Intellectual Capital
for Communities
In the Knowledge
Economy

United Nations
Educational, Scientific and
Cultural Organization

Information for All
Programme

CONFERENCE REPORT

The World Conference on Intellectual Capital for Communities
15th Edition

Artificial intelligence and the next generation of competencies:

How Digital - and Artificial Intelligence will impact jobs and professional qualifications?

Organised by
The European Chair on Intellectual Capital, the University Paris-Sud and UNESCO's Intergovernmental Information for All programme (IFAP)

Paris - June 11 & 12, 2019

With a Regional Focus:
The Russian Federation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740322

BETTER POLICIES FOR BETTER LIVES

THE NEW CLUB OF PARIS

PRESENTATION

The central theme of the 15th Edition of the World Intellectual Capital (IC) Conference is ***"Artificial intelligence and the next generation of competencies: How will Digital – and Artificial – Intelligence impact jobs and professional qualifications?*** The future of jobs and the accompanying competencies are ever-important questions as digital technologies have become an ubiquitous part of everyday life, in a continuously-changing society. This dynamic context requires new business models. At the same time, digital intelligence is driving profound organizational transformation via its sources, scope (now global), scale and speed (the 4s's noted in Bharadwaj et al. 2013).

The debate on the impact of digital transformation on societies, and their vulnerability, is at the forefront of work by economists and international institutions (OECD, World Bank, UNESCO, ITO and WEF). Economists such as Robert Gordon consider that humanity is entering a period of slow growth where the impact of (digital) technology will be weak, while others consider that it will have a fundamental role in the transformation of jobs and productivity in general[1]. Despite the lack of studies on the impact of robotics on employment, there is growing policy interest in the impact of digital technology – especially artificial intelligence – on jobs and the qualifications that will be needed in the workplace of tomorrow.

The starting point: the impact of digitization on employment

The study by Frey and Osborne (2013)[2] paved the way for questions about the impact of robots on jobs. This was one of the first studies to systematically examine the impact of automation on jobs in the USA. It analysed the probability of the computerization of 702 jobs, and concluded that 47% were at risk. The level of risk varied depending on the type of job and the level of qualification. The sensitivity factor (risk) of various employment profiles ranged from 99% (for telemarketers) to 0.28% for recreational therapists.

In France, a study by the *Conseil d'Orientation pour l'Emploi (*2017), provides an in-depth approach to job sensitivity. It begins with an investigation of working conditions (mainly in 2013), and is based on the calculation of an Automation Index, which varies between zero and one. The distribution of the index is non-homogeneous, and it reaches its maximum (over 0.7) for less than 10% of the labour force. While only 10% of jobs are likely to be entirely lost, almost 50% are likely to change.

In Japan, a study by the Nomura Research Institute concluded that 49% of industrial jobs are sensitive to automation, compared with 35% in the United Kingdom and 47% in the USA. The potentially high rate of automation in Japan is justified by the fact that many of the tasks that are already automated in the United Kingdom or the USA are still performed manually in Japan.

More recently (March 2017), Daron Acemoglu and Pascual Restrepo published a study that showed the considerable negative impact robotics have already had on jobs in the USA. Between 1990 and 2007, up to 670 000 jobs were lost in the manufacturing industry. According to the authors' calculations, the introduction of a robot can replace 1000 jobs, which reduces the

[1] MIT economists, Erik Brynjolfsson and Andrew McAfee, in particular

[2] Carl Benedikt Frey and Michael A. Osborne in The Future of Employment: How Susceptible are jobs to Computerisation? September 17, 2013, available at: https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

employment rate by 0.18 to 0.34%, and wages by 0.25 to 0.5%. For the whole OECD area, the study conducted by Arntz et al. (2016) clearly shows that around 9% of jobs are automated, and that this figure can be differentiated by job type – the least skilled and therefore the least educated are most affected. The study concludes that there is an evolution rather than a revolution in progress; there is no scarcity of jobs, but rather a change in their structure. Recently, the World Bank also indicated that such impacts have begun to affect emerging and developing countries.

Change in work content and conditions

Historically, technology has removed jobs in some sectors, while creating jobs in others. In the 1920s, the automobile industry destroyed jobs in equestrian transport, but led to the creation of motels in the hotel industry. Today, technology is changing the nature of work, not only by changing the boundaries of companies, but also by reshaping skills and reducing industrial employment, although impacts might have been exaggerated (World Bank 2018).

It is therefore to be expected that the labour market will continue to be transformed by the ongoing digital revolution. There are a number of notable trends (OECD 2017):

- jobs in production will disappear globally, with possible redeployment between regions;
- new forms of work will emerge;
- the rapid growth of transactions on online platforms – in particular in housing and mobility – has resulted in the creation of a set of often precarious, flexible and temporary jobs;
- growth in self-employment, which is already observable in several OECD countries.

Given current developments, there is therefore a need for a systemic vision of the structuring of the labour market in relation to emerging value spaces. The differentiation between salaried and non-salaried jobs is a key aspect of understanding work forms – closely followed by the distinction between formal and informal jobs.

From a long-term perspective, the question posed here is how employment is structured at regional or country level, and what are its main determining factors? This question should also be considered with regards to innovation in the workplace, and the contribution of higher education institutions.

Artificial intelligence and the wetware[3] landscape

Artificial intelligence (AI), driven by machine learning, offers a set of skills that can surpass human capacities in specific cognitive domains. AI deployment should also be considered from the standpoint of knowledge, creativity and social interaction. It is already present in formalized/ programmable knowledge and is currently spreading to interactions with tacit knowledge. What will happen next? Will social interaction and wetware combine with programmable knowledge, taking advantage of deep learning? The stakes for societies are high, especially those related to investment in competences, and technology rent generation (IPRs).

[3] *Wetware* refers, in particular, to the human mind and its capacity to generate and combine ideas. It is often used as a concept that is complementary to hardware and software.

Another issue is the issue of human–AI interaction (and substitution), especially with respect to literacy and numerical competences (Elliott, 2017). In other words, will the shift in jobs and skills change in the future compared to what has been observed in the past, as a result of AI taking over existing and future competences?

This question raises the issue of aligning education with emerging needs. More generally, beyond the technological revolution, AI raises societal and ethical issues that need to be addressed globally (UNESCO, 2018). It also raises the question of AI knowledge distribution among nations – and therefore of the AI divide. Challenges relate to infrastructure, skills, knowledge gaps, research capacities and the availability of local data, which need to be overcome to fully harness the deployment of AI.

Changing competencies: challenges

A Competency Profile Analysis is an important way to determine job profiles. A recent report (McKinsey, 2018), indicates four trends:

1) A decrease in physical and manual skills over the period 2002–2030 (from 33% to 26%);
2) A decrease in the share of basic cognitive skills (from 20% to 15%);
3) No significant change in higher cognitive skills (around 22%); and
4) An increase in the respective shares of social and emotional, and technological skills.

The latter finding suggests the relative importance of technological, and complementary emotional and social interaction competences will grow. Furthermore, demand for the following specific skills is expected to grow by 2022: analytical thinking and innovation; active learning and learning strategies; creativity, originality and initiative; technology design and programming; critical thinking and analysis; complex problem-solving; leadership and social influence; emotional intelligence; reasoning, problem-solving and ideation; and systems analysis and evaluation. At the same time, demand for the following skills is expected to decline: manual dexterity, endurance and precision; memory, verbal, auditory and spatial abilities; management of financial and material resources; technology installation and maintenance; reading, writing, mathematics and active listening; management of personnel; quality control and safety awareness; coordination and time management; visual, auditory and speech abilities; and technology use, monitoring and control (WEF, 2018). These lists indicate that besides technology, the future will see demand increase for competencies related to emotion, social interaction and creativity, while physical tasks and those requiring reading and writing skills are expected to decrease.

Beyond these lists, it is also important to develop a systematic view of how human–AI interactions will operate, how they will impact competencies and job profiles, and how higher education and other academic institutions prepare their students. Earlier editions of the *IC for Communities* conference series have discussed some of these issues. However, they will be explored in more depth in the 15th Edition. The conference will look at these competencies from different angles: geographical (Asia, Europe, North and South America, and Africa), institutional (large companies, large international institutions, small companies), and professional (scholars, policy and private sector decision-makers). The following themes will be addressed during the conference:

1) Foresight exercise for next-generation jobs and competency profiles

o ***Foresight exercises for next-generation jobs and competency profiles***. Although several studies have addressed the issue of job profiles and competencies, the findings are often divergent. Key scholars and experts are invited to present their methodological framework, content and conclusions, in order to arrive to a consensus on policy recommendations.

o ***Modelling future production systems*****:** How will value (of any innovative offer) be created in the medium term? What are the roles of digital and AI technologies? What are the characteristics of the 2030 enterprise? What will be the role of real-time decision-making, and what employment profiles and competencies will be required?

o ***Intangibility, digital, and future production systems*****.** The question here relates to the type of exchange instruments used by people, especially in a context where acceleration – e.g. the accelerated production of links – becomes a major production system. The multiplicity of spaces for value creation and the ubiquity of digitality means that we can expect exchange and social interaction to become organized along the lines of intangibles such as brands, data and reputation.

o ***The role of digital data in productivity systems, and the impact on human capital***. How will digital and human capital and, more generally, intangibles (intellectual capital) impact productivity growth? What new measures can be proposed, given (the) emerging value of production system(s)?

o ***Analysing platforms and hybrid organizations.*** The hybridation of resources is being accelerated by the theoretical role of data. This is clear in the case of digital platforms (GAFA and others) that hold the market power around which innovations are concentrated and organized. We also need to look at hybrid organizations that combine private and public resources, or market- and non-market-oriented organizations. Beyond establishing typologies, it is important to document governance structures and processes in detail, examine the impact of innovation capabilities and the sustainability of ecosystems on society in general, and understand the impact of such an organisational form on job profiles and competence development.

2) AI and the digital divide

o ***The AI technological and societal divide*** **among nations.** How will investment in AI affect the distribution of technological and scientific power among nations? How, specifically, will developing and emerging nations contribute to, and benefit from, the AI revolution? What is the role of their scientific and technological capabilities?

3) The role of education in a world of AI

o ***Education and institutional challenges.*** The emergence of AI poses important challenges for education and innovation systems, and societies in general. Such challenges need to be addressed from different angles (funding, programmes, leadership, and changes in competences).

4) The responsible development and implementation of AI for learning

o ***AI and ethics*.** The massive use of data, together with human interfaces, means that AI raises important ethical issues. How should this dimension be addressed in different contexts? What is the role of international coordination? How can AI contribute to a safe and ethical cyberspace? Several issues are posed, including those related to the status of the agent[4].

5) Competencies for AI: Entry points and new orientations

o ***Key competencies for real-time management*. The generalization of real-time data poses important questions for decision-making:** What competences are needed for real-time management, and what impacts will the latter have on organizational performance? Earlier World IC Conferences have addressed these questions at various levels: national, regional and local, cities, companies and networks.

The conference will also address various recurrent topics from previous World IC Conferences, such as intangibles and productivity growth, innovation policy, information sharing, knowledge transfer, measurement, valuation and reporting, as well as the future research and policy agenda for intangibles and intellectual capital.

This year, following the success of IC8 (South Korea), IC9 (The Mediterranean), IC10 (Brazil), IC11 (China), IC12 (Africa), IC13 (Japan) and IC14 (France), the regional focus was on the Russian Federation.

We will also dedicate a session to the forthcoming special issue of the Journal of Intellectual Capital on the topic of **Intellectual Capital, Firms' Innovation Growth and Emerging Value Spaces**. (http://emeraldgrouppublishing.com/products/journals/call_for_papers.htm?id=8559).

[4] See COMEST/ UNESCO reports. For instance, the UNESCO World Commission on the Ethics of Science Knowledge and Technology (COMEST). COMEST report on Robotics Ethics. 14 September 2017.

Welcome address

In his welcome address**,** Professor **Étienne Augé**, Vice President of Université Paris-Sud, Université Paris-Saclay, highlighted the fact that AI is not only a research subject, but also very important in social sciences. He expressed his pride that the University Paris-Sud is a leading research hub – and also one of the organizers of this conference, where policymakers, scientists and other participants can meet to discuss different facets of this technology.

Ahmed Bounfour, Professor, European Chair on Intangibles, Université Paris-Sud, Université Paris-Saclay, drew attention to three major questions on AI: first, how is AI contributing to productivity by taking account of intangibles? Second, how can the positive economic outcomes of AI be shared within society? And last, how can AI help to create an inclusive society? He emphasised that this conference will contribute to the discussion related to these issues.

Boyan Radoykov, UNESCO, stated that AI has great potential. In 1959, the United Nations brought together over 2000 experts from over 30 countries to discuss digital data processing. Sixty years later, AI has started to change our existence. He affirmed that AI will be useful in meeting UNESCO's goals: education for all, and access to information for present and future generations.

Session 1- Artificial intelligence, competencies of tomorrow: the policy agenda

Moderator

- **Dorothy Gordon,** UNESCO

Speakers

- **Doreen Bogdan Martin,** ITU
- **Dominique Guellec,** OECD
- **Bertrand Pailhès**, French National Strategy for AI
- **Takao Nitta,** Bureau of Science, Technology and Innovation Policy, Cabinet Office
- **Maxim Fedorov**, Skoltech Center for Computational and Data-Intensive Science and Engineering

The session on 'Artificial intelligence, competences of tomorrow: the policy agenda' was moderated by **Dorothy Gordon,** IFAP Chair, UNESCO.

Doreen Bogdan Martin, Director of the Telecommunication Development Bureau of the International Telecommunication Union (ITU), Switzerland, pointed out that AI is transforming our world. It has the potential to help accelerate progress by supporting the 17 sustainable development goals. Health, disease control, ecology, migration and many other problems could be solved with this technology. Managing the risks associated with AI in the age of interdependencies, interoperability and multilateral cooperation is necessary. The ITU, which has a long tradition of drawing up communication protocols and providing support for new technologies, is one of the leading entities engaged in these problems. It is focused on critical issues, best practice for regulatory frameworks, digital skills, the digital empowerment of youth, and providing assistance to developing countries to become connected. The ITU is also working with other UN agencies to extend the benefits of AI to poorer nations and improve the lives of everyone, by balancing technological progress with social progress.

Dominique Guellec, Head of Division, OECD Directorate for Science, Technology and Innovation, pointed out that AI is on the policy agenda. In his presentation, he underlined that current AI technology is an extension of Big Data analytics. AI was born out of the huge quantity of data that is now available. Despite the hype, he predicted that large-scale effects will progressively become apparent in 2–10 years. AI, he argued, is more important than the agriculture revolution; the autonomous car is expected to become commonplace, although not very soon. AI is a general-purpose technology that will transform all economic sectors and social activities. It will boost productivity in all sectors, and affect income distribution and, hence, social equilibria. Moreover, AI is an instrument of state power, notably in the form of weapons and mass surveillance. As a result, it raises complex societal and ethical issues. AI is associated with the very identity of humanity – and governments are not ready. They find it difficult to hire AI experts because the private sector offers more competitive salaries, and the current situation makes it challenging to design appropriate regulations. Moreover, governments operate at the national level, whereas many features and issues raised by AI are global. He concluded that AI is driven by 8 international companies – 5 from the United States and 3 from China. Europe is lagging behind and needs to catch up quickly.

Bertrand Pailhès, Coordinator of the French National Strategy for AI, France, noted that various entities have supported the development of AI-related policies in France, including the Fields medallist MP Cedric Villani, the army and some politicians. There are a number of ministries that are taking AI into account when improving their policies. This is notably the case in the creation of research strategies. The French National Strategy for AI has three main goals: 1) creating a healthy ecosystem for AI firms; 2) increasing the availability of skills on the market (which is different to excellence); and 3) developing an ethical approach. He highlighted five types of skills that relate to the development of AI: 1) improving scientific skills and increasing the number of PhD candidates; 2) producing engineers and designers who understand the processes involved, and can integrate this knowledge into companies, drawing upon the cross-disciplinary skills of staff educated to Master's level; 3) training people who can train algorithms; 4) general training of lay people in AI via MOOC; and 5) addressing the issue of jobs that will become obsolete. The economy has changed over the past 50, or even 100 years. AI is not only a question of how to train people, but also a question of how to organise the workspace.

Nakao Nitta, Director of the Bureau of Science, Technology and Innovation Policy, the Cabinet Office, Japan, presented Japan's AI Strategy. Society 5.0 is the fusion of cyberspace and physical space. The 5.0 society will balance economic advancement with the resolution of social problems. It will help in constructing a human-centric society. Technology will help to achieve these goals, particularly the IoT, by helping in the fusion of physical and cyberspace. Japan's AI strategy has three key components: 1) dignity: the use of AI to augment capability and creativity by engaging people in rewarding jobs; 2) diversity and inclusion: AI will create new values for diverse people; and 3) sustainability: AI will be used to address global and national issues for a better future. Japan's AI strategy is multifaceted and aims, first, at educational reform to increase AI literacy and alleviate the shortage of AI experts. Second, it seeks to make Japan an attractive base for researchers around the world and promote next-generation AI technologies. The third priority is the deployment of AI to the real world, by fusing AI and data to address social issues.

Maxim Federov, Professor, and Director of the Skoltech Center for Computational and Data-Intensive Science and Engineering, Russian Federation, highlighted the role of the Russia in the global AI movement. The biggest risks of AI are digital obesity, culture and education (which are changes resulting from different technologies), and the potential of AI for discrimination through data analysis. Moreover, AI technologies based on data are susceptible to manipulation through false data. He highlighted that Russian experts have prepared various AI strategies and plans. The analysis of 8000 joint publications on AI-related scientific articles shows that Russia is collaborating with different countries in the AI field. He presented Skoltech as an example of a research and educational platform based on international collaboration in R&D and innovation. He concluded by saying that regulation should be harmonised globally, and that Russia will remain an important actor in the AI movement.

Session 2 – Keynote Speech

Moderator

- **Ahmed Bounfour,** Université Paris-Sud

Speaker

- **Leonard Nakamura**, Federal Reserve Bank of Philadelphia

Leonard Nakamura, Emeritus Economist at the Federal Reserve Bank of Philadelphia, the United States of America, gave a presentation on economic growth: how are intangibles valued and what is the contribution of AI to growth? He began by asking if growth is too slow or too fast? Data shows that between 2005 and 2017, per-capita GDP growth in the United States was the slowest in the post-war period (by far) at 0.8%. However, since 2005, various innovations have been introduced by the Big Four internet companies. These innovations are driven by hyper incentives: huge global markets, the use of platforms, and IPR that creates monopolies. At the same time, firms are making immense profits that exceed their market value.

In 2005, Big Four market capital was $200 million; in 2017 it had reached $3.2 trillion. Post-tax profits soared in 2007–2017, to nearly 50% above the previous 60 years. Mr Nakamura argued that these profits come from intangibles. There is an explosion of knowledge and creativity, and access to them. However, he argued, we do not know how to measure the value of intangible assets, and asked how we can have rapid change and slow GDP growth at the same time? He stated that answers relate to new business models, the free products that Google, Facebook and other firms are providing, unmeasured quality change, outsourcing, and better and easier information acquisition (through Wikipedia and open source products) due to permissive IP schemes. He added that although our standard of living has changed, it is not easy to quantify. There is a problem in measuring digital activities, and statistics don't understand the digital age. We lack tools to show and quantify these changes, because the facts show that the US economy is extremely dynamic. He argued that economies are not slowing down, and real US GDP growth is 2 points higher than reported, and inflation 2 points lower. He also argued that AI is adding 2 points to the annual growth rate, with a risk of deflation. It is possible to measure these changes through surveys on how the internet has contributed to our lives. He concluded by saying that these challenging questions are a work-in-progress and that some of the best economists and statisticians in the world are working on such issues.

Session 3 - Foresight exercises for next-generation jobs and competency profiles

Moderator

- **Frédéric Caillaud,** Institut National de la Propriété Industrielle (INPI)

Speakers

- **Valerio Dilda,** McKinsey
- **Ekkehard Ernst,** International Labour Organization (ILO)
- **Nicolas Sabouret**, Université Paris-Sud, Université Paris-Saclay
- **Wolfgang Baer, Mustafa Canan, Raymond Jones, Ben Carlton, Johnathan Mun and Thomas Housel,** Naval Postgraduate School (NPS)

The session on 'Foresight exercises for next-generation jobs and competency profiles' was moderated by **Frédéric Caillaud** from the INPI.

Valerio Dilda, a partner at McKinsey France, spoke about the impact of automation on the future of workforce skills. He began by noting that the transformation of people and their jobs leads to three questions.

The first is how skills' demand has changed historically. He pointed out that a massive reskilling of the workforce is not new. If we look at the recent past, digital capability penetration is already above 50%, and changing rapidly, as the number of jobs requiring digital skills has increased from 50 to 70% in only 15 years. In addition, many jobs that previously were primarily manual and physical, now contain digital content, to some extent. The trend will continue – and accelerate. He argued that 45% of people will need to retrain in 2030, about 90% of the current population. Furthermore, only around 15% of jobs will become obsolete, a number

that is expected to be offset by the number of new jobs created by technology. A second question concerns the skill shifts that we can anticipate in the next 15 years. He noted three types: high cognitive capabilities, social and emotional skills linked to leadership and entrepreneurship, and technological skills intended to support digitization. At the same time, a significant decrease is predicted in physical, manual and basic cognitive skills by 2030. A third question concerns how companies and policymakers can address the skills mismatch. The answer is that sectors and companies have to anticipate the skills required and use this time as an opportunity. The important point to note is that this has to be done primarily by companies, they cannot wait for institutions to do the job.

Ekkehard Ernst, Chief Macroeconomic Policy Unit at the International Labour Organization, Switzerland, drew a comparison between human and machine intelligence. Machine intelligence can sometimes be inefficient, for example from an energetic point of view, and it is necessary to identify the consequences for sectors where new technologies will be deployed. Clearly, the use of machines can have considerable benefits in terms of production. From this point of view, three roles can be identified for them: labour saving, capital saving and factor enhancing. Looking at the big picture, he noted that AI is causing a dramatic fall in the cost of computer storage and destroying jobs, while inequality is increasing. He highlighted four inequality challenges. First, an increase in the demand for skills; second, job polarization; third, competition; and fourth, granular discrimination. AI has destroyed more jobs in developed countries than in developing countries, because of the prevalence of routine tasks. Automation and AI will accelerate changes in the skillset of the workforce. To conclude, he argued that structural transformation, although a constant feature of our economies, might increase inequality. It is necessary to prepare businesses and the workforce to use digital technologies, and be aware of significant up-scaling costs, in order to be able to exploit the large productivity gains that AI can bring.

Nicolas Sabouret, from Université Paris-Sud, Université Paris-Saclay, discussed the use and limitations of AI. Currently, robots and humans cannot interact naturally. Robots cannot simulate emotions, take autonomous decisions or demonstrate adaptive behaviour, although there are robots such as conversational agents, companion robots and autonomous cars that can answer questions, repeat a scripted text, gesture, or use sensors and image processing. To understand why all of this is so difficult, we need to understand how the process works. A computer program is a machine that receives some information as input and produces other information as output. This is based on decision rules and there are several approaches to developing them. In the 1980s, the rule-based system was popular. Relying on the presence of a human expert who knew what to do, this approach had several limitations, including simple decision rules, the time needed for implementation, and the need to include multiple exceptions to the standard routine.
More recently, the machine learning approach has taken its place. Here, although a human expert, who knows which elements are important, is still needed, the process is based on data

with thousands of examples and corresponding decisions, which is also its main limitation. These limitations make it very difficult to write perfect machine learning programs: AI programs must be able to make errors, as optimal solutions cannot be computed in a reasonable time. He concluded with a remark on the impact on jobs. Although, in some cases, robots could replace human workers, this would not necessarily be cheaper, and requires pre-existing cost reduction policies. In general, AI can create new jobs. This is because it still needs us, as domain experts, as programmers and as data collectors. Companies that invest in AI products increase their profits and create new jobs, among many other benefits.

Thomas Housel, from the Naval Postgraduate School, presented an analysis of AI based on an econophysics approach. He began by noting that AI represents a very volatile, high-potential application. This makes the focus on value even more important, but requires new and complex technological ideas. The primary goal of automation is to improve productivity by reducing the cost of outputs. In this context, a new challenge arises: the issue of measuring values in common units. Evaluating investments in some sectors, such as the defence sector, is particularly difficult, as the acquisition of information cannot be converted to a monetary value. The value of such embedded intellectual capital cannot be determined via traditional accounting and finance practices, and a new theory of value is required to account for this so-called “missing value” phenomena.

Economics and physics have a number of analogies that can be used in such a setting. The idea is to adopt a new, common unit of value that automatically includes the desires of humans and the best mixture of all potential outcomes. We need to change the paradigm – from considering an economic entity as an activity whose goal is to own more things – to seeing it as an activity where the goal is to experience more satisfaction. By adapting quantum theory mathematics to a new theory of value, we can develop a new measure, based on satisfaction. By associating satisfaction with physical action it is possible to square economics with the intrinsic forces that govern all systems of nature.

Session 4 - Education and Jobs in a world of AI

Moderator

- **Andrés Barreneche,** OECD

Speakers

- **Jerome Morresey,** Global eSchools & Communities Initiatives (GESCI)
- **Federica Saliola**, World Bank
- **Stefan Güldenberg**, Wiesbaden Business School
- **Ilmi Salminen**, Reaktor

The session on 'Education and Jobs in a world of AI' was moderated by **Andrés Barreneche,** OECD.

Jerome Morresey is as an educationalist and CEO of the Global eSchools & Communities Initiative. He offered several thoughts on how ICT has influenced, and been integrated into the educational system. He began by noting that technologies began to be introduced into schools in the late 1970s and early 1980s as an exciting initiative, but this failed. In 1984, Sweden was the only country with a 4-year strategy for the inclusion of ICT technologies in teaching and learning. He noted that, despite investment of 2 billion euros over the past 25 to almost 30 years in technology, and its use in primary and secondary schools, it has achieved very little.

He argued that, in his opinion, the history of incorporating technology into schools in Europe and other parts of the world has been one of failure. He went on to say that this is because there is no serious proof or evaluations to show that learning has been enhanced – which is, ultimately, the expected outcome of education. He referred to an 'Eureka moment', when government ministries realised that the training of teachers was key, as their ICT skills and pedagogic understanding of them are essential for the successful rollout of new technologies. He pointed to the fact that a lot more can be done from a European perspective.

However, a major obstacle is that teachers are trained to be subject-specific and are there to guide students through a syllabus. Moreover, examinations are a problem if they just serve to assess the reproduction of facts. On a more positive note, technology is beginning to be seen as an enabler for teachers to prepare their lessons and deliver a 21st century learning experience. He spoke about projects in Kenya and all over Africa that aim to ensure the quality of teaching; here the use of technologies is part of the professional development of teachers. Currently, in this part of the world, 260 million young people experience intermittent schooling. In Africa, 25 million people have never been inside a school. Fifteen million of them are girls, who have fewer opportunities. The issue is particularly serious in refugee camps run by the UNHCR, where he has seen over 150 children crowded into rooms too small to accommodate them all. These environments lend themselves to the use of new technologies. AI and virtual reality have the potential to change the nature of schooling. He ended by noting a common problem, which is that universities in Kenya have copied European universities, but young people do not want to take the courses on offer. He ended by noting that Africa is also suffering from ICT skill shortages and that cohesive lobbying is needed to ensure that clear strategies are put in place to address this issue.

In her presentation 'The Changing Nature of Work', **Federica Saliola**, a Director at the World Bank, presented the main parts of the World Development Report 2019. She began by making the point that job opportunities may expand thanks to technological progress. This is underlined by two important features: first, although technology destroys some jobs, it also creates many new ones. It is not about destruction versus creation. Second, for the first time, emerging economies are leading the way in new technologies. Never before have new technologies been adopted so fast by emerging economies. She went on to show how recent technological advances have accelerated firm growth, based on examples of multinationals such as IKEA, Walmart and Alibaba. In the case of IKEA, it took the company 70 years to reach a sales volume of 42 billion US dollars. Alibaba, the Amazon of China, took 15 years to build a business worth 700 billion US dollars. The two companies are fundamentally different in that Alibaba is an online platform and does not require as much investment in assets and people as IKEA. With this example, Ms Saliola

highlighted revolutionary changes in the business world that have been enabled by technologies, accompanied by the ability to reach markets that could not be reached before. Furthermore, she noted that these platforms are changing working conditions, for example, temporary employment is increasing, while digital platforms tend to create monopolies, bypassing regulations, taxation, etc.

In the next part of her presentation she spoke about skills, emphasising that more than ever before, human capital is essential. One reason is that innovation adoption has accelerated. For example, there are 4 billion app developers in India today. She noted that investment in skills that complement technologies is needed, as well as adaptable workers. The consequence is that people will have multiple jobs, not only multiple careers. Ms Saliola finished her presentation by asking the question 'What can governments do in light of these changes?' She pointed out three areas of policy action: human capital and lifelong learning; social protection and labour policies; and revenue mobilisation. In terms of human capital, she noted that foundational human capital continues to be lacking, a fact that was highlighted in the human capital index launched this year by the World Bank to help compare the state of human capital in different countries. A key issue is that governments are not used to taking action in this domain. In terms of rethinking social protection, she proposed that people, rather than jobs should be protected, and that there should be a move from a social protection system to universal social protection and, eventually, to life-long learning.

The presentation by **Stefan Güldenberg** from the University of Liechtenstein and **Klaus North** from Wiesbaden Business School on Tomorrow@Work: The Great Work Shift and What it Means for Our Lives" contained excerpts of a planned book. Prof. Güldenberg began by pointing out the exponential shift in workplace dynamics that are just starting, and will have changed our lives by 2030. They have developed a typology to show how technology has shifted work from 1.0 to 4.0., and supports thinking about benefits and challenges at each stage. Their presentation focused on the challenges of work 4.0, and they asked the audience to project themselves to the year 2030 – how and to what extent will you interact with machines? What will your workplace look like? Will we have lost control over thinking? Will digitization increase or decrease your own productivity? What, when and where will you work? Meaningful or stressful? Motivated or frustrated? What will happen when emerging technologies outperform you? All these questions are addressed in their forthcoming book.

In the remainder of their presentation they focused on the question 'What kind of further education and learning will you require?' Klaus North presented their vision of learning in the year 2030. He emphasized that the work-life model will shift, in that learning will become an integral part of people's entire lifetime. The responsibility to learn is up to the individual. Professionals will have to take responsibility for self-organised learning, and human and machine learning will become more integrated. Moreover, competences will have to be managed, which requires knowing

what you are good at. In addition, the education industry will see profound changes – away from educational institutions to multiple organizers of learning flows.

They then reflected on the role of AI Meta-Tutors to assist in scaffolding self-regulated learning. Teachers will become guides that accompany learning flows (the successors of educational institutions), and virtual or real guides will be needed. They speculated that the future of learning might consist of uploading knowledge to the brain – neurostimulation technology in the form of electric signals. They cited the example of the California-based HRL Laboratories, where researchers claim to have found a way to amplify learning by feeding signals from the brain of an experienced airplane pilot into the brains of trainees. Trainees receiving the electric signal learnt to pilot airplanes in a flight simulator 33 per cent better than a placebo group. They closed by welcoming the audience to the future of learning.

Ilmi Salminen presented *Elements of AI*, a free online course for everyone interested in learning what AI is, what is possible (and not possible), and how it affects our lives. She shared the story of an online course that was jointly developed by the University of Helsinki and Reaktor in 2018. The goal was to demystify AI and to address the fear that AI is a beast from the future. Her mission is to create a worldwide movement that helps people be empowered, not threatened by AI. She noted that 1% of the Finnish population had enrolled in the course, which consists of six elements, 25 exercises, and takes about 30 hours to complete. At the end, each participant receives a course certificate. She pointed out that they put a lot of effort into making it as attractive and appealing as possible, knowing that it was competing with many other mobile applications.

The initiative has been endorsed by the Finnish president, and efforts have been made to ensure that people know about it. One approach was the creation of the #AIChallenge, which involved asking over 250 large companies to offer the course to their staff. Ms Salminen pointed out that they observed how groups formed in order to learn together and jointly complete the exercises. She was proud to share the fact that *Elements of AI* is now ranked as the number 1 computer science online course in the world, ahead of Stanford, Harvard and MIT (Class Central May 2019). So far, 170,000 students have registered since its launch in May 2018. They are from 110 countries, 37% are female, 25% are over 45 years old and over 250 companies participate. She ended with some success stories about how the course has inspired people, such as motivating people to train themselves in AI when they were on sick leave. Regarding the future, a launch in Sweden is only the beginning of a new phase. The target is to teach more than 1% of the world's population the basics of AI by 2020, and a follow-up course on the practice of AI is already in preparation (https://www.elementsofai.com/).

Session 5 – AI and the digital divide

Moderator

- **Jaco Du Toit**, UNESCO

Speakers

- **Irene Kitsara**, World Intellectual Property Organization (WIPO)
- **Frédéric Caillaud**, Institut National de la Propriété Industrielle (INPI)
- **Ahmed Bounfour**, Université Paris-Sud, Université Paris-Saclay
- **Mark West**, UNESCO

The session on 'AI and the digital divide' was moderated by **Jaco Du Toit**, UNESCO.

Irene Kitsara from the World Intellectual Property Organization spoke on the topic of 'AI and the digital divide: trends in AI and what patent and non-patent data tell us'. She began by noting that AI has become part of day-to-day life, and that it has the potential to revolutionize and impact every aspect of our lives. Her recent study addressed the questions: 'To what extent is AI reflected in the academic literature? What is its impact on the scientific literature and data?' To answer these questions, she and her colleagues analysed and compared patenting and scientific publishing activities. This identified a boom in patent filings and a decrease in the ratio of scientific papers to patented inventions. In 2010 this ratio was 8:1, falling to 3:1 in 2016. She moved on to highlight the issue of defining what AI is, and

what AI-related patent applications are about. The team created a taxonomy to distinguish between techniques (the 'how'), functional applications (the 'what'), fields of application, and disciplines where AI techniques may find an application.

In the next part of her presentation, Ms Kitsara highlighted the finding that 70% of patent datasets include a combination of at least one AI technique with a functional application and/ or field of application (i.e. the commercial application of theory). In terms of machine learning, she pointed out that 40% of all patents are AI-related. A notable trend within the domain of machine learning is deep learning and neural networks, measured in terms of 2013–2016 growth rates. Regarding functional applications, Ms Kitsara pointed out that almost 50% of all AI-related patents were in the area of computer vision, a growth rate of 24%. Even higher growth rates were found for robotics and control methods (both 55%).

With regard to applicants, she noted that they are mainly big corporations. Although their portfolios span many different areas, there are specialized players such as Baidu (deep learning), Facebook and Tencent (networks), and Toyota and Bosch (transportation). In terms of academic players, she reported that 17 of the top 20 academic patent applicants are Chinese, and 3 Korean. Of the 500 top patent applicants, 167 are academic institutions; of these over 100 are Chinese, 20 are American, 20 are Korean, 4 are Japanese, and 4 are European Union public research organizations. She closed her presentation by presenting some opportunities and challenges, notably the need for supportive ecosystems (policy, education, business, legislation), funding (public and private), regulation of access to data, and the use of specialized data.

Frédéric Caillaud from the French National Institute of Industrial Property began his presentation on 'Business models of the owners of core AI patents' by pointing out the need for a widely-accepted definition of AI core patents given the current plethora of definitions. He reported the results of his study, carried out in collaboration with IBM, which identified 12,208 IBM patent families. IBM was found to be the leader in terms of the number of AI core patent families (over 700), followed by Microsoft (about 650) and Google Alphabet (slightly over 300). Mr Caillaud pointed out that, by country, the United States was by far the leader, with over 6,000 patent families, followed by China with over 3,500, and Japan with slightly over 500.

The next part of his presentation focused on a topographical map showing patents as a function of conceptual categories. Experts analysed and compared the patenting activities of the leading companies: Microsoft, IBM and Google Alphabet. He pointed out that IBM has filed multiple core patents in similar areas. They also looked at social network companies – Facebook, Baidu, LinkedIn and Google – and technical giants – Intel, Samsung, Siemens, Nec, Qualcomm and Cisco. A comparison of the USA and China revealed that China is particularly dominant in the area of image processing, while the USA dominates in smartphones. A map of European patents highlighted that there were very few. In absolute numbers, the share is small, with 445 (the EU and Russia combined), compared to 3,784 Chinese and 6,088 Russian AI core patents. In conclusion, he pointed out that the biggest players (Microsoft, Google and IBM) are not yet negotiating to buy and sell licenses, but are looking to attract collaborators in order to access data for the development of future applications. Finally, he noted that although so far, they have

not set fees to access their services, this may come in the future, along with negotiations over licensing fees.

In the presentation 'Delineating the Major platforms acquisitions practices (incl. in AI)', Professor **Ahmed Bounfour** from Université Paris-Sud, Université Paris-Saclay, presented a current working paper from his research group. He began by explaining that platforms are important because they are a mode of organising that raises several business issues, notably: competitive conditions, customer relations, suppliers, complementors and ecosystems and, with respect to policy: competition policy, innovation policy and society as a whole. He pointed out the risks of platforms – namely, market dominance leads to less innovative suppliers who only advertise their own products and could, potentially control society. In this context, a key question is: 'How do platforms contribute to innovation?', with a view to controlling intangible assets. This very important point was a recurring theme throughout the presentation and can be addressed in several ways. Approaches include: analysing products/ services and the variety of services; looking at investment in, and control of, critical resources; analysing the organisational design of platforms; and the internalisation of ecosystemic innovation.

He went on to present reference data regarding the acquisition behaviour of major platforms, noting that they had selected 15 representative platform companies in the USA and China. In terms of revenue, he highlighted that most comes from advertising, which has an important influence on economic structures. When comparing platform revenues to the number of employees, it is clear that Apple's revenue exceeds that of Amazon, but employs fewer people. Similarly, Google's revenue exceeds that of Microsoft, with fewer employees.

The next part of his presentation focused on acquisition behaviour. He pointed out that, so far, Google and Microsoft have the highest number of acquisitions. In terms of types, most were in the sectors of software, mobile, enterprise software, the internet and IT. Regarding locations, most acquired organisations were in the US, followed by the UK, Canada, China, Israel and Germany. He then highlighted the correlation between the number of patents filed by companies and the number of acquisitions. He ended by presenting the interim conclusions of his research, which suggest that the analysis of intangibles complements the dualistic approach to the two-sided market. Furthermore, studying platform behaviour with respect to intangibles advances both research and the policy agenda. It is important to examine future strategies by looking at how major platforms invest externally, while further research (in particular at national and regional level) is needed, especially in relation to competition and innovation policies.

Mark West presented a preview of his forthcoming book *I'd Blush if I Could: Closing the Digital Skills Gender Divide with Education and Training*. He began by asking if anyone in the audience knew a female tech leader, and went on to cite a study in which only 10% of respondents said yes to the question; of these 50% were Alexa, Siri or Cortana. He then went on to point out that skills are quickly eclipsing access as the primary cause of the digital gender divide. In recent years, skills deficits have eclipsed access barriers as the primary contributor to the digital gender divide, due to the rapidly declining price of connectivity and hardware. For many years, this divide was assumed to be symptomatic of technical challenges: women were assumed to catch up with men when the world had cheaper devices and lower connectivity prices, due to their limited purchasing power and financial dependence. While the cost of ICT access remains an urgent and salient issue, this challenge is surpassed by educational gaps. For instance, the gender gap in internet penetration is around 17% in the Arab States, and the Asia and Pacific region, whereas the gender gap in ICT skills is as high as 25% in some Asian and Middle Eastern countries.

Today, billions of people have access to affordable devices and broadband networks, but do not have the requisite skills to take advantage of this technology to improve their lives. Thus, education has become the biggest challenge. Mr West went on to note that, globally, women only hold 24% of all digital sector jobs; in developing countries, men are 2.7 times more likely than women to work in the digital sector. While this figure is low, it obscures a much wider gender divide among people working in technology. For example, in frontier technologies research, only 12% of personnel are women. Why? One issue is self-confidence. However, taking the example of measures of digital literacy and skills there is a paradox: girls score higher in every country, but their self-perception is lower than boys. Even worse, he highlighted that gender gaps grow wider as digital tasks become more complex. In terms of enrolment by field of study, he reported that the global proportion of female enrolment in ICT is only 29.2%, compared to 56% in the natural sciences, and 36% in STEM. One interesting potential explanation relates to the outcome of an analysis of a dating app, which found that ICT was the least attractive skills for a female.

He went on to dismiss the argument that girls just don't like digital technologies, noting that at the beginning of the computer era, software development was almost solely done by women until the mid-1970s. This only changed at the beginning of the 1980s, when the computer came into homes and became a 'toy for boys', used by fathers and their sons. He concluded by pointing to the ICT gender equality paradox: female ICT graduates tend to come from countries with low gender equality scores, while the proportion of women working in the same sectors in gender-equal countries is low. He cited the example of Belgium, where it is only 6%. To conclude, he noted that we lack a clear explanation for this negative correlation, and argued this universal issue should be addressed urgently.

Session 6 – Responsible development and implementation of AI for learning

Moderator

- **Raffaele Trapasso**, OECD

Speakers

- **Nathalie Smuha**, KU Leuven, Faculty of Law & EC High-Level Expert Group on AI
- **Bernd Stahl,** Centre for Computing and Social Responsibility, De Montfort University
- **Thomas Baudel**, International Business Machines Corporation (IBM)
- **Irina Zoubenko-Laplante**, Section, Bioethics and Ethics of Science, Sector for Social and Human, UNESCO

The session on 'Responsible development and implementation of AI for learning' was moderated by **Raffaele Trapasso** from the OECD.

In her presentation 'Ensuring Trustworthy AI – a fundamental rights-based perspective to AI governance', **Nathalie Smuha**, from KU Leuven & EU HLEG, presented the work of the European Commission in the field of AI and, notably, an ethical framework for AI systems. Although AI comes with certain benefits and new technology, there are a number of legal, social, psychological and ethical risks. In April 2018, the European Commission adopted the European strategy for AI, consisting of three pillars. First, boost AI uptake; second, tackle socio-economic changes; and, third, ensure an adequate ethical and legal framework is in place.

With respect to the third pillar, an Independent High-Level Expert Group on AI has been set up, which consists of 52 experts from industry, academia and civil society. The group has the task of drafting ethical guidelines for AI, and providing policy and investment recommendations. Ms Smuha emphasized the need for a human-centric approach to ethics guidelines, which means that AI should always be seen as a means to enhance individual and societal well-being. Furthermore, the expert group believes in an approach to AI ethics based on fundamental rights. Trustworthy AI is fundamental, and has three components: it should be lawful, ethical and robust. Fundamental rights play a dual role: they are legally-enforceable (lawful AI) and moral entitlements (ethical AI). Based on five "families" of fundamental rights relevant to AI systems, four ethical principles were formulated. These include: respect for human autonomy; prevention of harm; fairness and explicability. Ms Smuha pointed out that seven, key requirements need to be continuously implemented and evaluated throughout the life cycle of an AI system. She noted the need to draw up a list to operationalize requirements, and presented some recommendations regarding measures that should be taken to ensure the trustworthiness of AI systems and boost Europe's competitiveness.

Bernd Stahl, from De Montfort University, spoke on the topic of 'When AI, Big Data and Ethics converge – ethics, human right and AI governance' within the context of the EU project, SHERPA. He pointed out that AI ethics consist of two, fundamental but related aspects: specific issues related to machine learning, and general questions about living in a digital world. He noted that there are many ethical benefits associated with AI, such as economic growth and the creation of wealth, personalized services, increased human capabilities, inclusion, democratic participation and empowerment. The project adopted a multimethod approach to understanding AI. In particular, 10 case studies examined aspects such as the IoT, government, agriculture, science, sustainability and smart cities, energy, insurance, communication, retail and trade, and manufacturing. In addition, scenarios were designed in the areas of predictive policing, warfare, mimicking technologies, education, along with self-driving cars. The case studies highlighted that privacy, security, transparency and the use of personal data were key ethical issues. With respect to the definition of AI, it can be understood as referring to systems that display intelligent behaviour by analysing their environment and taking actions to achieve specific goals. Mr Stahl concluded by discussing some general questions about the digital society and human rights in business, public engagement and representative democracy, and outlined some next steps.

Thomas Baudel from IBM and Université Paris-Saclay spoke on the topic of 'Ethics of AI, for researchers and practitioners'. The contextual nature of ethical analyses was noted: what matters most is the human activity that our technology challenges. Ethical behaviour is traditionally enforced through morality and law. Tech industries hire ethicists, privacy engineers, and future challenges will require engineers versed in dialectics. He presented some lessons learned from teaching information ethics to 450 PhD students in a MOOC. The aim of the course is to engage students and co-construct a shared set of ethical values and practices. Overall feedback is positive, with 15% enthusiastic and 55% appreciative students. He noted that there is a need to start with a conformity-based approach, to address the broader public, before moving to a more abstract ethical analysis. Mr Baudel concluded with a discussion of an ontological approach to information ethics, pointing out that if an ethical system is designed according to the conditions of our existence, and information technologies are changing in response to these conditions, they force us to reconsider our approaches to ethical analyses.

In her presentation titled 'Technical and legal aspects relating to the desirability of a standard-setting instrument on the ethics of AI', **Irina Zoubenko-Laplante** from UNESCO talked about UNESCO's work on a normative ethical AI instrument. The ethics of AI is a priority for UNESCO. The purpose of two expert bodies of independent experts – the World Commission on Ethics of Scientific Knowledge and Technology (COMEST) and the International Bioethics Committee (IBC) – is to discuss the most important issues related to new technologies, and related moral, ethical and social problems. It was noted that, although there is a growing number of initiatives on the ethics of AI, there is currently no single instrument at the international level that extensively addresses the issue. From UNESCO's perspective, AI challenges the role of education in societies in many respects. Firstly, it requires a rethinking of the societal role of education. A second aspect concerns its role in the education process itself, as an element of digital learning environments, educational robotics, and systems for "learning analytics". Finally, engineers and software developers should be appropriately trained to ensure the responsible design and implementation of AI. UNESCO's work also focuses on ethical-global dimensions of peace, cultural diversity, gender equality, and sustainability.

Session 7 – Competencies for AI: entry points and new orientations

Moderator

- **Thomas J. Housel,** NPS

Speakers

- **Cécile Wendling,** Group Head of Foresight at AXA
- **Omar El Sawy,** Marshall School of Business at the University of Southern California; **Pernille Rydén**, Technical University of Denmark
- **Catarina Midoes**, Bruegel
- **Colin de la Higuera,** UNESCO Chair for training of teachers through OERs, University of Nantes

The session on 'Competencies for AI: entry points and new orientations' was moderated by **Thomas J. Housel,** NPS.

Cécile Wendling, Group Head of Foresight at AXA, France, gave a presentation focused on what the world will look like in 5–10 years. To answer this question, she said, it is necessary to understand how work is evolving, and the growing need for upskilling the workforce. She highlighted four important trends in ongoing transformation. The first concerns the diversity of workers' profiles. An analysis of demographics and longevity in several countries highlights a widening workers' age gap. This might be a problem, as companies are not ready to have very young people working with very old people, and this type of team is currently very difficult to create.

Another aspect is social interrelations and diversity, and the fact that new skills are required. The problem also extends to the integration of immigrants, as, even when highly skilled, they often have to retrain. A second trend relates to changes in management methods, workforce externalization and an increase in interactions between human and machines. A third trend concerns the goal of work and the sense of purpose, which are changing with growing automation. It has been found that many occupational illnesses are related to this lack of a sense of purpose, or to the fact that people, especially youngsters, need a sense of belonging. A final trend is job polarization; this may increase in the future as semi-skilled jobs are threatened by low-cost automation.

A number of conclusions can be drawn from these trends. First, new jobs will be created, for example, taking decisions based on insights produced by machines. Empathy and the ability to sense human feelings will be a domain where humans will retain a competitive edge; curiosity, in general, will be critical to continue learning in order to remain employable, while technology development and adoption should be managed in a responsible way. Concrete tools include: strategic workforce planning, self-assessments of employability, providing tools to help employees understand their skills, new management styles, leadership and organization, everyday learning, financing research on neuro ergonomics, HR foresight, and presenting results to stakeholders.

Omar El Sawy, holder of the Kenneth King Stonier Endowed Chair in Business Administration and Professor of Information Systems in the Data Sciences & Operations Department of the Marshall School of Business at the University of Southern California, and **Pernille Rydén**, Associate Professor at the Technical University of Denmark, spoke about the relationship between real time management and AI. Real time management is becoming a very important competence for the future, in a world in which digital platform connectivity is increasing rapidly, and gaining momentum is becoming essential for managers. At the same time, disruptive technologies, such as AI, are leading to new business practices.

The two presenters introduced the concept of 'fast and flow', which emerged from a combination of surveys and interviews in the US and Europe, where approximately 1,000 managers were asked about how they perceive real time. This found a broad spectrum of definitions and perceptions among managers, ranging from those who considered it too fast to be measured, to others who quantified it as 'up to a day'. Managers who perceive time as fast are those who generate most profits. In other words, the faster, the better: enterprises are more profitable when they identify real time as a very short period, but leave scope for taking flexible actions. This translates into the concept of 'fast and flow', which encompasses two ideas: one considers time as a monetary asset that helps to increase value; the second does not seek to control time, and does not define it on the clock scale. This leads to three possible scenarios. The first is 'business as usual', but faster and more complex; the second is more focused on consumers, and is based on an ideal combination of AI and the fast and flow approach; in the third, there is an overflow of technology – AI is too fast and people are unable to control it.

Catarina Midoes, Bruegel, talked about the impact of ICT and robots on the European job market. Production processes have become increasingly automated, and some of the work performed by humans can now be performed by machines. Does that mean that robots are taking away our jobs? It is true that in some cases robots are able to replace human tasks, but automation also leads to productivity gains. The impact of technology in the future is usually evaluated by analysing existing technologies on the basis of data observed in past years. One example is the impact of industrial robots, defined as *"automatically controlled, reprogrammable, multipurpose manipulators programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications"*.

Robots have been an important part of the industrial transformation in many countries. Their impact was analysed by Acemoglu and Restrepo (2018) who found a negative effect of their introduction on employment for the period 1990–2007 period in the US. Chiacchio et al. (2018) reached the same conclusion for the period 1995–2007. However, the extension of Chiacchio et al.'s (2018) methodology to the period 1995–2015 does not seem to show further evidence of negative impacts on the employment rate, a result confirmed by Graetz and Michaels (2018). Furthermore, according to the so-called "routine-biased technological change" idea, semi-skilled workers are the most disadvantaged from the introduction of technology. In conclusion, concerns about robots stealing our jobs seem, arguably, overly alarmist. Productivity effects more than compensate for problems created by replaceability, and any negative effects are temporary, although the transition may be more difficult for new, broader-reaching technologies, than it has been for industrial robots.

Colin de la Higuera, UNESCO Chair for the training of teachers through OERs, Université de Nantes, France, presented the key digital and information literacy competencies required for AI. Teaching machine learning requires understanding the difference between the physical world and the digital world. Algorithms do not do things faster, just differently.

To understand the issues related to them, he pointed out the need to look at five pillars. The first concerns data, which is usually inconsistent, in the sense that it does not always reflect a perfect mathematical rule. How can it be possible to have perfect responses from AI if the data observed in reality are uncertain and contradictory? A second aspect is randomness, which is related to the previous aspect: decisions often do not follow rules, but have a certain degree of randomness. Next, there is the problem of coding and computational thinking, which can create a bias caused by the inability to look at data and human error. A fourth issue is critical thinking. We cannot rely totally on anything, notably given the possibility of fake data, so it is important to evaluate everything critically, at all times. Finally, the fifth point refers to 'post-AI humanism'. This relates to how AI changing us, our intelligence, experience, creativity, etc.

Session 8 – On the way to the society of digital equality: challenges and perspectives

Moderator

- **Boyan Radoykov**, UNESCO

Speakers

- **Mikhail Nasibulin,** Department of Digital Economy Projects Coordination and Implementation
- **Svetlana Malkarova**, State University of Management, UNESCO Chair 'Societal, Legal and Ethical Frameworking of the Knowledge Society'
- **Alexandra Adaskina**, UNESCO Chair 'Societal, Legal and Ethical Frameworking of the Knowledge Society"
- **Pavel Terelyansky**, Department of Information Systems of the Institute of Information Systems of the State University of Management

The session on 'On the way to the society of digital equality: challenges and perspectives' was moderated by **Boyan Radoykov** from UNESCO.

Mikhail Nasibulin spoke on the topic of the 'Digital Economy of the Russian Federation: how Russia Works with Knowledge and Information'. The goals of this national programme include the elimination of digital disparity and the acceleration of technological development. It is divided into six parts.

The first is a law that regulates the digital environment, notably, stimulation of the digital economy, regulation of digital interactions between businesses and the state, sectoral regulation, and the creation of a unified digital environment of trust. The second concerns data infrastructure, in particular broadband connections to the Internet, IoT infrastructure creation, and the construction of primary data centres, among other tasks. The third refers to the human resources required by the digital economy; it includes tasks such as providing the digital economy with competent human resources, support for talented pupils and students in maths and IT, and for all citizens in learning digital literacy and digital economy skills. The fourth part concerns data security, which includes support for national data security technologies, the provision of a safe Internet and IoT, maintenance of secure data and communication lines, and information systems. The fifth part refers to digital technologies, notably the creation and implementation of roadmaps for the development of promising end-to-end technologies, support for leading Russian high-tech companies, and increasing demand for advanced Russian products, and platform solutions. The sixth deals with public administration, in particular, the digital transformation of the public administration, and state and municipal services, together with the creation of end-to-end digital infrastructure and platforms.

Svetlana Malkarova's presentation was titled 'Bridging a Digital Divide: Ongoing Comprehensive Digitalization of the University and Digital Volunteering Initiative'. She noted the role of Russia in the Global Digital Race and highlighted that it belongs to the group of countries that are relatively developed in terms of digital technology; it is ahead of other BRICS countries, and a global leader in providing online governmental services. Nevertheless, ICT is not one of the main drivers of the national economy, and the country's regions are lagging behind the capital.

She spoke about education component of the Russian National Program, which stipulates that by 2024, all Russian universities should have adopted the Digital University Model. In this context, she presented details of the State Management University, which is a key institution for preparing professionals for the digital economy. The program encompasses three main areas the digitalization of: projects within education and youth policy; scientific and research activities; and administrative activities. She noted that the UNESCO "Societal, Legal, and Ethical Frameworking of the Knowledge (Information) Society" Chair had been launched at the University as part of a systematic effort to respond to the challenges of the digital world. The Chair's qualitative research seeks to identify region-specific manifestations of the digital divide. This work is based on the idea that human capital is a core issue when dealing with educational barriers. She noted that the University has put forward two key proposals to address the issue of human capital: developing a "Digital

Segregation of the Education Assess" index, and promoting the Digital Volunteering initiative on a large scale.

The presentation by **Alexandra Adaskina** was titled the 'UNESCO Chair 'Societal, Legal and Ethical Frameworking of the Knowledge Society': Education for All Initiatives'. The Chair's activities are consistent with the objectives of the UNESCO Medium-Term Strategy for 2014–2021. The SUM Academic Council Grant is a new, competitive program that was launched to give talented students an opportunity to study at prestigious international organizations. The speaker introduced the Third International Scientific Forum "Stepping into the Future: Artificial Intelligence and Digital Economy". The results of this role-playing business game include the creation of an active group of school and university students, and young researchers. These groups support the UNESCO mission, in the context of the Chair's activities: preparation of a resolution on the outcome of the UNESCO business model; and the organization of on-the-job training/ internships for the most active participants in international companies. Alexandra Adaskina concluded with a discussion of digital volunteering and digital information inequality.

Pavel Terelyansky spoke about the 'Society of digital Equality. The lock-in effect of the reproduction of intellectual capital'. He discussed the basis of the lock-in effect of intellectual capital reproduction, and its postulates. Lock-in can be viewed as a one-sided funnel, where a recipient country receives intellectual capital from a donor country via open borders and migration. In this way, donor countries invest resources in educating individuals, however, the migration of intellectual capital means that they have to 'buy' it back from abroad. Ways out of this paradox were outlined: one is to prohibit the migration of individual intellectual capital or illegally 'borrow' technologies; another (proposed by UNESCO and the UN) is to develop a mechanism to acknowledge that certain information technologies and educational resources belong to the whole of humanity. In conclusion, Mr Terelyansky presented the development of the Digital Segregation of Education Accessibility Index and outlined some ongoing questions.

Session 9 – Intangibles Capital Agenda: An Update

Moderator

- **Stefan Güldenberg,** University of Liechtenstein

Speakers

- **Yann Menière,** European Patent Office (EPO)
- **Noboru Konno**, Japan Innovation Network
- **Carolin Lin,** The New Club of Paris & National Chengshi University

The session on 'Intangibles capital agenda: an updates' was moderated by **Stefan Güldenberg** from the University of Liechtenstein.

In his presentation titled 'Patents and the Fourth Industrial Revolution: the inventions behind digital transformation', **Yann Menière**, Chief Economist of the European Patent Office, shared some insights on AI, focusing on patent data. Until the third industrial revolution, patents were mainly used to protect hardware. The fourth industrial revolution has, however, seen the patent system transforming towards super-software technology. Core (networked sensors, 5G connectivity, RFID, etc.) and enabling (artificial intelligence, cloud computing, 3D systems, etc.) technologies are integrated to create new applications. They are embodied in connected objects; they collect and transfer data from one object to another, while enabling technologies are used in combination with a connected object to process and analyse data. He highlighted that so-called super-software (software for AI) will become more important in the future. In Industry 3.0, software was used to improve machines, but in Industry 4.0, software will be used to improve software.

Noboru Konno, President of the Japan Innovation Network, presented his paper on 'the Knowledge Ecology and New Organizational Practices: For Future IC Navigation', and shared some insights on how to create and mobilize intellectual capital.

Nowadays, people can create value, even if they are considered as unemployed from a traditional productivity perspective. This is because we are now living in a new knowledge production ecosystem, which requires a new understanding of value creation. Regarding the difficulty of mobilizing intellectual property, he highlighted the importance of *Ba* (Space) for creating and sharing knowledge. He highlighted that firms with Ba tend to experience more tangible changes. He gave the example of the FCAJ (the Future Center Alliance Japan). This alliance/ platform brings together corporations, government ministries/ municipalities, universities, NPOs, etc. to generate and accelerate open/ societal innovation, and precompetitive collaboration, utilizing Ba to innovate. The initiative is running Future Centers, Innovation Centers, and Living Labs, which are part of society. Future Centers are not working spaces, but open an innovation hub for knowledge creation. Innovation Centers connect knowledge based on concepts and viewpoints, and Living Labs are public spaces for social co-creation and co-development. He argued that a city that operates as a knowledge ecosystem, providing multi-layered Ba can lead to open and social innovation. Moreover, he emphasized the importance of a clear vision. With a clear, long-term vision (meta-purpose), it becomes possible to orchestrate people who have different goals.

In her presentation titled 'Digital Competences: Comparing Advanced Countries with Developing Countries', **Carol Y.Y. Lin**, Professor at the National Chengshi University, introduced her work on the comparison of digital competencies among advanced and developing countries. Using the IMD database, she compared Nordic countries (Denmark, Finland, Sweden), Western Europe (Germany, France, the U.K.) and developing countries (China, Indonesia, India) based on six indicators: cybersecurity; investment in communication; communication technology; broadband subscribers; digital technology skills; and the development and application of technology. Several findings emerged. Firstly, cybersecurity in Nordic countries has a negative correlation with their GDP growth. India's drastic increase in communication investment has failed to advance communication technology development. Western European countries have regressed in the domain over the past 7 years, while the number of broadband subscribers has a positive correlation with GDP growth. All countries had seen a decrease in digital technology skills, except China. Finally, its development and application in Nordic countries has not changed over the past 7 years. Western Europe, China and Indonesia have a positive correlation with GDP growth but this is negative in India. She ended by introducing her forthcoming publication, *The National Intellectual Capital Yearbook 2018*, which covers the impacts of global recession, recent economic developments, and the current state of innovation and competitiveness in 59 countries.

Session 10 – Intangibles, productivity and innovation growth

Moderator

- **Marianne Paasi,** TU Berlin

Speakers

- **Hannu Piekkola,** University of Vaasa
- **Felix Roth**, University of Hamburg
- **Keung Oui Kim**, University Paris-Sud
- **Alberto Nonnis**, University Paris- Sud
- **Francesco Baldi**, University of Turin

The session on 'Intangibles, productivity and innovation growth' was moderated by **Marianne Paasi** from TU Berlin. This session was dedicated to the forthcoming special issue of the Journal of Intellectual Capital, to be issued under the auspices of the H2020 GLOBALINTO project.

In his presentation 'Intangibles and labor-augmenting technical change', **Hannu Piekkola** outlined his recent work on intangibles. His research has found that organizational capital improves productivity by 240–320%. The effect is largest in large firms (with market power), underlining the pivotal role that management and marketing have in productivity improvement. R&D-driven improvement in productivity is less (160–190%) than organizational-driven capital. Furthermore, increased productivity that increases the labour force is strongest in large firms. In conclusion, he argued that knowledge spillovers are most important among SMEs. R&D leads to commercialized innovations and, hence, contributes more to the accumulation of intangible assets (such as innovations that are not freely available or shared); at the same time, the latter increase R&D-driven technological change.

Felix Roth from the University of Hamburg presented his academic research on the topic of 'Intangible Capital and Labour Productivity Growth: Panel Evidence for the EU from 1995–2015'. He used INTAN-INVEST intangible datasets to explain the relationship between intangible capital and labour productivity growth. Earlier empirical results, based on a framework that accounts for pre-crisis and crisis growth indicate that the incorporation of intangible assets into national accounts has had three effects: significant investment in GDP; a sizable positive contribution to labour productivity; and growth acceleration. However, econometric results based on a inter-country approach are scarce. Therefore, his study analysed the relationship between intangible capital investment and growth in labour productivity for a sample of 16 countries in the EU. The results show a positive relationship between them, while intangible capital services explain 35% of growth. Finally, like earlier studies, he found that intangible capital investments have still not recovered to pre-crisis levels.

Keung Oui Kim, a postdoctoral research fellow at Université Paris-Sud, Université Paris-Saclay, presented a working paper on the topic of 'The contribution of ICT to productivity focusing on intangibles and interior/exterior ICT externalities'. He pointed out the difficulty of estimating the effect of ICT as a function of GPT, and introduced the BFOS model, which is designed to reflect the unique features of ICT in the productivity function. He noted the limitations of previous studies on the conceptualization and measurement of ICT externalities, and the consideration of intangibles. To overcome these problems, he proposed an empirical BFOS model based on an integrated country–industry panel. His results provide evidence of positive spillovers for ICT use both within and between countries, and highlight the importance of intangibles, notably organizational capital and design.

Alberto Nonnis, a postdoctoral research fellow at Université Paris-Sud, Université Paris-Saclay, presented his research on 'Analyzing the productivity contribution of intangible assets and participation in global value chains'. Global value chains refer to all of the activities that contribute to product creation, from initial conception to final distribution. They can be seen as huge networks for the exchange of materials, intermediate inputs and information that connect industries and firms located in different countries. In his work, he used network centrality measures (Eigenvalues, Random Walk, and Betweenness centralities) obtained from the WIOD to analyse how the global value chain and intangibles contribute to productivity. His results show that having many connections matters for productivity, while being a 'bridge' to other industries does not. In conclusion, he noted evidence that supports the idea that intangibles and global value chains are drivers for productivity.

Francesco Baldi presented evidence from multiple case studies involving 10, Fortune 500 best companies to work for. The aim of his research was to: 1) model the promotion of staff to mid-level management, embedding the option to rise to top management; 2) provide practical guidelines on how this methodology can be applied to companies like Google; and 3) present a way to quantify the option value of a career development program based on the sample of 10 firms. He also noted some implications of his work for HR strategy scholars and managers. First, the new method has the potential to impact both HR scholarship and managerial practice. Second, HR scholars and managers can assess the value of the flexibility gained from deploying human resources in the face of unanticipated demand and skills' shifts. Finally, strategy scholars and managers may better understand how developing adaptive organizational capacity can be a source of sustainable competitive advantage for firms in dynamic industries.

Closing remarks

The Conference was closed by **Dorothy Gordon** and **Jaco du Toit**, UNESCO and Prof. **Ahmed Bounfour**, Université Paris-Sud, Université Paris-Saclay. They thanked all participants for their active engagement and discussion during the sessions, and acknowledged the interesting conversations that had been stimulated by the wide variety of themes that were discussed during the two days. Prof. Bounfour thanked the European Chair on Intangibles' sponsors and partners, and the team at University Paris-Sud that helped to organize the conference. He wished everyone a safe journey home, and emphasised that he is looking forward to reconvening again next year, at IC16, to discuss a new theme.

Artificial intelligence
and the next generation of competencies:
How Digital - and Artificial Intelligence will impact jobs and professional qualifications?

Conference report: Keung Oui Kim, Altay Ozaygen, Alberto Nonnis , Tatiana Beliaeva, Laura Kreiling & Ngoc-Phung Tran, Université Paris-Sud, Université Paris-Saclay
Pictures and organisation: Laura Kreiling, Université Paris-Sud, Université Paris-Saclay

Scientific Coordination:
Pr. Ahmed Bounfour, Université Paris-Sud, Université Paris-Saclay
European Chair on Intangibles: ahmed.bounfour@u-psud.fr

http://www.chairedelimmateriel.u-psud.fr/