DIGITAL FUTURES OF WORK

Initial Thoughts on Policy Issues for the Future of Work

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Abstract

This working paper explores the range of possible futures for the world of work and employment, and the possible policy responses thereunto. It starts with a critical overview of some of the key issues concerned with how thinking about and forecasting the future is taking place at global and other levels. Digital innovation is only one of a set of challenges that policy makers face, and often its effects overlay and amplify pre-existing trends and challenges. The paper goes on to offer a framework for categorising and analysing the different types and orders of effects that digitalisation (and other factors) may have on skill needs and education and training (E&T). The working paper concludes by setting out the emerging priorities and foci for the next stages of our research.

keywords: skills | work | digital | policy

Introduction

This working paper is concerned with the range of possible futures for the world of work and employment, and the policy responses that might help delivered desired outcomes. Determining what these futures might be is bound up with a set of high-level and sometimes inter-related global debates about the future of employment; the impacts of digitalisation and other forms of technological change; the next stages of globalisation (or de-globalisation) and political responses to this; environmental and climate challenges; and now the potential economic, political and skills impacts of the Covid-19 pandemic (see Agrawal et al., 2020).

This working paper sets out some the policy issues to be addressed under the Digital Futures of Work research programme. These include:

- Who owns the thought leadership within governments, academia and research, and wider society on digital technologies and their implications (including skills)? How is this leadership being exercised, with what intent, and, insofar as it is possible to judge, with what effect?

- What are the policy responses in a set of key countries (initially identified as Canada, the US [at state level], the UK, Finland, Germany, Japan, China and Vietnam)?

- What are the breakpoints in policy path dependency and how best can a nation generate change and escape repeating the errors of the past or the errors of others in the present?

- What kinds and levels of capacity are required to generate a better future of work for the benefit of all rather than a few?

- How can digital transformation be utilised in ways that contribute to labour augmentation and to inclusive growth and individual wellbeing? Where are the international examples that show signs of promise or, better still, evidence that they work?

The aim here is to provide an over-arching analysis of a limited number of key aspects of the current state of research and policy thinking, and sets out the main research issues and foci that our policy analyses will at least initially be exploring. The Working Paper draws on an ongoing synthesis of the rapidly evolving research and policy literature in the field, across a number of disciplinary perspectives, and at a range of different levels. It also deploys some results emerging from an on-going major Oxford University research project being conducted for UK Research and Innovation (UKRI) on the impact of artificial intelligence and digitalisation on the practice of law and the future of the legal profession in England. The project involves staff from the Law Faculty, the Said Business School, Computer Science, the Oxford Internet Institute, and the Education Department.

What follows starts with a critical overview of some of the key issues concerned with thinking about and forecasting the future that is taking place at global and other levels. It then sets out a framework for categorising and analysing the different types and orders of effects that digitalisation (and other factors) may have on skill needs and education and training (E&T). The working paper concludes by setting out the emerging priorities and foci for the next stages of our research.

Thought leadership – complex times, complex issues

Creators and audiences
The last 30 years have witnessed the rising power of globalisation and with it a much more internationalised set of policy debates about employment and skills. This both mirrors, but has also been in part led by the concomitant increase in the activities, reach and importance of globalised 'policy clubs and fora' (for example the Organisation for Economic Cooperation and Development [OECD], and the World Economic Forum [WEF]), global institutions like the World Bank, the International Labour Organisation [ILO], and UNESCO, and many different forms of internationally focused 'think tanks' – some free-standing, others linked to and funded by large banking groups and business consultancies (McKinsey and Co being a leading example). The lines between the policy work of these different organisations is blurred as they are all offering analysis and advice on similar issues and competing with one another for attention within the global marketplace for ideas and influence.

Education and skills have become a major focus for many of these organisations, led by the OECD and its research on international skills testing and benchmarking (via the PISA and PIAAC tests) and policy comparisons. This focus on international benchmarking and national performance therein has, on occasion, come to act as a substitute for joined-up, contextualised policy, with national governments assuming that if their state does well in the

league tables, this is a strong indication that they are doing the right thing and that good economic and social results will follow.

The arrival of digitalisation and its potential impacts on jobs, education, training and skills means that these issues are now firmly entrenched within the research and policy agendas of many of these global opinion formers. However, they are not the only players in this area. The literature and policy thinking on AI, digital technologies and work and skills is being generated at a number of levels:

1. International – via global and multi-national organisations and agencies and other large consultancies and banks, the European Commission and its agencies, etc

2. National – by governments and their agencies, national think tanks, social partner organisations, charities and academia

3. Regional and local governments and their agencies, regional organisations and think tanks and academic researchers

4. Sectoral/occupational (usually with a national focus), for example, the burgeoning UK academic and practitioner-generated literature on the impact of AI and digitalisation on the legal profession and law firms (Cunningham, James and Taylor, 2018; Law Society, 2019; Smith and Spencer, 2020), in Fintech (Oakley et al, 2019; EY, 2020), and in construction (Agarwal, 2016; CITB, 2018)

The debates that these activities drive concerning the possible impacts of digitalisation and the most appropriate policy responses mirror this multi-layer/level reality, and, as previously noted, thought leadership in this space is heavily contested, with many different players jostling for attention.

One of the key issues facing both the authors and readers of the global policy literature on digitalisation is that it is aimed at a variety of policy and practice audiences, including:

1. Supranational agencies and their attendant policy 'communities' (e.g. OECD, World Bank, International Labour Organisation)

2. The media – globally and within national contexts, including the 'trade press' and business publications

3. National governments and their agencies

4. Regional and local government and their agencies

5. National and sectoral employer bodies

6. Trade unions

7. Human resource professional associations

8. Think tanks (international, national, and regional)

9. Individual companies

10. Individual trade unions

11. Individual workers and citizens

12. Individual managers

13. Academics and other bodies designing and conducting research on skills and E&T

14. Organisations that research and facilitate innovation and technology adoption/usage

15. Third sector organisations working in the skills and employment arena

16. E&T providers – public and private

17. Bodies that design qualifications and the curriculum

18. Organisations that design and provide teaching/instructional materials

19. Organisations that train teachers and other learning professionals

This very diverse set of potential audiences creates an inherent challenge for those organisations that are seeking to craft an internationally-relevant, over-arching policy analysis and narrative, as by their very nature globalised accounts and analyses struggle to contextualise the developments within specific national, and sub-national place-based, and sectoral settings, and often take limited account of different national starting points (e.g. the structure of the economy, the labour market and labour market regulation). They also often find it hard to present data and predictions at a level of granularity that will animate the formulation of successful policy responses at many of the levels listed above.

Furthermore, it is already apparent (Neufeind, O'Reilly and Fafti, 2018; Aiao et al, 2018) that the national trajectories of digitalisation, and the resultant scale and shape of the changes in skill need vary very considerably between countries, as well as across different regions and sectors within countries. Policy responses to the 4th Industrial Revolution are also varied in terms of scope and the foci for action and intervention, timescales and resourcing (see Aiao et al, 2018 for a systemic literature review of public policy responses across a range of developed and developing countries). These studies suggest that, on their own, global headline projections and figures relating to the employment and skills effects of digitalisation will be of relatively limited direct utility in informing and crafting national policies.

The difficulties of forecasting digitalisation's impacts on skill need
Forecasting future trends in job growth and loss, and resultant patterns of skill demand is extremely difficult, and this represents a fundamental problem for much of the globalised policy literature. As Frey (2019a & b), Neufeind, O'Reilly and Fafti (2018), and Manyika, et al (2017) explore, the speed, spread and shape of the adoption of digital technologies will be determined

by a range of factors. These include the economic incentives and payback from adoption and the ability of organisations to make the capital investments required, and will therefore vary very considerably across countries, regions, sectors, occupations and firm size.

Moreover, the development of digital technology and its multiple potential usages is in some settings evolving very rapidly. In the initial stages of the adoption of a new technology, skill demand tends to assume a very sharp upward curve as it is starting from a very low base (for example, see Robert Walters/Vacancysoft, 2019). The potential problem is that current patterns of skill demand and responses thereunto may reflect the early stages of technological adoption within the context of an emergent technology rather than the patterns that will pertain when the technology and its usage reach maturity. Some of these early applications and approaches will almost certainly turn out to be dead ends that will rapidly be superseded by more productive or easier-to-implement alternatives, and this process may in part reflect the availability of skills and knowledge to drive and shape adoption (Vona and Consoli, 2014). As a result, current developments may not prove to be a good guide to what subsequently emerges as the technology and people management, recruitment and training responses evolve and mature. Consequent upon this, a major difficulty is that within such a rapidly evolving field, skill needs will change at a pace that the providers of education and training will often struggle to apprehend and match.

Thus the need for better, more timely information and analysis to inform policy choices and responses will become important as the spread of digitalisation produces increasingly visible impacts on sectoral and occupational patterns of employment and skill demand. For example, in UK retail banking a third of all bank branches have closed between 2015 and 2019 (Brignall, 2019), resulting in large-scale job loses, but also presumably in a radically changed skills profile within retail banking providers' workforces. There is little sign in the UK that this shift has yet been reflected in thinking about E&T aimed at supplying the retail banks' skill needs.

This set of challenges suggests a number of potential responses. One is that employers will need to provide as much information about their evolving skill needs as is possible and do so in a timely manner. A second is the use of web scraping techniques to analyse in real time changing patterns of job advertisements and skill demands.[1] The analysis can deliver labour market information (LMI) at a speed and level of granularity that more traditional forms of survey-based information gathering and analysis cannot. A third requirement is for more and better research on both the general impact of digitisation on work, and more particularly on the skills aspects of this, particularly as it relates to individual sectors, or occupations. One example of good practice in this respect is the work undertaken in Germany by the Federal Institute for Vocational Education and Training (BiBB), which has undertaken a set of sectoral/occupational case studies, looking in detail at the impact of digitalisation on work, skills and qualifications (see Conein and Shad-Dankwart, 2019; and Bretschneider, 2019). Without better analysis of future job and skill trends the E&T providers will face considerable difficulties in planning the scale of provision, the nature of the curriculum that should be offered, and deliver appropriate and timely responses.

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[1] Analysis of real-time labour market data is conducted as part of the Digital Futures of Work research programme. Refer to Brown, P., Sadik, S. & Souto-Otero, M. (2021). Digital futures of work: reimagining jobs, skills and education for a digital age. *Digital Futures of Work Research Programme, Working Paper 1.* Accessible at https://digitalfuturesofwork.com/wp-content/uploads/2021/02/WP01-Introduction-to-the-Programme.pdf

Besides the technical challenges encountered in knowing what skills in what quantities and at what levels will be required and the problems for policy and practice that this creates, there are also a set of wider issues and weaknesses in the global policy literature on digitalisation. It is to some of the most relevant of these that we now turn.

Some wider problems and issues with global policy and analysis production
To begin with, at all levels of analysis much of the literature on digitalisation is designed to be inspirational or aspirational – 'this is what you ought to be aiming for and/or doing' at a very high level of generalisation, but it is often relatively light on what concrete policy moves governmental actors or others should actually be taking. There is much talk about how things could or should be, but blueprints for delivering this are much less fully-formed and mainly consist of broad areas for future policy development. It is a literature that sets over-arching goals, sometimes offers some high-level design principles, but has relatively little to say in relation to constructing a blueprint for national and sub-national policies, or for their implementation. To put it another way, this is a prescriptive literature in terms of setting out desired policy outcomes, but the means to deliver these and the nature of the journey towards what is desired are left very loosely specified.

In addition, many of the long-standing problems with globalised literatures on high-level future prediction and the prescription of appropriate policy responses are at play in relation to AI, digitalisation and work. For example, the sheer volume of material makes it hard to sift through, analyse or digest. There is also no system of quality control and finding nuggets of wisdom or useful examples of best practice is not easy amidst a sea of wild prognostication, sweeping generalisation and hyperbole (Brown, Lloyd and Souto-Otero, 2018).

More specifically, the global level policy literature is plagued by:

1. Varying degrees of (im)precision about what evidence base and analytical methods much of the prediction is founded upon

2. An enthusiasm for bold, eye-catching, but often weakly evidenced headline figures concerning the scale and nature of possible change

3. Limited reference back to or understanding of the speed with which earlier waves of technological change rolled out, and a tendency to claim that digitalisation is an unprecedented development that has no real historical parallels (see below)

Unsophisticated models of policy choice and change. The underlying modus operandi within the policy literature is generally to motivate and catalyse policy responses through a mixture of threats and promises – AI and digitalisation is an unprecedented threat, but could also (at least in some cases) become a massive opportunity to deliver social and economic desiderata – "while the challenge is tremendous, there is a unique window of opportunity today to mobilize human collaboration and technology to move towards more equitable outcomes" (WEF, 2019: 1).

Moreover, the use of carrot and stick to engender whatever type of reform is believed to be required, often without any recourse to a well worked-through theory of change and with

limited acknowledgement that digitalisation is but one challenge among many that are impacting and interacting together, is an unsophisticated approach that undercuts the complexity of the policy choices and trade-offs that will need to be made. This is certainly the case with some of the literature, which dangles the prospect of greater prosperity, well-being, and high quality employment opportunities (if not for all, then for the vast majority) if policy makers choose their prescriptions for action. Do what we say, and you will achieve a 'soft landing' and live happily ever after is the promise and the policy sales pitch (WEF, 2019).

Thus this approach produces a binary and poorly-nuanced model of change that is problematic for a number of reasons. First, it assumes that the challenges thrown up by digitalisation will act as the prime catalyst for a wide range of policy actions around employment and skills – for example, a policy response around fairer, more equitable and higher quality work. However, within the UK the Scottish and Welsh governments have chosen in recent years to adopt new fair work policies for reasons that are largely to do with other factors and policy challenges (e.g. the growth of in-work poverty, widespread perceptions of poor job quality, various forms of discrimination in the workplace, lack of employee 'voice' and representation, etc). In other words, policy has been motivated by concerns that pre-date and have little to do directly with digitalisation (Scottish Government, 2016; Welsh Government, 2019; Sisson, 2019; Sisson, 2020).

Thus, as ever, we need to bear in mind that digitalisation and its impacts are but one challenge among many, and at any given moment may not always be at the top of policy makers' lists of things to worry about (for the breadth of issues confronting national actors, see the ILO's 2017 report on *National Dialogues on the Future of Work*, or the OECD's *Policy Challenges for the next 50 years,* 2014). All the topics covered by these reports are competing in a race for attention from senior policy makers, opinion formers and practitioners, and the digitalisation debates occur alongside and sometimes inside multiple, over-lapping, multi-layered discourses concerning policy and practice. For example, at present it could be argued that policy makers are grappling with a vast array of issues concerned with the global pandemic; climate change, environmental hazards, and failing biodiversity; alongside rising inequality, new geopolitical conflicts, slowing growth, and the future direction of globalisation and global systems of governance and dispute resolution (to list just a few....). Some of these are focused on phenomena and problems that are relatively new, while others have been around for a long time, but which have either remained unresolved or where past solutions have broken down in the face of economic, structural and societal change.

Moreover, many of these issues are inter-linked, sometimes in obvious and sometimes in more subtle ways. To give just one example, there are concerns that digitalisation may end up benefiting a small section of society via a 'winner takes all' effect, and that it will further exacerbate pre-existing tendencies towards greater income and wealth inequality (Frey, 2019a & b), which are already a considerable source of concern (Picketty, 2013). In other words, the effects of digitalisation will confirm and magnify pre-existing trends. Therefore, trying to see and analyse this aspect of digitalisation's impacts as an isolated phenomenon is probably dysfunctional. It needs to be explored alongside other factors (some long pre-existing) with which it is constantly interacting. At the same time, the impacts of Covid-19 on the need to re-train and re-skill sections of the workforce, not least in terms of enhanced digital skills, has become a topic for debate (Agrawal et al, 2020).

These linkages between different strands or streams of policy thinking are an important complicating factor in how research is analysed and policy options developed. For example, if we focus down to the field of work and skills, current debates encompass the following, by no means exhaustive list of topics:

1. The impact of AI/digitalisation/automation on levels of employment, shifts in the occupational structure, new forms of employment and new and changing skill requirements.

2. The growth of precarious work and employment

3. The persistence of low pay and in-work poverty

4. Unemployment, social exclusion and economic inactivity

5. Workplace stress and its impacts on physical and mental wellbeing

6. Demographics and an ageing workforce

7. A slowing in the rate of productivity improvements

8. Slowing rates of innovation

9. Poor work organisation and job design

10. Weak utilisation of existing skills

11. Limited employee engagement and commitment

12. Lack of effective employee voice and participation mechanisms

13. Diversity

14. Talent management and career structures and their management

15. Skill shortages and gaps

16. Labour shortages

All but the first of these pre-date the 4th Industrial Revolution, although some may be exacerbated by the impacts of digital technologies, but many have been with us since the latter decades of the nineteenth century and have been the central concerns of traditional models of employment and labour market policy, industrial relations and personnel management since that time.

To look at the impact of digitalisation from another viewpoint, from an organisational perspective the three key objectives in managing the employment relationship probably remain:

- the development and maintenance of effective systems of recruitment/talent attraction,

- worker retention, and

- employee motivation in order to mobilise workers' discretionary effort and creativity (Sisson and Purcell, 2010; Keller and Meaney, 2017; Saroya, 2018).

Rather than representing some fundamentally disruptive paradigm shift or 'game changer', in many sectors and occupations digitalisation and its potential effects merely adds another set of challenges to problems and issues that were already complex, often fairly intractable and which have been responded to, at nation state and organisational levels, by the creation of a set of long-established, sometimes path dependent socio-economic institutional responses.

A lack of historical understanding. A second weakness is that much of the digitalisation literature adopts an ahistorical approach, justified by a belief that these technologies are so disruptive that they render all lessons from the past irrelevant. A very stark contrast in beliefs (contained in the same volume – Frey and Garlick, 2019) about what can and cannot be learned from the previous experiences of technological change is offered by Frey (2019a) and Seddon (2019). Frey explores lessons from various earlier stages of industrialisation and technological change, such as the 18th century industrial revolution in the UK and the introduction of mechanisation in US farming, and suggests that there are parallels to be drawn with what is happening now. By contrast, Sir Anthony Seddon (popular historian, ex-head of an elite English private school, and biographer to successive UK prime ministers) opines that:

> We can learn nothing about the labor market from technological revolutions in the past, because the 4.0 revolution is quantitatively different. The 4.0 revolution in education alone will the biggest since the printing press. It will affect every single aspect of education and society as well as the society and world of work that education is preparing people for. (Seddon, 2019: 118)

This dismissal of the utility of trying to learn from earlier periods of disruptive technological and economic change is probably unhelpful. There have been earlier waves of automation and in their time these attracted the attention of researchers and policy makers. For instance, debates about the 'Third Industrial Revolution' in the late 1970s and early 1980s were predicated on forecasts of massive job losses and were concerned with the economic, social and political consequences that were believed would be attendant upon such developments (Jenkins and Sherman, 1979) – issues which have considerable resonance today. There were also research and policy debates about the implications of these developments for skills and E&T. For examples from the mid-1980s in the UK, see Burgess (1986) and Brady (1986).

Moreover, even if the current round of AI and digitalisation presents new challenges and has an inherently greater long-term potential for disruption than earlier, more limited iterations of automation, patterns of human behaviour remain fairly constant (for example, reactions to

threats, opportunities and different incentive structures) and the range of broad policy responses also remains fairly fixed. Frey (2019a&b) constructs a persuasive case for there being opportunities for learning from the past, for example in terms of an appreciation of the tendency for new technologies to be slow to deliver hoped-for productivity gains, and for their introduction to produce wage stagnation for many workers and heightened income inequality. These are lessons that have considerable contemporary policy relevance and resonance.

Capacity issues. International bodies often implicitly assume that nation states possess the capacity to address the issues thrown up by digitalisation and to consult and coordinate with other actors and stakeholders and then take a lead in fashioning appropriate and effective cross-government policy responses. This is a large and potentially risky assumption. It is far from clear that all countries, even in the developed world are in a position to do this. In some developed countries, where social partnership bodies are absent or weak and thus the capacity for collective action is very limited, and where national government operates in a siloed, vertically-sliced way rather than holistically, the ability to fashion a coherent response to digitalisation may be limited. For example, as Sisson (2020) observes, the UK's lack of a government department that has a central focus on work and employment is a long-standing problem that makes coordinated policy responses on issues such as digitalisation, precarious work, or job quality extremely hard to engineer.

Across the developing world, many countries are still struggling to deliver basic educational services (World Bank, 2017), such as effective universal primary education, and for them the skill demands posed by digitalisation represent just another problem to add to a long list. To give two very different examples, in their report on national dialogues about the future of work, the ILO note that the governments of Brazil and Vietnam both reported that they were concerned at their ability to respond to challenges posed by technological change (ILO, 2017: 14).

Research suggests that a key barrier to progress is a lack of what is termed 'state capacity' (Soifer and vom Hau, 2008) to deliver policy effectively. This is dependent not only on resources and the competence of staff, but also on issues such as the culture of policy formation (for example, its inclusiveness and willingness to interact with social partners and stakeholders) and, as noted above, on the capacity of government to envisage policy formation in a manner that transcends individual policy silos.

More broadly, there are a wide range of historical, cultural, and institutional and structural capacity factors that will impel or impede the speed and coherence of policy responses. For example, if the collective organisation of employers is weak or absent, particularly at sectoral, sub-sectoral and occupational levels, then government's ability to gather meaningful intelligence on future skill needs and help concert collective action to address these is liable to be severely constrained. The result is that in many countries there are considerable gaps between the policy goals and outcomes that the state aspires to achieve and what actually gets delivered (Rothstein, 2011).

From universal prescription to national realities. As noted above, the global literature also faces problems with the translation of its often universalistic policy prescriptions into policy actions that can be designed and delivered within specific national, sub-national and sectoral environments and circumstances. The possibilities offered by the universal prescriptions are

in reality mediated at national level by a range of 'filters' comprised of pre-existing ideological, structural and regulatory choices that mean that the original global 'answer' then enters a nationally-specific decision tree of policy possibility and choice. Thus universalistic prescriptive models run up against national capacity issues (see above), ideological positions and norms, policy traditions, and resources within which are encoded the 'limits of the possible' in terms of potential moves and responses. For example, the digital challenges facing the UK and Germany are not fundamentally that different in nature, but the starting points and resultant policy choices and trajectories of the two nations are, at least at present, very different indeed. One of the key national differentiators is the relative power of different actors within the labour market and the distributional outcomes that this produces. It is to this that we now turn.

Digitalisation, labour market power and distributional outcomes

As noted above, the global literature underscores the potential for policy choices to deliver dystopian or much more appealing versions of the 4th Industrial Revolution/Work 4.0, wherein digitalisation delivers, "inclusive and sustainable economies with a human-centric approach at its core" (WEF, 2019: 5). As a result, one important dimension that frames debates about E&T and skills is its treatment of issues to do with labour market power and the potential for digitalisation, on its own and also in combination with other structural changes, to further exacerbate the trend towards growing inequality (Ernst, Merola and Samaani, 2018; Frey, 2019a & b; Global Commission on the Future of Work, 2019; Wallace-Stephens, 2019).

The key point to note in relation to the focus of this working paper is that there is an implicit (sometimes explicit) recognition that change engendered by digitalisation is liable to produce winners and losers (for example, between countries, regions and localities within countries, social classes, and occupations), and that skills will play an important role in determining how this plays out and how some of the worst effects might in part be mitigated (Frey, 2019a & b; Global Commission on the Future of Work, 2019; Wallace-Stephens, 2019; Bughin et al, 2019; WEF 2020a). As policy develops the distributional element is likely to prove increasingly important and it is an issue to which we will return in future working papers.

The Potential Impacts of Technology on Skills, Education and Training

Having explored some of the central issues and problems with the global literature on digitalisation and work, we now turn to look at how our policy research intends to analyse digitalisation's impacts on the shape and level of demand for skills and how education and training can respond to this.

An innovations systems approach

This work includes consideration of innovations system (IS) thinking to help frame the relationship between technological innovation and the scale and effectiveness of any educational responses thereunto (Vona and Consoli, 2014). An IS consists of the grouping of organisations, institutions and the connections between them that enable the diffusion of new technologies across the economy and labour market (Lundvall, 1992). It ranges from firms to financial institutions, regulatory agencies, R&D providers and educational institutions, all of which deliver resources to enable innovation to take place. The nature of the interactions between these organisations is in turn governed by rules and by sets of incentives that will motivate particular behaviours and responses.

The close inter-relationship between technologically driven labour market change and responses by the education system has long been noted (see Kerr et al, 1960). Plainly, if technological change induces demand for new skill requirements within the workforce – among both new entrants, but also among existing employees – then the nature of the response from education will be important, as skill shortages can materially impact on the scale, pace and productive deployment of technology. Some commentators have advanced the view (Goldin and Katz, 2008) that what emerges is a 'race' between education and technology, wherein education has to speed up in order to respond to resultant labour market change in a timely manner, and that therefore there is a danger of 'system failure', whereby education providers either do not respond swiftly enough or at a level of volume that meets emerging needs (Vona and Consoli, 2014). However, it can be argued that a simple application of this model is prone to technological determinism, as any technological advance can be used in different ways for different purposes and that therefore its effects on the labour market and the shape and volume of demand for particular skills can be much more varied and complex than the simple race analogy allows (Brown, Lauder and Cheung, 2020; Brown, 2021).

Furthermore, the adjustment process is liable to operate in both directions, as the supply of different levels and types of E&T will influence how skills are deployed and can help drive further technological adoption which in turn further increases demand, and, at the same time, the nature, structure and scale of demand for skills will have an influence on how education responds. In particular, the structure, volume and quality of skills supply available to firms will influence their 'absorptive capacity' in relation to successfully adopting and deploying new technology (Cohen and Levinthal, 1990; Grimshaw and Jones, 2016, Mason et al, 2019).

These effects will play out within national and international contexts in relation to specific sectoral and occupational labour markets and the E&T infrastructure that serves the needs of that sector or occupation. For example, within legal services a lack of adequate numbers of computer literate lawyers might drive particular approaches to the adoption of technology that relied on importing into firms computer scientists or by outsourcing the technological element to specialist support organisations. It might also lead to the adoption of different business models or staffing structures, whereby technology substitutes for legal 'person power' rather than augmenting or assisting its deployment. If, on the other hand, law schools are successful in producing large volumes of graduates with the desired mix of legal skills and technological awareness, then this might support the retention of more traditional business models and staffing structures. It is also the case that different law schools, depending on their place in the education, training and labour market supply hierarchy, and which segments of the legal labour market they service, will be faced with different choices about how they respond. For instance, the options facing a university the bulk of whose law students go into para-legal occupations, which are those most at immediate risk of replacement by AI and digitalisation, are very different to those confronting the University of Oxford's Law Faculty, whose students tend to go into employment in large, international law firms or become barristers and ultimately judges (Janacek, Williams and Keep, 2020).

The effectiveness and pattern of adaptive behaviours displayed by national innovation systems and E&T systems will vary considerably, and it is possible that approaches to dealing with the new skill demands being generated by digital technologies will be addressed in

different ways and with varying degrees of efficacy across countries. Firm size will also matter. Capacity – in terms of skills, expertise, money, management time, etc – is highly variable and large firms generally (though not always) have more of it to deploy than smaller and sometimes less profitable firms. Thus, what looks important and feasible to a large organisation may appear in a very different light to an SME, unless the SME is located in a country that has an IS that provides considerable support to smaller firms to enable technology adoption and associated workplace change, as is the case in Finland (Keep, 2016).

A framework for thinking about the impacts of technological change on skills
IS thinking provides a useful method for conceptualising the inter-linkages between skills supply and technological adoption and usage, and in turn on the impacts this has on. demand for skills. These impacts can occur in two ways, which overlap and interact with one another (see below):

- Direct and immediate influence on the type and volume of skills needed to undertake existing jobs/roles

- Influence in the longer-term upon the shape of jobs and career pathways, which will in turn impact on both the design of initial and continuing education and training

Furthermore, at any given time, the impact of digital innovation on skills can also be conceived of as occurring at three levels:

1. The creation of new skill needs and jobs directly related to the digital/sector(s) and digital technology. Examples include cyber security, social media managers, and blockchain developers (see Berger and Frey, 2016 for an international range of examples, Seet et al, 2018 for examples from Australia, and Bakhshi et al, 2017 for the UK picture).

2. The need for digital skills within jobs that are not themselves primarily focused on or located within digital industries. For a useful international overview of where we stand on this, see Martin (2017).

3. The broader impact of digital innovation on skills needed in all forms of employment. This reflects digitalisation's influence on the shape of work, the numbers employed in different occupations and sectors, and the ways in which digitisation may change how work is organised, for example by unbundling existing jobs and adding or subtracting new tasks and associated skill and knowledge requirements to existing forms of employment (AlphaBeta, 2017).

These differentiated temporal and occupational/sectoral effects provide a potential framework for conceptualising and analysing the way demand for skill is evolving and will in future change at a level of detail that would enable effective responses from the E&T system.

In terms of the more detailed state of play on the three different levels of digitalisation's impacts, the current story can be illustrated by the following examples:

The creation of new skill needs and jobs directly related to the digital/sector(s) and digital technology *(digital skills for ICT professionals – Ecorys, 2016).* In the UK context, various attempts have been made at forecasting the shape, nature and scale of the demand for these skills (see Shadbolt, 2016; Ecorys, 2016; Kispeter, 2018; Nania et al, 2019). Ecorys (2016) looked at higher level digital skill needs in big data, financial services, healthcare, the creative sector and logistics.

Importantly, the overall number of these jobs may be quite limited relative to total employment. In the US about four per cent of the workforce is employed in the development and production of computer hardware, software and applications, and between 2014 and 2024 the US Bureau of Labor Statistics forecasts an increase of 135,000 in software jobs, whereas over the same period there are expected to be 458,000 additional care assistant posts, and 348,000 home care aides (Turner, 2018: 29; see also Berger and Frey, 2016).

In the UK research by Nesta (Djumalieva and Sleeman, 2018) shows that we need to be cautious about assuming that all digital skills will be equally important in the future labour market. Their projections suggest that, paradoxically:

> "occupations that we are more certain will have poor prospects, are more likely to require a digital skill than are occupations that are most likely to grow by 2030. This is because the relationship between the digital intensity of an occupation and its potential for growth is not straightforward: there are occupations that are currently not digitally intensive, but are expected to grow in the next 10-15 years, as varied as teachers and chefs. The type of digital skills needed in a job also makes a difference: the digital skills most likely to be needed in growing occupations are ones that are used in non-routine tasks, problem-solving and the creation of digital outputs." (Djumalieva and Sleeman, 2018: 1)

The need for digital skills within jobs that are not themselves primarily focused on digital technologies or located within digital industries *(digital skills for the general workforce and basic digital literacy for citizens – Ecorys, 2016).* As Orlik puts it, "…ICT specialists are not the only workers who need digital skills. Whatever their role, people need to update their skills to deal with the wide-ranging transformations brought about by digitalisation" (2018a: 9). For example, in the UK, the legal sector has been trying to think through the employment and skills implications of structural change, of which digitalisation is but one element, see the Law Society's *Lawtech Adoption Research* report (2019).

More generally, many individuals and organisations have devoted significant energy to creating a range of different definitions of the digital skills or digital literacies that they believe adults (as workers, but also in many cases as citizens) will need in future. For an example of an attempt to create a global standard for digital literacy, see DQ Institute (2019), and for one of the more rigorously constructed national attempts (UK-focused) see Nesta (2018).

The problem with digital literacy or citizenship skills is that as Mark Brown notes (2017), digital skills and digital literacy are a 'messy construct' and many of the definitions and lists that have been created are weakly contextualised and extremely vaguely specified. For a helpful overview of what is available, see DQ Institute (2019) and also van Laar et al's (2017) review of 75 papers and articles on digital skills, which synthesises the identification of seven core

digital skills and five wider contextual factors or dimensions. One very useful approach to managing and shaping the process of definition is suggested by Orlick (2018b). He argues that in order to specify skill need with sufficient precision for this to be converted into E&T provision, it is important to take three steps:

1. Identify the group of people who will need the skills

2. Identify the context in which they will need to deploy these skills

3. Identify the period over which these skills will be relevant

The broader impact that digital innovation will have on the shape of work, how work is organised, the addition and/or subtraction of new tasks to existing forms of employment and how this will change skill need. Considerable effort has been invested in trying to forecast what broader skill sets workers will need in order to navigate their way through a more digitalised and changing world of work. For example, the Foundation for Young Australians (2017: 10) noted that the three transferable skills that had seen the largest increase in demand in internet job postings over the previous three years were: digital literacy (up 212 per cent), critical thinking (up 158 per cent) and creativity (up 65 per cent); while White (2018) also explored trends in employability skills demanded by Australian employers in internet job postings since 2014, and found that these were in:

1. communication skills

2. organisational skills

3. writing

4. planning

5. detail orientation

6. teamwork / collaboration

7. problem-solving

8. time management

9. research

10. computer/digital skills

    (in that order).

Other Australian research (Payton and Knight, 2018) indicates that the time spent by workers on physical and routine tasks each week has declined by two hours over the last 15 years, mainly as workers have switched to other tasks within the same job and machines have taken over repetitive routine work (AlphaBeta, 2017). The same study suggests that by 2030

Australian employees will spend an average of another two hours a week less on routine and manual tasks, and more time on creative and inter-personal tasks.

More generally, technology and shifting patterns of demand for goods and services are inter-acting across the economy to change occupational structures and work organisation and job design, and, as a result, impact upon and re-orient the structure and levels of demand for different kinds of skills and knowledge. For instance, data on the use of and wage returns to skills between 2002 and 2016 (Dickerson and Morris, 2019) indicates that the use of and rewards to possessing analytical and interpersonal skills increased over the period, while the need for and returns to physical skills declined.

This research mirrors the views of a range of contributors to Frey and Garlick (2019), who argue that while important, digital skills are by no means the end of the story when it comes to the broader E&T implications of changes to the world of work. Discussions are going on across the developed world about the need to embed within education a set of generic or employability skills, sometimes now also known as meta or 21st century skills (WEF, 2020).

The genesis of these debates long pre-dates the current phase of digitalisation, with national and international bodies constructing successive multiple iterations of lists and associated definitions of such skills since the early 1980s (see, for an overview of their development in the UK, Ravenscroft and Baker, 2019; and for an example of a much earlier version of meta skills, see Business-Higher Education Forum, 1999). On the whole, what can be said is that the detailed categories in these lists and the labels that have been used to describe them (employability, generic, life, transferable, essential, transversal, and now meta and 21st century skills) have changed, but the basic underlying shape of what is being talked about has remained broadly constant. This suggests that whatever motivates and drives the need for such skills, digitalisation plays only a partial and relatively recent role in this, and that wider changes in employment, the economy and society are also important in motivating thinking about the need for these transversal or generic skill sets. It is also the case that there are choices to be made about how and with what intent technologies are introduced, and these choices have very significant impacts on job quality and the shape and level of demand for skills. For example, technology can be deployed to augment human skills or to replace them.

Within these broader discourses, the lists of required skills and attributes vary at level of detail, but cover broadly similar items. One example is provided by Garlick (2019). He suggests that the skills needed to thrive in a more digitalised world and labour market will be: critical thinking and problem solving, creativity, communications, and collaboration. For other models and lists, see Fadel, 2008; Partnership for 21st Century Skills, 2008; Institute for the Future, 2011; Trilling and Fadel, 2012; Bialik et al, 2015; EPSC, 2016; Singlehurst et al, 2017; Ravenscroft and Baker, 2018; OECD, 2018; Glasbeek, 2018, CBI, 2019; WEF 2020b). These frameworks are generally presented as being trans-occupational in nature and they aim to specify a universally-applicable minimum platform of skills. However, there is a parallel literature which seeks to create the case for and contextualise these generic/meta skills within particular occupational needs, identities, cultures and settings. For examples in relation to law and legal education, see Smathers (2014), and Runyon and Carrel (2019).

In essence, the data currently available suggests that transferable, transversal 'soft skills' and an ability and willingness to learn, will be increasingly critical to supporting employability within

the labour market of the future, albeit that in low skilled service work and elementary occupations, these requirements may remain of limited importance (Glasbeek, 2018). At the same time, it has been argued that these types of skill and capabilities have a major role to play in supporting more active models of citizenship and a wider and deeper engagement in lifelong learning (Schleicher, 2018; Centenary Commission on Adult Education, 2019).

The issues surrounding 21st Century Skills brings us to an important point. The skills impacts of digitalisation are not simply creating new issues they are also revitalising or re-focusing many pre-existing debates within education.

The impact of technology on pre-existing debates within education policy

It is important to remember that in terms of the skill demands that are triggered by AI and technological change more broadly, one of the central responses is for these threatened changes to re-ignite or simply overlay long-standing debates about some of the core issues of education, such as those centring on:

1. The importance of basic skills (maths and native language – written and spoken)

2. The role of science, technology, engineering and maths (STEM) within the curriculum at various stages/levels of education, and the balance between STEM and other subjects and areas of skill and knowledge (OECD, 2018)

3. The importance of meta/generic/employability skills and the question of what over-arching skills, knowledge, capabilities, dispositions and attitudes the educated 21st century worker/citizen needs to be successful and to perform those duties that their employer and wider society require from them? Digital skills will be a relatively small, though potentially important part of the answer to this question.

4. The scale, nature and funding of lifelong learning provision (Aspen Institute, 2019; OECD, 2019; European Commission, 2019; Kapetaniou, 2020).

5. Inequalities in access to and outcomes from education. The pandemic has thrown into sharp relief the issue of 'digital poverty' and the inability of many students to shift to online learning and home schooling.

These fundamental issues go to the heart of many of the longer-term policy choices that will need to be addressed in response to digitalisation's effects on education, to be explored in the Digital Futures of Work research programme.

A Research Agenda

Given the framework previously laid out above:

Two types of impact:

1. Direct and current

2. Longer-term re-shaping of jobs and the labour market

Taking place at three levels:

a) Digital jobs and skills

b) Digital skills needed in jobs not primarily focused on or located within digital technologies and industries

c) Broader impacts on changing skill needs

There are also a very wide range of topics that could potentially form the focus for the next phase of our work. Three broad-ranging challenges and issues that could help lay the groundwork for future stages of activity, and which also focus on areas where the international debate seems keenest, are:

1. Policy responses to digitalisation and skills issues in a group of countries, with a strong focus on the resources, institutions and capabilities and capacity that are required to deliver those policies.

2. 21st century skills and models of the 'new worker', which in turn reflect a set of expectations and predictions about the future shape and nature of work, and the organisational and societal contexts within which it will be undertaken.

3. Thinking about how adult and lifelong learning will be required to change to accommodate new needs and circumstances.

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