



## ● WHAT COMES AFTER?

BEYOND4.0 supports an inclusive European future via examining the impact of Industrie4.0 and the Digital disruption on the future of jobs, business models and welfare.

# POLICY BRIEF #2

## The human side of Industrie 4.0

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**BEYOND4.0** supports the delivery of an inclusive future of decent work and decent lives for EU citizens. In the context of the Covid-19 crisis, this Policy Briefing focuses on the impacts of the digitalisation of production, commonly known as Industrie 4.0, on work and welfare. It outlines the opportunities and challenges, highlights past and emerging research findings, summarises current policy thinking and makes recommendations for future evidence-based policy development:

- Choices exist in how digital technology is used by firms. Roles exist for government and other social partners in shaping those choices across sectors, regions and countries.
- Monitoring employer demand for skills and the use of skills in work will help identify new jobs and tasks as they emerge and develop.
- Monitoring the impact on broader aspects of work additional to skills – such as pay, employment security and wellbeing – will help identify job quality trends.
- To generate benefits for all, what those benefits are and how they are to be realised requires understanding of the business models of companies and how value is created, captured and then used and distributed.
- There needs to be a focus on the business models of firms regardless of sector. Business models are required that are mission focused to ensure wider benefit from the digitalisation of production.
- There is a need for governments to rethink the design of welfare in the digital age so that it can shape not just respond to work.

## Background to Policy Brief #2

Funded by the Horizon 2020 programme, BEYOND4.0 examines the impact of new digital technologies on the future of jobs, business models and welfare in the European Union (EU).

Its aim is to support the delivery of an inclusive European future that provides decent work and decent lives for EU citizens.

Two particular developments are salient to policymakers: Industrie 4.0 and the platform economy. The first represents the digitalisation of production, epitomised by Industrie 4.0. The second involves the digitalisation of work, sometimes referred to as ‘Uberisation’. Both are examined by BEYOND4.0 and both offer opportunities and challenges.

This Policy Brief focuses on the first development – Industrie 4.0 in the context of the 4th Industrial Revolution. It highlights some of the findings from past and emerging research. It then outlines current policy thinking about the opportunities and challenges before making recommendations for further evidence-based policy development.

## Industrie 4.0: the Opportunities and Challenges

Any technological revolution disrupts the economy and society but is capable of providing long-term development benefits. Popularised by Charles Schwab via the World Economic Forum, the term ‘4th Industrial Revolution’ is used as shorthand to describe the new digital technology. Because this technology is general purpose, it can transform all aspects of our lives: the way we buy, sell, network, communicate, participate, create, consume and, of course, the way we work.

First used as a term in Germany in 2011, Industrie 4.0 has become emblematic of the 4th Industrial Revolution. Its digitisation of production involves a ‘cyber-physical system’ of machines and humans. This new socio-technical system was first conceived for the manufacturing sector but is applied increasingly to services and has gone global in terms of policy and academic interest. Although there are definitional problems, Industrie 4.0 involves Artificial Intelligence (AI) and advanced automation combined with the emergence of big data, the internet of things and ever-increasing computer power.

In assessing the impact these technologies have on organisation and employment, two main views dominate. On the one hand, the optimists see technology supporting new organisational forms with increased flexibility, reduced production time and enhanced productivity and growth. Organisations are transformed into smart producers of goods and services. With massively enhanced computer processing power, information and systems are integrated across the whole value chain including suppliers, distributors, contractors and customers. Customers can suggest bespoke products, which can be produced quickly. Processes are monitored and controlled and configured as product and production needs arise, with workers using augmented reality and intelligent tools. Furthermore, the vast quantities of data from these systems, activities and networks are collated and analysed for further commercial exploitation.

Moreover, combined with the emergence of big data, the internet of things and ever-increasing computer power, robotisation is ‘clever’. These robots do not just work continuously as they did in the past. Now, they are able to learn, machine from machine, and so adapt to be more efficient at these tasks. These technologies both enable production to become autonomous and offer

opportunity to integrate the conception, production and consumption of goods and services. Digitalisation thus makes production of goods and services more efficient.

On the other hand, the technology pessimists worry that there will be massive job losses with increased social exclusion, and reduced job quality for remaining workers. The clever robots can undertake both physical (manual) tasks and, increasingly, cognitive (mental) tasks. In doing so, they can substitute human labour. The outcome is the end of (paid) work and mass redundancies. Triggered by the influential report by Carl Frey and Michael Osborne which claimed that up to 47% of jobs in the US were at risk of eradication, a raft of publications quickly followed. Although citing different numbers, all contained the same message: significant job losses will occur – what has been called ‘robo-geddon’. Existing concerns that the distribution of value generated by firms is draining away from workers and being consolidated in the hands of management and shareholders are compounded by this fear of technology-driven mass unemployment. If wages are a key distributor of wealth from production, with fewer people in work, even if more wealth is created from the new technologies, less of it will be spread around, creating exclusion, poverty and even political unrest.

Even if paid work remains, there are other challenges. The new production system could lead to polarised workplaces with a small number of high-skilled workers designing, introducing and maintaining the digital technologies, and low-skilled other workers either being left with only monotonous tasks for which technological substitution would be too expensive or sidelined into machine-minding, simply overseeing machines that do the work. The digital illiteracy that exists amongst some types of workers and regions within the EU could become entrenched. There are also concerns that the new technologies will create new psychological strains as humans are subordinated to intense machine surveillance that intrusively monitors workers’ behaviour and impersonally measures and evaluates their performance, sometimes in discriminatory ways.

To try to get the balance right between the opportunities and challenges, the German Federal Ministry of Labour and Social Affairs argues that policy has to avert a techno-centric future in which machines make the decisions without human consideration. Instead the future has to be human-centric in which people make decisions for people.

## Current Policy Thinking

Despite this call for a human-centric approach to the 4th Industrial Revolution, much current policy thinking is based on the new technology determining the future, assuming that the predictions will simply translate into socio-economic reality. Policy is then shaped to that assumed reality. In this respect, two main policy positions can be identified, one a feature of mainstream politics, the other of more radical politics.

The first policy position, evident in mainstream politics, recognises and worries about mass unemployment. It offers two approaches to policy: one more conservative, the other more ground-breaking.

The more conservative response rests on workers needing help to adjust to the new circumstances. The solution offered is to develop policies that, firstly, will ensure the employability of workers in what will become a highly competitive labour market and, secondly, help regions adjust by creating jobs that are less at risk of technological substitution. A number of policy prescriptions follow. Active labour market policies to support workers displaced by digital technology to find new jobs. Social protection such as income support and re-employment assistance. Enhanced skill policies to focus on both digital literacy and soft skills such as problem-solving. Schools and university curricula needing

to focus more on STEM subjects, human interaction and employability. Lifelong learning opportunities to update workers' skills over their working lives. Big Data could be used to monitor skills demands and changing occupational compositions to enable better careers advice and guidance. To aid regional development, entrepreneurship skills to help create new jobs in sunrise industries. The call for Industrie 4.0 itself typically suggests a vertical policy for support traditional manufacturing industries to enable digital changeover.

The more ground-breaking response argues that if growing poverty and social inequalities are to be avoided, welfare will need to be more drastically redesigned. It will mean entitlement aligning within individual needs rather than jobs or unemployment. Residual work could be distributed across the workforce, with workers again supported by digital, soft skills and other types of training. For periods between work, welfare support will again be needed as a safety net. However this welfare would be based on explicit redistribution policies, delivering a guaranteed minimum income level financed through robot (including algorithm) taxes. In addition, a minimum level of employment protection would be introduced for all workers. Going further, some argue that Industrie 4.0 requires a new social contract with improved worker consultation and participation. Such arguments resonate with calls for new minimum standards of job quality and which might even extend along global value chains. New cooperative ownership models or sustainable ownership models might also be encouraged to give workers a voice in business development, a fairer share of the gains and provide location-specific benefits.

To varying extents, what is being suggested in this first position are versions of flexicurity for the digital age. Safety nets for workers between jobs are to be created and transitions for workers to new jobs are to be enabled. These jobs should be decent jobs. The underlying principle is that workers, welfare and regions need to accept and adjust to the changes that are coming. The hope is that fear of digitalisation would be eradicated and public support for the impending changes secured.

The second, more radical position rests on a post-work scenario. Proponents of this position do not see the point of safety nets and transitions. They do not seek to adjust work and tinker with welfare but instead want to realise the full potential of the new digital technology to eradicate not redistribute work. They advocate the end of all paid work and see a new welfare society replacing capitalist society. Claiming that paid work is exploitative and dehumanising, they call for full unemployment to be adopted as policy. Humans would be liberated as a consequence. The robots would create value still; indeed they are needed to maximize the productive capacity of digital technology. The wealth created would then be redistributed to all through a universal basic income (UBI). This UBI would go beyond the provision of minimum needs intended to sustain workers between jobs and support them into new jobs. Instead, it would provide for all life's needs. In doing so, it would provide social stability and support outside the wage system and also end the inequalities that are structural features of capitalism. Freed from paid work, humans could then relearn how to be human.

The crux of this second position is that work in the future should be done by the clever robots. Policy should focus less on delivering decent jobs but instead on providing decent lives underpinned by a revolution in welfare provision. Whilst unashamedly utopian, this policy position highlights the ultimate possibilities of digitalised production and infuses more radical politics.

## What Does the Evidence Say?

The problem for current policy thinking is a current lack of evidence. The predictions of impending mass unemployment tend to be drawn from econometric modelling. The different figures for the extent of mass unemployment reflect the use of different models, and which tend to be over-confident in the abilities of digitalisation. Moreover, much of the modelling focuses on jobs lost, not jobs created or the changes that happen to jobs. Indeed predictions tend to be static, lacking appreciation of the dynamism of transformations.

The challenge is that, even in Germany, very few firms currently operate the full version of Industrie 4.0. Evidence of its outcomes are therefore difficult to identify and evaluate. However, other sources of evidence can help fill the gaps.

The first source comes from a recent survey of firms in the UK introducing AI with automation for both cognitive and physical tasks within the last five years. The survey reveals that as many firms (around two-fifths) had added jobs as had shed jobs, and that the new jobs tended to be higher skilled, and the jobs lost lower skilled. Moreover, some aspects of job quality had improved. One-third of firms reported that jobs had become more complex and over half reported that jobs required more skills and knowledge. Two-fifths reported pay increases. In only one-fifth of firms had jobs become more insecure – in fact two-fifths of firms reported jobs becoming more secure.

The second and much overlooked source is historical evidence. Similar claims of mass job loss, called ‘de-employment’, and the need for lifelong learning for the small number of residual jobs and what would now be regarded as the radical version of UBI were made for the 3rd Industrial Revolution driven by the introduction of micro-electronic technology in the mid-twentieth century. However since its introduction, levels of employment generally have risen in Europe. In many Member States, prior to the Coronavirus, there were record numbers of people in employment. In some European counties, there has also been an upgrading of job quality.

There are multi-level explanations as to why job outcomes are unpredictable. The first level is that of the job. Not all tasks, physical or cognitive, can be automated, even with AI and machine learning. Some jobs are simply too complex or variable to be substituted by technology and are better done by humans, childcare for example. In most cases, the technology promises much but fails to deliver. Other jobs can be automated but aren’t because the public, as customers, prefer them to remain done by humans – piloting passenger aircraft for example.

The second level is the organisational level. Firms make conscious decisions about investing in new technology. They run cost-benefit analyses to assess whether financial savings or gains can be made by substituting humans with machines. Sometimes there are none. Similarly, if there is no demand from customers (including the public sector) for product or process innovations, firms have little market-driven incentive to make technology investments. The outcome in both cases can be business as usual.

The final level is the broader political-economic environment. This environment comprises: the distribution of income and wealth between capital and labour; the state of the labour market; the strength of labour market institutions; corporate governance models; the extent and nature of business regulation; the state as a stimulator of innovation and demand; and the business cycle. In this environment, labour and skill shortages can encourage firms to adopt digital technology and make its cost necessary. Restrictions on employers’ capacity to fire employees might mean that employees are retained, retrained and reskilled to work alongside any new digital technology. Digital

technology might also lower the cost of goods and services, thereby stimulating consumer demand which, in turn, can lead to more jobs being created.

Versions and combinations of these possibilities help explain why, despite the predictions, the outcome of the 4rd Industrial Revolution might not be mass unemployment. However, the outcome should not be inertia. Technological change does happen. Understanding what changes occur, why these changes occur and how they occur becomes important. Evidenced-based, it is this information that enables the development of both feasible and desirable policy options.

## Policy Implications and Recommendations

The two policy positions outlined above emerge from what might be called the first wave of thinking about the digitalisation of production. A new wave of policy thinking is beginning to emerge that is more cautious. It appreciates that, as with all technological change, there is likely to be job creation and job change as well as job loss. However it still needs an evidence base that identifies not just the challenges and opportunities but also the available options for policymakers.

This need for new policy thinking comes at a time when the EU is already concerned about a rise in non-standard work, job polarisation, labour market flexibility and now the likely recession caused by the Coronavirus. The European Commission has introduced the European Pillar of Social Rights to address some of these concerns. These rights cover equal opportunities and access to the labour market; fair working conditions; and social protection and inclusion. To support these rights, the Commission also wants upward convergence towards better living and working conditions in the EU.

Thus, in the context of an emerging digital transformation of work and welfare, there is already a clear political desire to develop an inclusive European future that provides decent work and decent lives for all. The key issue is how to deliver that future in ways that maximize the opportunities and mitigate the risks with the digitalisation of production.

The analysis presented in this Briefing has implications for policy and policy recommendations.

*1 Choices exist in how digital technology is used by firms and a role exists for government and other social partners in shaping those choices across sectors, regions and countries.*

Too much current debate and policy remains technologically determinist. Historical evidence suggests technologies affect society and the economy via policy decisions on how they are introduced and regulated. Technology should not be anthropomorphized. It is humans that should be given the opportunity to co-decide about why, when and how new technology is introduced and so shape its outcomes.

*2 Monitoring employer demand for skills and the use of skills in digital work will help identify new jobs and tasks. Also monitoring the impact of digital work additional to skills – such as pay, employment security and wellbeing – will help identify job quality trends.*

Mainstream policy responses to the digitalisation of production still focuses on job losses, the solution to which is supply-side interventions in the labour market, most obviously skill acquisition through education and training. However there is a disconnect between this supply and employer demand for skills generally and in relation to the use of digital technology. It is just as likely that new jobs will be created and residual jobs reconfigured.

*3 To generate benefits for all, what those benefits are and how they are to be realised requires understanding of the business models of companies and how value is created, captured and then used and distributed.*

Whilst the challenges for workers arising from Industrie 4.0 are clear, what the opportunities are is less clear. To date, most of the opportunities have been attributed to firms – greater integration of production and, with it, efficiency and productivity gains. How those organisational gains translate into mutual gains for workers needs to be made evident particularly in the context of weakened trade unions.

*4 To ensure an inclusive future, there needs to be a focus on the business models of firms regardless of sector. Business models are required that are mission focused to ensure wider benefit from the digitalisation of production.*

National and regional responses to Industrie 4.0 and interventionist policy generally tend to have two forms. The first is vertical, backing the manufacturing sector as the core of the economy. The danger is that other sectors, which often provide the bulk of employment and key services are ignored and that large incumbent firms assert undue influence. The second is horizontal and sector blind. It fosters a general climate favourable to business enterprise, for example through fiscal stimulation, usually reduced corporate tax, and by encouraging more flexible labour markets.

An alternative for national and regional government is to proactively steer innovation and investment towards particular objectives or ‘missions’, for example to enhance the well-being of EU citizens. Firms digitalising their production could then be encouraged to compete for government funding based on how they help deliver this mission. In doing so, government can have a role in ‘market shaping’ rather than just deal with ‘market failures’, providing safety nets to deal with rising inequality. This government role will be crucial in delivering post coronavirus economic recovery.

*5 There is a need for governments to rethink the design of welfare in the digital age so that it can shape not just respond to work.*

Longstanding policy thinking is premised on moulding welfare to work, funded through tax receipts drawn from standard employment relationships, maximising employment participation and business models in which revenues and revenues streams are transparent. The digitalisation of production has helped to improve the opportunities of the flexible labour force at the expense of the standard employment relationships. The coronavirus crisis has highlighted this problem. Governments need to rebalance labour markets and, with it, the welfare of citizens.

*6 More and better data is required that integrates analysis across different levels and which is historically sensitive.*

Too much current policy thinking lacks an evidential base. Past and some recent research shows not just a range of job outcomes but that these outcomes emerge from the choices and constraints that arise within a complex interaction of different levels of socio-economic organisation. More and better data is needed to understand this interaction so policymakers can maximise the potential of the new digital technologies and identify the options that exist for delivering an inclusive European future generally and in the wake of the coronavirus.

## Authors

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## Useful Reading

Bughin, J., Hazan, E., Allas, T. Hjartar, K., Manyika, J., Sjatil, P.E. & Shigina, I. (2019) *Tech for good*, McKinsey Global Institute, <https://www.mckinsey.com/featured-insights/future-of-work/tech-for-good-using-technology-to-smooth-disruption-and-improve-well-being>

Davies, R. (2015) *Industry 4.0 Digitalisation for productivity and growth*, Briefing, European Parliamentary Research Service.

European Commission (2017) *Germany: Industrie 4.0*, Digital Transformation Monitor, [https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM\\_Industrie%204.0.pdf](https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Industrie%204.0.pdf)

Federal Ministry of Labour and Social Affairs (2017) *Work 4.0: Re-Imagining Work*, Berlin: Federal Ministry of Labour and Social Affairs.

Frey, C.B. & Osborne, M.A. (2013) *The Future of Employment: How susceptible are jobs to computerisation*, Oxford Martin Programme on the Impacts of Future Technology Working Paper, Oxford Martin Programme on Technology and Employment, University of Oxford.

Jacobs, M. & Mazzucato, M. (eds) (2016) *Rethinking Capitalism*, Chichester: Wiley Blackwell.

Jenkins, C. & Sherman, B. (1979) *The Collapse of Work*, London: Eyre Methuen.

Meil, P. & Kirov, V. (eds) (2017) *Policy Implications of Virtual Work*, London: Palgrave Macmillan.

OECD (2018) *Putting faces on the jobs at risk of automation*, Paris: OECD.

OECD (2019) *OECD Employment Outlook 2019*, Paris: OECD.

Perez, C. (2002) *Technological Revolutions and Financial Capital*, Cheltenham: Edward Elgar.

Warhurst, C. & Hunt, W. (2019) *Digitalisation and the Future of Work*, Joint Research Council Working Papers Series on Labour, Education and Technology 2019/05, Seville: European Commission.

Warhurst, C., Barnes, S. & Wright, S. with Dhondt, S., Erhel, C., Greenan, N., Guergoat-Larivière, M., Hamon-Cholet, S., Kalugina, E., Kangas, O.E., Kirov, V., Kohlgrüber, M., Mathieu, C., Murray Leach, T., Oeij, P., Perez, C., Pomares, E., Ryan-Collins, J., Schröder, A. & van der Zee, F. (2019) *Guidance paper on key concepts, issues and developments*, [BEY4.0 WP02 Task 2.1 guidance paper v1.0 \(beyond4-0.eu\)](#)

World Economic Forum (2017) *The Human Capital Report 2017: Preparing people for the future of work*, Insight Report, World Economic Forum, [http://www3.weforum.org/docs/WEF\\_Global\\_Human\\_Capital\\_Report\\_2017.pdf](http://www3.weforum.org/docs/WEF_Global_Human_Capital_Report_2017.pdf)

Review of Digital Innovation for the Economy and the Future of Work in Wales (2019) *Wales 4.0: Delivering Economic Transformation for a Better Future of Work*, Cardiff: Welsh Government.



## Project Identity

<b>Project name</b>	Inclusive Futures for Europe BEYOND the impacts of Industrie 4.0 and Digital Disruption — BEYOND4.0
<b>Coordinator</b>	Prof. Dr. Steven Dhondt (scientific coordinator), Dr. Peter Oeij (project coordinator). Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek TNO, Netherlands
<b>Consortium</b>	Department of Social Research, University Of Turku, Finland Institute for Employment Research, University of Warwick, UK Institute for the Study of Societies and Knowledge, Bulgarian Academy of Sciences (ISSK-BAS), Bulgaria Le CNAM-CEET, France Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek TNO, Netherlands Technische Universität Dortmund, Sozialforschungsstelle Dortmund (sfs) (TUDO), Germany UCL Institute for Innovation and Public Purpose (IIPP), London, UK University of Helsinki, Finland University of the Basque Country - Sinnergiak Social Innovation, Basque Country - Spain
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