European Prosperity Through Human-Centric Artificial Intelligence
The Intelligent Enterprise
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Artificial intelligence (AI) will be a core driver of productivity and economic growth, enabling the “intelligent enterprise” through human-machine collaboration. AI will help address critical societal challenges and yield tangible benefits for citizens. Europe must lead AI development to ensure future competitiveness and citizen well-being. Multistakeholder dialogue is required to explore the economic and societal benefits AI can bring and ensure a human-centric approach and broad acceptance of the new technology in Europe.
Executive Summary

Artificial intelligence will be an enabler for innovation, productivity, and economic growth. In the emerging “intelligent enterprise,” **AI will drive core business processes**, enabling humans to focus on higher-quality work. AI will also help address societal challenges in areas such as healthcare, public security, and disaster management. Europe must be at the forefront of AI developments to ensure future competitiveness and well-being.

At the same time, AI raises public concerns, such as impact on jobs or loss of human control in automated decision-making. However, in practice, at least some of those concerns relate to AI use cases that may occur, if at all, in the far future. The “dark” factory or the “dark” office taken over by AI and run without human intervention is more fiction than fact. AI will be evolutionary rather than revolutionary, giving us time to prepare for the changes and challenges ahead. Nevertheless, those concerns must be taken seriously. AI development must respect European values and legal standards. The success of AI in Europe will depend on its broad social acceptance.

Europe has the potential to compete with the United States and China in the global race for AI leadership. One area where Europe can and must lead is the emerging AI business-to-business market and the development of the intelligent enterprise.

To this end, SAP proposes the following actions:
- First and foremost, policy makers should start an informed dialogue with all relevant stakeholders. The purpose is to discuss concerns about AI openly and agree on common measures to exploit the potential of AI. This inclusive approach will be essential to ensure social acceptance for the disruptive technology.
- AI will have an impact on the labor market: Jobs will be changed or, in extreme cases, eliminated by machines. New jobs will be created, and many jobs will be transformed through AI. The future of work will be marked by human-machine collaboration. We must provide employees in Europe with the skills they need to exploit AI rather than compete with it.
- Large-scale AI research and innovation clusters should be established in Europe that can compete with those in the United States and China. There are promising AI programs at several research institutions in Europe that need to be scaled and better coordinated at the European level.
- Policy makers must ensure a favorable EU regulatory framework that establishes a single market for AI products and services, provides legal certainty, and addresses AI-related risks. Although SAP believes there is no need for AI-specific regulation, it does contend that action is required in some areas to make the existing regulatory framework applicable to AI.

Europe should develop its own **vision for the new technology** that aims at European prosperity through human-centric artificial intelligence.
Another important area is the availability of training data for AI. The greater the volume of data available, the more algorithms can learn and the better AI offerings will be. A wealth of valuable data is being created in Europe by governments, industry, and citizens. We must make this data available for AI applications, especially by having governments boost open-data policies.

Industry should do its part to address AI concerns. SAP proposes the creation of a “code of conduct of good AI business practices” to help ensure AI development respects European values and ethical and legal standards.

Small and midsize enterprises (SMEs) are the backbone of the European economy. Fostering broad and speedy AI adoption by SMEs should be a priority.

The public sector should become an early adopter of AI to improve public services and to demonstrate that AI can yield tangible benefits to citizens.

The emerging global market for AI products and services will provide tremendous business opportunities for European industry. Unfortunately, digital protectionism is on the rise, especially in emerging markets. Therefore, any European AI strategy should strive to ensure a level playing field and open AI markets for European industry in countries outside the European Union.

SAP believes that integrating AI into business processes will yield tremendous efficiency gains, drive innovation, and enable new business models. Human centrism is a core principle of SAP’s vision of the intelligent enterprise and aligns with our overall mission to help the world run better and improve people’s lives.

This paper is SAP’s contribution to the public debate on artificial intelligence in Europe. The titles of the sections that make up this paper clearly delineate the AI discussion presented. To start off, “AI and the Intelligent Enterprise” describes the development of AI and the intelligent enterprise. This is followed by a discussion of the many economic and societal benefits AI can mean in “Economic and Societal AI Benefits.” An analysis of the social and ethical concerns related to AI is presented in “Social and Ethical AI Concerns.” How Europe can compete with the United States and China in the global race for AI leadership is discussed in “Europe and the Race for Global AI Leadership.” “Recommendations” provides a set of suggestions for governments and industry to help Europe realize the vision of European prosperity through human-centric artificial intelligence.
AI and the Intelligent Enterprise

Artificial intelligence\(^1\) can be defined as the capability of a machine to imitate intelligent human behavior. While AI includes different technical concepts, such as robotics or autonomous driving, the focus in the public debate is often on machine learning (ML), a subset of AI. In fact, ML is currently the best bet in getting closer to the objectives of AI. ML describes algorithms that can learn from experience without having to be explicitly programmed. Using ML, machines can see, read, listen, and interact.

Increased computer processing power, better algorithms, and the evolution of Big Data are the foundation and drivers for AI. In fact, it is the explosion of data that has led to the recent breakthrough in AI. The greater the volume of data available, the more algorithms can learn and the more accurate AI offerings will be. Forecasts estimate that the global amount of data will be 10 times higher in 2025 than in 2015 (see Figure 1).

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**Figure 1: Annual Size of the Global Datasphere**


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1. For the sake of simplicity, the term AI will be used throughout the document.
AI will enable disruptive innovation in many domains. And it is about to have a major impact on the enterprise software market. We are witnessing the emergence of the intelligent enterprise.

Today, most organizations have enterprise software that uses rules-based processing to ensure compliance, maintain data consistency, and automate tasks. Yet, while task-based automation resulted in significant efficiency improvements, the software could not learn and improve with experience as humans do. Until now. Self-learning algorithms will take enterprise software to a new level. AI allows much faster improvement of processes with less human intervention or expertise. The intelligent enterprise will utilize both machine learning and rules-based systems to the best effect, freeing up humans to focus on high-value tasks.

The case of analytic tools illustrates this. For the last 20 years, analytic tools have been used in companies to discover patterns in data, translate those patterns into business insights, and prepare human beings to make business decisions. AI techniques are now used to automate many tactical and operational decisions, such as optimizing customer services, by routing inquiries to the most appropriate service professional. In most cases, AI is integrated with existing rules-based systems. For instance, a system trained to recommend a product to consumers, when combined with inventory rules, would only make a recommendation if that product is in stock.

New AI techniques called “deep learning” can make ever greater use of unstructured data – such as text, language, images, and video – and enable image classification and language understanding. This is important because 80% of enterprise-generated data is unstructured, and the volume of unstructured data is growing at twice the pace of structured data. For example, the error rate in AI-driven image recognition has fallen dramatically – practically to near-human performance levels – opening up new ways for humans and machines to interact. In the intelligent enterprise, employees will operate complex enterprise software systems by “talking” to them.

SAP believes that integrating AI into business processes will yield tremendous efficiency gains, drive innovation, and enable new business models. SAP has made a significant investment in AI. We are committed to making all SAP® applications intelligent, integrating them into our core technology platform, and advancing human-machine interfaces. Human centrism is a core principle of SAP’s vision of the intelligent enterprise and aligns with our overall mission to help the world run better and improve people’s lives.

Most analysts agree that AI will be a core driver for economic development. According to a recent study by the McKinsey Global Institute, the global AI applications market will reach US$127 billion by 2025. Given the huge market potential, investment in AI has increased significantly. In 2016, companies invested between $26 billion and $39 billion in AI, with ML attracting nearly 60% of that investment. The macroeconomic benefits of AI will be significant. PwC predicts that AI could potentially contribute almost $16 trillion to the global economy and boost GDP growth by up to 26% in 2030. Likewise, a recent analysis by Accenture of selected economies found that AI could double annual growth rates in those markets by 2035 (see Figure 2). This is based in part on the potential boost in productivity of up to 40% that AI can generate and in part on the creation of entirely new products and services that will drive new revenue streams and create new markets.

**Figure 2: Economic Impact of AI**

Economic impact of AI – selected G20 countries

Real gross value added (% Growth)

<table>
<thead>
<tr>
<th>Country</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>4.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>3.9</td>
</tr>
<tr>
<td>Germany</td>
<td>3.0</td>
</tr>
<tr>
<td>France</td>
<td>2.9</td>
</tr>
<tr>
<td>Japan</td>
<td>2.7</td>
</tr>
<tr>
<td>South Korea</td>
<td>2.9</td>
</tr>
</tbody>
</table>


Benefits will occur in almost all industries and sectors. Industry sectors currently leading in AI deployment are automotive, financial services, high tech, telecommunications, manufacturing, energy, travel and transportation, and logistics. See Figure 3.

AI could potentially contribute almost $16 trillion to the global economy and boost GDP growth by up to 26% in 2030.

Figure 3: Industry Sectors Leading in AI Adoption

Sectors leading in AI adoption today also intend to grow their investment the most.

Future AI demand trajectory
Average estimated % change in AI spending, the next 3 years, weighted by firm size

1. Based on the midpoint of the range selected by the survey respondent.
2. Results are weighted by firm size. See Appendix B for an explanation of the weighting methodology.

While AI adoption is still at an early stage overall, experiences of first movers demonstrate the significant economic gains that AI will yield for organizations. Companies could save an astounding $3 trillion to $4 trillion annually through AI-enabled task-based automation. However, benefits go beyond cost savings. They also mean improved forecasting, optimized operations, more personalized customer services, and enhanced user experiences. Moreover, early AI adopters can disrupt entire industries as AI-powered new entrant Uber Technologies Inc. demonstrated in the taxi business. At this stage, early movers tend to be large businesses that are digitally mature and more focused on AI-enabled growth than just cost savings.

AI can also advance public services and help address some of the most pressing societal challenges, with tangible benefits for citizens (see Figure 4).

AI-based applications can improve health outcomes and the quality of life for millions of people, with uses ranging from detecting early forms of diseases to analyzing radiology scans. AI can help clinicians give faster and more accurate treatment to their patients.

**Figure 4: Artificial Intelligence and Life in 2030**

![Diagram showing potential applications of AI in 2030](image.png)

- **Infrastructure**
  - Smarter cars
  - Self-driving vehicles
  - Transportation planning
  - Smart grids
  - Smarter buildings

- **Healthcare**
  - Electronic health records
  - Healthcare analytics
  - Healthcare robotics
  - Mobile health
  - Care for the elderly

- **Education**
  - Teaching robots
  - Intelligent tutoring systems
  - Learning analytics

- **Low-resource communities**
  - Helping government agencies spend their budget well
  - Planning of food distribution

- **Service robots**
  - Service robots: deliver packages, clean, enhance security
  - Personal assistant robots (with features such as speech recognition)

- **Public safety and security**
  - Cameras for surveillance
  - Drones
  - Predictive police applications (such as predicting white-collar crime)


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7. For potential use cases, see “Why Machine Learning and Why Now?”

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AI promises to enhance education at all levels, be it through robot teachers or online learning systems that will expand the opportunity for adults and working professionals to enhance their knowledge and skills. AI algorithms can personalize a learning experience and related learning content.

AI can be an effective tool for disaster prevention. In cooperation with the European Space Agency, SAP is combining Earth observation data and other publicly available data sets with deep-learning technology to predict the occurrence of wildfires and landslides more accurately. This, of course, leads to optimized rescue response management prior to possible outbreaks.

AI has the potential to advance the public safety and security of citizens by detecting possible crimes earlier. In another use, autonomous vehicles can predict what nearby cars and pedestrians will do, learn human behavior, and understand how to react to changing driving conditions, including weather changes. Autonomous vehicles could decrease the number of accidents by 90% by 2050.8

AI can help to detect, investigate, and prevent fraud, which has become a significant issue for many public and private organizations. For example, the SAP Ariba® Supplier Risk solution uses machine learning to collect hundreds of data points and reports from civil society, auditors, and media. This data can flag the possible risk of supply chain incidents, including corruption, human rights infringement, neglect of environmental standards, and forced labor issues. Real-time risk reporting on possible incidents enables companies to take more immediate action.9

Europe must be at the forefront to reap the economic and social benefits of AI and to ensure future competitiveness and well-being.

9. SAP Ariba Supplier Risk solution.

AI can advance public services and help address some of the most pressing societal challenges, with tangible benefits for citizens.
Social and Ethical AI Concerns

Just like other disruptive technologies, AI raises public concerns. At least some of those concerns relate to AI use cases that, if they occur at all, will occur in the far future. Nevertheless, those concerns must be taken seriously and should be addressed by appropriate measures. AI developments must respect European values and legal standards in order to gain broad social acceptance on which the success of AI in Europe depends.

Foremost in the public debate is the impact of AI on jobs. While it is widely expected that AI will have the potential to change the nature of many jobs as well as the skills required to do them, it is difficult to predict the precise effects. In fact, there is a controversial debate among academics on how many jobs and tasks could be automated through AI. A 2013 study from Oxford University claims that about 47% of total U.S. employment could be affected by automation. A report from the Centre for European Economic Research on behalf of the Organisation for Economic Co-operation and Development (OECD) predicts that up to 15% of jobs could be automated through AI. Arntz, Gregory, and Zierahn (2016) estimate that on average across the 21 OECD countries, 9% of jobs are automatable. McKinsey states that fewer than 5% of today’s occupations are candidates for full automation, but almost every occupation has partial automation potential.

The tasks most likely to be automated are predictable and repeatable physical activities, data collection and processing, and routine tasks. It should be stressed that AI contributes to human safety by taking over jobs that are too hard or too dangerous for people. AI will also lead to the creation of new jobs, as experts will be needed to design, operate, and use the AI systems. While exact roles are hard to define at this stage, occupations as experts in training neural networks, ethics compliance managers, algorithm forensics analysts, and empathy trainers will be on the rise.

In the past, technology often ended up creating more jobs than it replaced. Nor does automation necessarily lead to unemployment. Japan and Germany both have a high level of automation but low levels of unemployment. And it should be noted that Europe and other mature markets face a shrinking supply of workers due to an aging population. AI may help address this gap. In addition, AI could reduce pressure for European companies to outsource operations to low-cost offshore markets.

AI developments must respect European values and legal standards in order to gain broad social acceptance on which the success of AI in Europe depends.

The real impact of AI for the foreseeable future will likely be the transformation of jobs and the augmentation of tasks. AI can liberate people from routine labor, allowing them to shift to higher-value tasks that depend on abilities unique to humans, thus enabling them to be more effective. Machines cannot set goals and are not responsible. Even when trained with high volumes of data, machines can only learn from the past; they cannot imagine the future. Unique human capabilities such as flexibility, creativity, curiosity, emotional intelligence, and critical judgment will be necessary in the future to run the intelligent enterprise. Ultimately, the future of work is expected to be about human-AI collaboration, which will supplement the strengths of humans with the strengths of machines.

Hence, the scenario of the “dark” factory or the “dark” office taken over by AI and run without human intervention is fiction rather than fact. AI will be evolutionary rather than revolutionary, giving us time to prepare for the changes and challenges ahead. It would be premature to adopt far-reaching policy measures, such as a tax on robots. In a hypothetical future economy, where most of the GDP is generated by machines rather than humans, a tax reform might have to be considered. Similarly, a guaranteed basic income for all could become a valid policy option in such a scenario. However, the current focus of policy makers should be on closely monitoring AI developments and providing the current and future workforce with the skills needed to exploit rather than compete with AI.

AI raises ethical issues and legal challenges as well. Modern AI techniques use complex numerical and statistical functions. Neural networks in particular offer low levels of reasoning or traceability to explain results. Black-box algorithms and automated decision-making are a concern as they could lead to a loss of human control and self-determination. Moreover, the Big Data element of AI spurs data protection and privacy concerns. Automated decision-making entails consumer protection issues. How neutral and objective is an algorithm that decides on whether or under what terms and conditions a person receives a bank credit or an insurance policy? And who is liable if automated decisions cause harm to people?

Good software design can mitigate the effect, and research is gradually improving algorithmic visibility. Remaining concerns must be addressed through good AI business practices by AI vendors and users. High-quality, nonbiased training data is as essential as the existence of proper controls and safeguards to maintain human control in critical decisions and to prevent harm.

Public opinion reflects the controversy on AI. In a recent EU survey, 74% of respondents expect that AI will cut more jobs than it will create. At the same time, 84% agree that robots are necessary to do dangerous or hard jobs, while 68% agree that AI helps people in everyday life. Most importantly, the better informed people are about AI, the less concerned they seem to be about the new technology. Therefore, policy makers and industry should increase efforts to educate people about AI and its benefits and limitations.

The future of work will be marked by human-machine collaboration. We must provide employees in Europe with the skills they need to exploit AI rather than compete with it.

Europe and the Race for Global AI Leadership

The United States is widely regarded as the leading hub for AI development (see Figure 5). U.S. IT and Internet companies such as Google LLC, Facebook Inc., Microsoft, and IBM have made significant investments in AI technologies and have access to a huge amount of data through their existing businesses. In 2016, roughly two-thirds of all external AI investment (venture capital, private equity, and M&A) went to the United States\(^\text{15}\) (see Figure 7). Moreover, the United States has the most robust and vibrant startup and venture capital ecosystem, which is focusing increasingly on AI. The United States leads by far in AI patent submissions (see Figure 6) and has the largest pool of AI talent.

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**Figure 5: Number of AI Companies in 2016**

![Number of Artificial Intelligence Companies (2016)](image)


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However, China is catching up fast and is well positioned to establish a global leadership role in AI.

First, China has a huge talent pool for AI. The country has a long tradition in mathematics, language, and translation research. AI patent submissions by Chinese researchers have increased by roughly 200% in recent years, making China number two following the United States (see Figure 6). Another advantage is data. China’s 1.4 billion people and 730 million Internet and smartphone users generate more consumer data than almost all the other nations combined. Similarly, China also leads in AI voice recognition. Because typing Chinese characters is more laborious than typing Western ones, people in China tend to use voice-recognition services more often than in the West.

Another asset is government support. The Chinese government just released an ambitious development plan to become the world leader in AI by 2030. The comprehensive new policy focuses on AI research and innovation programs, the rapid adoption of AI across industries, the use of AI in defense and public services, and the construction of a suitable telecommunications and computing infrastructure for AI. A combination of public and private funding will be made available to implement the AI development plan. Chinese government spending on AI research has grown by double digits annually throughout the last decade. Meanwhile, Beijing and Shenzhen have become strong AI hubs.

Chinese IT and Internet companies – like Alibaba Group Holding Limited, Tencent Holdings Limited, and Baidu Inc. – are investing heavily in AI use cases such as autonomous driving, smart traffic, defense, and healthcare. According to recent estimates, the AI market in China reached €3.1 billion in 2016 and could grow to almost €5 billion by the end of 2018.

Figure 6: Number of AI Patent Applications


Europe has the assets and the potential to compete with the United States and China in the global race for AI leadership. One area where Europe can and must lead is the emerging AI business-to-business market and the development of the intelligent enterprise.

Many small and large European companies are innovation and market leaders in their respective markets and will need to invest in AI to maintain their competitiveness. European enterprises generate a wealth of business data that can be leveraged to train algorithms. There is strong industry domain know-how in Europe that is essential for the creation of state-of-the-art AI solutions. London, Paris, and Berlin have become important AI startup hubs with a strong focus on AI enterprise solutions. There are some mature and well-funded European AI companies in the field of data analytics. Similarly, there are several universities and institutes – such as the University of Oxford, the University of Amsterdam, and the German Research Center for Artificial Intelligence (DFKI) in Saarbrücken – that are becoming leading research centers for AI enterprise applications.

Europe should build on these strengths. Playing a leading role in the AI business-to-business market could be a strong asset in the global race with the United States and China for AI leadership.

Figure 7: External Investment Behind Growth in Artificial Intelligence

<table>
<thead>
<tr>
<th>Year</th>
<th>North America</th>
<th>Asia</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.0—2.0</td>
<td>~0.1</td>
<td>~0.1</td>
</tr>
<tr>
<td>2013</td>
<td>2.5—4.0</td>
<td>~0.2</td>
<td>~0.1</td>
</tr>
<tr>
<td>2016</td>
<td>5.0—8.0</td>
<td>1.5—2.5</td>
<td>11—17</td>
</tr>
</tbody>
</table>

Estimates consist of annual venture capital investment in AI-focused companies, private equity investment in AI-related companies, and M&A done by corporations. This includes only disclosed data available in databases and assumes that all registered deals were completed within the year the transactions were announced.


Europe can and must lead in the emerging AI business-to-business market and the development of the intelligent enterprise.

Europe must be at the forefront of AI development and reap its economic and societal benefits. At the same time, public concerns related to AI must be addressed to obtain broad social acceptance for the disruptive technology.

Europe must develop its own vision for the new technology that aims at European prosperity through human-centric artificial intelligence. Governments and industry need to join forces and take firm action to realize this vision.

**ESTABLISH AN AI MULTISTAKEHOLDER DIALOGUE**

An informed dialogue must be conducted among all relevant stakeholders to establish a common understanding of the new technology, address AI-related concerns, and agree on measures to exploit the benefits of AI fully.

Some Member States have already launched a structured debate on AI. For instance, in December 2016 the French government initiated a dialogue among multiple stakeholders within its “France AI Strategy” policy program. The dialogue was guided by the government to gather input from industry, academia, and other stakeholders. A final report was submitted to President Hollande in March 2017.19 In Germany, a new stakeholder platform for AI was recently launched,20 which is supposed to complement the well-established “Plattform Industrie 4.0.” SAP welcomes these initiatives by Member States because many actions to promote AI, such as skills development, are most effective when taken at the national level.

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In parallel, SAP suggests coordinated actions at the EU level be taken to avoid market fragmentation, to exchange best practices, and to coordinate and scale the scattered AI initiatives in Europe. The European Parliament conducted a public consultation on AI in 2016, which provided input for the European Parliament Resolution with recommendations to the European Commission on Civil Law Rules on Robotics. The European Commission has also launched a public dialogue on AI and plans to adopt a communication on a European AI strategy in 2018.

As a next step, SAP encourages the European Commission to set up a high-level EU AI stakeholder group composed of senior executives from industry as well as representatives from academia and civil society. This stakeholder group could be supported by expert groups that would address specific AI challenges and opportunities. The stakeholder group could be asked to prepare a report with concrete recommendations on AI policies for the European Commission and Member States.

Finally, SAP welcomes stakeholder dialogue on AI at the global level. Suitable platforms could be leveraged within the OECD and the G20 framework.

DEVELOP SKILLS FOR AI AND THE INTELLIGENT ENTERPRISE

Both the existing workforce and future talents must develop the skills to leverage the many job opportunities that AI and the intelligent enterprise will offer.

Unfortunately, the existing digital skills gap in Europe is widening as these new technologies emerge. Out of more than 100 organizations questioned by SAP and the Technical University of Munich, only 21% answered that they have highly skilled employees that meet the requirements for an AI environment. Governments, business leaders, and educational institutions must join forces to develop AI capabilities in order to ensure future employability and that industry can find the talent in Europe to exploit the potential of AI. Actions are required to forecast the AI skills that will be needed, reform the educational system, and up-skill the existing workforce.

An informed dialogue must be conducted among all relevant stakeholders to establish a common understanding of the new technology, address AI-related concerns, and agree on measures to exploit the benefits of AI fully.

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Develop AI forecasting skills: Closing the skills gap will have to be based on a solid understanding of the existing skills base and the skills needed in an AI environment in the future. We must define future skills needed for jobs undergoing transformation as well as skills required for new types of jobs that will be created through AI. It should be stressed that future job roles will often require a blend of various skills across different domains, especially in business administration, mathematics, and computer science (see Figure 9). Most importantly, there is a need for data scientists with a broad skills base who can train algorithms and pull actionable insights out of results produced by AI machines.

Reform the education system: AI and the digital economy require governments to reconsider today’s educational models and make learning more attractive and inclusive:
- Define a new curriculum: Dedicated AI university studies and studies combining AI with other disciplines should be established. Students across all areas of learning should obtain foundational knowledge in digital skills and AI.
- Improve STEM skills: Skills in science, technology, engineering, and mathematics (STEM) should be promoted. They provide a good foundation for AI-related jobs.
- Boost transversal skills: Educational institutions should emphasize creativity, critical and systematic thinking, and social and emotional capabilities to strengthen the human role in an AI environment.
- Set up a teaching repository: Create an online database with AI-relevant teaching materials (a one-stop shop), such as massive open online courses (MOOCs), and make them available for professionals, schoolteachers, and professors.
- Raise awareness: Help young people make career and education choices. Raise awareness about AI job opportunities and related skills requirements.

Figure 9: Future AI Jobs Require Broad Skill Sets

- Statistics
- Econometrics
- Forecasting
- Finance
- Databases
- Information systems
- Programming
- AI and machine learning
- Business acumen
- Problem solving
- Design thinking
- Communication
Up-skill existing workforce: Apart from improving the educational system, measures should be taken to up-skill employees:

- **Promote the creation and adoption of AI training:** AI training material exists today. For instance, the open “Enterprise Machine Learning in a Nutshell” course from SAP helps participants understand the significance of ML. Topics include ML’s recent advances, its basic concepts, and how it can help solve business problems. These training materials should be made available to employees, especially through popular MOOCs, which offer instant access and are free of charge.

- **Encourage lifelong learning:** Lifelong learning will become increasingly important in a dynamic AI environment. Companies should provide sufficient training opportunities. While companies may often not be able to provide lifelong job guarantees, they can foster lifelong employability of people through continuous training.

- **Invest in human capital:** Business leaders must invest more in human capital and place skills development front and center in their corporate strategy.

SAP encourages the European Commission to set up a dedicated expert group on AI skills development. It could reside within the framework of the existing EU Governing Board of the Digital Skills and Jobs Coalition or under the umbrella of the proposed EU AI stakeholder group.

There is a need for data scientists with a broad skills base who can train algorithms and pull actionable insights out of results produced by AI machines.

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FOSTER LARGE-SCALE AI RESEARCH AND INNOVATION CLUSTERS

Europe must establish large-scale AI research and innovation clusters that can compete with those in the United States and China. This will require increased and coordinated efforts by universities, industry, and governments across Europe.

While much of the AI technology framework has been already established, more basic and applied research must be conducted to realize the vision of the intelligent enterprise. SAP has built a network with top-ranking universities to address some of the most pressing challenges: AI models must become more robust, accurate, and credible. Interpretability and traceability of algorithms should be improved so that users can understand results. AI networks must produce accurate results with less data. The collaboration benefits research partners, who get funding, business data, and industry problems to work on, while the additional pool of expertise and machine learning models enables SAP to advance its AI product portfolio.

SAP has also created a dedicated research project called “Future of Work.” As job requirements change in an AI environment, the concern is how to keep people engaged and motivated. How do you encourage creative freedom, collaboration, knowledge sharing, and lifelong learning? And how can technologies help companies to evolve toward purpose-led, people-centric, self-directed organizations? These are questions we are exploring within the “Future of Work” program.

Several universities in Europe have already established dedicated AI research programs. These activities now need to be scaled up and coordinated at the European level. Against this background, SAP welcomes the recently launched EU AI-on-demand platform. The platform serves as a central point to gather and provide access to AI-related knowledge, algorithms, and tools. The intention is to support the integration of AI into business processes and applications. The platform also facilitates the interaction with existing data portals needed for AI algorithms and resources. We encourage the European Commission to leverage existing AI technology platforms when implementing the program.

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Europe needs to invest in test labs, where industry and universities can jointly develop innovative AI applications and test them in a real-life environment. The SAP Leonardo Center global enablement network provides facilities and technologies to help industry experts and researchers work together on innovative applications and business models with a strong focus on AI. SAP Leonardo Centers foster co-innovation with customers and partners and connect a broader ecosystem, including universities, startups, and accelerators.

Public funding is needed to encourage SMEs to participate and provide innovative use scenarios to these test centers. Publicly funded test centers for digital technologies have been established in France, Germany, and other Member States. We welcome the European Commission’s investment of €500 million in a pan-European network of digital innovation hubs. Moving forward, these centers should help accelerate innovation with and exploration of AI.

Likewise, Europe should promote AI startups, as they often lead in disruptive innovation. Many startups are set up in areas close to universities or technology companies. Hence, they benefit the most from research and innovation clusters. The SAP Startup Focus program offers free access to technology, funding, mentoring, training, and engagement with SAP partners and customers on concrete projects to help startups scale their business. The program supports more than 2,400 startups in the Europe, Middle East, and Africa (EMEA) region, with the number of AI startups on the increase. Moreover, the SAP.iO Fund and the SAP.iO Foundries programs were launched in 2017 to accelerate the creation of a vibrant ecosystem around cloud solutions from SAP and platform technologies, including AI.

Governments can do their part to support AI startups by improving access to finance, simplifying and harmonizing regulation, and providing tax incentives. EU startup programs and those in Member States should put a strong focus on AI.

Europe must establish large-scale AI research and innovation clusters that can compete with those in the United States and China.

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26. SAP Leonardo Center global enablement network
27. SAP Startup Focus program
28. SAP.iO Fund program
29. SAP.iO Foundries program
ENSURE A FAVORABLE EU REGULATORY FRAMEWORK

A favorable EU regulatory framework is needed to establish a single market for AI products and services, to provide legal certainty, and to address AI-related risks. Focus areas would be data protection and privacy, consumer protection, liability, and intellectual property protection.

We believe that the current EU regulatory framework is sufficiently robust and does apply to AI. We caution policy makers against rushing into specific AI legislative initiatives that could hinder the development of AI and create legal inconsistencies. However, action may be required in some areas to make the EU regulatory framework applicable for AI.

Data Protection and Privacy

AI becomes meaningful when it has access to a large volume of high-quality data, including personal data. The Big Data element of AI raises data protection and privacy concerns. The EU just adopted the General Data Protection Regulation (GDPR). Its underlying principles also apply within the context of AI. They include provisions with respect to legal grounds for data processing, data minimization, and purpose limitation.

Moving forward, it all now depends on how the GDPR will be implemented by data protection authorities (DPAs). The objective is to find the proper balance between ensuring data privacy and allowing data-driven business models to flourish. To this end, DPAs should encourage tools and approaches foreseen under the GDPR, including anonymization, privacy impact assessments, and privacy by design. When rigorously applied, these approaches can help minimize the impact on privacy in AI use cases.

Consumer Protection

While AI offers significant business benefits that largely will be handled by mutually agreed-on contracting, impact on consumers may call for additional review. These concerns are not new phenomena but may require an update to existing approaches specific to, for example, media plurality or regulation of advertising sales and price promotions. Other concerns can be handled by simple escalation procedures, ensuring that customers talk to a human customer service agent when seemingly trapped in an automated decision loop.

More complex AI platforms require transparency, not so much of the underlying algorithms but of the overall management of online platforms and related advertising and pricing strategies. A code of conduct on good AI business practices could help to address consumer protection issues (see “Establish Good AI Business Practices”).

The EU regulatory framework is sufficiently robust and does apply to AI. Policy makers should not rush into specific AI legislative initiatives that could hinder the development of AI and create legal inconsistencies.
Liability
The EU liability framework covers damages caused to third parties in cases where the cause of an AI act or omission can be traced back to a specific human agent. It might involve a manufacturer, operator, owner, or user of an AI application in cases where that agent could have foreseen and avoided harmful AI behavior. Those agents could then be held strictly liable.

AI relies on complex supply and value chains, creating interdependencies between service providers and users, which indeed may sometimes make it difficult to assign liabilities. This, however, is the case for many other business models, where liability is assigned in contract terms, thereby providing legal clarity and ensuring a fair allocation of risks among all market players. AI should be treated as any other technology. Applying the existing EU Products Liability Directive will be crucial for avoiding overlap and complexity through different layers of legislation.

It is not clear that the current legal framework will cover all damages caused by third parties in all future AI use cases. However, we caution against attempts to envisage or adopt AI liability regimes hastily.

Assigning liability to market players through new, specific legislation runs the risk of ignoring the complexity of the supply chain. It can lead to unbalanced or unjustified conditions. For instance, a specific liability combined with mandatory insurance schemes for AI owners or users, as proposed by some, should be carefully analyzed before it is introduced. Especially in the business-to-business area, we should not lose sight of the need for contractual arrangements to ensure sufficient flexibility, which may vary depending on the use case.

Within such agreements, the legal obligation of the AI vendor must be clearly stated. Let’s take the example of a software vendor who provides a service with AI functionality to a business customer. Any proposal recommended by that AI functionality based on existing customer data can serve only as a recommendation. The customer is the sole agent who makes any business decision based on that recommendation. In an AI environment, it is not the “result” that is the main legal obligation to be delivered by the AI vendor, but the precision of the algorithm leading to a specific proposal.
Intellectual Property Rights
As AI will be a driver for innovation, an adequate intellectual property rights (IPR) regime is essential to encourage investment and ensure fair competition. The existing EU IPR regulatory framework seems to be adequate to address AI developments alongside existing planned reforms. The future Unified Patent Court represents a milestone in this respect and, it is hoped, will be put in place as soon as possible. Moreover, the new EU Trade Secrets Directive to be implemented in Member States should provide further improvement.

Against this background, the development of AI gives no cause for additional regulatory efforts aimed at increased IPR protection. Notably, there is no need to change the legislative setting on either patent or copyright protection. Rather, it is a matter of case law to define available patent and copyright protection on a case-by-case basis by applying existing laws. This should apply to AI-related innovation – such as intelligent algorithms or findings resulting from their use – the same way it does to any other field of technology.

Another IPR-relevant topic is access to data as the basis of running AI analytics, known as text and data mining (TDM). Potentially, copyright or database protection might stand in the way of conducting TDM. In any case, the AI context is one reason – but not the only reason – why it would be detrimental to create unique rights for data in addition to existing types of IPR. Attributing ownership of such unique rights to certain stakeholders would hamper the evolution of new business models to the detriment of other market players.

In conclusion, there is no immediate need for a major reform of the existing EU regulatory framework to address AI developments. Rather, we encourage the European Commission to establish an expert group, possibly under the umbrella of the proposed EU AI stakeholder group, to review the existing regulatory framework carefully.

We also invite policy makers to review existing regulations that could hinder the development of AI. In any case, any regulatory initiatives for AI should be coordinated at the EU level to ensure a fully functioning single market for AI products and services. We also urge European policy makers to align regulatory efforts with international trading partners to foster global harmonization of AI policies.
FOSTER AVAILABILITY OF TRAINING DATA

As noted before, the success of AI depends to a large extent on the availability of training data. The more data available, the more algorithms can learn and the better AI offerings will be. Data must be of high quality, credible, timely, and available in machine-readable formats.

A wealth of valuable data is being created in Europe by governments, industry, and citizens every day. Technical, administrative, and cultural hurdles must be overcome to make these data sets accessible for AI across Europe, although different approaches are needed for public data, business data, and personal data. Obviously, these efforts must be compliant with the existing EU regulatory framework, including rules for data protection and privacy.

Public Data

Public agencies produce and commission huge amounts of data. They should make these data sets available for AI stakeholders through open-data portals. SAP welcomes related open-data initiatives by Member States and the European Commission.30 The open-data portal of the European Commission references up to 600,000 data sets across 34 countries, available in 15 different languages, and in machine-readable format. Opening up public data has tremendous economic potential. The 2015 European Data Portal Study forecasts that the market size of open data would increase by 36% to a value of €75.7 billion by 2020.31

However, much more needs to be done. A lack of metadata standards, the costs for providing and maintaining open-data portals, restrictions on the commercial use of public data, and lack of standard open licenses remain bottlenecks that must be addressed. Only 15% of European countries provide more than 75% of their data in machine-readable format. Open-data policies should become a core priority of governments for all Member States.

Moreover, better coordination at the EU level on open-data policies is needed, especially for the exchange of best practices, the development of common standards, and to facilitate access to public data across borders. In this respect, SAP welcomes the review of the EU Directive on the reuse of public sector information and the creation of the open-data maturity indicator, which evaluates open-data policies in portals in Member States.

A wealth of valuable data is being created in Europe by governments, industry, and citizens. We must make this data available for AI applications, especially by having governments boost open-data policies.

30. For example, in France, opendata.paris.fr; and in the United Kingdom, data.gov.uk.
Business Data

Business data generated by companies across industries is essential input for the creation of solid AI solutions. Still, companies are often hesitant to share sensitive business data. Concerns relate to data security, data protection and privacy, and IPR issues. These concerns should be addressed in contractual terms between the AI vendor and its business partners. AI vendors must be committed to strong data governance and policies around data use and sharing.

SAP includes language in its “Cloud General Terms and Conditions” agreement to allow SAP under strict conditions to perform machine learning using customer data and information derived from the customer’s use of a cloud service or consulting service. Moreover, the use of customer data for machine learning purposes is agreed on in the co-innovation projects that SAP conducts with many customers.

Personal Data

There are several AI use cases, such as in healthcare, where personal data is essential for training algorithms. As noted before, the GDPR sets the regulatory framework that states under which conditions companies can use citizens’ personal data for Big Data and AI applications.

There are several tools and approaches foreseen under the GDPR that can help minimize the impact on privacy in AI use cases. Companies have the possibility to enact rigorous technical safeguards. They include pseudonymizing or encrypting data, automated data logging, consent management, data analytics restrictions, access management, and automated data validation. A legal system that is closely attuned to these additional safeguards will enable organizations to maximize data utility while minimizing privacy risks. If companies set tighter controls on access to such data and provide consumers with meaningful controls, it should be acknowledged and encouraged through more liberal legal treatment and lighter obligations.

SAP encourages the European Commission to set up a dedicated expert group to develop recommendations on how to facilitate the availability of training data for AI in Europe. This expert group could be established under the umbrella of the high-level EU AI stakeholder group already proposed.
ESTABLISH GOOD AI BUSINESS PRACTICES

Industry should take responsibility to build trust for AI. To this end, SAP proposes the creation of a code of conduct on good AI business practices. Such a code of conduct should contain basic principles and concrete measures to ensure that AI business operations acknowledge ethical and legal standards. Companies that adhere to the code of conduct should be able to use it for marketing purposes. A code of conduct could help address public concerns around AI and, as such, serve as a market-driven alternative to AI-specific regulation, which might hinder the development of the new technology. It is important that the code of conduct be endorsed by policy makers to help ensure market acceptance.

Areas to be potentially covered by an AI business code of conduct are data protection and privacy, liability issues, and ethics in research. Focus should be put on establishing guidelines for training algorithms. This could include criteria for high-quality, unbiased training data; definitions of AI use cases that may require supervised learning; and guidelines for supervisors who conduct algorithm training. A code of conduct could also contain controls and safeguards to maintain human control for critical decisions.

Some organizations have already developed principles on how to address ethical issues and other concerns related to AI.32 These could be taken into account for the development of a business code of conduct.

The objective should be to establish a global code of conduct for AI since many AI applications and business models will be global by nature. Suitable platforms for such initiatives could be the global partnership for AI33 and the International Chamber of Commerce, which has a track record of establishing globally recognized business standards and guidelines.

Obviously, a global code of conduct cannot address all concerns and challenges related to AI. There may be a need to establish a European code of conduct to reflect specific European requirements or additional codes of conduct that address specific industries or use cases, such as autonomous driving. However, we must avoid a “zoo” of uncoordinated codes of conduct for AI containing conflicting provisions that confuse users.

A code of conduct on good AI business practices could help address public concerns and serve as a market-driven alternative to AI-specific regulation.

32. For example, the “Ethics Commission’s Complete Report on Automated and Connected Driving” by the German Federal Ministry of Transport and Digital Infrastructure or “The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems.”
33. Partnership on AI to Benefit People and Society.
PROMOTE ADOPTION OF AI BY SMES

SMEs are the backbone of the European economy. They account for two-thirds of employment and roughly three-fifths of value added in the non-financial business sector. Broad and speedy adoption of AI and supporting digital technologies by SMEs will be crucial for ensuring future European competitiveness.

However, SMEs are lagging behind in the uptake of digital technologies. The gap between larger companies and SMEs broadens even further when it comes to more sophisticated applications, such as cloud computing, Big Data, the Internet of Things, and AI. The bottlenecks are well known: SMEs lack access to capital, find it difficult to attract and retain digitally skilled talents, and lack managerial capabilities to steer comprehensive digital transformation programs.

Addressing these bottlenecks and fostering AI adoption by SMEs should be a priority. SMEs will benefit the most from the measures outlined above, including a favorable regulatory framework, digital skills development, the availability of training data, and collaboration with larger companies and universities in research and innovation clusters.

Broad and speedy adoption of AI and supporting digital technologies by SMEs will be crucial for ensuring future European competitiveness.
PROMOTE ADOPTION OF AI BY THE PUBLIC SECTOR
As noted above, AI could help to address many societal challenges and could improve public services. Advanced planning and personalization of services through AI could boost public service efficiencies, especially in education, healthcare, and infrastructure.

For that reason, public agencies in Europe should become early adopters of AI. The public sector could also become a role model for AI deployment and demonstrate that the new technology yields tangible benefits for citizens. Moreover, with general government spending at almost 50% of the EU GDP, broad adoption of AI in the public sector would drive the overall development of AI in Europe.

To this end, we encourage the European Commission to work with Member States on ways and means to promote AI adoption in public services across Europe. This could include identifying suitable AI use cases in public services; addressing technical, cultural, and legal bottlenecks for AI deployment; and exchanging best practices.

ENSURE A GLOBAL LEVEL PLAYING FIELD FOR AI
The emerging global market for AI products and services will provide tremendous business opportunities for European industry. Unfortunately, digital protectionism is on the rise globally and creates market entry barriers for European providers.

Therefore, any European AI strategy should contain a strong international market-access component. The European Commission should use all relevant policy instruments – trade, development, and bilateral dialogues – to ensure a level playing field globally and open AI markets for European industry worldwide.

The public sector could become a role model for AI deployment and demonstrate that the new technology yields tangible benefits for citizens.