#A Creative European Approach to Digital Intelligence

Digitalisation and AI in Europe

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Abstract

Artificial Intelligence (AI) is one of the most discussed technologies today. Industry, policy-makers, and the general public alike are debating its role and importance for Europe's economy as well as its potential threats and shortcomings. A large part of the debate centres on a deficit narrative: it depicts other regions in the world as more advanced, focuses on the potential disadvantages and dangers of AI technology, and debates its regulation. Here, we propose a more positive focus, concentrating on the areas where European strengths lie and taking a creative approach to AI and digital technologies. As AI matures into a mainstream field of computer science, it will be necessary to foster European creativity in designing our European digital sphere. Opportunities to build on existing bastions of European strength range from embedded systems within healthcare, to education and Europe's rich culture – all of which are insufficiently exploited in current post-pandemic recovery initiatives. Europe needs to overcome its deficient perspective and create its own digital sphere, not only for prosperity, but also for a value-based approach to new and digital technologies.

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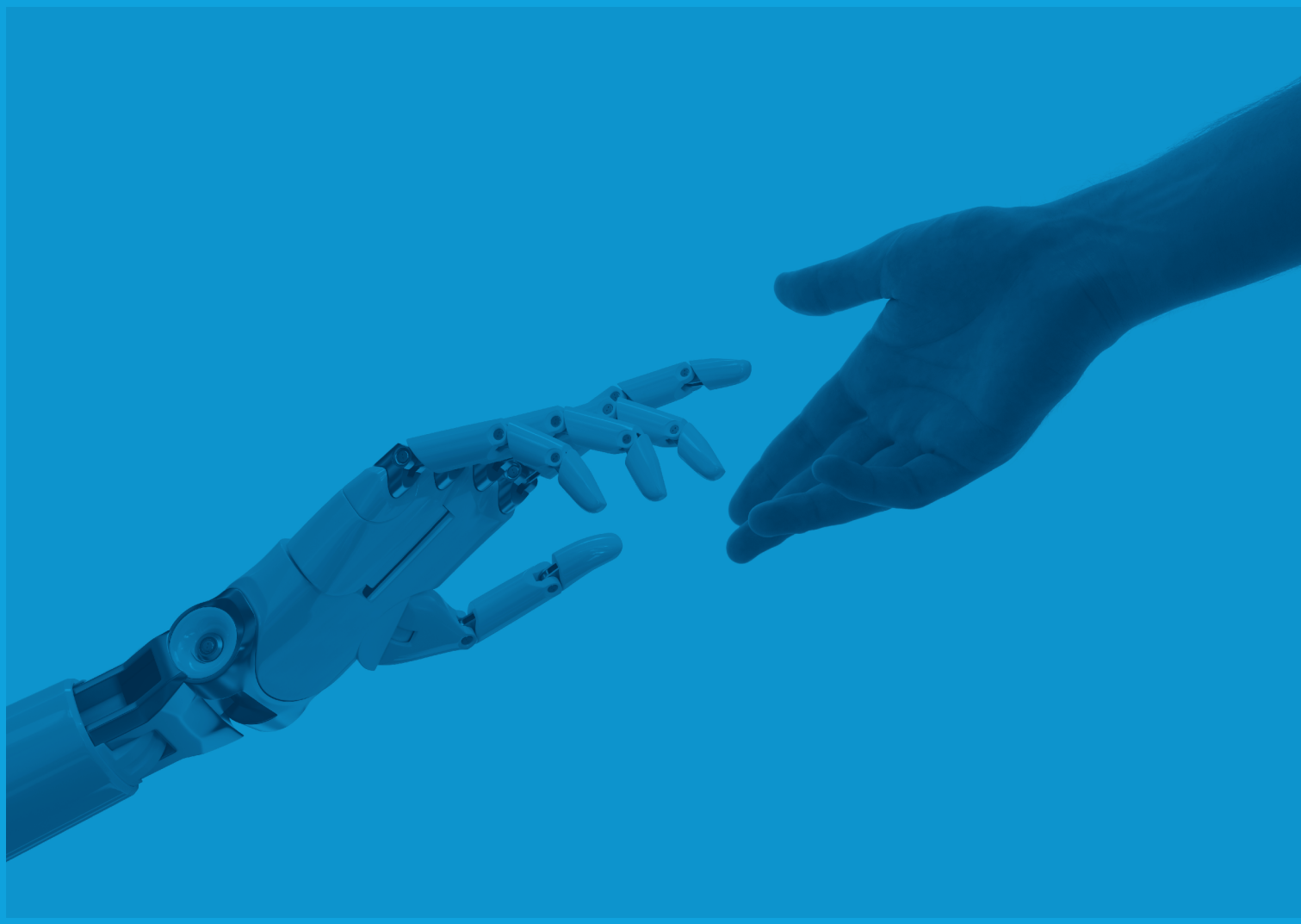
Introduction

When it comes to the broad field of digitalisation, the saying goes that "Europe must close its huge tech gap". The fact that none of the "Big Five" (Google, Amazon, Facebook, Apple, and Microsoft) is of European origin, is often used as a core argument. At the same time, Artificial Intelligence (AI) is seen as an essential technology, shaping businesses and societies alike. The current European regulations and policy debates focus on a risk-based deficit approach. This paper argues that such an approach fails to recognise how AI has thus far been developed, insufficiently furthers innovation and economic growth, and does not prepare citizens to actively shape technological change.

As an alternative, a creative European Approach to digital intelligence is needed:

- We need to see AI for what it is, a loosely and differently defined term, based on machine learning, algorithms, and statistical techniques, which is on its course to becoming one of the many computing paradigms. This means that AI regulation is likely to affect a large part of all software, not only a small niche of applications deemed to be 'intelligent'.
- The creation of "AI" solutions is inherently experimental, and any regulatory framework needs to account for that. Instead of overburdening research and development with regulations and a risk-based approach, an experimental setting which fosters a creative mindset is needed.
- Instead of emphasising deficits, Europe should focus on its strengths, like intelligent embedded systems. A significant number of AI applications do not use personalised data and, thus, the focus on the usage of individual data and risks for citizens does not necessarily match the development and deployment of AI solutions.
- Finally, one cannot regulate every possible risk for citizens. Instead of burdening science and companies with regulatory hurdles to protect "passive citizens", we should focus on education. The goal must be that European citizens become engaged consumers, a well-trained workforce, and responsible entrepreneurs, who actively shape the digital transformation together.



Chapter 1

Understanding AI-based innovation

Artificial Intelligence (AI) is widely believed to be essential for preparing the next wave of innovative products and services. Private and public sectors are drafting strategies and debating the next steps in rolling out AI. However, AI is also poorly defined and, consequently, often misunderstood, including by those debating it (Legg & Hutter 2007). Here, we use the term 'AI' for computing systems that exhibit intelligent behaviour. Systems using AI analyse data, often from sensors in their environment, and act partially autonomously to reach their goals. They work using rules designed by experts or by deriving their behaviour from data.

Innovation using AI has had an impact on consumer markets, industrial applications, and public administration. There was a massive surge in innovative AI applications after around 2015 when the AI market grew from around US$ 5 bn to somewhere between an estimated US$ 17 bn and US$ 34 bn and is now forecast to reach over half a trillion U.S. dollars by 2024[1]. While many people associate household robots and smartphone speech recognition with AI, the industries leading AI adoption are actually located in the high-tech and telecoms sectors, in financial services, and in healthcare and pharmaceuticals. The global corporate AI investment is estimated at over 67bn USD1. It is, therefore, only natural that European policy makers and company managers alike are interested in participating in this massively expanding market. Many countries devised national AI strategies and the European Commission has asked the member states to each present an AI strategy (Van Roy 2020) and a similar exercise exists at OECD level (OECD AI). This poses the question of how to approach AI strategies in Europe and at member state level, i.e. what should drive strategic thinking? In the following, we suggest considering characteristics of AI that are also driving AI-based innovation as a basis for a positive and creative perspective. Body copy with footnote.

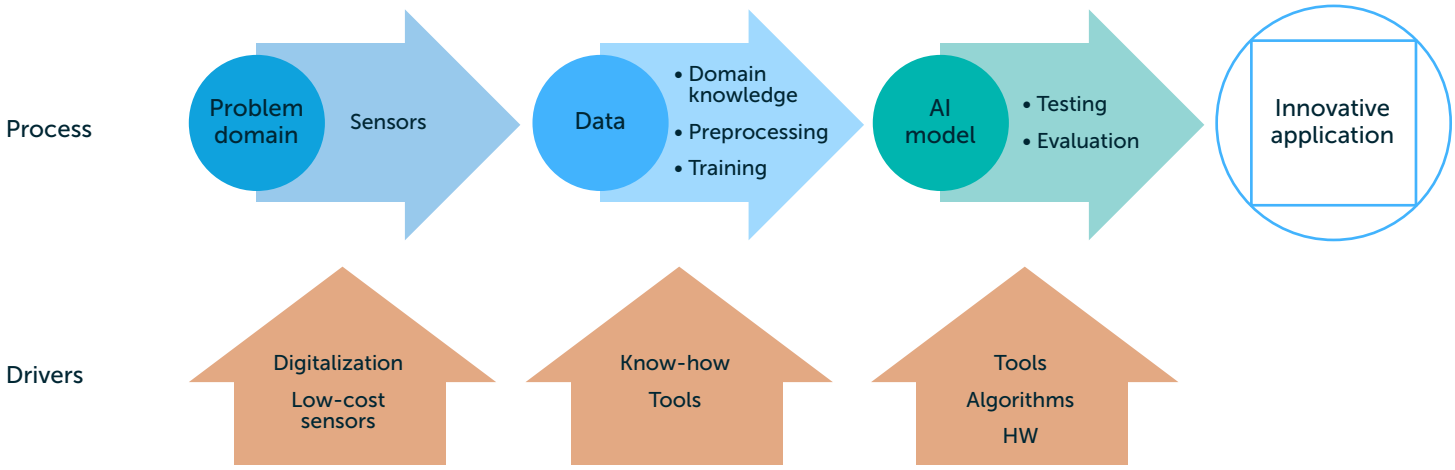
1.1 The AI-based innovation process

From a software perspective, developing novel applications with AI differs significantly from more traditional, algorithmic programming. In part, this is due to the history of AI. In the 1960s and 1970s, AI referred to the aim of early computer scientists (cyberneticians) to make computers smart. The resulting

1 https://www.statista.com/statistics/941835/artificial-intelligence-market-size-revenue-comparisons/ (19-Mar-2021)

field was a rather fractured conglomerate of sub-disciplines of computer science addressing the detection of objects in images, understanding text, transcribing spoken utterances, calculating chess moves, and navigating robots through mazes, etc. These fields made reasonable progress during the 80s and 90s. They addressed aspects of intelligent behaviour, but they did not achieve *general artificial intelligence.* These successes can be attributed to the recent availability of large amounts of data, often due to an increased use of sensors in industry and households. There are also more powerful variants of often older computational methods to create AI models and easy-to-use tools, some of which are available online. Finally, memory, data storage, and high-speed computation have become increasingly available and affordable commodities. The following figure depicts the steps of the AI modelling process: (see figure 1)

Figure 1: An abstract view of AI modelling



An abstract view of AI modelling. Sensors deliver information about a problem domain in the form of data. Knowledge about this data combined with pre-processed data becomes input for an AI model. Such models can be hand-crafted with rules or learned by statistical techniques. The resulting AI model requires testing and evaluation to verify its suitability for the task at hand. Various drivers from low-cost sensors to novel tools operate at different stages.

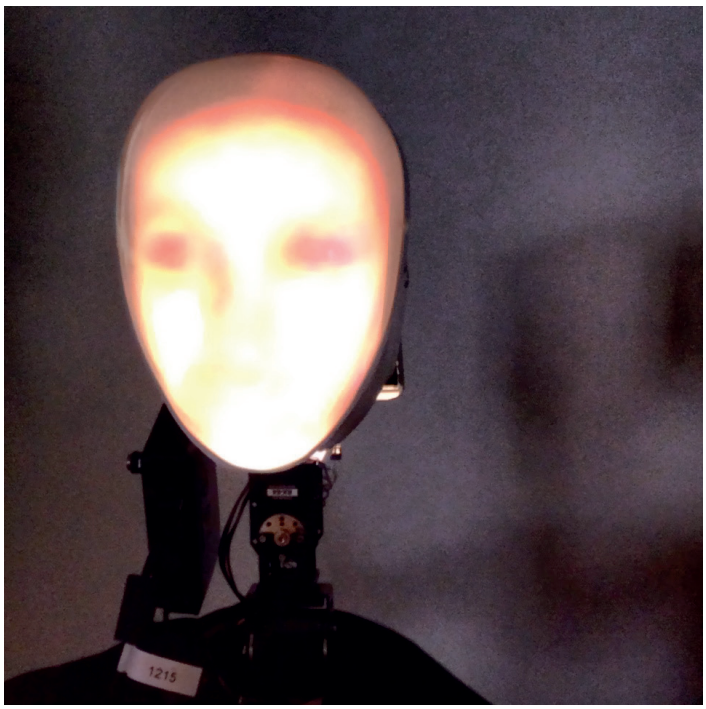


Figure 2: "My Robot Companion: Familiar" by Anna Dumitriu and Alex May in collaboration with The University of Hertfordshire

This process *diverges* in many respects from conventional approaches to computer programming. A traditional approach to developing a computer programme is much more focused on a detailed analysis and a specification of the problem as well as on designing a sequence of steps, i.e. an algorithm, to transform computer inputs (data) into outputs. Such programming typically requires an in-depth understanding of the problem or the system to be modelled. In an AI approach, however, the algorithms are often general learning methods that will fit general statistical models of the input data. The main advantage is that we may not need an in-depth understanding of the problem domain. However, developing the AI model often fails to provide insights in this domain; it only provides a working model.

AI model development and hence AI-based innovation is inherently *experimental.* Even when there is reason to assume that the sensors deliver the necessary information, it is typically only after model building and evaluation that we can know its precise behaviour (Ozkaya 2020, Prem 2021). To make things worse, many AI learning algorithms will create different models even when using the same data in a different order or with different start parameters. Hence, two AI models trained with similar data may have different characteristics – even to the extent that one may be of good quality for the task while the other does not work.

These are important characteristics for both innovation management and technology policies. For innovation, it implies an *experimental, interactive* approach to system design. For regulation and policy, it means being open to failure and the inherent risks. The precise qualities of many AI systems need to be tested more frequently than they can be designed and planned. For innovation managers and policy makers it is thus necessary to *embrace a certain level of risk and surprise, especially in the design phase* of an AI system. (See Figure 2)

Software and other tools facilitate experimentation with data and its application and helps to create classifier and predictive systems without much knowledge of programming. Training AI models from data, i.e. from examples, can liberate creative minds from some of the algorithmic complexities involved in programming. While this does not mean that the resulting components reach professional levels of quality, it makes it easy for interested people to play around with data. This has resulted, among other things, in various artists using AI models, either as part of their works or for creating them.

1.2 Towards a mainstream computing paradigm

It is to be expected that AI will not disappear. In fact, given the emergence of new AI courses and curricula in educational institutions around the globe, it is more likely that AI will become one of many computing or programming paradigms that software developers may use where traditional algorithmic approaches do not work well, e.g. in pattern recognition. In other words, AI methods are currently becoming part of the canon of methods for the programming of computer systems (cf. Alkashri et al. 2020, Fitz & Romero 2021). However, there is only a very limited understanding today of where AI can and will replace algorithmic approaches. For example, we currently have little knowledge of which data characteristics afford the use of high-quality AI models and which problems may not be suited for machine learning at all.

Despite their fascinating and powerful capabilities, AI systems will often be smaller components performing relatively limited – although often important – functions of an overall larger software system. For example, a speech recognition system is likely to contain a trained neural network as an AI component, but most of the input and output, data handling, communication, and other functions are likely to be programmed using more conventional algorithms. In practice, the future of programming, therefore, is likely to see a combination of algorithmic and data-driven programming methods, eclectically chosen depending on available data, task, requirements, and preferences.

An emerging, seamless integration of AI components with traditional programming in combination with an increase of AI-based functionality implies that any regulation affecting AI is likely to simultaneously affect software at large. Therefore, strategies for AI and AI regulation need to consider their potentially wide-ranging impact on software as well as on the aforementioned experimental nature of AI in AI-based innovation. It seems necessary to embrace the risks, focus on opportunities, and to foster creative experimentation. In many cases, however, AI regulation and strategies seem to be conceived from a deficit perspective rather than embracing risks as we argue in the next section.

Chapter 2

A strengths-based view versus the deficit perspective

The enormous promises and potentials of AI technology seem to drive a world-wide race for domination, also called an *AI arms race* (Antebi & Dolinko 2020). Because AI often means machine learning from data, this race includes a race for data and personal data (WHO 2021). There is growing concern that large global players collect data from all sources accessible only by them and that this provides them with an unrivalled capability to develop AI systems. Companies and states worry that they are no longer competing with one another but also with firms (Polido 2020). This also poses ethical questions and has intensified calls for improved regulatory intervention, e.g. (Bartlett 2021, Ala-Pietilä & Smuha 2021). Several international forums discuss AI (e.g. at the level of the OECD) and the European Commission has also reached out internationally to explain and further its data ethics and privacy principles. It has addressed important regulation as a part of the Digital Single Market (DSM) initiative and proposed a new regulation for AI (EC 2021). The challenge is all the greater given that the technologies in question are still developing and it is necessary to consider key challenges resulting from AI, such as changes in skills and the workforce, and legal aspects including, for example, automated decision making.

Today, many national and EU policies refer to Europe's disadvantages and shortcomings in international competition in AI, cf. (Hoffreumon 2021). Apart from the seemingly unrestrained ability to exploit large amounts of personal data, other regions in the world are perceived to invest more than Europe and to more effectively support AI development. In this way, a deficit view has emerged where European strategies emphasise *AI's potential weaknesses* in combination with *perceived European weaknesses,* centering on catching up, avoiding shortcomings, and on regulation. The resulting narrative is rather paradoxical: on the one hand, it navigates between warnings about other regions in the world leading and Europe missing out while simultaneously requiring Europe to mitigation the dangers of AI before it hits any markets. In addition, there is currently a strong European focus on ethical and social threats arising from AI systems including, for example, bias in decision making, transparency, and the threats of large-scale automation replacing human labour. While this narrative addresses important potential dangers, it focuses on deficiencies and threats. Warning about injustice and insecurity, it argues for policing, restraint, and moderation in the development of AI systems. Consequently, it implicitly promotes the requirement for developers to first

understand a complex set of regulations before experimentally developing a new AI project idea.

A good example is the case of data. There is an important role of open data and open source in the light of the peculiar role that IP plays in the ICT world (Nepelski 2019, OECD 2017, OECD 2019). Data and knowledge are typically non-rivalrous factors of innovation, i.e. they can be shared and used by many. On the other hand, the exclusive availability of data and knowledge can constitute important competitive advantages. In short, data plays a key role for innovation. This further increases the importance of data, access to data, and sharing of data and poses key policy challenges in regulating the ownership of data. Above all, there is broad agreement that thriving innovation requires at least some degree of clarity and reliability concerning ownership and data usage rights. In light of this, the concerns about a strategic lack of data are understandable. Unfortunately, such a view is unlikely to create an environment in which AI can thrive. It sends messages of being too small, being too late, and doing too little. Most importantly, it may distract our attention from areas where Europe still has plenty of opportunities to contribute innovative AI for social good. This too will require a liberal, i.e. proactive and positive, approach to developing AI-based innovation, rather than hindering experimentation through overly strict requirements including in the research phase. This simply means to grant some level of freedom also in research programmes and innovation funding activities.

2.1 A positive vision of creation

With its focus on negative aspects and catching up, the deficit narrative does not truly embrace creativity and a willingness to shape technologies for the future through their design. Nor does it seem to embrace the risks inherent to AI-based innovation. We certainly should aim to avoid any disadvantages of AI technology, but we need a more positive narrative in Europe. Technologies are not our fate, they can be formed in positive and fruitful ways and AI is no exception. This requires a much more positive, constructive, creative, and risk-taking, in short, liberal attitude tuned to the special characteristics of AI.

The reason for most strategists to focus on *strengths* to exploit opportunities rather than focusing on overcoming weaknesses, is because it is usually the more effective way to go. Efficient strategies typically focus on strengths and opportunities to avoid investment failures and missing chances. The values of strength-based policies have been particularly well argued for in social policy, cf. (Chapin 1995, Maton et al. 2004). Just improving areas of weaknesses does not deliver excellence.

For example, the above-mentioned inherent uncertainty in developing AI systems means that all stakeholders need to understand the resulting challenges, such as iterative design approaches and continuous evaluation. This means that we require a certain level of freedom to design, to experiment, to operate, and to fail. Europe should focus on areas where data is available and abundant, where there are opportunities to harvest social and economic

benefits, and where the balance between the risks and the possible advantages tilts in favour of the positives. Europe has enormous and continually growing data resources that are candidates for providing essential information to AI models. Rather than lamenting about what we do not have, we need to focus on what we do and take it from there (Hoffreumon 2021).

A positive and liberal stance on AI and its creation also needs to focus on the people who can create it. After all, it is people who design technologies and even though AI systems can learn, it takes people to choose what to learn and why. European challenges due to a lack of digital skills are known to all.[2] From a creative perspective, there should be a strong participation of young people as well as broad and diverse communities in the creation of AI. While this needs to be based on digital skills, it will be even more important that younger generations acquire the necessary skills, such as programming, to experiment with new AI tools. They should be equipped to develop ideas according to their needs and aspirations. Today, levels of digital education differ widely throughout Europe. 1 out of 5 to 1 out of 4 students still never use a computer at school.[3] The required coding and design skills are even more important as those new AI systems will particularly have an impact on the younger generation. Such systems can also provide decisive advantages for groups with special needs. A broad participation in designing and developing AI systems can help ensure that the needs and concerns of many groups in our society are heard.

2.2 Europe is good at many things

A major disadvantage of the AI deficit narrative is that it leads us to ignore European strengths and opportunities for AI-based innovation. Rather than complaining about where we are lagging, it will be more productive to focus on areas where Europe is strong and where we can expect to harvest the benefits of AI most effectively for societal and economic benefit. This means looking for domains where large amounts of data are available, preferably in areas that are either ethically unproblematic or highly promising, i.e. worth the risks. These fields exist: Europe still has an excellent and internationally competitive machining industry – from smart manufacturing and systems engineering to the automotive ecosystem. It can build on well-developed and functioning systems of public administration in many areas including the health sector and education. Its proverbial cultural affluence and diversity have proven robust, even during the pandemic.

2 For a recent account see the Commission Staff Working Document on the proposal for the 2030 policy programme "Path to the Digital Decade", COM(2021) 574 final.

3 ISCED level 2 and ISCED level 3, respectively. Cf. Executive summary of 2nd survey of schools: ICT in education. Objective 1: Benchmark progress in ICT in schools. Study for the EC by Deloitte, Contract number: 30-CE-0819210/00-33, SMART number 2015/0071.

2.2.1 Intelligent embedded systems

Europe's strengths in smart mechanical engineering are perhaps most clearly visible in the automotive sector. Europe's car builders and their suppliers recognised many of the opportunities that electronics provided both in the manufacturing process and even more in the car itself early on (Juliussen & Robinson 2010). This has led to a sufficiently prompt take-up of digital opportunities and resulted in an internationally renowned competence in embedded systems. Embedded systems are computing systems that are built into other devices to help control anything from a car to a heating system in your home. The design, networking, and programming of these integrated computing devices require specific know-how that combines knowledge of processors with knowledge of physics. This area differs from desktop computer systems as it often demands the integration of competencies in the digital world with the analogue world. Throughout recent decades, Europe was able to harvest talent in both fields, often sourcing knowledge about analogue and mixed-signal devices from its new member states. Eastern European countries provided (and in some case still provide) excellent education in this rather specialised area that helped build EU Embedded Systems companies and systems. It would only be natural to now build on this competence and expand it with new and creative approaches to Embedded AI. Examples include novel smart multisensory processing, distributed reasoning systems and decision support for smart automation, improved energy and resource efficiency, robustness, safety, security, etc.

There is an added advantage in the field of smart embedded systems engineering. In many applications, the use of personal data is not in the foreground and often data cannot be traced to a particular individual. This reduces the potential negative impact on user privacy and, in many applications, the focus is not on people at all, but on improved control of machines. Privacy and similar areas are eyed critically, especially in Europe, and they are subject to regulation. Therefore, areas that focus on machine data lend themselves perfectly for considerable experimentation with AI, for example, to build highly reliable, scalable automated machines which harvest European competencies in all the involved research fields from mixed signal systems, embedded systems, and AI, to the mechanical systems engineering domain.

It is no coincidence that embedded devices is one of the few areas where there is still a European semiconductor industry. Only recently, semiconductor company Infineon opened a new high-tech chip factory for power electronics on 300-millimeter thin wafers. The €1.6 bn investment will strengthen the global supply of power electronics chips, used, for example, in energy-saving applications. In addition, the site is twinned with its partner factory in Dresden, clearly an example of cross-European linkage overcoming fragmented national responses. With its focus on energy conversion, it also demonstrates synergies of electronics-based systems for the reduction of CO2 emissions.

The field of engineering provides an environment conducive to AI and digital technologies for another important reason. As a key differentiating factor from

many less technical business sectors, engineering-minded companies often have *access to staff with proper technical skills* and competencies in areas such as mathematics, science, or statistics. Even where the staff are not experts in AI or digital technologies, it may often be easier for such companies to improve skill levels compared to other sectors. The lack of digital competencies has become one of the principle showstoppers of digital innovation in Europe. Already today, companies are no longer able to pursue, let alone realise, all the potentially interesting innovation ideas due to a lack of qualified staff. Engineering companies should exploit their relative proximity to the field of AI wherever possible. Some countries have, of course, recognised the opportunities for AI in this area.[4] But there remains ample room to make the field a thriving area for cutting-edge research and technology development in order to foster abundant sources of investment, stimulate ingenuity, and share a vision of a creative Embedded AI community throughout Europe.

2.2.2 Healthcare

Despite large differences across the EU, our health systems are very good, and some are among the best in the world (OECD Health 2019). At the same time, they are experiencing increasing challenges - climbing costs, increasingly elaborate interventions, complex infrastructure requirements, staff shortages, and regulation to name just a few. Between 2012 and 2018, healthcare expenditure in the EU climbed from €1.177 billion to €1.331 billion.[5] This was an increase of 13%, even before the pandemic. For some member states, costs climbed by as much as 81% (Romania) or 66% (Estonia). Anything that can be done to automate procedures, improve healthcare quality, increase the efficiency of healthcare processes from administration to training will help foster an affordable, high-quality healthcare system in Europe. This includes efforts to help people live healthier lives and manage health problems more easily.

From the point of AI, the health sector is interesting as it has a strong tradition of working with large amounts of data across various systems and actors. While there still are many areas where paperwork literally means working with paper and most systems are not fully integrated, there are also massive opportunities where data could provide information about health risks, both at an individual and a demographic level. There is also vast and growing digital information about treatments, health risks, procedures, good practices, etc. Some of this information is already being used, for example, in molecular tumour boards where doctors often search large data bases for the best treatments for their patients. However, much of this is currently still manual work. Today, doctors and nurses spend massive amounts of time documenting their work, often manually. Beyond documentation, there is a considerable administrative burden from patient management to certification and procedural rules that consume

4 The European Industry Association ARTEMIS-IA https://artemis-ia.eu/ is among the most active promoters of Embedded Intelligence activities and provides a strategic research agenda.

5 | Eurostat (online data code: hlth_sha11_hf)

large amounts of health workers' time at all levels. In short, there is ample room for digitalisation including the use of AI to improve the way healthcare is provided in Europe, even outside of diagnosis and therapy.

While privacy is typically less of an issue in industrial Embedded AI, it is a central concern in the medical domain. From bias in decision making to ensuring patients' rights, there are numerous legal, organisational, and ethical challenges. There are abundant opportunities for creative approaches exploiting novel digital technologies to overcome such challenges. The field of privacy-preserving machine learning and other new methods for provably maintaining people's privacy have made great progress. There is no longer a strict discrepancy between avoiding full transparency of a patient's data and being able to use it for AI.

But there are also huge challenges related to improving interfaces and facilitating collaboration and data provision between various actors within the system. The healthcare system is a complicated network of various public and private actors governed by extensive rules and red tape. Interests and incentives are varied. In addition, health systems are rarely easily interoperable across member states and there is little power in the health sector at the European level – a fact which has been proven by the pandemic. In order to exploit existing opportunities, healthcare actors will require clear rules and practical support in exploiting data for improving systems across the healthcare value chain. The state has ample opportunity to take a leading role. It has data that can be used for third parties, it can incentivise cross-party collaboration, simplify approaches, and support tools and standards.

The healthcare sector provides an immense opportunity to demonstrate the benefits of AI to the public. It can showcase seamless integration from diagnosis to post-treatment procedures or help manage healthy lifestyles. Europe needs more experiments that build on the strengths and overcome the boundaries of national health systems.

2.2.3 Education

The pandemic has made us painfully aware of the role that information technology can play in the education sector. Without the possibility of distance learning and the help of online educational resources, the pandemic would have had an even greater negative impact on the younger generation than it has. It has clearly laid bare the many places in which Europe's digital environment lacks quality and robustness and the points where we reach the limits of what can be achieved in a family household.

From a more positive perspective, the pandemic has demonstrated that it is possible to manage education in different ways. Large groups of students have developed and improved their ability to exploit online resources, collaborate with their peers online, and request targeted support from their teachers where needed. In lockdown, the traditional *one size fits all approach* to teach a class of students often had to shift to a more self-driven, personalised style

of learning. On the downside, this has not worked for everybody, and many students have been left behind. They lacked the infrastructure (broadband), equipment (computers), support, skills, and autonomy to deal with the new situation.

Digital tools including AI can help provide students with new and highly individualised, interest- and progress-driven ways to learn (Song & Wang 2020). Examples exist in practically all areas of teaching. This includes language learning as perhaps one of the most common adaptive resources for students. There is also AI-based software that analyses student errors in mathematics and provides dedicated help based on identified proficiency gaps. While these tools do not and are usually not designed to replace teachers, they can go a long way in providing individualised support and facilitating interest-driven acquisition of competencies. Digital tools can provide a safe environment for trial-and-error – much beyond what students would dare in typical classroom settings. Contrary to its European reputation as a bias-prone technology, AI has also been used to neutrally grade tests and homework. Statistical analysis can also help teachers in better understanding the needs of students and identifying points to improve their courses. Finally, digital tools are mobile and may accompany students throughout the day wherever they are.

It is unclear to what extent the lessons of the pandemic will help re-orientate and expand ways of learning in the direction of digital and AI tools. Unfortunately, the term *'remote teaching'* suggests a one-off intervention that may not lead to lasting changes. However, there are numerous opportunities not just from the perspective of the learner; AI-based teaching software, novel collaborative learning tools and environments, interactive resources for students, community forums etc. all provide opportunities for the creation of new and improved ways of learning supported by digital means.

Throughout Europe, the public sectors of member states hold massive stakes in education. It has the power to incentivise both the development and use of digital tools for learning. It can do this in collaboration with, rather than in opposition to, teachers. And in combination with Europe's multilingualism and cultural resources (see below), there are ample opportunities for pan-European fertilisation in digital education.

2.2.4 Culture

Europe's cultural resources including its lively cultural scene are so abundant that they are sometimes taken for granted. It is true that many regions in the world can combine a rich cultural history with an active arts and culture scene, but Europe certainly stands out with huge public investment, an extremely broad variety of cultural offerings, and an international attraction of its culture for visitors from all over the world. Digital technologies support the preservation of cultural heritage, help manage cultural activities and performances, and provide access to cultural resources of all kinds. Still, digital technologies and AI are often not seen as synergistic with culture.

This is surprising considering that AI concerns itself with essential human and cultural aspects of our lives. The first AI programmes were developed for language or playing board games. They have moved into the realm of language translation. They are becoming tools to provide rich visualisations and virtual experiences of ancient cultural sites and facilitate new forms of interaction for traditional arts. They are also starting to help express human genius from composing music to writing stories or designing architecture. AI has barely scratched the surface of new ways of experiencing European culture and contribute to the creation and reflection of contemporary culture (Boden 1998).

The relationship between digital technologies and culture is not a unidirectional support function where digital tools improve access to cultural resources. Nor should the arts be regarded solely as a playground for experimenting with new digital technologies that then become large-scale product innovations. Digital technologies and the world of art and culture deserve a much stronger and a much more pronounced European approach. The two worlds have long started influencing each other, critically reflecting corresponding developments, and much of our culture is now already *born digital.* Europe has actively shaped this interaction with a wave of electronic arts festivals, schemes for digital preservation of art, or experiments with digital performances. These festivals are often true magnets for broad audiences, and – as opposed to computer science studies – there is no hesitance of women to participate as artists and designers. However, we are still lagging in fully embracing a creative vision of how the digital and the cultural worlds could influence each other.

A cultural embedding and reflection of digital technologies including AI helps to ensure a value-based, human-focused and societally-minded approach to their understanding (Ćosić 2018). Arts and culture can stimulate more than just a passive consumption of digital content. In the right environment, with appropriate tools and guidance, Europe's rich cultural resources can help facilitate active engagement, creativity, and co-creation processes with broad audiences. It cannot be enough to consider Europe's culture just content. We need to find new ways of facilitating productive approaches that reflect our cultural history and European values, including in the design of AI technologies. The technology can and should be shaped according to our preferences and values in view of our culture. Apart from the necessary tools (digital technologies) and material (culture, data, content) this requires people willing and able to create, rather than just consume, what was produced elsewhere in the world.

Chapter 3

The situation today and how to improve it

There are numerous activities that already support the creation of innovative AI and other digital systems in the areas of opportunity for Europe identified above. Many of them have been designed with good intentions and some have found success. But they are generally too little and too dispersed to achieve a more positive perspective on how to approach the challenge of designing our digital worlds.

The *European Recovery Fund* is but one example. The current plans (September 2021) include some significant efforts in digitalisation. At the same time, the activities often lack an effort to learn lessons from the pandemic or focus on a forward-looking, creative approach, as advocated here. The case of Austria can be regarded as an insightful example. Its planned investments in the areas of 'Digital recovery' are not small and exceed the investments in digitalisation of other countries in proportion to their size. However, the topics addressed appear rather focused on the above-mentioned deficit-view. In the area of 'Broadband expansion' the plan addresses Gigabit-capable access networks and the establishment of an internet infrastructure platform. The area of 'digitalisation of schools' remains limited to the provision of devices for pupils and access to *basic digital literacy skills* for all students. In addition, Austria's plans include *digitalisation of public administration* and *digitalisation and encouraging companies to become greener.* This can hardly be called a visionary, forward-looking initiative, which is based on the lessons learned during the pandemic for a creative approach to Europe's shared digital future. These investments all make sense but are, however, lacking aspiration. To be fair, Austria has included further measures under the title of *knowledge-based recovery* which addresses mostly research and education, for example, in the areas of quantum technology and precision medicine as well as research infrastructure. It also includes funding for microelectronics and hydrogen - areas for *Important Projects of common European Interests (IPCEI)*.[6] The educational part, however, focuses mostly on deficits and less on digital aspects, for example, by adding a policy package for remedial lessons *(Förderstundenpaket).*

In summary, there is currently a strong deficit narrative that underlies AI technology policy. In contrast, we propose a more positive, creative approach

4 IPCEIs are EC initiatives promoting core European value chains in selected resource-intense market segments. https://ec.europa.eu/competition-policy/state-aid/legislation/modernisation/ipcei_en

to fostering AI innovation. It suggests focusing on areas of European strengths such as embedded AI, applications in health, and the rich cultural resources in Europe. Education can be a particularly fruitful area for AI experiments. These potential focus areas would facilitate societal and economic benefits and can provide a productive and stimulating environment for a creative approach to European AI. In order to achieve this, we recommend the following:

- Policy makers at European level and in member states should foster a more *positive, constructive, creative, and risk-taking attitude* tuned to the special characteristics of AI, such as its experimental nature. We should focus on areas where rich data is available in Europe, where there are opportunities to harvest social and economic benefits, and where there are clear advantages of AI solutions compared to the associated risks.
- Policy makers and industry should foster a positive perspective of digitalisation, emphasising and facilitating ways to influence the design of technologies including AI. For example, using risk-taking public research and innovation initiatives. While the threats of AI systems need to be addressed, the focus needs to be on a *creative mindset* which facilitates experiments with AI systems in many different directions, from formal technology areas to artistic fields.
- Member states and the European Commission should *facilitate research and development in AI without burdening researchers and innovative enterprises with restrictive regulation* in the research and development phase. Rules for research activities, including publicly funded research, must be clearly distinguished from offering AI-based products and services in the market. For example, while bias in applications should be avoided, it may be acceptable if properly identified and should not limit research or research funding in early technology readiness levels.
- The European Commission and the member states should carefully *consider the costs of regulatory requirements for AI developers.* Where regulation is considered essential, regulators should ensure lightweight procedures and equal treatment throughout the European Union.
- Member states should *facilitate simple and light-weight regulatory sandboxes* in which a diverse set of stakeholders finds it easy to partake.
- The European Commission should initiate and coordinate a *study of positive effects and take-away messages from the role that digitalisation played in Europe during the pandemic* to build on them for the future. This is particularly important for lessons learned in education and work.
- Member states should increase their efforts to harvest the benefits of digital technologies including *AI for education* in Europe. The European Commission should support these activities with benchmarking and best-practice activities, RTDI funding, and pan-member-state collaboration and interoperability. It is important to clarify the role that AI can play to provide *new educational services,* adapt to the varying needs of students, or help relieve teachers of repetitive tasks.
- Member states should increase their efforts to *exploit novel digital technologies for improving education – especially education of the STEM*

subjects. Curricula should include creative ways of investigating and shaping Europe's future. Member states should ensure *broadly available programming skills* as an essential prerequisite for a creative approach to digitalisation.

- Policy makers need to *overcome traditional boundaries of engineering disciplines, humanities, and the arts.* Digital innovation, including AI-based innovation, may flourish best where these boundaries are overcome. This requires increased cooperation between traditionally separate programmes, agencies, and departments of government services.
- The European Commission should *incentivise and facilitate interoperability* between AI-based and other digital services and solutions throughout the European Union. Beyond current activities to achieve a common Digital Single Market, this concerns improved interoperability in areas such as health and education, where the European Commission has only limited competences. The Commission should *foster pan-European awareness,* e.g. through identification of best-practices, support exchange and interoperability and improve information and the awareness of member states.
- Developers and educators should *specifically target young and broad audiences* to let them experiment with AI. Industry and public authorities should jointly ensure that a broad community participates in the design of future AI systems, one which represents a large proportion of Europe's population.

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