



Joint expert workshop on “Digital Transformation – Higher Education and Research for Sustainable Development” (8-9 November 2018)

Background paper for roundtable: Digitalisation in Industrialised Countries – Opportunities and Societal Challenges

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1 Executive summary

This paper defines sustainable development in reference to the United Nations' Sustainable Development Goals. It sees the role of higher education in both ensuring access to higher quality learning for all and in providing new knowledge and promoting new forms of exchange on the grand challenges affecting our interconnected world.

Opportunities

- Digitalisation can facilitate new digitally-enhanced learning formats, which enable accessible, affordable access to high quality active learning environments
- Digitalisation offers the chance of new and more intensive forms of international collaboration in teaching, learning and research

Fundamental questions

- How should higher education adapt to changes on the labour market, where sustainability will be created through the use of automation and higher quality services?
- How can higher education and research institutes ensure that research activities achieve a dual focus of ensuring a sustainable transformation of society, while paying attention to solving the 'grand challenges' to our planet's future?

Implications for higher education

- Learners need to acquire new skills and competences, which enable them to fully benefit from the 'digital dividends' of technology
- Study programmes need to reflect on and react to the developments in society and the labour market
- Higher education institutions should be a place to consider and even practice future social reform, which can truly harness the benefits of digitalisation for all
- The opportunities of digitalisation for creating new learning spaces should be harnessed to improve the accessibility and quality of educational provision

Impact on international research networks and collaboration

- The combination of digitalisation and globalisation is leading to an interconnected world and research and development must be intensified across national borders in this context.
- The more complex the connection between countries, the more opportunities for countries, firms and researchers to learn from each other and improve their own products, processes and practices.
- The current status quo of collaboration is still dominated by industrialised countries. However, it is clear that the grand challenges require international collaboration, which is not limited to researchers from countries with similar economic and technical infrastructures.

2 Preamble: The Sustainable Development Goals

Sustainability is known to be a slippery concept (Wals & Jickling, 2002). This background paper focusses on the understanding of sustainability as expressed in the UN Sustainability Development Goals (SDGs). In relation to the current challenges of educational systems across the world becoming more inclusive, increasing the quality of learning provision and becoming more reactive to requirements of society and the economy, SDG 4 states the goal for education:

“Ensure inclusive and quality education for all and promote lifelong learning.”

More specifically, the goal referring to tertiary education is expressed as target 4.3. It states:

“By 2030 ensure equal access for all women and men to affordable quality technical, vocational and tertiary education, including university” (United Nations, 2015)

Furthermore, education can also contribute to achieving the other 16 key SDGs in two ways: Within this framework, education has three clear roles:

- *as enabler*: in particular to enable more capable, more inclusive societies in order to contribute to achieving *gender equality* (SDG 5), *creative and impactful innovation* (SDG 9) and *inclusive and sustainable economic growth* (SDG 8)
- *as mediator*: to provide *new knowledge and promote exchange* which will contribute to achieving all of the other SDG goals

That means that the goals for tertiary education focus particularly on ensuring that higher education provision is accessible, affordable and of high quality for all. These goals are as relevant to developing countries as they are to industrialised countries.

3 Q1: Where are the opportunities of digitalisation for sustainable development?

According to the Oxford Dictionary, digitisation stands for the conversion of text, pictures, or sound into a digital format that can be processed by a computer. This material process per se would not have a great impact. It must be embedded in a wide-ranging process that harnesses digital materials in order to achieve digital transformation (Brennen & Kreiss, 2016). For their literature and policy review in the Nordic region, Randall et al. define digitalisation as follows (Randall, Berlina, Teräs, & Rinne, 2018):

“The transformation of all sectors of our economy, government and society based on the large-scale adoption of existing and emerging digital technologies.”

The Internet and digital networks are the means to connect disparate information and communication channels and are changing how society is organised and works. Therefore, it is not so much the technology, but the new information nodes and the forms of their connection, which allow processes to be organised differently (Castells, 2010; Cerwal, 2017).

In terms of the educational role of higher education, digitalisation enables **new forms of learning** and **new access routes to information, knowledge and expertise**, therefore supporting the achievement of SDG 4.3 for an accessible and affordable route to high quality tertiary education provision.

The two areas main developments, which have harnessed these new opportunities are: the provision of ‘Massive Open Online Courses’ (MOOCs) and of ‘open educational resources’ (OER):

- **MOOCs** and, in general, online learning provision offer new access to international expertise and prepared courses for students, often without the need to pay for enrolment or with qualifications as prerequisites for participation. They are offered at scale by utilising platform technologies for the provision of content and networked and peer-learning opportunities for enrolled learners. In the future, these provisions will harness learning analytics and machine learning in order to step the learning support available to the registered student.

The main platform providers are Coursera, EdX and Udacity from the USA, FUN from France, FutureLearn from the UK and XuetangX from China; all except EdX and FUN are profit-orientated organisations. The content itself comes from universities across the world keen to use these platforms to share their knowledge and expertise, but also to use such courses as a way to market their domestic (largely on-campus) courses and to recruit new students from their own and different countries.

Whilst these major players dominate the international market place, many universities in industrialised countries have developed their own MOOCs and are now using their own platforms for as access routes. A European survey in 2017 shows that two-thirds of responding European universities had developed MOOCs and that the majority of these offer their MOOCs on their institutional platforms or on available regional/national platforms (Jansen & Konings, 2017).

In both cases, MOOCs are also being embedded into domestic study programmes as a way of making study provision more flexible for students, who are studying part-time. But also and as a way of enriching course programmes through different forms of learning like the ‘flipped classroom’ method, which encourages more active learning during periods on-campus.

- Almost all MOOCs are proprietary, and their content is protected through intellectual property rights. This presents as obstacle to sharing content or even for third-parties to improve the original content. These are goals of the movement around **Open Educational Resources** (Orr, Rimini, & van Damme, 2015), where learning materials are placed under an open licence which specifically allows the processes of sharing, revising and adapting to new educational settings. Digitalisation in combination with open licencing makes these processes more efficient. Within Europe, the universities of Edinburgh (Scotland) and Louvain (Belgium) and the University of Technology of Delft (Netherlands) have institutional strategies of open licencing by default to enable full use of OER by other educational institutions.

An interesting educational initiative is the Kiron educational platform that utilises MOOCs from other providers (e.g. through a cooperation with EdX), which have been open licenced as OER, to offer refugee students in Germany and through Kiron MENA in Jordan and Lebanon micro-credentials, which can be used for access to partner higher education institutions. A further interesting initiative that has just been announced is a partnership between China's MOOC platform XuetangX and the United Nation's SDG Academy, which will offer courses around the SDGs on this platform from 2019 ("SDG Academy Partners with China's Largest MOOC Provider XuetangX," 2018).

These developments are ways to make the increasing abundance of knowledge being generated in the science system and published through digital media available to all. Beyond this, digitalisation can **change the way researchers interact**. In their classic analysis, Brynjolfsson and McAfee identify four innovation trends which are enabled through digitalisation (2014): improved real-time measurement of business activities, faster and cheaper business experimentation, widespread and easier sharing of ideas, the ability to replicate innovations with greater speed. Knowledge-based processes in science can also be improved through these opportunities, which make sharing of knowledge, sharing of experienced, personalised services and support feasible at scale (Schwarz, 2010).

This offers new chances for international cooperation between research institutes and researchers from different countries. There are indeed indicators for this type of interaction increasing: Data for the Association of American Universities shows that the **share of publications with international co-authors rose** from 19% to 37% between 2001 and 2016; and in the case of MIT this share grew from 25% to 50% ("A Global Strategy for MIT," 2018).

4 Q2: Which fundamental new questions arise due to digitalisation?

The fundamental new questions arising from digitalisation are, in fact, old questions with a higher urgency, since **digitalisation in combination with globalisation** is making the world figuratively 'spin faster'. The main question is how to assure that all people in a country's population and all nations of the globe benefit from digitalisation. As highlighted in a World Bank study, it is about ensuring the '**digital dividend**' and avoiding an increasing '**digital divide**' (Hess et al., 2016). Industrialised nations have a particular responsibility here, since their values and activities have knock-on effects along the global value chain to the less developed countries which they cooperate and do business with.

The main issues can be encapsulated in two leading questions:

- How should higher education adapt to changes on the labour market, where sustainability will be created through the use of automation and higher quality services?
- How can higher education and research institutes ensure that research activities achieve a dual focus of ensuring a sustainable transformation of society, while paying attention to solving the 'grand challenges' to our planet's future?

Turbulence in labour markets

We can expect labour markets in industrialised countries to change dramatically in the next decade. The task combinations required by most people's jobs will change and diversify as routine and predictable tasks are increasingly being automated (OECD, 2017b, 2017a). One OECD study has shown that the effects are already becoming visible with over one third of variance in the occupational unemployment rate attributed automatability of the common tasks by occupation (Nedelkoska & Quintini, 2018).

Future business growth in developed economies is expected to be reliant on **smart services and smart products** (Hüther, 2016). Both are examples of extending the value-added through additional services, which increase the complexity of the value chain and are likely to be reliant on high-skilled labour. This shift will require closer interactions being computers and humans in order to augment task execution in production and service delivery. This shift will also lead to people's jobs consisting of a **higher share of non-routine, creative and communicative tasks**. Moreover, the expectation for increased frequency of innovation and change lead to predictions that large shares of the population in developed countries will have bumpy career pathways, which require **frequent periods of reorientation and retraining** (Manyika et al., 2017). This all requires a review of how **lifelong learning** is recognised and embedded in our societies.

Grand challenges and ethical concerns

Learning not simply about achieving smoother transition and success in the labour market, but also about contributing to the transformation of society for the good of all. The SDGs cover social and economic development issues including poverty, hunger, health, education, global warming, gender equality, water, sanitation, energy, urbanization, environment and social justice. These 'grand challenges' present a challenge to science, which is typically organised along the disciplines. Raising people out of poverty, for instance, is about **taking a global view** on how food provision, health, education and the labour market work together to create a situation, which may have a positive or negative effect on raising people out of poverty – for instance: whether digitalisation is providing a dividend for all parts of the population or cementing a great social divide. Research and development must be **creative, interdisciplinary and intercultural** in its search for solutions. This

requires more cooperation in research and development and the need for researchers to work on finding common ground from which to integrate their different perspectives into new solutions.

Further challenges emerge out of research and development itself. For instance, where molecular biology is focussed on the modifying the genes or behavioural patterns of insects to solve one technical problem (e.g. reduce the need for pesticide in agriculture), the ethic question of the knock-on effects for other parts of the ecosystem must be examined. The ***fields of [ethics + scientific field]*** are not new, but their importance is growing with the new possibilities for experimentation and adaptation made available through digitalisation. One central focus is the ethical consequences of Artificial Intelligence. This particular challenge is being taken seriously internationally, with the ***Asilomar AI Principles from the Future of Life Institute***, which have already been endorsed by over four thousand academics from across the world.¹ Still, more work is needed here. As a recent UNESCO publication states: “While research is moving full speed ahead on the technical side of AI, not much headway has been made on the ethical front.” (UNESCO, 2018) It remains a fundamental challenge to ensure that all parts of society are aware of the ethical considerations, which go along with digital progress.

The slogan of the Future of Life Institute states: “*Technology is giving life the potential to flourish like never before... Or to self-destruct. Let's make a difference!*”

¹ <https://futureoflife.org/ai-principles/>

5 Q3: What are the implications for higher education, a corner stone for development?

Higher education is the domain, where many aspects of change arising for the digitalisation of our world come together. There are four specific requirements of a higher education, if industrial economies are to fully embrace the opportunities of the digital age within the framework of sustainable development:

- Learners need to acquire new skills and competences, which enable them to fully benefit from the ‘digital dividends’ of technology
- Study programmes need to reflect on and react to the developments in society and the labour market
- Higher education institutions should be a place to consider and even practice future social reform, which can truly harness the benefits of digitalisation for all
- The opportunities of digitalisation for creating new learning spaces should be harnessed to improve the accessibility and quality of educational provision

This understanding of higher education echoes what Ron Barnett has called the ‘ecological university’, which focusses on its role in society: “This is a **university** neither in-itself (the research university) nor for-itself (the entrepreneurial university) **but for-others**” (2011, p. 452).

Digitalisation of processes in society will require citizens in society to have the right skills and competences to fully benefit from them. Thus all persons active in the labour market (or wishing to enter it) will require a combination of foundational skills (esp. literacy and numeracy), transversal skills (creativity, social and emotional skills – the so-called ‘engineering bottlenecks’) and digital skills (Bialik & Fadel, 2018). The OECD Education 2030 project has identified three further categories of competencies, the ‘**Transformative Competencies**’, that together address the growing need for young people to be innovative, responsible and aware (OECD, 2018):

- Creating new value
- Reconciling tensions and dilemmas
- Taking responsibility

Higher education needs to be able to provide study programmes, which reflect these demands. There has been an assumption that many of these competences are available in higher education in the so-called ‘graduate attributes’ of university graduates (Barrie, 2006), which are commonly part of the university mission in Anglo-Saxon countries. It is fundamentally new that these skills and competencies should be **embedded explicitly in all programmes**.

Furthermore, changes in the labour market are likely to make **frequent episodes of learning** necessary. This means that the organisation of entry and exit to study programmes should be made more flexible (e.g. through modules and study credits), as should the provision of learning, to allow people to undertake some of their learning alongside their career.

The other fundamental challenge is to fully **harness the possibilities of digitalisation** for better teaching and learning. If access to high quality learning experiences is to be aided through more flexible learning pathways and digital provisions, appropriate pedagogical structures need to be provided, as discussed at a recent conference of the Austrian Presidency entitled ‘The new student: Flexible Learning Paths and Future Learning Environments’ (Unger & Zaussinger, 2018). Many of

the MOOCs have not been able to achieve this and have been criticised as pedagogic-poor learning arrangements (Margaryan, Bianco, & Littlejohn, 2014).

These issues are important, since without programmes which focus on teaching the appropriate skills for well-being and a sustainable career and without supportive learning structures, the combination of the pressure of a digital world and the lack of effective learning arrangements will lead to a greater '**digital divide**' in our populations (CEDEFOP, 2016; Hess et al., 2016; Wong, Law, Fung, & Lee, 2010). A significant problem for the future is that those people who have not attained a higher education degree are more likely to be in jobs, where a high level of automation can be expected, are more likely to have deficits in their skill profile (foundational, transversal and digital skills) and are less likely to undertake further education during their career. Part of a concerted response to this challenge of getting such learners back into formal education should be undertaken by higher education providers.

This is, however, not a singular role for the higher education institutions but also requires good policy at state and intergovernmental level:

“In times in which the digital economy is transforming both economic and social life, a progressive state cannot serve as a mere bystander, but must find ways to channel technological and social transformations for the benefit of the great majority in society” (Andersson, Alaja, & Buhr, 2016).

6 Q4: What impact does digitalisation have on international research networks and science cooperation?

The combination of digitalisation and globalisation is leading to an **interconnected world** and research and development must be intensified across national borders in this context.

The economists Stiglitz and Greenwald state that “**Knowledge is free**. The biggest cost in its transmission is not in its production or distribution, but in its assimilation.” (Stiglitz & Greenwald, 2015, p. 507). The more complex the connection between countries, the more opportunities for countries, firms and researchers to learn from each other and improve their own products, processes and practices. However, an effective and impactful collaboration is the key. Digitalisation might facilitate this process in two ways:

- Intensified collaboration as result of the demands of an interconnected world
- Intensified collaboration facilitated by the technologies of an interconnected world

Collaboration in research and development along the global value chain

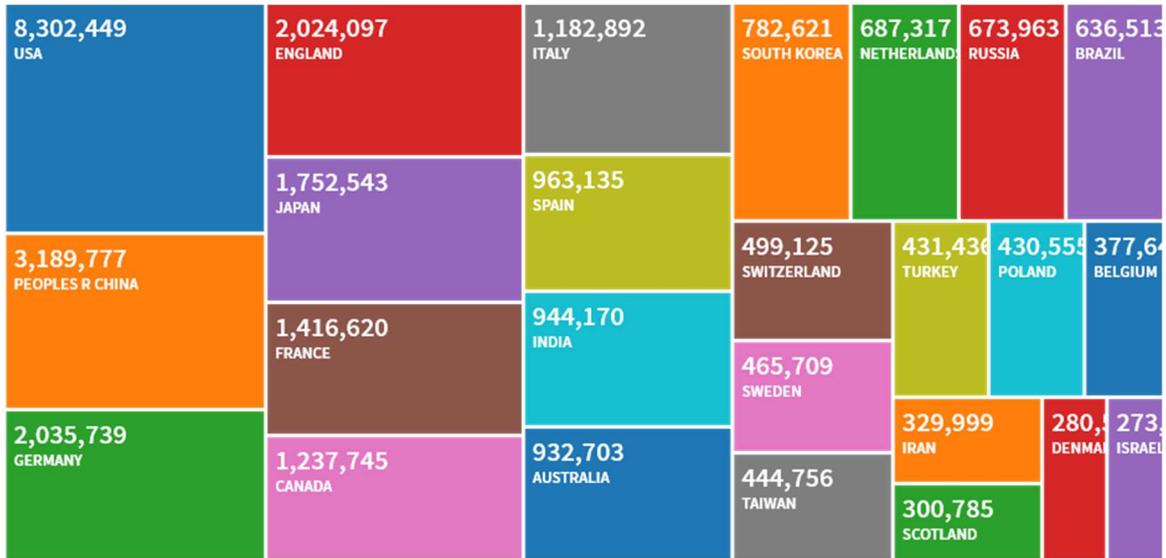
In research and development, collaboration between different countries with the additional support from policy can make use of global links to the common benefit of both countries. An example of this is the collaboration between key industries in Germany and India, in each case making use of the **relative comparative advantage** of the respective countries. Germany has a key strength in manufacturing. However, **manufacturing increasingly requires related smart services** built around it and Germany currently suffers from a shortage of data technicians due both to its training system and demographics. In contrast, India has a key strength in data scientists and technicians, but a weak manufacturing base due to inefficiencies and the fact that most companies, which operate in India are small. Connecting firms in key industries from each of these countries can provide a beneficial dividend for both – thereby extending the value chain to include both smart manufacturing and smart services (Holtkamp & Iyer, 2017).

Collaboration through communication technologies

The current status quo of collaboration is still **dominated by industrialised countries**. However, it is clear that the grand challenges require international collaboration, which is not limited to researchers from countries with similar economic and technical infrastructures.

The current domination can be seen in the two following charts. The first shows the share of scientific publications by country of author. This shows that most research authors still come from industrialised countries (including China) – see Figure 1 below. This suggests that even in the case of co-authorship, most collaborations remain with the group of industrialised countries.

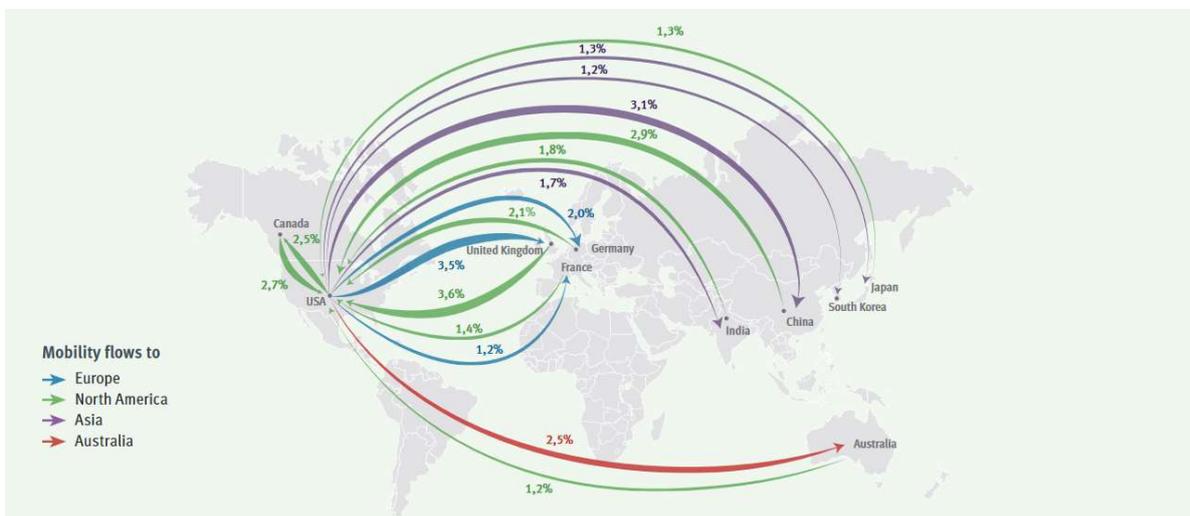
Figure 1: Proxy analysis of publications in Web of Science 2007-2017 by country



Source: Web of Science. Own analysis. Note: Proxy method used: all scientific articles in the database in the period 2007-2017 with the word letter combination “the” in the title.

Secondly, data from one international analysis shows that the flows of academics between key partners across the world is relatively balanced (Burkhart et al., 2018) – see Figure 2. However, again the key countries are members of the OECD – with the exception of China and India.

Figure 2: Major flows of internationally mobile academic authors, 2006-2016 as share of all internationally mobile academic authors



Source: (Burkhart et al., 2018)

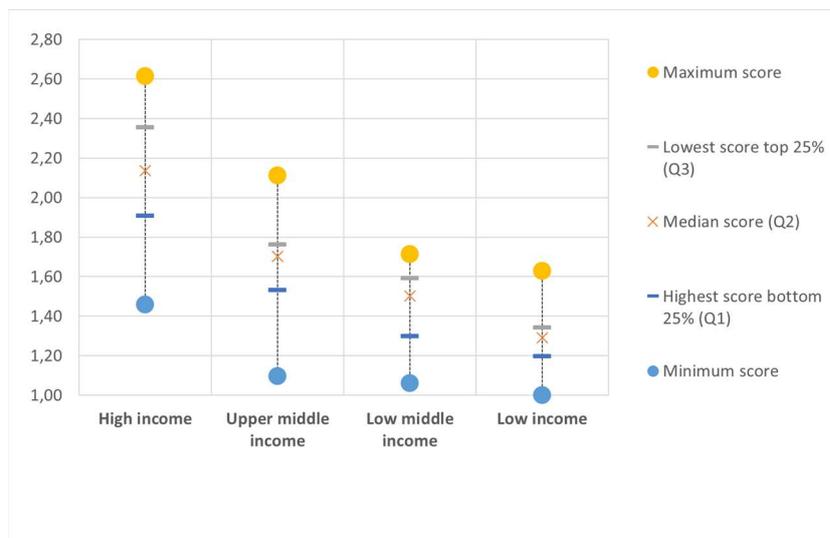
Chances for collaborations between researchers in developed and developing countries

It has been argued that digitalisation presents opportunities for developing countries' emerging economies to catch up with more mature economies and to 'leapfrog' some stages of industrial development (Chandra, Eröcal, Padoan, & Braga, 2009; World Bank, 2008) – and this is specifically related to the use of communication technologies: “Given the pace at which things are changing,

most developing countries should continue to see a rise in their ability to communicate and process information over the next few decades. This should help speed the diffusion of other technologies as well.” (Chandra et al., 2009, p. 195)

This should be the case for research collaborations too. However, it is heavily also dependent on the technical and skills capacity of a group to benefit from digital methods. The most comprehensive quantitative approach to judging provision of the right conditions for ‘digital networking’ is so-called ‘Networked Readiness Index’ (Baller, Dutta, & Lanvin, 2016).

Figure 3: Networked Readiness Index by countries' income group (according to World Bank), percentiles for each country group



Source: Networked readiness index. Own calculations.

Note on interpretation: the scores were taken from the NRI, but recalculated, setting the lowest country score to 1 and relating all other scores to this one. That is to say that around half of the low income countries have a score which is 30% higher than the lowest country's score, whilst the top performing countries in the NRI have scores at least 2,4 times higher. The chart shows that there overlaps between countries' scores in different income groups.

That is to say that collaborations should be built carefully and not assume the level of digitalisation infrastructure and capacity available in industrialised economies – only then can they have an impact.

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