, with five organisations steering AI policy in the country (European Commission/OECD, 2020[8]). The following areas of co-ordination can be distinguished:

- Co-ordination within the AI policy domain,
  - Along the AI policy making process, from policy design, to implementation to monitoring and evaluation.
  - Between policy initiatives targeting SMEs and entrepreneurs (AI/SMEE), and generic AI policies.
  - Between innovation policies and technology diffusion policies.
- Co-ordination across policy domains, between AI.SMEE policies and finance, tax, skills or even other innovation policies.
- Co-ordination at supranational level of AI/SMEE policies, where applicable (e.g. at EU level).
- Co-ordination between subnational policy initiatives (e.g. regional industrial strategies) and national policy initiatives.

Fine-grained evaluation of policy co-ordination would involve detailed policy mappings by country, looking not only at institutional arrangements but also at co-ordination mechanisms and policy practices at the micro-level. Given the recent implementation of most initiatives under study here and the information contained in the Compass, this task is difficult to undertake. However, it is possible to analyse which organisations are responsible for which initiatives, and how AI/SMEE policy initiatives are calibrated within the broader AI policy mix. This is the objective of this section. Emphasis in this research work is placed on co-ordination between AI/SMEE policy initiatives and generic AI policies. It should be stressed that institutional arrangements for STI policy are highly idiosyncratic and context-specific, and that there is no "one-size-fits-all" arrangement (OECD, 2010[55]).

The following research questions are treated in this section:

- Which types of organisations are responsible for AI/SMEE policy initiatives?
- Where applicable, which government portfolios are in charge of AI/SMEE policy initiatives?
- How are AI/SMEE policy initiatives calibrated within broader AI policy mixes?
- Are AI innovation initiatives implemented by the same organisations as AI diffusion initiatives?

Six country cases (see following sub-section) specifically focus on the institutional arrangements in Australia, France, Germany, Korea, the Netherlands and the United States, in order to evaluate the centrality of AI/SMEE policy initiatives in the national STI policy mixes.

General observations

A variety of organisations are traditionally responsible for administrating STI policy intervention, sometimes jointly. The different types of organisations involved are listed in Table 6.4. This includes ministries/departments, agencies, research centres or organisations and dedicated organisations.

Organisations may be jointly responsible for policy initiatives, for example, the *High Performance Computer RIVR-VEGA infrastructure* (Slovenia) is jointly steered by the Institute of Information Science, the Academic and Research Network of Slovenia and the University of Maribor.

AI policy initiatives are slightly more likely to be jointly steered. Information on the type of responsible organisation(s) is not present in the Compass, but organisations responsible for AI/SMEE policy initiatives are classified "manually". For the larger subset of AI policy initiatives and the full Compass, a keywords search is conducted on the names of responsible organisation(s), using "minister", "ministry", "department", "state secretariat" and "secretary of state" as keywords. This approximation is likely to miss a few ministries/departments (e.g. Innovation, Science and Economic Development Canada), but it provides a rough estimate. On average, 22.4% of all AI policy initiatives are steered by more than one organisation as compared to 18.7% for other policy initiatives. This raises the particular importance of co-ordination in the field.

Table 6.4. Types of organisations in charge of AI policy initiatives

Responsible organisation	Description	Country examples
General executive	The government or the executive branch.	United Kingdom government
Ministry/department	An organisation which forms part of the core of the executive branch, and is responsible for a policy area or sector. This includes federal ministries (Germany), departments (Australia, United Kingdom), and secretaries of state.	Ministry of Science and ICT (Korea)
Other public organisation	This category mainly comprises various public or semi-public agencies, with varying levels of independence from the government.	Foundation for Science and Technology (Portugal)
Research centre/organisation	Publicly or partly publicly funded organisations that conduct research.	National Center for Scientific Research Demokritos (Greece)
Dedicated organisation	An organisation specifically set up to design and/or implement AI policy. This can be a component of a larger agency.	Task Force on AI of the Agency for Digital Italy
Other	Any other responsible organisation, such as public investment banks or higher education institutions.	Bpifrance

Source: Own elaboration, based on policy information drawn from OECD (2020[56]), A to Z of Public Governance Terms, http://www.oecd.org/gov/a-to-z-public-governance.htm (accessed on 01 December 2020); and national documentation.

AI/SMEE policy initiatives tend to be administrated directly by ministries, especially those targeting SMEs and entrepreneurs. This also reflects the high number of guiding documents and governance arrangements in the policy mix. More than half of the organisations responsible for AI/SMEE measures are ministries. In addition, AI policies that target SMEs and entrepreneurs are slightly more likely to be implemented by ministries than other AI policies. Nevertheless, other institutional arrangements are also common.

AI/SMEE policies often fall under the aegis of institutions in charge of STI and industry policy, less often under those in charge of economic development. Two main groups of government portfolios are usually in charge of AI/SMEE policy initiatives. The first is focused on STI and industry themes, including, in some countries, transport and digital infrastructure (e.g. Innovation, Science and Economic Development Canada), while the second on broadly focused on economic affairs, business, and economic development (e.g. the Ministry of the Economy in Luxembourg). Table 6.5 lists different portfolio types. The most common portfolio type for AI/SMEE policy initiatives is STI and industry, which signals the interest.

The integration of AI/SMEE initiatives in industrial policies signals both the potential of the technology for an industrial renewal and the lack of transferability of AI solutions across different environments. Australia's *Industry 4.0 Testlab for Australia Pilot Program*, for instance, is implemented

by the Department of Industry, Innovation and Science. Poland's Ministry of Entrepreneurship and Technology is responsible for the country's *National Smart Specialisation* initiative, while Turkey's Ministry of Industry and Technology is responsible for several initiatives, such as the *Digital Turkey Roadmap* and *Tübitak's RDI support in AI*. New industrial policies, which term emerged in the 2000s, aim to support technologies upstream (at the R&D stage), and reinforce networks and specialisation through cluster approaches, as opposed to former models that have been widely criticised as interventionist measures ultimately leading to "picking winners" (OECD, 2016[17]).

Other ministerial arrangements also exist.

- **In EU countries, AI/SMEE initiatives are often implemented by ministries in charge of economic affairs**. This is the case of Luxembourg's *Digital Tech Fund* (Ministry of the Economy), for example. Economic affairs portfolios are often jointly responsible for high-level initiatives such as Germany's *Platform Industry 4.0*, the *Artificial Intelligence Mission Austria 2030* or the *Strategic Action Plan on Artificial Intelligence*.
- **In some cases, there is overlap between the two policy areas (STI/industry and economic affairs)**, as in the case of Denmark's Ministry of Industry, Business And Financial Affairs, which is responsible for *SME: DIGITAL* and for the *National Strategy for Artificial Intelligence*.
- **Other government bodies have a lesser role to play, but ministries in charge of higher education and research are sometimes in charge,** such as Italy's *Artificial Intelligence and Intelligent Systems National Laboratory* (Ministry of Education Universities And Research).

Table 6.5. Types of ministries in charge of AI policy initiatives

Type	Example
Industry, energy, innovation, technology, transport, digital infrastructure	Innovation Science and Economic Development Canada
Economic affairs, economic development, business, finance, budget	Ministry of the Economy (Luxembourg)
Education, universities, research, culture, sport, media	Ministry of Education (Turkey)

Note: This typology is not standard in the literature. However, it corresponds to the types of ministries in charge of the policies analysed here.

Other common responsible organisations are public or semi-public organisations, most often agencies. These agencies can take various forms and accordingly they have different levels of autonomy from central governments (OECD, 2010[57]): Agencies within ministries, separate agencies subject to ministry control, autonomous government agencies, or public-private partnerships. **Agencies in charge of AI/SMEE policy initiatives are innovation authorities and research councils.** Examples include Canada's Treasury Board Secretariat, Israel's Innovation Authority, or Portugal's Foundation for Science and Technology (see Table 6.6). The latter organisation is an exception in that it is SME-specific.

Table 6.6. Examples of agencies in charge of AI/SMEE policy initiatives

Country	Responsible organisation(s)	English name
Canada	Treasury Board Secretariat	AI Source List
France	High Commissioner for Investment	Investments for the Future Programme (PIA)
Israel	Israel Innovation Authority	AI R&D Framework and Activities of the Israeli Innovation Authority
Malta	Malta Council for Science and Technology	Smart Specialisation Strategy As Part of the National R&I Strategy 2020
Poland	National Centre for Research and Development	Poland-Taiwan Scientific Co-operation
Turkey	Scientific and Technological Research Council of Turkey	Tubitak'S RDI Support in AI, Digital Turkey Roadmap
Turkey	Small and Medium Enterprises Development Organisation	The SME Development Support Program (Kobigel) - Digitalisation in Manufacturing Industry

Source: Own elaboration based on policy information drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

A small minority of policy initiatives depend on AI dedicated organisations, like AI Innovation Sweden (responsible for the *Co-location Sites* initiatives) or the Netherlands' NL AI Coalition.

Finally, national digital transformation frameworks and national strategies are often steered by the executive branch directly, unlike most AI/SMEE initiatives.

Agencies and ministries tend to be in charge of a comparable number of AI initiatives: ministries in charge of AI/SMEE initiatives are in charge of two other AI initiatives on average, while agencies in charge of AI/SMEE initiatives are in charge of 1.6 other AI initiatives on average.

Due to their recent implementation, few AI initiatives have been evaluated so far. 9.14% of all AI initiatives as reported in the Compass are being or having been evaluated. By contrast, a slightly larger proportion of all innovation initiatives are evaluated (16.45%). AI initiatives are more recent on average, with a mean start year of 2016, as against a mean start year of 2010 for the full set of initiatives reported in the Compass. However, the AI/SMEE initiatives are more likely to be evaluated than other AI initiatives (12.70%). Policy evaluation can play a strong role in ensuring good co-ordination between various policy instruments.

National AI policy governance structure: Selected country cases

National innovation policy systems consist of institutions responsible for policy design and implementation, forming networks of organisations collaborating on innovation and AI-specific policy development. Different forms of co-ordination could exist between these institutions.

Due to the horizontal and generic nature of AI, policy developments in the area will imply enhanced efforts to improve policy co-ordination and coherence across government levels and domain-specific measures. Co-ordination relies upon a mix of hierarchical, market and network-based interactions (OECD, 2012[58]). It has both vertical and horizontal aspects, the former referring to co-ordination between a ministry and its delivery agencies, and the latter covering inter-ministry relations. Instruments of co-ordination can be based on regulation, incentives, norms and information, with different degrees of formalisation. They can be top-down and rely upon the authority of a lead actor, or bottom-up and emergent. Governance arrangements contributing to the co-ordination of innovation policy include roadmaps and guiding documents, inter-agency programming, policy evaluation, job circulation of civil servants, inter-ministerial councils or even informal channels of communication, etc.

This exploratory work more specifically examines the existence of co-ordination mechanisms through joint programming between agencies and ministries. From the Compass dataset, networks of national innovation governance arrangements have been constructed for a selection of countries. The visualised networks show how different types of organisations are linked to each other, and identify the locus of the national innovation landscape. Each organisation responsible for STI policy is represented by a node, while the edge connecting the two nodes reflect the collaboration between a pair of organisations by the means of sharing the same policy initiative. The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The graphs are force-directed – an algorithm to define how the nodes are laid out - to make it more legible (Kamada and Kawai, 1989[59]).

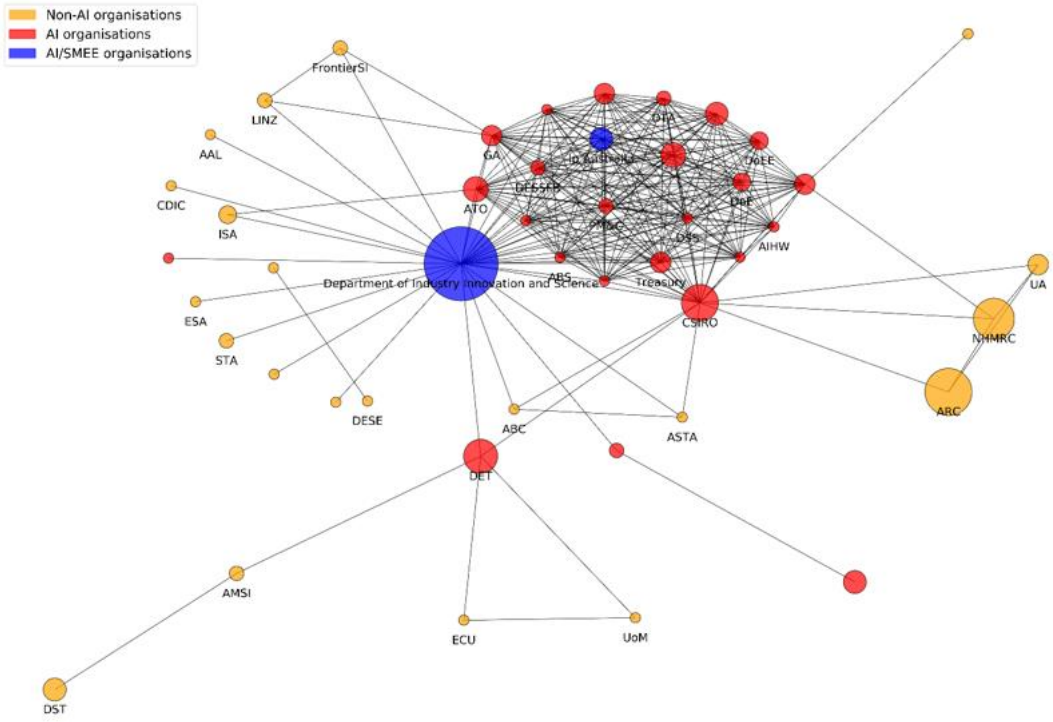
The result shows that countries usually have one or two clusters of organisations taking care of national innovation policies. The majority of countries have centralised network around one large organisation (usually at a ministerial level) such as France, Korea, Israel, while a number of countries have two sizeable loci such as Austria, Germany, or the Netherlands, and some countries have decentralised, distributed networks with each organisation linking directly to many different partners in the clusters such as the Australia, Canada and the United States.

However, very large country differences emerge from this network analysis. Australia, France and The United States lead as countries with the largest number of organisations issuing AI policies, while the Netherlands have four ministries targeting SMEE as the centre of their innovation policies. The detailed analyses of a sample of six countries' innovation networks are presented below.

Australia

The governance arrangements of Australia seems to indicate a broad engagement of innovation policy institutions in the AI policy agenda. The Department of Industry, Innovation and Science plays a central role in the country's policy innovation networks, administrating the largest number of AI initiatives in the country, while covering SMEE as its strategic target (Figure 6.5). The Department is a part of a large, dense cluster of organisations linking strongly on AI policy development, including Ip Australia (an agency within the Department), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Treasury, the Australian Tax Office (ATO), Geoscience Australia (GA), the Digital Transformation Agency (DTA), the Department of Environment and Energy (DoEE), the Department of the Prime Minister and Cabinet (PM&C), the Department of Social Services (DSS), the Department of Education, Skills and Employment (DOE). The majority of organisations in the network are AI related, with non-AI organisations at the peripheral of the central cluster.

Figure 6.5. Network of organisations responsible for innovation and AI policy in Australia



Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations are coloured orange.
Source: Own elaboration based on raw data drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

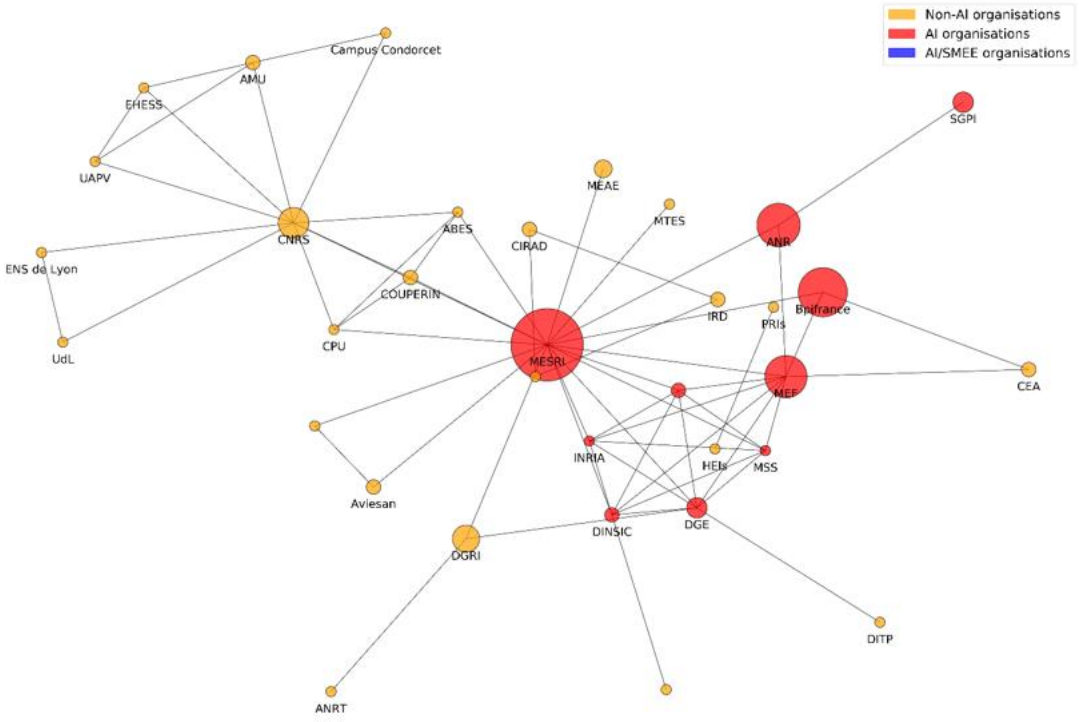
France

France has a high number of organisations involved in AI policy design and implementation and the Ministry of Higher Education, Research and Innovation (MESRI) is at the centre of the governance network, connecting to a cluster of AI policy organisations, including the Ministry of Economy and Finance (MEF), the French National Research Agency (ANR), the General Secretariat for Investment (SGPI), the French Institute for Research in Computer Science and Automation (Inria), the General Directorate of Enterprises (DGE), and Bpifrance (Figure 6.6). Besides, the French National Centre for

Scientific Research (CNRS) is the locus connecting the AI-policy cluster to universities, but the institution itself does not run any AI-related programme.

None of the French institutions involved in the AI innovation policy landscape have SMEs identified as a specific target for public intervention.

Figure 6.6. Network of organisations responsible for innovation and AI policy in France



Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations are coloured orange.
Source: Own elaboration based on raw data drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

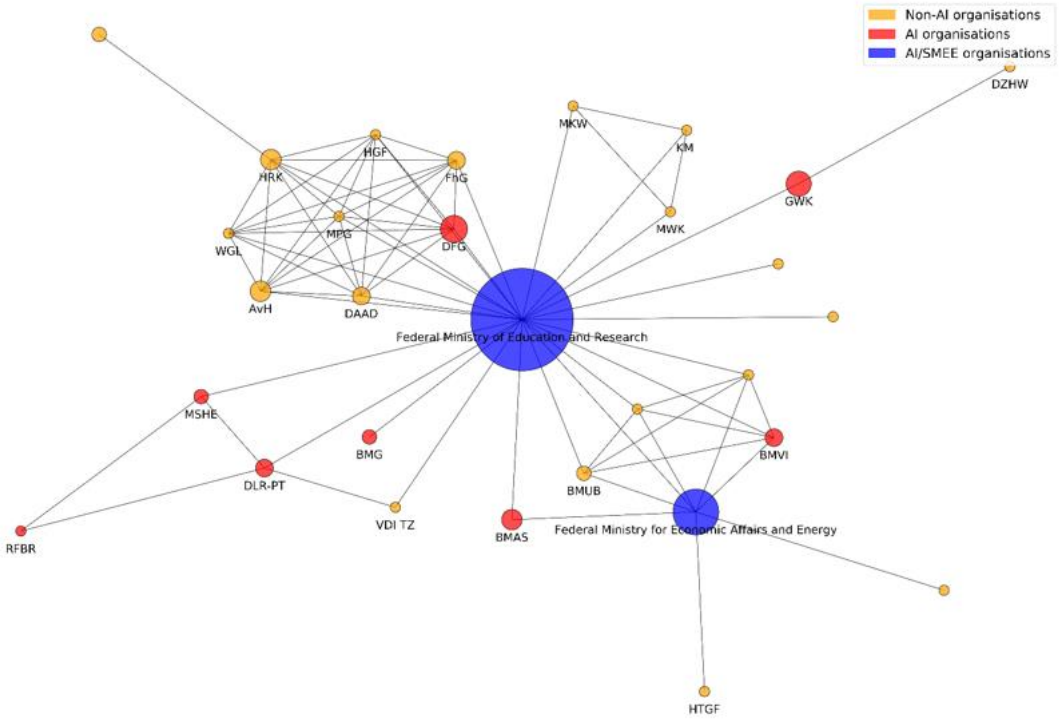
Germany

In Germany, three organisations are responsible for more than 70% of AI policy initiatives (Figure 6.7). The Federal Ministry of Education and Research (BMBF), and to a lesser extent, the Federal Ministry for Economic Affairs and Energy (BMWi), play central roles in STI policy making, also observed by Sofka, Shehu and Hristov (2018[60]). The Federal Ministry of Education and Research is responsible (sometimes jointly) for half of the 20 AI initiatives reported by Germany, while the Federal Ministry of Economic Affairs and Energy is involved in one-fifth of them. The Federal Ministry of Labour and Social Affairs (BMAS) also shares competences in the field, reflecting the strong impact AI will have on the world of work and society. BMAS for instance is jointly responsible with BMBF and BMWi for the development of the *National AI Strategy* and runs the *German AI Observatory*. Not included in the STIP Compass but worth noting, BMAS operates the *Hubs for tomorrow AI* ("Zukunftszentren") programme that supports SMEs and their employees in introducing AI-based systems in a participatory and co-creative manner.

There are other organisations engaged in AI policy making, i.e. agencies, ministries and associations, such as the Federal Ministry for Transport and Digital Infrastructure (BMWi), the DLR

Project Management Agency (DLR-PT), the National Academy of Technology Germany, the Federal Ministry of Health (BMG), or the German Research Foundation (DFG). These organisations have links with both the Federal Ministry of Education and Research and with the Federal Ministry for Economic Affairs and Energy, with which they are often jointly responsible for AI policy initiatives. This could increase the horizontal co-ordination between AI initiatives in Germany. *Platform Industry 4.0*, which aims to co-ordinate and support SMEs' transition to Industry 4.0, is jointly steered by the Federal Ministry of Education and Research and the Federal Ministry for Economic Affairs and Energy, which makes it central in the national STI policy mix.

Figure 6.7. Network of organisations responsible for innovation and AI policy in Germany



Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations are coloured orange.

Source: Own elaboration based on raw data drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Korea

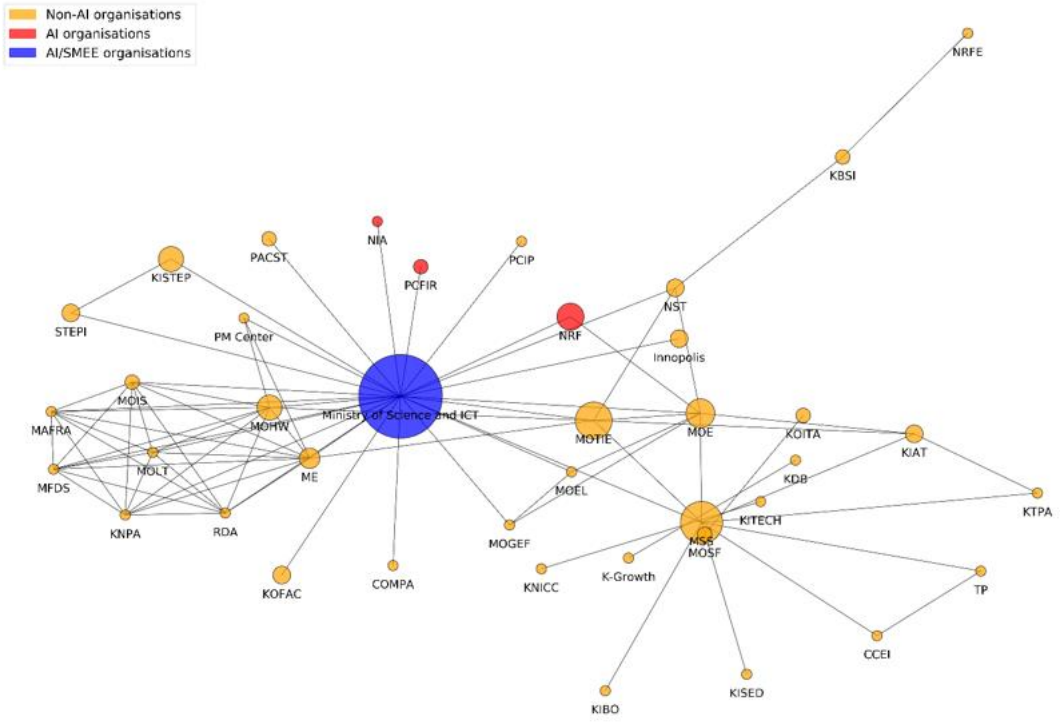
Korea's innovation and AI policies network is highly centralised, with four of the seven AI policy initiatives identified with the keywords methodology steered by the Ministry of Science and ICT (Figure 6.8). Despite having a large network of organisations responsible for innovation policy, only three organisations have AI initiatives in place and they are all linked to the Ministry of Science and ICT, which are the Presidential Committee on the Fourth Industrial Revolution (PCFIR) with the *Plan to Respond to the Fourth Industrial Revolution for Innovative Growth* initiative, the National Information Society Agency (NIA) with *Ethics Guidelines for Intelligent Information Society*, and the National Research Foundation (NRF) with *Brain Pool Program*. In total, the Ministry is responsible or jointly responsible for almost all of the policy initiatives reported in the Compass by Korea, and collaborates with 25 other organisations in the implementation of STI policy initiatives. The Ministry also has initiatives specifically targeting SMEE, which

is the *Smart Media Technology R&D Support Program*, which supports SME R&D in the field of advanced digital technologies (IoT, cloud technologies, big data, artificial intelligence, augmented reality, and virtual reality).

Another important actor in the Korean national innovation system is the newly-created Ministry of SMEs and Startups (MSS) in 2017.

The centralised institutional arrangements for governing AI policy in Korea could help minimise potential issues of vertical co-ordination. In addition to this, AI policy targeted at SMEs falls under the STI portfolio in Korea, rather than the SMEs and Startups. This is liable to increase co-ordination between various AI policy instruments, including between AI innovation instruments and AI adoption instruments.

Figure 6.8. Network of organisations responsible for innovation and AI policy in Korea

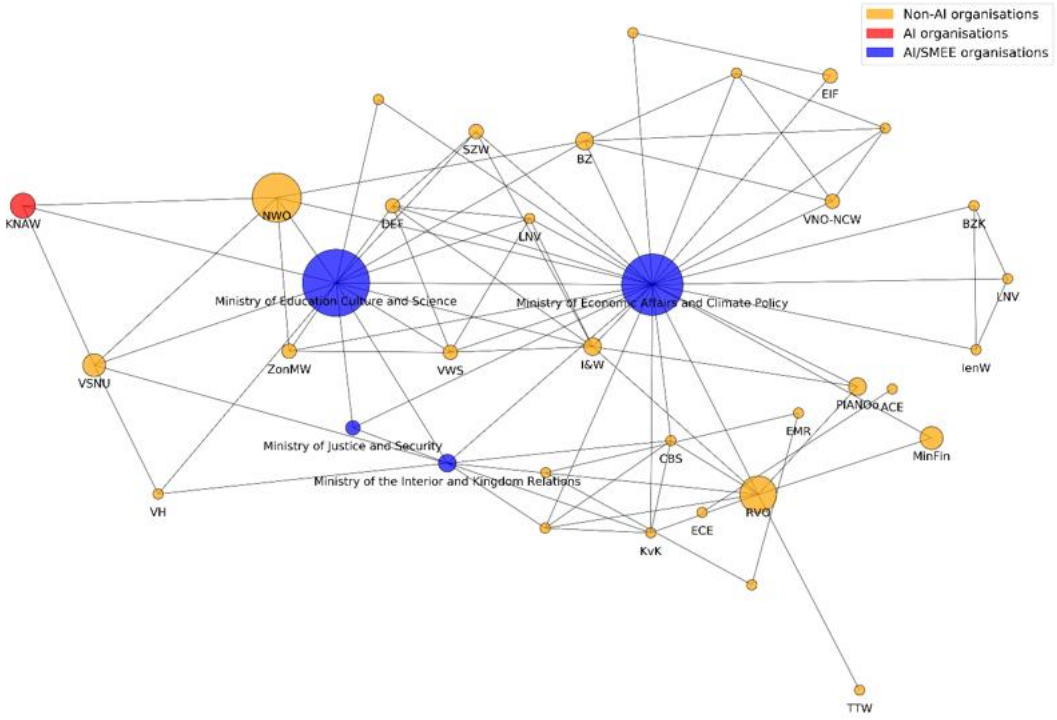


Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations responsible for innovation policy are coloured orange.
Source: Own elaboration based on raw data drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

The Netherlands

The Netherlands' overall innovation policy framework is made of the largest number of organisations targeting SMEE, among all countries in the dataset, which are the Ministry of Education, Culture and Science, the Ministry of Economic Affairs and Climate Policy, the Ministry of Justice and Security, and the Ministry of the Interior and Kingdom Relations (Figure 6.9). The first two organisations are also the two loci identified as responsible for the largest numbers of AI/SMEE policy initiatives implemented in the country, athough the analysis relies on few initiatives.

Figure 6.9. Network of organisations responsible for innovation and AI policy in the Netherlands



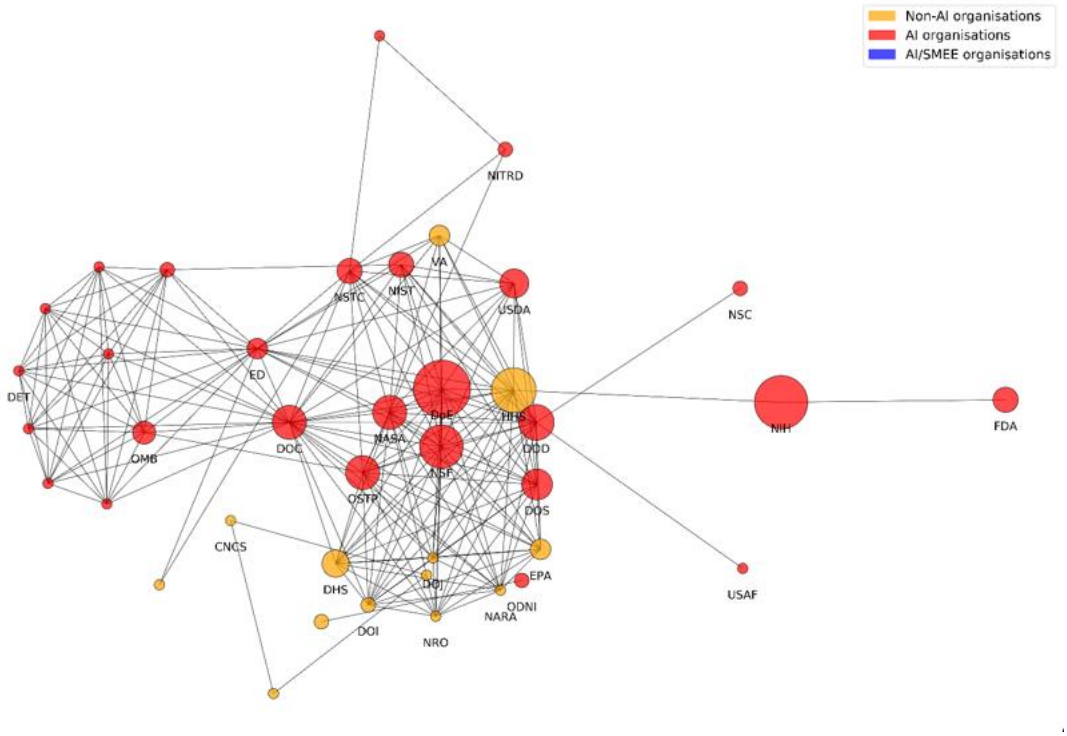
Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations are coloured orange.
Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

The United States

The United States' innovation policy landscape is rather decentralised, with influential organisations spanned across different sectors. The United States has the highest number of AI policy institutions among innovation-responsible organisations (Figure 6.10). U.S. policy emphasises collaboration between federal agencies, academia, the private sector, and non-profits to foster an innovation ecosystem that can in turn be responsive to SME diverse needs.

Most US institutions have intensive network connections through the joint administration of initiatives. Through these connections, they form two major clusters. The larger cluster centred around the Department of Energy (DOE), the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), Office of Science and Technology Policy (OSTP), the Department of Defense (DOD), and the Department of State (DOS). The other, smaller, cluster is connected to the larger cluster by mainly two organisations, the Department of Commerce (DOC) and the Department of Education (ED). In addition to these, the Small Business Administration administers the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programmes, which encourage small businesses to partner with Federal agencies on R&D with the potential for commercialisation. The NSF has identified AI as a priority for its SBIR/STTR portfolios.

Figure 6.10. Network of organisations responsible for innovation and AI policy in the United States



Note: The size of the nodes is proportional to the number of policy initiatives for which it is responsible. The organisations responsible for an AI/SMEE policy initiative are represented in blue. Organisations responsible for non-SMEE AI organisations are represented in red. All other organisations are coloured orange.
Source: Own elaboration based on raw data drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Conclusion

AI adoption can have many benefits for SMEs, including giving them new innovation opportunities and helping them increase cost efficiency and productivity gains, thanks to enhanced automation and predictive capacity (CFE/SME92020)15/CHAP7). AI is also poised to transform SME business environment and create room for more efficient public administration, more secure digital infrastructure, better access to finance or to skills, etc.

However, SMEs lag in implementing AI solutions and face a number of barriers in catching up in the transition. A literature review has helped identify several points of interest to policy makers aiming to ensure SMEs can benefit from the AI-driven digitalisation: i) achieving a minimum SME data readiness; ii) reskilling managers and workers in order to adapt business practices and guide AI models; iii) bridging the financing gap; iv) ensuring SME access to well-functioning knowledge markets where they can find cloud-based AI solutions to circumvent their capacity limitations; v) developing a sector- or industry-specific approach in the AI policy agenda to account for the lack of transferability of AI models; and vi) Fostering mutual learning and knowledge sharing among a broad range of stakeholders.

Using an exploratory keywords-based method to navigate the EC/OECD STIP Compass, a large international repository on national innovation policies, this chapter identified a subset of policy initiatives with a focus on AI and which target SMEs and/or entrepreneurs. These AI/SMEE initiatives were analysed along several dimensions, replacing them within the broader context of national innovation policy mixes. The main findings are reported in Table 6.7.

Table 6.7. Main characteristics of national AI/SMEE policy mix

Directionality	Rather supply-side oriented (technology push) than demand-side oriented (market-pull)
Legacy	Youth of the policy domain, reflected by the recent implementation of first national AI strategies in many countries
Target populations	Some initiatives targeted towards SMEs, entrepreneurs, start-ups, but also research institutions and higher education institutions. Some initiatives that are not targeted to SMEs but that aim to address the barriers identified, suggesting the SME policy agenda is mainstreamed into the AI policy agenda.
Sector targeted	Frequent focus on the manufacturing sector and Industry 4.0, incl. manufacturing SMEs
Technology complementarity	
- Targeting associated technologies (common)	IoT, 5G, blockchain, cloud computing, big data, augmented reality, robotics, Industry 4.0, cybersecurity
- Targeting associated technologies (specific)	AI-related hardware, language technologies, additive manufacturing
Main policy instruments	A majority of governance instruments (formal consultation of stakeholders or experts, national strategies and plans, or governance/co-ordination bodies and structures) More of direct financial support than other AI policies, More of collaborative infrastructure than other AI policies
Responsible organisations	Large variety of institutions in charge, often co-ordinating action through joint programming. Ministries (more often STI/industry portfolios, then economic affairs), agencies, general executive branch (governments) Frequent integration of AI/SMEE initiatives into industrial policies.
Policy areas	STI, industry, economic affairs, SME support
Networks and clusters of governance institutions	Great variety of configurations, from rather centralised AI policy system (Korea) to decentralised approach (US), from strong SME targeting (the Netherlands) to more mainstreaming (France). Most countries have one or two ministerial level organisations that serve as the loci of innovation policy clusters. Few target SMEs.

Source: Own elaboration based on analysis of the EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

In the core discussion of this chapter, one of the crucial findings is that AI/SMEE policy initiatives predominantly focus on supporting AI innovation rather than AI diffusion. This seems to be a feature of most national AI policy mixes. Several observations could be made, also to temper these exploratory results:

- AI is an emerging technology in which adopters are rather innovators or early adopters, representing a minority of the business population. AI technology diffusion is therefore a more recent policy area of attention than AI innovation, which could explain the more limited number of initiatives in place on the diffusion side.
- Data for the Compass is collected via the CSTP (Committee for Scientific and Technological Policy) and ERAC (European Research and Innovation Committee), both of which traditionally focus on innovation rather than diffusion, especially technological innovation and R&D and science and technology policy issues. The Compass reflecting the views of the respondents in selecting the "major" policy initiatives in their field of intervention, results could be skewed towards a "hard" part of innovation policy and the supply-side. The findings of this work overlook therefore a subset of policy initiatives that aim to foster AI innovation diffusion and have gone under the radar of the Compass.
- A number of AI diffusion initiatives are likely to be implemented at subnational level, i.e. as part of regional industrial strategies, or local SME digitalisation frameworks or local SME development policies, including training. Information about these subnational policy initiatives are not available in the Compass.

Going forward, policy mapping exercise of this kind should consider using complementing policy information, especially to bridge the knowledge gap in different policy domains and levels of governance.

For instance, countries may have in practice SME-relevant initiatives in their policy mix for “firms of any size”. While the present report does not consider those, future analysis could investigate to which extend adding these initiatives into the sample under review could alter the results and findings.

Likewise, access to co-operation infrastructure is often enabled by digital technologies and Internet infrastructure (online access to data, cloud computing or online “networking” through platforms, for example), showing that policy instruments to foster technology adoption are leveraging digital instruments themselves (OECD, 2019[25]). The availability of digital infrastructure and quality broadband has been shown to be a key enabler of technology adoption among firms (OECD, 2019[14]; Andrews, Nicoletti and Timiliotis, 2018[7]).

Another area of interest that did not emerge from this analysis based on the Compass is the role regulators and governments play in ensuring the well functioning of knowledge markets that provide cloud-based AI solutions to SMEs, and how to address issues related to data ownership, data portability and locks-in effects.

As the AI transition turns to the reskilling of managers, business owners and the workforce, a closer attention will have to be paid to subnational policy arrangements in support of AI diffusion, the types of initiatives put in place, and their relative balance both at local level and within national policy mixes. This is a full stream of research work to be developed.

Annex 6.A. Country coverage of the Compass

The Compass covers the following geographical entities: ARE, ARG, AUS, AUT, BEL, BGR, BRA, CAN, CHE, CHL, CHN, COL, CRI, CYP, CZE, DEU, DNK, EGY, ESP, EST, EU, FIN, FRA, GBR, GRC, HRV, HUN, IDN, IND, IRL, ISL, ISR, ITA, JPN, KAZ, KOR, LTU, LUX, LVA, MAR, MEX, MLT, MYS, NLD, NOR, NZL, PER, POL, PRT, ROU, RUS, SAU, SGP, SRB, SVK, SVN, SWE, THA, TUR, URY, USA, VNM, and ZAF. Belgium is divided into five administrative authorities which answer the questionnaire separately (Brussels-Capital, Flanders, Wallonia, Wallonia Brussels Federation, and Federal government). Of the 63 countries, 6 (ARE, SAU, SGP, SRB, URY and VNM) completed only 2 questions related to artificial intelligence, with data for these questions collected under the aegis of the Committee for Digital Economy Policy for the OECD AI Observatory – see (OECD, 2020[61]; OECD, 2020[21])..

Annex Table 6.A.1. Policy instrument types used in the Compass, with categories

Policy instrument type category	Policy instrument type
Collaborative infrastructures (soft and physical)	Dedicated support to research infrastructures
	Networking and collaborative platforms
	Information services and access to datasets
Direct financial support	Project grants for public research
	Institutional funding for public research
	Equity financing
	Grants for business R&D and innovation
	Procurement programmes for R&D and innovation
	Loans and credits for innovation in firms
	Centres of excellence grants
	Fellowships and postgraduate loans and scholarships
	Innovation vouchers
Governance	Formal consultation of stakeholders or experts
	National strategies, agendas and plans
	Horizontal STI co-ordination bodies
	Regulatory oversight and ethical advice bodies
	Standards and certification for technology development and adoption
	Creation or reform of governance structure or public body
	Public awareness campaigns and other outreach activities
	Policy intelligence (e.g. evaluations, benchmarking and forecasts)
Guidance, regulation and incentives	Intellectual property regulation and incentives
	Science and innovation challenges, prizes and awards
	Emerging technology regulation
	Labour mobility regulation and incentives
	Technology extension and business advisory services
Indirect financial support	Corporate tax relief for R&D and innovation
	Debt guarantees and risk-sharing schemes
	Tax relief for individuals supporting R&D and innovation

Note: The Compass taxonomies are based on former theoretical and operational attempts to map and classify policy information in the field of STI. See (Meissner and Kergroach, 2019[20]) for a more comprehensive overview.
Source: EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Annex Table 6.A.2. STIP Compass: Basic descriptive statistics by country

	Number of policy initiatives	Average number of themes	Average number of target groups
United States	195	1.82	4.8
Austria	178	1.72	3.14
United Kingdom	176	1.64	2.64
Portugal	174	1.91	4.59
Germany	165	1.84	3.74
Italy	163	1.15	3.4
Australia	158	1.8	3.72
Turkey	154	1.81	3.62
Poland	153	1.53	3.01
Ireland	153	1.71	1.85
France	148	1.66	2.99
Canada	140	1.93	3.84
Brazil	138	1.77	6.4
Spain	137	1.46	2.09
Lithuania	133	1.83	3.41
Norway	129	1.66	2.1
European Union	123	1.59	3.41
Korea	119	1.39	4.25
Slovenia	119	2.04	3.86
Russian Federation	114	1.68	3.13
Hungary	113	2.31	3.38
Colombia	112	1.32	6.59
Netherlands	110	1.97	3.27
Thailand	101	1.8	4.47
New Zealand	98	1.76	2.76
Belgium - Flanders	92	2.22	3.85
Denmark	91	1.86	3.57
South Africa	90	1.58	3.22
Israel	90	1.78	2.76
Malta	87	2	5.57
Japan	86	1.5	3.1
Switzerland	84	1.88	2.56
Finland	82	1.61	3.12
Kazakhstan	74	1.2	4.58
Costa Rica	73	2.01	3.3
Sweden	72	1.78	3.03
Luxembourg	72	1.67	2.46
Argentina	68	1.81	4.46
China (People's Republic of)	67	1.79	3.57
Peru	65	1.77	3.57
Latvia	64	1.97	3.83
Cyprus	63	1.84	4.87
Malaysia	63	1.33	1
Croatia	62	1.52	1.4
Chile	61	1.98	3.15
Estonia	61	1.89	3.38
Czech Republic	58	2.78	5.34
Greece	58	2.09	3.59
Belgium - Brussels Capital	55	2.96	2.07
Morocco	47	1.4	2.21

	Number of policy initiatives	Average number of themes	Average number of target groups
Romania	45	1.18	1.47
Belgium - Wallonia	45	1.87	1.62
Indonesia	40	1.15	1
Belgium - Federal government	40	1.48	3.38
Bulgaria	40	2.28	3.2
Mexico	35	1.94	2.69
Iceland	32	2.41	3.84
Belgium - Wallonia-Brussels Federation	30	1.23	2.9
Slovak Republic	30	2.13	4.07
Egypt	24	3.04	1.67
Singapore	15	1	2
India	10	1.1	8.1
Uruguay	4	2	1
United Arab Emirates	3	1.33	7.67
Viet Nam	2	1	1.5
Saudi Arabia	1	1	3
Serbia	1	2	11

Source: Own elaboration based on EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

Annex Table 6.A.3. Distribution of AI/SMEE policy initiatives by geographical entity

By descending order

Geographical entity	Number of policy initiatives
European Union	8
Turkey	7
Italy	4
Australia	3
Canada	3
Colombia	3
France	3
Malta	3
Poland	3
Belgium - Federal government	2
Denmark	2
Germany	2
Netherlands	2
United Kingdom	2
Austria	1
Estonia	1
Finland	1
Greece	1
Ireland	1
Israel	1
Luxembourg	1
Malaysia	1
Mexico	1
New Zealand	1
Portugal	1
Korea	1

Geographical entity	Number of policy initiatives
Slovenia	1
Spain	1
Sweden	1
Viet Nam	1

Source: Own elaboration based on policy information drawn from EC/OECD (2020[8]), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, Edition 2/27/2020, https://stip.oecd.org.

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Notes

[1] For basic descriptive statistics on the Compass, see Annex 6.A.

[2] Mandatory fields are the following: name in English, description, objective(s), target group(s), name of responsible organisation, policy instrument type and/or yearly budget range.

[3] This question was broadened since the 2017 edition of the survey, where it used to read *What policy initiatives exist, if any, to support research on artificial intelligence?* (European Commission/OECD, 2020[8]). The Compass contains data collected as part of an AI-specific survey using the same infrastructure (OECD.AI, 2020[62]).

[4] This study lists the following incomplete set of keywords: i) generic AI keywords (notably "artificial intelligence", "AI", "machine learning" and "machine intelligence"); ii) keywords pertaining to AI techniques (notably "neural network", "deep learning", and "reinforcement learning"); and iii) keywords referring to AI applications (notably "computer vision", "predictive analytics", "natural language processing", "autonomous vehicles", "intelligent systems" and "virtual assistant") (OECD, 2018[24]).

[5] For a full list of initiatives, see Annex 6.A. A few possible duplicated entries were found, but are left in the subset of initiatives, because the fields are slightly different.

[6] The original taxonomies specified by respondents in the "Target group(s)" field are not used here, because they were not used to conduct the initial search. Generally, the fact that respondents tend to specify a large number of target groups for a given initiative reduces the value of this field.