Special Analysis

Regional Profiles of AI Capability: The European Union

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HYPERION RESEARCH OPINION

In 2018, the European Union (EU) officially entered the competition for global leadership in artificial intelligence, outlining its strategy under the Coordinated Plan on Artificial Intelligence. Like China and the United States, the EU sees the technology as a major driver for regional economic growth and productivity, as well as a way to solve the world's most pressing environmental and social challenges.

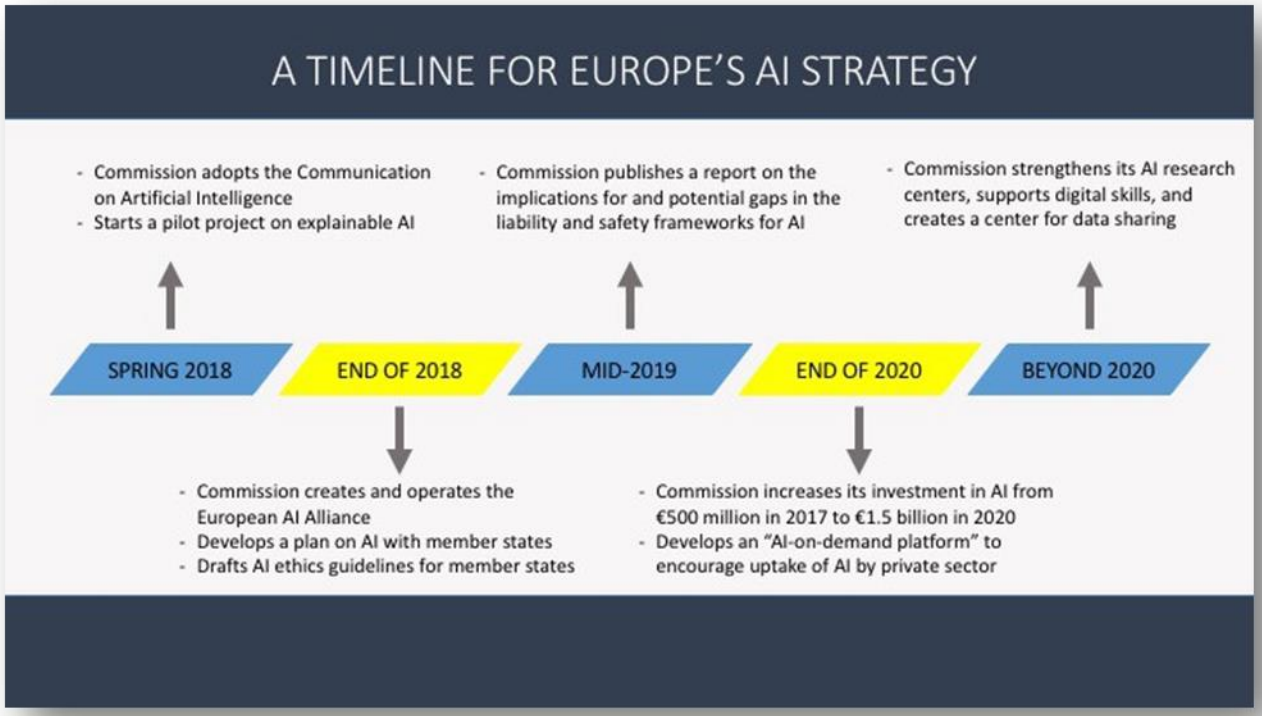
At this point, the EU is perceived as playing catch-up in the AI race, having entered the space largely without the commercial base in artificial intelligence that both the US and China enjoy. The Coordinated Plan admits that AI investments within the EU have been low and fragmented compared with their two main competitors. Certain member states, including France, Finland, Sweden, and Germany, have distinct AI strategies in place, while the other members are either in the process of developing plans or have included AI initiatives as part of a broader IT strategy. Since the UK has now officially left the EU, it is uncertain how it will be involved in the EU's AI plans going forward.

The approach put forward under the EU's Coordinate Plan is driven by the need to make AI technologies available to small and medium-sized businesses (SMEs), which make up the vast majority of companies in Europe. According to the plans, as seen in Figure 1, this is meant to be accomplished via an "AI-on-demand platform," a network of digital innovation hubs and clusters, and a network of centers of excellence. The plan also focuses on the need to make public and private datasets more widely available to users, while maintaining the requisite safeguards for security and privacy.

A central element of this coordinated strategy is the concept of "trustworthy AI," setting up ethical guidelines and eventually a regulatory framework for the use of the technology. The rationale for this approach is to ensure that commercial value is balanced with core European values of privacy, transparency, explicability, and accountability. The EU plan also involves soliciting global cooperation for establishing these guidelines, with the goal of making them internationally recognized standards.

- There is some concern that this approach is anti-competitive and will constrict development and deployment of AI. More broadly, the trustworthiness of the technology is a critical factor everywhere, not just in the EU, especially as AI becomes more generally deployed.
- With the proper investment and collaborations, the region should be able to retain its indigenous AI talent and expand its expertise in areas critical to private and public interests in Europe.

FIGURE 1



Source: Hyperion Research 2020 and *A Timeline for Europe's AI Strategy* (medium.com/swlh/a-timeline-for-europes-ai-strategy-d2fc9f7bbcf1)

SITUATION OVERVIEW

PUBLIC SPENDING

When the EU launched its 2018 AI Coordinated Plan, the goal was to increase investments to €1.5 billion by 2020, representing a 70 percent spending increase over the preceding period from 2014 through 2017. However, the plan's larger ambition is to boost total public and private sector spending to at least €20 billion by the end of 2020, and to further increase total investments to €20 billion per year over the next decade. Such spending would place the EU on par with that of the US and China.

Individual European governments are also investing, especially those representing the largest economies in the region:

- France has allocated €1.5 billion for AI research that will fund a variety of efforts through 2022 and has earmarked €5.4 billion to help build more technology unicorns (startups with valuations of more than $1 billion).
- Germany has pledged €3 billion for AI research and development to be spent through 2025.

- The UK, although no longer a member of the EU, set aside £1 billion for AI research in 2018, on top of £400 million that the government previously allocated.

COMMERCIAL ECOSYSTEM

AI technology development and use in the private sector in the EU is something of a mixed bag. The region offers an advanced industrial and business environment that is ripe for AI adoption, but its lack of information technology companies that are actively driving AI development is a decided disadvantage.

Of the three major AI powers, the EU likely ranks last in AI spending in the private sector. The region also offers a less mature venture capital industry compared with its overseas competition. According to the Center for Data Innovation, a think tank focused on how public policy impacts information technology, European Union companies received $2.8 billion in venture capital and private equity funding from 2017 to 2018, which is about one-fifth of what China and the US received. The EU does somewhat better in the number of AI startups, recording 726 such companies in 2017, about twice the number that China had, but just half of the US total.

To stimulate investments, the European Fund for Strategic Investments (EFSI), the European Investment Fund, and VentureEU were created to help bring venture capital to EU-based startups and other early-stage companies, including those in the AI space. In 2018, the EU established an enhanced pilot for a European Innovation Council, which brings funds as well as business guidance to cutting-edge technology startups and SMEs. In aggregate, these funding initiatives would provide hundreds of millions of euros per year to AI ventures.

A significant challenge for the EU is the small number of IT firms at the forefront of AI research and development. The region has neither data-rich web firms like Google, Amazon, or Baidu, nor IT providers on the scale and influence of firms like Intel, Microsoft, or Samsung. These companies not only fund significant AI R&D efforts but are also putting resources into smaller AI companies either via investments and partnerships or by acquiring them. Examples of the latter include Intel Corp's recent $2 billion acquisition of Israeli AI chip startup Habana and Google's $500 million purchase of the London-based deep learning specialist DeepMind in 2014.

The DeepMind acquisition points to another European problem, namely that the most valued (that is, the most innovative) AI companies born in Europe are at risk of being acquired by non-European firms, depriving the region of indigenous talent and IP. Establishing a more welcoming investment and business environment in Europe can help with the retention and growth of such home-grown companies, and that strategy is part of the EU's Coordinated Plan, as well as the various AI initiatives of the individual member states.

The AI patent landscape in the EU also reflects the lack of commercial drivers. According to IPlytics GmbH, Siemens is the lone EU-based firm with a significant patent footprint in the AI space (IBM, Microsoft and Samsung are the three largest AI-related patent owners). In total, the number of AI patents filed under the international Patent Cooperation Treaty (PCT) from 1960-2018 show that the EU is on par with that of China, with slightly over 1,000 each. Both, however, trail the US, with over 1,800 patents filed. For highly cited patents (patents filed for the same invention in multiple jurisdictions), the EU ranks second with nearly 3,000, besting China's 691, but significantly behind the US with more than 28,000. While patents don't capture the value of all IP produced in the private sector, it serves as a good proxy for the intensity of innovation happening at a regional level.

At this point, the EU relies heavily on non-European companies for its AI hardware. This may change with initiatives like the European Processor Initiative, which is tasked to develop high performance computing processors, including AI accelerators based on the RISC-V architecture, for both edge and data center environments. If the project proceeds as planned, such processors will be available by 2025.

Neuromorphic computing hardware suitable for AI is also being explored in Europe (and elsewhere), but these efforts are still in the early research stage. Hyperion Research believes that the current EU lack of domestically produced AI hardware is not a significant impediment to overall capability, but its addition could broaden the local AI ecosystem and create opportunities for additional research and development.

RESEARCH AND INNOVATION

If the EU can claim to lead in any element of artificial intelligence, it would be in the realm of research capability. Whether considering the numbers of researchers and the papers they produce or the government's commitment to advance AI innovation, the EU is well-positioned to be a leading global research hub.

According to Data Innovation, the region has more than 43,000 AI researchers, which is nearly as many as the US and China combined. Of these researchers, about 5,800 are considered at the top of their field, which is slightly more than the approximately 5,100 in US and far better than the 1,000 or so in China.

The Europeans are also well-represented in the number of AI research papers submitted, with approximately 14,800 – nearly the same as top-ranked China with 15,200. Using a standard metric that assesses the quality of those papers, on average, the ones produced in the EU are intermediate between those of the US and China.

The region's strength in AI research is not unassailable. The US and, to a lesser extent, China, are drawing talent away from Europe, bidding up salaries and offering high-profile positions at prestigious IT firms and research institutions overseas. However, the EU's Coordinated Plan has provisions for retaining and even expanding domestic talent.

One avenue for supporting this capability will be through the European Research Council, which has funded over 150 advanced AI research projects in areas such as deep learning, neural networks, prediction, machine translation, natural language processing, computer vision, robotics, artificial agents and medical imaging, as well as governance and standards.

A more explicit approach to retain and develop AI talent is exemplified by the European Laboratory for Learning and Intelligent Systems (ELLIS), a new pan-European technology consortium that is in the process of establishing multiple AI research institutes across the continent. Significantly, it is broadening the scope of participants, allowing non-EU countries such as Switzerland, the UK, and Israel into the project. An initial outlay of $220 million in December 2019 is intended to fund the first sites in Amsterdam, Copenhagen, Helsinki, Tel Aviv, Zurich, and elsewhere over the next five years.

The EU also intends to work with industry partners to develop regional AI centers of excellence to help attract and develop indigenous talent. In conjunction with this effort, the Union has proposed €700 million be made available to develop advanced skills in artificial intelligence, high performance

computing, and cybersecurity. This includes support for university graduate programs as well as on-the-job training.

APPLICATION DOMAINS

As a result of Europe's mature manufacturing base, EU-based firms have a substantial presence in areas such as robotics and autonomous vehicle development, smart cities, as well as other AI-enhanced transport. Development of smart power grids is another area of European strength and is considered to be more advanced than in the US. Personalized and precision medicine is yet another important area of expertise, reflecting the region's advanced healthcare industry.

Due to the aging and shrinking European workforce, there is a strong incentive to bring AI-powered automation and other efficiencies to labor-intensive industries like manufacturing, energy, and healthcare. Specifically, the EU workforce is expected to decrease by 14 percent by 2030, double the 7 percent decline in the population as a whole. The attraction of AI in such an environment is that the technology can help mitigate these population declines by making the remaining workers more productive, while potentially reducing costs for products and services.

PROSPECTS FOR SUCCESS

Europe faces significant challenges in any attempt to overtake either China or the US in overall AI capability, at least in the near-term. In particular, the region's lack of top tier information technology companies that can wield global market power and amass vast amounts of data for model building limits Europe's ability to compete in web-based applications.

That doesn't mean that these models can't be used and deployed at scale within Europe, especially in the edge computing environments. As an economic powerhouse with a mature industrial base and a highly developed public sector, the EU is well-positioned to benefit from the application of AI across its economy. As discussed above, EU-based manufacturing, healthcare, and energy are particularly attractive domains for these applications.

Europe's other major strategic advantage is its regulatory power, which is backed by the region's market size. This was most recently demonstrated by the EU's General Data Protection Regulation (GDPR) law that enforces data protection and privacy. If the EU can take advantage of its regulatory strength to establish ethical guidelines for AI that are recognized internationally, it can help shape how the technology is developed and deployed.

FUTURE OUTLOOK

Taking advantage of a vibrant AI research community that is globally competitive and the basis for commercial startups plays to the region's strength and is the foundation of the EU strategy. As the Coordinated Plan states, to keep its AI talent and innovation within Europe will require both government support and industry collaboration.

Although not well-aligned with its Euro-centric strategy, Hyperion Research believes part of Europe's AI strategy should involve seeking out partnerships with commercial firms and research organizations lying outside the EU. Its global competitors are already doing so. For example, the US is now home to Baidu research centers, while China has welcomed Google research centers. (Here it's worth noting that Google already operates a machine learning research center in Europe in the non-EU locale of Zurich, Switzerland.) This more globalized strategy has the advantage of bringing the UK back into the

European fold, while enabling partnerships with organizations from non-aligned countries that operate in the EU, such as Japan, South Korea, and Canada.

One proposal that supports a more globalized strategy has been submitted by the Center for Security Studies (CSS) at ETH Zurich, which suggests establishing a world-class international research hub for AI in Europe. Such a project is fashioned after the model of the European Organization for Nuclear Research (CERN) and would take advantage of the international aspect and open culture of the AI research community. In this formulation, Europe's role is less a regional competitor in a global AI arms race and more a politically neutral facilitator for the technology. Given the heterogeneous political makeup of the EU and its inherent limitations, this kind of approach may end up being a more workable model for the Europeans.

About Hyperion Research, LLC

Hyperion Research provides data-driven research, analysis and recommendations for technologies, applications, and markets in high performance computing and emerging technology areas to help organizations worldwide make effective decisions and seize growth opportunities. Research includes market sizing and forecasting, share tracking, segmentation, technology and related trend analysis, and both user & vendor analysis for multi-user technical server technology used for HPC and HPDA (high performance data analysis). We provide thought leadership and practical guidance for users, vendors and other members of the HPC community by focusing on key market and technology trends across government, industry, commerce, and academia.

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