

Digital Skills and Education Sector Development in a Changing ICT Environment: Some Aspects and Trends

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Abstract

We live in a connected world characterized by the unprecedented transformative power of ICTs. They impact the way we live, the way we work, the way we play, the way we socialize, learn and are deeply transforming our society. Digital skills key to new employment and business opportunities. We are now in an era of digital transformation that is fundamentally changing our economies and societies and improving service delivery in many other sectors. The paper will start some definitions related to the Digital economy, digital skills and brief overview of the IR.04, Digital transformation, Strategic technology and ICT trends, and its impacts for education system development and digital skills. Paper will introduce and review research/study findings on digital skills and education development goals; challenges and trends related to the Digital economy & job/skills including labor market and skills by the international line organizations such as WEF, ITU, UNESCO, UNCTAD and researchers. Then, paper will cover digital skills pyramid, education development aspects and trends including digital skills requirement and education in the Digital Era for universities, students and teachers. Also will discuss, particularly ICT can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum, skills disruption, core skills for the future. In conclusion the universities and colleges need to radically re-examine their curricula towards producing graduates with skill-sets and frameworks for teacher professional development, policies to develop skills for the Digital economy.

Keywords: digital economy, artificial intelligence, core and digital skills, higher education, teachers professional development

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1. World Development Trends and MDGs

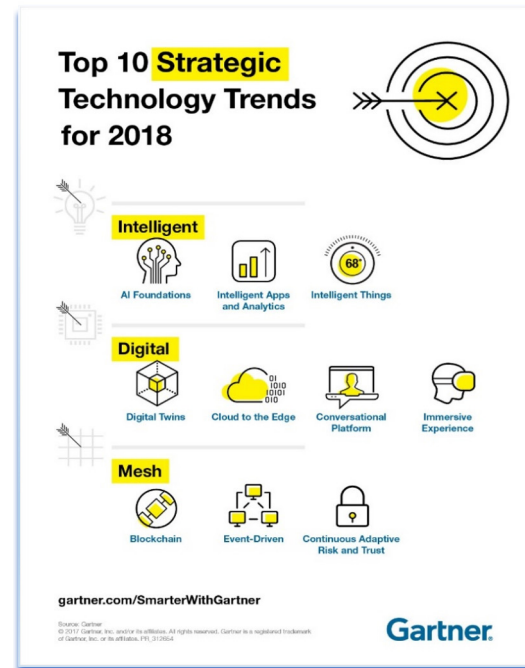
Industry 4.0 is a term often used to refer to the developmental process in the management of manufacturing and chain production. The term also refers to the fourth industrial revolution. The term Industry 4.0 was first publicly introduced in 2011 as “Industrie 4.0” by a group of representatives from different fields (such as business, politics, and academia) under an initiative to enhance the German competitiveness in the manufacturing industry. The German federal government adopted the idea in its High-Tech Strategy for 2020 [1].

Although “Industry 4.0” is the common term referring to the fourth industrial revolution, academics still struggle to properly define the approach. This makes it even harder to distinguish the main components of such an approach. In their Literature Review, Hermann, Pentek, and Otto take it upon themselves to find out the main components of the industry. Cyber-Physical Systems, Internet of Things, Smart Factory, and Internet of Services are the most common four terms cited in academic research publications related to the industry. Consequently, and given its initial stage, these are the four main components of the industry [1, 2].

The Fourth Industrial Revolution (IR4.0) - a global transformation characterized by the convergence of digital, physical, and biological technologies - is ongoing (2016). Building on the foundations of the digital revolution, emerging technologies in the IR4.0 scale up exponentially through digital interoperability, emerge physically in smart products and services, and embed themselves prolifically in society [3].

"Gartner's top 10 strategic technology trends for 2018 tie into the Intelligent Digital

Mesh. The first three trends explore how AI and machine learning are seeping into virtually everything and represent a major battleground for technology providers over the next five years. The next four trends focus on blending the digital and physical worlds to create an immersive, digitally enhanced environment. The last three refer to exploiting connections between an expanding set of people and businesses, as well as devices, content and services to deliver digital business outcomes. (Source: www.gartner.com/SmarterWithGartner, 2018 Gartner, Inc)



We are now in an era of 3-rd digital transformation that is fundamentally changing our economies and societies and improving service delivery in many other sectors. Each digitization wave has a specific set of social and economic impacts.

The third wave of digitization, whose diffusion start point can be somewhat arbitrarily placed around 2010, entails the adoption of a range of technologies aimed at enhancing

information processing and the quality of decision making, while further automating routine tasks within business enterprises and governments.

This particular effect has been well researched in the microeconomics literature. The opportunity provided by broadband to increase market reach and seek out the highest possible selling price in open economies is essential in the development of a vibrant manufacturing sector. In the service sector, broadband enabled firms generate between 7.5% and 10% more sales. In this case, the impact is primarily driven by enhanced access to foreign markets. In both cases of manufacturing and service industries, broadband improves export performance by facilitating the communication with foreign buyers, improving information on overseas markets, consumers and standards, and by ultimately linking the enterprise to consumers, and by allowing bidding for contracts or participating in business-to-business platforms [3].

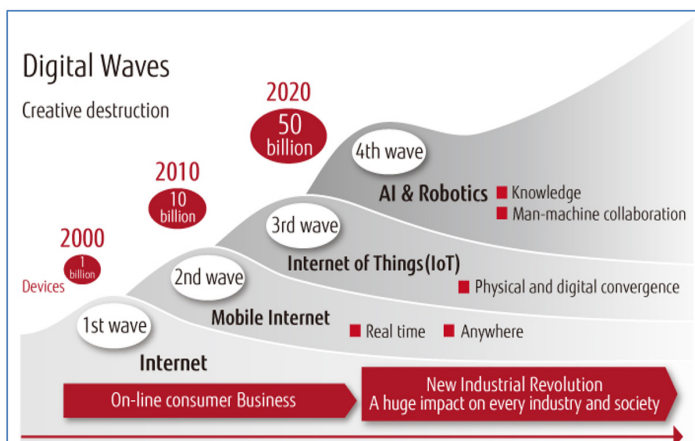
At an aggregate level, Katz and Callorda (2017) estimate that 1% increase in a digital ecosystem development index, which corresponds mainly to the first and

second waves of digitization (including all telecommunications technologies and digital services such as e-commerce, e-government, e-health) yields 0.13% increase in per capita GDP growth, meaning that a ten-point increase in the index yields 0.26% increase in per capita GDP (which includes direct and secondary effects). The coefficient is higher for OECD countries than emerging economies [7].

Digital transformation impacts society at several levels. On the production side of the economy, digital transformation enables the automation of business operations, yielding operational efficiencies, such as reduction of transaction costs, with an impact on productivity. Similarly, digital transformation provides new business opportunities, impacting employment and entrepreneurship. Regarding the delivery of public services, digital transformation enhances the provision of health and education, while improving the way citizens interact with their governments.

Finally, digital transformation has an impact on human relationships and individual behavior, facilitating social inclusion and communication. It should be noted, however, that digital transformation could also result in

Figure 1. Digital Waves and Transformation, ITU, 2017



potential negative effects, such as workforce disruption, the disappearance of companies, cybercrime and social anomie [8].

Today's digital transformation is bringing important changes for all: with emerging technologies, ICTs increasingly power and enable the global economy.

The role of ICTs in the implementation of the 2030 Agenda for Sustainable

Development is gaining importance. With reduced costs of collecting, storing and processing data, and greatly enhanced computing power, digitalization is transforming more and more economic activities around the world.

The 17 Sustainable Development Goals (SDGs), with their 169 targets, form the core of the 2030 Agenda. They balance the economic, social and ecological dimensions of sustainable development, and place the fight against poverty and sustainable development [11].

- Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all,
- Goal 5: Achieve gender equality and empower all women and girls,
- Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all,
- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation,
- Goal 17: Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Under the theme “Developing skills for the digital economy and society”, ITU Global ICT Capacity Building Symposium (ITU CBS-2018) explored how emerging trends in the field of information and communication technologies (ICTs) have changed skills requirements for the digital economy and society, and in turn impact capacity building and skills development. These are [17]:

- skills requirements for using ICTs to contribute towards achievement of the UN SDGs;
- the role of academic institutions in

preparing a workforce fit for the digital economy;

- challenges and opportunities faced by least developed countries, landlocked developing countries, and small island developing states and related implications for skills development;
- digital skills needed in view of the global digital transformation, including AI, robotics and machine learning, the IoT, cloud computing and big data analytics; and
- capacity building needs and policy interventions particularly on community-based ICT development.

2. Digital Economy and impacts on labour market and jobs

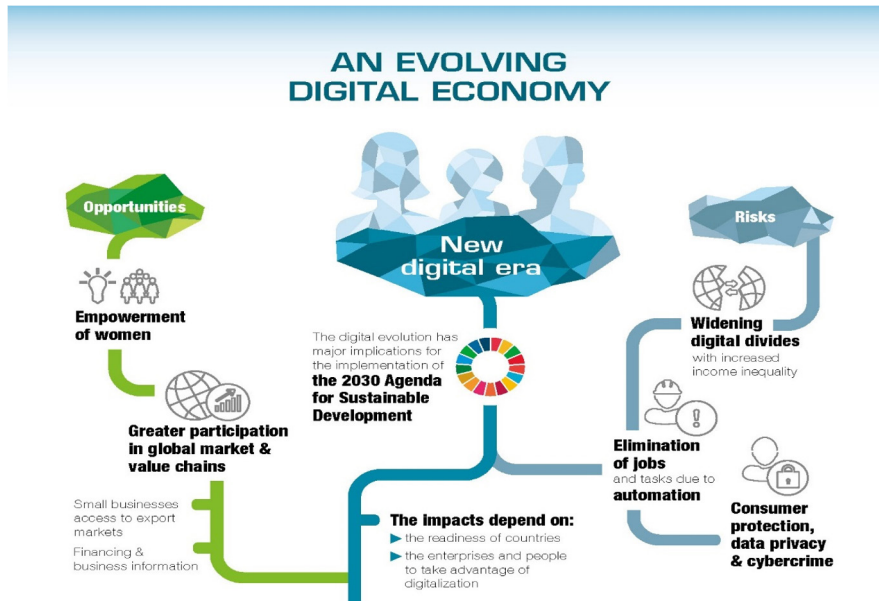
Industry 4.0 has a lot to promise when it comes to revenues, investment, and technological advancements, but employment still remains one of the most mysterious aspects of the new industrial revolution. It's even harder to quantify or estimate the potential employment rates.

What kind of new jobs will it introduce? What does a Smart Factory worker need to have to be able to compete in an ever changing environment such as this? Will such changes lay off many workers? All of these are valid questions to the average worker.

The research shows that the digital economy is creating new opportunities for trade and development. It is helping smaller businesses and entrepreneurs in developing countries to connect with global markets more easily, and is opening up new ways of generating income [12].

Information and communication technologies (ICTs), e-commerce and other digital applications are being leveraged to promote entrepreneurship, including the

Figure 2. Digital Economy: Opportunity and Risks, UNCTAD and ITU, 2017



empowerment of women as entrepreneurs and traders, and to support productive activities, decent job creation, creativity and innovation. Furthermore, mobile and digital solutions are contributing to facilitating greater financial inclusion. And small firms in developing countries with sufficient connectivity may be able to access various cloud services and obtain crowd finance in online platforms.

The factors regarding time of adoption notwithstanding, the third wave of digitization promises to have an impact on employment. That said, research is clustered around two bodies: one that forecasts a dramatic disappearance of jobs as a result of automation, and a second one that establishes that negative disruption effects are overstated [19].

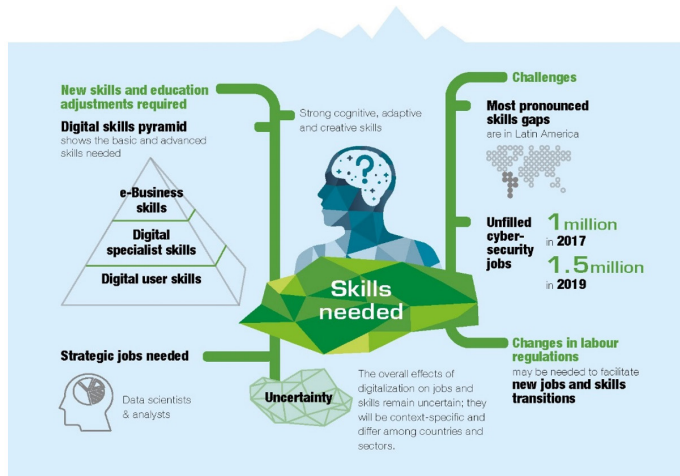
The digital economy relies increasingly on the generation, storage, processing and transfer of data, both within and across national boundaries.

The future jobs require digital skill so we need

to identify the core skills that will be sought after across different economic sectors. Universities and teachers a highlighting that how their programmes are responding to developing skills in core areas, and industry representatives shared their views on core skills required in their sectors and initiatives taken to strengthen those skills [21].

Increased digitalization and automation is leading to new types of jobs and employment, changing the nature and conditions of work and altering skills requirements, as well as affecting the functioning of labour markets and the international division of labour. The ability of countries and enterprises to exploit new digital resources will become a key determinant of competitiveness. The overall effects of digitalization remain uncertain; they will be context-specific, differing greatly among countries and sectors. This makes it increasingly important for countries to ensure they have an adequate supply of skilled workers with strong cognitive, adaptive and creative skills necessary for “working with the machines”.

Figure-3. Digital Economy and Skills, UNCTAD & ITU, 2017



3. Digital Skills and Higher Education in the Digital Era

Digital technologies are creating a new digital ecosystem which brings productivity gains and improve human wellbeing but which is also disruptive because it needs new skills.

Higher-learning institutions need to adapt their teaching methodologies in order to produce graduates who meet skills requirements for the digital economy [18, 20].

The role of digital technologies in facilitating teaching and learning across national boundaries, enabling learners to participate in training activities without being restricted by their geographical location or that of the teachers or experts, is also discussed.

Skills for sustainable well-being in the digital age “Many new jobs will appear for which skilled human workers are needed with a set of skills that combine technical education with humanities, arts and social sciences.” Today, ITU already working with our sister UN agencies: UNESCO on education, WHO on health, FAO on agriculture, ILO on digital skills for decent jobs, UNIDO on innovation and World Bank on digital financial inclusion [15].

Equally important is to enhance development of ‘generic’ or soft skills.

Digital skills, at all levels, are in short supply and high demand. Organizations face major disruption to their markets, customers and workforces. Fundamental changes to business, talent and commercial models are being driven by new technologies and digital platforms. The pace of this

change, and the accompanying disruption it creates, will only increase.

- How can education support the equitable development of digital literacy and skills for all?
- How can we advance digital skills development continually, in the context of fast-changing environment and emerging technologies?

While digital skills education and training has evolved over the past 20 years, the quality and effectiveness of its provision remain inconsistent. Higher education has been evolving rapidly to respond to fast changing demands and environment.

Quality assurance is one of the main ways to develop and ensure trust, and recognition of qualifications [20]. Clearly, education and training are key ingredients of efforts to develop digital skills.

Digital skills development takes place across a full range of education contexts: from formal institutions such as schools, colleges and universities to non-formal provision and training, and various forms of self-directed and informal learning.

The requirement for higher education

institutions to develop and publish quality assurance strategies and evaluation reports is becoming increasingly important one. Educational institutions play a leading role in measuring, assessing and certifying digital skills and competencies - not least in the form of recognized academic and vocational qualifications [14].

Research and analysis shows that, within developed economies, 90% of jobs require some level of digital skills (UNESCO, 2017).

Adapting to a changing environment and emerging technology. Skills mismatch between education and the labour market. Requirements for Digital Skills: ICT can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum. Education is therefore a significant way in which individuals develop technology-related skills, competencies. The Student: Graduates who are less familiar with digital skills are increasingly at a disadvantage in the national and global economy. The Teacher: HE teachers are the key players in enabling students' learning, and appropriate training in teaching skills both before being employed and throughout careers is an essential pre-requisite for a high quality system. Teachers need specific professional development opportunities in order to increase their ability to use ICT for formative learning assessments, individualized instruction, accessing online resources, and for fostering student interaction and collaboration [17].

Digital Skills Pyramid and Actions: Recent moves towards developing cross-industry units, skill sets and qualifications, and their adoption across multiple industries. Top: E-Business Skills-'Higher level' skills: using digital technology in empowering

and transformative ways. Middle: Digital Specialists - The increased provision of ICT specialist training continues to be a growing area within the technical and vocational education and training sector. Foundation: Digital Users Skills, Digital Information Literacy, Digital Literacy (Basic functional digital skills: Accessing and engaging with digital technologies; Generic digital skills: Using digital technologies in meaningful and beneficial ways) [13,14].

Core skills needed for the future (Academic): Deep systems understanding; Ability to grasp new systems/programming languages and systems quickly; Awareness for security, privacy and human-computer interaction; and "Learn to learn" [20].

4. Key Challenges

- The next decade will see the rapid growth of mobile access, cloud-based computing, IoT, digital data, AI and an increase in computer-driven decision-making and other forms of automation.
- The rise of digitally-based public services reflects the fact that the day-to-day lives of many people have to digital skills.
- Still, Senior executives of organizations do not believe that enough graduates enter the labour market with the right mix of digital skills. In my view, digital represents a public policy issue which may require changes to curriculums to meet the current and future demands of the country's digital economy policy.
- In global terms, digital divide and inequalities continue to in many instances, divides across lines of geography, gender, age, socio-economic status, language, and educational attainment are growing (Ensure inclusion, equity and gender equality).

5. Conclusions

ICTs need to be integrated into national policies and in the implementation of development projects and activities and emphasized the importance of capacity building and skills development as an integral component of the digital agenda.

As the physical, digital, and biological worlds continue to converge, new technologies and platforms will increasingly enable citizens to engage with governments, voice their opinions, coordinate their efforts, and even circumvent the supervision of public authorities. Simultaneously, governments will gain new technological powers to increase their control over populations, based on pervasive surveillance systems and the ability to control digital infrastructure. On the whole, however, governments will increasingly face pressure to change their current approach to public engagement and policymaking, as their central role of conducting policy diminishes owing to new sources of competition and the redistribution and decentralization of power that new technologies make possible.

Main conclusions and recommendations are the followings:

- Legal frameworks and Leaderships for promoting digital economy and skills at all level of the education system (Ensure effective Government support and multi stakeholder cooperation; State-supported digital skills provision and special programs/projects);
- In the era of 4IR and Digital economy, universities and colleges need to radically re-examine their curricula towards producing graduates with skill-sets and knowledge that are more relevant to emerging industry needs and changing societal requirement;

- Increase public expenditures in education to increase the skills (including digital skills) acquired through formal training;
- Ensuring the development of digital skills through education;
- Equally important is to enhance development of 'generic' or soft skills;
- Quality assurance continues to be an area of dynamic development in country's HE system and it can promote skills;
- To support teachers as they change their teaching, it is also essential for education managers, supervisors, teacher educators, and decision makers to be trained in ICT use;
- Promote demand for skilled workers by accelerating the rate of innovation in areas likely to be affected by job disruption effects.

Digital transformation has an impact on human relationships and individual behavior, facilitating social inclusion and communication. It should be noted, however, that digital transformation could also result in potential negative effects, such as workforce disruption, the disappearance of companies, cybercrime and social anomie.

Governments need to build cross-institutional links fostering the collaboration among education, ICT, industrial promotion, science and technology to devise and jointly implement policies.

We are at the beginning of a qualitative transformation of our economies and societies. All stakeholders of the ICT ecosystem should work together to create an enabling environment for the future. It is our collective responsibility.

Definition and terms:

- 1) Digital transformation: Digitization refers to the transformations triggered by the

- massive adoption of digital technologies that generate, process, share and transfer information. It proceeds in waves driven by technological progress and diffusion of innovations.
- 2) Digital Skills: The term 'digital skills' refers to a range of different abilities, many of which are not only 'skills' per se, but a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings (ITU and UNESCO, 2017).
- 3) Digital divide: The digital divide refers to disparities of digital media and internet access both within and across countries, as well as the gap between people with and without the digital literacy and skills to utilize media and internet (ITU).
- 4) Scott Adams' Success Formula: Adams has analyzed his rise to the top of his profession as well as the lives of other successful individuals. The result is the Adams success formula: "Every skill you acquire doubles your odds of success".

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