Italian Talent Abroad **Group**

ARTIFICIAL INTELLIGENCE
AS A NEW GROWTH FACTOR

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Artificial Intelligence
as a new growth factor

Artificial intelligence is the science of making machines do things that would require intelligence if done by men.
(Marvin Minsky, 1968) [1]

1. INTRODUCTION

1.1 From Science Fiction to the enterprise, artificial intelligence is with us

The factory of the future will have only two workers: a man and a dog. The human being's job is to feed the dog, whose function is to keep the man away from the machine[2]. Warren Gameliel Bennis devised this crude image of the possible consequences of large-scale use of Artificial Intelligence (AI) in modern production systems. To paraphrase Alan Turing[3] –one of the founding fathers of modern artificial intelligence - AI can in fact be described as the science of making computers do things that require intelligence when they are done by human beings; or, more correctly, as the branch of computer science that deals with creating intelligent machines capable of performing new tasks and resolving new problems, of adapting to the environment and understanding it, and of understanding natural language. One of many examples of the importance of AI today comes from Jeff Bezos, founder, President, and CEO of Amazon.com, possibly the biggest Internet sales company in the world.

In his letter to shareholders this year,[4] Bezos stressed the need to know and adopt *"the important external trends"*. He believes, for instance, that now *"we're in the middle of an obvious one: machine learning and <u>artificial intelligence</u>"*. The fact remains, Bezos goes on, that it may be difficult for large organizations to adopt them, because *"too many organizations spend too much debating if something is going to be big. If you've spent that much time debating it, it's probably too late"*. As will become clearer in due course, Amazon is an ideal example. The world leader in the retail industry, Amazon has made technological innovation - and AI first and foremost, to manage its logistics, customer profiling, and so forth - its very trademark in order to guarantee streamlined delivery and consistent quality. Using modern ICT technology, Amazon has completely transformed well-established sectors and markets, creating a new model of access to consumption

So AI is with us… but not only when we receive a package from Amazon! Apart from the best known fictional representations, such as Hal 9000 – the supercomputer on board the spaceship Discovery in the movie "2001: A Space Odyssey", or C-3PO, the anthropomorphic droid in the "Star Wars" movie – a great many AI applications, less well-known but nevertheless important, have been an integral part of our lives for some time. Autonomous vehicles, robots, voice recognition and automatic translation systems, planning and logistics, games, spam filters, and voice control for electronic devices are concrete examples of the use of AI. The growing spread of AI in various sectors of industry is inexorable and yields varying benefits in terms of operating costs, depending on the application. In a recent study, the McKinsey Global Institute estimates savings in operating costs of 10-15% through the automation of a hospital emergency system, of 25% in aircraft maintenance, and as much as 90% in automated mortgage origination. Overall, the virtuous cycle of greater productivity through AI -> greater economic growth -> greater economic resources (partly to counterbalance the impact on employment) has been demonstrated by a

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[1] B. Whitby (1996), Reflections on Artificial Intelligence.
[2] M. Fisher (1991), The millionaire's book of quotations.
[3] A.M. Turing (1950), Computing Machinery and Intelligence. Mind 49.
[4] Cf. http://phx.corporate-ir.net/phoenix.zhtml?c=97664&p=irol-reportsannua/ *(last accessed June 2017).*

sufficient improvement in productivity to permit a growth factor of between +0.8 and 1.4% per year[5]. Even more optimistically, Accenture foresees a 40% improvement in productivity, which by 2035 could result, in such countries as the United States, in an economic growth rate of 2% per year[6] and in Italy, for instance, an increase of more than 10% in GDP[7].

A survey by the National Business Research Institute shows that in 2016 38% of US companies were already using AI, and that this figure is expected to increase to as much as 62% by 2018. A Forrester study forecasts a 300% increase in investments in AI in 2017 over the previous year. According to the Harvard Business Review, in 2016 alone machine intelligence attracted venture capital investments totaling $5 billion[8], partly because, IDC says[9], AI is quickly becoming a crucial part of companies' IT infrastructure. It is no coincidence that such companies as Amazon, Apple, Baidu, Facebook, Google, IBM, Intel, Microsoft, and Oracle are among those most involved in the development and spread of AI, while the top 10 of the world's 500 leading companies[10] include others such as Exxon Mobil, Ford, General Motors, and Walmart that also rely on AI. There are indeed a great many AI applications - from customer care to health and from digital marketing to the Factory 4.0 – creating a market that is expected to rocket from the present US$3 billion to $47 billion by 2020[11].

So to embrace AI is now a necessity, and no longer an option,. To do so before one's rivals offers a competitive advantage. It cannot be the only measure adopted, as is shown by Priceline, an Internet discount travel search service. In the past 10 years Priceline has achieved average annual returns of 42,1%, better than any other company on the Fortune Global 500 list, which demonstrates how execution can still make the differences, irrespective of the technologies used. But there is no doubt that adopting AI before one's rivals offers a competitive advantage, particularly if Andrew Ng is right in saying that AI is the *"new electricity"*[12].

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[5] McKinsey (2017), A Future That Works: Automation, Employment, and Productivity: http://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works *(last accessed June 2017)*

[6] Accenture (2016), Why Artificial intelligence is the Future of Growth: https://www.accenture.com/lv-en/_acnmedia/PDF-33/Accenture-Why-AI-is-the-Future-of-Growth.pdf *(last accessed June 2017)*

[7] Accenture (2017), Country Spotlights: Why Artificial Intelligence Is the Future of Growth: https://www.accenture.com/t20160929T215035__w__/us-en/_acnmedia/PDF-33/Accenture-Why-AI-is-the-Future-of-Growth--Country-Spotlights.pdf?la=en *(last accessed June 2017)*

[8] S. Zilis-J. Cham (2016), The Competitive Landscape for Machine Intelligence. HBR: https://hbr.org/2016/11/the-competitive-landscape-for-machine-intelligence *(last accessed June 2017)*

[9] IDC (2017), Cognitive/Artificial Intelligence Systems and Content Analytics: https://www.idc.com/getdoc.jsp?containerId=IDC_P18069 *(last accessed June 2017)*

[10] Fortune 500 (2017): http://fortune.com/fortune500/ *(last accessed June 2017)*

[11] IDC (2017), Op. Cit.

[12] A. Ng (2017), The New Electricity: http://news.stanford.edu/thedish/2017/03/14/andrew-ng-why-ai-is-the-new-electricity/ *(last accessed June 2017)*

1.2   *Two elephant(s) in the room*

Because it has spread so far and wide, AI has gained such a major role as to have become a key topic of public debate almost throughout the world, alternating between the two elephants in the room: the employment issue and the ethical issue. They are both crucial to society today, and even more so to society in the future. The former – which seems closer to common understanding because, since it relates to work, it seems to have a greater impact on everyday life – is the net loss of jobs that the growing use of AI might cause, at least to begin with. The latter – apparently more remote from common understanding, because it relates to so-called ethical matters - is the "dictatorship" of AI, which might gradually replace mankind not only in the performance of physical tasks, whether sophisticated or not, but also in intellectual tasks.

These are both topical and long-term issues. They are topical inasmuch as the pervasive strength of AI evokes Schumpeter's "creative destruction", the process whereby major technological innovations spark a far-reaching selective process, in which many enterprises disappear, others emerge, and yet others grow stronger, and with them jobs, which are "destroyed" more or less swiftly than new ones are created. Hence the pressing question, to which there is as yet no commonly accepted answer: will there be only job losses, or will new ones be created? Will the emergence of new professions absorb the inevitable human surplus that AI will soon create in the service industries, just as machines did, first in farming and then in manufacturing? If not, what will happen to the people who lose their jobs first: how will they survive, what will they do all day? There is a risk that masses of people will spend their time "hunting in the morning, fishing in the afternoon, rearing cattle in the evening, criticizing after dinner, as they may please, without ever becoming hunter, fisherman, herdsman or critic"[13], paradoxically transcending the division of labor theorized by Karl Marx.

They are topical because the idea that typically intellectual activities such as the search for and compilation of precedents to create a memory in common law systems can be taken over by machines - working to instructions by other machines, which will gradually achieve forms of autonomous logical reasoning and self-organization – actually deprives human beings of certain responsibilities and perhaps even their raison d'être. They are topical because they confront us with such questions as, how real is the danger that the excessive development of biotechnologies and AI together might lead to a social dictatorship - as Yuval Noah Harari[14] seems to fear – with mankind's division into a small class of "superhumans" and a large underclass of "useless" people. And more besides - it could be a very long list - because they cause us to consider whether it is likely, as Lamtharn Hantrakul suggests, that the dictatorship of AI can also be "cultural", because technology is not culturally neutral, and neither are algorithms, which are an essential expression of whoever develops them.

They are long-term because they have been known about for a long time, though hitherto neglected. Indeed, as often happens, this is being realized only at the last moment, once technological progress on the one hand and the reduction of production and service costs on the other have created the conditions for AI to become ubiquitous. This, even though it has been clear

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[13] K. Marx-F. Engels, L'ideologia tedesca, Editori Riuniti, Roma, 1972.
[14] Y.N. Harari (2017), Are We About to Witness the Most Unequal Societies in History? The Guardian:
https://www.theguardian.com/inequality/2017/may/24/are-we-about-to-witness-the-most-unequal-societies-in-history-yuval-noah-harari *(last accessed June 2017)*

for some time that this problem would emerge and that we would, predictably, find ourselves unprepared to deal with it. The new and increasingly sophisticated algorithms being developed to make sense of the vast mass of data (Big Data) that the IoT (the Internet of things) in particular makes available and that is used to issue instructions to "machines," such as robots, are justified by the fact that it is now becoming possible, both technologically, but above all economically, to gather large amounts of data and to process it in real time, or almost. The new machines with large calculating capacity, networks of increasingly sophisticated sensors, and the capillary connectivity now available at affordable prices, compared to a mere 3-5 ears ago, explain the huge investments that the financial world is making in the frenetic search for data processing algorithms.[15]

This report proceeds from the observation that AI is already with us, and seeks to explain how its adoption is no longer an option but a necessity. This, because it is a matter of seizing an existing phenomenon. If we want to embrace its positive aspects of economic growth we must act right away, before our rivals, in order to gain a competitive advantage. It remains to decide what needs to be done, particular from Italy's vantage point, to facilitate the emergence of an ecosystem open to AI, while avoiding – if it is still possible – lapsing into overdependence on first movers in the United States and China, and keeping in mind the ethical issues at stake.

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[15] C. Mercer (2017), 10 tech giants investing in artificial intelligence: What is their plan and who are other key players? TechWorld: http://www.techworld.com/picture-gallery/data/tech-giants-investing-in-artificial-intelligence-3629737/ *(last accessed June 2017).*

2. ARTIFICIAL INTELLIGENCE: THE STATUS OF TECHNOLOGY

2.1 Artificial intelligence: what it is and how it works

AI is not a new idea. There is no one single definition of AI, nor is there any broad consensus among researchers and computer scientists about how to define it, because the concept embraces a large number of arguments ranging from pure computer science to neurology, via studies of how the brain works. In general terms, we could say that artificial intelligence is the science that deals with how to create intelligent machines and that has found the most practical and feasible way of achieving it in the possibilities offered by computer science. This field of science is closely linked to the even broader field which has for some time been trying to answer the ultimate question: how does human intelligence work? Discoveries about intelligence may lead us to develop the best possible AI, but other researchers believe the opposite may happen: by developing AI we may discover things about how our brain works.

Put simply, intelligence is the combination of psychical and mental capacities that make it possible to think, to understand actions and facts, and to explain them, in order to formulate abstract models on the basis of reality. These processes produce the capacity to achieve a certain kind of result, with varying degrees of efficiency. Intelligence almost always refers to human intelligence, the only kind of which we have direct knowledge and experience, and this limits our ability to imagine different kinds of intelligence, which might be better suited do the development of AI.

Centuries of scientific, but also philosophical, studies have identified particular mechanisms that underlie intelligence. Drawing inspiration from their functioning, it has been possible to develop computers that mimic some of these mechanisms. The problem is that it is not yet been possible to mimic and integrate them all, so the AI systems available to us are basically incomplete. A computer program can therefore imitate the mechanisms necessary to win a game of Go or to drive a car automatically while abiding by the Highway Code, improving these capacities and becoming broadly speaking "intelligent".

Decades of research have tested various ways of achieving real AI. Two basic approaches have been chosen: one involves observing human behavior, the way we reason and behave, to build software that imitates our logical processes as far as possible. The other, more creative, approach involves proceeding from the problems that reality creates and, on that basis, having AI formulate its own method of behavior. These two approaches often intersect and one does not necessarily exclude the other, partly because their designers are still human beings, with a way of thinking and reasoning that is reflected in the design of AI.

Meanwhile, more and more new and important technologies are emerging, thanks to the simultaneous development of Big Data, cloud storage systems, and data processing, three preconditions for AI's growth. Forrester[16] has identified 13 of them as most important to enterprises for application development and delivery in business processes to facilitate decision-making.

Each of these technologies seems to share certain common features:

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[16] Forrester (2017), TechRadar™: Artificial Intelligence Technologies, Q12017:
https://www.forrester.com/report/TechRadar+Artificial+Intelligence+Technologies+Q1+2017/-/E-RES129161 *(last accessed June 2017).*
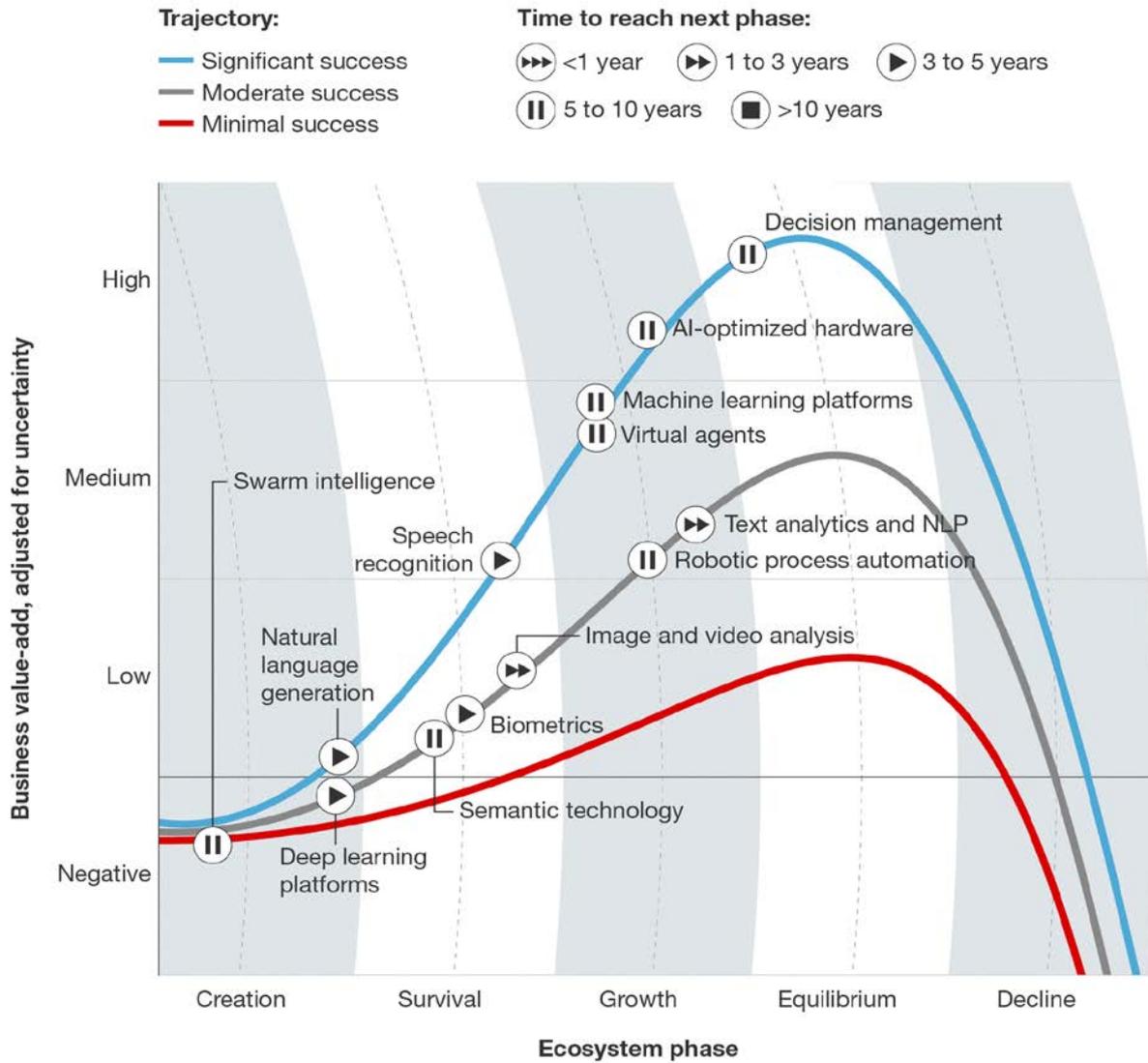
- It already plays, or will soon play, an important part in increasing cooperation between man and machine;
- It is commercially available from at least one supplier and is not merely a research project;
- It has potential value to businesses in several different fields.

Organized according to different phases depending on the level of maturity (see Fig. 1), here is a list of 10 technologies considered to be of particular importance:

- Natural Language Processing – this is an elaboration of natural language, that is, automatic processing by an electronic calculator of written or spoken information in a natural language. Basically, NLP enables a machine to understand a text, but also provides the capacity for expression, for instance by enabling it to create a summary. NLP is used in customer care, automatic summaries, and text analysis, but also in the analysis of "sentiment," to measure the level of emotion in a particular piece of speech and to interpret whether the speaker is in favor of, against, ironical, and so forth vis-à-vis the concept expressed.
- Speech recognition – The transcription and transformation of human speech using computer applications. It is currently used in interactive voice response systems.
- Virtual agents – These are currently the subject of media attention. They range from simple *chatbots*, in practice "virtual secretaries" capable of an automatic dialogue in a chat with clients, answering simple and common questions, to more advanced systems. This technology is currently used in customer services and the smart home.
- Machine learning platforms – This area of computer science grants computers the capacity to learn without being explicitly programmed. In practice, it involves the capacity of an algorithm to learn from data, or to avoid previous mistakes. Machine learning platforms are used in a wide range of business applications, mainly involving various kinds of forecasting and classification.
- AI-optimized hardware – Graphics processing units (GPU) and devices specifically designed and built to perform computing tasks efficiently.
- Decision management – Engines that insert rules and logic into AI systems and are used for initial setup, training, maintenance, and calibration. It is a mature technology, used in a wide range of business applications to facilitate or perform automatic decision-making processes.
- Deep learning platforms – A special kind of machine learning that involves an artificial neural network, currently used mainly in pattern recognition (for instance, the recognition of shapes or faces by photograph archiving systems - such as Google Photo and iCloud - or surveillance systems).
- Biometrics - This permits more natural interactions between human beings and machines, including interaction with images, touch recognition, words, and body language. It is used mainly in market research.
- Robotic process automation – The use of texts or other methods to automate human actions in order to support efficient business processes. It is used where it is too costly or inefficient to have certain tasks performed by human beings.
- Text analytics and NLP – Natural Language Processing (NLP) uses and supports text analytics to facilitate the comprehension of the structure and meaning of sentences, but also of their "sentiment" or intention by means of statistical and machine learning methods. They are used to identify fraud and in security.

TechRadar™: Artificial Intelligence Technologies, Q1 '17

TechRadar™: Artificial Intelligence Technologies, Q1 2017

Trajectory:
- Significant success
- Moderate success
- Minimal success

Time to reach next phase:
- ▶▶▶ <1 year
- ▶▶ 1 to 3 years
- ▶ 3 to 5 years
- II 5 to 10 years
- ■ >10 years

Business value-add, adjusted for uncertainty (High, Medium, Low, Negative)

- Decision management
- AI-optimized hardware
- Machine learning platforms
- Virtual agents
- Swarm intelligence
- Text analytics and NLP
- Speech recognition
- Robotic process automation
- Natural language generation
- Image and video analysis
- Biometrics
- Semantic technology
- Deep learning platforms

Ecosystem phase: Creation, Survival, Growth, Equilibrium, Decline

Source: Forrester Research

2.2 Outlook and limitations in the adoption of AI in enterprises

AI technology helps enterprises to liberate and improve the quality of human work, helping to increase turnover and profits and to gain new clients, as well as limiting the risks of certain activities and improving overall efficiency. However, AI is used not only to optimize the contribution of human work but also:

- To expand human intelligence: AI works mainly as an aid to expanding human intelligence, supplying contextual knowledge originating from data that the human mind alone cannot access and/or process;
- To free workers from monotonous or strenuous tasks: companies have responsibilities and roles requiring little human cognitive effort but that have been excluded from AI's sphere of use;
- To permit robotic processes for self-improvement and self-correction: AI technologies can be very useful in situations where there is no longer any direct interaction with human beings, once an application has been installed and launched.

So AI has the potential to bring about great changes throughout the enterprise, turning it into an ecosystem, once it starts moving in the following directions:

- Rapid transformation in applications addressed to customers. Customer services and support organizations are already testing AI-driven transformation, through the use of voice recognition, NLP, virtual agents, and machine learning. This does not merely reduce the volume of calls: AI will fundamentally alter practices in the employment and training of an organization's employees, the creation and storage of knowledge, and procedures and processes to involve customers.
- Major upheavals in the traditional industries. The changes linked to AI are not always immediately apparent in the industries concerned. In some instances, such as dispatch and logistics, the accumulation of multiple technologies requires major changes in an industry, once these technologies reach a certain level of maturity. The introduction of sufficiently safe self-driven vehicles on land, at sea, and in the air has been under way for decades, but once they are introduced, they will radically alter the level of service previously provided, the business model, and even employees' pay structure.
- Interconnected business intelligence Web. The tendency to anthropomorphize intelligence is typical of all human beings, and we can see that this extends even to AI software. Today, Watson, Alexa, and Cortana, like Amelia, ABI, and Holmes are known to a greater or lesser extent as concrete examples of AI applications. The AI systems that will form the foundation of future smart enterprises will however be similar in their development to many other technologies, constituting an ecosystem of interconnected and mutually supporting parts. We can already see developers building smart applications and talking about "pieces" of Watson or Cortana. AI within an enterprise will often involve a launch on a very small scale, rather than the acquisition of a complete solution.

Following on from these opportunities, a number of considerations need to be made about the limits of such development. Still according to Forrester's research, the main obstacle to the adoption of AI generally seems to be the fear of replacing men with machines. The reality is rather different: the future will be hybrid, with human beings and machines working together to enhance overall efficiency. A number of aspects need to be kept in mind in this regard:

- Human beings and smart machines work better in tandem. Much of the present anxiety about AI systems stems from anxiety about technological unemployment. In fact, most AI systems do not always and not only replace employees: they often permit the performance of low-value

tasks or those that are too costly or arduous for man. It is indeed human beings that must link the technologies of all three sensorial components to build AI systems capable of feeling, thinking, and acting autonomously.

- Interaction between man and computer far exceeds the interaction between computer and man. We are just beginning to discover how machines can communicate with us more efficiently, and this is a field that has been studied relatively little.
- More limited use cases yield better results. There is no such thing as real AI at present. Companies that have achieved real business successes from by using these systems have limited the scope of use cases and have developed their applications in such a way that AI can be confined merely to responding to queries or inputs within a limited ambit. The most successful implementations include: virtual customer agents, image analysis in the security and surveillance sector, and interactive voice response systems.
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Another consideration is the fact that, though investments in AI technology are increasing, the challenges to the adoption of AI technology still remain, and they include the absence of certain elements, including:

- A clear business case. Since current AI development is a relatively recent phenomenon, many organizations have not yet understood how to apply AI to achieve specific business objectives. As with many technologies, researchers and academics were the first to develop and spread AI systems, whereas enterprises are just beginning to take an interest in them. Without a clear path to achieving ROI, many organizations struggle to justify investments in this field.
- Specialized skills to build, implement, and manage AI systems. There are now a group of researchers, well-known in academic circles, who are specializing in deep learning and AI, while the talent pool in the business world remains very small. Furthermore, since the adoption of AI in business is still embryonic, even fewer people have the capacity to interpret AI and to apply it to the business context. That does not mean that in the future a company's staff will need to be completely replaced, but new staff will have to be added. For instance, a major international consultancy is adding a linguist to its team with the aim of building an application that can automatically classify text content.
- A robust data management platform. Generally, computers do what they are asked to do, hence the expression "garbage in, garbage out", and this is particularly true in the case of AI systems. These systems often require vast amounts of data to learn to perform a specific activity. At the same time, "ensuring the quality of the data extracted from a large range of sources", which should be a goal for many organizations, remains a remote prospect for most companies.
- Change management practices and processes. Apart from challenges relating to individual cases, business skills, and data, one of the greatest organizational effects of AI systems, and the one that enterprises seem most worried about, is their impact on the enterprise itself. Indeed, change management seems to be considered one of the major risks, highlighting the need to prepare for labor force restructuring as a result of AI.

One initial conclusion is that it is important to adopt maturing AI technologies and to monitor the progress of those having real potential for development. This, for the following reasons:

- AI systems still require particular care in their design, knowledge engineering, and model compilation. The purpose of many AI systems us to obtain functionally autonomous applications; the problem is that AI systems require a significant design effort to engineer the knowledge contained and to build models that can receive input and perform actions.

- AI technologies require new skills, not new staff. They involve the use of new abilities, such as familiarity with dep learning, text analysis techniques, and emotive computation. But it is neither necessary nor advisable to hire new staff specializing in AI, separate from the rest of the staff. Smart systems can be developed with existing development and data science personnel, but while adopting new cooperation models and new roles, though only if adequate training is provided.

A second conclusion is that AI technologies, through their own instruments and existing service platforms, enable application developers to fulfil the promise of further attractive and smart contextual applications. It may seem impossible to build complex AI systems, but in fact many AI functions are already an integral part of exiting business applications and processes. In order to achieve this it is necessary:

- To begin with a modular approach and then to adopt a scale-out approach. The addition of AI to business applications is not a monolithic process: often, intelligence is supplied not via a single application that has been fully trained and fine-tuned, but through the addition of functionalities, either individually or all at once.
- To exploit the platforms and products on the market to obtain ready-made intelligence components. Not all organizations can afford to build a large internal unit dedicated to AI, especially to try to resolve complex problems such as language analysis and some aspects of NLP and NLG. For these use cases, which require niche skills and data for their basic models, it is preferable to purchase tools or platforms already on the market.
- To establish orders of priority in gathering and processing data specifically intended for AI tasks. Without data, there can be no intelligence. All the software technologies analyzed in this document require a certain amount of algorithmic training to achieve results. Gathering a sufficient quantity of suitable data also takes time and investment. Even if an enterprise is unwilling to adopt advanced AI technologies, applications designed for gathering behavioral data and reviewing internal practices and processes on the representation of knowledge will in the future permit a very swift start.

3. ARTIFICIAL INTELLIGENCE: A NEW GROWTH FACTOR?

3.1 AI's long march in businesses

The implementation of AI, and hitherto principally of machine learning techniques in sectors of industry, is spreading quickly, thanks to the benefits deriving from the availability of functions such as:

- Real-time identification of fraudulent transactions;
- Street identification and navigation, micro-segmentation for insurance based on telematics data relating to driving behavior;
- Personalized digital advertising;
- Real-time price/booking optimization, personalized financial products;
- Predictive maintenance in manufacturing industry;
- Medical forecasting/personalized diagnostics.

Though AI is spreading inexorably, this is happening gradually and at different rates of penetration in different sectors of industry. In the United States, for instance, its adoption in ICT, media and financial services sectors is much greater than in the utilities or manufacturing industry, and even more so than in hospitality, construction, and farming.

The benefits in terms of operating costs vary according to the application, but are considerable: for instance, the McKinsey Global Institute calculates a 10-15% reduction in operating costs thanks to automation in a hospital emergency system, 25%in aircraft maintenance, and as much as 90% in automated mortgage creation. In total, enterprises' enhanced productivity is reflected in a growth factor of +0.8-1.4%per year[17].

However, the adoption of new technologies is still in the initial phase. McKinsey estimates that the United States has realized 18% of its "digitization potential", France 12%, and Italy 10%. As we have seen, one of the major forms of resistance to its adoption seems to be linked to its impact on employment. It is indeed expected to have an impact on employment, but varies greatly from one sector to another. Though theoretically an estimated 51%of waged activities in the United States could potentially be automated, in some cases - such as the hospitality industry - the actual practical realization is not yet technically feasible and the automation estimate based on technologies currently on sale is as low as 5%.

To avoid anxieties and exaggerations that might give rise to an emotional rejection of AI, it is important to remember that enhanced productivity does not necessarily or automatically result in job losses. Here are some examples:

1. In the 1970s and 1980s the spread of bar codes in the United States did not (as had been forecast) lead to a fall in the total number of checkout staff (in fact there was an increase of a few percentage points during that same period);
2. In many cases improved efficiency makes it possible simply to reallocate activities to areas offering greater added value. One good example is the efficiency of a CEO's activities if he uses AI technologies. McKinsey estimates that 25% of a CEO's activities can be automated, but it is difficult to imagine that this could result in a CEO's

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[17] McKinsey (2017), A Future That Works: Automation, Employment, and Productivity: http://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works *(last accessed June 2017)*

dismissal or an overall reduction in the number of CEOs (we should also consider the efficiencies achieved during the past decade by multifunction devices such as the Blackberry and the smartphone, without any appreciable impact on the employment of CEOs);

3. Not to mention ATMs, which were first introduced 50 years ago[18]. It was forecast that this forerunner of activities previously performed by human beings would reduce the number of bank clerks. In fact, there seems to have been no reduction[19].

Of course, some professions are bound to disappear, or at least to become less important[20], but we must not forget that AI permits the development of digital platforms that can be used on a large scale, permitting new kinds of jobs. Consider the kind of savings, however controversial, brought about by such platforms as Uber, AirBnB, of even Facebook and Instagram in Asia, where they drive informal peer-to-peer commerce undergoing exponential growth. McKinsey estimates that 20-30% of the working-age population in the United States and the EU are involved in informal and "extra" jobs, facilitated by digital platforms, to supplement their incomes - the so-called "gig economy," to which we will return in Chapter Four. Because of the concerns that seem to be emerging in connection with these new kinds of work, it would be advisable to regulate access to these flexibilities, rather than to adopt a rearguard Luddite anti-digital approach.

So automation means not only reductions in costs and staff, but above all greater reliability and robustness, improved quality and security (in financial transactions, for instance). It certainly means improved competitiveness, for instance by means of predictive maintenance in an industrial enterprise, or through the faster and more reliable delivery of consumer goods for a service company. So it is important not to fall into the trap of identifying AI as the scapegoat for an economic crisis caused by other factors. On the contrary, AI can and must be a strong driving force behind enhanced productivity in industry and services. This is particularly important in countries such as Italy, experiencing slower growth and an aging population.

3.2. Initial goals of industrial leaders in AI

As we have said, the new wave of AI is happening here and now. However, the actual industrial application of these new opportunities is only just beginning. It is no coincidence that those championing the adoption of new technologies are the very ones that introduced the digital revolution (Apple, Amazon, Google: the "usual suspects"). In other words, the architects of AI innovation are also becoming its principal users. Apart from enjoying greater technological maturity, they also draw on their own established Cloud and Big Data infrastructure and capacity to gather, store, and analyze huge amounts of data (both of which, as we saw earlier, are crucial to the development and sophistication of AI systems.

Here are some examples:

- Thanks to its acquisition (for $775 million) of Kiva, a robotics company specializing in automated picking & packing, Amazon has sharply reduced the time lag between click and dispatch (60-75 minutes if managed by human resources) to 15 minutes, while

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[18] T. Harford (2017), We are still waiting for the robot revolution. The Financial Times: https://www.ft.com/content/4423a404-5c0f-11e7-9bc8-8055f264aa8b *(last accessed June 2017).*

[19] J. Bessen (2016), The Automation Paradox. The Atlantic: https://www.theatlantic.com/business/archive/2016/01/automation-paradox/424437/ *(last accessed June 2017).*

[20] One of the numerous websites that show how likely it is that a job will disappear because it has been replaced by a robot is "WILL ROBOTS TAKE MY JOB?": https://willrobotstakemyjob.com/ *(last accessed June 2017).*

warehousing capacity has increased by 50%. The overall return on investment has been 40%;

- As is well known, Netflix makes extensive use of its own personal recommendation algorithm for its 100 million customers. Netflix estimates that its client satisfaction (by rapidly identifying desired content - 90 seconds is the measured limit of "endurance") results in $1 billion in turnover from churn prevention (that is, revenue from clients that would otherwise have canceled their Netflix accounts).

Other players, not digital natives but nevertheless enjoying the benefits of scale and investment capacity, have focused on AI. BMW and Toyota, for instance, have recently made major investments in AI. Toyota alone announced that it has allocated $1 billion to R&D in robots and machine learning to support driverless cars. Other industrial giants such as ABB, Bosch, General Electric, and Siemens are also announcing major investments in AI.

With regard to the various sectors, the ones that espoused AI earliest are telecommunications, the high-tech industry, and advanced manufacturing. These were followed by a group of industries that have digitized to a lesser extent, such as the utilities, financial and professional services, and construction. From the value chain viewpoint, practical AI applications are to be found mainly in customer services (for instance in telecommunications and financial services,) marketing and sales, and operations (especially in the automotive industry and industrial assembly, the consumer goods sector, and the utilities) and in product development.

The following are some specific examples of value creation:

- Forecasting is one of the areas most concerned (as regards supplies and demand forecasting). AI-based forecasting can reduce errors by 30-50% compared to traditional methods. Logistical costs are reduced by 5-10%, while warehousing can be reduced by 20-50%. With regard to demand forecasting, one German online retailer says that it has developed an AI algorithm that can forecast its customers' purchases in the coming month with 90% accuracy.[21]
- In marketing, the main role of AI algorithms is to personalize and dynamize the offer (for instance, by means of "Amazon-style" Next Best Offer models). Pricing also becomes dynamic, thanks to predictive and optimizing algorithms which adapt in real time to supply and demand trends. The applications extend both to the consumer world (online retailing, personalized mortgages, and flight and hotel pricing), and to the B2B world (for instance, in the aerospace industry, where maintenance cost forecasting is used in pricing).
- In manufacturing industry, robots equipped with computer vision are particularly useful. New AI-based video cameras can be trained to recognize empty spaces or to identify an object and its position, for subsequent use in production logistics. Some companies (such as Rethink Robotics) are developing "collaborative" robots that can be instructed by human operators to replicate movements and actions, thus increasing productivity in fields that cannot be completely automated. In semiconductor production, AI motors analyze vast amounts of production data to identify erroneous production processes and to suggest corrections, achieving a significant reduction in the number of manufacturing defects.

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[21] McKinsey, Op. Cit.

- In <u>retail</u>, applications are still experimental, but offer great potential for innovation. Amazon, for instance, has constructed a physical supermarket in Seattle (Amazon Go) that allows customers to "leave without paying" for purchased goods, and to receive an invoice at home (the system is based on an AI system that recognizes the goods purchased by means of computer vision). There are also the many tests of drone delivery, which requires deep learning functions to improve their accuracy and reliability.
- In the <u>utilities</u>, programming and maintenance can be entrusted to AI: using data gathered by sensors, machine learning applications help operators to predict when and where maintenance will be needed, whether scheduled or not (inspections etc.). The estimated savings to Europe's utilities companies amounts to 30% of power transformer maintenance costs, for instance.

The overall impact of the adoption of AI on companies' finances is still difficult to quantify confidently, but companies that say that they have invested in AI report margins 3-15 percent higher than the sector average, though almost all of them believe that they have derived only part of the productivity benefits that technology provides or believe that most of the benefits will materialize in the coming years).[22]

3.3 The AI giants: a threat, but also an opportunity

As we have seen, the adoption of AI by industry offers great potential, and companies that accelerate in this direction will be able to develop a significant competitive advantage. The fear is that, as happened previously with the digital revolution, the asymmetry in the adoption of AI, among digital leaders first and foremost, will ultimately cause a further separation between "advanced" sectors and laggards, with companies in countries such as Italy at greater risk of being among the latter because of the delay in adopting new technologies. Furthermore, the observed correlation between a company's scale and the speed and ease of adopting digital/AI technologies exacerbates the vulnerability of countries such as Italy that lean toward small and medium scale-sized enterprises.

It is no coincidence that the concentration of technological innovation in the hands of a few North American giants such as Google, Amazon, Apple, and Microsoft, or Chinese companies such as Alibaba and Tencent, is causing concern in other parts of the world, though this phenomenon is not specific to AI (consider Microsoft's decades-old dominance in operating systems).

At the same time, we see a clear trend toward an open approach by the leading AI player, who are opening up their capabilities to developers and third parties. At the latest annual "Google I/O" event, CEO Sundar Pichai not only further confirmed progress with, and the crucial importance of, AI in all the US giant's areas of development, but also announced the offer to third parties of its own ultrafast chips to execute machine learning code, via an open source project. Amazon and Microsoft are pursuing similar policies, obviously centered on and benefiting their own respective platforms (Alexa and Cortana). This competition between cloud/AI solutions should have a beneficial impact on the speed of innovation in in the coming years and certainly represents an opportunity to participate in the AI ecosystem for those hitherto excluded from it.

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[22] McKinsey, Cit.

In the recent past similar trends have produced technological breakthroughs: consider, for instance, Apple's offer to external developers of its App Store, permitting the creation of such powerful applications as Uber and Instagram. Or, in China, the availability offered to third parties of Tencent's WeChat platform, for the development of such functionalities as news, taxis, food delivery, and payments. The open model is a powerful driver behind the development of a digital ecosystem alternative to the one based on Apple iOS, Google Android, and traditional payment circuits.

4. SOME UNANSWERED QUESTIONS

4.1 Governance and the relationship between man and machine

As pointed out above, AI and robotics will become increasingly important in the coming years. Indeed, it is not a matter merely of AI as such, but of its applications in various fields, starting with robotics. The most advanced systems will indeed involve the use of technological architectures capable of deducing information from data, learning from it, and applying what has already been acquired in subsequent elaborations ("learning machines"). All this, thanks to the combination of: increasingly high-performance computers, the spread of digital infrastructure, and AI and robotics algorithms to optimize large-scale processes and enhance productivity at lower cost. Examples include autonomous vehicles, robots managing industrial warehousing, and the automated comprehension of medical images, for instance to identify cancer (such as systems to assist melanoma diagnosis[23]).

Though still remote from the automation of processes requiring reasoning and planning[24], nevertheless the question arises of the governance of the man-machine relationship. The World Economic Forum includes robotics and AI among the 20 emerging technologies of the Fourth Industrial Revolution destined to transform the world in the coming years, pointing out that they can give rise to major opportunities, and at the same time major risks:[25] the balance depends on the efficiency of the system governing them, that is, the combination of rules, standards, incentives, institutions, and other mechanisms designed to regulate their development and use.

The governance question is particularly relevant to AI because it poses real dilemmas in terms of ethics and responsibility, for instance in connection with autonomous vehicles. Furthermore, it raises questions concerning security and privacy, as well as the possible social impact in terms of employment, possible increased disparity between various sectors of the population, and the delicate relationship between man and machine. These new technologies cannot avoid interaction with human beings: they are at their service and work in an integrated manner with human intelligence. Human beings are quick at parallel processing, or pattern recognition: they can recognize a known person's face, even with a different hairstyle or behind sunglasses; they can understand what someone is saying even if the tone of voice changes; they can read a handwritten letter. But they are not so quick at sequential processing. Computers have not made much progress in the former field, but have become super-fast in the latter field. Only the integration of both these kinds of intelligence can maximize the opportunities and mitigate the risks. Through machine learning, for instance, man can properly train robots and their intelligence or can write programming code able to perform complex operations implemented and corrected by self-learning. AI will thus be able really to support man, strengthening and supplementing his capacities.[26]

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[23] A. Bowling (2017), Training Watson to Help Detect Melanomas Earlier and Faster, IBM:
https://www.ibm.com/blogs/think/2017/03/training-watson-to-detect-melanomas-earlier-and-faster/ *(last accessed June 2017)*.

[24] Afor instance, virtual agents that can conduct a real dialogue (transcending question-and-answer systems as in the case of IBM's Watson) or truly autonomous machines capable of moving safely in complex environments. With regard to IBM's Watson, it remains to be seen what this machine can actually do: see B. Darrow (2017), Has IBM Watson's AI Technology Fallen Victim to Hype?. Fortune: http://fortune.com/2017/06/28/ibm-watson-ai-healthcare/ *(last accessed June 2017)*

[25] WEF (2017), The Global Risks Report 2017: http://www3.weforum.org/docs/GRR17_Report_web.pdf *(last accessed June 2017)*.

[26] Unipol (2017), Intelligenza artificiale e robotica: http://www.unipol.it/sites/corporate/files/documents/quaderno_intelligenza-artificiale-e-robotica_2017.pdf *(last accessed June 2017)*.

4.2 Ethics and threats, the capitalism of data: some unanswered questions

Like all other technologies, AI and robots are neither good nor bad in themselves, but neutral tools. It is the intention with which these technologies are used that determines their ethics. Using AI to penetrate a database in order to harm a human being is unethical, but to penetrate that same database to halt a nuclear missile launch could be considered ethical. At present, it is human beings that determine how AI is used. AI and robotics are not so advanced as to have a reasoning "soul," a plan, or an intention, let alone emotions or empathy. We are decades away from such developments, if indeed they ever become possible. Before worrying that artificial intelligence is becoming "the greatest existential threat" (Elon Musk[27]), we must promptly develop ethical rules for the use of technology, at its present stage of development.

Ethical rules must consider several different aspects, and first and foremost security, privacy, and trust/transparency. The less obvious considerations relate to how to prevent the further unequitable distribution of wealth, due to the use of these advanced technologies only by an élite, while the sector of society untrained in these technologies is left behind, without jobs. First, there are the jobs that cannot currently be automated and that society should recognize more: such as teaching, handicrafts, design, and care for the elderly. Furthermore, AI and robotics will still need human support for a long time. This will give rise to new specialized professions, for which there will still be a market demand. Third, companies that use AI and robotics intelligently (and that enhance productivity by using fewer people) must contribute more to welfare systems. Governments are slow to anticipate such changes, and even slower to implement appropriate provisions. Italy could try to set an example in this regard.

Of course, some say that we are witnessing the emergence of a new era, that of so-called "data capitalism" (which until just a few years ago was defined as "surveillance capitalism"[28]). Now the field of social interaction overlaps with that of profit. Capitalism centers on a huge mass of data: it depends on data because that is how it generates wealth. It is struggling for its own survival and thus becomes part of social life. As sociologist Evgeny Morozov put it, "digital technologies are both our best hope and our worst enemy"[29]. We need to reverse the paradigm and renegotiate our freedom because, from Google to Facebook, it is "click capital" – as Morozov defined it – that counts and that in practice subjectivizes the social players of the Web. A few giants appropriate our behavior and turn our online habits and pleasures into a virtue (for their own benefit). If capital accumulation is focused on two aspects – first the gathering and then the analysis of data – it alters relationships between people and the relationship between institutions and people, giving rise to new kinds of work. The sharing economy is one aspect of what Arun Sundararajan renamed "crowd-based capitalism"[30].

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[27] 2014 Centennial Symposium, MIT AeroAstroMIT: http://webcast.amps.ms.mit.edu/fall2014/AeroAstro/index-Fri-PM.html *(last accessed June 2017)*.

[28] S. Zuboff (2014), A Digital Declaration, Frankfurter Allgemeine : http://www.faz.net/aktuell/feuilleton/debatten/the-digital-debate/shoshan-zuboff-on-big-data-as-surveillance-capitalism-13152525 *(last accessed June 2017)*.

[29] E. Morozov (2015), Digital Technologies And The Future Of Data Capitalism. Social Europe: https://www.socialeurope.eu/2015/06/digital-technologies-and-the-future-of-data-capitalism/ *(last accessed June 2017)*

[30] A. Sundararajan (2016): The Sharing Economy. The End of Employment and the Rise of Crowd-Based Capitalism. MIT: https://mitpress.mit.edu/sharing-economy *(last accessed June 2017)*

But everything comes at a price. Indeed, the "price of connection is surveillance capitalism", Nick Couldry argues[31]. Shoshana Zuboff speaks in terms of an outright process of extraction, commodification, and control of data within an overall architecture based on an accumulation rationale known as "surveillance capitalism"[32], arguing that "the answer to the question, 'who participates?' is: those with the necessary material, knowledge, and financial resources. The answer to the question 'who decides?' is: access is decided by markets in behavioral control. These are composed of those who sell opportunities to influence behavior for profit and those who purchase such opportunities"[33].

4.3 Today's "creative destruction": work, the gig economy, and algocracy

Other unanswered questions relate to the so-called paradox of our time, that is, the perception of Schumpeter's "creative destruction" under way. This is a process whose major technological innovations spark an extreme selective process, in which many companies disappear, others emerge, and others again grow stronger, while at the same time jobs are "destroyed" more or less as fast as they are created. It is a paradox precisely because, by virtue of its substance or expression, the theory seems to conflict with the common opinion that the resulting overall job balance is negative.

Apart from the diverse range of applications now grouped under the term "artificial intelligence", bots[34] and robots are the "creative destruction" of the present. It is regarded as a threat to existing models of employment, because historically technological innovation has always created sharp tensions, eliminating traditional jobs and giving rise to new ones.

The gig economy[35] - a growing economic model in which ongoing work activities (permanent jobs with long-term contracts) no longer exist and people work on demand - and algocracy, the "power of algorithms", which determines, organizes, and binds human interactions with these systems, are the concrete manifestation of the "creative destruction" currently under way. In the gig economy demand and supply are managed online via dedicated platforms and apps: for instance,

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[31] N. Couldry (2016),The Price of Connection: 'Surveillance Capitalism'. The Conversation: http://theconversation.com/the-price-of-connection-surveillance-capitalism-64124 *(last accessed June 2017)*.

[32] S. Zuboff (2015), Big Other: Surveillance Capitalism and the Prospects of an Information Civilization. Journal of Information Technology: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2594754 *(last accessed June 2017)*

[33] Cfr., Quando i dati sono il nuovo capitalismo, I Diavoli (2016): http://www.idiavoli.com/focus/dati-nuovo-capitalismo/ *(last accessed June 2017)*.

[34] In IT terminology, the bot (an abbreviation of robot) is generally a program that accesses the Web via the same kind of channels as human users employ (for instance to access Web pages, to send chat messages, to make videogame moves, and so forth). Such programs are widely used in seeral different Web services and for various purposes, generally linked to the automation of tasks that would be too strenuous or complex for human users.
Cf., https://it.wikipedia.org/wiki/Bot *(last accessed June 2017)*.

[35] A. Aloisi (2016), On-Demand Work and Online Platforms in the Collaborative Economy. Labour&Law Issues: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2883530 *(last accessed June 2017)*. Aloisi argues that "the gig economy is a freelicense system of work, facilitated by technology relating to generational and social demands. It is an efficient form of capitalist enterprise. A scientific paper published a few years ago noted drily that there is no shared definition of jobs requiring flexibilty and part-time commitment (…) or of the sharing economy. The doctrinal definition of the sharing economy is the monetization of underused or unsed resources. (…) The sharing economy seeks to cut costs by sharing activities that would be carried out in any case. Blablacar is a perfect example: the driver plans a route and sells free places to save money. But the Uber driver does not decide to set off from Milan's central railroad station for a hotel and while so doing to give a tourist a lift. The Uber driver travels on request. Like a taxi driver. This has caused anger in the profession. Another example is Foodora, paid on delivery. "Rider" is no more than a flattering synonym for a deliveryman. These couriers are subject to working relationships organizerd by the customer. For instance with regard to shift management, they have to wear a company uniform, but they also have to pay for their own equipment, such as smartphones and bicycles".

temporary room hire (e.g. via Airbnb), such freelance activities as web design (e.g. Upwork or Fivver), the sale of handicraft goods (e.g. Etsy), alternative private transport (e.g. Uber), home delivery (e.g. Deliveroo or Foodora in the case of food). Gig economy workers are all freelancers and pursue temporary/short-term, part-time/casual/interim activities. Unlike what happens in a bureaucratic system, in which administrative authority is based on laws and regulations and is exercised by a hierarchy, in the gig economy algocracy[36] draws on code, algorithms, and their programmability to create models of work entirely dictated by algorithms, thus reducing the need for supervision and control.

The "subsistence wage", which is now being tested in a number of countries including Finland, appears to offer the model whereby our societies believe they can accommodate the excessive numbers of unemployed that the current creative destruction will create. As though, by guaranteeing such a wage, it would be possible to separate the symbiosis that has for centuries coupled work with subsistence, thus leaving individuals with no defined professional identity. That means a society in which people will spend their time "hunting in the morning, fishing in the afternoon, rearing cattle in the evening, criticizing after dinner, as they may please, without ever becoming hunter, fisherman, herdsman or critic". The elephant in the room is the disempowerment of professional identities, as though the ability to do something well were of secondary rather than primary importance, not only to subsistence but also to everyone's identity.

However, to oppose the creative destruction wrought by technological innovation is not only anti-historical but generally disadvantageous. One typical example are the old English élites the 18th century, "whose major source of income was from landholdings or from trading privileges they enjoyed thanks to monopolies granted and entry barriers imposed by monarchs" who controlled countries' governments and who following the Industrial Revolution were already clearly the losers[37]". The lesson, then as now, is that "economic growth does not stem simply from the introduction of better and more numerous machines, or from improvements in workers' educational standards; it is a destabilizing process, which leads to radical changes and is coupled with phenomena of creative destruction." And these must be governed proactively, with a clear awareness of the context and of ethical and social factors.

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[36] Cf., http://blog.terminologiaetc.it/2015/12/02/origine-significato-algocrazia/ *(last accessed June 2017)*. Algorithms determine the results of search engines, what advertising appears when we visit a website, the notifications highlighted on Facebook, the most suitable washing machine program, but also priorities in transplant waiting lists, who is subjected to checks and controls, for instance by the taxman or at airports, and much else besides. Algorithms are a part of almost all aspects of everyday life involving technology. They also liea t the root of political and administrative decisions that affect us directly as citizens but that are not always documented and transparent: See also J.Danaher, Rule by Algorithm? Big data and the Threat of Algocracy. IEET: https://ieet.org/index.php/IEET2/more/danaher20140107 *(last accessed: June 2017).*

[37] D. Acemoglu-J.A. Robinson (2012), Why Nations Fail: The Origins of Power, Prosperity, and Poverty.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

AI is with us, and has been for some time. Leaving aside its most famous fictional representations, a great many of its applications, little known but nevertheless important, are now an integral part of our lives. So adopting AI is now a necessity, and no longer an option. To do so before a rival means seizing the opportunity of a competitive advantage, which may even permit improvements in GDP, which in Italy's case might amount to as much as 10%[38].

5.2 Recommendations: what can Italy do?

As we have seen, AI technologies help businesses to improve the quality of human work, to increase turnover and profits, and to gain new customers, as well as reducing the risks of various activities and making them more efficient. In order successfully to choose the most suitable technologies the following should be kept in mind:

- To adopt maturing AI technologies and follow the progress of those having the potential for specific development;
- To building complex AI systems may seem impossible, whereas in fact many AI functionalities are already integrated in existing business applications and processes;
- To remember - in order to avoid anxieties and exaggerations that might cause an emotional rejection of AI - that improved productivity does not necessarily result in dismissals.

In Italy specifically, in order to create an ecosystem favorable to AI and to avoid becoming dependent on first movers, and particularly such massive ones as the United States and China[39], it is necessary to manage:

- The need for businesses swiftly and confidently to adopt the applications made possible by AI in order to improve internal productivity and stay globally competitive. Leading Italian businessmen must quickly invest in AI (platforms/technology and skills); as has been pointed out, digital assets and skills are "the new balance sheet". It is important for politicians and opinion leaders to develop a similarly receptive attitude to the adoption of these technologies, in order to avoid counterproductive rearguard battles: policy makers must encourage the adoption of AI to create the surplus productivity and economic prosperity needed to "finance" the management of its social implications.
- The asymmetry between the few (foreign) firms enjoying the benefits of AI, often thanks to business model disruption, and the many (Italian) firms struggling to exploit its potential. In particular, the "winner takes all" dynamics typical of the digital economy (for instance, 12% of world trade in goods is in the form of e-commerce via a very few players such as Alibaba, Amazon, and eBay, and therefore with no significant local players). It is therefore crucial for Italy to adopt a clear role in the global digital ecosystem. Though direct competition with the Internet giants seems beyond reach, the growing spread of open platforms allows more far-sighted countries to participate and play a role in the major ecosystems.

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[38] Accenture (2017), Country Spotlights: Why Artificial Intelligence Is the Future of Growth:
https://www.accenture.com/t20160929T215035__w__/us-en/_acnmedia/PDF-33/Accenture-Why-AI-is-the-Future-of-Growth--Country-Spotlights.pdf?la=en *(last accessed: June 2017)*

[39] L. Lucas-E. Feng (2017), China's push to become a tech superpower triggers alarms abroad: https://www.ft.com/content/1d815944-f1da-11e6-8758-6876151821a6?mhq5j=e1 *(last accessed: June 2017)*

- The widespread lack of the skills needed to manage AI, which must be promoted even at school, counterbalancing them with a continued focus on creative design, which is one of Italy's real strong points. With regard to the skills problem, McKinsey estimates that in the United States alone the gap between the supply of and demand for data scientists will reach 250,000 in the next few years. Italy must support STEM (basic science, technology, engineering and math) technologies through the education system, while adapting them to the new context by developing the younger generations' digital literacy. Recent international developments also suggest opportunities to attract foreign talent (for instance from the Far East).
- The ethical problem raised by AI, and particularly the assumed asymmetrical distribution of the benefits deriving from its large-scale adoption, must be discussed on the basis of agreed standards and real best practices, with an understanding of what has actually been done and can be done, and within what timeframe.

Italy could receive a major contribution from businessmen, public/private policy makers, and opinion makers committed to focusing on the growth prospects and new professions deriving from the introduction of AI, with investments to counterbalance the negative impact on employment, the returns on which could be very positive if properly managed. Here are some possible concrete proposals:

- To promote a public-private partnership to facilitate investments in digital platforms. Digitization is important, because it makes it possible to gather the data needed to "train" AI systems. To manage the large amounts of data it is crucial to create a data ecosystem using open standards in order to attract talents and to accelerate innovation.
- To support new forms of private enterprise made possible by digital platforms. Support must be given to opportunities for individual profit based on digital resources and the establishment of individual businesses, by simplifying taxation and regulation.
- To introduce tax benefits for businesses, to stimulate investments in digitization (and human capital) in digital job areas. The tax relief on human capital for AI and digitization could be compared to R&D.
- To create AI centers and laboratories at universities, in cooperation with the private sector, seeking to attract the "AI giants" and to persuade them to establish a presence in Italy, which could help to reduce the present gap.

Italy might enjoy a particular opportunity by virtue of so-called Industry 4.0, the tendency of industrial automation to integrate new production technologies to improve working conditions, thus enhancing productivity and factories' product quality.

Italy, whose industrial backbone is still largely centered around manufacturing, is indeed positioning itself within the major aspects of Industry 4.0[40]. New-generation factories are adopting advanced technologies to achieve highly integrated automated systems capable of producing goods on demand, both efficiently and dynamically. A system of sensors linked to the Internet (the Internet of Things) makes it possible to gather from machines production data relating to the current production process. This networked data provides important information about the manufacturing process and the status of the machinery. The real-time analysis and monitoring of

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[40] L. Maci (2017), Industria 4.0, a business excellence organization to define the Italian path. EconomyUp: https://www.economyup.it/innovazione/industria-40-cisco-lancia-un-club-di-imprese-per-tracciare-la-via-italiana/ *(last accessed: June 2017).*

such data thus makes it possible to identify and predict any technical problems, minimizing downtime, and to achieve the optimal management of supply and demand flows - always an important aspect, but particularly so in such sectors as e-commerce.

The introduction of this kind of algorithm based on artificial intelligence is still in its early stages[41]; Italy has the opportunity to specialize in the application of these advanced systems to enhance productivity and to make them a factor of industrial excellence. This latter objective is shared by many other countries, starting with the United States, for which the manufacturing system is equally crucial and to revive which the McKinsey Institute recently proposed an active reappraisal in four directions: "*Reinvesting, Retraining, Removing Barriers, and Reimagining Work*"[42]. This approach should be adopted in Italy to answer three crucial questions:

1. Does it still makes sense to produce in Italy or, rather, is there a modern and adequate manufacturing system - and if so, to what extent in this country - that can compete with the rest of the world?
2. Does Italy's labor force have the expertise and skills to be an active part of a modern manufacturing system?
3. What measures need to be taken to revive an industry such as manufacturing, which in Italy suffers from declining employment, low wages, and inadequate productivity?

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[41] In 2015 in Italy, the Big Data and Analytics market grew by only 14% to 800 million euros (the Big Data Analytics & Business Intelligence Observatory, Milan Politecnico School of Management) and it is unclear how much AI was introduced.
[42] McKinsey (2017), Making It in America: http://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works *(last accessed: June 2017).*

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