# DIGITALEUROPE Recommendations on AI Policy

## Towards a sustainable & innovation-friendly approach

*Brussels, 7 November 2018*

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## ABSTRACT

In this paper, DIGITALEUROPE outlines the main aspects and considerations of a European policy approach towards Artificial Intelligence (AI). This includes both long-term strategic considerations as well as more immediate and ongoing initiatives. We address key topics such as ethics, liability, skills and investment. The paper concludes with an overview of case studies and examples of AI and its role in the renewal and digital transformation of the European industry.

We take current legislation and governance as the baseline, in assessing how today's regulatory framework is often equipped to answer questions related to AI, as well as noting how various rules should take into account the broader innovation and data economy perspective, to boost research into AI technologies and stimulate their uptake among businesses and citizens. A common European AI policy should encourage developers and practitioners towards a sustainable deployment of AI, as well as building trust with users.

DIGITALEUROPE and its members, across business and national trade associations, aim to be a constructive, informative and collaborative partner in the policy discussions around AI. We find that a multi-stakeholder approach, built on research, evidence and proportionality will be the foundation of a forward-looking and sustainable AI regulatory landscape. This ensures that policy remains dynamic and fluid, adapting to the constant evolution of technology. We build on the strengths of European innovation while keeping a global perspective.

# FOREWORD

The European Union is uniquely positioned to take a leading role towards a human-centric approach for an Artificial Intelligence (AI) policy. The development of shared principles for the ethical and sustainable development and application of AI would aid in building trust among users, both citizens and businesses, and create certainty to support investment and uptake of AI research and services across Europe.

By encouraging and accelerating the development and use of AI algorithms and tools the EU stands to gain, not only in jobs and economic growth overall, but the creation of many new start-ups that will develop important solutions. Many of these solutions will be life saving technologies, addressing serious issues such as climate change or energy scarcity or will help provide inclusionary services.

We have many examples in the annex section that provides use cases of such solutions. For example, the use of big data analytics that is helping oncology research to process huge amounts of data for the development of gene therapy. Other examples are tracking endangered species, improving agriculture, and ensuring our roads and railways run safely. This paper also includes examples where companies are helping to close the gap on the digital skills that are required or developing AI tools that check for bias and discrimination in the data sets that are being used.

As technology develops, computing power and speed increase, and more data becomes available due to increased industrial and Internet of Things usages, the overall impact and uptake of AI is expected to grow significantly. If managed properly, AI is a tremendous opportunity for European society as a whole.

We are still incredibly far removed from a world where autonomous robots could pose a threat to society. But it is also the case that AI is being employed already in many sectors, industries, businesses and governments. Therefore, a discussion on the best environment for a sustainable development and ethical use of AI should be fostered. A new framework should be broad enough to allow innovation and new solutions and be proportionate to the application and impact of AI.

However, much more work needs to be done in the EU which will require more incentive based legislation to close the gap that exists in AI. For example, only 10-25% of large to small enterprises are using big data analytics. A more alarming statistic is that 83% of all AI investments will be done outside Europe. More needs to be done to accelerate adoption

To fully realise that potential, and to achieve a wide and sustainable uptake of AI across society, we need to ensure that development policy and deployment strategy is underpinned by human-centric and European values. Given the diversity of AI use-cases, this will not be achieved by a one-size-fits-all solution. Proportionate and targeted action will have the greatest impact, allowing for continuing innovation.

Policy debates will also be fruitful if they rely on a common understanding based on dialogue between all actors, in Europe as well as globally. The European Union has a key role to play in

forming a platform for discussion and coordination, and to put in practice a robust AI industrial strategy – where one of the key priorities should be the quick take-up of AI solutions in European businesses.

The EU, national governments, industry, AI developers, labour and civil society will need to work together towards a responsible, 'trusted AI' framework, ensuring values and ethics in design and implementation while fostering innovated solutions and applications. Stakeholders need to partner with each other to deliver a positive realisation of AI, to build R&D eco-systems and stimulate uptake. This requires forward-thinking policies on data, education and infrastructure.

At DIGITALEUROPE, as we strive towards achieving these goals, we identify the following key recommendations to unlock and enable real progress in Europe for Artificial Intelligence:

- Foster a debate on values and ethics, across all partners and stakeholders. Targeted initiatives, based on evidence and analysis, will have the best results towards addressing fairness, accountability and transparency concerns in a pragmatic and effective way.
- Take immediate action for stimulating AI development via current and ongoing legislative initiatives, in particular as regards to data access. This would also reduce bias from poor data availability and level the playing field for AI research and development.
- Implement a forward-looking approach in the fields of education and labour. Innovation is needed to rise up to the challenge of a rapidly changing labour market, with clear strategies for developing the skills in the future (digital) workplace.
- Support the above actions via a comprehensive investment and funding strategy. This must also be in coordination with the EU Member States, to build on each other's strengths.

*Cecilia Bonefeld-Dahl*
*Director-General, DIGITALEUROPE*

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## 1. Definitions

In the formulation of a European policy for AI, it is first necessary to outline its various aspects: its scope, usage, underlying technology and applications. Artificial Intelligence is as such not a singular technology, nor a clearly delineated type of service or product. Technologies such as advanced analytics deep learning and machine learning, etc., are already being used in many fields and are constantly evolving. They can become a component of existing products, a tool to advance research or become the foundation of an entirely new service.

Therefore, to quickly outline the main terminology:

By *Artificial Intelligence*, today, we indicate a level of advanced or high-level processing capability of a machine, robot or software, with some degree of self-learning and reasoning. This can be very focused on a specific task (also called 'weak or 'narrow' AI, e.g. optimising electricity usage on a smart grid) or more general (e.g. an advanced chatbot). We are still quite far removed from AI that would exhibit the same (or higher) level of intelligence of a human being (sometimes called 'Artificial General Intelligence').

AI is based on the perception and interpretation of vast amounts of information (data), which might originate from multiple and heterogeneous sources, such as sensors, images, language or text. From this information, software draws conclusions, learns, adapts, adjusts parameters accordingly (e.g. in feedback loops) and generates hypotheses. In the end, it reaches decisions on its own or makes recommendations that human partners can use to underpin their own actions.

An *algorithm* is a series or set of instructions and operations. This can be a very simple or a very long and complex set of software and lines of programming code. It is the 'recipe' by which to process the input and data supplied to it. Algorithms as such are nothing new – it is only the more recent influx of big data and advancements in machine and deep learning technology that have fostered the development of more advanced types of algorithms.

*Machine learning* and *deep learning* are processes and techniques whereby algorithms or combinations of algorithms analyse vast amounts of data, process it or interpolate results, and then re-use this output again as new input. Eventually, this continuous process can start to reach levels of abstraction by which the link between the original input and output is not immediately visible.

This is sometimes called a 'black box' situation and can occur when the link between input and output data in a deep learning process is not immediately clear or easy to discern. Industry and researchers are using and developing techniques to visualise or re-construct such processes, in order to achieve intelligible information of AI-driven decisions.

An example can be analysing images and identifying its content – by supplying the software with a large data set of image files, and with certain instructions what to compare for, the algorithms will eventually start making links and interpolations between the images and 'realise' the differences between a photo of a cat or that of a dog.

## 2. Building Trust

### a. Transparency, Explainability, Bias and Accountability

One of the most important and highlighted topics in the public discourse regarding Artificial Intelligence is the 'uncertainty' or lack of clarity about its usage. Citizens and businesses are not sure when algorithms or computer programmes are being utilised, who (or what) is taking part in the decision-making process and what factors and elements are playing a role.

For Europe to reap the benefits of AI, it is important for people to understand when and how it is applied. In this context, we view 'transparency' as meaningful information to users about their interaction with an AI-powered service or product. We believe such disclosure, proportionate to the product's and service's purpose and context, will enhance users' trust in the technology and facilitate uptake across the board.

The other dimension to this is interpretability. A certain level of clarity should be envisioned on why a model returns a certain outcome. This can be delivered in different ways, which we explore below. The level of transparency and explainability will vary depending on the application. Machine learning being used to assist critical decision-making with a direct impact on human healthcare for example raises different concerns than AI used for logistics and supply chain management. The industry fully recognises the need to provide meaningful information and facilitate the interpretation of algorithmic decisions.

Several approaches could be considered to address concerns related to the usage of AI, transparency and explainability. DIGITALEUROPE advocates for a strategy that is proportionate, flexible and adequately recognises the vast spectrum of different AI applications. In the following pages, we put forward several principles on transparency and explainability, and look at the question of bias and algorithms.

### b. Proportionate framework and safeguards

Artificial Intelligence, and related technologies including algorithms, advanced and predictive data analytics are already being used to great benefit in a vast array of sectors, with uses ranging from managing critical infrastructure, government systems, to online shopping assistants and GPS navigation software.

DIGITALEUROPE expects that there will be only a limited scope for a 'one-size-fits all' approach to AI policies or regulation. Instead, proportionality will be needed to assess when an AI application requires particular scrutiny. This can be achieved by a combination of updated sector-specific principles and – if needed – guidance for specific use cases. Existing rules can often already be adequate to address many of the concerns, such as on bias and discrimination.

A set of specific provisions within the General Data Protection Regulation (GDPR) affect AI-based decisions on individuals, particularly those related to automated decision-making and profiling. Many of these are contained in Article 22 of the regulation. Article 22 is a general restriction on automated decision-making and profiling. It only applies when a decision is based solely on automated processing – including profiling – which produces legal effects or similarly

significantly affects the data subject. This wording sets a high threshold for triggering the restrictions in this provision. Moreover, the stricter information requirements of Article 15 are specifically linked to automated, individual decision-making and profiling that fall within the narrow scope of Article 22.

Despite the narrow applicability of Article 22, the GDPR includes a handful of provisions that apply to all profiling and automated decision-making and of course all GDPR provisions also apply – including, for instance, the principles of fair and transparent processing.

One of the most frequently debated topics in the context of GDPR and AI discussions relates to the so-called GDPR "right to explanation". Despite common misinterpretations, the GDPR does not actually refer to or establish a right to explanation that extends to the "how" and the "why" of an automated individual decision. "Meaningful information about the logic involved" in relation to Article 22 of the GDPR should be understood as information around the algorithmic method used rather than an explanation of an automated decision. For example, if a loan application is refused, Article 22 may require the controller to provide information about the input data related to the individual and the general parameters set in the algorithm that enabled the automated decision. But Article 22 would not require an explanation around the source code, or how and why that specific decision was made.

### c. Meaningful insights, explainable AI, interpretable models

When it comes to transparency and explainability, concerns could remain on how the AI interaction between algorithm and data actually works and how to ensure that this process is in line with European ethics and social norms. We have clarity on what factors influence a system – we know what data it was fed – but there are challenges around understanding how that information was combined to arrive at an output. Human reasoning works in a similar way, as most of us would not be able to describe the exact process behind their decisions.

With AI systems, we can actually take action to make this decision-making process more equal and fair. As industry, we consider it the aim **to provide intelligible and meaningful explanations of AI-based decisions.**

When we talk about explainable AI, we should therefore not understand this as a public disclosure of the software programming code. Instead, initial considerations of algorithmic transparency have quickly demonstrated this is not the way forward. Disclosing an algorithm would not be informative to users and would be a challenge for Intellectual Property Rights and security. In some cases, public disclosure could also facilitate abuse and undermine the algorithm, whether it is 'gaming' the ranking on a commercial website or breaking cybersecurity systems.

Explainability of AI should then rather be understood as the interpretability of models and its interaction with the input and training data. This affects both the data quality and input, as well as aspects of the output data and how to 'reconstruct' the algorithmic method.[1] A much

[1] This includes techniques such as Partial Dependency (PD) Plots, Individual Conditional Expectation (ICE) Plots, Local Interpretable Method-Agnostic Explanations (LIME) as methods that offer insights into algorithms at varying degree of details. There are various industry initiatives towards visualisation and tracking of data as it is processed

more impactful way to guarantee visibility into an AI system and to offer a meaningful insight regarding the rationale of an AI-based decision, is instead to focus on the training data and the resulting model. This includes continued research on how to ensure interpretability, by testing and analysing the model rigorously and looking carefully at the training data.

Industry and academia researchers are already developing techniques giving more information and context behind AI-driven decisions. Principles and guidance are being produced to assist developers in making systems auditable from the start. This effort meets the needs of the users, but also of the practitioners themselves, who want to build better models and ensure that the AI is fit for purpose.

DIGITALEUROPE supports an EU stakeholder dialogue to exchange on current and future trends and research in this area in order to inform the policy considerations around explainability and transparency. An open and educated discussion on AI will be essential to form the principles for a proportionate and risk-based approach regarding intelligible and meaningful explanations of AI-based decisions.

### d. Fostering fairness and tackling bias

For AI to be beneficial for society at large, we must tackle a very important concern: how do we ensure AI systems make fair and objective decisions, without being skewed by bias hidden in the data? Bias itself is a not necessarily good or bad. For example, the intended function of a CV screening is to have a 'bias' towards certain characteristics of the candidate that fit the vacancy. It would not be acceptable of the screening system to be biased towards a certain gender, race or demographic.

Such unwanted discriminatory bias could be the result of subconscious or historical behaviours. Removing sensitive data from the data set – like gender or race – might not solve the problem: the model might pick up the bias by recognising patterns between proxies of data (e.g. linking socio-economic demographics with location and zip code data).

Limited and non-diverse datasets can therefore shape the algorithm in an unintended, but very damaging way. The biases may lie in the data, but they can also be the result of the personal experience of the data scientists who build the models. They might fail to identify the lack of diversity in a dataset or overlook problematic results. Whatever the case, it is clear that the dataset is key in ensuring the model provides acceptable outcomes.

AI models will never be completely free of bias, as bias permeates our world and societies. Yet, there is a lot we can do to minimise the problem and constantly improve models. In order to try avoiding such problems in the first place, especially as regards implicit biases, and to ensure ethical, fair and accountable AI, many companies have set in place constant re-evaluation processes, to detect divergences and anomalies, and to quickly correct these flaws. This also requires to an equal degree diversity across input and high-quality datasets, and among designers and software engineers for the output evaluation. It is also important to ensure

(input, thru-put and output), for example: https://distill.pub/2018/building-blocks/ or, for data sets, https://pair-code.github.io/facets/

appropriate training for data scientists and software engineers, so they can acknowledge and address their own biases.

Further, one of the ways to reduce bias is to place attention on the quality of data sets. The higher the quality of the input, the higher the quality of the output. This, combined with training and education of the designers and users of AI and algorithms, will help to prevent discrimination but also to better detect and correct issues as they arise.

DIGITALEUROPE believes that it is important that governments and stakeholder bodies discuss the principles and the ethical and social norms which should underpin the use of Artificial Intelligence. Public sector in particular can take a key role in using AI to reduce bias in decision-making processes and to lead by example. It is in any case clear that the issue of discriminatory bias warrants a broad and public discussion.

### e. Relationship between AI and other EU policy files

AI policy cuts across sectors and regulatory fields. It cannot be assessed in a vacuum or as a niche, but instead must be part of a holistic strategy. Assessing the role and impact of a policy file on AI and the broader data economy should be a recurring exercise. For example, DIGITALEUROPE would highlight the following current and ongoing legislative files:

**ePrivacy Regulation:**[2] AI and machine learning rely on innumerable data points collected from our devices, be they smartphones or machine-to-machine (M2M) and Internet of Things (IoT) applications. All these devices are considered 'terminal equipment' for the purposes of the proposed ePrivacy Regulation and many of them will be linked to communications features, thus being subject to inflexible rules built around basic telecoms services.

The proposed ePrivacy Regulation would seriously restrict companies' ability to use communications and device data, which in many cases may even be non-personal, for legitimate purposes such as AI-driven research and development into new products and features. It would also severely restrict the use of AI and machine learning to improve the detection and patching of cybersecurity vulnerabilities, which need to process massive amounts of data to protect users, services and infrastructure from increasingly harmful attacks.

**Public Sector Information Directive:**[3] Public sector creates large quantities of data, for instance geographic mapping data, air quality data, and economic statistics. In 2017, it was estimated that the current economic impact of solutions based on public data would be representing at least €52 billion per year in the European Union.[4]

[2] Regulation 2017/0003(COD) - http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2017/0003(COD)&l=en

[3] Directive 2018/0111(COD) - http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=&reference=2018/0111(COD)

[4] Deloitte, "Study to support the review of Directive 2003/98/EC on the re-use of public sector information", Impact Assessment support study, April 2018, https://publications.europa.eu/en/publication-detail/-/publication/45328d2e-4834-11e8-be1d-01aa75ed71a1/language-en

Access to and re-use of public sector data is critical for the development of AI. Restrictive control over data means that not all companies will be able to enter the AI market or that their AI solutions will not be as competitive due to the lack of data available to train their systems and to extract information from. Access to datasets is therefore essential to create a competitive AI market and enable AI R&D.

The PSI Directive (originally published in 2003, now expanded and up for review) establishes the framework to encourage access and allow the re-use of public sector data, based on the principles of free flow of data, transparency and fair competition. The current review is aimed at fostering cross-border innovation based on AI and big data solutions.[5] It will help strengthen the position of companies by reducing market barriers to re-using public sector data for commercial purposes. It also extends the scope to public utilities and transport, to reduce the cost of re-using data and give real-time access to relevant data.

Copyright in the DSM Directive:[6] Copyright legislation, which is already very fragmented across Europe, could pose strong obstructions to AI development by blocking and complicating data analysis. Text and data mining is a common technique whereby researchers and industry gather information via an automated process (for example, by 'reading' through information on websites). This information and data are then analysed and used to train AI and machine learning.

Even though there is no new publication of that copyrighted content, the Copyright Directive would block text and data mining activities and require licenses and permissions. This contrasts with other countries, such as Japan, which explicitly permit text and data mining under a 'right to read, right to mine' principle.

Equally, provisions applicable to platforms and cloud services, via the expanded liability regime and potential filtering obligation of the Directive's article 13, may hold back the development of much-needed commercial data sharing platforms that are needed to access and analyse vast amounts of data between European businesses and the public sector.

New Deal for Consumer package:[7] The review of the 2011 Consumer Rights Directive, as part of the 'New Deal for Consumers' package, aims at increasing transparency requirements for contracts concluded on online marketplaces, requiring the disclosure of main parameters determining ranking of the different offers, which often represent a core part of the competitive advantage of each business. This provision, if adopted, could endanger trade secrets, potentially infringe intellectual property and lead to seller competition abuse to achieve top rankings.

Additionally, the Commission's proposal aims at reducing pre-contractual requirements in case of distance communication with limited space or time to display. This could bring further

[5] European Commission, Impact assessment on the PSI directive, staff working document, April 2018.
[6] Directive 2016/0280(COD) - http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2016/0280%28COD
[7] Directive 2018/0090(COD)- http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2018/0090(COD)

flexibility to present information to consumers without necessarily having to demonstrate the information on a screen, such as through devices where AI is built in.

**Platforms-to-Business Regulation:**[8] The Regulation 'on promoting fairness and transparency for business users of online intermediation services and online search engines in the Digital Single Market' (also known as the Platforms-to-Business or P2B Regulation), similarly to the aforementioned Consumer Rights Directive review, would affect AI design by leading legislators to impose rules on the complex area of ranking by algorithms.

### f. Policy recommendations

From this brief look at the questions related to AI and algorithm transparency, explainability and bias, the importance of data and with the aim of forming a European value-based, ethical approach to AI policy, DIGITALEUROPE would put forward the following key principles and proposals:

- **Encourage stakeholder dialogue and discussion fora, such as the High Level Expert Group as initiated by the European Commission**

DIGITALEUROPE welcomes the actions proposed by the European Commission so far, in its Communication on 'Artificial Intelligence for Europe' (April 2018) and its proposed high-level AI Alliance expert group.

Cooperative and joint work between actors across government, civil society and private sector can help develop a fundamental layer for Artificial Intelligence aligned with European values. Broad stakeholder engagement ensures that the technical and practical expertise is matched with the political, ethical and social goals of Europe. This should be paired as well with an eye towards the global context, in order to formulate robust common principles and take a leadership role for others to follow.

DIGITALEUROPE also strongly supports strategies to build up the technical expertise internally within government and regulatory agencies, with scope to share best practices across public and private sector. This should initially be analysed and implemented per sector, rather than creating a centralised AI Observatory or agency. We further strongly encourage initiatives for fostering stakeholder dialogue, building alliances, and especially for improving the coordination between EU institutions' and Member States' policies.

- **Exchange on key principles for a proportionate and risk-based approach towards transparency, explainability and bias**

To build trust and foster the uptake of AI, a European approach with clear principles should be discussed. A holistic and comprehensive overview is necessary, to give clarity to users and

[8] Regulation 2018/0112(COD) - http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2018/0112(COD)

developers alike. Policy coordination at EU level will be essential to avoid divergent or conflicting obligations, while ensuring that European values are respected and safeguarded.

Concerns around transparency, explainability and bias are not necessarily unique to algorithms, or are already addressed by both sector-specific as well as horizontal (and non-AI specific) regulation. The first task should be to examine to what degree the existing regulatory and legislative framework could be made more effective by additional clarification and guidance documents, or targeted amendments.

To the extent that, in a stakeholder dialogue, further need for action is identified, DIGITALEUROPE would advocate a proportionate and risk-based approach shared across the EU or even on a global level.

Further, and in the meantime, industry is already working hard to advance explainable AI research, formulate codes of conduct and establish internal auditing and accountability processes to detect and correct bias or unwanted algorithm behaviours and outcomes. DIGITALEUROPE's membership shares the ambition to deliver intelligible and meaningful context on AI-based decisions.

Many of DIGITALEUROPE's members consequently take part in discussion fora and the development of broad, common principles on AI development and deployment. This includes both contributing with policy insights as well as technical expertise and research. For example:

- Partnership on AI[9]
- IEEE principles on Ethically Aligned Design[10]
- The Asilomar Conference on Beneficial AI[11]

- A better data economy and policy framework for AI R&D in Europe

In the immediate term, one thing that stands very clear is the reliance of AI on the availability of data. It is the main resource on which AI algorithms, machine and deep learning are trained and developed. Using high-quality data sets are also incredibly important in striving towards reducing bias and imbuing values of diversity and fairness into an AI process.

Therefore, DIGITALEUROPE calls on EU and national decision-makers to take concrete action to boost European leadership in AI by addressing current and ongoing legislative issues in this area. This means an improved and robust data policy framework with positive and forward-thinking initiatives such as the Free Flow of Data Regulation and the Public Sector Information Directive. Roadblocks towards access to data should be reduced as much as possible, for instance through a broad text and data mining exemption in Copyright policy and through flexible and innovation-friendly implementation of GDPR and Privacy standards.

These measures will contribute to more R&D work being done in Europe, helping to safeguard ethics and social norms in the development process. Access to diverse and high-quality data

[9] https://www.partnershiponai.org/
[10] https://ethicsinaction.ieee.org/
[11] https://futureoflife.org/ai-principles/

sets will not only help EU companies catch up in the training and development of algorithms, but also take a leading role for a global, sustainable and human-centric deployment of AI.

## 3. Liability

The European Union features a robust and balanced regulatory framework concerning liability and safety of new products and technology, including for example the Product Liability and Machinery Directives. Standards, safety requirements and cybersecurity norms are among the highest in the world, fostering consumer and business trust. In the context of Artificial Intelligence, robotics and related technologies, a common question raised is whether the existing regulatory framework is fit for purpose. Risks should be identified in the first place to assess whether existing legislation is adequate. Also, only then it would be possible whether the risks are fairly split between all parties involved.

DIGITALEUROPE understands that the interaction between AI, Internet of Things and other connected devices can produce a larger degree of complexity. It is important that existing norms and standards are not reduced or endangered with the advent of these technologies. The existing safeguards should not be lowered or put at risk.

In order to maintain these safety standards, while at the same time ensuring competitiveness and innovation in this early stage of technological development, DIGITALEUROPE advocates for a balanced and stakeholder-driven approach. The first step of any action should therefore involve the thorough assessment of the existing regulatory framework. This assessment should further bear in mind that an all-encompassing liability regime for the various types, sectors and layers of AI deployment would be impossible. Applying an analysis based on identifying risks would be a way to more adequately assess the existing legislation and, for example, whether these risks are fairly split between all the involved parties.

In practice, we see that the Product Liability Directive and Machinery Directive have worked and continue to function well. Even with new technologies, the underpinning foundations, rules and responsibilities remain clear and offer legal certainty to the various partners in the value chain, including consumer and business end-users. We see this recognised also in the recent assessments and consultations carried by the European Commission.[12]

Further analysis on the complex matter of liability, negligence and fault, and the attribution of risk and accountability should be done in an informed and evidence-based manner.[13] DIGITALEUROPE looks forward to engaging with stakeholders such as the European Commission Expert Groups in this constantly evolving discussion.

[12] http://ec.europa.eu/growth/content/public-consultation-rules-liability-producer-damage-caused-defective-product-0_en

[13] https://ec.europa.eu/growth/content/call-experts-group-liability-and-new-technologies_en

## 4. Education, Skills & Training

### a. Impact of AI on jobs and labour markets

The widespread usage of Artificial Intelligence and robotics will have a profound impact on economy and society. These technologies are invaluable tools for supporting and enhancing the work and skills of people in the labour market. For many jobs and professions, this will make several tasks much easier, less burdensome and more efficient. Some tasks and roles may be replaced, while other functions and the need for new skills will emerge. Human specialists will remain necessary to work alongside and even guide AI software and robotics, in a new type of collaborative workplace.

The changes on the labour markets are already visible. Jobs involving significant amounts of repetition have already been affected by technology and remain at a high risk of automation. According to OECD studies carried on their member countries over the past two decades, labour markets have been polarised, with a rise in the share of both high- and low-skilled jobs, on the one hand, but a fall in the share of medium-skilled, routine jobs, on the other.[14]

AI technology can also contribute to a more efficient labour market at a time where European countries are experiencing lower productivity, an aging workforce, and increased global competition. Location, language or other obstacles might cease to be a barrier. The introduction of robotics in factories has already led to increased safety and productivity, while AI analysis has made huge strides forward in delivering more accurate and objective results, for example in healthcare.

The debate about the impact of AI on labour markets is dominated by the long-run perspective, which is difficult to assess due to the lack of reliable data to make such predictions. To this effect, the inaugural meeting of the European Commission's High-Level Expert Group on the Impact of the Digital Transformation on EU labour markets[15] took place in September 2018. One of the group's tasks is to identify potential social impacts of the large-scale application of AI, and the expected job losses and gains. By early 2019, the group is expected to produce a report with policy recommendations.

The biggest challenges in reaping the benefits of technological progress would be quickly predicting which skills would be needed in the near future (something which AI analysis may even help with), modernising Europe's education, improving training systems, including upskilling and reskilling, introducing lifelong learning during the whole working life and later, as well as building a robust social framework to safeguard against the most disruptive changes and protect people who would be most negatively affected.

Overall, AI technology needs to be developed in unbiased and inclusive ways to ensure that it reflects on the society as a whole – a more diverse and demographically representative participation of programmers, AI experts and designers, will help realise this goal.

[14] OECD Employment Outlook 2017, available online: https://read.oecd-ilibrary.org/employment/oecd-employment-outlook-2017_empl_outlook-2017-en#page14

[15] https://ec.europa.eu/digital-single-market/en/news/call-expression-interest-high-level-group-impact-digital-transformation-eu-labour-markets

### b. Policy proposals

In order to ensure that Artificial Intelligence and its digital transformation will benefit people and society as a whole, DIGITALEUROPE advocates as a fundamental principle the continuous dialogue between all stakeholders across governments, education institutions, employees and trade unions, employers and businesses.

DIGITALEUROPE proposes that all stakeholders work together towards the following actions:

- Modernise education curricula

Ensuring that the whole society possess at least basic digital skills should be a common and immediate goal. At the same time, we must also aim at supporting development of advanced skills, across both science and engineering, as well as arts and culture. The workplace of the future is unknown and unpredictable. Therefore, Europeans should not only be digitally literate, but also foster the right mind- and skill-set to create innovative solutions.

STEAM (Science, Technology, Engineering, Arts and Mathematics) education and careers should be further encouraged; they are the backbone of Europe's digital skill set. STEAM has also proven to attract a growing percentage of female careers (in some cases 50% or more) – a trend that should be further promoted. We also need completely new forms of education that are modular and easily scalable.

- Improved data analysis and reporting

Flexibility in terms of adjusting training and education will be crucial to adequately prepare for the digital transformation impact of AI on the labour market. To have that fast response, more effort should be put on comprehensive data collection, analysis and interpretation on the national and European level, in order to better predict the skills needs and adjust trainings accordingly. This could include adding new indicators to Eurostat reports regarding the labour market and impact of digital transformation.

- A continuous professional development framework

EU policy should foster investments in training, upskilling and professional development during the whole working life. We encourage the European Commission and Member States to exchange and collect best practices, develop roadmaps for attaining the necessary skills based on industrial and practical use cases, and to introduce schemes supported by EU funds and programmes. For Member States, re-training of the workforce should be part of national training funds and tax incentives schemes.

- Reflecting market relevance in trainings

EU funds and programmes should support and be included into a comprehensive plan for investment into digital skills and new technology. For instance, the new Digital Europe Programme aims at boosting frontline investments in *inter alia* advanced digital skills (including

AI) through specialised courses and internships in companies deploying advanced technologies. This is a step in the right direction, provided that quality assurance of these trainings is ensured. The scope of the current European Globalisation Adjustment Fund should further be broadened to cover also redundancies caused by digitalisation and automation.

In order to build on a holistic and comprehensive strategy, we also advocate a stronger promotion and support of business-education links and public-private partnerships. Cooperation and coordination between all stakeholders and actors on the labour market needs to be improved. For example, this can be strengthened via Erasmus and similar education and exchange programmes.

## 5. Investment & Uptake

### a. EU funding for AI: a steady rise

Since 2004, the European Union has been allocating significant funding to cognitive systems, robotics and Artificial Intelligence, mainly through the European Framework Programmes for Research and Innovation. Funding for cognitive systems and robotics is officially fully integrated into European research funding schemes since the Framework Programme of 2007-2013. During this period, around €550 million had been allocated to this specific research field.

For 2014-2020, with the Horizon 2020 Framework Programme, AI and AI-related research funding is estimated to be close to €3.3 billion. This figure can be broken down into robotics (€700 million) and AI-related areas (€2.6 billion). AI-related research accounted to a €1.1 billion investment from 2014 to 2017 whereas the 2018-2020 period will reach €1.5 billion.[16,17] Assessing the funding allocated to AI in Horizon 2020 remains rather complicated, as AI is not outlined as a specific research topic. In the Specific Programme implementing Horizon 2020, AI is technically part of the "Advanced interfaces and robots" research area, but without a single mention of AI itself.[18]

With Horizon Europe, the next Framework Programme for 2021-2027, research funding is expected to increase significantly. Compared to Horizon 2020, Horizon Europe names one research sub-cluster "Artificial Intelligence and Robotics", with clear references to AI, and not only robotics. The Commission's proposal allocates €15 billion to the research cluster in which AI and robotics are located. Funding could be up to €2 billion, much more depending how the budget is shared between AI-related areas. AI is for instance listed in 'healthcare', 'protection & cybersecurity', 'big data', 'space' and 'mobility' research areas.

For 2021-2027, the Commission is proposing a new investment scheme, the Digital Europe programme. This Programme aims to be the bridge between investment in research and in infrastructures. It has two main objectives: 1. developing and reinforcing capacities in key

[16] "Artificial Intelligence for Europe", European Commission communication, 25 April 2018, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=51625

[17] "Artificial intelligence: Commission outlines a European approach to boost investment and set ethical guidelines", press release, 25 April 2018, http://europa.eu/rapid/press-release_IP-18-3362_en.htm

[18] Council decision establishing the specific programme implementing Horizon 2020, Annex 1, 3 December 2013, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2013.347.01.0965.01.ENG

digital technology areas and 2. ensuring their deployment and best use in areas of public interest and in the private sector. €2.5 billion will be directly allocated to AI, and indirectly up to €700 million, through investment in advanced digital skills training and education. Through a networks of digital innovation hubs located all over Europe, the Programme will also specifically target SMEs and mid-cap companies to help them develop AI-based capacities, products and services. Similar to research funding under the Framework Programmes, AI activities in Digital Europe should be mainly grant-based.

With the Digital Europe programme's figures and Horizon Europe's estimates, AI, robotics and AI-related EU funding could reach about 6-7 billion from 2021 to 2027.

### b. Europe's need for further public and private investment

Compared to North America and Asia, Europe's private sector is lagging on AI investment. Private investments in AI in Europe totalled approximately €2.4 to 3.2 billion in 2016, compared with €12.1 to 18.6 billion in North America and €6.5 to 9.7 billion in Asia.[19]

The European Union is committed to leverage financial support and encourage uptake by public and private sectors with its April 2018 AI strategy. The EU estimates that its €1.5 billion investment boost in Horizon 2020 will trigger €2.5 billion of additional AI funding from existing public-private partnerships on robotics and big data, from 2018 to 2020. The Commission hopes to foster public and private investment in AI by at least €20 billion between now and the end of 2020 with extra support schemes from instruments such as the European Fund for Strategic Investments.[20]

In the coming years, the EU will support private investment with two main types of instruments:

The Digital Europe programme and the Framework Programme for Research, Horizon Europe, will encourage private investment through European partnerships on robotics, big data, high-performance computing, etc. For instance, the robotics partnership is expected to mobilise €2.1 billion of private investment until 2020. Another example is the Electronic Components and Systems for European Leadership (ECSEL) partnership, worth €4.8 billion of public and private investment on components such as neuromorphic chips, specifically built to run AI operations. The European Commission is also expected to be working on a partnership specifically dedicated to AI.

The second instrument to be used by the EU is the InvestEU Fund.[21] Compared to programmes such as Horizon Europe, InvestEU is not based on grant financing, but on loans. The Fund is based on the same scheme as the Juncker Plan: with a guarantee of €38 billion, the EU hopes to leverage about €650 billion of public and private funding. Out of the €38 billion guarantee, €11.5 billion will be allocated to research, innovation and digitisation, which includes AI.

[19] "Digitization, AI, and the Future of Work: Imperatives for Europe", McKinsey & Company, 2017, p. 4.
[20] "Artificial intelligence: Commission outlines a European approach to boost investment and set ethical guidelines", press release, 25 April 2018, http://europa.eu/rapid/press-release_IP-18-3362_en.htm
[21] Factsheet on the InvestEU Fund: https://ec.europa.eu/commission/sites/beta-political/files/budget-june2018-what-is-investeu_en.pdf

Keeping the same calculation used by the Commission,[22] the InvestEU Fund guarantee earmarked for digital innovation of €11.5 billion would in theory mobilise around €160 billion of investment from 2021.

### c. Recommendations

To promote investments and uptake in AI, the EU needs to strongly increase its investments, to reduce the current research gap compared to other continents. This should be combined with an openness to the industry to foster an innovative public-private environment for AI.

- Strongly increase EU investments on AI and AI-related fields

Overall, DIGITALEUROPE's Member companies are not very dependent on EU funding to invest in AI, particularly as this field is seen as a major area for future commercial developments. Private companies are carrying AI research, development and deployment without a strong need for EU funding. After all, Horizon 2020, the EU flagship programme for research and innovation, worth €77 billion,[23] represents less than 4% of the total EU-wide R&D expenditure.

Yet an increase in EU funding is crucial to create a nurturing environment for AI activities in Europe. Most of the EU investment programmes on AI (Horizon Europe and Digital Europe) award grants to consortia gathering public and private actors. With the current lack of EU investment in research and innovation, many proposals are not awarded a grant: the success rate in Horizon Europe until now is only 11.9%[24] and even worse in the ICT field, with only 6.7% in 2015.[25] Decreasing success rates have a direct impact on the effectiveness of the EU funding programmes and their ability to attract the most talented and innovative applicants. There is a significant risk that public institutions and the Industry might increasingly choose not to submit or join proposals to participate in these EU programmes, since the chances of success are so low and disproportionate to the cost of applying for grants, which may increasingly be seen as a waste of resources.

If the EU does not invest more on AI research, development and deployment, this oversubscription issue will prevent many public research institutions and universities from participating to these programmes and thus from investing in AI. As EU public funding fosters private funding, for instance through public-private partnerships or schemes such as the InvestEU fund, increased investments are needed for Europe to develop its AI capacities.

[22] The European Commission estimates a 13.7 multiplying factor for the InvestEU Fund.
[23] In current prices. For the period 2014-2020.
[24] "From Horizon 2020 to Horizon Europe: Monitoring flash", August 2018, European Commission report, p. 1. https://ec.europa.eu/research/evaluations/pdf/archive/h2020_monitoring_reports/h2020_monitoring_flash_092018.pdf
[25] "Horizon 2020 Annual Monitoring Report 2015", November 2016, European Commission report, p. 14, https://ec.europa.eu/research/evaluations/pdf/archive/h2020_monitoring_reports/second_h2020_annual_monitoring_report.pdf

- Promote the Industry as a key partner to AI investment and uptake

EU funding may not be crucial for the Industry, but strong investments are necessary to support the creation of an innovative AI field in Europe, comprising private and public organisations. Even though the funding provided by the EU Programmes might be relatively small in monetary terms, it adds real benefits as a decisive instrument in the available policy mix of capacity-building, research, innovation and deployment support.

Compared to similar national or regional funding programmes, the EU programmes support cross-border R&D&I pre-competitive cooperation between different stakeholders, even competitors, while avoiding anti-trust issues. Such programmes help building pan-European partnerships and synergies with critical mass, making Europe competitive beyond fragmented national investment programmes. Finally, these programmes facilitate the development of industry capabilities for Europe-wide R&D&I platforms and infrastructures and the creation of European networks with customers and suppliers. For AI, this means that EU funding programmes can ensure that AI research pilots are quickly initiated and their results scaled up.

For Europe to be a leader in AI, the EU needs therefore to acknowledge the crucial role of creating networks between public and private organisations, particularly through public-private partnerships. Whether it is made through grants, public procurement or loans, EU investment in AI should include, as much as possible, private companies and tailor funding rules to make them industry-friendly[26]. Adapting the EU funding obligations to the business environment would ensure the participation of key industrial sectors and companies and allow to support the needs of all actors in innovation.

[26] For instance by aligning EU funding accounting practices with those of private companies or by defending a stable intellectual property (IP) regime.

## 6. Conclusion

Artificial Intelligence presents Europe with a tremendous opportunity. AI-related technologies and applications are already having an incredible impact. We see great strides forward from digital transformation and AI deployment in areas of healthcare, mobility, industry and many other sectors.

DIGITALEUROPE encourages a dialogue on proportionate and targeted action that will have the greatest impact and allowing for continuing innovation. We encourage a common understanding based on dialogue between all actors, in Europe as well as globally.

The EU, national governments, industry, AI developers, labour and civil society will need to work together towards a responsible, 'trusted AI' framework, ensuring values and ethics in design and implementation while fostering innovated solutions and applications. Stakeholders need to partner with each other to deliver a positive realisation of AI, to build R&D eco-systems and stimulate uptake. This requires forward-thinking policies on data, education and infrastructure.

DIGITALEUROPE and its members, across business and national trade associations, aim to be a constructive, informative and collaborative partner in the policy discussions around AI. We look forward to working together with everyone on this incredibly important topic.

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**For more information please contact:**
Jochen Mistiaen, Senior Policy Manager
+32 496 20 54 11 or jochen.mistiaen@digitaleurope.org

Ray Pinto, Policy Director
+32 472 55 84 02 or ray.pinto@digitaleurope.org

## 7. Annex

In this section, we explore various examples of AI. It aims to show the diversity of AI and machine learning applications across all manner of sectors (including healthcare, industry and even sports), as well as offering some best practices on skills, education and how to tackle various deployment challenges.

*Skills & Best practices*

### Case study: Finland training & development plan

AI has been extensively discussed in Finland. The University of Helsinki and Reaktor launched a free and public course to educate 1% of the Finnish population on AI by the end of this year. They have challenged companies to train employees on AI during 2018 and many member companies of the Technology Industries of Finland association (e.g. Nokia, Kone, F-Secure) have joined and support the programme. More than 90,000 people have enrolled in these courses.

More information can be found here: https://www.elementsofai.com/ai-challenge

### Case study: SAP - Training for boosting people's AI skills

SAP has made available various Massive Open Online Courses (MOOCs) both for internal and external users, with goals ranging from basic knowledge/awareness building, for example programmes and courses on 'Enterprise Machine Learning in a Nutshell' (see: https://open.sap.com/courses/ml1-1), as well as more advanced skills, for instance on deep learning (see: https://open.sap.com/courses/ml2). Two-thirds of SAP's own machine learning (ML) team is made up of people who already worked for SAP in non-ML roles and then acquired the necessary ML knowledge and skills on the job.

### Case study: SAP – Addressing bias & ensuring diversity

SAP created a formal internal and diverse AI Ethics & Society Steering Committee. The committee is creating and enforcing a set of guiding principles for SAP to address the ethical and societal challenges of AI. It is comprised of senior leaders from across the entire organisation such as Human resources, Legal, Sustainability and AI Research departments. This interdisciplinary membership helps ensuring diversity of thought when considering how to address concerns around AI, e.g. those related to bias.

AI itself can also help increase diversity in the workplace and eliminate biases. SAP uses, offers and continues to develop AI powered HR services that eliminate biases in the application process. For example, SAP's "Bias Language Checker" helps HR identifying areas where the wording of a Job Description lacks inclusivity and may deter a prospective applicant from submitting their application.

See further: https://news.sap.com/sap-introduces-intelligent-hr-solution-to-help-businesses-eliminate-bias/ & https://news.sap.com/sap-tv/sap-successfactors-moves-business-beyond-bias/

### Case study: Who can be held liable for damages caused by autonomous systems?

AI and robotics have raised some questions regarding liability. Take for example the scenario of an 'autonomous' or AI-driven robot moving through a factory. Another robot surprisingly crosses its way and our robot draws aside to prevent collision. However, by this manoeuvre the robot injures a person. Who can be held liable for damages caused by autonomous systems? The manufacturer using the robots, one or both or the robot manufacturers or one of the companies that programmed the software of the robots?

Existing approaches would likely already provide a good approach. For example, owner's liability, as with motor vehicles, could be introduced for autonomous systems (whereas 'owner' means the person using or having used the system for its purposes). The injured party should be able to file a claim for personal or property damages applying strict liability standards against the owner of the autonomous system.

### Case study: Sony - Neural Network Libraries available in open source

Sony has made available in open source its "Neural Network Libraries" which serve as framework for creating deep learning programmes for AI. Software engineers and designers can use these core libraries free of charge to develop deep learning programmes and incorporate them into their products and services. This shift to open source is also intended to enable the development community to further build on the core libraries' programmes.

Deep learning refers to a form of machine learning that uses neural networks modelled after the human brain. By making the switch to deep learning-based machine learning, the past few years have seen a rapid improvement in image and voice recognition technologies, even outperforming humans in certain areas. Compared to conventional forms of machine learning, deep learning is especially notable for its high versatility, with applications covering a wide variety of fields besides image and voice recognition, including machine translation, signal processing and robotics. As proposals are made to expand the scope of deep learning to fields where machine learning has not been traditionally used, there has been an accompanying surge in the number of deep learning developers.

Neural network design is very important for deep learning programme development. Programmers construct the neural network best suited to the task at hand, such as image or voice recognition, and load it into a product or service after optimising the network's performance through a series of trials. The software contained in these core libraries efficiently facilitates all the above-mentioned development processes.

*Network & Security*

### Case study: Cisco – Reinventing the network & making security foundational

Cisco is reinventing networking with the network intuitive. Cisco employs machine learning (ML) to analyse huge amounts of network data and understand anomalies as well as optimal network configurations. Ultimately, Cisco will enable an intent-based, self-driving and self-healing network. The network will redirect traffic on its own and heal itself from internal shocks, such as device malfunctions, and external shocks, such as cyberattacks.

To simplify wide area network (WAN) deployments and improve performance, ML software observes configuration, telemetry and traffic patterns and recommends optimisation and security measures via a centralised management application. Machine learning plays a role in analysing network data to identify activity indicative of threats such as ransomware, crypto-mining and advanced persistent threats within encrypted traffic flows.

Moreover, to help safeguard organisations in a constantly changing threat landscape, Cisco is using AI and ML to support comprehensive, automated, coordinated responses between various security components. For businesses in a multi-cloud environment, cloud access is secured by leveraging machine intelligence to uncover malicious domains, IPs, and URLs before they are even used in attacks. Once a malicious agent is discovered on one network, it is blacklisted across all customer networks. Machine learning is also used to detect anomalies in IT environments in order to safeguard the use of SaaS applications by adaptively learning user behaviour. Infrastructure-as-a-Service instances as well are safeguarded by using machine learning to discover advanced threats and malicious communications.

For an overview, please see: https://www.cisco.com/c/dam/en/us/solutions/collateral/digital-transformation/ai-whitepaper.pdf

*Healthcare*

Case study: Intel – AI for cardiology treatment

Precision medicine for cancers requires the delivery of individually-adapted medical care based on the genetic characteristics of each patient. The last decade witnessed the development of high-throughput technologies such as next-generation sequencing, which paved their way in the field of oncology. While the cost of these technologies decreases, we are facing an exponential increase in the amount of data produced. In order to open the access to more and more patients to precision medicine-based therapies, healthcare providers have to rationalise both their data production and utilisation and this requires the implementation of the cutting-edge technology of high performance computing and artificial intelligence.

Before taking a therapeutic decision based on the genome interpretation of a cancer, the physician can be presented with an overwhelming number of genes variants. In order to identify key actionable variants that can be targeted by treatments, the physician needs tools to sift through this large volume of variants. While the use of AI in genome interpretation is still nascent, it is growing rapidly as acting filter to dramatically reduce the number of variants, providing invaluable help to the physician. The mastering of high performance computing methods on modern hardware infrastructure is becoming a key factor of the cancer genome interpretation process while being efficient, cost effective and adjustable over time.

The pioneer collaboration initiated between the Curie Institute Bioinformatics platform and Intel aims at answering those challenges by defining a leading model in France and Europe. This collaboration will grant Institute Curie access to Intel experts for defining high-performance computing and artificial intelligence infrastructure and ensuring its optimisation in order to implement the Intel Genomics ecosystem partner solutions and best practices, for

example the Broad Institute for Cancer Genomics pipeline optimisation. Also anticipated is the development of additional tailored tools needed to integrate and analyse heterogeneous biomedical data.

Read more: https://www.intel.com/content/www/us/en/healthcare-it/solutions/ai-helps-cardiologists.html

### Case study: MSD – AI for healthcare professionals

MSD has launched, as part of its MSD Salute programme in Italy, a chatbot for physicians, powered by AI and machine learning. It has already achieved a large uptake with healthcare professionals in Italy. The programme's sector of focus is immune-oncology.

From the MSD prospective, physicians are digital consumers looking for relevant information for their professional activity. Some key factors like the increase of media availability, mobile devices penetration and the decrease of time available, are resulting in a reduction of time spent navigating and searching on the web. Therefore users (and physicians with their pragmatic approach) read what they see and do not navigate as much but just 'read and go'. This means that there is an urgent need to access content quickly, easily and efficiently.

The chatbot is developed in partnership with Facebook and runs on their Messenger app framework. As an easy and practical tool, it helps to establish a conversational relationship between the users. The MSD Italy ChatBot service is available only for registered physicians. Integration with Siri and other voice recognition systems is also worked on, to improve the human experience during the interaction with the chatbot. This initiative is a key item in MSD Italy's digital strategy which focuses on new channels and touch-points with healthcare professionals, leveraging on new technologies.

See: https://www.linkedin.com/pulse/chatbot-ai-pharma-industry-danilo-pagano/

### Case study: Philips – AI in clinics and hospitals

With the clinical introduction of digital pathology, pioneered by Philips, it has become possible to implement more efficient pathology diagnostic workflows. This can help pathologists to streamline diagnostic processes, connect a team, even remotely, to enhance competencies and maximise use of resources, unify patient data for informed decision-making, and gain new insights by turning data into knowledge. Philips is working with PathAI to build deep learning applications. By analysing massive pathology data sets, we are developing algorithms aimed at supporting the detection of specific types of cancer and that inform treatment decisions.

For more information, please read here: https://www.philips.com/a-w/about/news/archive/standard/news/press/2017/20170329-philips-and-pathai-team-up-to-improve-breast-cancer-diagnosis.html

Further, AI and machine learning for adaptive intelligence can also support quick action to address patient needs at the bedside. Manual patient health audits used to be time-consuming, putting a strain on general ward staff. Nurses need to juggle a range of responsibilities: from quality of care to compliance with hospital standards. Information about the patient's health was scattered across various records, making it even harder for nurses to

focus their attention and take the right actions. Philips monitoring and notification systems assist nurses to detect a patient's deterioration much quicker. All patient vital signs are automatically captured in one place to provide an Early Warning Score (EWS).

Read more: https://www.philips.com/a-w/about/news/archive/case-studies/20180315-early-warning-score-reduces-incidence-of-serious-events-in-general-ward.html

### Case study: Microsoft – Machine learning for tumour detection and genome research

Microsoft's Project InnerEye developed machine learning techniques for the automatic delineation of tumours as well as healthy anatomy in 3D radiological images. This technology helps to enable fast radiotherapy planning and precise surgery planning and navigation. Project InnerEye builds upon many years of research in computer vision and machine learning. The software learned how to mark organs and tumours up by training on a robust data set of images for patients that had been seen by experienced consultants.

The current process of marking organs and tumours on radiological images is done by medical practitioners and is very time consuming and expensive. Further, the process is a bottleneck to treatment – the tumour and healthy tissues must be delineated before treatment can begin. The InnerEye technology performs this task much more quickly than when done by hand by clinicians, reducing burdens on personnel and speeding up treatment.

The technology, however, does not replace the expertise of medical practitioners; it is designed to assist them and reduce the time needed for the task. The delineation provided by the technology is designed to be readily refined and adjusted by expert clinicians until completely satisfied with the results. Doctors maintain full control of the results at all times.

Further, Microsoft has partnered with St. Jude Children's Research Hospital and DNANexus to develop a genomics platform that provides a database to enable researchers to identify how genomes differ. Researchers can inspect the data by disease, publication, gene mutation and also upload and test their own data using the bioinformatics tools. Researchers can progress their projects much faster and more cost-efficiently because the data and analysis run in the cloud, powered by rapid computing capabilities that do not require downloading anything.

For more information and other examples: https://www.microsoft.com/en-us/research/lab/microsoft-research-cambridge/

*Industry & Digital Transformation*

### Case study: Siemens – AI for Industry, Power Grids and Rail Systems

Siemens has been using smart boxes to bring older motors and transmissions into the digital age. These boxes contain sensors and a communication interfaces for data transfer. By analysing the data, AI systems can draw conclusions regarding a machine's condition and detect irregularities in order to make predictive maintenance possible.

AI is used also beyond industrial settings, for example to improve the reliability of power grids by making them smarter and providing the devices that control and monitor electrical

networks with AI. This enables the devices to classify and localise disruptions in the grid. A special feature of this system is that the associated calculations are not performed centrally at a data centre, but de-centrally between the interlinked protection devices.

In cooperation with Deutsche Bahn, Siemens is running a pilot project for the predictive maintenance and repair of high-speed trains. Data analysts and software recognise patterns and trends from the vehicles' operating data. Moreover, AI helps build optimised control centres for switch towers. From the billions of possible hardware configurations for a switch tower, the software selects options that fulfil all the requirements, including those regarding reliable operation.

Find out more: https://www.siemens.com/innovation/en/home/pictures-of-the-future/industry-and-automation/the-future-of-manufacturing-ai-in-industry.html

### Case study: Schneider Electric – AI for industry applications

Schneider Electric has used AI and machine learning in various sectors. In the oil and gas industry for example, machine learning is steering the operation of Realift rod pump control to monitor and configure pump settings and operations remotely, sending personnel onsite only when necessary for repair or maintenance – when Realift indicates that something has gone wrong. Anomalies in temperature and pressure, for instance, can flag potential problems, even issues brewing a mile below the surface. Intelligence edge devices can run analytics locally without having to tap the cloud — a huge deal for expensive, remote assets such as oil pumps.

To enable this solution an AI model is previously trained to recognise correct pump operation and also different types of failures a pump can experience, the AI model is deployed on a gateway at oil field for each pump and is fed with data collected at each pump stroke. Then, it outputs a prediction regarding the pump state. As we mimic the expert diagnostics, predictions can be easily validated, explained and interpreted.

Read more here: https://www.schneider-electric.com/en/product-range-presentation/63084-realift/

### Case study: Schneider Electric – Improving agriculture and farming with AI

Another example is in the agriculture sector, where Schneider Electric has proposed an AI solution for Waterforce, an irrigation solutions builder and water management company in New Zealand. Schneider Electric' solution makes water use more efficient and effective in water use, saving up to 50% in energy costs, and provides remote monitoring capabilities that reduce the time farmers have to spend driving to inspect assets. The solution is able to collect data, from the weather forecast, pressure of pumps, temperatures, level of water, humidity of the ground, cleaning and selecting quality data, and preparing the data, in order to propose services such as fault diagnosis, performance benchmarking, recommendation and advise on operations.

For further information: https://www.schneider-electric.com/en/work/campaign/life-is-on/case-study/waterforce.jsp

AI and machine learning therefore represent a new way for humans and machines to work together – to learn about predictive tendencies and to solve complex problems. In the above examples, the challenges presented today in managing a process that requires tight control of temperatures, pressures, and liquid flows is quite complex and prone to error. Many variables need to be factored in to achieve a successful outcome – and the quality of the data that trains the AI algorithms could deliver very different results that the human brain should anyhow interpreted and guide. With the support of AI to make better operational decisions, critical factors such as safety, security, efficiency, productivity, and even profitability can be optimised in conjunction between machine/process and operator. This way, the training and combined skills from AI and expertise are a key success factor to deliver those values to Industry.

### Case study: Canon - Application of automation in the office environment

Canon's digital mailroom solution has been at the forefront of Robotic Process Automation (RPA) since it was first launched. A digital mailroom allows all incoming mail to be automatically captured, identified, validated and sent with relevant index data to the right systems or people (case study: https://www.canon-europe.com/digital-mailroom/). RPA technology is centred on removing the mundane to make lives easier. In the P2P world, RPA automates labour-intensive activities that require accessing multiple systems or that need to be audited for compliance.

Canon believes the next step in automation is the intelligent mailroom. The key challenge of the future will be the integration of digital and paper-based information into robust, effective and efficient processes. This means that organisations need more intelligent, digital mailroom solutions that enable data capture across every channel. One example of intelligent mailroom is the Multichannel Advanced Capture. This allows banks to enable customers to apply for an account minimising the amount of paper and using a mobile-friendly web page capturing the core details required. Automated checks on customers' ID and credit history are made first. If all initial checks are valid, a second human check can be made. The bank is then presented with all the information required to make an informed decision on the application to open the bank account, based on applicable business rules as well as on (automatically) gathered historical business process knowledge.

*AI for Good*

### Case study: SAS – Crowdsourcing and analysing data for endangered wildlife

The WildTrack Footprint Identification Technique (FIT) is a tool developed in partnership with SAS for non-invasive monitoring of endangered species through digital images of footprints. Measurements from these images are analysed by customised mathematical models that help to identify the species, individual, sex and age-class. AI could add the ability to adapt through progressive learning algorithms and tell an even more complete story.

Ordinary people would not necessarily be able to dart a rhino, but they can take an image of a footprint. WildTrack therefore has data coming in from everywhere. As this represents too much information to manage manually AI can automate repetitive learning through data, performing frequent, high-volume, computerised tasks reliably and without fatigue.

Read more: WildTrack: protecting endangered species with AI.

### Case study: SAS – Using AI for real-time sports analytics

AI can also be used to analyse sports and football data. For example, SciSports models on-field movements using machine learning algorithms, which by nature improve on performing a task as they gain more experience. It works by automatically assigning a value to each action, such as a corner kick. Over time, these values change based on their success rate. A goal, for example, has a high value, but a contributing action – which may have previously had a low value – can become more valuable as the platform masters the game.

AI and machine learning will play an important role in the future of SciSports and football analytics in general. Existing mathematical models shape existing knowledge and insights in football, while AI and machine learning will make it possible to discover new connections that people would not make themselves.

Various other tools such as SAS Event Stream Processing and SAS Viya can then be utilised for real-time image recognition, with deep learning models, to distinguish between players, referees and the ball. The ability to deploy deep learning models in memory onto cameras and then do the inferencing in real time is cutting-edge science.

See: Finding the next football star with artificial intelligence

### Case study: Google & TNO – AI for data analysis on traffic safety

TNO is one of the partners of InDeV, an international collaboration of researchers which was created to develop new ways of measuring traffic safety. Statistics about traffic safety were unreliable, insufficiently detailed, and hard to collect. Researchers often resort to filming busy intersections and manually reviewing the recording. This a time-intensive and expensive process. A single intersection needs to be monitored for three weeks with two cameras to create an estimation of its safety, adding up to six weeks of footage, which can take six weeks of work to analyse. Typically, less than one percent of the recorded material is actually of interest to researchers. The job of TNO is to apply machine learning to video of accident-prone hot spots to rate intersections on a scale according to their safety. With TNO's neural network based on TensorFlow, researchers report that it takes only one hour to review footage that would previously have taken a week to inspect.

For more details: https://cloud.google.com/customers/tno/

# ABOUT DIGITALEUROPE

DIGITALEUROPE represents the digital technology industry in Europe. Our members include some of the world's largest IT, telecoms and consumer electronics companies and national associations from every part of Europe. DIGITALEUROPE wants European businesses and citizens to benefit fully from digital technologies and for Europe to grow, attract and sustain the world's best digital technology companies. DIGITALEUROPE ensures industry participation in the development and implementation of EU policies.

DIGITALEUROPE's members include in total over 35,000 ICT Companies in Europe represented by 63 Corporate Members and 39 National Trade Associations from across Europe. Our website provides further information on our recent news and activities: http://www.digitaleurope.org

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