Human Dynamics of Automation and Digitalisation of Economies: Discussion on the Challenges and Opportunities

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ABSTRACT

The current chapter addresses the automation and digitalisation of the economies by specifically focusing on their influences on humans – primarily employed workers. Initially, the chapter highlights trends in this regard by specifically referring to artificial intelligence, robotics, internet of things (IOT) and 3-D manufacturing. This is followed by a specific discussion on the people specific challenges - especially in relation to the job losses in Europe. We also use publicly available statistics to complement the arguments presented in this concern. After this, our chapter discusses the opportunities for humans emanating through these technological advancements. We highlight new work and entrepreneurial possibilities which are emerging as a result of these advancements. Finally, the chapter also refers to the new skillset need that will allow individuals to take advantage of these opportunities.

Keywords: Automation, Artificial Intelligence, Digitalisation, Europe, Human Dynamics and Internet of things (IOT).

This is an author's accepted manuscript version of the chapter published in " The Palgrave Handbook of Corporate Sustainability in the Digital Era" available online at https://link.springer.com/chapter/10.1007/978-3-030-42412-1_31

Kindly cite the chapter as: Arslan A., Ruman A., Naughton S., and Tarba S.Y. (2021). Human Dynamics of Automation and Digitalisation of Economies: Discussion on the Challenges and Opportunities. In: Park S.H., Gonzalez-Perez M.A., Floriani D.E. (eds) ***The Palgrave Handbook of Corporate Sustainability in the Digital Era.*** Palgrave Macmillan, Cham. pp. 613-629.

INTRODUCTION

Automation and digitalisation are the current manifestations of technological development trend which has historically offered both opportunities and challenges for the societies (e.g. Wajcman, 2017). Economic and sociological studies have addressed the influences of similar earlier changes in detail. These studies highlighted the changes in societies including employment dynamics due to developments such as industrial revolution, the Fordist manufacturing revolution and the rise of the internet (Matthews, 1996; Giovanetti *et al.,* 2003; Stearns, 2018). However, the current trend of automation-based change (including robotic and artificial intelligence), as well digitalisation has far reaching implications for societies including specific concerns for both blue and white-collar workers (Tegmark, 2017; Ustundag and Cevikcan, 2017). It has been argued that the Fordist revolution paved the way for the United States of America's industrial dominance for the major part of the 20th century and resulted in a significant rise in the standards of living for different categories of workers (Dean and Broomhill, 2018). During 1970s and 1980s, this aspect of industrial efficiency was dominated by Japanese firms that resulted in concepts like total quality management and continuous improvement gaining traction (e.g. Womack *et al.*, 1990). In recent years, the rise of emerging economies from Asia and Latin America have been linked to efficient labour management, low costs and increased investments by multinational firms (Chakraborty, 2018; Gunvald Nilsen and von Holdt, 2018).

Technological advancements such as the use of artificial intelligence and robotics, as well as digitalisation manifested through the internet of things (IOT) mean that many traditional industrial sectors face restructuring leading to new competitive dynamics. For example, IOT coupled with advancements in 3-D printing is influencing the traditional manufacturing sector significantly. Manufacturing sector was once difficult to enter due to the high costs associated with plant establishment, but these technological advancements are opening it to many new players (e.g. Petersen and Pearce, 2017; Heinis *et al.,* 2018). Such technological advancements raise a significant question with regards to their influences on human beings - especially in terms of jobs and work (Stearns, 2018; Frey, 2019). It should be noted that the previous industrial and technological revolutions not only improved efficiency, but also resulted in lifestyle improvement for most of blue and white-collar workers (Barlanstein, 2003; Allen, 2009). However, the current pace and multidimensional influences of automation and digitalisation are challenging the notion of improvement in wellbeing of the human workers that were historically associated with technological advancements. This key characteristic of automation and digitalisation in current times form the starting point and motivation of our chapter. We argue that a better understanding of the multifaceted nature of present-day automation and digitalisation is important in order to specifically address the challenges presented by it, as well as highlight the potential opportunities it presents. The contribution offered by the current chapter is twofold. Firstly, it is one of the very few studies that attempt to take a broader view of the complex phenomenon of automation and digitalisation with a focus on both challenges and opportunities for the people (humans), rather than a narrow organisational focus as is the case in many studies. Secondly, despite being conceptual in nature, the current chapter presents some important statistics that clearly highlight different dynamics of the situation in different European countries, thereby providing a basis for future studies to delve further and analyse issues arising within specific countries.

The current chapter aims to undertake this task by adopting a step-by-step approach. We firstly present an overview of the current trends in automation where issues such as robotics, artificial intelligence, 3-D printing and digitalisation aspects including IOT will be discussed. This is followed by a section dedicated to the discussion of influences for humans of this automation by specifically discussing challenges including job losses. Alongside presenting theoretical arguments incorporating multidisciplinary prior research, we also use relevant publicly available statistics to further highlight the different aspects of these challenges and opportunities. It should be further noted that in order to make the discussion specific we focus on European developed economies, as their industrial dynamics tend to differ significantly from North American and Southeast Asian developed industrial economies. Therefore, the statistics used in the current chapter represent mostly European economies with occasional references to other developed industrial economies. The next section takes a pragmatic look at automation and tries to highlight the opportunities for humans both in the form of new jobs associated with specific skills set requirements as well as entrepreneurial opportunities that are emerging from the current automation trend. The chapter concludes with the presentation of specific theoretical and policy implications.

CURRENT TRENDS IN AUTOMATION AND DIGITALISATION OF ECONOMIES

The automation of economies is manifested by the increased visibility of artificial intelligence (including robotics), digitalisation and internet of things which has specifically been linked to the rise of 3-D printing (Lipson and Kurman, 2013; Schwab, 2017; Frey, 2019). Artificial intelligence has been mentioned as a key driving force behind automation by many scholars (Perez and Falotico, 2019). Alongside industrial processes, artificial intelligence is increasingly becoming visible in home-based electronic devices (smart devices) illustrating an increase in the level of trust placed in them over the years (e.g. Abbass, 2019). Beyond this, the notion of self-driving (automated) vehicles is becoming a reality, with some arguments augmented by the notion of improved road safety standards and a reduction in the number of fatalities caused by human error (Vella, 2017). Self-driving vehicles are now visible on the roads of different European countries (Marletto, 2019), and there is an ongoing debate regarding their regulation on the issues of risk and responsibility (Liu *et al.,* 2019). It should be noted that the increase in self-driving vehicles will not only impact transportation and logistics industries, but it will also influence the way associated industries operate such as finance and insurance (Lohman, 2016; Clements and Kockleman, 2017). Artificial intelligence usage is becoming more visible in the service sector as well, illustrated by the adaptation of artificial intelligence backed decision making in the banking, insurance, healthcare and media sectors (Lipton *et al.,* 2016; Gentzkow, 2018 Riikkinen *et al.,* 2018; Eisen, 2019). Specific statistics about automation in all these industries and services are not readily available due to these being a new and ongoing trend. There are, however some recent studies and policy reports that focus on different European countries, where references to automation and the use of artificial intelligence in some of these sectors have been made (Dolvik and Steen, 2018; Frontier Economics, 2018; Jin, 2019). We build on these prior works and present a specific discussion focused on the European context as below.

We start by presenting some statistics on global industrial robot stock and usage. According to IFR (2019), annual installation of industrial robots is increasing by approximately 10% with additional ca. 400,000 robots being installed every year during last decade. This number is expected to increase to ca. 500,000 robots being installed annual during 2020-2020 (IFR, 2019). These statistics highlight that the replacement of human workers will take place across a range of global economic sectors, and more specifically in the manufacturing sector.

In this specific context, it is also important to refer to statistics about robot density per 10000 employees (industrial workers) in the key European industrial economies, as well as an average at EU level. The statistics show that Germany leads the way in usage of industrial robots per 10000 employees followed by Sweden, Denmark and Italy. In case of Germany, there are currently over 300 robots per 10000 industrial workers (IFR, 2019). This number is closely followed by Sweden at approximately 250 robots per 10,000 employees (IFR, 2019). The current average in EU is approximately 100 robots per 10,000 industrial workers (IFR, 2019). An interesting observation in this concern relates to France, a heavily industrialised economy where industrial usage of robots in the manufacturing sector is slightly less compared to Germany and some other European economies (IFR, 2019). This can be partially explained by referring to peculiarities in the French industrial context, regulations and the role of unions (Arntz *et al.,* 2016; Courtioux and Erhel, 2019). As the artificial intelligence technology develops making robots more effective and efficient, it is logical to expected that human (employees) to robot ratio will increase further in all EU countries in the future.

Following this discussion on artificial intelligence and robotics, we move our focus towards the digitalisation. Digitalisation has influenced international markets and workforces in both positive and negative ways. Competition usually brings with it not only an increase in consumer choice, but lower prices (Pekgun *et al.,* 2017). The advancement of the internet has ensured sales now take place internationally without the need for the development of complex distribution networks, thus the realistic markets that suppliers can work within have expanded without the subsequent need for investment to buy into the said markets. The logical conclusion here being that the benefits to the consumer are significant, improving standards of living and ways of life. Yet, as identified by Brennen and Kriess (2014), “digitalisation serves both as an organising mode across social domains and as a destabilising force”.

There is research evidence to suggest that a significant number of people believe that digitalisation brings benefit to business. However, at the same time, less than 50% believe digitalisation also results in new business models (Siemens, 2019), which can potentially have significant influences of humans in the labour market. Such a point, if it is an accurate prediction, carries with it the expectation that the future will simply be a continuation of the past – with the difference being the movement of the industrial and financial power bases to different continents. However, such assumptions fail to acknowledge the significant impact digitalisation brings with it. Principally, digitalisation requires a deeper understanding of methods of analysis and integration within the organisations for it to be operationally viable. Furthermore, it needs to be grounded and controlled relative to presently available data and shown to be of economic value before it is more widely used (Siemens, 2019). The assumption that digitalisation in itself is the answer is therefore an over simplistic view to take. It is clearly a management and operational tool, yet as with all such tools, needs to be considered in line with financial and other practical considerations. Alongside such considerations run the concerns associated with ethics regarding its usage and encroachment on an individual’s privacy. Subsequently, some European researchers argue for the development of a set of specific ethical guidelines to ensure negative issues do not arise, so as to build trust in the technology (Sciencebusiness.net, 2019).

Digitalisation is increasingly being manifested by IOT and 3-D printing. IOT comprises of any electronic and electrical equipment that connects to the internet, and ranges from cell phones to home electronics to oil rigs (Forbes, 2014). It should be noted that IOT is closely related to the earlier discussion on robotics and artificial intelligence. IOT can be considered as a series of disruptive digital technologies, influencing the daily life of both individuals and businesses (Del Giudice, 2016, Santoro *et al.,* 2018). IOT enables firms to become more intelligent in developing, adopting and adapting disruptive technologies in their business processes, in order to increase their efficiency and innovativeness through knowledge flows and data/information gathering (Del Giudice, 2016). IOT usage has increased dramatically since 2010 and is expected to continue increasing in the future with number of connected devices reaching approximately 50 Billion by the end of 2020 (NCTA, 2015). The resulting interconnectedness between the increasing number of IOT devices offers significant opportunities to many smart firms and entrepreneurs; but carries with it the risks of many firms losing out and individuals losing their jobs (Solima *et al.*, 2016).

Increased digitalisation manifested by IOT and other advancements has resulted in firms adapting new and disruptive strategies which have the potential to change the overall landscape of economies as we know them. Tesla for example, have removed all worldwide electric vehicle patents so as to help grow the market and make their technology the industry standard (Tesla, 2019). Such a radical step could never have been envisaged from Ford or Toyota in the past. Similarly, Ingersoll-Rand has developed a monitoring system for its air conditioning units to remotely balance light and heat level needs in line with energy reduction goals (Trane, 2019). Whilst such a system may align (to some extent) with home based smart systems, new business concepts such as Philips' Pay-per-lux, sold to various organisations including airports, ensure clients only pay of the light used rather than the fixtures and fittings (Luxreview, 2019). Hence, the digitalisation process can be argued to change the very nature of business models in many sectors. However, if business models such as these are more widely adopted, it is not so much the manufacturing processes that hold value – it is the development of the technologies, forms of delivery and changes in ownership that will hold the key to market control.

Along with IOT, 3-D printing is an aspect of digitalisation which is also increasing rapidly at a global level. 3-D printing technology has been around since 1984, but its popularity grew at the turn of the millennium when the cost of printers dropped and manufacturing possibilities increased rapidly (Bogue, 2013). 3-D printers are increasingly being utilised in a range of industries, from basic to complex manufacturing, thereby, resulting in new competitive dynamics for traditional manufacturing firms. An interesting example in this concern if of GE (General Electric) which now utilises 3D printing for part manufacture of its Leap Engine such that multiple parts are produced that are five times stronger than in the past from one print run (Fortune, 2019).

The popularity of 3-D printing is increasing globally. According to Grand View Research (2019), global 3-D printing market is rapidly increasingly and currently the biggest market is in North America (40%) followed by EU (28%). Moreover, 3-D print spending in Europe is increasing and expected to reach 7 Billion US Dollars annually by 2022 (IDC, 2019). Hence, use of 3-D printing in

European countries will be visible increasingly in all industries resulting in several challenges for the humans (both workers and entrepreneurs). It is from this point that we begin to discuss the challenges of automation and digitalisation in the next section

CHALLENGES OF AUTOMATION AND DIGITALISATION

Automation was once a state-of-the-art process developed under Fordist principles and it offered substantial benefits to modern organisations (Hurley, 2019). Automation under Fordist principles initially increased the employment levels. However, the ongoing developments surrounding automation and digitalisation depict a decrease in employment throughout industrial economies globally (Pierce *et al.*, 2018). It should be noted that there have been earlier instances in history representing similar significant changes. However, the relationship between humans and machines has never been as complex as it is now. In earlier technological advancements such as the steam engine and electrification, machines predominantly replaced physical effort and complemented the human work (Landes, 2003) As technologies advanced further and the second machine age dawned, machines are doing direct physical work, as well as undertaking cognitive tasks using artificial intelligence. Hence, there is an increased discussion surrounding the disappearance of many jobs from society due to this automation. The jobs at the highest risk from automation are characterised by routine tasks and repetition, which can easily be automated and digitalised (e.g. Puoliakas, 2018). Some practical examples in this concern are non-executive office occupations (routine information occupations) and industrial assembly occupations (routine manual occupations) which are slowly disappearing. This may have been considered a risk for those operating at the top of the pyramid as upcoming competitors have less to lose through automation (from the basis of their starting point – it can only improve matters if starting at the bottom of the pyramid). The Fordist process experienced by organisations and countries largely brought about benefits, infrastructural improvements, investments and employment. The Fordist process took a considerable time to reach its full potential. However, the very nature of current automation and digitalisation in and of itself has speeded up the development process to such an extent that what might have taken decades to achieve eighty years ago, may now be completed in a few years.

A new automated manufacturing plant can be set up virtually anywhere in a relatively short period of time and the newcomers can compete immediately with those already in the market. Their relative position has been improved by the requirement of a personal approach, flexibility, problem-solving ability or creativity associated with the work (which is more difficult to digitalise). During the second machine age, rather than only operating based on pre-programmed inference rules, machines themselves are learning to use neural networks and large datasets (Harteis, 2018). This has added to the possibilities of utilising automation in many new applications associated with such fields as translating languages, pattern recognition, diagnosing illnesses and self-driving modes of transport. These new application areas may mean that the impacts on employment will also touch many information processing and cognitive occupations as well, which were deemed relatively safe some years earlier. In recent years, there is a significant decrease in the number of middle-wage workers across the European Union (EU) member states (Harteis, 2018). This is driven by industrial and technological changes and has significant social implications as reduction in middle class population is going to influence their purchasing power with spill over effect for many other businesses as well (Salvatori and Manfredi, 2019).

According to Puoliakas (2018), almost 15% of EU workers are in sectors that are at a high risk of automation (70% or more job losses), and 40% are in sectors that are going through significant automation related transformation (50%-70% job losses). Hence, no industrial sector is safe from these changes, and even in the little change category, the expected percentage is higher than 10% (Puoliakas, 2018). In this context, it has been established that routine tasks are at the highest risk of job losses due to automation followed by autonomous tasks and customer service tasks (Puoliakas, 2018; Salvatori and Manfredi, 2019). The tasks facing the least risk of automation in Europe are the ones that require 4C skills i.e. communication, creativity, critical-thinking and collaboration (Puoliakas, 2018). This is an important aspect which we also highlight in later section while addressing new skills development in people in order to deal amicably with the challenges of automation and digitalisation.

It should further be pointed out that the rise of automation and digitalisation not only represents a bleak picture fraught with risks and challenges, but opportunities as well. In this context, researchers analysing similar topics have found that the economic influences of these technological advancements have been milder than originally anticipated in many cases (e.g. Itkonen, 2017). Moreover, these technological advancements have created new business models (e.g. Neumier *et al*, 2017), which offer a number of new job and entrepreneurial opportunities for people. We offer a specific discussion on these opportunities in the European context in the next section.

AUTOMATION, DIGITALISATION AND THE NEW OPPORTUNTIES

In recent years, several researchers have focused on the changing nature of employment due to digitalisation and automation. It has been argued by them that in certain sectors, the concept of what constitutes “work” needs to be rethought (e.g. Dufya *et al.*, 2017; Antila *et al.*, 2018). It is evident from earlier discussion in this chapter that routine and low-skilled jobs are at the highest risk of disappearing due to automation. It should also be noted that even though some other tasks may not disappear, parts of them may become automated (e.g. Koski, 2018; Salvatori and Manfredi, 2019). It has further been argued that automation and digitalisation will create new tasks and occupations that will take time to be understood by potential employees due to the new skill sets required (Linturi and Kuusi 2018). There will be an increase in highly skilled and knowledge-based jobs, and even routine jobs may require a certain level of IT skills (Susskind and Susskind, 2018). In sectors like elderly care, logistics and construction, the interaction between workers and automated machines (including robots) is slowly becoming visible (Koski, 2018; Chen et al., 2018). Moreover, this automation and digitalisation is expected to lead to what has been referred to as a "task-based mode of economy" (Acemoglu and Autor, 2011; Nedkolska and Quintini, 2018). In such economic model, the demand for workers to undertake cognitive tasks will be higher (Harteis, 2018; Koski, 2018; Paus, 2018).

Researchers have also predicted that the changes initiated by automation and digitalisation will increase the need for the retraining and development of relevant skills (Harteis, 2018; Paus, 2018). They are also likely to introduce new forms of jobs in the service sector (Acemoglu and Restrepo, 2018; Susskind and Susskind, 2018). There are expectations that independent and platform-based job opportunities will increase, thus, certain levels of new IT skills will be needed. This development is already present in Europe, alongside an increase in online jobs (relative to location-based jobs) – a trend that is anticipated to continue to increase as identified through data published by the ESDE (Employment and Social Development) index in the EU. It has been estimated that in professional services, creative tasks, translation, software development, sales and clerical tasks, already more than 30% work is online now (ESDE, 2018). On the other hand, this percentage is still very limited in transportation and ancillary services (ESDE, 2018). However, for transportation services, increasing number of autonomous (self-driving vehicles) offer a challenge, which is expected to grow in future as well (Coppola and Esztergar-Kiss, 2019). At the same time, there are new opportunities associated with this specific technological development, which can be tapped in by target policy initiatives (Coppola and Esztergar-Kiss, 2019).

In terms of the level of preparedness of European countries in terms of dealing with this change in employment dynamics, a useful indicator is digital economy and society index (DESI) developed by European Commission (DESI, 2019). This index shows that Nordic and Western European countries are better prepared to deal with the changing work environment relative to other counterpart nations as depicted by their high DESI scores (DESI, 2019). It is also important to mention that despite this digital connectedness, in a recent world economic forum (WEF) future of jobs survey, it was found that the need in days for reskilling in Western Europe is approximately 3 months (WEF, 2018). This retraining needs to inculcate specific skills in vulnerable people (workers) which have been highlighted by Puoliakas (2018:7). These skills include technical skills especially linked to the use of connected devices, problem solving skills, continuous and on-job learning skills, team working skills, planning and organisational skills, foreign languages and communication skills and multifaceted customer handling skills.

Along with the new job opportunities and relevant skills development needs discussed so far, automation and digitalisation also offer many entrepreneurial possibilities that can be utilised by individuals possessing the needed skill sets. In this context, it is important to mention the important role of open innovation and platforms for this new entrepreneurship. A key aspect of open innovation is openness because established firms including multinationals are receptive to ideas and technologies sourced from elsewhere (e.g. Bogers *et al.*, 2017). Prior researchers have found this openness, which was not there in past due to the strategies of undertaking in-house R&D, has helped many new bIoTechnology ventures to benefit from collaboration with large pharmaceutical firms (Nambisan *et al.*, 2018). In a recent paper, Mittal *et al.* (2019) highlight that 3-D printers can significantly help the entrepreneurial firms (small and medium sized) to gain a foothold in previously out of bound (due to high entry costs) high end manufacturing sector.

Alongside open innovation, another aspect of this technological change is rise of the digital platforms. These platforms not only enable entrepreneurship, but also deal with a fundamental barrier of risk – a key concern in the minds of many entrepreneurs (Kenney and Zusman, 2016). Platforms such as Alibaba, eBay, and Amazon Marketplace have played a major role in redefining the nature and extent of market risk for small businesses by broadening market access (Nambisan *et al.*, 2018). Similarly, cloud computing platforms and associated digital infrastructures help to enhance the overall agility of small businesses and enable them to up-scale their new ventures without assuming greater levels of investment risk (Moeuf *et al.*, 2018).

Along with these above-mentioned aspects, certain digital platforms (especially Apple's App Store and Google Play Store) have created entirely new markets for digital entrepreneurial activities (Kenney and Zysman, 2016; Nambisan *et al.*, 2018). These platforms have radically altered economic aspects associated with starting a business, as well reduced barriers and market risk (Zysman and Kenney, 2018). It has also been argued that open innovation and digital platforms have enabled entrepreneurs to share their risk with several other actors. Financing has been an aspect, where many potential entrepreneurs have historically struggled (e.g. Burns and Dewhurst, 1996; Herciu, 2017). However, platforms such as Kickstarter offer new sources of start-up finance, and they have helped to significantly expand entrepreneurial activity outside capital rich environments (e.g. Herciu, 2017). Moreover, platforms such as CrowdSpring and others allow entrepreneurs to engage in a global pool of product designers, while platforms like Mobilework and Amazon Mechanical Turk provide access to low-cost, less-skilled workers (Lehdonvirta, 2018). It has therefore been argued that crowd-based platforms make it easy to take control of routinised functions in entrepreneurial start-ups, leading to reduced costs and start up time (e.g. Caspin-Wagner *et al.*, 2018). Like the new job opportunities discussed earlier; these new entrepreneurial opportunities resulting from automation and digitalisation also require specific skills as well as their continuous development. These skills have similarities with the ones mentioned earlier for job hunt in the new automated and digitalised economy, as well as some entrepreneurship specific skills. A key aspect in this concern has been identified in prior research as "dual-skills", where entrepreneurial mindset is complemented with communication and technological awareness skills (e.g. van Welsum and Lanvin, 2012; van Welsum, 2016). It has been argued that such skills are highly needed for the entrepreneurs in digital age to "pitch" their business case (van Welsum, 2016) so that that they can take advantage of the above-mentioned new entrepreneurial opportunities. Hence, such skills development should be the focus of policymakers in European countries; an issue that we more specifically discuss in the next section.

IMPLICATIONS, LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The purpose of the current chapter was to offer an overview of automation and digitalisation specifically in the context of European countries, highlight the challenges associated therein, and discuss the emerging opportunities. As the chapter has focused on a relatively less-researched and an emerging topic, it offers both theoretical and policy implications. A key theoretical implication of the chapter relates to the urgent need for management scholars to develop applicable theoretical frameworks with which to address these complex issues. Despite an increasing amount of research being completed on these topics, we found out that there is a rather lack of specific theoretical frameworks or conceptual models to address issues such as job loss dynamics, new work, entrepreneurial possibilities, continuous training and skills development need for employees, and strategies of firms (both large and small) in an increasingly automated and digitalised economy. Given the fact that automation and digitalisation are multifaceted topics with multidisciplinary roots, we believe that they offer fertile ground for specific theory development based upon established organisational, sociology and behavioural sciences theories. Such theory development work will enrich extant literature and guide future research in a more structured way in all domains of social sciences including management and organisation studies.

The policy implications of the current chapter are associated with initiatives that can be undertaken to address the myriad of challenges as well as fruitful opportunities offered by automation and digitalisation for European economies. Firstly, each country according to its specific situation should have policy initiatives in place to identify vulnerable people who have lost or can lose their work (jobs and businesses) due to these changes. Retraining these individuals as well as linking social benefits to retraining and skills acquisition is important to avoid their alienation and problems of economic polarisation in society. As the role of automated and digital technologies will increase in all occupations in future, training programmes should incorporate technological and interaction skills for the people operating at all levels in different industries and sectors. This educational push should incorporate the earlier discussed elements identified by Puolikas (2018), as well as the ones referred in current chapter and should be visible at all levels from basic to higher and vocational education. Another important aspect highlighted in the chapter relates to digital entrepreneurship and platform working opportunities in the changed environment. In order to fully utilise these opportunities, training and skill acquisition programmes should focus on specific areas rather than being general, as is the case currently in many countries. Moreover, there is a significant variance in European economies in relation to digital preparedness. The more competent ones like Nordics and Western European economies can embark on policy knowledge sharing programmes with other countries that are finding it difficult to cope with these issues.

A big risk for the future is linked to certain automated and digitalised businesses becoming monopolies and abusing their dominant powers. This coupled with these large automated technological giants not offering employment opportunities to a reasonable number of people, as well as pushing other competitor firms out of business, leads to more unemployment. This risk is difficult to tackle for individual EU member states due to the significant economic power of these technological giants. However, EU-wide regulative initiatives can be very helpful in tackling and regulating these power technological firms, as the recent cases involving Apple and Google may suggest (e.g. Moore and Tambini, 2018). Moreover, labour mobility should also be supported to move workers to tasks that better match their retrained skills. Hence, specific regulations in this context as well as incentivising firms should also be the focus of policy makers.

The current model in most European countries has elements of welfare within it, which becomes very visible in the cases of Nordic and other Western European countries. This welfare regime was developed in the post-world war two time period around the wage-tax relationship (Pierson and Castles, 2006; Taylor-Gooby *et al.*, 2018). Due to the changes in employment patterns presented above, including the rise of freelancing and platform work, it is reasonable to expect significant disruptions to that model. Hence policy makers in different European economies need to align social insurance and labour market regulations to minimise the influences of this disruption. Rather than initiatives such as universal basic income, whose effectiveness has been debated by academics, especially in the current form (e.g. Fouksman and Klein, 2018), specific policy initiatives targeted at public support for mobility and the retraining of vulnerable people may possibly be more beneficial. In this concern, automated and digitalisation specific taxation, sometimes referred as taxing the robots has also been suggested by some scholars (e.g. Oberson, 2017; Abbott and Bogenschneider, 2018) Also, as most European countries are EU-member states, the role of the EU needs to be very visible in terms of ensuring such initiatives succeed in the coming years.

Our chapter has several limitations as well. Firstly, it is a conceptual piece of work supplemented by statistics based on publicly available data. As we have not undertaken primary research, specific insights in terms of the dynamics of challenges, as well as the work and entrepreneurial opportunities present in different European countries are missing from the discussion. However, we believe that our chapter builds a suitable basis for future studies to delve into different aspects of these challenges and opportunities in different European countries more specifically. Moreover, future studies can also perform specific analyses of policy initiatives in different EU member states and see if those initiatives match the training and skill development needs associated with a more automated and digitalised economy. Finally, linking and analysing the roles of automation and digitalisation with the larger debate on sustainability is very important, and specific case studies with benchmark best practices from different countries (both European and non-European) can be developed by the future studies.

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