The Future of Labour in the Digital Era

Ubiquitous Computing, Virtual Platforms, and Real-time Production

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Preface

Distinguished reader!

Digitalisation, automation and increasing robotisation in health care, industry and beyond, coupled with the advent of platform-based competitive mediation of work (crowdworking) – all impact on the future of work and labour. The associated challenges to the labour market, working conditions, wages, and the blurring boundary between private and professional life are the topic of intensive political and societal debate in many countries. Just take the conflicts surrounding Uber and AirBnB and their entry to traditional markets, as well as the vision of the so-called Internet of Things or cyber-physical systems, as the most prominent issues.

Technology assessment (TA) always tries to be at the forefront of such debates. It is therefore not surprising that the member institutions of the European Parliamentary Technology Assessment (EPTA) network have already devoted a number of projects on labour issues related to digitalisation.[1] Under the heading of "Productivity and New Technologies – Consequences for Work and Welfare" in 2014 the EPTA members contributed to a first international debate on this topic.[2] In 2016, these developments advanced further, the issues reached public debates in many countries, and new issues such as the platform-based economy came to the fore. Therefore, the EPTA members decided to continue this particularly important, but at the same time politically controversial debate in 2016. The Annual EPTA Conference 2016 "The future of labour in the digital era: Ubiquitous computing, virtual platforms and real-time production" was thus devoted to this timely and exciting topic.

This report continues a series of similar reports compiled by the respective presidency of the EPTA network. As in previous years, it is a collection of contributions written from the perspectives of all full and associate members of EPTA. In 2016, for the first time, a general introduction and a synthesis gives the reader a compact summary of the state-of-the-art in the EPTA countries. The report was originally intended to inform the participants of the Annual EPTA Conference held in the Austrian Parliament in Vienna on 21st October 2016. After the conference it has been amended to reflect the lively debates and to include the preliminary results of the conference debates. The report is published online, openly accessible to everyone interested in this salient topic.

On this occasion, I would like to thank all contributors to this report, not least for their determination to go through several rounds of feedback and revisions, and in particular Dr Tanja Sinozic from the team of the Institute of Technology Assessment (ITA) who compiled the introduction and synthesis chapters as well as gave in-depth feedback to all the contributors.

We wish you a good read,

Vienna, November 2016

Michael Nentwich

(EPTA President 2016,
Director ITA/Austria)

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1 See the EPTA project database at eptanetwork.org/database/projects. [Note: this and all following URLs have been last visited and checked on 7. Nov. 2016.]

2 Download the 2014 EPTA report at epub.oeaw.ac.at/0xc1aa500e_0x0031e598.pdf.

1 Introduction

The future of labour in the next wave of digitalisation

Debates about the impacts of the transformative power of digitalisation on work and employment have rapidly increased in the recent couple of years or so in the media, politics, labour unions, and in science. There are conflicting views about the potential for the next wave of computerisation to create jobs and increase health and well-being, and the extent and degree of technologically induced unemployment under existing conditions. For example, in the Europa 2020 growth strategy of the EU, the proliferation of information communications technologies (ICTs) is given a central role as a key technology for innovation in virtually all traditional and non-traditional sectors, and as an underlying factor for productivity and creating employment.[3] However, studies such as those by Frey and Osborne[4] caution against widespread optimism by providing evidence of massive job losses in the near future, as computers become increasingly effective in codifying more and more work tasks.

Other authors refer to the uncertainty of direct effects, as well as their differentiated impacts over time. Ubiquitous computing is said to shift the boundaries between work and private lives, creating flexible opportunities to work and communicate, but also excessive stress brought on by almost continuous multi-tasking. Online platforms are creating new ways of working and challenging traditional sectoral structures, working regulations, and competition. Furthermore, cyber-physical systems usher in a stage of digitally integrated industrial production and services. Robots continue to replace not only industrial workers, but spread to health care, cleaning, and other areas, and cognitive tasks formerly exclusively performed by humans.

These issues beg the question of which kinds of policies for labour, education, health, and the environment are required to create and manage sustainable societies in the face of rapid changes with relatively unpredictable effects. Will productivity gains from large-scale automation occur and, if so, how can such benefits be distributed across society? Is crowdwork a viable way to create jobs and how can we ensure work standards; income stability and social security are maintained in new forms of working? What role can digitalisation play in maintaining employment over our entire working lives as we live and work longer years? This report is intended to provide food for thought and promote debates and critical thinking on these issues.

Aim of this report

The EPTA network of international TA institutions produces an annual report on timely topics concerning the relationships between technological change, society, economy and politics. Each year a different partner assumes the presidency of the network. The main tasks of the EPTA presidency are to create the report based on the contributions from each network member, and to organise a conference on the chosen topic in the presiding country for presentation and discussion of the report's findings with members of parliament. The present report also serves to provide information on changing labour conditions in the face of current digitalisation processes for international policy makers, researchers, and the wider public.

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[3] European Commission (2010) 'A strategy for smart, sustainable and inclusive growth', COM (2010) 2020 final, Brussels, eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC2020&from=de.

[4] Frey, C. B. & Osborne, M. A. (2013) 'The future of employment: How susceptible are jobs to computerisation?', Oxford Martin School, September.

The aim of this report is to present the European, national and regional evidence and perspectives on changes to employment, working conditions and work practices that are influenced to a large degree by changes to digitalisation, which have occurred in the depicted context in the last few years.

Guiding questions and approach

The main guiding question of the study was: What is being discussed in the scientific community, in government, industry and broader society about the direct and indirect relationships between work and digitalisation in the respective country or region? To facilitate answers to this question the presidency suggested three main themes and a series of subquestions to help collect relevant information:

1. Status Quo: What is going in the country or region?

What are the main economic and social trends taking place in your respective country or region, in the areas of work and computerisation? What are the main changes, based on empirical evidence? What are the quantitative and qualitative changes at the individual and industry levels?

2. Policy dimensions

How are the changes being addressed by national and regional policies? How are change processes being addressed by labour unions and employers' associations? How are the issues represented in societal debates? What policies are proposed to address the consequences of these technical developments and resulting challenges for the flexibility for workers and companies, employment effects, as well as social security systems? Are there forms of regulation with regard to peer-to-peer platforms and crowdwork (such as Uber, Airbnb, and others) already in place? How do education and training systems seek to address these changing forms of labour and production?

3. Main findings from national and regional TA studies

What are the main challenges and opportunities for labour based on existing technology assessments on the main ICT-based technology areas currently affecting work (such as crowdworking, robotics, manufacturing industries, and services)? What are the gaps in TA research that need to be addressed in future on this topic?

These aspects are dealt with in greater detail in the individual country and regional accounts of documented impacts (Chapters 2 to 18). Each individual contribution describes research and other evidence of the interrelationships between digitalisation and demand for labour, changes in work practices, policy, and TA research. The final chapter provides a summary synthesis of the main cross-cutting themes and empirical findings, makes some suggestions for future TA studies, and concludes with insights for policy which were gained during the EPTA conference held at the Austrian Parliament on 21st October 2016.

2 Austria

2.1 Status Quo and societal debates

Austria is ranked tenth of the EU28 in terms of the integration of digital technology, as measured by the indicators business digitization and eCommerce.[5] With a 41% digital integration share, Austria is above the EU average, but no forerunner.[5] In Austria, the main policies targeting the relationship between computerisation and employment are guided by the innovation paradigm of the EU, highlighting the actual and potential performance of this sector for economic growth and employment generated by technological innovation, the integration of ICTs in other leading sectors of the Austrian economy, such as manufacturing, environmental technology and tourism, and in the potential of computing technologies in improving welfare (such as for the elderly population).[6] The integration of recent computing developments in manufacturing have focused on maintaining or increasing the competitiveness of the Austrian economy internationally and steering industrial progress with changes in production (the leitmotif is represented by "Industry 4.0"), as well as managing changes in work practices to maintain employment stability and the well-being of workers throughout their working life.

Smart Production: Anecdotal evidence highlights changes with big impacts on individual work tasks and firm-level processes that are rapidly changing how people do their work. For example, handheld devices have changed how supply firms coordinate and manage product delivery in pharmaceuticals.[7] A further example is provided in the construction industry, where measurements taken with handheld devices are quickly translated into offers to be sent to potential customers, significantly reducing the workload for builders.[8] Although some manual tasks will continue to be replaced by machines, people who know how to operate these machines will be in higher demand.[7] The regions in Austria with high productivity levels (such as Vienna, Vorarlberg and Salzburg) are also the regions with the highest levels of digitalisation, according to a recent WIFO study.[9] The transformation is, according to the authors, happening at a slow and incremental pace. In contrast, a future-oriented business person predicts that between 20 and 30 per cent of current work will be replaced by computers in about ten years.[10] Others see this as posing challenges to society if it is not broadly managed.[9] In order to facilitate digitalisation the need for a comprehensive area-wide broadband network is emphasised. The government plans to invest one billion € for the expansion of broadband in Austria, and the telecom company A1 has pledged to invest one Euro for every Euro it receives for this purpose, and is already investing € 500 million per year for the expansion.[8] In 2016, the Austrian members of the group of SAP users (DSAG) composed of about 200 firms have increased their investment in digitalisation of work and production processes to 4.1%, which is almost twice the amount invested by the DACH region (2.7%).[11]

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5 ec.europa.eu/digital-single-market/en/integration-digital-technology.

6 European Commission, Digital Agenda for Europe, COM (2010) final, Brussels, eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=URISERV:si0016&from=EN; ec.europa.eu/digital-single-market/

7 AK FUER SIE, "Die ChefInnen der Roboter", 09/2016, pp. 14-15, Arbeiterkammer Wien, media.arbeiterkammer.at/wien/PDF/Publikationen/akfuersie/AKFS_September_2016.pdf.

8 Strobl, G., (2016) 'Digitalisierung pflügt Arbeitsmarkt komplett um', *Der Standard*, published 23. August

9 Peneder, M. et al., (2016) 'Österreich im Wandel der Digitalisierung', WIFO Austrian Institute of Economic Research, wifo.ac.at/wwa/pubid/58979.

10 Hahn, A. (2016) "Wir steuern auf eine Krise der Arbeit zu", *Der Standard*, published 18 February.

11 Bruckner, R., (2016) 'Unternehmen denken digitaler', *Der Standard*, published 14. April.

Recent studies[12] have addressed Austria's potential for adapting its manufacturing production structures to changes in computerisation in international comparison, and surveyed firm-level awareness and implementation of associated concepts (such as Industry 4.0 and Big Data). The Bloomberg Innovation Index finds Austria to be one of the five top locations worldwide for efficiency in manufacturing production processes and overall manufacturing capacities.[13] According to the Roland Berger Industry 4.0 Readiness Index, Austria is one of the best countries for the implementation of associated production changes.[13]

In spite of the internationally recognised potential for industrial progress in manufacturing, the preparations for associated changes in automation for the majority of Austrian firms (most of which are small and medium sized enterprises, SMEs) occur at varying degrees and in the majority of cases are at a very early stage of deployment[14]. The European Manufacturing Survey also found that the most common technical changes in production are industrial robots and handling systems, followed by processes associated with supply chain management and automated warehouse management systems.[14] To date, these technologies are implemented in more than a third of the Austrian production companies surveyed. According to a more recent survey, 53% of industrial executives were unfamiliar with the notion "Industry 4.0".[15] SMEs face specific challenges such as small budgets for investment in automation and ICT capabilities. On the other hand, small lot sizes and many different products (common for SMEs) are conditions for which Industry 4.0 promises high gains.

Working conditions and welfare: In response to the changes in computerisation and work practices, labour unions in Austria are focused on managing the relationship between ICTs and working conditions. This has so far mainly occurred through attention on working hours and the data security and privacy issues associated with monitoring of computer activities and tasks. The research conducted in international surveys puts Austria among the top OECD and EU countries in terms of computer use at work.[16] Austria is very near the top countries (70%);[17] and Austria has 40% of "intensive" computer users. There has been a steady increase in non-standard (a-typical) forms of work in Austria over the last decade, to a share of 31% of all employees.[18] A view voiced by the labour unions is that the increase in job instability and rising unemployment is to be addressed by a rise in real wages in sectors which are less prone to job losses through computerisation, such as healthcare and education, as well as a reduction in overall time spent working[19]. Aspects of computerisation linked to increase in welfare in Austria are also associated with closing the "digital divide" (between people and places) and the potential of computing technologies such as robots to improve conditions in healthcare and for the elderly.[6]

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12 Roland Berger Strategy, (2014) 'INDUSTRY 4.0 – The new industrial revolution: How Europe will succeed', rolandberger.com/media/pdf/Roland_Berger_TAB_Industry_4_0_20140403.pdf.

13 bloomberg.com/graphics/2015-innovative-countries/.

14 The European Manufacturing Survey (EMS) is carried out by a group of research institutes collecting data on technological innovations at the organisational level in manufacturing industries. The data for Austria was collected in all five surveys since 2001. Here we refer to the data available from the 2012 survey. For more information see isi.fraunhofer.de/isi-en/i/projekte/fems.php.

15 FESTO, (2015) 'Trendbarometer Industriebetriebe Österreich 2015: Industrie 4.0 – Trend oder Hype?', festo.com/cms/de-at_at/19301.htm.

16 OECD, (2015) *OECD Employment Outlook 2015*, Paris, dx.doi.org/10.1787/empl_outlook-2015-en.

17 Kirchner, S., Wolf, M. (2015) 'Digitale Arbeitswelten im europäischen Vergleich' In: WSI Mitteilungen 68(4): 253-262.

18 SWSA, (2014), 'Atypische Beschäftigung', 01/2014, wien.arbeiterkammer.at/service/zeitschriften/SozialundWirtschaftsstatistikaktuell.

19 GPA/djp, (2015) 'ARBEIT 4.0 oder das Ende der Arbeit? Digitalisierte Arbeit und gewerkschaftliche Gestaltungsansätze'.

A further important perspective from Austrian labour unions highlights the changing boundaries between work time and private time, data security and privacy issues to do with increasing volumes of generated data, different health risks, increasing polarisation in incomes and changing knowledge requirements of work towards more digital skills.[20] Austria has implemented a number of training reforms for this purpose, such as for example in 1998 the paid leave for education and the reform of this programme in 2008 which allowed for the inclusion of persons who have been unemployed for one year.[20] Furthermore, worker training continues to be highly emphasised.[20] Vienna's labour union for private sector employees in print, publishing and journalism[21] calls for social creation of digitalisation, with a focus on employee participation and a fair distribution of economic gains throughout the process.[22] The subject is also topical in publications from the Chamber of Labour in Upper Austria which will award a prize 9,000 € in 2017 for the best piece of research on the changes to unemployment in Austria related to digitalisation, automation and crowd- and click-working.

Big Data is associated with the potential of computerisation to help firms become more competitive. However, the capacities to exploit such potential have yet to be developed. Austrian SMEs are sceptical towards the promise of Big Data to improve profitability and regard large amounts of data to be "unmanageable".[23] Concurrently, there exist a number of innovative SMEs that engage in R&D collaborations with other firms and research institutions to develop Big Data capacities, mainly supported by national and EU research funding programmes.[24]

Crowdworking: The Austrian media repeatedly draw attention to changes in modes of working influenced by computerisation of "extra-organisational" tasks and services, such as for example platform-mediated work, "crowdworking", or "collaborative consumption". The Crowd Working Survey conducted by UNI Europa and the University of Hertfordshire results for Austria show that 36% of the 2,003 adults surveyed stated that they have tried to find work with online platforms such as Upwork, Uber or Handy.[25] A further important finding is that a relatively large minority of 11% of those persons stated that the income they receive from crowdwork represents more than half their income.[25] A recent study by the University of Vienna and FORBA on virtual work highlights the precarious conditions which creative workers in Austria face in terms of income and social security, and that fierce competition for design work which has increased through online platforms has a negative effect on creativity.[26] Furthermore, creative workers report to have to give up on control over their time in favour of good ratings on platforms.[27] The issue of insufficient le-

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20 Fritsch, C., Greif, W. & Schenk, T., (2015) 'Gestalten oder bestaunen? – Der steinige Weg Europas durch die "digitale Revolution": Anforderungen aus gewerkschaftlicher Perspektive', *WISO*, 4/2015, Institut für Sozial- und Wirtschaftswissenschaften, Linz.

21 Gewerkschaft der Privatangestellten, Druck, Journalismus, Papier (GPA-djp) gpa-djp.at/cms/A03/A03_3.4.1/ueber-uns/bundeslaender/wien.

22 GPA-djp, (2016) KOMPETENZ, 'Sonderausgabe Digitalisierung: Digitalisierung sozial gestalten', June.

23 Köhler, M. & Meir-Huber, M., (2014) 'Big Data in Austria: Österreichische Potenziale und Best Practice für Big Data', bmvit.gv.at/service/publikationen/innovation/downloads/big_data_in_austria.pdf.

24 IIT – Institut für Innovation und Technik, (2015), iit-berlin.de/de/indikator.

25 Huws, U. & Joyce, S., (2016) 'Character of Austria's 'Gig Economy' revealed for the first time', *Crowd Working Survey*, UNI Europa Global Union, University of Hertfordshire, and AK Wien, feps-europe.eu/en/publications/details/432.

26 Flecker, J., Schörpf, P., Schönauer, A. and Eichmann, H., (2016): ‚Arbeit und technischer Wandel in der Kreativwirtschaft: Erwerbsbiografien zwischen lokalen kreativen Milieus und Perspektiven virtueller Arbeit', Final report to the Jubiläumsfonds der Österreichischen Nationalbank, March 2016, Institute for r Soziology, University of Vienna, Forschungs- und Beratungsstelle Arbeitswelt (FORBA).

27 Schörpf, P., Flecker, J., Schönauer, A., (2017) 'On call for one's online reputation – control and time in creative crowdwork', in: Briken, K., Chillas, S., Krzywdzinski, M., Marks, A. (Eds.)(2017): 'The new digital workplace. How new technologies revolutionise work'. London: Palgrave Macmillan (forthcoming).

gal protection of crowdworkers is being raised in the area of Austrian labour regulation in the context of, for example, the lack of workers' protection in getting paid, a poor definition of work and work tasks, and the risks associated with the short-term nature of the work in terms of holiday entitlement, and participation in decision-making with regards to the working relationship.[28]

The view of the labour unions is that for such changes, existing regulations (e.g. sector-specific collective bargaining agreements; rules about working from home) are sufficient and do not need to be modified. Changes to collaborative consumption practices, such as through Uber or AirBnB, is on the rise in Austria as it is globally. For example, between 2014 and 2015, the number of apartments offered through AirBnB in Vienna increased by 140%.[29]

Data protection and privacy concerns: A further area of discussion concerns the monitoring of computer activities and work practices (such as recording, analysis and surveillance). This affects larger sectors and has therefore attracted relatively more attention from labour unions. The Austrian data security regulation from 2000 is the main law that labour unions are focusing on to manage the changes. The next major step that will affect these regulations will occur in 2018 through the EU Data Protection Regulation.

2.2 Policy dimensions

The main issues addressed by policies affecting employment changes regard general measures on income taxes;[30] supporting groups vulnerable to unemployment; education; introducing flexibility in working hours; reducing labour costs; and policies specifically targeting industrial upgrading. The motivation behind these changes is the current Austrian government's goal of the re-establishment of full employment and the achievement of growth rates above that of the Eurozone. According to a WIFO study,[31] policy documents for the national ICT sector in Austria share a broad perspective which incorporates infrastructure, research, investment in human capital, and diversification of use and applications.[31]

Labour market: Proven labour market policy instruments such as integration subsidies, wage subsidies and social enterprises (the so-called second labour market) are expected to benefit from 50,000 people per year and create more than 20,000 long-term jobs.[30] Furthermore, a number of measures are being taken to improve the education of young people and young migrant workers. A special challenge is related to Austria's high rate of part-time employment among women (annual average of 45.5% in 2013).

Manufacturing industries: Most recent direct measures addressing industrial upgrading were launched in 2014 and 2015 under the label of "Industry 4.0". At the end of 2014, a national "Plattform Industrie 4.0" was launched based on the suggestion of industry representatives and by the Austrian Ministry for Transport, Innovation and Technology (BMVIT). In June 2015, the association "Industrie 4.0 Austria" was founded as the platform for intelligent production. The platform is designed to coordinate and interlink existing and future activities, initiatives and measures at the federal and state level. Founding members are

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28 Risak, M., (2015) 'Crowdwork: Erste rechtliche Annäherungen an eine "neue" Arbeitsform', *Zeitschrift für Arbeits- und Sozialrecht*, January.

29 Putschloegl, M. & Zoidl, F., (2015, published online March 28), 'AirBnB: Vermieten in der Grauzone'. *Der Standard*, derstandard.at/2000013565755/Airbnb-Vermieten-in-der-Grauzone.

30 Federal Chancellery, (2015) *National Reform Programme Austria*, Vienna, bka.gv.at/DocView.axd?CobId=59537.

31 Friesenbacher, K. S., (2012) 'Kommunikationsinfrastruktur: Verfügbarkeit in Österreich und Anwendungspotential im Sozialbereich', Österreichisches Institut für Wirtschaftsforschung, WIFO Working Paper 434, wifo.ac.at/publikationen?detail-view=yes&publikation_id=45018.

the BMVIT, the Federation of Austrian Industry, the Chamber of Labour, the production union, the Association Machinery & Metalware Industry and the Association for the Electrical and Electronics Industries.

Since 2004, the BMVIT has invested a total of € 1 billion for the research and development of technologies or processes, which also form the basis for Industry 4.0.[32] For 2015/2016, approximately € 250 million in subsidies are expected to flow into the improvement of performance of the industry from the BMVIT.[33] The funds are invested not only in R&D programmes such as "production of the future", "ICT of the future" and research programmes, but also in endowed professorships surrounding "Industry 4.0" and pilot factories. At the provincial level, Upper Austria and Styria are considered to be national pioneers in Industry 4.0 initiatives. Upper Austria is to be expanded into a model region for Smart Production.[34] Moreover, since mid-2015, the Federal Council of Austria has been actively promoting "digital transformation".[35] Together with the democracy platform "besserentscheiden",[36] ideas regarding "digital transformation and politics" have been collected online as well as debated in accompanying discussion events. A central question was which legal and political changes are necessary in order to use digital transformation in society and economy as an opportunity.

Platform-mediated work: Although P2P platforms are present on the Austrian market; there have been no major changes to existing regulations. There are ongoing discussions between the new and existing service providers, political actors at the municipal level, and consumer protection organisations, but as yet existing regulation is considered applicable and adequate. Uber, for instance, includes in its service only rented cars with licensed drivers, not private cars and drivers (hence avoiding legal problems as in Germany). In Vienna, Airbnb is under pressure to find a suitable solution for taxing revenues and the handing over of data about hosts who exceed income thresholds and are legally required to obtain business licences. The issue is mainly seen as a matter of implementing existing rules and regulations.

2.3 TA perspectives

In accordance to the relatively little sceptical attention given to the impact of new technologies on labour demand in economics and politics during the last decades, this topic also essentially disappeared from the agenda of TA research for a considerable long period of time. Last ITA projects explicitly addressing quantitative employment effects date back to the mid-1990s (AD-EMPLOY and the Austrian Technology Delphi). Recently WIFO has launched the research programme "Austria 2025" with unemployment being one of the core issues. The distribution of work was also addressed in the recently concluded EU project "Welfare, Wealth and Work for Europe".[37]

Past technology assessments by the ITA focused on issues such as employment effects of advanced communications technology. The study AD-EMPLOY found the use of advanced

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32 Wiesmüller, M., (2014) 'Industrie 4.0 und die Herausforderungen an die Innovationspolitik', APA Science Dossier. science.apa.at/dossier/Industrie_4_0_und_die_Herausforderungen_an_die_Innovationspolitik/SCI_20141030_SCI59952815420997610.

33 Zimmermann, K., (2014) 'Production of the Future: Advanced Manufacturing in Austria', Bridges, 42, December 2014/Feature; European Commission, (2015) 'Innovation in Digital Manufacturing', Report from the Workshop on Innovation in Digital Manufacturing, ec.europa.eu/digital-agenda/en/news/european-co-operation-innovation-digital-manufacturing.

34 Wasserfaller, M. (2014) 'Revolution in der Produktion', *APA-Science Dossier*. science.apa.at/dossier/Revolution_in_der_Produktion/SCI_20141030_SCI59932815220982648.

35 parlament.gv.at/PAKT/PR/JAHR_2015/PK1273/index.shtml.

36 besserentscheiden.at.

37 foreurope.eu.

communications technology based services likely to have "positive effects on the employment volume whereas expenditures on tele-equipment hardware and software tend to be associated with labour-saving effects".[38] Prospects for contributing to net job creation were more modest but a number of qualitative employment effects were identified at the level of the organisation, occupations, tasks and the individual. A related topic of the ITA was the impact of ICTs on the organisation of work, in particular teleworking.[39]

The ITA has undertaken a project in co-operation with the Austrian Institute of Technology on smart manufacturing, commissioned by the Austrian Parliament.[40] A major part of this project was a first assessment of societal impacts to be expected in nine major areas (employment, work organisation, education and training, health and wellbeing, use of resources, economy and competition, safety and security, technical standards, regulation). Recently, the Chamber of Labour of Upper Austria advertised a science reward on "Arbeit 4.0" (Labour 4.0) for 2017 addressing all the topics mentioned above.[41] Possibly this call will trigger in-depth debate.

38 Millard, J. et al. (1995) 'Employment trends related to the use of advanced communications', ITA, Vienna.

39 Aichholzer, G., (1998) 'A social innovation in its infancy: experiences with telework centres', in: Jackson/van der Wielen (eds), *Teleworking: International Perspectives. From telecommuting to the virtual organisation*, London/New York: Routledge, 292-302; Aichholzer, G., Kirschner, A., (1999) 'Telearbeit in europäischen Nachbarschaftsbüros' (Telework in European Neighbourhood Offices), Vienna: BMAGS.

40 Aichholzer, G. et al. (2015) Industry 4.0. Background Paper on the pilot project "Industry 4.0. Foresight & TA on the social dimension of the next industrial revolution", Vienna: ITA & AIT, epub.oeaw.ac.at/ita/ita-projektberichte/ITA-AIT-1en.pdf; Aichholzer, G. et al. (2015). Industrie 4.0. Foresight & TA zur gesellschaftlichen Dimension der nächsten industriellen Revolution. Final report, Vienna: ITA & AIT, epub.oeaw.ac.at/ita/ita-projektberichte/ITA-AIT-2.pdf.

41 ooe.arbeiterkammer.at/beratung/bildung/studium/AK-Wissenschaftspreis.html.

3 Catalonia (Spain)

3.1 Status quo and societal debates

In Catalonia, in a widespread move that is required throughout Europe, work is under way on the smart specialisation strategy (RIS3CAT), which defines a shared vision of the country for 2020. Catalonia is a country with an industrial foundation, an open, competitive, sustainable economy combining talent, creativity, a varied business fabric and its own system of top-level research, all in the framework of a dynamic, entrepreneurial and inclusive society. It includes multinationals as well as local businesses, established sectors with international leadership and emergent technological sectors.[42] RIS3CAT has been drawn up based on ample analysis of the weaknesses, dangers, strengths and opportunities of the Catalan economy, also by sectors and technological skills. This analysis identifies three main vectors that connect the activities with which the Catalan economy can successfully face the great social and economic challenges of the 21st century:

1. The legacy of Catalonia's extensive industrial history needs to evolve: in the 21st century, Catalan industry needs to evolve with the emphasis on key competitive factors such as innovation, technology, design and training for professionals.
2. Personal well-being in areas such as food, health, leisure or lifestyle, in which R&D&I generates economic opportunities and direct benefits for individuals and society.
3. The global challenges posed by climate change, the impact of human activity and the shortage of natural resources.

Some of the tendencies of the new digital technologies with an obvious impact on the world of labour and on society can be found in *Spain 20.20: ICT and Sustainability Report* by the 'Club de Excelencia en Sostenibilidad'. The first thing it mentions is the demand for sustainability in the social sphere by workers in search of a higher degree of reconciliation between personal and work life using options like teleworking or the incorporation of information technologies. It is well known that in the coming decades we will witness a transition in the workforce in which the type of employment will vary, the same as happened in the Industrial Age. Jobs will have a technological side to them, which will offer better quality and security at work, and will also require longer training. Continuing education and an ability to adapt to the demands of the labour market will be key in the next decade, and will depend largely on each individual. ICT will provide new work models in which physical presence will become less important than the results obtained. Working hours will be much more flexible and, as far as possible, adapted to each individual worker and his or her particular moment in life, allowing for greater diversity and equal opportunities. The creation of new jobs could also mean that work that is now done by hand will become automated (for example, automatic reading of smart utility meters cuts out the need for manual inspection by an employee visiting Spanish homes in person).[43]

The annual *Enquesta sobre l'ús de tecnologies de la informació i la comunicació i del comerç electrònic a les empreses* ('Survey on the use by businesses of information and communication technologies and of e-commerce')[44] (ETICCE), carried out by the INE[45] (Spanish Institute of Statistics) in partnership with the Idescat (Statistical Institute of Cata-

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42 Catalan Government (2015) RIS3CAT 2015-2020 action plan. catalunya2020.gencat.cat/web/.content/00_catalunya2020/Documents/estrategies/fitxers/pa_ris3cat.pdf.

43 Club de Excelencia en Sostenibilidad (2012). *Spain 20.20: ICT and Sustainability Report*. clubsostenibilidad.org/f_publicaciones/spain%202020.pdf (in Spanish), clubsostenibilidad.org/main.asp?id_pagina=33 (in English).

44 INE & IDESCAT (2015). *Enquesta sobre l'ús de TIC i del comerç electrònic a les empreses*. idescat.cat/estad/eticce.

45 ine.es.

lonia),[46] provide a snapshot of the incorporation and use of ICT and e-commerce in businesses active in Catalonia. According to the latest figures available:

- In the first quarter of 2015, the ICTs most used in Catalonia by businesses employing ten or more people were the computer (99.3%), Internet (99.1%) and the mobile telephone (95.3%). Local area networks (LAN) are also available in a very large proportion of them (95.3%).
- In companies employing less than ten people, the main ICT is the computer (78% use them), followed by mobile telephones (76.7%) and Internet (70.7%), which has dropped since 2014 (74.3%). These businesses stand out for the high proportion of them using open source software (62.5%).
- Practically all businesses with access to Internet use a broadband connection (landline or mobile). A point worth mentioning is that in the case of companies employing ten or more people the use of cabled and fibre optics networks, present in 33.1% of the total, has dropped 9.7% with respect to the previous year.
- Of those businesses employing ten or more people, 83.9% have a website or web page (either working or under construction), while the gap with respect to companies employing less than ten people widens to 54 percentage points, as only 29.9% of these have a website or page.
- Of those businesses employing ten or more people, 43.3% use social media for reasons of work and, in the case of companies with less than ten employees, the proportion is 27.2%, a gap of 16.1%.
- The total volume of e-commerce purchases by companies with ten or more employees reached 26 million euros in 2014, 7.5% more than in 2013, and sales exceeded 40.7 million euros, an increase of 5.9% over 2013.
- As regards activities with a high-tech profile:
- As of 31 December 2015, there were 244,542 people registered with the Social Security in sectors of this type, 8% of the total for Catalonia.
- 3.8% were registered in industrial sectors with a medium to high-tech profile (116,673), 3.3% in high-tech or cutting-edge services (100,084) and 0.9% in high-tech industrial sectors (27,785).
- Since 2010, employment figures for potentially more digitisable activities are better than employment as a whole and since 2013 have shown an increase.

3.2 Policy dimensions

The report by the European Trade Union Institute (ETUI) *Digitalisation of the economy and its impact on labour markets*[47] asks for a new social pact in the age of the digital economy and states that the creation of jobs in new sectors, new products and new services will transform labour:

1. For one, digitalisation allows the emergence of new forms of occupation, such as on-demand work organised through online platforms, and new forms of interaction between people and machines. This change involves, on the one hand, new social risks (intensification of work, effects on health and safety, blurring of the boundaries between work and private life, lack of proper information or discrimination) and, on the other hand, changes in management and organisation to adapt to new ways of working.
2. Secondly, jobs could be destroyed as a result of computerisation, automation and robotisation or there could be a shift in jobs as the development of digital platforms leads

[46] idescat.cat.

[47] European Trade Union Institute (2016). *Digitalisation of the economy and its impact on labour markets*. etui.org/Publications2/Working-Papers/Digitalisation-of-the-economy-and-its-impact-on-labour-markets.

workers in one country with high levels of social protection to enter into competition with workers in developing countries with low levels of protection.

One interesting publication in this field of action, by the Consell de Relacions Laborals de Catalunya (Catalan Council for Labour Relations),[48] a forum for dialogue between trade unions and employers' associations, is its *Recomanacions per a la negociació col·lectiva en matèria de gestió del temps de les persones treballadores* ('Recommendations for collective negotiation in matters of workers' time management', 2009).[49] The document deals with locational flexibility (remote work or teleworking) as a more flexible and rational management tool for work time: teleworking. In this respect, it indicates that collective and company agreements should state that the fact that a worker accepts the company's offer of teleworking should not affect his or her remuneration, professional career with the company or the number of hours worked.

The digital era could be a threat or an opportunity, but a priori its impact could be either positive or negative. In this context, public policies and the role of regulators are key issues:

- Maximising the positive effects, favouring a setting that allows the creation of new businesses and new employment, eliminating the institutional barriers in their way, and establishing educational and training policies that help turn workers' skills to the new needs.
- Developing continuous education throughout life.
- Palliating the negative effects through active and passive policies.
- Supporting mediation to ease job transitions.
- Adding guarantees to regulations for self-employed workers.
- Improving social protection measures.

Catalonia wants to lead the regulation of the collaborative economy (a competency shared between the Spanish state government and the autonomous communities) and put the Catalan economy at the head of the new digital economy, and in the framework of the Catalan Smart Strategy (SmartCAT). In this respect, on 5 April 2016 the Catalan Government began revising all the sectoral regulations to incorporate the collaborative economy, with the aim of creating a legal framework to regulate this new economic practice and, at the same time, guarantee fair competition between the different ways of providing services:

- Promoting collaboration agreements between collaborative employment platforms and the administration to increase information and transparency regarding the activities undertaken and to improve adaptation of public policies to the needs of users and different sectors of activity, at the same time respecting the right to privacy and the protection of personal data.
- Promoting the drafting of a Code of Good Practice in the collaborative economy sector in Catalonia, establishing the general principles for defining the activities included in the framework of the collaborative economy.
- Convening sectoral boards in which agents for the collaborative economy and representatives of traditional organisations take part.
- Supervising government action in response to the present situation and future trends in keeping with the emerging technological, economic and organisational paradigm.

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[48] Consell de Relacions Laborals (2009). *Recomanacions per a la negociació col·lectiva en matèria de gestió del temps de les persones treballadores*. empresaiocupacio.gencat.cat/web/.content/13_-_consell_relacions_laborals/documents/04_-_recursos/publicacions/arxius/recomanacionsnctemps.pdf.

[49] empresa.gencat.cat/web/.content/13_-_consell_relacions_laborals/documents/04_-_recursos/publicacions/arxius/recomanacionsnctemps.pdf.

- Analysing the characteristics defining the collaborative economy and key factors in its development, prospects for growth and evaluation of the impacts on the productive, economic and social model, the challenges for adapting it to the obligations of the platforms connecting supply and demand as intermediaries in the transaction.
- The analysis of the measures adopted by other countries and by the institutions of the European Union.

This policy should lead to objectives that strengthen those activities with most added value and drive new economic activities and niches on the basis of innovation.

Another point to mention, as an experience in civil society, is the mSchools initiative,[50] led by the Mobile World Capital Barcelona[51] foundation, to publicise the results of applying technology in learning, promote methodologies and best practices for adopting mobile technology to education and to inform and motivate heads of schools in the implementation of effective and useful policies.

3.3 TA perspectives

The Parliament of Catalonia's Resolution 1155/X (Conclusions of the Report by the Study Commission on Public Policies in Matters of Collaborative Economy) shows its commitment to the collaborative economy. The resolution also recommends adapting the legal regulations in the framework of Community directives, the role of mediating technological platforms and their rights and obligations with relation to consumers and administrations. In questions of working conditions it recommends establishing boundaries between collaboration in an activity and employment.

The Parliament of Catalonia also urges the Catalan government to regulate rental of rooms in one's place of residence as a new form of accommodation and revise the rules covering the powers of the Generalitat to allow carsharing, establishing the boundaries with other activities involving regulated forms of transport and differentiating between the use of private vehicles as leisure resources in the framework of a trip one had already planned (which needs to be promoted and allowed) and providing passenger transport in return for a price and on a professional basis (which requires the corresponding taxi licence or vehicle rental with driver).[52]

CAPCIT's report on *Research and Business: collaborating to compete better* (June 2014) stated that: 'Specific plans for communication and information to citizens and society must be designed in order to make them aware of the advances and benefits of innovation and its role in the development of our country'.[53]

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50 mschools.mobileworldcapital.com.

51 mobileworldcapital.com.

52 Resolution 1155/X of the Parliament of Catalonia approving the conclusions of the *Informe de la Comissió d'Estudi de les Polítiques Públiques en Matèria d'Economia Col·laborativa* (Report of the Study Commission on Public Policies in Matters of Collaborative Economy. google.es/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjeyou0t5jMAhWHfRoKHf1NDFEQFggjMAA&url=http%3A%2F%2Fwww.parlament.cat%2Fgetdocie%2F10014975&usg=AFQjCNFt0DkyLOGTl378FQ1l7wwbiYIjxw.

53 CAPCIT (2014). *Research and business: collaborating to compete better*. See: parlament.cat/document/intrade/31300.

4 Denmark

4.1 Status Quo and societal debates

The digital revolution grabbed Denmark quite fast. Already in the mid-1980s Danish companies took in quite advanced robotics and there were local activities in making "digital citizen houses" as a parallel – and often physically in connection to – the Citizen Houses, which made the foundation for Danish democratization and public education 1½ century ago. Denmark has kept up the speed of digitalization and ranks as number 1 of the 28 EU member states in EU's *Digital Agenda Scoreboard*[54] and *Digital Economy and Society Index.*[55] Danes are (with Swedes) those Europeans who have the most positive attitude to robots – 88% have a positive view.[56] A majority (59%) of Danes find that "Robots steal peoples' jobs", which in fact is an optimistic position as compared to EU average (70%) or most concerned country Portugal (89%).[3]

Industry status

Automation has been important for Danish industry. Danish robotics industry is at the front in Europe with a strong cluster, mainly on the island of Fuen (Fyn), which includes at least 80 companies with Universal Robots as the most well-known,[57] and which has strong back-up from Danish universities. The production industry is highly automated as a consequence of the high labor costs in Denmark but also because of Danish work environment regulation, which has forced industry to reduce monotonous repetitive work and heavy lifting at work places. Automation is at a level where Denmark is beginning to take back production which earlier was outplaced to cheap-labor countries.

Public sector status

The public sector in Denmark has been undergoing very fast and, reasonable to say, drastic digitalisation. The Agency of Digitalisation was established in 2011 and had its precursor in the Digitalisation Task Force established in 2001. Being an agency of the Ministry of Finance gives it power to push for strong implementation of rationalization and online services in the entire Danish public sector. One-by-one public services are being pushed into the online domain as the only access point for the citizens – although some citizen may apply for exemption and receive personal services. New Public Management has had its share of the digital development, for example in terms of front service personnel being logistically managed and reporting through hand-held PDA's such as for example in elderly care.

Private sphere status

Danish homes are well-connected to the internet and have taken online services in. 88% make use of eBanking and 82% make use of online shops.[2] Danish youth is trained in using online services, and a PC is a necessary work tool for a Danish pupil from primary school. Work from home is wide-spread and supported by the majority of Danish employers.

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54 ec.europa.eu/digital-single-market/en/digital-scoreboard.
55 ec.europa.eu/digital-single-market/en/desi.
56 Eurobarometer 382: http://ec.europa.eu/public_opinion/archives/ebs/ebs_382_en.pdf.
57 Steno, C. (2016) En klynge, der virker – Universal Robots og det fynske robotmiljø 1986-2016, csteno.dk.

Stress and work-life balance

Stress is a widespread condition among Danes. Costs of stress-related conditions are estimated as 1% of the Danish GNP (14 billion DKK) [58]. Surveys reported 5.8% of work force indicating stress symptoms in 1989 and 14.5% in 2015[59]. Out of those reporting stress in 2015, 99% related the condition to their working conditions, and 42% to a mix of work life and private conditions. This state of affairs is connected to high demand for adaption to organisational change, new or constantly changing ICT infrastructures, an increasing tendency towards work-at-home and work-at-any-time, work blending into private life, loss of joy with the work as a result of mainstreamed systems and less influence on one's own work, and a general high performance demand.

Reinforcing the Danish advantages

In June 2016 the Danish Government established a "Produktionspanel 4.0"[60] with 10 production/digital industry leaders, 2 university and technology services representatives, 2 representatives from the industry worker union CO-industri, and one person representing the World Economic Forum. The terms of references for the panel follow up on an earlier "Produktionspanelet" 2014-15, which looked at productivity in a broader sense. The new 4.0-panel will have a specific focus on Industry 4.0 and the challenges, especially for Danish SMEs, this will bring. The panel is to make recommendations about future frame conditions for Danish production so that Denmark can exploit the new opportunities for growth and enhanced productivity. It is to deliver its report by April 2017 at the latest.

Automation and the labour market

In December 2015 the Danish left-of -centre think-tank CEVEA and the Union of Office Workers (HK Danmark) published a report on the consequences of automation for the Danish labour market.[61] The results were comparable to known international studies but with a twist. For example, because of the already very high level of automation in Danish industry, the highest risks for loss of jobs were found to be in office work and customer services, and below that montage, operating and transport.

The debate has focused much on those job categories which are most at risk. Since these are jobs already known to be at risk, and since Denmark has already made a shift towards automation, much of the debate was dominated by a rather optimistic attitude to the development. Industry and union leaders seemed to be quite in agreement that Denmark would be able to cope with this – because we had done it before and because this was an already known tendency.

However, at the Danish democracy festival (Folkemødet) in June 2016 the Danish Board of Technology gathered industry, university and union representatives for a debate on the developments with a specific view on the full spectrum of jobs at risk. Taking the full picture into consideration, jobs at higher competence levels need to be seen at risk at levels of say 30-40% risk of job loss. This would make a more complicated situation, since even those jobs that the new unemployed in theory could be trained for, would be subject to much larger job market competition. There was broad agreement that this had largely been ignored in the Danish debate, and that it gave a picture which led to less optimism and called for increased political attention.

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58 stressforeningen.dk/om-stress/fakta-om-stress/stress-i-tal.
59 Danish Statistical Agency and National Research Center for Work Environment.
60 evm.dk/nyheder/2016/16-06-12-regeringen-har-sammensat-et-slagkraftigt-produktionspanel-4.
61 cevea.dk/filer/dokumenter/analyser/Digitale_trends_og_det_danske_arbejdsmarked.pdf.

Digital platforms

In general, Danish workers will find it hard to compete on crowdwork platforms because of the high competition on salaries on those platforms. The CEVEA/HK study[6] documents this, since Danish workers experience much lower salaries on these platforms than the Danish minimum wages.
In June 2016, the so-called "Uber trial" was concluded in Danish court, resulting in conviction of a number of Uber taxi drivers because they had driven taxis without permission and without living up to the specific and quite demanding set of rules for Danish taxis. More trials will come as a result of this test-case. The verdict will be challenged at a higher court level so the final word is not said yet.

4.2 Policy dimensions

Danish policy development has mainly had industrial advantages of developments in mind. Less attention has been given to the social and employment developments. The Parliament Folketinget has had several debates in Plenary but with no clear outcomes.

Equal rules for all

The debate around the 'Uber trial' indicated two contradicting positions: one stating that such platforms need to adapt to existing rules, and the other stating that rules need to be changed in order to provide space for such platforms and for more competition.
Among the involved branches the position seems to be that such platforms are here to stay and that the branches should adapt, but this demands that future policies should seek non-discrimination between known service systems and new platform based services. For example, the Danish taxi branch, the hotel branch and the transportation worker union 3F seem to agree that they are ready to compete with Uber and Airbnb if the same regulatory demands are put to all on the market.
Others call for an active Danish policy towards establishment of national or European platforms in order to provide competition to the multi-national or US-based frontrunners.

Job and income distribution

The Danish widespread optimistic approach to automation seems to somewhat have pacified policy-makers, since no clear strategies towards social consequences have been formulated yet. However, there are indications of a growing attendance towards the risks for increasing inequality.
As one means to counteract inequality there has been a call for Basic Income[62] – in Danish termed "citizen salary" – being a minimum yearly salary given to all citizens, employed or unemployed. One core argument for re-introducing the concept now is that Basic Income makes it easier to distribute work more evenly in times when there is not – or maybe even never will be – work for everyone. The main arguments against it are the need for strong taxation of work to finance it, and the lack of incentives for taking available work. No matter if Basic Income is the answer or not it seems that the future will bring a need for political clarification about distribution of available work.

4.3 TA perspectives

The Danish perspective on digitalisation and Industry 4.0 is already very much focussed on growth and productivity. TA needs to supplement this focus in order to provide a complete picture of the future developments. The societies that come out of these developments as winners will be those who will be able to balance between using the new techno-

62 en.wikipedia.org/wiki/Basic_income.

logical opportunities and still be able to ensuring welfare for its citizens. Three of the many important questions TA could take up:

Automation where it brings new qualities

Industry 4.0 provides opportunities for solving new problems or doing things in new and better ways for the population. For example, Fonden Teknologirådet in 2014 and 2016 reported that drones have potentials in organic agriculture, in search-and-rescue operations, dangerous fire and police work, difficult tele-medical situations, etc.,[63] and that Denmark is developing clusters for development of advanced application of drone platform[64], and these could be enhanced by strategic innovation for solving societal challenges. One can say that if automation brings risks of social disadvantages with it then it gets important to direct its use towards products and services, which bring other forms of advantages to workers, consumers and citizens. TA can identify needs and opportunities based upon input from industry and service providers, and not least from end-users in society.

The good life without (same amount of the same) work

Losing jobs in many and large sectors will bring serious societal conflicts with it if it results in a societal divide between the few well-off with jobs and the many poor without jobs. Imagining the combination of a labour market destabilised by digitalisation and a new financial crisis does not make up an attractive scenario. Therefore, innovative solutions to split work, and renewed definitions of the meaning of the word “work”, seem to be unavoidably connected to the future of higher digitalisation and automation if we want resilient and self-sustainable communities.
TA has a role to play by offering its methodologic services to communities and employers who wish to develop new approaches, be frontrunners in the definition of the post-digitalisation work balance, and in gathering examples and cases for others to be inspired from. The high stress levels in highly effective societies like the Danish already calls for such TA activities, since the existing welfare states already have a deep split between those at over-time work and the many being supported by social security systems, calling for new and innovative approaches.

User-defined and -owned platforms

The case of Uber shows that platforms developed by a foreign company intending to be universal will not live up to rules, ethics and social demands in all countries. The idea of making platforms developed by users and able to meet many kinds of needs has therefore been introduced. TA would be an obvious initiator of such a development by gathering actors – legal, employers, unions, trade branches, CSO’s and others – to define how platforms which balance different interests would look like, and to explore policy and framework condition changes needed.
Further, the de facto monopolisation and centralisation taking place when one platform is taking over a service at a global level has been a theme for political debates around the sharing economy: How much sharing is really going on when in fact very few persons harvest the profits? New models of platform ownership for the sharing economy therefore need to be developed if such a development is to become sustainable, and again, this could be a case for bottom-up TA exploration.

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63 Fonden Teknologirådet (2014) for the Danish Ministry for Science and higher education: tekno.dk/projects/civile-droner-i-danmark-potentialer-udfordringer-anbefalinger/.

64 Fonden Teknologirådet (2016) for the Danish Ministry for Science and higher education: tekno.dk/wp-content/uploads/2016/04/teknologiradets-kortlaegning-af-fou-uddannelse-og-offentlig-anvendelse-af-droner.pdf.

5 European Union

5.1 Status quo and societal debates

European society benefits enormously from progress in science and technology. The speed of development in this area raises challenges in policy development. An effective science-policy interface is crucial to ensure that legislators and policy-makers are equipped with the expertise needed to deliver effective responses to the opportunities and challenges facing the European society.

STOA has been supporting parliamentary work since 1987. During this time, it has grown into an indispensable service, supporting the European Parliament (EP) in responding to the wide-ranging consequences of rapid developments in science and technology. The STOA process supports mutual understanding between the science and policy communities and ensures that quality research is available to policy-makers at the right time. It delivers independent, impartial and accessible expertise to support the Parliament in a wide range of key areas following five priority thematic areas:

- Eco-mobility and modern energy solutions
- Sustainable management of natural resources
- Potentials and challenges of the Information Society
- Health and new technologies in the life sciences ('perfect life')
- Science policy, communication and global networking

Furthermore, STOA is active in science communication, promoting evidence-based knowledge and ensuring it is accessible to all citizens and stakeholders with regular publications, an active presence on the EPRS blog, and public workshops, seminars and annual lectures. Given that science and technology issues are present in so many of the opportunities and challenges facing European society, the analysis provided by the work of STOA enriches parliamentary debates and activities.

5.2 Policy dimensions

The impact of the ongoing digitalisation upon work and employment has become a source of major concern. The Members of the European Parliament (MEPs) are currently investigating this impact though studies and hearings with technical and social science experts. In particular, MEPs are interested in the future of labour in the digital era, trends regarding the digitalisation of work, and the development of instruments to anticipate possible future outcomes – both desirable and undesirable – in a robotised world. For instance, some MEPs consider the digital and robotics evolution as a positive challenge. Others are concerned about its disruptive character, such as for example the availability of jobs and the ways in which robots interact with humans in the workplace.

Two particularly relevant EP Working Groups have been recently set up. The Committee on Legal affairs (JURI), created the *Working Group on Robotics and Artificial Intelligence* at the beginning of the current legislative period. It will prepare a report on legal and ethical aspects of robotics. They are investigating many issues linking robotics and jobs, which are related to how we will live and work in the future. The Group's mission is to stimulate the reflection of Members on these issues by facilitating an exchange of views with experts and enabling Members to conduct in-depth analyses/examinations of the challenges and prospects at stake, in order to pave the way for the drafting of civil law rules in connection with robotics and artificial intelligence. The input gathered by the Working Group will be put

forward as a basis for future legislative activities. Its report is scheduled to be adopted by the Parliament in November 2016.[65]

STOA was asked to conduct a Scientific Foresight project to underpin the JURI own-initiative report, and to elaborate the ethics and future impacts of cyber-physical systems or CPS, being intelligent robotics systems, linked with the Internet of Things, or technical systems of networked computers, robots and artificial intelligence that interact with the physical world. The result was a study[66] illustrating where developments in the area of cyber-physical systems might take us and identifying related impacts and concerns. The study also identifies the areas of jurisdiction that should be addressed pro-actively along with issues of potential legal or regulatory interest. A policy briefing linked to the study presents legal reflections for seven areas of concern that fall within the jurisdictional remit of the European Parliament, identifying the issues that might have to be dealt with, the EP committees potentially concerned, and the legislative acts that might need to be revisited. STOA's work in this field is supported by a study on the impact of new technologies on the labour market and the social economy conducted by the Austrian Institute of Technology (AIT).

The Committee on Employment and Social Affairs (EMPL) has launched a *Working Group on the Labour Market Impacts of Digitalisation and Robotics* and has held several hearings focusing on understanding the possible impacts upon employment and labour. The Working Group is supported by two studies: one on *'Employment and Skills: Aspects of the Digital Single Market Strategy'*[67] and another on *'The future of Work digitalisation in the US Labour market',*[68] which focused more on jobs in the IT sector rather than on employment overall.

5.3 TA perspectives

The impact of new technologies on the labour market and the social economy

Despite a wealth of theoretical models and empirical evidence on the employment effects of technological innovation, there is a lack of studies on the complexities of the connection between technological innovation and employment and, more importantly, on the effects of specific technological trends upon specific employment sectors and professions in the European Union (EU) and their long-term impacts on our societies. Given that most of the employment effects of service digitalisation remain unacknowledged, especially in the context of the social economy, and thus poorly addressed in related policy measures, the purpose of this STOA project is to provide such a long-awaited assessment that could serve as a basis for legislative and policy initiatives that could safeguard meaningful employment.

The first part of the study will provide an in-depth assessment of the employment and wider social effects of the introduction of a wide range of new technologies based on a focus on selected technological trajectories and professions that are under threat. The study will assess how new technologies, especially the massive trend towards computerisation and digitalisation of tasks carried out by humans, could transform existing job profiles and affect EU labour markets on the whole and assess which job profiles will disappear as a result of digitalisation. Among these challenges, the study may need to look at the impact

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65 More information is available here: europarl.europa.eu/committees/en/juri/subject-files.html;jsessionid=BC99F48A4A420741A24E04FD184C34C6.node2?id=20150504CDT00301.

66 epthinktank.eu/2016/06/30/how-will-robots-change-our-lives-new-study-on-the-ethics-of-cyber-physical-systems-published/. A video summary is uploaded on the STOA YouTube channel at youtube.com/user/MySTOA.

67 europarl.europa.eu/RegData/etudes/STUD/2015/569967/IPOL_STU(2015)569967_EN.pdf.

68 europarl.europa.eu/RegData/etudes/BRIE/2016/578959/IPOL_BRI(2016)578959_EN.pdf.

that the introduction of digital technologies will potentially have on full-time and part-time employment, gender balance, work-life balance and, in particular, income inequality. Special attention will be paid to the influence of new technologies on the development of new forms of employment, with a special regard to different forms of crowdsourcing, and their influence on the labour market, including problems with flexicurity.

The second part of the study will examine whether technological developments can in fact be used as a response to ongoing unemployment problems and facilitate the design of social and labour market policies in a socially acceptable manner. The objective is not only to gain knowledge about the potential employment risks and opportunities associated with specific technological trends, but also to create a basis of discussions and analysis of active policy responses that could prevent or mitigate technological unemployment in concrete professional contexts and would be tailored to the needs and particularities of the employment markets of EU Member States. Finally, a set of policy options for their political management will be outlined and assessed based on the outcomes of the overall analysis that should include 'smart' regulatory and legislative pathways.

A workshop on the impact of new technologies on the labour market and the social economy is planned to take place in Brussels on the 11th of October 2016 that will bring together the main experts and stakeholders in the area.

Assistive technologies for the inclusion of people with disabilities in society, education and jobs

STOA hosted a workshop[69] and is now conducting a study on the role and impact of assistive technologies for the inclusion of people with disabilities in society, education and jobs. Access to society, education and the labour market are strongly interlinked. The project is examining the role of technology in fostering a more inclusive society, and also the wider impacts of these technologies, for example on people without disabilities.

Creating more high-skill jobs – Quantum technologies for Europe

Two recent high-level STOA events are relevant within the proposed EPTA theme, as they focused on key technologies and their possible applications for creating more high-skill jobs, which are key subjects for both Technology Assessment (TA) and Scientific Foresight work. On the occasion of the International Year of Light, STOA invited Professor Serge Haroche, winner of the Nobel Prize in Physics 2012, as a keynote speaker at its Annual Lecture 2015, entitled 'The power of single quantum particles of light and matter'[70]. He talked about what quantum physics means for the modern technological era: TVs, smartphones, computer screens, navigation systems and fibre-optical devices were developed as applications of quantum science.

The STOA workshop '*Quantum technologies for Europe – Opportunities for economy and society*'[71] served as a basis for addressing a comprehensive European synergy – essential for the full development of quantum technologies (QT), and provided an overview of the main advances in recent years and directions for future research. High-level scientists explained how and why quantum technologies will revolutionise the way we perform computation, communication and sensing. In addition, high-profile speakers representing a variety of enterprises already investing in QT described the disruptive potential of QT, as well as their vision for exploiting them in the market. This may have the potential of creating numerous high-skill jobs in Europe.

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[69] Held on the 23rd June 2015 stoa.europarl.europa.eu/stoa/cms/home/workshops/inclusion.
[70] europarl.europa.eu/stoa/cms/home/workshops/annual_lectures/annual2015.
[71] europarl.europa.eu/stoa/cms/home/workshops/quantum.

Earlier STOA work of relevance to the EPTA Conference theme includes the following studies:

New learning and teaching technology options

STOA hosted two workshops[72] and conducted a study on learning and teaching technology options.[73] These are relevant to labour in the digital age for two reasons. First, the educational sector involves many people with teaching jobs and, second, the job market requires skills that have to be acquired and taught. Both for teaching and learning, new technological trends can cause huge transformations.

Educational technology encompasses a wide array of technologies and methodologies shaped by stakeholder behaviour and affected by contextual factors, which, if adequately mixed, can contribute to students and teachers better achieving their goals. There is evidence that emerging technologies and the Internet are changing the way we receive, learn and memorise information, but compelling evidence of the benefits of technology on education is elusive. It is, however, clear that more technology does not yield better results by itself, as countries performing better in education worldwide and within the EU show a moderate use of technology. How technology is integrated in the educational process is the factor that makes the difference. It is expected that educational technology could contribute to improving educational achievements and increase competitiveness of EU workers.

The study found that technological development needs to be integrated into the educational process that in turn has to react faster to changes and innovation. Providing infrastructure and deploying technology needs to be combined with innovation in the curriculum, assessment methods, pedagogies and organisation of education. Learner data analytics can substantially improve education by personalising the process, but this raises security and privacy concerns.

Comprehensive on-going policies are required, covering technological, methodological, economic and regulatory aspects and counting on strong stakeholder engagement. Careful evaluation of the results of different interventions is crucial. Challenges in the field include: multiple ways of using technology, the increasing speed of technology evolution making current policies rapidly obsolete, a wide array of short-term outcomes and long-term impacts, persistent inequalities among and within countries, and the rise of the new 'knowledge' digital divide as a result of varying ability of students to use technology in their daily activities ('content consumers' vs 'content producers').

Impact and potential of collaborative Internet and additive manufacturing

New technologies appear set to become part of the accelerating co-creation process that will drive a fast-changing market for goods and services. As an example, 3D printing is changing the manufacturing and healthcare industries, as users become an active part of the process and products are personalised. In the near future, we can expect to have 3D-printed drugs, furniture, food and clothes. It will also become increasingly common for new businesses to be crowd funded.

The shared economy will have a considerable impact on the way we work in the future. This STOA study on this subject[74] comprises a review of the latest developments in the

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[72] The first was on 8 April 2015 europarl.europa.eu/stoa/cms/home/workshops/learning and the second on 6 May 2015 europarl.europa.eu/stoa/cms/home/workshops/teaching.

[73] Report: europarl.europa.eu/RegData/etudes/STUD/2015/547407/EPRS_STU%282015%29547407_EN.pdf.

[74] See: europarl.europa.eu/stoa/cms/cache/offonce/home/studies;jsessionid=0DC77D89644DAF09E3CF8CB86611713D?reference=EPRS_STU(2015)547425.

field, a forecast of the likely breakthroughs in the next ten years, an assessment of their potential impact, identification of key stakeholders and the formulation of policy options. Attention is drawn to a number of social, political, economic, moral and ethical issues also associated with the migration into this new way of working. Importantly, the impacts of the Collaborative Economy are not restricted to the conventional workplace, where economic activity currently takes place.[75]

[75] In addition to STOA activities, we would also like to highlight three examples of relevant work of other services of the EP and other European institutions: (1) *Economic and Scientific Policy, Wage and Income Inequality in the European Union*, a study by the Policy Department for Economic and Scientific Policy, Directorate General for Internal Policies, EP, 2015, europarl.europa.eu/RegData/etudes/STUD/2015/536294/IPOL_STU%282015%29536294_EN.pdf, (2) *ICT-induced Technological Progress and Employment: a Happy Marriage or a Dangerous Liaison? – A Literature Review*', a study[75] by the Joint Research Centre (JRC), European Commission, 2013: ftp.jrc.es/EURdoc/JRC76143.pdf, and (3) *Upgrading or polarisation? Long-term and global shifts in the employment structure: European Jobs Monitor 2015*, Eurofound, Publications Office of the European Union, Luxembourg, 2015.

6 Finland

6.1 Status quo and societal debates

As recorded by OECD,[76] Finland is facing an ageing population in an economic cycle where competitiveness has deteriorated and output has fallen, as the electronics and forestry industries have collapsed. Despite the recession, unemployment has not risen very much. The production structure has shifted from high-productivity manufacturing jobs to lower-productivity services. Finland, as well as other Nordic countries, is characterized by low income inequality due to its rather narrow wage dispersion.[77] In an EU study, Finland appears to be the least unequal country. Computerisation is expected to shape labour markets in the near future. Industrial Internet, peer-to-peer platforms and the sharing economy all have implications for labour markets and wage determination even though clear changes are not yet visible in statistical data.

According to ETLA[78] computerisation threatens one third of Finnish employment: "Low-wage and low-skill occupations appear to be more threatened. Service and public sector jobs are relatively more sheltered than those in manufacturing and the private sector. Nevertheless, computerisation will, to some extent, affect all occupations". Research results of ETLA comply with a survey conducted by the Association for Finnish Work in 2014: Over 80% of Finns believe that technology will replace human work and 27% are afraid of technology hampering their work[79]. The trend is towards self-organised work and occasional work placements. Ever more often, work end results (instead of working time) are seen as an indicator of work performance, and meaningfulness of work is more important than productivity. Work is no more the main route to societal connectivity.[80, 81]

According to Statistics Finland,[82] the share of labour force will decrease from 64% in 2015 to 57% in 2060. Finland follows a track of low economic performance.[83, 84] A digital disruption and its influence on disappearing work opportunities are recognised. The Institute for Economic Research[85] presents futures' scenarios of the Finnish economy until 2030. Scenarios are produced together with four ministries: economic affairs and employment; social affairs and health; education and culture; and finance. The structural change of the Finnish

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76 OECD (2014) OECD Economic Surveys Finland. Overview Finland 2014, oecd.org/eco/surveys/Overview_Finland_2014.pdf.

77 European Parliament (2015) 'Wage and Income Inequality in the European Union', European Parliament, Brussels. europarl.europa.eu/RegData/etudes/STUD/2015/536294/IPOL_STU(2015)536294_EN.pdf.

78 Pajarinen, M. & Rouvinen, P. (2015) Computerization Threatens One-Third of Finnish and Norwegian Employment. ETLA Brief 34, April 2015, Helsinki, etla.fi/en/publications/computerization-threatens-one-third-of-finnish-and-norwegian-employment/.

79 J. Juhanko et al. (ed.) Industrial internet transforms Finland's challenges into opportunities: background synthesis, ETLA Reports, No. 15, in Finnish.

80 Työn muutoskulut, osa 1: organisaatiot ja työn käytännöt (2016) Keskustelu: dialogi, työ ja tulevaisuus (2016), VTT Technical Research Centre of Finland Ltd, date Sept. 16, 2016, tyontulevaisuus.fi/2016/09/06/tyon-muutoskulut-osa-1-tyon-sisalto/.

81 Työn muutoskulut, osa 2: organisaatiot ja työn käytännöt (2016) Keskustelu: dialogi, työ ja tulevaisuus (2016), VTT Technical Research Centre of Finland Ltd, date Sept. 16, 2016, tyontulevaisuus.fi/2016/09/14/tyon-muutoskulut-osa-2-organisaatiot-ja-tyon-kaytannot/.

82 Nuorten osuus väestöstä uhkaa yhä pienentyä. Väestöennuste, Tilastokeskus, pvm. 16.9.2016, stat.fi/til/vaenn/2015/vaenn_2015_2015-10-30_tie_001_fi.html.

83 Suomen Tilastokeskuksen katsaukset vuodesta 2004. Suomen tilastokeskuksen kotisivu: Katsaukset: stat.fi/til/ntp/kat.html, pvm 15.9.2016.

84 Elinkeinoelämän Keskusliitto (2016a): Suhdannebarometri. Elokuu 2016. Elinkeinoelämän keskusliitto (2016b): Yleinen suhdannekuva likimain ennallaan elokuussa (2016) Luottamusindikaattorit, elokuu 2016, Elinkeinoelämän keskusliitto EK: both at ek.fi.

85 Työvoiman tarve Suomen taloudessa vuosina 2015–2030. Institute for Economic Research VATT:n tutkimukset 181, Helsinki.

national economy by widening the share of services (compared to refinement and primary production) is expected to continue in 2030. Foreign demand remains low and the growth of national economics is based on domestic demand. Public policy is expected to take action towards an increased rate of social involvement. This could mean decreasing poverty, since – for the most part – poverty in Finland means social alienation from the prevailing lifestyles.[86]

The Finnish economy suffers from offshoring, i.e. businesses moving abroad, even if there are efforts of turning the flow back to Finland.[87] Out of 229 business respondents, 30% have permanently moved production abroad in the last five years (2010–2015) and 13% have imported business to Finland.[88] There are, however, also strong arguments where technology has been seen as an opportunity rather than a threat. It is seen as a possibility to human betterment and well-being.[89] There are lists of new work opportunities, professions and customer needs that arise from technological triumph.[79, 90, 91]

It seems then, that Finland is reaching a turning point where a list of potential technology-based work tasks, professions and businesses suggested by researchers would probably get longer than a respective list of professions that are expected to disappear because of increased technology. The general spirit has changed towards the positive. Computerisation and digitalisation are most visible in banking and services. Finnish banks have been forerunners in developing Internet banking and payment transactions as part of digital services.[92] Combined with nano-, bio- and gene-technologies, robotics develops into new combinations of technological applications. Investments in new technology are seen to transform into work, economic growth and well-being. Together with “digi-affiliated” cultural and social innovations (intelligent networks and interfaces, intensified interaction, social media software) there are positive future prospects. In the industrial framework, the industrial Internet offers a lot of possibilities and there are both strengths and weaknesses in the current system.[79]

The sharing economy can be seen as an alternative way of securing welfare and income. The sharing economy can be seen both as a challenge as well as an opportunity for labour. It is not self-evident, however, that all changes caused by digitalisation and technology are good. Part-time jobs and precariousness of labour markets are one possible outcome suggested to have arisen from computerisation. Labour unions and employers’ associations have raised concerns about the effects of changing labour markets on an employers’ position. Part-time jobs are often not a voluntary choice but the only available option.[93] These changes also have consequences for the system of social security: How should legislation adapt to changing labour markets? Discussion on the forms of regulation with regard to peer-to-peer platforms and crowdwork (such as Uber and Airbnb) has main-

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86 See the definition of poverty in: Niemelä, M. & Saari, J. (2013) Suomalaisen Yhteiskunnan Notkelmat teoksessa Niemelä M. & Saari J. (toim.) Huono-osaisten Hyvinvointi Suomessa. Tampere. Juvenes Print.

87 Tavoitteena U-Käännös: Tuotanto Takaisin Suomeen, mutta Uudenlaisena (2016), Tampere University of Technology, Sept. 16,2016: tut.fi/rajapinta/artikkelit/2015/1/tavoitteena-u-kaannos_-tuotanto-takaisin-suomeen_-mutta-uudenlaisena.

88 Palaako tuotanto takaisin? Tutkimus Suomessa sijaitsevien yritysten tuotannon sijaintipäätöksistä ja tuotannon siirroista pois Suomesta ja Suomeen (2015) Tutkimusraportti, Tampereen teknillinen yliopisto, joulukuu 2015, Tampere.

89 Kiiski-Kataja Elina (2016) Megatrendit 2016. Tulevaisuus Tapahtuu Nyt. Sitran Raportti, Helsinki. Sitra.

90 Robotit Töihin, EVA Raportti 2/ 2016. ISSN 2342-8082, ISSN 2342-8090, Helsinki, Nextprint Oy.

91 Andersson, C. & Kaivo-Oja, J. (2012): Boho Busines, Ihmiskunnan voitto koneista. Talentum media Oy, Hansaprint Oy Vantaa 2012.

92 Dahlberg, T. and M. Halén (2016) Suomalaisten pankkien digitaalinen edelläkävijyys syntyi yhteistyöllä, Finnish banks became forerunners in digitalisation by co-operation, in Talous ja Yhteiskunta, in Finnish.

93 Akava, SAK, STTK (2012) Työelämän murros vaatii tarkennuksia lainsäädäntöön, in Finnish: sak.fi/ajankohtaista/uutiset/akava,-sak,-sttk-tyoelaman-murros-vaatii-tarkennuksia-lainsaadantoon.

ly focused on how the income from those sources should be taxed. There is need for composing a more comprehensive picture of how digitalisation and atypical work will change individual lives.

6.2 Policy dimensions

The Committee for the Future of the Parliament of Finland wrote in the previous Futures Report from 2014[94] that it "*agrees with the Government that work is of great importance both for the individual's wellbeing and also for the tax base of the welfare society. New technology, new operational models and the increasingly multipolar nature of the world are right now changing the structure of work and Finland's status in international value chains. Possible obstacles to re-shaping the structure of production and employment must be identified and dismantled…. The emergence and growth of also long-term unemployment must be tackled by increasing training, rehabilitation and various incentives aimed at employees and employers such as wage subsidies and participation rewards." The Committee recommended that "a key objective in the next Programme for Government and also a theme for a later Government Report on the Future be that of restructuring working life and employing Finns in such a way that the theme includes also promoting enterprise, using people's partial work ability as well as developing social security in a direction that supports these aims*."

In the Government Programme[95] there are work-affiliated issues with a plan of enhancing structural change of work. Special attention is paid to removing regulation and laws, which hinder the rise and utilisation of new technologies and intelligent digital applications. There are targets of digitalising public services and defining frameworks for growth of digital businesses, especially health care. Once during each electoral period, the Government submits to Parliament a report on the future (Futures Report) focusing on long-term perspectives. Each Futures Report is restricted to some key strategic issues relative to policy decisions to be taken in a 10–20-year period. Preparation of the next Government Futures Report commenced in March 2016 and the main themes involve reconfiguration of work and the future of Finnish labour.[96]

The purpose of the Government's Futures Report too is then to find answers to broad questions on the future of how we work and how Finland can adapt to the changes successfully. The Government Futures Report will be later responded to by the Finnish Parliament/The Committee for the Future. This futures dialogue between the Government and the Parliament is the key element of the Finnish futures policy. The Government foresight report will be prepared by the National Foresight Network (established in 2003)[97] that conducts regular foresight work. The aim of the National Foresight Network is to raise awareness of Finland's new challenges and opportunities so they can be discussed, studied, and considered in decision-making. There are, for example, web-based working modes with open discussion platforms. The National Foresight Network is coordinated by the Government Foresight Group, which was appointed by the Prime Minister's Office on 21 January 2015. This Group is responsible for leading and coordinating national foresight efforts and

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94 Committee for the Future (2014) An enabling state – experimenting Finland. 10/2014. Helsinki, eduskunta.fi/EN/lakiensaataminen/valiokunnat/tulevaisuusvaliokunta/Pages/default.aspx.

95 Ratkaisujen Suomi (2015) Pääministeri Juha Sipilän hallituksen strateginen ohjelma, hallituksen julkaisusarja 10/ 2015, pvm 29.5.2015, valtioneuvosto.fi/sipilan-hallitus/hallitusohjelma.

96 Government Report on the Future (2016), Sept. 19 2016: vnk.fi/tulevaisuusselonteko?p_p_id=56_INSTANCE_SSKDNE5ODInk&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=2&_56_INSTANCE_SSKDNE5ODInk_languageId=en_US.

97 foresight.fi/info-in-english/.

for making this operation visible.[98] By selecting work as the next theme of the Government Futures Report the Finnish national governance has shown the way of not only governing "digi-driven" structural change of work life in a long range, but also demonstrating new ways of foresight-supported decision-making processes with crowdsourcing and citizen involvement.

6.3 TA perspectives

According to the Committee's Futures Report Finland has traditionally been a land of pioneers and eager embracers of innovations. As long ago as the 19th century, Finland was one of the leading countries in the adoption of new inventions. It was among the first countries in Europe to have electric light and telephones. Nokia's success as a developer of telephone technology was more than just a fortunate coincidence. For example, a professorial chair in theoretical electronics was created at the Helsinki University of Technology already in the 1950s, followed by the first chair in telecommunications the following decade. The same period saw the creation of chairs in data processing science at the University of Tampere (1965) and the University of Helsinki (1967), and the electrical technology department at the University of Oulu (1965). It was from these investments in information technology (including radio technology) and telecommunications that Finnish competence in information technology grew. Electrical technology and electronics accounted for 2% of Finnish exports in 1970, 4% in 1980, 11% in 1990, 31% in 2000, and 15% in 2010. Thus, science and basic research are turned into business operations and industry, but the time lags can be very long.[94]

The Finnish pioneering spirit in technological development was still alive and thriving in the 1980s and 1990s. In the 1990s, Finland was a shopping window for the world after it had been faster than others to embrace the Internet and mobile technology. Almost imperceptibly, however, the pioneering spirit ebbed in the first decade of the new century, although there was much talk of innovation. The ebbing pioneering spirit and narrowing perspective have been noticed by the Committee for the Future, whose Radical Technologies section developed the technology foresight model which combines a comprehensive recognition of the possibilities of new radical technologies with a systematic assessment of these possibilities.[99,100] As a result of the study, 100 radical technological solutions that were judged, in the light of the most up-to-date information then available, to be those likely to change the world most were identified. These hundred technologies can be awarded points both generally (global model) or from the perspective of Finland. From the point of view of Finland, the list of most important technologies is presented in the box below.

These TA results were evaluated in 2016.[101] According to this evaluation, the technologies ranked in the top quarter in the four-level model progressed more quickly during the review period than those ranked in the second quarter. From the perspective of the four-level

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98 National Foresight Cooperation, website of the Prime Minister´s Office, pvm 18.9.2016, vnk.fi/ennakointi?p_p_id=56_INSTANCE_suTesGGAoTTd&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=2&_56_INSTANCE_suTesGGAoTTd_languageId=en_US.

99 Linturi, R. & Kuusi, O. & Ahlqvist, T. (2013): Suomen sata uutta mahdollisuutta: radikaalit teknologiset ratkaisut. Tulevaisuusvaliokunnan julkaisuja 6/2013. Helsinki.

100 Kuusi O. & Vasamo L. (2014): 100 Opportunities for Finland and the World. Radical Technology Inquiries (RTI) for Anticipation/ Evaluation of Technological Breakthroughs (2014). From the original Finnish book "Suomen 100 uutta mahdollisuutta" (2013). Translated, updated and edited by O. Kuusi & A. Vasamo. Publication of the Committee for the Future 11/2014, eduskunta.fi/EN/lakiensaataminen/valiokunnat/tulevaisuusvaliokunta/Pages/default.aspx.

101 Linturi, R. (2016) Technological Change 2013–2016. Preliminary investigation: Development of radical technologies after the review in 2013, Publication of the Committee for the Future 2/ 2016, eduskunta.fi/EN/lakiensaataminen/valiokunnat/tulevaisuusvaliokunta/Pages/default.aspx.

model, the result means that the technology baskets ranking highest in the model are the most likely to make progress. From the perspective of anticipation, this is a very important achievement:

Technology baskets 1–25 rate of progress 3.64
Technology baskets 26–50 rate of progress 3.36
Technology baskets 51–75 rate of progress 3.00
Technology baskets 76–100 rate of progress 2.76

The above figures describe the average rate of progress by category. The categorisation is the same as was used in original report,[99] influenced by Finnish expertise and export channels. When these influences are eliminated and a global ranking is applied[100] the difference between the top and bottom quarters increases slightly, while the difference between the second and third quarters becomes slightly narrower.[101]

According to the Committee for the Future,[94] Finland must have up-to-date competence in these technologies with the potential to change the world significantly in the next few decades. Finland should be especially active in those technologies that are of importance for the country's biggest sectors, particularly those yielding the highest exports. In addition, the Finnish research and training system should already in good time create competence in technologies that are predicted to become widespread only in 20–30 years' time. If we get into action only when technologies are already mature and certain, we are hopelessly late. Playing a pioneering role in technology presupposes vision and boldness.

Work on radical technologies by the Committee for the Future continues internationally as an EU Call for Tender for a study on "Horizon Scanning for Radical Innovation Breakthroughs".[102] There are European research groups competing for financial support for the enhancement of anticipating and advancing possibilities of radical technologies.

Epilogue: The Committee for the Future has approached the issue of future´s work through the anticipation of such new radical technologies that have wide-scaled influences on the society at large. The Committee's vision is that new technologies create work. In the list below radical technologies are listed according to the needs of society (sc. value baskets) and Finnish export cluster's global competitiveness. By this way the Committee is promoting not only growth but sustainable growth. Additionally, in the Government´s programme the role of entrepreneurship and investments are emphasized. New technologies alone are not enough. We will need new kinds of business intelligence (like sharing economy) too. New technologies will create new kinds of work. They will change traditional work tasks and create totally new ones. The third action line is education. In Finland, Regional Councils are composed of surrounding municipalities and they function as an authority for the anticipation of education needs in their own region. Latest foresight reports of education needs by the Finnish National Board of Education consider food (including retail and processing chains), games industry and services for elderly (years 2015-16).[103] Education of social issues, health, natural resources, exercise and environment will also be increased. The Ministry of Education plans to increase the amount of higher education (university) degrees too and resources are allocated to the education of technics and traffics until 2020.[104]

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[102] Horizon Scanning for Radical Innovation Breakthroughs (2016) Call for tender of the European Commission, Directorate-General Research and Innovation, Directorate A – Policy Development and Coordination Unit A.6 – Data, Open Access and Foresight Call, tender specification: Ref. Ares(2016)2934001 – 24/06/2016, etendering.ted.europa.eu/cft/cft-display.html?cftId=1725 and infoeuropa.eurocid.pt/files/database/000072001-000073000/000072476_2.pdf.

[103] Koulutus- ja osaamistarpeiden ennakointi, pvm. 27.9.2016, julkaisuja: oph.fi/tietopalvelut/ennakointi/koulutus_ja_osaamistarpeiden_ennakointi.

[104] OKM:n työryhmä linjasi 2020-luvun koulutustarpeita, pvm. 1.7.2015, tiedote OKM:n kotisivulla, pvm. 18.9.2016: http://minedu.fi/OPM/Tiedotteet/2015/07/koulutustarpeet.html?lang=fi.

Box: The most important radical technologies for Finland

Radical technological solutions in sectors with the strongest export preparedness

- Antibacterial and other dirt-rejecting materials and surfaces
- Nano-cellulose and cellulose micro-fibre
- Wireless transmission at 2.5 terabits per second (vortex beam)
- Production of liquid fuels with the aid of enzymes, bacteria and algae

Top Ten radical technological solutions in the sector with good capability to export

- Gamification of cooperation and society
- Robot car
- 3D printing of goods
- Printable and similar inexpensive sensors
- Rapidly cheapening solar energy
- Personal analyser for own body
- Medication to prevent dementia
- Light and efficient rapidly chargeable batteries and condensers
- Haptic user interfaces
- Movement-based drive controllers

Top Ten radical technological solutions in the sector with limited export capabilities

- Open data and Big Data
- Freely organisable distance work and organisations that form on the Internet
- Expanded reality instruments
- Reorganisation of learning
- Biochips or biosensors that quickly and cheaply recognise diseases, physiological states and the properties of organisms
- Cloud computing, massive concentrated data and processing power
- Routine comprehensive DNA reading
- Material radar
- Modular robotics
- Real-time 3D environment modelling

Top Ten radical technological solutions in the scientifically most interesting sectors

- Extremely dense processors that take quantum phenomena into account
- Biochips or biosensors that quickly and cheaply recognise diseases, physiological states and the properties of organisms
- Routine comprehensive DNA reading
- Medication to prevent dementia
- Genetics-based medicines
- Life simulation on the cellular level and artificial cells
- Genetically modified organisms as producers of multi-use materials
- Prolonging life and slowing ageing
- Repair and re-growth of organs, cell cultivation
- Nano-carbons in removing salt or bacteria and other separation techniques

Top Ten radical promises at laboratory test level

- Wireless transmission at 2.5 terabits per second (vortex beam)
- Life simulation on the cellular level and artificial cells
- Piezoelectric energy sources, harnessing kinetic energy
- Prolonging life and slowing ageing
- 3D printing of buildings
- Repairing brains and enhancing abilities
- Efficient light solar panels
- 3D and 4D printing of materials
- Repair and re-growth of organs, cell cultivation
- Self-organising virtual world from Internet 3D data

7 France

7.1 Status quo and societal debates

Just as any other national industry all over the world, French industry is transformed in depth by the new industrial revolution. This change arises as a result of pressure from international competition, which requires each producer to remain up-to-date with their respective digital tools.

This “Fourth” industrial revolution means that new production methods are implemented. They are based on the introduction of disruptive digital technologies, mainly in four domains:

- Additive Manufacturing
- Cobotics (Collaborative Robotics)
- Artificial Intelligence
- Internet of Things

The aim is to produce in a shorter time, more properly, for a product quite more “tailored” to customer demand. All this requires a redefinition of work organization and business models. This is not without consequences on the development of skills and qualifications of employees in place and future.

The implementation of these disruptive digital technologies make it possible for new industrial actors, coming from digital world, to take control of traditional activities, thanks to Internet of Things and Big Data, with better services and better prices.

There is something *quite usual in this impact of new technologies on business*: more competitive activities replace less competitive ones, and available workers must learn and use them and increase their skills.

Yet there is also something *quite specific* about this digital revolution: there is a change to a finer and finer division of labor, and the main consequence is an increase of independent workers, with a risk for them to be deprived of any social or legal protection.

One figure confirms that something is going on towards this direction: after a long decline, the share of independent workers in France has continuously increased since 2000 from a minimum of 8.8% to 10.6%.[105] Even more precisely, this share has grown from 5.6 % to 7.8 % for all sectors except for farming.

7.2 Policy dimensions

In France, like anywhere in the world, we can already observe the effects of this Digital Revolution in two traditional activities: hotel and taxi, with, on the one hand, the successful spread of Airbnb and Uber, and, on the other hand, protest movements from trade unions.

This evolution is partially linked to the fact that the *digital revolution allows better and more precise management of information*. So there is less need for traditional organizational mediation through big companies or factories, in order to deal and spread information, because coordination can now be more easily digitally managed: according to this new scheme, an order could be given directly from the customer to all concerned workers, each for his share.[106]

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[105] insee.fr/fr/themes/series-longues.asp?indicateur=part-non-salaries.

[106] This is a result of the French “Economics of Conventions”. Cf. for example : *L'entreprise dans l'économie des conventions*, P. Ughetto, Revue économique 2000, vol. 51, n. 1. persee.fr/doc/reco_0035-

Some trade unions fear that such an evolution may destroy their negotiating power in the end. They notice that there is a strong trend of externalization for many activities which were usually managed internally, such as for example cleaning and transportation. The next step towards externalization could be getting all new services from independent workers only.

Some even describe a future industrial world where all jobs will be digitally auctioned day after day, service by service, in order to get the best price for each.[107]

As a consequence of this evolution, two kinds of new institutional events are observed:

- First, there are trials: since September 2015, a trial against Uber by the General Attorney, based on the accusation of breaking the rules of transportation; since May 2016, a trial against Uber by URSSAF, which is the French organism in charge of collecting welfare taxes for Social Security; and trials against Airbnb by tourism organizations for unfair competition;
- Second, French Parliament have more often to deal with problems concerning social rights acknowledged to individual workers rather than social rights acknowledged to industrial workers. A law was voted in October 2014 to protect taxis against Uber (*loi Thevenoud*). A general law about digital problems (*loi pour une République numérique*) voted in July 2016 includes articles to protect traditional renting against Airbnb.

7.3 TA perspectives

The implementation of disruptive digital technologies involves many challenges for society, and some official French assessment bodies, among them OPECST, has been already asked to deal with them:

- As far as *Additive Manufacturing* is concerned, a study has been made by the "Conseil économique, social, environnemental"[108] which is an advising body next to the Government and the Parliament;
- OPECST has organized a public hearing about "*Robotics and Law*"[109] in December 2015;
- OPECST recently appointed two of its members in order to assess the impact of progress in *Artificial Intelligence* on all everyday life activities; they have delivered a preliminary study;
- OPECST has organized a public hearing about *Internet of Things and Big Data*[110] in July 2015.

There are generally two main ideas coming out from these studies:

First, there is a need for more research to *improve the implementation of these technologies*, and to use them both for competitiveness and for sustainable development.

An example may be drawn from *precision agriculture*: thanks to Internet of Things, and captors put on farming machines, some Big Data calculations may infer guidance information, so that it is possible to reduce the quantities of fertilizer exactly to the necessary

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2764_2000_num_51_1_410496. For a more recent analysis of the same kind, cf. The Economist, 3rd January 2015, *There's an app for that,* economist.com/node/21637355/print.

107 Cf. for example this quotation of a member of IG Metall: sitecommunistes.org/encheres.htm.

108 lecese.fr/travaux-publies/innovations-technologiques-et-performance-industrielle-globale-exemple-impression-3D.

109 assemblee-nationale.fr/14/rap-off/i3551.asp.

110 assemblee-nationale.fr/14/rap-off/i2969.asp.

level, inch by inch. This makes it possible to only use the necessary quantity of fertilizer, and thereby to reduce both the cost of production and pollution.

The other main idea coming out from these assessments is that there is *a need to train workers* in order to help their adaptation to new technological context.

The *first need for training* concerns how to use new technological tools, since new technical possibilities are not completely fulfilled in case of poor hand using. Generally the improvement in skill is a way to get more comfortable work conditions, since new tools are conceived in a view of cooperation between workers and machines: they are “cobots” in a large meaning.

In France, like in other countries, prospective analysts consequently raise several questions:

- What are the skills requirements for the transition to the factory of the future?
- Can we anticipate what the jobs of tomorrow will be?
- How will the scope of the businesses concerned evolve?
- What will be the impact on work organization and management methods?
- How should the challenge of a probable break in the structure of employment and qualifications be managed?
- What is the best way to adapt initial training to support these developments?

In France, up to now, the answer to all these questions is an increasing awareness of the need for offering enough continuing training for all workers throughout their professional life. For example, Parliament took this need clearly into account in the law on university and research of July 2013.

Unfortunately, there is a *second new need for training* along the digital revolution, and it concerns how to move to new jobs, since the implementation of these disruptive digital technologies make it possible for new industrial actors, coming from digital world, to take control of traditional activities, thanks to Internet of Things and Big Data, with better services and better prices.

8 Germany

8.1 Status quo and societal debates

Digital media now not only affects private life, but also work life to a degree which should not be underestimated. The impact of the internet and new technologies on the economy and society are tremendous, and the rapidly growing proliferation of information and communication technologies (ICT) is playing an increasingly central role in companies' abilities to compete and innovate. According to many experts, the digitising of production and business processes, shifting work to the Cloud with the creation of suitable new business and employment models, and the growing use of mobile devices for work, are key in processing change in the working world. Although the focus has long been on options for technical implementation and the economic significance of digitisation for business and particularly for production, there has been greater focus on questions regarding changes related to work in line with digitisation for some time now. The topicality of this topic, and the increasing social significance, are both reflected in the countless recent trend studies, analyses and projections of relevant research institutes and interest groups and their numerous publications on this subject in feature sections.[111,112]

8.2 Policy dimensions

All experts agree that the effects of digitisation will change the workplace. However, there is disagreement as to how specifically and to what extent this change will take place. There are a lot of possible future scenarios, but it is also clear that digitisation processes are inevitable for companies and the economy. This is already evident in all production and service sectors. Adapting to and integrating digital technologies and innovations will remain a key challenge for companies of all sizes in the future. For employees, solid and continuous education appears to be important in order to keep up with these changes, as well as remaining flexible enough to be able to manage the challenges posed in professional life. With respect to social challenges, brought about by developments in digitisation, it will be key for politicians to recognise possible drawbacks of digitising the workplace too early and to regulate these. This topic is now also of great importance for political agendas; how the increasing digitisation of business will influence the workplace in the future is, amongst other topics, addressed in a green book presented by BMAS in April 2015, and a dialog that was initiated on this topic. The goal is to discuss the challenges and opportunities during times of technological, demographic and cultural change with science, social partners, associations and industry practitioners, as well as with zens.[113,114,115] In 2016 BMBF is also attempting to find innovative approaches for creating sustainable and socially acceptable jobs through various programmes, like for example,

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111 Landmann, J.; Heumann, S. (2016): Auf dem Weg zum Arbeitsmarkt 4.0? Mögliche Auswirkungen der Digitalisierung auf Arbeit und Beschäftigung in Deutschland bis 2030. Bertelsmann Stiftung, Stiftung neue verantwortung (ed.), Gütersloh/Berlin.

112 ver.di (ed.) (2015): Gute Arbeit und Digitalisierung. Prozessanalysen und Gestaltungsperspektiven für eine humane digitale Arbeitswelt. Berlin.

113 BMAS (Bundesministerium für Arbeit und Soziales) (2015): Grünbuch Arbeiten 4.0. Berlin.

114 BMAS (2016a): Foresight-Studie "Digitale Arbeitswelt" (by Wenke, A., Bovenschulte, M., Hartmann, E., Wischmann, S.). Research report No. 463, Berlin, bmas.de/SharedDocs/Downloads/DE/PDF-Publikationen/Forschungsberichte/f463-digitale-arbeits-welt.pdf;jsessionid=11EC0CB6A6F224D34D291DB1AE2C1A90?__blob=publicationFile&v=2.

115 BMAS (2016b): Werkheft 01. Digitalisierung der Arbeitswelt. Berlin.

the program “The Future of Work” and the umbrella programme, “Innovations for Production, Service and Work of the Future” which runs until 2020.[116]

8.3 TA perspecitives

Literature and the public debate on digitising the working world typically address the following four main topics with regards to changes and impacts on people and work or society: 1) effects on employment, 2) further education and qualification, 3) flexibility and balancing work and family, as well as 4) new digital forms of work.

Trend 1: Economic effects, particularly effects on employment due to digital streamlining

A number of prominent studies focus primarily on the potential positive economic effects which accompany digitising the workplace in Germany. Bitkom and Fraunhofer IAO for example, expect an additional growth potential of 78 billion euros in Germany by 2025 from “Industry 4.0”, i.e. through digital, intelligent, integrated and autonomous production.[117] This is made possible by merging production methods through ICT and the internet. A study on behalf of The Federation of German Industries (BDI) cites digitisation as a basic innovation which determines the sustainability of European industry. Integrated production, as well as new business models, could provide Europe with 1.25 trillion euros of gross value added by 2025.[118] Inconsistent are the discussions in literature as to the expected effects on employment in Germany. On the one hand, there are positive expectations, e.g. from Bitkom, which predict that digitisation will further result in a considerable increase in jobs. According to Bitkom, already in 2012 every 25th job was owed to digitisation.[119] Boston Consulting Group is also assuming net growth; it predicts that while 610,000 jobs in industrial production will be lost in line with Industry 4.0 establishing itself by 2025, 960,000 jobs will be created in IT and data processing, which would mean a total of 350,000 new jobs in Germany.[120]

On the other hand, there are concerns over negative effects on employment, i.e. concerns over massive job losses in business. This often focuses primarily on the social effects of digital job rationalisation potentials, whether in application fields of production, logistics or increasingly so, even knowledge-intensive jobs.[121,122] Frey and Osborne for example came to the conclusion that by 2030, about 47% of all jobs in the USA will fall victim to automation.[123] Various studies have attempted to apply the calculations from this study to the German job market. Bonin et al. concluded a similar probability of automation in Germany, therefore meaning that 42% of employees would be directly affected by possibly losing their jobs.[124] Wolter et al. along with ING DiBa are painting a comparatively pessimistic

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116 BMBF (Bundesministerium für Bildung und Forschung) (ed.) (2016): Zukunft der Arbeit. Innovationen für die Arbeit von morgen. Berlin, pt-ad.pt-dlr.de/_media/zukunft-der-arbeit_programm.pdf.

117 Bitkom; Fraunhofer IAO (Fraunhofer Institut für Arbeitswirtschaft und Organisation) (ed.) (2014): Industrie 4.0 – Volkswirtschaftliches Potenzial für Deutschland. Berlin/Stuttgart.

118 Roland Berger Strategy Consultant; BDI (Bundesverband der Deutschen Industrie e.V.) (2015): Die digitale Transformation der Industrie. Berlin.

119 Burger, C. (2014): Bitkom: 1,5 Mio. neue Stellen durch Digitalisierung. In: VDI Nachrichten 7, o. S.

120 BCG (Boston Consulting Group) (2015): Industry 4.0. The Future of Productivity and Growth in Manufacturing Industries. bcgperspectives.com/Images/Industry_40_Future_of_Productivity_April_2015_tcm80-185183.pdf.

121 Brynjolfsson, E. & McAfee, A. (2014): The Second Machine Age. New York/London.

122 Kurz, C. & Rieger, F. (2013): Arbeitsfrei. Eine Entdeckungsreise zu den Maschinen, die uns ersetzen. München.

123 Frey, C. & Osborne, M. (2013): The future of employment. How susceptible are jobs to computerisation. Oxford Martin Programme on the Impact of Future Technology and Employment, Oxford.

124 Bonin, H.; Gregory, T. & Zierahn, U. (2015): Übertragung der Studie von Frey/Osborne (2013) auf Deutschland. Kurzexpertise Nr. 57, Mannheim.

picture.[125,126] The BMAS also assumes the probability of automating jobs is highest for low-qualified and low-income earners, and these jobs would also be most likely at stake.[113] Currently, however, Germany is seeing no negative digitisation-related rationalisation trends and so, at this time, it remains uncertain as to how employment will hang in the balance in relation to the digital workplace. However, German labour experts are pointing out great differences in the business and qualification structures between the USA and Germany.[127] Germany has a relatively high level of qualification in various areas of production and production-related services; about 90% of employees in the automotive industry, and 85% of employees in the ICT service industry, hold a vocational or university degree. 71% of all employees in Germany are already seeing and managing significant technical and organisational changes in the workplace. Employees therefore have a "spirited work capacity" in handling complexity and uncertainties, i.e. they manage multiple changes and apply the necessary knowledge to their job, putting them in a good position to maintain their employability during times of digitisation.[128]

Trend 2: Further education and qualification

The current debate often addresses how much the technical-economic changes will affect the requirements and skills of employees, and which actions can be taken in response. Current publications agree that increasing digitisation of the workplace particularly requires everybody to be well qualified and to have ongoing education in order to be flexible and adapt to technical changes, but also to potential changes in the employment structure. These aspects are still discussed as a priority as they mainly relate to changes in production and less so to the service sector. According to a Fraunhofer IAO study on future production jobs, 80% of the companies surveyed assume a great need for qualification among their employees in order to meet future requirements of flexible production.[129] The importance of data analysis, information and data processing, data security and protection, the use of digital tools, 3D printing, but even self-management and team working skills, will increase with regards to production in the future.[130] But despite greater requirements with respect to acquiring IT skills, employees will still need sound knowledge in their core fields of competence, be it in assembly or in mechanics. Experts also predict a high need for qualifications and retraining in the service sector.[114] The overall trend expected is that jobs in the production and service sector, created from digitisation and automation, will be more challenging than those eliminated by the expected pushes for mechanisation. Accordingly, this means that it will be essential to lay the foundations to qualify a large number of employees for these more complex jobs, which are also more difficult to automate. Many German economic sectors already have a significant culture of continuing education within

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125 Wolter, M.; Mönnig, A.; Hummel, M.; Schneemann, C.; Weber, E.; Zika, G.; Helmrich, R.; Maier, T. & Neuber-Pohl, C. (2015): Industrie 4.0 und die Folgen für Arbeitsmarkt und Wirtschaft. Szenario-Rechnungen im Rahmen der BIBB-IAB-Qualifikations- und Berufsfeldprojektionen. IAB Research report No. 08/2015, Nürnberg.

126 ING DiBa AG (2015): Die Roboter kommen. Folgen der Automatisierung für den deutschen Arbeitsmarkt. ing-diba.de/pdf/ueber-uns/presse/publikationen/ing-diba-economic-research-die-roboter-kommen.pdf.

127 Pfeiffer, S. (2015b): Schriftliche Stellungnahme zum öffentlichen Fachgespräch des Ausschusses Digitale Agenda. Deutscher Bundestag (ed.), Ausschussdrucksache Nr. 18(24)70, bundestag.de/blob/389692/4700320897bb1fc031a6cb27af2ce293/a-drs-18-24-70-data.pdf.

128 Pfeiffer, S. (2015): Auswirkungen von Industrie 4.0 auf Aus- und Weiterbildung. Wien, epub.oeaw.ac.at/ita/ita-manuscript/ita_15_03.pdf.

129 Spath, D. (ed.); Ganschar, O.; Gerlach, S.; Hämmerle, M.; Krause, T.; Schlund, S. (2013): Produktionsarbeit der Zukunft – Industrie 4.0. Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO, Stuttgart.

130 VDI/VDE-IT (2016): Wandel von Berufsbildern und Qualifizierungsbedarfen unter dem Eindruck der Digitalisierung. Horizon-Scanning, Berlin (in preparation).

many companies, although some companies do not adequately promote further education and qualification.

Trend 3: Flexibility and the balance between job and personal life

In terms of mobile digital work, an increasing loss of boundaries between work and private life and the increasing intensity of work are often discussed. The opportunities to work anytime and from anywhere result in more flexible working, which also impacts upon personal life. Based on the booming opportunities for digital and mobile work, literature often discusses flexibility in a positive tenor with respect to being able to balance job and personal or family life better.[131,114] On the other hand, some studies and opinions also reflect a rather pessimistic picture of digital flexibility. In addition to the increasing consolidation and trend to speed up work, these also address the increasing risk of being constantly available due to eliminating the boundaries between work and personal life.[132] Instruments such as "digital closing time" at companies such as VW or Daimler, or even the "right not to be available" discussed in politics, are attempts to respond to potential negative impacts in the sense of worker protection as early as possible. In this respect, many labour experts point to the fact that this elimination of boundaries or increased stress is not only being caused by digital technologies as such, but that this trend can often be attributed to extensive economic and political processes. This interplay between the potential influences and effects of digital technologies, organisational processes, and the social context, is currently being addressed more and more in various discussion groups, bodies of experts and dialogue forums (recent examples are the digital forum BMAS "Labour 4.0" or the ver.di "Good Work Initiative").

Trend 4: New digital modes of working

New digital modes of working such as crowd working, i.e. outsourcing traditionally internalised tasks to an external group online, are currently being fervently discussed. On one hand they represent a "nice new workplace", promising new forms of virtual collectiveness, many degrees of freedom and gains in autonomy. On the other hand, there are concerns over a growing casualisation and erosion of working standards. Contrary to the USA, for example, crowd working is still on the fringes in Germany and it is unrealistic to expect that it will become a predominant work model anytime soon.[133] This can neither be assumed within the ICT sector, nor for other workplaces. At this time, the future development of crowd working and related forms of new, digitally supported work is still unclear. Nevertheless, the creation of digital business and employment models, contrary to traditional work models, can be observed. New forms of technology-assisted division of labour are evolving, using online platforms to allow new ways to collaborate, and could potentially further fragment and differentiate global value chains through more global division of labour. In this respect, it is the job of politicians and the players involved, particularly trade unions, to negotiate the safeguarding of work and to create "fair rules of the game" in order to soften potentially increased competition and ensure negotiated labour standards.

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131 Kagermann H. (2014): Chancen von Industrie 4.0 nutzen. In: Bauernhansl, T.; Hompel, M.; Vogel-Heuser, B. (eds): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Wiesbaden, pp. 603–614.

132 IG Metall (2014): Ausmachen, abschalten. Kampf dem E-Mail-Wahnsinn: ständige Erreichbarkeit macht krank, igmetall.de/kampf-dem-e-mail-wahnsinn-staendige-erreichbarkeit-macht-krank-13415.htm.

133 Leimeister, J.M. et al. (2015): Digital Working und Crowd Working: Neue Arbeits- und Beschäftigungsformen heute und für die Zukunft. In: Schlick, C. (ed.): Arbeit in der digitalisierten Welt. Beiträge der Fachtagung des BMBF 2015. Frankfurt am Main, pp. 107–118.

9 Greece

9.1 Status quo and societal debates

Developments in information and communication technology are leading to fundamental changes in normal working relationships, which are becoming increasingly flexible. New forms of employment emerge which are in the grey area between employment contracts and independent work.

The most common change resulting from the recent technological development is the recourse to the nomadic work, i.e. work through smartphones or laptops during all working hours. In the same context, there is a development of on-call work, i.e. work which does not ensure the employee fixed working hours (instead, these vary depending on the needs of the company). Crowdwork in the field of services is not highly developed yet, however it is expected to start rising soon.

9.2 Policy dimensions

The fact that the changes reported are still not very widespread, the issues associated with them are not present much in societal debates and no policies are proposed to address the related consequences. The only issue we can mention is the establishment of a presumption of dependent work in the case of telework and the regulation of the working conditions of teleworkers.

As the debate concerning digital labour, sharing economy and automation is still quite new, there are not many proposed policies on the topic in Greece. It seems that issues relating to the contemporary economic crisis naturally absorb the attention of labour unions and employers' associations.

9.3 TA perspectives

Status of employee

The status of employee constitutes a condition of application of protective rules of labour law. However, ICT workers, taking into account that they work away from the premises of the company, appear as independent workers. Therefore, labour law is not applied even if they are economically dependent.

Article 1 of the Greek Law 2639/1998 provides, especially in cases of tele-working, that, between the employer and the employee, for the provision of services or work for a fixed or indefinite time, a contract of dependent employment can be presumed: in the event that the work is provided personally, solely or primarily for the same employer for nine consecutive months, it is presumed that the contract is a dependent employment contract. The employer, however, has the option to prove that the worker is not employed subject to his or her instructions.

On the other hand, concerning ICT workers, with unconventional work schedules, calculation of their 'actual working time' is entirely unrealistic. Another system of calculation of work and of rest periods must be conceived.

Crowdworking

One particular area of ICT work is "crowdworking". Activities that were originally performed by employees protected by labour law and collective agreements are now being performed by contractual partners offering their services to a larger number of people by means of an internet based "platform". The crowdworking platforms intervene between the crowdwork-

ers and the crowd-sourcers providing the infrastructure for tasks to be completed. However, the economic situation of crowdworkers, for whom this type of work represents the main source of income, are comparable with employees. The question of minimum income is important if we take into account that there is direct competition with people from countries with lower costs of living.

Crowd-sourcing is problematic in many other aspects, for instance if we consider the difficulties of defining the law applicable to each individual case.

Private life

Information and communication technology, even if it sometimes allows a better balance between private life and work, often creates a system of subordination of private time to work time. Information technology allows everything to be controlled in real time and from a distance. Work and private life constantly interact.

In order to preserve private life of employees a specific right to disconnect from the mobile phone/computer is proposed as a possible solution.

Health and safety

Long periods of working in front of a computer without a break or suitable exercises can lead to important musculoskeletal problems. Electromagnetic radiation produced by mobile phones and wireless internet can also cause headaches for any kind of ICT employees.

However, the risks related to work are moving from issues of physical safety to issues of mental health. The use of electronic communication in the workplace means that there is less need to move around, not even for a conversation with a colleague. This constitutes an important source of stress and a major risk for the health of ICT employees.

10 Netherlands

10.1 Status quo and societal debates

The political debate in the Netherlands about robotization and potential impacts on labour was kicked off in September 2014, by Dutch Minister Asscher of Social Affairs and Employment.[134] His speech took prospects of technological unemployment seriously. In his speech, Asscher refers both to a study by Frey & Osborne[135] about potential job loss and to growing pressure on medium-skilled workers due to job polarization. Frey & Osborne predicted that 47% of jobs in the United States will be susceptible to automation in the next twenty years. Deloitte[136] projected these findings to the Dutch situation and came to similar conclusions. In 2012, the Netherlands Bureau for Economic Policy Analysis (CPB) pointed to a development of job polarization in the Netherlands since the 1980s.[137,138] Their analysis shows that on the Dutch labour market there is an increasing demand for interactive and analytical work (such as teaching, sales, managing, research, planning, design), and a diminishing demand for routine cognitive and routine manual tasks (such as accounting, making calculations, controlling engines). Routine cognitive work entails work that can be successfully captured in rules and automated.[139] In his speech, Minister Asscher also sees opportunities for robotization, referring to new local job opportunities for example made possible by smart manufacturing solutions such as the highly automated factory of Philips in Drachten.

The study by Frey and Osborne[135] and books such as *The Second Machine Age* by Brynjolfsson and McAfee[140] helped to kick start the public debate in the Netherlands. Since 2014, the public and political debate in the Netherlands about digital technologies focused more on the potential negative impacts of robots. Before that, robots were mainly seen as part of a broad cluster of digital technologies, mostly bringing opportunities for the Netherlands, in terms of economic growth and social welfare. For many years, the Netherlands ranks high on several digital readiness indexes available, scoring high on available infrastructure, ICT-usage (both businesses and individuals) and available skills[141], although according to some indexes the country is losing momentum.[142]

While the Ministry of Social Affairs and Employment looks seriously into scenarios of future unemployment, the Ministry of Economic Affairs emphasizes robotization, automation and digital technologies as an opportunity for the Netherlands. Such technologies have the potential to increase production, economic growth, and make humans free for new and dif-

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134 rijksoverheid.nl/documenten/toespraken/2014/09/29/robotisering-kansen-voor-morgen-toespraak-van-minister-asscher-tijdens-het-szw-congres-op-29-9-2014.

135 Frey, C.B. & M.A. Osborne (2013). *The Future of Unemployment. How Susceptible Are Jobs to* Computerization*?* Oxford: Oxford Martin Publication.

136 Deloitte (2014). *De impact van automatisering op de Nederlandse arbeidsmarkt. Een gedegen verkenning op basis van Data Analytics*.

137 Centraal Planbureau (CPB, Economic Policy Analysis) (2012). *Loonongelijkheid in Nederland stijgt*. CPB Policy Brief 2012/06. Den Haag: CPB.

138 CPB (2015). Middensegment onder druk. Nieuw kansen door technologie. Baanpolarisatie in Nederland. CPB Policy Brief 2015/13.

139 See for example Autor, D.H., F. Levy & R.J. Murnane (2003) The Skill Content of Recent Technological Change: An Empirical Exploration. The Quarterly Journal of Economics 118, pp. 1279-1334.

140 Brynjolfsson, E. & A. McAfee (2014). The Second Machine Age. Work, Progress, and Prosperity in a Time of Brilliant Technologies. New York: WW Norton.

141 See the European Commission's Digital Economy & Society Index (DESI 2016): europa.eu/digital-single-market/en/desi.

142 Chakravorti B., Tunnard C., & Chaturvedi, R. (2015). Where the digital economy is moving fastest. Harvard Business Review, February 19, 2015.

ferent tasks.[143] The Ministry of Economic Affairs, together with industry, initiated in 2014 a 'Smart Industry' agenda, which focuses on reaping the benefits of ICT, digital production and digital services.[144] The public debate also seems captured between these two extremes: the Netherlands are 'robot champion' or the Netherlands as 'Modern Times 2.0'.[145]

10.2 Policy dimensions

Early 2015, the Standing Committee for Social Affairs and Employment (SAE) of the Dutch Parliament asked the Rathenau Instituut to conduct a short-term study to explore the latest scientific findings on the impact of technological developments on employment. It connects the discussion about robotization with discussions on digital platforms and new business models. The report '*Working on the robot society*' was published in June 2015 and calls for politicians, employers, employees, teachers and citizens, to get acquainted with the upcoming 'robot society'.[146] Policy options need to focus on stimulating innovation, education and equal opportunities for all. The report was widely picked up by not only media and politicians, but all kinds of organizations (see also section 10.3).

The report of the Rathenau Instituut was the first report in a series of reports from Dutch advisory bodies. All reports broaden the debate from robot technology to a broad cluster of relevant digital technologies, such as Internet of Things, Big Data, Artificial Intelligence and robotics. The reports also clarify that the relationship between technology, the quantity and quality of work and labour markets is complex and multi-fold. For some key characteristics of the Dutch labour market, such as unemployment, income distribution, job polarization and flexibilization of labour relations, see Box below.

Unemployment

The unemployment percentage in the Netherlands in 2016 lies around 6.5 percent, which is lower than the average 10 percent in the Eurozone.

Income distribution

The most well-known measure that expresses the distribution of income and wealth in a single numeral is the Gini coefficient. This assumes a value of 0 in the case of a completely equal distribution, and a value of 1 in the case of a completely unequal distribution. According to the *Chartbook of Economic Inequality*[147]income inequality in the Netherlands fell between 1959 and the mid-1980s, that income inequality and the Gini coefficient have remained 'relatively stable' since the 1990s. Currently, the Netherlands has a Gini coefficient of 0.57, which is similar to that for many other European countries. Redistribution (through progressive taxes, benefits, surcharges, and grants) ensures that the secondary income distribution (disposable incomes) is, with a coefficient of 0.33, much more uniform – similar to the Scandinavian countries. According to Salverda[148], the Gini

[143] Kamp, H. (2014). Toespraak van minister Kamp bij de opening van de 'Nacht van de Economie', Rotterdam.

[144] FME et al. (2014). Actieagenda Smart Industry. Dutch Industry Fit for the Future. smartindustry.nl/wp-content/uploads/2014/11/Smart-Industryactieagenda-LR.pdf.

[145] Asscher, L. (2015). Toespraak van minister Asscher NRC Live 'Aan de slag', bij NRC Live Amsterdam, November 12, 2015. rijksoverheid.nl/regering/inhoud/bewindspersonen/lodewijk-asscher/documenten/toespraken/2015/11/12/speech-asscher---aan-de-slag.

[146] Est van, R. & Kool, L. (Eds.) (2015) Working on the robot society. Visions and insights from science concerning the relationship between technology and employment. The Hague: Rathenau Instituut.

[147] Atkinson, A.B. & S. Morelli (2014). Chartbook of Economic Inequality. Ecineq Working Paper 2014. Society for the Study of Economic Inequality. ecineq.org/milano/WP/ECINEQ2014-324.pdf.

[148] Salverda, W. (2014). 'De tektoniek van de inkomensongelijkheid in Nederland'. In: Kremer et al. Hoe ongelijk is Nederland? Amsterdam: WRR/Amsterdam University Press, pp. 39-58.

coefficient, however, is an inadequate measure because it does not provide any understanding of the distribution between the upper and lower ends. Salverda analyses the deciles of gross incomes over the period 1977-2011 and, based on this, concludes that the income distribution shows "massive and virtually permanent stagnation" at the bottom and a "strong steady rise for a limited group".[149]

Job polarization

Various authors claim that, since the 1970s, the IT revolution has led to job polarization: demand for medium-skilled work is dwindling, whereas demand for high-skilled and low-skilled work is increasing.[150,151] The Netherlands Bureau for Economic Policy Analysis (CPB) finds that job polarization is also going on in the Netherlands[152]. According to CPB, the composition of unemployment in the Netherlands has changed as a result of rising demand for high-skilled individuals and the dwindling of employment options for medium-skilled workers: "What is striking in the current recession is that mainly people with intermediate levels of education and training have lost their jobs. This is a phenomenon that occurred barely, if at all, in previous recessions. In the 1970s and 1980s, it was mainly a lot of jobs at the bottom end of the labour market that disappeared, and the army of unemployed people consisted of people with relatively low levels of education and training".[153]

Flexibilization of labor relations

The percentage of people working in flexible labour relations has increased from 15 percent (2004) to 22 percent (2014) in the past decade.[154] In the same period, the share of independent contractors has increased from 8 to 12 percent, and the share of employees with a temporary contract has grown faster in the Netherlands than in most other European countries. Within the Netherlands, there are regional differences with respect to flexible working.

In response to the public debate on robotics, in September 2015 the Ministry of Social Affairs and Employment asked the Social and Economic Council of the Netherlands (SER) – an advisory body representing trade unions and employers' organisations – to advise on the relationship between robotisation, automation and digitalisation of the labour market and labour relations.[155] Their report is expected in the summer of 2016.

In December 2015, the Netherlands Scientific Council for Government Policy (WRR) published 'Mastering the robot', which called for an 'inclusive robot agenda' with four topics: inclusive robotisation (using robots to make people productive, instead of replacing people by machines), the need to develop complementary skills and expertise at all levels of edu-

149 Ibid. pp. 40.

150 Goos, M., A. Manning & A. Salomons (2010). Explaining Job Polarization in Europe. The Roles of Technology, Globalization and Institutions. CEP Discussion Paper. London: Centre for Economic Performance, LSE. cep.lse.ac.uk/pubs/download/dp1026.pdf.

151 Acemoglu, D. & D. Autor (2010). Skills, Tasks and Technologies. Implications for Employment and Earnings. NBER Working Paper, no. 16082.

152 Centraal Planbureau (CPB, Economic Policy Analysis) (2012). Loonongelijkheid in Nederland stijgt. CPB Policy Brief 2012/06. Den Haag: CPB.

153 Centraal Planbureau (CPB, Economic Policy Analysis) (2012). Loonongelijkheid in Nederland stijgt. CPB Policy Brief 2012/06. Den Haag: CPB, p. 5

154 Chkalova, K., A, Goudswaard, J. Sanders & W. Smits (2015) Dynamiek op de Nederlandse arbeidsmarkt: De focus op flexibilisering. Den Haag: Centraal Bureau voor de Statistiek (CBS).

155 Ministerie van Sociale Zaken en Werkgelegenheid (2015). SER-adviesaanvraag Effecten van technologische ontwikkelingen op de arbeidsmarkt en arbeidsverhoudingen. 30 september 2015.

cation, ownership of work, new issues of inequality[156] (Went et al. 2015). Around the same time, the Dutch Royal Society of Economists published a report on 'The match between humans and machines'[157], making a similar point.

Based on the above mentioned advisory reports the Dutch government will formulate its policy. In November 2015 the Minister of Social Affairs and Employment reacted by means of a letter to Parliament to the report of the Rathenau Instituut. In his response, Minister Asscher outlines three areas of current Dutch policy: stimulating the economy, education and the labour market (explained in more detail below). The Standing Committee for Social Affairs and Employment (SAE) of the Dutch Parliament discussed this response in April 2016. As a result, the Minister promised to react on the advice of the Social and Economic Council of the Netherlands (SER) in September 2016. That reaction will include an 'inclusive robot agenda' and a list of concrete policy actions.

Current Dutch policy

Current Dutch policy aims to anticipate technological developments in areas: 1) favourable conditions for establishing businesses, 2) well trained working population and 3) smooth transitions to (new) work.[158]

1) Favourable conditions for establishing businesses

The Dutch government focuses in its industrial policy on innovative and technical businesses. In 2015, it started to implement the Smart Industry policy agenda.[159] In this agenda, the government aims to strengthen (the sharing of) knowledge of advanced robotics, internet of things and software in businesses, especially Small and Medium Enterprises (SMEs). It also aims to stimulate and speed-up innovation in so called 'Field labs'. Field labs are real-world environments in which Smart Industry solutions are developed and tested and in which businesses and academic partners collaborate. They are partly funded by government. The Smart Industry policy agenda further aims to stimulate necessary knowledge, skills and ICT-conditions to innovate (such as developing standards or sharing data).

2) Well-trained working population

A broad public dialogue has been launched in 2015 to explore future skills necessary in primary and secondary education ('Education in 2032').[159] The report was published late 2015. It advises government to give more attention in the school curriculum to ICT skills (digital literacy), citizenship and English, as well to societal and personal developments of students. Government responded early 2016 and has requested the Platform Education 2032 to design the new curriculum for primary and secondary education.[160]

The Dutch governments further expects that learning on the job will become increasingly important. It therefore experiments with flexible higher education and it has requested the OECD to advise the Netherlands in formulating a strategy for building future skills.

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156 Went, R., Kremer, M. & Knottnerus, A. (eds) (2015) De robot de baas. De toekomst van werk in het tweede machinetijdperk. WRR Verkenning 31. Amsterdam University Press: WRR. [Mastering the Robot The Future of Work in the Second Machine Age]

157 Ter Weel, B. (ed.) (2015). De match tussen mens en machine. Koninklijke Vereniging voor de Staathuishoudkunde Preadviezen 2015.

158 Tweede Kamer 2015-2016 29 544, nr 676. Brief van de Minister van Sociale Zaken en Werkgelegenheid. 30th November 2015.

159 Tweede Kamer 2015-2016 29 826, nr 64. Brief van de Minister van Economische Zaken. 8th October 2015.

160 Ministerie van Onderwijs, Cultuur en Wetenschap (2016). Beleidsreactie op het advies van het Platform Onderwijs 2032. 23rd January 2016.

3) Transitions to new work

In 2015 new regulations came into force to increase flexibility of the Dutch labour market.[161] The new law changed unemployment allowances (shortening the period for which unemployed workers receive benefits), it changed severance payments when contracts are terminated, and it restricted the period and amount of fixed term contracts (aiming to improve the legal position of flex workers). The new law is fiercely debated in media and politics, whether it has the desired effects, and is under evaluation.[162]

The government further aims to improve labour mobility for specific groups, especially young people and the elderly. It initiated the Action Plans 50+ and Youth Unemployment. It also broadened the criteria since April 2016 until 2018 for retraining people that are unemployed, or about to be unemployed ('brug-ww'), in which the employer pays no labour costs for the time the employee spends on his or her retraining.

Future policy challenges

The government acknowledges that in the longer term impacts on the labour market may be higher than currently foreseen, which will require different policy measures than are currently in place. The government has its attention on two aspects in particular: 1) how social, ethical and legal aspects influence technological development and 2) how income and wealth are distributed in the Netherlands.

1) Social, ethical and legal aspects

The Dutch government is exploring new models for future-proof policy making in relation to new technology in concrete cases, such as digital platforms, self-driving cars or drones.[162] One policy area is to create room for experiments and to explore what type of regulations might be effective. For example, the government allows experiments with flexible regulation in the taxi sector (while restricting Uberpop). It also allows experiments with self-driving cars in several Dutch cities, and Dutch municipalities started to collaborate with Airbnb to collect taxes. The Dutch Ministry for Economic Affairs commissioned research on how to regulate platforms. The report showed that governments already have a wide toolbox available to deal with specific problems that different platforms might raise.[163] Effects of the sharing economy on the labour market are taken into account by an advice of the Social and Economic Council of the Netherlands (SER) on the circular economy.

2) Distribution of income and wealth

As several reports from advisory bodies warn for potential negative effects of new technological developments on income and wealth distribution, the Dutch government has indicated that it will continue to monitor the developments in the Netherlands closely.

To summarize, current Dutch policy covers a wide range of relevant topics for addressing impacts of new technology on the Dutch labour market. It seems to be responsive to new technological developments (see for example the focus on future proof regulation) and the Dutch government is monitoring the discussions on expected impacts of new technology closely. It takes not only robotics into account, but also explores the impact of other technologies, such as big data and digital platforms. However, most of the current policies discussed above have been in place, or have been initiated, before the start of the 'robot de-

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[161] Tweede Kamer 2013 – 2014, 33 818, nr. 1. Brief van de Minister van Sociale Zaken en Werkgelegenheid.

[162] Tweede Kamer 2015–2016, 34 352, nr. 1. Brief van de Minister van Sociale Zaken en Werkgelegenheid.

[163] Eijk van, N., Fahy, R., Van Til, H., Nooren, P., Stokking, H. & Gelevert, H. (2015). Digital platforms: an analytical framework identifying and evaluating policy options. TNO, Ecorys and IViR. TNO report: R11271.

bate' in the Netherlands in 2014. In 2016, the reports from different advisory bodies will be discussed in Parliament, which might alter current policies in place.

10.3 TA perspectives

As the main TA institution in the Netherlands, the Rathenau Instituut has been involved in policy discussions on this topic relatively early. The Dutch Parliament had a strong wish to take initiative on this topic, and requested a study by the Rathenau Instituut early 2015.[164] This report was the first in line in a series of reports from different advisory bodies. Before that, the Rathenau Instituut was looking into potential impacts of digital platforms, including economic impacts[165]. Before that, the Rathenau Instituut monitored developments regarding robot technology and other digital technologies, but more from a social and ethical lens than an economic and labour market lens.[166,167]

Both the report of the Rathenau Instituut and the Scientific Council for Government Policy[168] stress that technological developments are not uncontrollable steamrolls, but can be influenced and guided by societal actors. The advisory bodies also show that the impact of new technology is very diverse, depending on how technologies are deployed in practice. In particular, the Rathenau Instituut identified nine different future scenarios about the future of work.[169] The scenarios describe the interaction between humans, smart machines and the role of Internet platforms in the distribution and organisation of work (see Figure below).

With such contributions, the Rathenau Instituut aims to nuance the debate that hitherto had been focusing on fear of massive job losses due to new technologies and ideas to distribute income and wealth in different ways, versus the argument that in the past new technology has not lead to such massive job losses yet and that would be no different this time. It also aims to direct policy discussions on how to maximize opportunities, and limiting threats.

After the publication of 'Working on the robot society', an increasing number of actors in the Netherlands is exploring potential impacts of new digital technologies. Ministries, provinces, trade unions, employers' organizations, companies and educational institutions are organizing meetings to discuss the topic or have started their own research to explore impacts and options on future work and workers. Major Dutch cities are thinking about "smart cities" and about how they should deal with platform initiatives such as Uber and Airbnb. The Dutch Association of Insurers has set up an insuranceLab so as to experiment with apps and big data, while a network manager started a lab to develop smart grid solutions and explores what type of work their technicians like to see robotised in their work (for example, what is dull or dangerous work?), and subsequently try to design robots based on their employees' input.

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164 Est van, R. & Kool, L. (eds) (2015) Working on the robot society. Visions and insights from science concerning the relationship between technology and employment. The Hague: Rathenau Instituut.

165 Kreijveld, M., J. Deuten & R. van Est (eds) (2014). De kracht van platformen. Nieuwe strategieën voor innoveren in een digitaliserende wereld. Den Haag/Deventer: Rathenau Instituut/Vakmedianet.

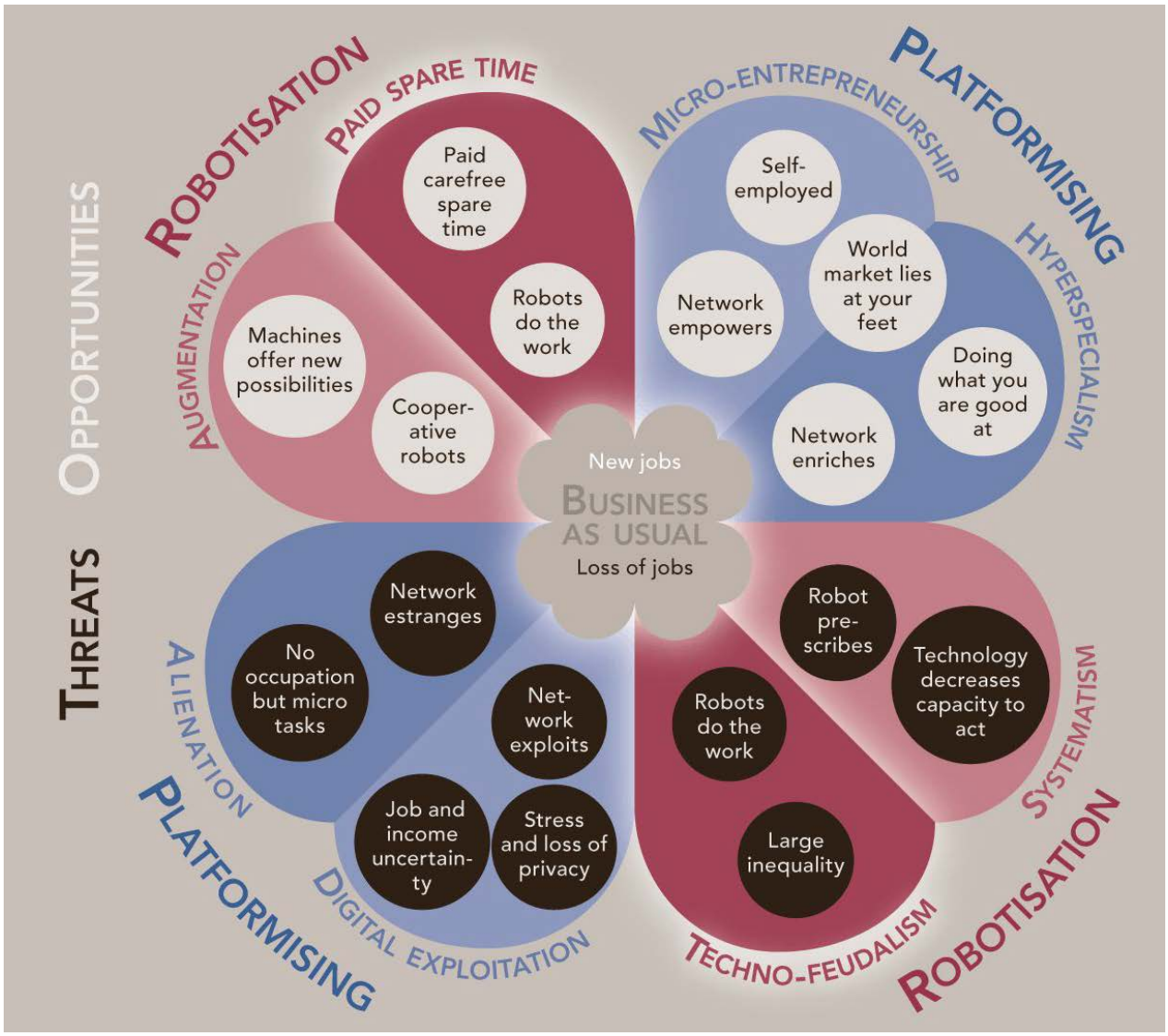
166 Royakkers, L., Daemen, F., & Van Est, R. (eds) (2012) Overal robots. Automatisering van de liefde tot de dood. Den Haag: Boom Lemma.

167 Royakker, L. & R. van Est (2016) Just ordinary robots: Automation from love to war. Boca Raton, FL: CRC Press.

168 Went, R., Kremer, M. and Knottnerus, A. (eds) (2015) De robot de baas. De toekomst van werk in het tweede machinetijdperk. WRR Verkenning 31. Amsterdam University Press: WRR. [Mastering the Robot The Future of Work in the Second Machine Age].

169 Kool, L. & Est van R. (2015) Kansen en bedreigingen: negen perspectieven op werken aan de robotsamenleving. In: Went et al. (eds). De robot de baas. De toekomst van werk in het tweede machinetijdperk. WRR Verkenning 31. Amsterdam University Press: WRR.

Figure: Threats and opportunities of the robot society



Source: Rathenau Instituut

11 Norway

11.1 Status Quo

EU's *Digital Agenda Scoreboard*[170] and *Digital Economy and Society Index*[171] put Norway in front when it comes to digitalisation. Industry, the public sector, and society in general have already been subject to digitalisation. In addition, Norway has one of the most organised labour markets in Europe, for both employers and employees.

33 percent jobs at high risk

The international debate on computerisation and jobs has been heavily influenced by Frey and Osborne's article "The Future of Employment: How Susceptible are Jobs to Computerisation"[172] published in 2013. Using the same approach, a recent report has estimated that 33 percent of Norwegian employment has a high risk of computerisation in the next decade or two.[173] This is on the same level as for Finland, while corresponding numbers for Sweden and the US are significantly higher.

This reflects differences in occupational structures, with fewer manufacturing and private sector jobs in Norway. The occupational groups in Norway that will be most influenced by computerisation are, among others, accounting and bookkeeping professionals, shop sales assistants and general office clerks.

Factories and labs

For Norway, the recent decline in the oil price has made the shift to a sustainable and digitalised economy more urgent than ever before. Leading actors are taking new initiatives to compete in a digital future. The Kongsberg Group, one of the biggest technology corporations in Norway, recently launched a new subsidiary, Kongsberg Digital[174], to complement its four established business areas in maritime, defence, remote weapon systems and oil and gas technologies.

The telecom-giant Telenor has established an innovation and research lab for AI and Big Data, in cooperation with the Norwegian University of Science and Technology and SINTEF Research Institute.[175]

In August 2016, a consortium of big industrial players announced the establishment of a national "top industry centre" with support from the government. The centre draws inspiration from a similar centre for Norwegian top athletes, and from Germany's *Industrie 4.0*-strategy.[176] The aim is greater collaboration and sharing between Norwegian industry (both big and small companies), research institutions and universities, and increased productivity and competitiveness for Norwegian businesses.

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170 ec.europa.eu/digital-single-market/en/digital-scoreboard.

171 ec.europa.eu/digital-single-market/en/desi.

172 Frey, C.B. & Osborne M. (2013) *The Future of Employment: How Susceptible are jobs to computerization?* oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.

173 Pajarinen, M, Rouvinen P. & Ekeland, A. (2015) *Computerization and the Future of Jobs in Norway* nettsteder.regjeringen.no/fremtidensskole/files/2014/05/Computerization-and-the-Future-of-Jobs-in-Norway.pdf. The researchers have used a slightly modified classification compared to Frey and Osborne. With this classification, the high-risk category of US employment drops from 49% to 45%. This share is still significantly higher in the US compared to Norway.

174 kongsberg.com/en/kog/news/2016/february/establishes-kongsberg-digital/.

175 telenor.com/no/media/pressemeldinger/en-digital-grundernasjon-telenor-investerer-i-norsk-entreprenorskap-og-digital-kompetansebygging/.

176 toppindustrisenter.no.

Another trend is the emerging shared factory spaces, in traditional industry areas on the west coast of Norway.[177] These shared spaces will give smaller companies access to advanced equipment for production, without having to take on the costs of investing in such equipment themselves.

Sharing economy in Norway

The number of potential users of digital platforms for sharing goods and services is very high in Norway. Numbers from Statistics Norway show that 97 percent of Norwegian households have Internet access, and 89 percent own a smartphone.[178] A study by the National Institute for Consumer Research shows that 45 percent of Norwegian citizens are familiar with the use of "sharing activities" in digital channels.[179]

Finn.no, a classifieds platform, has long been the dominant platform for sharing goods and services in Norway. From this home market of early adapters, Schibsted Media Group, which owns Finn.no, has expanded to 30 countries.

In addition to Finn.no, there are several other sharing services established in Norway. Nabobil.no, a service coordinating the sharing of private cars, has been one of the fastest growing sharing services the last year.[180] Other successful start-ups include Nimber, a delivery service utilising empty space in cars, trains, and vans, and Gelato, which connects printers from different locations to a print cloud open to everyone.

International actors like AirBnB are also entering the Norwegian market. In 2015 AirBnB had 197 000 guests stayed with 7900 registered Norwegian hosts.[181] Uber also has a presence, but face more difficult market access because of the strictly regulated taxi market.

11.2 Policy dimensions

Stakeholders in the labour market

Norwegian labour policy is firmly based on a tripartite co-operation between the government, trade unions and enterprise federations. Trade union membership is high, wage formation is relatively coordinated at the national level, and working life is well regulated. This is also the case when it comes to discussing the emerging sharing economy.

In March 2016, the Government appointed a commission that will investigate how the sharing economy can contribute to increased resource efficiency.[182] Reflecting the emphasis on stakeholder involvement, the commission has members from both academia, business, interest organizations and labour unions. The Commission will present its report in early 2017.

The Commission's mandate includes assessment of regulation (both at the general and sector specific level), assessment of the effects of the sharing economy could have on the labour market and the possible need for adjustment of consumer rights and requirements for standards.

While the ICT sector is generally positive and sees many possibilities in the sharing economy, the tourism and hotel industry wants a regulation of new actors like Airbnb and Uber.

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177 Examples include Creator Makerspace in Stavanger, RobTek in Brattvåg, and BitRaf in Oslo.
178 ssb.no/teknologi-og-innovasjon/statistikker/ikthus.
179 SIFO 2016 sifo.no/files/file80528_sifo_oppdragsrapport_3_16.pdf.
180 dn.no/grunder/2016/09/09/0807/Delingskonomi/nabobil-er-ett-r--slik-har-det-gtt. After one year of running, the service has more than 50 000 users and 13 000 transactions completed.
181 airbnbaction.com/wp-content/uploads/2016/03/norway_minireport_D3_norwegian_20160302.pdf.
182 regjeringen.no/no/aktuelt/utvalg-skal-utrede-delingsokonomien/id2478123/.

The Norwegian Confederation of Trade Unions (LO) warns against a new precariat, and demands tougher regulation of the sharing economy and digital labour. LO insists on clear definitions of the roles as employer and employee, regardless of whether a job is facilitated through an app or in a more traditional way.[183]

Competition in the taxi market

The Norwegian Competition Authority has investigated future challenges in two areas: financial services (peer-to-peer lending and crowdfunding) and transportation (the taxi market)[184]. The Authority sees the need for updated, and in some instances new regulation, and regards the introduction of new digital services as a productive force. The Authority is not in favour of a de-regulation of the taxi market, but see this as a good opportunity to rethink existing regulation to create a market better suited to new business models and consumers' needs.[185]

Recent court cases illustrate how the legislation for transport services in the sharing economy has yet to be clearly defined. The Norwegian taxi market is highly regulated, and in the autumn of 2015, an Uber driver was fined by the police for providing illegal transport services.[186] The Norwegian law for taxi services specifies that a permit is required for offering transport services in public space. In December 2015, the District Court annulled the charges against the driver, stating that the online Uber app does not count as a legally defined "public space".[187]

However, the Appeal Court revoked the annulment. Although the Appeal Court agreed that the Uber app is not a public space, it stated that the intention of the driver, to use Uber to provide transportation services on a regular basis, makes the services subject of regulation. More recently, three drivers using the Norwegian ridesharing app Haxi have gone through Supreme Court in a similar case. The Haxi-drivers were acquitted of all charges, on the basis that using the app does not count as offering taxi services in a public space.[188]

Digitised tax and the sharing economy

The Norwegian tax system is digital, and has been so for many years. This should make it easier to develop real-time solutions to report income from different types of employment in new and more flexible forms of employment. The Norwegian Tax Administration has tried to clarify how current taxation applies for sharing services[189] and has an ambition to develop technical solutions for reporting and informing the public.

While it seems to be feasible to collect taxes from the users of sharing services (and the possible income is quite modest), there are bigger problems related to the sharing platforms themselves. Most of these are big, international companies that pay no taxes to the countries where they are active.

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183 lo.no/Documents/Okonomi_og_sysselsetting/Samhandlings%C3%B8konomien%20hefte%20A4-NETT.pdf.

184 konkurransetilsynet.no/globalassets/filer/publikasjoner/rapporter/rapport_drosjemarked-for-fremtiden.pdf.

185 konkurransetilsynet.no/nb-NO/aktuelt/artiklar-og-innlegg/deling-for-konkurranse/.

186 osloby.no/Politiet-avskiltet-Uber-bil-8205700.html.

187 e24.no/lov-og-rett/uber-sjaafoer-frifunnet-i-oslo-tingrett/23576065.

188 domstol.no/globalassets/upload/hret/avgjorelser/2016/avgjorelser-juni-2016/sak-2016-477-anonymisert.pdf.

189 skatteetaten.no/delingsokonomi.

11.3 TA perspectives

Manufacturing renaissance without jobs?

Development in robotics, 3D-printers and digitalisation bring new opportunities for high-cost countries like Norway. Hence, industrial policy is back in fashion. The NBT-report "Made in Norway" investigates how advanced manufacturing technology could revolutionise industrial production in Norway.[190] A further investigation of the possibilities of a competitive, high tech Norwegian industry outside the oil and gas cluster was published in 2015.[191] One point of discussion is how policy-makers can facilitate this development, while refraining from "picking the winners" in the industrial sector.

This time it is personal: time to rethink public services

In the report "This time it's personal – the digital shift in the public sector", the NBT identifies technology-driven trends that has the potential to affect public services in fundamental ways.[192]

1. *Participatory*: Interactive technologies such as smartphones and the Internet of things could make citizens not only users, but also *active participants* in designing and executing public services. For example, patients with chronic illnesses can monitor their health from home instead of going to see a doctor.
2. *Personalised:* Public data gives the government more detailed knowledge of citizens, and creates possibilities for a more diversified and *personalised* service, tailored to each citizens need. Adaptive learning technologies can provide personalised learning opportunities and more and better feedback to students.
3. *Predictive:* Widespread use of data analysis by public institutions can create opportunities towards *predictive* work, instead of reacting and rectification after an incident. The national tax authority could for example make targeted controls by using predictive models that identifies tax reports with a high probability of error.

Increased focus on digital services and data analysis creates new challenges: are algorithms used to provide support and alternatives, or can they contribute to stigmatization of individuals and groups? Where are the limits for what technology and algorithms can do in the public sector?

Platforms and power in employment

Emerging platforms and digital labour challenges the traditional ways of organising employment. More flexible relations and the notion of "micro-entrepreneurs" blur the distinction between being employed and being an independent contractor. The on-demand economy's use of algorithms and information asymmetries also change traditional power structures that have a great effect on working conditions.[193]

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190 Norwegian Board of Technology (2013) *Made in Norway? How robots, 3D-printers and digitalisation bring new opportunities for Norwegian industry.* teknologiradet.no/wp-content/uploads/sites/19/2014/10/Made-in-Norway-engelsk_m-forside.pdf.

191 Teknologirådet (2015) *Luksusfellen – omstilling i en oljeøkonomi* d2dczhp6dhfxqb.cloudfront.net/sites/19/2015/07/Luksusfellen-endelig_120615_med-forside.pdf.

192 Teknologirådet (2016) *Denne gangen er det personlig. Digitalt skifte for offentlig sektor.*

193 A. Rosenblat & L. Stark (2015): *Uber's Drivers: Information Asymmetries and Control in Dynamic Work* datasociety.net/output/ubers-drivers-information-asymmetries-and-control-in-dynamic-work/.

12 Poland

12.1 Status quo and societal debates

Poland is a country where the level of technological development and automation in general is still significantly lower than in the old European Union (EU) countries. Since 1990, the labour market in Poland has undergone profound changes associated with the transformation of the political system, the development of a market economy and EU accession, the effects of which include the inflow of EU funds and economic emigration of approximately two million citizens. These changes are influenced by progressive development of information and communication technology (ICT) as well as by automation. This leads to a fundamental transformation of the model of work, service pricing and demand for labour. However, the scale, scope and impact of these transformations are varied.

Polish companies make limited use of the possibilities offered by information technologies. There are differences in this aspect depending on the size of enterprise. ICT solutions are primarily used by large companies, while small entities rely on them to a limited extent. The percentage of employees in the ICT sector in Poland in 2014 accounted for only 2.42% (a significant increase compared to 2011 when it was 2%). Both low labour costs and relatively well-prepared human resources currently place Poland among the leaders in the sector of business services in Europe (SSC, BPO, ITO). In 2015 this sector employed approximately 170,000 people and is characterised by rapid growth – it is estimated to reach 250,000 employees by 2020.

The process of computerisation in the public sector, although it has accelerated in recent years, is still relatively poorly advanced (only 22% of the Internet users submit electronic forms – DESI 2016[194]). On one hand, the success is that in 2016 as many as 49% of tax declarations were submitted via the Internet. On the other hand, IT solutions are clearly missing, such as for example in the health-care system.

Opportunities associated with modern information technologies are hindered by a number of barriers in Poland. Poland, according to DESI 2016 is a country where the use of the Internet by citizens is below average (65% are regular users). Among other reasons, this is due to the still limited access to fixed broadband networks (57% of households) and the low level of digital literacy in the overall population (40% of the population has at least basic digital knowledge). Characteristic are significant territorial differences in access to networks between cities and rural areas (about 40% of the country's population live in rural areas) as well as striking disparities in digital skills correlated with age. As a result, modern technologies contribute to territorial segregation in Poland and lead to social exclusion of groups that are not able to join the modern economy. This raises concerns about the further deepening of existing social gaps. Therefore, it is necessary to take tailored actions aimed at balancing present social inequalities.

From the point of view of economic development, the education level of employees is crucial. Poland is still a country where a relatively small fraction of the population has a university degree (27% of the population who are aged 25-64 years). Deficit of professionals including engineers, specialists in the field of sciences and health-care already exists or will occur in the near future. The educational boom observed in the recent years is, unfortunately, not accompanied by adequate quality of higher education. There are also training programs implemented largely with the support of EU funds. However, what raises concern about these measures is the assessment of their actual impact on the labour market.

[194] The Digital Economy and Society Index, DESI 2016, ec.europa.eu/digital-single-market/en/news/desi-2016-country-profiles.

12.2 Policy dimensions

The most recent strategic document is the Responsible Development Plan[195], adopted by the Government in February 2016. This document outlines the development of Poland within five pillars, i.e. re-industrialisation, the development of innovative companies, building capital for development, international expansion, balanced social and regional development. Among strategic documents, a strategy published in 2013 by the Ministry of Economy is noteworthy – 'Dynamic Poland 2020'[196], prepared in line with the goals adopted by the EU. The main objective of this document, such as a highly competitive economy based on knowledge and cooperation, is going to be implemented via four specific means: adapting the regulatory and financial environment to the requirements of innovative activities; enhancing economy with appropriate knowledge and labour supplies; sustainable use of resources; increase in the internationalisation of the Polish economy. Furthermore, in 2014 the Polish government adopted a programme Digital Poland[197], with the aim of focusing on three areas: digital competencies in the society, universal access to the Internet, e-administration and open government. By 2020, this program, which is carried out with the use of EU funds, will have been allocated 2.2 billion euros.

Topics related to the labour market undertaken recently in the public debate in Poland include: retirement age (lowering the retirement age which since 2013 is being raised up to 67 years for men and women), stability of employment (fixed-term contracts in 2014 applied to 28.3% of employees), remuneration for work, prohibition on work on Sundays as well as modifications in education. Adopted solutions, with essential impact on the labour market, include: limiting the possibility of arranging fixed-term contracts down to 33 months; introducing minimum wage for those employed on the basis of civil law contracts in the amount of 13 PLN per hour and an increase in the minimum salary up to 2,000 PLN; the abolition of compulsory education for 6-year-olds and the development of vocational and technical education.

In Poland, the sharing or Peer-to-Peer economy is actively used by 20% of the Internet users[198]. There are companies such as Uber and Airbnb. Dynamic development of this branch of economy is not accompanied by legislative measures to regulate the process. As a result, part of the business remains in the grey zone. The scale of protests against these forms of activity is relatively small and, so far, could be brought down to a few attacks on cars providing services within the Uber network.

Trade unions are not active partners in the discussion about the direction of changes in the labour market in Poland. This is due to the specificity of these organisations which gather relatively few employees (in 2014, 11% of those employed, i.e. 1.6 million) mainly in the public sector, especially people who work in education, mining and the extractive industry in Poland. Unions are dedicated to protecting principal interests of these groups.

12.3 TA perspectives

The impact of technological development on the labour market in Poland in the recent years is the subject of a growing number of studies and analyses. Particularly noteworthy

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195 Responsible Development Plan, Ministry of Economic Development, mr.gov.pl/media/14873/Responsible_Development_Plan.pdf.

196 Strategy for Innovation and Efficiency of the Economy (SIEG), Ministry of Economy 2013, rio.jrc.ec.europa.eu/en/library/strategy-innovation-and-efficiency-economy-sieg.

197 Operational Programme, Digital Poland for 2014-2020, polskacyfrowa.gov.pl/media/10410/POPC_eng_1632015.pdf.

198 POLSKA.JEST.MOBI 2015, Raport, tnsglobal.pl/coslychac/files/2015/05/POLSKA_JEST_MOBI_2015.pdf.

are publications of the think-tank WiseEuropa Institute. With the support of public institutions, WiseEuropa Institute prepares studies on changes in the current Polish labour market, including reports on employment such as 'Employment in Poland 2013 – Work in the time of structural change'[199] and 'Employment in Poland in 2014. Labour in the age of innovation'[200] or 'Will a robot take your job? A WISE working paper'.[201] These studies analyse the labour market in Poland in the context of ongoing global technological developments. Risks and opportunities associated with these changes are highlighted. Among other publications worth mentioning are studies on the digital economy, including a general report 'Digital Economy',[202] which outlines challenges associated with development in the ICT sector as well as analyses of selected elements of the labour market, such as for example the area of information technology – 'IT@PL – The labour market in Poland'.[203]

Studies indicate that, on one hand, modernisation in previously underdeveloped sectors such as for example banking and telecommunication has made leaps and bounds, yet now they are placed among the most modern in Europe. On the other hand, technological change will increasingly affect the labour market: Poland is a country with a relatively large share of industrial production but predominantly with a low degree of innovation, having a dominant quota of the low- and medium-qualified employees. Due to the relatively low cost of labour, investment in modernisation was in many cases previously economically unprofitable. An increase in labour costs can change this situation and, consequently, lead to the replacement of traditional professions by modern technologies. As a result, this can pose a threat by increasing structural unemployment. It is estimated that in Poland 36.1% of jobs are at risk of liquidation due to technological advances and modifications in production models (compared to 35.9% of jobs classified at medium risk and 28.0% classified as safe).[204] Although these processes will bring significant social consequences, they are still not considered a priority by trade unions or public authorities.

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199 P. Lewandowski, I. Magda, Zatrudnienie w Polsce 2013 – Praca w dobie przemian strukturalnych, Centrum Rozwoju Zasobów Ludzkich, Warszawa 2014, wise-europa.eu/wp-content/uploads/2016/03/Zatrudnienie-w-Polsce-2013.pdf.

200 M. Bukowski, Employment in Poland 2030 – Labour in the age of innovation, Centrum Rozwoju Zasobów Ludzkich, Warsaw 2015, wise-europa.eu/wp-content/uploads/2014/11/ZWP_2014_EN.pdf.

201 M. Bitner, R. Starościk, P. Szczerba, Czy robot zabierze ci pracę? Sektorowa analiza komputeryzacji i robotyzacji europejskich rynków pracy, WISE, 2014, wise-europa.eu/wp-content/uploads/2016/03/PolicyWorking-WISE-_nr1_141029.pdf.

202 D. Batorski, Cyfrowa gospodarka, Kluczowe trendy rewolucji cyfrowej, Mazowiecka Jednostka Wdrażania Programów Unijnych, euroreg.uw.edu.pl/dane/web_euroreg_publications_files/1335/cyfrowa_gospodarka_kluczowe_trendy_rewolucji_cyfrowej.pdf.

203 Ł. Kośnik, S, Majman, IT@PL – The labour market in Poland, Polska Agencja Informacji i Inwestycji Zagranicznych (Polish Information and Foreign Investment Agency publications): paiz.gov.pl/publications/labour_market.

204 M. Bitner, R. Starościk, P. Szczerba, Czy robot zabierze ci pracę? Sektorowa analiza komputeryzacji i robotyzacji europejskich rynków pracy, WISE, 2014, wise-europa.eu/wp-content/uploads/2016/03/PolicyWorking-WISE-_nr1_141029.pdf.

13 Russian Federation

13.1 Status quo and societal debates

Russia is deeply integrated in the world economy. The mobile telecommunication devices' expansion, remote workplaces creation, geographically distributed business in the online mode, robotization of production – all these make the labour relations evolve.

The transformations primarily take place in high-tech industries. Russian lawmakers work on the issue of stimulating the development of high technology and innovative industries. The general approach has two sides of the same coin: how to stimulate the growth of production and its efficiency on the basis of the digital economy and, at the same time, to avoid social problems and legal obstacles that arise in the course of rapid dissemination of digital technologies.

Digital technologies are proliferating in various areas in Russia. According to experts of the Russian Economic University, named after G.V. Plekhanov, two million people have their jobs in 17 segments of the Russian Internet part (Runet) economy.

Russia vigorously supports and implements electronic document circulation, which significantly affects the labour relations in many aspects:

- Most government services are now available online.[205] Even the legal regulation of the labour is gradually shifting to digital format. The government developed the Federal state information system of the account of results of a special assessment of working conditions (issues of occupational safety).[206] Now the employers are required to store and transmit relevant data in a single information system;
- Electronic signature standards are being adopted. For example, a labour contract with a remote employee can be signed with the use of so called "reinforced qualified electronic signature".[207] Currently, proposals are being prepared to simplify the procedure and eligibility;
- Labour Code of the Russian Federation contains specific Chapter 49.1 regulating the remote workers recruitment and organization of their work, including provision of certain social guarantees. An increasing number of companies attract employees to work at home or remotely. One of the companies actively implementing a system of staff work outside the office is a telecom operator VympelCom.[208]

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205 General Government Services Portal of the Russian Federation: gosuslugi.ru.

206 The Federal state information system of the account of results of a special assessment of working conditions aimed at formation of labour protection services market and is intended to inform workers about labour conditions at workplaces; to monitor the conditions. Elements of this system are the two registers: register of organizations providing services in the field of occupational health, register of organizations conducting special assessment of working conditions, the roster of experts (akot.rosmintrud.ru).

207 The Federal Law No. 63-FZ "On Electronic Signature" dated 6 April, 2011.

208 At the end of 2015, the company VympelCom launched a project called BeeFREE in a pilot mode in HR Department of its headquarters and at its branch office in Rostov-on-Don city. The project involves up to 300 employees totally, most of whom are not completely switched to work outside the office but partly. In the morning, the employee prepare a "to do list" for the day, and the project shows that this list is performed in 92% of cases. VympelCom conducted a survey among project participants and found that 64% of headquarters employees believed that their performance has not changed, and 22% thought it has increased. Now in Moscow, about 800 employees have signed an annex to the labour contract, allowing them to join BeeFREE. The annex was signed also by 1.5 thousand people in the regions. During the 2016 the project will be launched in 36 cities. By the end of 2017 it should cover 50-70% of the company's employees throughout Russia. It is expected that the project will eliminate 30% of leased office space. "However, the main effect is to teach employees to work on the result, to raise the level of digitalization of the company and win the battle for talent – become more attractive and innovative

In some industrial sectors and fields of employment (still quite narrow) *the digital evolution of labor relations* in Russia is clearly evident. The following examples relate to the technologies applications which are under Analytical Department monitoring.

- *Creation of service robots.* Since 2013 the "Promobot" company, the largest manufacturer of service robots in Eastern and Northern Europe, has successfully implemented this project.[209]
- *Telemedicine distribution.* This field is actively developing due to country specificities – a large territory, differences in material equipment level and medical specialists training level in central and remote regions.[210] It should be noted that the International Telemedicine Community set up by the BRICS IT Forum in June 2016[211] will serve as a common floor for better use of telemedicine systems in five states.
- *P2P platforms.* It should also be noted that almost all of these services, such as Uber,[212] are operating in the Russian market and many people are familiar with them.

13.2 Policy issues

The discussions among legislators, experts and public are focused on the following aspects:

- Evolution of employment relations in new forms of production and in the sphere of remote employment;[213]
- Potentially negative tendencies such as growth of unemployment among the older generation due to the inability to adapt to new technologies; and risks for young people, unskilled workers and migrants who may not always learn a profession;[214]
- Social and legal protection of employees who become more independent, and taxation issues caused by widespread remote (mobile) jobs, geographically-distributed online-

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employer in anticipation of a staffing crisis 2020, when we expect another reduction in workforce due to the fertility crisis of the 1990s",– says company officials (moskva.beeline.ru).

209 The company is a resident of the innovation centre "SKOLKOVO", awarded with dozens of prestigious international scientific prizes. The product known as Promobot V.2 became the bestselling service robot in Europe. It can be found in shopping malls, theatres, hotels, libraries and universities of Russia, Kazakhstan and Ireland. Robots of the third generation Promobot V.3 (the development is already completed) will increase the number of covered markets. The official presentation of Promobot third generation will take place in autumn 2016 (v3.promo-bot.ru).

210 Currently remote medical consultations are conducted in 64 regions of the Russian Federation.

211 The agreement establishing the International telemedicine community of the BRICS countries was signed in the framework of the VIII International IT forum (itforum.admhmao.ru) with the participation of the BRICS and the SCO (Shanghai Cooperation Organization) representatives at the session "Creating a compatible complex telemedicine systems in the regions of the BRICS countries" in Russian Khanty-Mansi Autonomous district – Yugra in June 2016.

212 According to the survey, 75% of respondents expressed the need to develop services aggregators which do not have their own auto park. According to experts, in Moscow the share taxi through the app reaches 65-70%, and about 30% in St. Petersburg.

213 According to the Ministry of Labour of the Russian Federation, informal labour market can be estimated at about 23% of the legal labour market. Illegal labour relations are observed primarily in construction industry and agriculture, which attract workers to large, but temporary work. Illegal labour is used in the field of trade and services, where goods and services are paid in cash. Prospects and risks of the implementation of patent system for self-employed citizens were discussed during the round table "Self-employment in the modern Russian conditions – are the citizens and the state ready?" The round table was held in the Civic Chamber of the Russian Federation (by the Commission on Development of small and Medium Businesses) on April 25, 2016. (oprf.ru/press/news/2016/newsitem/33743).

214 For instance, according to data of Federal Statistics Service, Russian companies in 2015 spent about 20% of its total ICT costs to hire external organizations as consultants on ICT issues. Companies spent less than 1% of this type of costs on personnel training.

business, crowdsourcing, etc.;[215]

- The changing role of the human factor (decreasing or increasing?) in production and transport fields, in the light of modern trends in area of information and, in particular, drone technology;[216]
- Inclusiveness – involvement of people with disabilities and groups excluded from the production processes in the new areas of activities;[217]
- Cybersecurity issues require the development of legislation in the national information security standards field and their harmonization with international standards.[218]

Various aspects of these broad areas are discussed in the Council of the Federation, whereas, Analytical Department develops the topic with the assistance of external experts, representatives of executive authorities and civil society.

In 2016, the Analytical Department held two scientific-methodical seminars on: "Labour in the digital age: the transformation of production, employment, taxation, training and social protection" (24.3.2016)[219] and "The future of labour in the digital age" (22.6.2016), devoted to this discussion. Some of the ideas and recommendations based on the results of the workshops were used in this report.

Up to now we have not yet received information about how these issues being addressed by labour unions and employers' associations. The expert position of the Russian Union of Engineers was voiced at the above mentioned Seminars.[220]

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[215] Currently, the legislation of the Russian Federation does not contain the term "freelancer" or in other words, "self-employed person". There is only the term and the statutory concept of an "individual entrepreneur". However, the activities of such individuals ("freelancers") not always can be called entrepreneurial. Since 2015, a new category of "self-employed" is under study, however, there are still no legislative norms in this field. Despite the fact that tax administration in Russia has considerably changed for the better in recent years, many people can still hide their income, particularly in the form of electronic money (Yandex money, Webmoney, Paypall). In order not to lose potential revenues, it would be better to pursue a policy of gradual withdrawal of self-employed persons from informal labour relations. Special attention should be paid to a differentiated approach to social and health insurance, disability benefits; levying of tax on individual income and sales tax. According to experts of the Financial University under the Government of the Russian Federation, insurance payments in Russia as a whole fall on the employer, not the employee. Attracting remote workers, employers often tend not to enter into a labour contract or a contract of civil nature. Thus, in order to comply with the legislation, self-employed persons must register as individual entrepreneurs and pay taxes. *Proceedings of Scientific-methodical seminar of the Analytical Department (24 March 2016, Council of the Federation)* – the web-version of the bulletin can be found at: council.gov.ru/activity/analytics/publications/?publisher=5.

[216] Questions of a gradual transition to unmanned vehicles on Russian roads and the way to arrange it were discussed at the conference "Safe road" in Kazan in March 2016 (etp-avtodor.ru/seminars/2104). Many of the presented pilot projects will be implemented on the territory of the Republic of Tatarstan.

[217] In the World Bank report "Digital dividend" (2016) it is noted that in order to avoid disparities it is necessary to increase access to the Internet and to information technologies.

[218] In 2015, the Federal Service for supervision of communications, information technology, and mass media (Roskomnadzor) has received more than 33 thousand messages from citizens about violations of their rights on the Internet. This was discussed at International forum on cyber security in Moscow (February 9, 2016). It was noted the need to improve security of citizens on the Internet. Among the main threats faced were allocated: fraud, cyber-bullying (trolling), surveillance, extortion, aggressive marketing and blackmail. International forum on cybersecurity (cybersecurityforum.ru) is held with the participation of international and Russian experts to exchange experiences and identify best practices in the field of information security technologies, legislation and decisions).

[219] Analytical Bulletin No. 18 (617) "Labour in the digital age: the transformation of production, employment, taxation, training and social protection". The web-version can be found at: council.gov.ru/activity/analytics/publications/?publisher=5.

[220] The report can be retrieved from: council.gov.ru/activity/analytics/publications/?publisher=5.

13.3 TA perspectives

A number of Russian state research institutions, civil society institutions, and regional structures are currently analysing the future of labour in the digital age. Some development projects should be named, in particular:

- Implementation of the integrated telemedicine system. It is expected that this system will provide the interaction of specialists from the federal and regional clinics and will be based on components of the State Unified Health Information System (EGISZ). It will provide training for doctors, in regional health organizations, as well as conducting scientific researches, remote consultation and diagnosis. At the first step, a single telemedicine network integrated with the components of EGISZ will be connected with 21 federal medical institutions whose experts will be able to consult doctors on different issues simultaneously.[221]
- The impact of robotics on the labour market. The Federal Service for Labour and Employment is working on creating analytical applications, on identifying dependencies and regularities of the impact of labour robotization on enterprises' employment level. In order to perform this task, it is planned to involve the participants of the 2nd all-Russian contest "Open data of the Russian Federation".[222]
- A simplified procedure for the registration of remote workers[223]. Undergoing work is on the draft law on self-employed persons' legal status who are not individual entrepreneurs, but deriving income from execution of orders placed on electronic labour exchanges and other similar virtual platforms. Special attention in the Bill will be paid to the specifics of self-employed persons' remote work, including a differentiated approach to the tax collection of income from the physical persons, as well as to social and health insurance for such persons (reducing the tax burden while simplifying the procedure of paying taxes and contributions).
- The introduction of unmanned vehicles in various sectors of transport. The 6th International Congress "Road Safety for the Safety of Life",[224] to be held in September 2016 in Saint Petersburg, will focus on the issue of the legislative base preparation aimed at the development of unmanned vehicles.
- In progress is work on selection of the expert centre specializing on the field of labour and/or high technology enabling a reasonable forecast on the scale of the release of labour in the sphere of transport in connection with the replacement in the medium run, part of the vehicle unmanned devices. During the Nevsky international ecological Congress in May 2017[225] it is planned to thoroughly examine the problem of unmanned small aircraft legislative regulation (for the purposes of environmental control).
- Implementation of coordinated policy in labour relations legal regulation in the digital age. Such a task is in the framework of the Eurasian Economic Union and the Union State of Russia and Belarus. Multidimensional cooperation in the field of information technology, innovation and information society will be the main theme of the Fourth Forum of regions of Belarus and Russia (to be held in 2017 in the Russian Federation).

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221 portal.egisz.rosminzdrav.ru.

222 Held from April 27 to December 2, 2016, the Analytical centre under the Government of Russia with the support of the Open government.

223 22% of companies employ remote workers in Russia. According to various estimates, the number of remote workers is 3-5 million. Of these 22% of specialists work in the field of IT-technologies, 17% in sales, 11% accounting, 10% in personnel.

224 road-safety.ru.

225 ecocongress.info/congress.

14 Sweden

14.1 Status Quo and societal debates

New jobs emerging in Sweden over the last twenty years are dominated by knowledge-intensive jobs, reflecting the structural change towards more highly processed production. Investments in research and development, new technologies and new digital systems, design and higher level of expertise, have become increasingly important for Swedish companies and Swedish competitiveness. This has been reflected in the export industry having a growing service content and suppliers to industry dominating in terms of service. Over half of the suppliers to industry in Sweden come from the service sector. Thus, the proportion of high-wage jobs has increased substantially and has also created increased demand from households for many different types of household services.[226]

Estimations show that 53 per cent of Swedish occupations risk being replaced by digital technology over the next twenty years.[227] The equivalent figure for the US is 47 per cent.[228] The jobs that may be replaced are primarily routine work in the retail trade and in administration, but also certain highly qualified positions. Low-paid jobs have already been automated to a high degree in Sweden. Jobs requiring medium education and including routine duties will also rapidly be replaced by automation and robotics. Indications of increased job polarisation, with a growing proportion of people employed in low and high wage occupations, combined with a decreasing proportion of people employed in occupations in the mid-wage category have recently been documented.[229] This development could lead to additional competition and wage pressure on low-wage jobs because many people with medium education will seek jobs with lower requirements. Sweden is likely to be affected more than comparable countries by this technological job substitution, because Sweden still has many industrial jobs that may be automated.[230] The fact that Sweden has high minimum wages increases the incentive to replace labour with robots. Other factors likely to affect the pace of automation are ageing population and a lack of skilled workers in some areas.[231] A recent report shows that during 2006-2011 the effects of automation on Swedish occupations correspond well to the expected rate i.e. if automation were to continue at the same pace, it would, according to the analysis, generate between 36-60 percent job losses in 20 years.[232] A large part of the Swedish economy is publicly funded, which means that rationalisation and efficiency through digitisation within the public sector can have a great significance. Services can be automated, digitised or performed by robots, providing a better service at a lower cost and liberating labour to other services that cannot be automated.

New jobs created by digitisation will be especially beneficial for those with higher education. The number of computer specialists, for example, increased by more than 3,000 peo-

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226 *Rådslag ett: De nya jobben? Digitaliseringens påverkan på arbetsmarknaden*, 2016-01 Digitalutmaning.se

227 Fölster, S. (2014) *Vartannat jobb automatiseras inom 20 år – utmaningar för Sverige*. Swedish Foundation for Strategic Research.

228 Frey, C. B., Osborne, M. A (2013) *The Future of Employment: How Susceptible are Jobs to Computerisation?* manuscript, Oxford University.

229 *Digitaliseringens dynamik – en ESOrapport om strukturomvandlingen i svenskt näringsliv.* (2016) Heyman F et al., Rapport till Expertgruppen för studier i offentlig ekonomi. Finansdepartetment (summary in English).

230 Fölster, S., Hultman, L. (2014) Varannan har ett yrke som inte behövs om tjugo år, Dagens Nyheter 15 June, dn.se/debatt/varannan-har-ett-yrke-som-inte-behovs-omtjugo-ar.

231 Blix, M. (2015) The economy and digitalization – opportunities and challenges. Report. The Confederation of Swedish Enterprise.

232 Fölster, S. (2015) *De nya jobben i automatiseringens tidevarv*, Swedish Foundation for Strategic Research.

ple per year between 2006 and 2011, and are expected to yield the greatest supplements in the number of jobs for all occupations over the next twenty years[6]. A comparison among OECD countries shows that employment of ICT specialists across all sectors of the economy has risen, reaching at least three per cent of total employment in most OECD countries. Finland, Sweden and Luxembourg employed the most ICT specialists in 2014 with shares of over five per cent.[233]

The contribution represented by an increase in the use of robots to economic growth has proven substantial. In a recent study, the economic impact of industrial robots was studied using data from 17 countries during 1993-2007. The conclusions of the study are that industrial robots increased both labour productivity and added value. Robots were found to increase both wages and total factor productivity. While robots had no significant effect on the total number of hours worked, there was some evidence to suggest that they reduced the hours of both low-skilled and medium-skilled workers.[234]

Fölster (2015) divides the positive effects of digitisation on employment into three channels: (1) a greater need for labour to produce digital technology (including computer technicians and engineers), (2) a greater need for labour to sell digitised services and the fact that (3) increases in income and lower prices of goods and services are increasing demand in the economy.

14.2 Policy dimensions

The Swedish Government established the Digitalisation Commission in 2012, the main objective of which was to analyse and identify strategic areas and policy options for the digitisation agenda both on a national and regional level. A goal has been set up for Sweden to take a leading position in the area.[235] The Government has tasked the Commission with conducting an analysis that highlights factors that affect digitisation in Sweden. The remit also includes identifying strategic areas that should be taken into consideration in the development of future digitisation policy. In order to keep up with other nations, the Commission points out a number of strategic choices that have to be made to ensure a successful digital transformation. Amongst others, the Commission highlights six strategic areas that should be considered in the future policy of Sweden: continuous government commitment to promoting digitisation in society; a regulatory framework that works in and for the digital transition; skills for the digital society; infrastructures to promote digitisation; data-driven innovation for growth and prosperity; and security and privacy in a digital time provide value and benefit.[236]

A working group under Sweden's former Minister for Strategic Development concludes that new technology and international division of labour has generated changes in Swedish business structures which is relevant to both the labour market and the welfare system. The number of employees in small and medium-sized enterprises have been increasing in Sweden for a long time and incomes from work in private business, voluntary or involuntary, are growing in importance. According to the group, this will have consequences for social security systems and the Swedish model of collective agreements.[237]

Similar to the industrial strategies of other countries – Digitisation and Industry 4.0 is of central importance in the new Swedish Governmental strategy "Smart Industry". However,

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233 *OECD Digital Economy Outlook* 2015.

234 Graetz, G. and G. Michaels (2015), *Robots at Work*, CEP Discussion Paper nr. 1335, cep.lse.ac.uk/pubs/download/dp1335.pdf.

235 Digital Opportunities 2015. Digitalisation Commission. Swedish Government Inquiries.

236 Summary Strategic Areas for Future Policy December 2015. Digitalisation Commission.

237 *Förslag från analysgruppen Arbetet i framtiden: Livslångt lärande för framtidens arbetsmarknad,* regeringen.se.

the strategy also encompasses a wider perspective because of the great demand placed on long-term sustainability of production and utilisation of resources. Increased resource efficiency, environmental considerations and a more sustainable production are key points in the new strategy. A system for supplying skills to meet the needs of the industrial sector and "test bed Sweden" promoting research in areas that contribute to strengthening the industrial production of goods and services are also outlined as important areas in the new strategy.[238]

Labour unions – ongoing debates

The Swedish Trade Union Confederation, LO, has debated the need for addressing the challenges that digitisation poses for the labour unions rather than hanging on to the myth that "jobs disappear when the machines take over". LO underlines the importance of a union strategy to adjust to the new work structure and investments in education. It is argued that labour unions play an important role in creating training that meets the requirements of the major groups whose work will be transformed.[239]The labour union Unionen underpins the need for unions to organise and achieve social regulation in the area of crowdworking.[240,241] Unionen cooperates with several other international unions, including German IG Metall, aiming at developing tools to enable everyone to get a salary for the job performed in that particular person's country. A recent study co-sponsored by Unionen and carried out by the University of Hertfordshire and Ipsos MORI estimated around 700 000 active crowd workers in Sweden. Around two thirds of the adult Swedish population (68%) are active in some way in the online economy, for instance selling goods online or renting out rooms on platforms such as Airbnb.[242] Concerning self-employment, it has been argued that it is time for Sweden to learn to exploit digitalisation opportunities better. The Swedish think-tank "Digital challenge" emphasises that regulations must be adapted to a labour market where permanent employment is no longer the norm and that the parties involved must take the initiative and jointly promote development as digitisation requires new security systems where the self-employed have a greater security than today.[243]

Sharing economy – challenges and ongoing activities

The car service Uber began operating in Sweden in 2013. As in several other countries, it was unclear whether its services were covered by current legislation on vehicle licensing i.e. should Uber be considered as a taxi service and follow the same rules? Representatives from the Swedish Transport Agency and the Swedish Taxi Association have both claimed that UberPOP should be categorised as a taxi service, which would make the current way of running Uber services illegal.[244] Several Uber drivers have been fined for violations of the requirement to have a taxi driver license.[245] The Swedish Government has initiated an inquiry that will clarify the definitions related to taxi services, and also review thor-

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238 *Smart industry – a strategy for new industrialisation for Sweden.* Government Offices of Sweden. Ministry of Enterprise and Innovation, 2016.

239 *Digitaliseringen utmanar facken – men stjäl inte våra jobb*, Arbetet, 2015-11-06.

240 Crowd employment has been defined as employment that 'uses an online platform to enable organisations or individuals to access an indefinite and unknown group of other organisations or individuals to solve specific problems or to provide specific services or products in exchange for payment'. Crowd employment is also known as crowd sourcing or crowd work, and aims to organise the outsourcing of tasks to a large pool of online workers rather than to a single employee. eurofound.europa.eu.

241 *Lätt att bli lurad av nätets nya arbetsgivare,* Fredrik Söderqvist, DN 2016-02-04.

242 Huws, U., Joyce, S. (2016) *Size of Sweden's 'Gig Economy' revealed for the first time.* University of Hertfordshire.

243 *Digitaliseringen kräver nya trygghetssystem*, Dagens Samhälle, Uddén Sonnegård, E. & Ilshammar, L. 2016-03-22.

244 EurWORK. *Digitalisation and working life: lessons from the Uber cases around Europe.*

245 Swedish Transport Agency, tranpsortstyrelsen.se 2016-03-23.

oughly the legislation on car-pooling.[246] The Government is also conducting an inquiry that will analyse the legal status of the actors involved in the sharing economy and examine whether current regulations are sufficient or if there is a need for legislative changes.[247] The inquiry will focus on consumer rights in the sharing economy, but also take into account the business conditions and entrepreneurs' opportunities to make use of new business models. Currently, the Swedish Tax Agency has the task of investigating how the sharing economy affects taxation. In an initial partial report, several challenges have been identified, among others the Tax Agency's hampered ability to carry out effective controls. The Agency concludes that national tax rules are complex within this area, which hampers the predictability of the tax consequences for the parties involved. Suggestions for improving correct taxation include more collaboration with stakeholders in the business of the sharing economy to ensure that the Tax Agency gets reliable information as a basis for taxation.[248]

A national agenda for Big Data Analytics

A Swedish national agenda for the emerging field of Big Data Analytics has been developed[249] with the goal of highlighting the recent and increasing importance of advanced analysis of very large data sets in society and in business. The objective is to contribute to Sweden's potential to be at the forefront in this area by leveraging national areas of strength in research and business development. From an international perspective, Sweden is in an advantageous position to meet these challenges. There is a strong national research tradition in both basic and applied research of relevance to Big Data Analytics, for instance in critical areas such as data analysis, cloud computing and networking. Swedish companies as well as the Swedish public sector also generate and collect large data sets of high quality today. In the services area, for example, Sweden has a developing ecosystem of small to medium sized end-user service companies that generate a wealth of data. These factors, in combination with a recent change in the view towards accessibility of data, lay the foundation for Swedish Big Data Analytics-based innovation.

14.3 TA perspecitives

A project on behalf of the Committee on Transport and Communications has the objective of studying IT infrastructure in Sweden; *IT infrastructure for the whole of Sweden – today and tomorrow.* Sweden is a leading ICT nation and holds a strong position with regard to both ICT use and broadband access.[250] Still, access is unevenly spread across the country and the demand is growing rapidly.[251] The focus of the report is both the capacity of IT infrastructure (the possibility to use high-speed broadband connections and/or mobile phones) and its robustness (system reliability or sensitivity). A high-quality infrastructure has the potential to provide societal and economic value and is usually recognised as a catalyst for social and economic development, while a poor infrastructure could lead to societal disadvantages and costs. Scenarios with consequences of different future levels of infrastructure will be outlined and effects on the labour market will be one of the other factors investigated. The final report will be published in the autumn of 2016.

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246 Government Inquiry. *Anpassning till nya förutsättningar för taxi och samåkning*. Dir. 2015:81.
247 Governement Inquiry. *Användarna i delningsekonomin*. Dir. 2015:136.
248 *Kartläggning och analys avdelningsekonomins påverkan på skattesystemet.* Uppdrag i regleringsbrevet 2016, delrapport. Skatteverket.
249 *Big Data Analytics – A Research and Innovation Agenda for Sweden*, (2013). Vinnova.
250 European Commission (2016). The Digital Economy & Society Index (DESI).
251 European Commission (2015). Broadband coverage in Europe 2014: Sweden.

15 Switzerland

15.1 Status quo and societal debates

In June 2015 seven big Swiss companies – three of them parastatal bodies such as the public broadcasting company SRG or Swiss Post – pledged to promote flexible forms or work in their own organizations, signing a Work Smart Charter.[252] This initiative followed a series of studies, commissioned by the Swiss Government and by Swiss industry, which concluded that flexible work would allow for a more efficient use of office space and transport infrastructures as well as considerably reduce overall energy consumption.[253,254]

The Centre for Technology Assessment TA-SWISS has been looking at new developments in the world of work for a long time. In 2000 it published a study focussing on the *"nomads of the working world",* at that time mostly home teleworkers.[255] Desk sharing was also investigated.

While these phenomena were still mainly found in specialist literature at the beginning of the 21st century, the situation has fundamentally changed since then. In addition to temporal flexibility and locational flexibility, work is also becoming increasingly flexible numerically and organisationally. Many businesses are making use of the possibilities of adjusting their workforce to the volume of work and if necessary outsourcing tasks. Employees, on the other hand, are increasingly committing themselves to working on short-term projects in alternating teams instead of working on the same tasks for decades.

The latest study by TA-SWISS in 2016,[256] focuses on different forms of flexibilisation, and in the process reaches the following conclusions:

Varying degrees and forms of flexibilisation

Regarding flexibility in working hours, part-time work is now a reality for 37 percent of the Swiss labour population which translates into a European top rank.[257,258] Part-time workers often report a better life-domain-balance, but rate their career opportunities lower than full-time employees. Roughly 61 percent of Swiss employees make use of flexible models of work time such as flexitime. This particular form is appreciated, but poses problems when timekeeping is waived.

With respect to locational flexibility, a quarter of all Swiss employees work at least partially from home which is also a top ranking percentage in the European context. Also increasingly observable are mobile forms of work that encompass work at home, at the customer's location, or during a commute. Furthermore, companies increasingly rely on desk-sharing as this allows them to be flexible with regard to their infrastructures. Provided that working from home is chosen voluntarily by employees and does not come on top of regular work in the office, it offers many advantages such as higher productivity and satisfaction and a better life-domain-balance.

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252 work-smart-initiative.ch.

253 Bundesamt für Energie (2014): Auswirkungen neuer Arbeitsformen auf den Energieverbrauch und das Mobilitätsverhalten von Arbeitnehmenden.

254 SBB und Swisscom (2013): Work anywhere. Zürich.

255 T. M. Schwarb, A. Vollmer & R. Niederer (2000): Mobile Arbeitsformen: Verbreitung und Potenzial von Telearbeit und Desksharing. Arbeitsdokument des Zentrums für Technologiefolgen-Abschätzung.Bern.

256 J. O. Meissner, J. Weichbrodt et al. (2016): Flexible neue Arbeitswelt. Eine Bestandsaufnahme auf gesellschaftlicher und volkswirtschaftlicher Ebene. TA-SWISS (editor), vdf Hochschulverlag an der ETH Zürich.

257 Bundesamt für Statistik, bfs.admin.ch.

Numeric flexibility, i.e. the flexible size of the workforce, is exemplified by temporary work contracts, freelancer-based projects or new forms of procurement like crowdsourcing on internet platforms. About 7 percent of all Swiss work contracts are temporary. At 5 per cent, the "traditional" on-call work has remained stable over the last 15 years. As for the relatively recent phenomenon of crowdsourcing, respectively crowdwork, there is no reliable data yet. However, this form of procurement is likely to gain importance in the near future, particularly in the IT and communications industries where a reduction of the permanent workforce is foreseeable. Additional manpower will be recruited as "liquid talents" out of the "human cloud" (i.e. specialists that hired through the internet) if necessary. In general, these new forms of work give rise to the assumption that only workers with higher qualifications will benefit while low qualified workers have to expect considerable drawbacks.[259]

Along with these clearly definable forms of temporal, spatial and numeric flexibilisation, the trend to flatter hierarchies in organisations continues. Predetermined goals can be reached on one's own authority and are often relevant for variable components of the salary. In this way, entrepreneurial risk is transferred to the employee. In the social sciences this blending of traditional roles has been termed employee-entrepreneur or "entreployee". Elsewhere, it is known as the subjectivisation of work.

Substantial increase in occupational diversity

In addition to the increase in the number of employee-entrepreneurs, a growing portion of the labour force is expected to combine one or more part-time jobs with freelancing activities. This form of (partial) self-employment can lead to the realization of professional alternatives and a better self-fulfilment. However, there are also some pitfalls, in particular the risk of employees sliding into precarious conditions. When part-time employees are temporarily employed and have fluctuating volumes of work, their income and employment situation are, in fact, no longer reliably predictable. The acquisition of work orders using crowdsourcing platforms hardly permits a dependable planning of income and workload. Moreover, this form of self-employment requires a lot of individual responsibility as well as, for example, negotiation skills.

The permanently employed benefit the most from flexibilisation. Especially qualified personnel in executive positions gain considerable freedom of action and leeway in decision-making.

15.2 Policy dimensions

New legal questions arising from flexibilisation

Labour legislation is intended to ensure that the interests of the social partners are accounted for in a balanced manner. The standard employment relationship is based on the normal individual employment agreement or the collective employment agreement according to the Swiss Code of Obligations. The individual and collective agreements regulate core aspects of the relationship between the social partners. This concerns the performance to be effected by the employed as well as the obligations regarding pay and the duty to care on the employer's side.[260]

Swiss labour legislation compares favourably with its European counterparts, especially with regard to social security. New forms of work entail considerable challenges to it, how-

[259] Kaganer, E., Carmel, E., Hirschheim, R. & Olsen, T. (2013): Managing the Human Cloud. MIT Sloan Management Review 54(2). S. 23–32.

[260] Knöpfel, C. (2015): Sozialstaatliche Rahmenbedingungen in der Schweiz. In: B. Wüthrich et al. (eds): Soziale Versorgung zukunftsfähig gestalten. Springer Fachmedien. Wiesbaden.

ever: of central importance is the differentiation between the individual employment agreement and other forms of contracts, such as the work order and the contract for work and services. While the individual employment agreement offers temporal and objective protection from dismissal, a work order can be revoked at any time. Also essential for the differentiation is the extent to which employees are subject to directives by management. This criterion determines whether a person is employed or self-employed. In the intermediate forms of work contracts which arise from from flexibilisation, individual workers are only rudimentarily integrated in corporate structures of employers, but economically fully reliant on them. These dependent contractors do not have legal access to unemployment benefits, occupational pension funds, compulsory accident insurance or protection from occupational diseases.

Crowdsourcing is also situated in a legal grey area. External crowdworkers are self-employed which renders all labour regulations (minimal pay, paid leave, continuation of payments, etc.) non applicable. Since these kinds of work relationships often cross national borders, the applicability of foreign legislation has to be clarified in a costly manner in each individual case. Presently also unresolved is the question how income and sales tax claims can be enforced. Furthermore, crowdsourcing platforms act as intermediaries and therefore as partners of principals and agents. The general terms and conditions of the platform hereby function as the legal framework.

Flexible work within the scope of a standard employment relationship might also require legal clarifications.[261] It is unclear how the means of labour and intermediate inputs paid for by the employees are to be compensated. Currently, the compensation for expenses is mandatory, but the use of private working equipment is not.

The continued growth in importance of working from home and on a mobile basis also raises the question of who is liable for damages. In corporations, the employer has to assume liability. However, if the computer at home breaks down and data is lost, the situation is unclear. Vice-versa, the risk for damages to the company increases with the professional use of private equipment. Productivity benefits from this "bring-your-own-device" practice, because employees can use the means they are accustomed to, and the costs of procurement are partially eliminated. But for all that, it is imperative to clarify who has to pay for software and support for devices owned by employees.

Macroeconomic benefits of flexibilisation depend on adequate qualifications

The macroeconomic consequences of flexible work cannot be predicted unambiguously, either. Training and education of the workforce play a key role: the higher the portion of the highly qualified, the better the chances for flexibilisation to increase overall productivity and subsequently unlock the potential for higher wages and tax revenue. Challenges can be found with regard to self-management: round-the-clock availability, waning separation of work and leisure and workplaces that are not always ideally arranged endanger both physical and psychological health[262]. On the other hand, spatial and temporal flexibility can also be helpful in finding a better fit of work and one's own needs (biorhythm, family, hobbies, etc.).

For the low- and unskilled workers flexibilisation holds considerable risks, however. Since the digital revolution facilitates outsourcing of routine activities to low wage countries, the chances of finding a job are diminished for workers with low or no skills. Often the only work left is in personal service industries. Additionally, low-skilled workers on average

[261] Gutzwiller, B. (2010): Arbeitszeitmodelle und ihre rechtlichen Folgen. Schweizer Arbeitgeber 10/2010.
[262] Han, B.-C. (2010): Müdigkeitsgesellschaft. Matthes & Seitz. Berlin.

have to perform more shift-work or work on-call, have a higher risk of falling physically or psychologically ill, have a lower work-satisfaction and are at a higher risk of becoming unemployed, especially if they work on a temporary basis or have a low quota of working hours[263].

The most important message of this report is that the individual and societal consequences of flexible work are ambiguous and should be steered through careful measures on different levels in order to reach a positive outcome. Which direction the development can take is not technically or economically predetermined, but depends on the shaping of new forms of work on the company and supra-company levels.

The existing surveys by the official statistical bodies and the periodicity of their publications do not permit a current and short-term future assessment in many cases. As the dynamics of the labour market are expected to increase, a more forward-looking monitoring is required in order be able to take efficient measures on different levels.

15.3 TA perspectives

Technological developments of the last decades, in particular the digital revolution, have led to a profound transformation of the world of work. This allows for increasingly flexible working arrangements with regard to several aspects:

- Thanks to the Internet and mobile phones employees can access company data from home or any other location and work on a mobile basis (locational flexibility).
- Fixed daily working hours are replaced by models for annual and trust-based working time (temporal flexibility).
- Instead of committing oneself to the same job for decades, work is increasingly done in shorter term projects with changing teams (organizational flexibility).
- In turn companies use the possibilities to adjust their personnel to the volume of work and outsource tasks, if necessary (numerical flexibility).

Important aspects and core results of the TA-SWISS study

The study commissioned by TA-SWISS aims to clarify what the consequences for the status of gainful employment in society are, to what extent the characteristics of the new forms of work are covered by the present legal situation and what macroeconomic consequences are to be expected and should be systematically observed in the future.

The following points represent the core results of the study:

1. The status of work is under threat from a trend to combine temporal-spatial flexibility and employee entrepreneurship.
2. The legal situation is generally clear and adequate. However, balancing between additional regulations and voluntary self-regulation of the social partners is necessary. Furthermore, virtual work-exchange platforms should be scrutinized.
3. As a macroeconomic consequence, few slight improvements are accompanied by relatively many (slight to considerable) deteriorations.

[263] Haupt, C. (2010): Der Zusammenhang von Arbeitsplatzunsicherheit und Gesundheitsverhalten in einer bevölkerungsrepräsentativen epidemiologischen Studie. In: Badura, B., Ducki, A. Schröder, H., Klose, J. & Macco, K. (eds): Fehlzeiten-Report 2009. pp. 101–107). Springer-Verlag. Berlin, Heidelberg.

4. For the flexibility of work, the principle of social partnership is a necessary and sustainable condition.
5. The monitoring and controlling systems miss certain aspects and lack anticipatory data.

In conclusion, the phenomenon of a flexible world of work remains diffuse, i.e. it is an ill-defined problem. As such, it is a challenge and its successful tackling can make a real difference towards a robust and resilient Swiss work environment able to keep or even expand its international top position. This is by no means a trivial task, but rather a collective achievement by all participants in order to be able to act in this currently fairly unclear, complex, but also interesting and promising situation.

16 United Kingdom

16.1 Status quo and societal debates

Advances in robotics and autonomous systems (physical and software tools that can perceive their environment, control their actions, reason, and adapt) are making it possible to automate activities that previously could only be done by humans.[264] Automation technologies are used across the UK economy, and are being increasingly applied to the automation of both physical and knowledge-based work (Box 1). They may be used to replace workers entirely; to undertake tasks that would be unsafe or unfeasible for human workers; or as tools to enhance workers' productivity.[265,266] The UK has seen a stagnation in labour productivity since the 2008/9 recession (Box 2). It also lags behind in the adoption of some automation technologies, such as industrial robots. The UK has fewer industrial robots than any other G7 country, with an estimated 17,000 operational in 2014, compared to 176,000 in Germany.[267]

Box 1: Applications of Automation Technologies

Automation of Physical Work

Robotics is moving beyond large, inflexible installations (commonly used for tasks such as building cars), towards robots that can be used in a variety of sectors including transport, logistics, agriculture, healthcare, the oil and gas industry, and in domestic settings.[268,269,270] For example:

- **Autonomous vehicles** – are being developed by many companies including Google, Tesla, Uber, and nearly all car manufacturers.[271,272,273,274] For instance, Volvo has announced plans to start testing semi-autonomous cars in London in 2017.[275]
- **Automated warehouses** – UK online supermarket Ocado, is trialling warehouses where robots pack and move goods autonomously.[276]
- **Medical robots** – are being developed at Imperial College London and elsewhere, to support medical tasks such as performing surgery and aiding rehabilitation exercises.[277]
- **Domestic tasks** – the Dyson 360 Eye robotic vacuum cleaner can find efficient paths around rooms, cleaning an area while avoiding obstacles such as furniture.[278]

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264 Written Evidence to the House of Commons Science and Technology Committee inquiry on Robotics and AI, Department for Business, Innovation and Skills (2016), data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee/robotics-and-artificial-intelligence/written/33177.html.

265 Why Are There Still So Many Jobs, D. Autor (2015).

266 RAS 2020 Robotics and Autonomous Systems, The Robotics and Autonomous Systems Special Interest Group (2014), connect.innovateuk.org/documents/2903012/16074728/RAS%20UK%20Strategy?version=1.0.

267 Industrial Robot Statistics, International Federation of Robotics (2015) ifr.org/industrial-robots/statistics/.

268 cambridgeconsultants.com/projects/ocado-next-generation-warehouse-automation.

269 archive.boston.com/business/technology/gallery/consumerrobots/.

270 aethon.com/tug/tughealthcare/.

271 Google website google.com/selfdrivingcar/.

272 Toyota Promises Driverless Cars on Roads by 2020, BBC News website, 7/10/16 bbc.co.uk/news/technology-34464450:

273 Steel City's New Wheels, Uber website, 19/5/16 newsroom.uber.com/us-pennsylvania/new-wheels/.

274 Driverless Cars: Who is Winning the Race?, The Telegraph, 13/1/16, telegraph.co.uk/cars/comment/driverless-cars-who-is-winning-the-race/.

275 Volvo Cars to Launch UK's Largest and Most Ambitious Autonomous Driving Trial, Press Release, Volvo, 27/4/16 media.volvocars.com/global/en-gb/media/pressreleases/189969/volvo-cars-to-launch-uks-largest-and-most-ambitious-autonomous-driving-trial.

276 Cambridge Consultants website cambridgeconsultants.com/projects/ocado-next-generation-warehouse-automation.

277 Imperial College website imperial.ac.uk/hamlyn-centre/research/robotics/.

278 Dyson website dyson.co.uk/vacuums/robot/Dyson-360-Eye/.

Automation of Knowledge Work
Software that uses techniques such as machine learning, can perform or support many types of knowledge-based work. Examples include:

- **Personal Assistant Software** – such as Siri,[279] Google Now,[280] and Cortana,[281] that can transcribe and send messages, make appointments, and make restaurant reservations
- **Robotic Process Automation Software** – that can be used to automate routine administration such as data entry and analysis. For example, Enfield Council has installed "Amelia" a 'virtual employee' that responds to queries and deals with applications for licenses and permits[282]
- **E-discovery** – which is used by some law firms to automate the task of searching through documents that may be relevant to a case (work that was previously done by paralegals or junior lawyers)[283]
- **High Frequency Trading** – that uses machine learning to predict the short-term behaviour of markets, allowing automated trading software to perform trades far faster than a human.[284]

Box 2: UK Productivity

In recent decades, labour productivity in the UK has grown by about 2% per year, but has stagnated since the 2008/9 recession. At the start of 2016, productivity was 0.1% above its pre-recession peak. International comparisons of labour productivity show that the UK is ranked sixth among the G7 countries, with Germany top and Japan bottom.[285] The causes of this weakness are not well understood. Alternative theories include:

- weakness in investment reducing the quality of equipment available to employees
- the banking crisis leading to a lack of lending to more productive firms
- employees within firms being moved to less productive roles
- slowing rates of innovation and discovery.

Information and communication technologies (ICT) are making it easier to share resources, for instance through online car sharing platforms such as Bla Bla Car.[286] Apps such as Uber can make it easier to access work and may provide greater flexibility to drivers.[287] However, this may come with greater uncertainty for drivers, for example due to fluctuations in fares.[288] The use of Uber has led to several protests by drivers of black taxi cabs in London.[289] The Central London Employment Tribunal is considering whether Uber is acting unlawfully by not providing drivers with basic workers' rights.[290]

Developments in ICT also underpin much of the innovation seen in the financial services. These financial technologies (FinTech) are changing the types of financial services availa-

279 Apple website apple.com/uk/ios/siri/.
280 Google website google.co.uk/landing/now/.
281 Microsoft website support.microsoft.com/en-us/help/17214/windows-10-what-is-cortana.
282 Robot Called Amelia to do the Job of Human Council Workers for the First Time, The Telegraph, 16/6/16 telegraph.co.uk/news/2016/06/16/robot-called-amelia-to-do-the-job-of-human-workers-at-a-local-co/
283 eBrevia Applies Machine Learning to Contract Review, Forbes, 20/2/15, forbes.com/sites/benkepes/2015/02/20/ebrevia-applies-machine-learning-to-contract-review/#387bd94340bb.
284 The Future of Computer Trading in Financial Markets, Government Office for Science (2012) gov.uk/government/publications/future-of-computer-trading-in-financial-markets-an-international-perspective.
285 Productivity in the UK, House of Commons Library Briefing (2016) researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06492.
286 BlaBlaCar website blablacar.co.uk.
287 In the Driver's Seat: A Closer Look at the Uber Partner Experience, Uber website, 22/1/15 newsroom.uber.com/in-the-drivers-seat-understanding-the-uber-partner-experience/.
288 Uber: Don't Take us for a Ride!, Unite the Union website, unitetheunion.org/how-we-help/list-of-sectors/passenger-transport/passengertransportnews/cabtradenews/cab-trade-news/.
289 Black-cab Drivers' Uber Protest Brings London Traffic to a Standstill, The Guardian, 10/2/16 theguardian.com/technology/2016/feb/10/black-cab-drivers-uber-protest-london-traffic-standstill.
290 Uber Challenged on UK Drivers' Status, The Financial Times, 20/7/16 ft.com/cms/s/0/2bedda7a-4e7e-11e6-88c5-db83e98a590a.html?ftcamp=crm/email//nbe/CompaniesBySector/product#axzz4F26VXnqt.

ble, who can access them, and how.[291] The UK has a well-established FinTech sector (POSTnote 525) including:

- online peer-to-peer lending and crowdfunding platforms that offer access to alternative sources of finance without going via a bank;
- automated financial advice services (Box 3);
- and distributed ledgers (digital records that can be securely shared among many different users) that can help to record the movement of items such as diamonds, or might potentially be used by Government to deliver welfare payments.

Box 3: Automation in Financial Advice

Automated advice services use software to provide personal financial advice with little or no human guidance.[292] Data, such as a user's income or risk tolerance, are analysed to recommend specific products or services. For example, companies such as Wealth Horizon[293] provide consumers with automatically-created online investment portfolios.[294] Potential benefits of automated services include lower costs and greater access to advice.[292,294,295] However, risks for consumers include the possibility that they do not understand the limitations of the service or how their data is used, and have a limited ability to seek clarification.[292]

Technology and UK Employment: Historically, technology has displaced human workers in specific tasks. Although this has not lead to mass unemployment in the long-term, it has altered the type of employment available. When automation has been deployed in existing industries, productivity gains have reduced the price of goods and services, raising consumers' purchasing power and fuelling demand. This has increased the number of jobs required to meet demand and hence created more employment.[296,297] However, it is not clear whether these patterns will continue.[298] A 2014 survey of technology experts and enthusiasts found that only half believed that technology will create jobs at a similar or faster rate than it displaces them.[299] Predicting the impact of automation is difficult because of uncertainties in the rate of technological development, rate of adoption,[264] and other factors that may affect employment, such as changes to the wider economy.

16.2 Policy dimensions

Boosting Productivity: The UK Government launched a productivity plan in 2015, intended to reverse the UK's long-term productivity problem and secure rising living standards.[300] The productivity plan highlighted ongoing initiatives that included providing 'Superfast broadband' (24 Mbps or above) to 95% of households by 2017, investments of £6.9 billion

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[291] Financial Technologies, POST (2016), researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0525.

[292] ESAs, Joint Committee Discussion Paper on Automation in Financial Advice (2015) eba.europa.eu/documents/10180/1299866/JC+2015+080+Discussion+Paper+on+automation+in+financial+advice.pdf.

[293] Wealth Horizon website wealthhorizon.com.

[294] Deloitte, Robo-Advisors, Capitalizing on a Growing Opportunity (2015) www2.deloitte.com/content/dam/Deloitte/us/Documents/strategy/us-cons-robo-advisors.pdf.

[295] HM Treasury, Financial Advice Market Review: Terms of Reference gov.uk/government/publications/financial-advice-market-review-terms-of-reference.

[296] Technology at Work, Citi GPS (2015).

[297] Labour's Share, A. Haldane (2015). bankofengland.co.uk/publications/Documents/speeches/2015/speech864.pdf

[298] The Second Machine Age, Brynjolfsson and McAfee (2014).

[299] AI, Robotics and the Future of Jobs, Pew Research Center (2014).

[300] Fixing the Foundations: Creating a More Prosperous Nation, UK Government (2015) gov.uk/government/publications/fixing-the-foundations-creating-a-more-prosperous-nation.

in UK research infrastructure, and further developing the UK network of Catapult centres for commercialising technology. It also includes the intention to develop a 'Digital Transformation Plan', which will set out actions that the Government intends to take to support the adoption of digital technologies across the economy and to tackle barriers faced by new businesses entering and creating new markets.

Autonomous Technologies: In 2013, McKinsey predicted that the automation of knowledge work and advanced robotics could be worth $7-$11 trillion globally by 2025.[301] The former UK Government Department for Business, Innovation and Skills (BIS) projected that the autonomous vehicles sector alone could be worth up to £51 billion annually to the UK economy by 2030.[264] The UK Government has announced over £200 million in funding to expand the UK's wide-ranging expertise in robotics and autonomous systems, which includes machine learning, unmanned systems such as autonomous vehicles (Box 4), and robots for use in hazardous environments such as space.

Debate around the potential implications of automation technologies for employment is just beginning in the UK, and the subject has entered the mainstream media.[302] The UK Government's Horizon Scanning Programme Team is exploring the implications of automation for policy, including employment, however details of this work are not currently publically available.[303,304]

Box 4. Autonomous Vehicles

It is estimated that the intelligent mobility sector (which encompasses connected and autonomous vehicles) could be worth £900 billion globally by 2025.[305] A 2015 review by the UK Government's Department for Transport (DfT) found that UK regulations provide a favourable environment for testing autonomous vehicles. DfT has published a code of practice that allows for automated vehicle testing to take place anywhere in the UK without the need for permits or surety bonds.[306,307]
The UK Centre for Connected and Autonomous Vehicles was established in 2015 to support the development of connected and autonomous vehicles in the UK. Trials are being performed in Bristol, Coventry, Milton Keynes and Greenwich. Further tests, including with platoons of semi-autonomous lorries, are expected to begin soon.

16.3 TA perspectives

A 2014 study by Frey and Osborne (published by Deloitte), estimated that 35% of jobs in the UK in 2013 had a greater than 66% chance of being automated in the coming decades.[308] It suggested that areas including sales, transport, logistics, office work and administration were particularly likely to be automated. Jobs in healthcare, education, and financial and management services were found less likely to be automated. The Bank of Eng-

301 Disruptive Technologies, McKinsey (2013).
302 Fear of the Robots is Founded in the Messy Reality of Labour, The Financial Times 17/4/16 ft.com/cms/s/0/e990a3f0-031a-11e6-99cb-83242733f755.html#axzz46N801uR7.
303 Written answer to Parliamentary Question HL3677, Baroness Neville-Rolfe 3/12/15 parliament.uk/written-questions-answers-statements/written-question/lords/2015-11-18/HL3677.
304 UK Government Website gov.uk/government/groups/horizon-scanning-programme-team.
305 Transport Systems Catapult website (accessed 20/7/16) ts.catapult.org.uk/intelligent-mobility/market-breakdown/.
306 The Pathway to Driverless Cars – Summary Report and Action Plan, Department for Transport (2015) gov.uk/government/uploads/system/uploads/attachment_data/file/401562/pathway-driverless-cars-summary.pdf.
307 The Pathway to Driverless Cars: A Code of Practice for Testing, Department for Transport (2015) gov.uk/government/uploads/system/uploads/attachment_data/file/446316/pathway-driverless-cars.pdf.
308 Agiletown: the Relentless March of Technology and London's Response, Frey & Osborne, Deloitte (2014).

land used the same methodology to estimate that up to 15 million UK jobs could be automated.[297] However, these figures may be over-estimates, as the studies only considered whether the automation of jobs was technologically (rather than economically) feasible.

A 2016 study by Arntz et al. analysed the tasks within jobs.[309,310] Based on data from 2012, it estimated that for 10% of UK jobs, it would be technically possible to automate more than 70% of their component tasks within the next decade, close to the 9% average for other members of the Organisation for Economic Co-operation and Development (OECD). A further 25% of UK jobs could have at least 50% of their tasks automated over the same period. None of these studies accounted for jobs that may be created, for instance if automation leads to increased demand for existing goods and services, to the creation of new industries, or to the creation of new types of job within existing industries.

A further study by Deloitte in 2015 looked at changes in UK employment from 2001 to 2015.[311] It found that that technology is likely to have displaced over 800,000 jobs, but created nearly 3.5 million new ones over the same period. The percentage of jobs at "low" (less than 33%) and "medium" (less than 66%) risk of automation increased over this period, while the percentage of "high-risk" jobs fell. On average, new jobs paid £10,000 more per annum than those displaced. However, it is not possible to isolate automation as the sole cause of these changes.

Skills and Education: A 2015 inquiry by a House of Lords ad hoc Select Committee on Digital Skills explored the impact of the labour market on automation.[312] It observed that "the digital revolution is changing the labour market fundamentally" and concluded that there is a shortage of medium- and high-level digital skills in the UK, needing immediate attention if the UK is to remain competitive globally.

UK Government initiatives to improve ICT skills include a new school computing curriculum in 2014,[313] University Technical Colleges focusing on technology,[314] higher education courses with more industrial engagement[315] and an £18 million investment (matched by industry) to promote training for ICT specialists.[316] However, the House of Lords Digital Skills Select Committee and others have raised concerns over insufficient funds; training for school teachers; and immigration restrictions that may make it harder to fill the skills gap. Greater female participation in IT specialist roles (which has remained at about 16% for 10 years) could also help to meet the skills gap.[312,317,318,319,320]

The Committee also observed that digital technology will challenge traditional methods of delivering education. Schools and teachers may be required to adapt, and new models of learning may be needed to keep pace with evolving technology, such as increased online learning and employer-designed short courses.[312] The UK Commission for Employment and Skills suggests that continuous learning and adaptation will be an essential part of successful participation in the labour market, due to the increasing rate of technological

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309 The Risk of Automation for Jobs in OECD Countries, M. Arntz, T. Gregory and U. Zierahn (2016).
310 Automation and Independent Work in a Digital Economy, OECD (2016).
311 From Brawn to Brains: The Impact of Technology on Jobs in the UK, Deloitte (2015).
312 Make or Break: The UK's Digital Future, House of Lords Digital Skills Select Committee (2015). publications.parliament.uk/pa/ld201415/ldselect/lddigital/111/111.pdf.
313 National Curriculum in England: Computing Programmes of Study, Department for Education (2013).
314 University Technical Colleges, Baker Dearing Educational Trust (2015).
315 The Information Economy Council Digital Skills Strategy, Information Economy Council (2014).
316 Progress Update April 2014 – March 2015, Tech Partnership (2015).
317 MK:Smart – Helping to Deliver the Internet of Things in Milton Keynes', MKSmart 23/5/14.
318 We're Just Not Doing Enough – Working Together to Meet the Digital Skills Challenge, TechUK (2015).
319 Digital Skills for Tomorrow's World, Digital Skills Taskforce (2014).
320 Women in IT Scorecard, e-skills UK (2014).

change.[321] They say that careers may also become more varied, as jobs change rapidly, increasing the need for employees to up-skill or re-skill.

Inequality: Concerns have been raised that automation might lead to an increase in social inequality.[322,297,296,298] One scenario is that the majority of the benefits of automation (such as any wealth created) may not be felt by employees (through wage growth) or consumers (through cheaper goods and services). In the past, growth in wages, pensions and other benefits ("compensation") has reflected growth in productivity but this trend has faltered since the 1990s with the former growing more slowly for many workers.[323]

Automation is also thought to be one of the main factors contributing to "job polarisation": a growth in the number of low-skill and high-skill jobs, alongside a reduction in the number of mid-skill jobs. This has been seen in the UK and other developed countries during the late 20th and early 21st centuries.[324,325] However, the studies by Deloitte in 2015, and by Arntz et al. in 2016, have predicted that future job losses caused by robotics and autonomous systems may primarily affect workers in low-skill roles.[309,310,311] If demand for low-skill labour decreases, while high-skill workers largely benefit from new job opportunities and higher wages, then many analysts believe that the wage gap between high and low-skill workers could expand, worsening inequality (POSTnote 534).[297,322] Some also suggest that automation might encourage the 're-shoring' of manufacturing to the UK,[326] which could inhibit the development of countries with labour-intensive manufacturing sectors, such as those in Southeast Asia.[327]

321 The Future of Work, UK Commission for Employment and Skills (2015).
322 The Rise of the Robots, Martin Ford (2015).
323 Decoupling of Wage Growth and Productivity Growth: Myth and Reality, J. Pessoa and J. van Reenen, Resolution Foundation (2012).
324 Explaining Job Polarization: Routine-Biased Technological Change and Offshoring, M. Goos, A. Manning and A. Salomons (2014).
325 The Anatomy of Job Polarisation in the UK, A. Salvatori (2015).
326 Reshoring – a new direction for the UK economy?, UK Economic Outlook, PwC (2014).
327 ASEAN in Transformation The Future of Jobs at Risk of Automation, International Labour Organization (2016) ilo.org/public/english/dialogue/actemp/downloads/publications/2016/asean_in_transf_2016_r2_future.pdf.

17 United States

17.1 Status quo and societal debates

As early as 1982, soon after the introduction of the IBM PC and the nascent adoption of information and communications technology (ICT) in the workplace, the GAO had performed a study[328] of the impact of automation on employment because of concerns over whether the advancement of automation will ultimately reduce the number of available jobs and increase the rate of unemployment. The findings of the 1982 study are surprisingly prescient, as that report noted:

> "*GAO found that, while current and proposed uses of automation can increase worker productivity and reduce unit cost, they can also have a significant impact on the size of the workforce needed to produce the same or increased output. Automation: (1) reduces the number of people required to perform the same task, causing employee displacement; (2) changes the nature of tasks performed by those who retain their positions; and (3) creates new occupations and increases the number of jobs in existing occupations in the same or other industries*." Other studies in the intervening years have reiterated one of the observations of that 1982 report: "*Although automation will undoubtedly cause some loss of jobs in the short run, much debate arises over whether it will eventually cause an overall increase in unemployment, or whether more jobs will be created because of it.*"

More recently, in a widely cited 2013 article,[329] economists Carl Frey and Michael Osborne estimated that around 47 percent of total U.S. jobs "could be automated relatively soon, perhaps over the next decade or two." A March 2016 Pew Research Center survey,[330] reported that "two-thirds of Americans think it's likely that in 50 years robots and computers will do much of the work currently done by humans." On the other hand, in another recent essay[331] David Autor offered an insightful counterpoint asserting that "journalists and even expert commentators tend to overstate the extent of machine substitution for human labour and ignore the strong complementarities between automation and labour that increase productivity, raise earnings, and augment demand for labour".

Whether digital automation causes an increase in overall unemployment or not, recent economic studies such as the ones from Federal Reserve Banks of Dallas[332] and St. Louis[333] point to "job polarization" in the economy, evidenced by the decline in middle-skill occupations such as manufacturing jobs while there is growth in both high- and low-skill occupations such as professional jobs at one end and caring for others at the other. The studies largely attribute the decline in middle-skill routine jobs that are cognitive or manual in nature to an increase in the automation of tasks and scarcity of workers with appropriate skills.

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328 *Advances in Automation Prompt Concern Over Increased U.S. Unemployment,* AFMD-82-44: Published: May 25, 1982. gao.gov/products/AFMD-82-44.

329 *The Future of Employment: How Susceptible are Jobs to Computerization?*, Carl Frey and Michael Osborne, 2013, oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf.

330 *Public Predictions for the Future of Workforce Automation*, Pew Research Center, Washington, DC pewinternet.org/2016/03/10/public-predictions-for-the-future-of-workforce-automation/.

331 *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*, Journal of Economic Perspectives, Summer 2015—Pages 3–30, economics.mit.edu/files/10865.

332 *Economic Letter*, Federal Reserve Bank of Dallas, May 2014, dallasfed.org/assets/documents/research/eclett/2014/el1405.pdf.

333 *Jobs Involving Routine Tasks Aren't Growing*, Jan 2016, stlouisfed.org/on-the-economy/2016/january/jobs-involving-routine-tasks-arent-growing.

Another impact of the digital economy, enabled by mobile Internet applications, is the rise of the so-called on-demand economy – such as the car ride services offered by Uber and Lyft or the apartment rentals from Airbnb. The on-demand economy has the potential for productivity and welfare gains but could potentially lead to worker displacement as well.

Wages are also affected by the job polarization due to increased automation. Analysis[334] of an occupation's median hourly wage and the occupational automation scores suggest that jobs that are easier to automate have lower wages. The jobs in the on-demand economy are also not like the traditional employment with well-defined salaries and benefits.

The current expectation is that growing use of cheap and powerful computing power and machine intelligence will result in more non-routine tasks becoming routine (for example, driverless cars, drones, online education, robotic surgery, etc.). As the power of digitization and machine intelligence grows, one could even foresee a future where there is no employment for large segments of the population. Some believe that we are at the cusp of an inflection point where automated, digital labour is about to start replacing human labour, leading to increasing technological unemployment and prompting the question whether life would be worth living in a world without work.[335]

All these employment changes wrought by the digital economy are getting the attention of U.S. businesses and government at all levels. Even if machines taking over human jobs mean humans moving on to new jobs that require more complex tasks or greater levels of independent judgment, the pace of this change may be too fast and disruptive to the society.

17.2 Policy dimensions

GAO notes[336] that the nation's workforce system is a shared responsibility of federal and state governments, with substantial flexibility for states – and in many cases local areas – to customize programs. The U.S. system includes supports for job seekers such as Unemployment Insurance benefits and multiple employment and training programs with diverse target populations. A slow economic recovery, heightened levels of long-term unemployment and continual shifts in the skills sought by employers are among the factors that present challenges for these programs.

To address the need for more skilled workers for non-routine tasks that are hard to automate, there is a need for a robust training and education agenda so that displaced workers are able to quickly and smoothly move into new jobs. In July 2014, President Obama signed into law the bipartisan Workforce Innovation and Opportunity Act, the first legislative reform of U.S. Federal job training programs in nearly 15 years, which consolidates existing funding initiatives, helps retrain workers in skills that employers are looking for, and matches those workers to employers. In March 2015, the U.S. government also launched the TechHire initiative,[337] part of which aims to train 17-29 year olds with skills necessary for jobs in information technology fields, including software development, network administration, and cybersecurity.

A problem with the government's employment and training programs is in assessing their outcome. Although the programs are required to report program performance, when GAO

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334 *Economic Report of the President*, Transmitted to U.S. Congress, February 2016 whitehouse.gov/sites/default/files/docs/ERP_2016_Book_Complete%20JA.pdf.

335 *Will Life Be Worth Living in a World Without Work? Technological Unemployment and the Meaning of Life*. J. Danaher, Sci Eng Ethics. March 2016 ncbi.nlm.nih.gov/pubmed/26968572.

336 *Employment in a Changing Economy*, U.S. Government Accountability Office, Key Issues, gao.gov/key_issues/employment_in_changing_economy/issue_summary.

337 TechHire Initiative, The White House, 2015 whitehouse.gov/issues/technology/techhire.

looked at three states' performance reporting systems, it identified challenges in the areas of limited guidance on performance reporting, cost and complexity of integrating data systems to track performance, and poor quality of data about participants in the programs.

Overall, GAO has noted three key areas of concern for various government programs for addressing the employment needs in a changing economy: (1) continued support for the unemployed; (2) growing need for employment and training programs; and (3) serving specific populations such as older workers and women that face unique employment challenges.

Besides the government programs for unemployment insurance and skills training, the potential for technological unemployment has brought renewed attention to controversial ideas such as "universal basic income" or "basic income guarantee." As Richard Caputo notes in a 2012 monograph on basic income guarantee,[338] prior experience with guaranteed annual income in the United States suggest that linking such income to resolving specific social problems increases the political acceptance of the idea, but does not ensure adoption and implementation. He goes on to conclude that the "likelihood of favourably influencing a national level debate of the issue is remote" in the United States.

17.3 TA perspectives

Past technology assessments by the Office of Technology Assessment (OTA), a now defunct agency of U.S. Congress, had focused on issues such as impact of technology on employment. For example, as early as 1983, an OTA report[339] had looked at employment change due to increasing use of programmable automation technologies. That study noted that analysis of employment change depends critically on methodology, while analysis of training requirements for new work requires an understanding of the existing delivery system for education and training.

Another 1995 OTA report[340] studied the potential effects of what it called the "digital electronic technology revolution" on the spatial distribution of jobs and people broadly, or on urban conditions in the United States specifically. That study found that though some places benefit from these digital technologies, the economies of some metropolitan regions could face further job loss and disinvestment.

GAO's technology assessments continue in the footsteps of OTA with a focus on providing a balanced analysis of interactions of technological innovation on society, the environment, and the economy, with particular attention to foreseen, but unintended consequences and effects of those interactions. A recent GAO assessment[341] of 3D printing technology notes the importance of U.S. government actions in the area of workforce education and training to develop a workforce capable of design-focused thinking, which is necessary if the U.S is to get the full benefits of the new ways of manufacturing that 3D printing enables.

A recent study[342] by Joel Mokyr, et al. looks at the history of technological anxiety and notes that "the more extreme of modern anxieties about long-term, ineradicable technolog-

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338 *Basic Income Guarantee and Politics*, 2012, Edited by Richard Caputo, Chapter 15, pp. 265-281, books.google.com/books?id=bSbHAAAAQBAJ.

339 Automation and the Workplace: Selected Labor, Education, and Training Issues, Office of Technology Assessment, U.S. Congress, March 1983 archived at theblackvault.com/documents/ota/Ota_4/DATA/1983/8304.pdf.

340 The Technological Reshaping of Metropolitan America, Office of Technology Assessment, U.S. Congress, September 1995 archived at theblackvault.com/documents/ota/Ota_1/DATA/1995/9508.pdf.

341 *3D Printing: Opportunities, Challenges, and Policy Implications of Additive Manufacturing,* GAO-15-505SP: Published: June 24, 2015. gao.gov/assets/680/670960.pdf.

342 *The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?* J. Mokyr, et al. The Journal of Economic Perspectives, Vol. 29 No. 3, Summer 2015, pp. 31-50.

ical unemployment, or a widespread lack of meaning because of changes in work patterns seem highly unlikely to come to pass." That study ends with a word of advice from Keynes:[343] "Meanwhile there will be no harm in making mild preparations for our destiny, in encouraging, and experimenting in, the arts of life as well as the activities of purpose."

In a December 2015 study,[344] McKinsey Global Institute noted that digitization across the U.S. economy is changing the dynamics in many industries, providing major opportunity to boost productivity growth, but also bringing about more economic dislocation. The study suggests that the "United States will need to adapt its institutions and training pathways to help workers acquire relevant skills and navigate this period of transition and churn."

It is important for technology assessments, especially those focused on ICT-related trends – such as Internet of Things and the Blockchain distributed ledger technology that underlies the Bitcoin digital currency – to study the potential impact of advanced ICT on the changes to jobs and the skills necessary for the new landscape of employment. Such assessments could use methodical analysis of emerging trends, called foresight research. Even though the future cannot be predicted, it is possible to conduct "scenario planning". Scenarios can be created by combining known facts about the plausible future trends in technology such as artificial intelligence, robotics, additive manufacturing, synthetic biology, and quantum computing, with plausible alternatives, such as reshaping of the job market and increase in income inequality. The goal of scenario-based foresight research is to conduct strategic planning to confront a range of changing realities.

However, the key to useful scenario planning is in being able to ascertain the trends of social or economic changes as early as possible and learning to develop nuanced scenarios based on currently observed changes. The challenge lies in identifying the typically exponential trends in digital technology's development, adoption, and impact on society and economy.

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[343] *Economic Possibilities for Our Grandchildren*, John Maynard Keynes. 1930. Essays in Persuasion (1963), pp. 358–73, W.W. Norton, New York.

[344] *Digital America: A Tale of the have and have-mores*, McKinsey Global Institute, December 2015. mckinsey.com/industries/high-tech/our-insights/digital-america-a-tale-of-the-haves-and-have-mores.

18 Wallonia (Belgium)

18.1 Status quo and societal debates

The increasingly important role played by digital technologies in the Walloon society affects many dimensions of labour in the region. Societal debates regarding digital technologies in labour are largely focused on potential benefits for the economy as a whole: in a region facing the challenges of a strong deindustrialisation, digitalisation is presented as a solution to boost Walloon economy. This explains why, possibly more than any other perspective, "Industry 4.0" is currently the most discussed issue in Wallonia regarding digital technologies. Hence the publication of numerous reports and policy notes on digital technologies' consequences on the industry.

In order to gain a better understanding of the Walloon's situation, it is interesting to take a look at the Belgian one. Digital technologies highly affect Belgium's economy and society. Indeed, its 2016 Digital Economy and Society Index (DESI), which summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness, Belgium ranks 5th among EU member states (with a score of 0.63). Concerning the integration of digital technologies by businesses, Belgium scores 0.5 and ranks 4th among member states, which is positively commented by the European Commission:

> *"In a truly digital economy, businesses take full advantage of the opportunities offered by digital technologies, both to improve their productivity and to reach consumers. Belgium has a pretty good performance in this area. Belgian businesses increasingly exploit most of the possibilities offered by on-line commerce, social media and cloud-based applications.*
> *Almost a quarter of its SMEs sell online and 13% do so cross-border, an important channel to address wider markets",* [345]

In Wallonia, digital technologies also affect industrial and labour dimensions. Two of the main changes concern telework and e-commerce, which are constantly increasing. Indeed, according to the 2015 Barometer of Walloon citizens' digital uses, 44% of Walloon employees practice a form of tele-work, and 53% of Walloon citizens have already executed commercial transactions online[346]. However, the picture is less optimistic regarding the integration of digital technologies in industry. A 2015 study, ordered by the Walloon Minister of Economy, showed that the level of digital technology adoption by the industry is still low. Big companies are often more advanced and innovative, while a spillover dynamic to boost the "digitalisation" of smaller companies is still to be established. All in all, even if the majority of important business actors have adopted sufficient technologies in order to maintain a certain level of competitiveness, few sectors have succeeded in establishing a competitive advantage regarding digital labour. This situation is linked to another observation: Walloon industry is still lagging behind Flanders and is sometimes facing problems to adequately support the economy.[347]

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345 European Commission (2016), *Digital Economy and Society Index 2016. Country Profile: Belgium.* ec.europa.eu/newsroom/dae/document.cfm?action=display&doc_id=14115.

346 Agence du Numérique (2015), *Baromètre 2015 des usages numériques des citoyens wallons.* digitalwallonia.be/wp-content/uploads/2015/11/Digital_Wallonia_Barom%C3%A8tre_Citoyens_2015.pdf.

347 SOGEPA (2015), *Regards sur l'économie wallonne. Economie par le numérique.* hsogepa.be/assets/df2e6d8f-b522-4ef2-ad61-5053a2e0a594/sogepa-economieparlenumeriquepdf.pdf.

18.2 Policy dimensions

In this context, digital technologies are presented as a way to boost Wallonia's economic competitiveness. "Industry 4.0" is proposed by the Government as a solution to increase Walloon companies' competitiveness in global markets.

Walloon political authorities have indeed developed an important strategy regarding digital technologies. In May 2015, the Walloon Government adopted its "Marshall Plan 4.0", which is a direct reference to the fourth industrial revolution represented by digitalisation. Related to economic competitiveness, this plan explicitly mentions the ambition to boost Walloon economy, notably by fostering digital integration to support companies' growth and competitiveness and by developing a digital culture among citizens.[348]

These ideas are strongly supported by companies' federations, who claim that the so-called "digital revolution" will bring unprecedented prosperity[349]. Their argumentation refers to the creation of new jobs (even if they recognize that some other jobs will disappear), the gain in productivity, the lowering of costs and sales growth. They thus plead public authorities to develop a technology-friendly environment by adapting the legislations toward softening labour organisation's rules, arguing that it would improve educative system's capacities to provide companies with skilled work force, and that it would turn social security into a 'motor' of economic development instead of what they consider 'a brake'.[350]

Surprisingly, labour unions seem less directly concerned by this thematic. They tend to focus on traditional forms of labour and they often do not tackle the impact of digital technologies in their most recent publications. The few related available documents show quite an optimistic view on the subject: the Christian Unions' Federation points to the creation of new jobs and to the gain of productivity resulting in a raise of wealth to be distributed[351], while the Labour General Federation of Belgium emphasizes the need to respect workers' rights and to think about creating new rights together with the emergence of digital technologies. The same federation also points to the potential collective reduction of work time allowed by digitalisation.[352]

In terms of concrete policies, in December 2015 the Walloon Government published a document titled "Digital Wallonia. Wallonia's Digital Strategy". This strategy states that the digital revolution is already ongoing and that it will radically change society. In this context, the Walloon Region wants to play a facilitating role to accompany digital transformation in all activity sectors. Five main themes are highlighted: the improvement of the digital sector, the development of companies' digital intensity to achieve an "Industry 4.0", the digitization of public services, the development of connected territories, and the improvement of competences and employment.[353] Regarding this last theme, a specific effort is deployed to train Walloons to master digital technologies and to provide them with relevant skills in or-

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348 Gouvernement Wallon (2015), *Plan Marshal 4.0*. wallonie.be/sites/wallonie/files/pages/fichiers/pm4__complet_texte.pdf.

349 FEB, BECI, VOKA, UWE (2016), *La révolution numérique et les entreprises belges: agir aujourd'hui pour les emplois de demain*. uwe.be/uwe/presse/communiques/la-revolution-numerique-et-les-entreprises-belges-agir-aujourd2019hui-pour-les-emplois-de-demain/?searchterm=num%C3%A9rique.

350 FEB, BECI, VOKA, UWE (2016), *La révolution numérique et les entreprises belges: agir aujourd'hui pour les emplois de demain*. uwe.be/uwe/presse/communiques/la-revolution-numerique-et-les-entreprises-belges-agir-aujourd2019hui-pour-les-emplois-de-demain/?searchterm=num%C3%A9rique.

351 CSC (2015), *Comment travaillerons-nous en 2039?* csc-en-ligne.be/csc-en-ligne/Actualite/nouvelles/travailler-en-2039.html.

352 FGTB (2016), *Faut-il mieux répartir le travail?* fgtb.be/web/guest/news-fr/-/article/4329744/.

353 Gouvernement Wallon (2015), *Digital Wallonia. Stratégie numérique de la Wallonie*. digitalwallonia.be/wp-content/uploads/2016/01/2081-Plan-du-Num%C3%A9rique-WEB5.pdf.

der to tackle new 'digital jobs'. The Government's digital strategy considers this training to be necessary both in schools as well as in companies and organisations themselves.

At the Belgian level, federal authorities recently expressed the will to tax the so-called "collaborative" economy's benefits. This concerns platforms such as Airbnb or Uber. The Belgian Minister in charge of the Digital Agenda at the federal level mentioned a 'grey zone' that has to be clarified in order to avoid illegality.[354]

18.3 TA perspectives

The digitalisation of labour has long been a central theme of Walloon TA-like studies and activities. In particular, the Labour-University Foundation (LUF) which is in charge of evaluating technological choices in the workplace, has dedicated many studies to this topic.

A 2010 article, based on a 2005 Dublin Foundation's inquiry, points to the fact that the digitalisation of labour presents advantages and disadvantages. Indeed, if digital technologies lead to the lowering of ergonomic risks and to better learning opportunities for workers, they tend to considerably increase their workload.[355] Another article, published in 2011, investigates the increasingly popular telework phenomenon. It emphasizes a major paradox: if telework globally improves worker quality of life, it also increases workload and working time.[356]

More recently, a March 2016 working paper written by two LUF scholars for the European Trade Union Institute provides powerful TA insights on digital labour.[357] The document, focusing on the European level, acknowledges the emergence of new labour practices induced by new technologies and business models such as, for example, clouds, big data, mobile applications, geo-localisation, or robots, considerably reshape labour practices and markets. These changes also generate new organisational forms of labour: ICT-based mobile workers, crowd working, and platform-organised work on demand. Here again, these transformations have pros and cons. On the upside, it is stressed that the expected changes are likely to increase work flexibility and autonomy, to allow gains in personal productivity, to develop new competences, and to improve communication and collaboration processes. However, adverse effects from this evolution are to be scrutinized, particularly as digital technologies also tend to increase workload, to generate information overload, to contribute to social isolation, to increase auto-organisation stress, to blur the private and professional spheres, and to require permanent availability. Therefore, it is concluded that digital labour raises fundamental questions that TA perspectives should address, either regarding its necessary preconditions (e.g. a particular work culture based on greater trust and autonomy), its regulation by political authorities (in order to get out of the current 'grey zone'), its translation in effective educative programs, or its consequences for social protection systems.[357]

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354 Haupin, B. (2016), Airbnb, BlaBlaCar, Menu Next Door... Le gouvernement veut taxer l'économie collaborative. rtbf.be/info/economie/detail_airbnb-blablacar-menu-next-door-le-gouvernement-veut-taxer-l-economie-collaborative?id=9264980.

355 Fondation Travail-Université (2010), La technologie et l'évolution des conditions de travail, *La Lettre EMERIT*, Numéro 61, pp. 1-3.

356 Fondation Travail-Université (2011), Le télétravail rêvé, réel ou redouté, *La Lettre EMERIT*, Numéro 66, pp. 7-8.

357 Valenduc, G., Vendramin, P. (2016), Le travail dans l'économie digitale: continuités et ruptures, *ETUI Working Paper 2016.03*.

19 Summary Synthesis

The EPTA report for 2016 provides an overview of recent developments in the area of work and digitalisation in 17 countries and regions in Europe, the USA and Russia. This final chapter presents a summary synthesis of the main findings in the country reports focusing on, first, the main changes in the labour market associated with digitalisation technologies reported for each country according to international and national evidence, second, some of the main international and national policy paradigms influencing the relationships between digital technologies and the labour market, third, national debates and protests that have been taking place regarding highly contested innovations, fourth, some suggestions for the directions of future technology assessment activities and fifth and finally, main insights gained during the discussions at the EPTA 2016 conference to inform policy and decision-making.

The relationship between technological change and unemployment has been investigated for centuries, and the general consensus among economists has been that in the long run each wave of industrialisation has created more jobs than it has destroyed. However, recent evidence suggests that the consensus on this pattern is changing,[358] and that, under existing conditions, some innovations may lead to lower rates of job creation and pose different challenges to existing jobs. The 2013 study by Frey and Osborne[359] has helped place the discussion at the top of the political agenda in several EU countries, and prompted similar investigations on the future of jobs in Germany, the Netherlands, Norway, Poland and Sweden. The expected job losses are associated with processes such as the codification of tasks especially in highly routinized jobs, automation and robotics in production processes, Internet platform mediated work, and associated changes in business models. These changes raise pressing questions about the adequacy of education and training, worker protection and conditions for overall welfare.

19.1 Labour market changes and digitalisation: recent evidence for countries and regions

Labour market changes associated with digitalisation are difficult to estimate but many countries have made beginnings in quantifying possible effects and it is likely that such studies will be more frequent in future, possibly leading to greater consensus on anticipated changes.

Digital integration in business

The integration of digital technologies into business functions has been a major developmental strategy for several decades now and remains a key indicator of productivity and productive potential. The EU's Digital Agenda Scoreboard[360] and the Digital Economy and Society Index[361] show that Ireland, Denmark and Sweden top the list when it comes to digital integration in business (above 50% integration), with the Netherlands, Germany and Austria also above the EU average. Countries that are below the EU average, such as Poland, are mainly countries that are undergoing transformations from more centralised economies. Polish companies for example make relatively less use of ICTs possibilities in

[358] Est van, R. & Kool, L. (eds) (2015) Working on the robot society. Visions and insights from science concerning the relationship between technology and employment. The Hague: Rathenau Instituut.

[359] Frey, C. B. & Osborne, M. A. (2013) 'The future of employment: How susceptible are jobs to computerisation?', Oxford Martin School, September.

[360] ec.europa.eu/digital-single-market/en/digital-scoreboard.

[361] ec.europa.eu/digital-single-market/en/desi.

business, but compete on lower labour costs than some of the more economically advanced EU countries, and enjoy high demand for their services in those sectors.

Estimates of automation

The alarming findings provided by Frey and Osborne[359] who state that about 47% of US jobs could be lost through automation in the next two decades prompted several countries to do similar calculations for their own national workforce contexts, all of which estimate a very high impact. For example, it is estimated that 53% of Swedish jobs are at risk of being replaced by digital technology in the next twenty years.[365] A similar study for Norway predicts that 33% of all existing jobs will be lost.[362] In Finland, it is expected that one third of all jobs will disappear as a result of digitalisation.[363] In Poland, it is estimated that 36.1% of jobs in Poland are at risk of being lost due to technological change in production processing.[364]

The country projections differ somewhat as to the types of jobs that will be lost. The results for Denmark,[365] Norway and Sweden are similar to the US results, which predict that the jobs most at risk are medium education routine occupations such as retail and administration. In Poland, the highest job losses are expected in manufacturing through technological changes in production processing. There is a general consensus among the studies suggesting that polarisation (meaning highest losses in the medium education routine occupations, and relatively lower changes in the highest and lowest education occupations) is likely to increase.[366] Countries with high labour costs, such as Denmark, are likely to be less competitive in areas of platform mediated work, where job opportunities may increase.[367]

In countries with advanced manufacturing industries such as Denmark and Germany, automation has been a central pillar for growth for a long period of time. The high level of automation has, for example in Denmark, led to a taking back of production that was previously located in cheaper countries. However, not all advanced economies experience the same benefits of automation. The UK, for example, has fewer industrial robots than any other G7 country with 17,000 operational in 2014 compared to 176,000 in Germany,[368] but bigger impacts are likely to be felt by automation through machine learning which automates knowledge work. For example, recent developments in machine learning algorithms in high frequency trading[369] analyse trading patterns and perform trades faster than humans.

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362 Pajarinen, M., Rouvinen P. & Ekeland, A. (2015) Computerization and the Future of Jobs in Norway nettsteder.regjeringen.no/fremtidensskole/files/2014/05/Computerization-and-the-Future-of-Jobs-in-Norway.pdf.

363 ETLA (2015): Juhanko, J. et al. (eds) Industrial internet transforms Finland's challenges into opportunities: background synthesis, ETLA Reports, No. 15, in Finnish.

364 Bitner, M., Starościk, R., Szczerba, P. (2014) Czy robot zabierze ci pracę? Sektorowa analiza komputeryzacji i robotyzacji europejskich rynków pracy, WISE, wise-europa.eu/wp-content/uploads/2016/03/PolicyWorking-WISE-_nr1_141029.pdf.

365 cevea.dk/filer/dokumenter/analyser/Digitale_trends_og_det_danske_arbejdsmarked.pdf.

366 Schwarb, T.M., Vollmer, A.& Niederer, R. (2000): Mobile Arbeitsformen: Verbreitung und Potenzial von Telearbeit und Desksharing. Arbeitsdokument des Zentrums für Technologiefolgen-Abschätzung, Bern.

367 cevea.dk/filer/dokumenter/analyser/Digitale_trends_og_det_danske_arbejdsmarked.pdf.

368 Industrial Robot Statistics, International Federation of Robotics (2015), ifr.org/industrial-robots/statistics/.

369 The Future of Computer Trading in Financial Markets, Government Office for Science (2012), gov.uk/government/publications/future-of-computer-trading-in-financial-markets-an-international-perspective.

Flexibilisation and changes to work practices

A further important dimension of digitalisation is its impact on individual work practices and daily life. This has been variously documented as changes in the extent and degree of independent work or part-time work, and associated with increased time and space flexibility of carrying out work tasks and the ubiquitous availability of ICTs with which the work is performed. An increase in independent work has been documented in virtually every country (see for example the chapters in this report on France, Germany, Switzerland, Poland and Wallonia). A study carried out by TA Swiss, for example, provides recent evidence stating that flexibility is increasing in terms of time and location of where work is done, as well as organisationally[366] with a shift to more project-based work which takes place in teams for a limited amount of time, rather than working for organisations. At 37%, the Swiss labour force has the highest percentage of people working part-time in Europe. The Crowd Working Survey conducted by UNI Europa and the University of Hertfordshire analysed first-hand evidence for countries such as the UK, Sweden Germany, the Netherlands and Austria.[370] The results for the UK show that 21% of the adults surveyed stated that they have tried to find work with online platforms such as Upwork, Uber or Handy.[370] For Austria, in the same study, this figure is higher at 36%.[370] Critical issues regarding these changing forms of work are individual financial security and income stability, regulations for social security and taxation, as well as individual health risks for example from round the clock availability[371]. TA studies in Wallonia point to specific disadvantages of flexible ways of working, stating that digital technologies tend to increase workload,[372] and that telework also increases workload and time spent working.[373]

19.2 Policy paradigms influencing digital technologies and the labour market

In the Europa 2020 growth strategy of the EU recent developments associated with ICTs are given a central role for all sectors, both as an underlying factor of production through changes in automation, as well as for changes in business models through for example platform-mediated work, and other types of innovation.[374] In EU countries, policies regarding digitalisation and work are mainly guided by the innovation paradigm of the EU which promotes entrepreneurship and sustainable growth of digital technology in all main sectors. The focus on adapting manufacturing structures is guided by for example the German Industry 4.0 paradigm, which focuses on both the intensification of automation within sectors, but also on the linking between sectors and across regions and countries, with so-called cyber physical systems (CPS). A further policy paradigm that is guiding these developments has to do with 'smart' or 'intelligent' systems technologies. For example, in Catalonia the shared smart vision emphasises the importance of innovation, technology, design and training for professionals. The computerisation and labour discussion is also highlighted in the "Spain 20:20" report, and emphasises the need for social sustainability which is under threat by digitalisation, by blurring the boundaries between personal and work life, but also creating opportunities. In 2016 the Catalan government has revised sectoral regulations to incorporate changes brought about by the collaborative economy, the creation of legal frameworks for example for good practice guidelines, participation in the

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370 Huws, U. & Joyce, S., (2016) 'Character of the UK's 'Gig Economy' revealed for the first time', Crowd Working Survey, UNI Europa Global Union, University of Hertfordshire.

371 Han, B.-C. (2010): Müdigkeitsgesellschaft. Matthes & Seitz. Berlin.

372 Fondation Travail-Université (2010), La technologie et l'évolution des conditions de travail, *La Lettre EMERIT*, Numéro 61, pp. 1-3.

373 Fondation Travail-Université (2011), Le télétravail rêvé, réel ou redouté, *La Lettre EMERIT*, Numéro 66, pp. 7-8.

374 European Commission, A strategy for smart, sustainable and inclusive growth, COM (2010) 2020 final, Brussels, eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC2020&from=de.

definition and shaping of the collaborative economy in Catalonia, and identifying measures adopted at the EU and in other EU countries.

In Denmark, policy also focuses on reducing inequality in incomes and although there exists a basic income there are no clear strategies for social consequences of digitalisation. In Finland, labour unions are pushing for more education and training in new technology areas for the existing workforce. The Finnish think-tank SITRA is currently carrying out a project on the transformation of labour markets, recommending more local contracting in work places.[375] In Germany, continuing education is important from the perspective of employees. The questions are being raised and going up on the political agenda, such as in the 2015 Greenbook "Arbeiten 4.0",[376] and the dialogue that was initiated by it. The German Ministry for Education and Research is finding innovative approaches for the creation of sustainable and socially acceptable jobs through specific programmes such as the "The Future of Work" and the umbrella programme "Innovations for Production, Service and Work of the Future" which runs until 2020.[377]

In the Netherlands, current policies focus on entrepreneurship, training and work regulations. New policies are needed for digital platforms and changes in income and wealth. In Norway, some initiatives have been launched to support industrial upgrading at the intersections between digital industries and established businesses in maritime, defence, remote weapon systems and oil and gas technologies through the Kongsberg Group.[378] More specific public discussions on digital labour, sharing economy and automation are quite recent in Norway and there are few proposed changes to policy in these issues. However, some important initiatives have been launched to define and address challenges associated with changes in employment such as the Confederation of Norwegian Enterprise (NHO) organised conference "REMIX – The Future of Work" in January 2016 where discussions were held on the increasing popularity of companies such as AirBnB and Uber as well the meaning of platform mediated work for the protection of employees, as raised by the Norwegian Confederation of Trade Unions (LO).

In terms of policies directly addressing digital issues, in 2014 the Polish government initiated the programme "Digital Poland"[379] which focuses on digital competencies in society, universal access to the Internet, e-administration and open government. 20% of Internet users actively used services such as Peer2Peer,[380] but companies such as Uber and AirBnB are currently not regulated by any new regulations. The US Government has intervened in formulating and implementing regulations to meet the changing demands on skills. Specifically, in July 2014 President Obama signed into law the bipartisan Workforce Innovation and Opportunity Act which consolidates existing funding initiatives, helps retrain workers and matches workers' skills to employers.

19.3 Debates on and protests against highly contested innovations

The platform mediated services that have caused the biggest number of local protests by existing workers in regulated sectors are those to do with taxi and accommodation services. In Denmark, as in France and in the UK, the national Uber trials resulted in the deci-

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375 Mäenpää, M. (2016) Millainen on työn ja työmarkkinoiden tulevaisuus? How is the future of labour and labour markets? SITRA Working paper, in Finnish.

376 BMAS (Bundesministerium für Arbeit und Soziales) (2015): Grünbuch Arbeiten 4.0. Berlin.

377 BMBF (Bundesministerium für Bildung und Forschung) (ed.) (2016): Zukunft der Arbeit. Innovationen für die Arbeit von morgen, Berlin, pt-ad.pt-dlr.de/_media/zukunft-der-arbeit_programm.pdf.

378 kongsberg.com/en/kog/news/2016/february/establishes-kongsberg-digital/.

379 Operational Programme, Digital Poland for 2014-2020.

380 POLSKA.JEST.MOBI 2015, Raport, tnsglobal.pl/coslychac/files/2015/05/POLSKA_JEST_MOBI_2015.pdf .

sion that Internet taxiing platforms need to abide the existing rules and regulations. Regulations have been implemented to protect regular taxis and traditional forms of renting of accommodation. In Denmark and in Norway it was also decided that new regulations need to be formulated so that platforms can help in the provision of services more effectively. In Finland the public discussions on Uber and AirBnB have focused on the question of taxation. In Sweden, the Swedish Transport Agency and the Swedish Taxi Association claimed that UberPOP should be categorised as a taxi service, making the current way of Uber operations illegal.[381] In Wallonia, there has been mention at the government level to tax or regulate the platform mediated transactions such as AirBnB and Bla Bla Car.[382]

Topics that have been discussed for several years now and that remain hotly debated are the changing conditions for employees in terms of 24/7 availability through mobile devices and increased competition from abroad in lower income countries via platform mediated work (e.g. in Spain). In Germany, the loss of boundaries between work time and personal time via mobile devices and possibilities for teleworking is being discussed both in positive terms such as being able to manage one's own time[383] or in terms of the dangers of constant availability.[384] Crowdworking occurs marginally in Germany, but is being criticised for potentially reducing the quality of work.[385] In the Netherlands, the Scientific Council for Government Policy (WRR) has argued that in order to counter the possible job losses through automation, governments should invest in skills upgrading to meet the knowledge requirement of changing forms of work and reduce inequality.[386] In the UK the debate on automation and its impacts on employment are just beginning.[387] In Poland, trade unions have not actively addressed the changes in labour markets due to automation, but maintain a focus on protecting the main pillars of the economy such as mining and extraction. Societal debates in Wallonia are not directed at criticising digitalisation processes, as the region suffers from deindustrialisation and views digitalisation as an underlying factor of growth.

19.4 Suggestions for future TA research

Research and policy organisations in the Netherlands, Germany, France and Sweden have already initiated research efforts through the TA lens and produced several reports as inputs into their respective parliamentary discussions on the topic. All 17 contributing TA organisations agree that further research into the causes and consequences of digitalisation, especially the social and institutional effects, are both highly relevant and timely. DBT suggests studies to focus on questions such as where automation may be used to

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381 EurWORK. Digitalisation and working life: lessons from the Uber cases around Europe.

382 Haupin, B. (2016), Airbnb, BlaBlaCar, Menu Next Door... Le gouvernement veut taxer l'économie collaborative, rtbf.be/info/economie/detail_airbnb-blablacar-menu-next-door-le-gouvernement-veut-taxer-l-economie-collaborative?id=9264980.

383 Kagermann, H. (2014): Chancen von Industrie 4.0 nutzen. In: Bauernhansl, T.; Hompel, M. & Vogel-Heuser, B. (eds): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Wiesbaden, S. 603–614.

384 BMAS (2016): Foresight-Studie „Digitale Arbeitswelt" (Wenke, A., Bovenschulte, M., Hartmann, E. & Wischmann, S.), Research report N0. 463, Berlin, bmas.de/SharedDocs/Downloads/DE/PDF-Publikationen/Forschungsberichte/f463-digitale-arbeits-welt.pdf;jsessionid=11EC0CB6A6F224D34D291DB1AE2C1A90?__blob=publicationFile&v=2.

385 Leimeister et al. (2015): Digital Working und Crowd Working: Neue Arbeits- und Beschäftigungsformen heute und für die Zukunft. In: Schlick, C. (ed.): Arbeit in der digitalisierten Welt. Beiträge der Fachtagung des BMBF 2015, Frankfurt am Main, pp. 107-118.

386 Went, R., Kremer, M. and Knottnerus, A. (eds) (2015) *De robot de baas. De toekomst van werk in het tweede machinetijdperk*. WRR Verkenning 31. Amsterdam University Press: WRR. [Mastering the Robot The Future of Work in the Second Machine Age].

387 Fear of the Robots is Founded in the Messy Reality of Labour, The Financial Times 17/4/16 ft.com/cms/s/0/e990a3f0-031a-11e6-99cb-83242733f755.html#axzz46N801uR7.

solve societal problems, and to reduce the risks of job losses and reduction in wellbeing. OPECST suggests a focus on changes in training and skills requirements, an exploration into what might become future jobs and job requirements, such as work organisation and management. Specific studies currently underway in Sweden are addressing the regulation of self-employed workers[388] and teleworkers. In Russia, the government is investigating the creation of a national health information system,[389] as well as the changes to the labour market that might be brought about by robotics. As in Sweden, the regulation of telework is being investigated in Russia as well. All countries are likely to benefit from posing questions currently being asked for example in Sweden, namely how conditions can be created to protect current and future workers from unlawful competition through platform mediated work, while at the same time not building barriers for future entrepreneurial activities.[390]

19.5 Policy conclusions

Based on the lively debate during the EPTA conference of 2016 which took place on 21st October at the Austrian Parliament in Vienna, several insights can be drawn that may be useful for informing social and economic policies for a sustainable development of digital technological and employment changes. The conference was structured as follows:

Session 1: Labour and digitalisation in international perspective
Session 2: Digitalisation, flexible work and crowdworking
Session 3: Robots and job automation, and
Session 4: Key economic and policy challenges for labour in the digital era.

The discussion following Session 1 highlighted the dimensions of digitalisation which are important but missing from the country reports, namely privacy and culture. Privacy is a key aspect of digitalisation more generally as more and more data gets remotely collected and analysed using algorithms that monitor activity on the web and beyond. Programs to monitor and limit employee browsing activity while at work are rapidly growing in number and variety, and countries differ to the extent and degree to which they are legal. Culture also plays an important role in the implementation of these surveillance technologies.

Session 2 raised both positive and negative aspects of crowdwork and technology platforms. On the one hand, platforms create opportunities for employment and can lead to faster solutions to complex questions faced for example by firms, when used as a knowledge sourcing tool. They can also be used to create new forms of labour unions, link up labour unions that have been formed internationally to support the creation of regulations for crowdworkers. The discussion also raised concerns over crowdworking, especially faced by workers in the creative industries who experience working long hours to obtain good ratings, as well as having to react immediately to work requests, which eats into private time and makes it virtually impossible to be offline or to take holidays. The use of crowdworking as a hobby may be both stimulating and exciting, but for those individuals whose incomes largely depend upon this type of work may not lead to creativity and self-fulfilment, but rather prolong and intensify stress. The point about rewards and promotions was also raised. For example, traditional firms may reward employees for good performance and the achievement of goals for the company (such as increasing profit and getting a bonus), but crowdworking may not lead to such rewards at all. Fairness mechanisms that can operate fairly well in traditional ways of working are currently lacking in crowdwork

[388] *Digitaliseringen kräver nya trygghetssystem*, Dagens Samhälle, Uddén Sonnegård E, & Ilshammar L. 2016-03-22.
[389] portal.egisz.rosminzdrav.ru.
[390] Governement Inquiry. *Användarna i delningsekonomin*. Dir. 2015:136.

communities. It was also stated that the development of fairness across crowdworkers may be a question of time, and that over time these could well come to being.

Session 3 on robots and automation raised the important issue of skills and new skill requirements to master digital technologies. The lack of certainty as to which kinds of school and education systems need to be reformed or changed, and which skills need to be acquired to deal with the changing knowledge requirements of new jobs, as well as what kinds of education programmes and training should be provided to meet future needs was noted to be particularly important. It was raised that a possibility would be to develop and reform vocational training as a key political strategy focusing on dealing with these new technological demands. A further set of important comments were raised on the issue of robots and robotisation. Robots in the home, for example in the form of vacuum cleaner robots, may be leading to people adjusting their home environments to fit the robot cleaning process, and a new term “Roombarisation” was used to describe this process. Is it a useful strategy to change our homes, and even build new homes that will fit what robots need to do their work? In Japan there are initiatives to create a robot-friendly society at a larger scale, including road transport and entry access to buildings (the “robot barrier-free society”).

In Session 4 we heard about a range of new issues which policy needs to address to maintain social security and well-being in the new forms of work such as crowdwork. Policies were suggested in the area of employment and income stability, the redistribution of productivity gains across society, and accompanying measures to balance employer and employee benefits from increased flexibility. Furthermore, mechanisms need to be created to ensure that individual needs are still met while bundling different types of roles (such as for example teacher, crowdworker, and freelance journalist) in one person’s work portfolio. It was suggested to introduce democracy into this process of shaping the role of digitalisation in our society. For example, it could be seen as disputable why bus drivers are normally not asked at all whether or not they want to be replaced by self-driving buses. It was stated to “call things by their name”, namely not to beautify the fact that people are working long hours virtually for free to solve problems online, but to realise that this is a “psychological experiment” not some great new way of doing work. On the issue of robotics we heard that robot use creates a need for a whole array of new laws in which policy should intervene to shape changes. Also, it was stated that taking a historical perspective is very important (and not so usual in TA studies) when discussing fears about job losses, because history tells us that we have been able to react to many of these challenges in the past and to deal with them.

Several important economic studies have been carried out to quantify employment changes, focusing on for example the share of jobs that are at risk of being lost, or the share of tasks that can be replaced by automation. The studies pose different research questions, are based on different assumptions, and use different methodologies, so it is not surprising that they arrive at different predictions as to the extent and degree of employment impact of digitalisation. The range of current predictions of positive and negative changes is quite large, for example between 9% and 47% for losses in jobs in the US in the next two to three decades. Despite the fact that these figures measure different kinds of impact, they are both quite alarming – even a 9% reduction of labour demand is very high, corresponding to roughly doubling current unemployment rates in the EU. Furthermore, new waves of digitalisation of manufacturing (for example the changes described in the literature on cyber physical systems and Industry 4.0) are predicted to create new manufacturing jobs in Europe and to ‘bring back’ jobs that were previously located to lower income countries. It was learned in the conference discussion that predictive research of this kind is very difficult to do because of the inherent uncertainty in technological change and the only partially predictable impacts of innovation, making it very difficult for policy makers to develop

strategies to reduce the potentially destabilising effects of digitalisation on jobs in the future. This makes it even more important to focus on more tangible as well as qualitative changes on which there is consensus (such as for example the relationship between increasingly precarious working conditions for some types of crowdworkers) and incrementally direct (existing labour regulation) policies on these specific undesirable changes.

Finally, a goal of the field of TA is to shape technological change through policies to support the needs of society, informed by a variety of disciplinary perspectives. The EPTA conference 2016 made an important step in that direction with scientific contributions from the fields of economics, TA, business, innovation, sociology and law, presented to parliamentarians from many countries. There are still many open questions of how policy can intervene, so the discussion and the research must go on, also at the interface between research and policy. A forum such as the one of the EPTA conference can serve to bring together perspectives from different disciplines, countries and traditions and improve our overall understanding. The presentations and discussions help us to have a more differentiated and complete view of technological change and the possibilities for intervention.

Annex 1: Abstracts of keynotes of EPTA conference on 21 October 2016

Flexible New World of Work: Taking stock on a societal and economical level. A TA-SWISS study

(Jens O. Meissner, Johann Weichbrodt, Bettina Hübscher, Sheron Baumann, Ute Klotz, Ulrich Pekruhl, Leila Gisin and Alexandra Gisler)

The world of work is going through a time of profound upheaval – around the globe, as well as in Switzerland. Constantly developing communication and information technologies and the increasingly flexible organisation of work are leading to change: traditional office work in the framework of a fixed, unlimited and full-time work contract are often supplemented by other flexible forms of work such as telework, mobile work or flexible working arrangements such as crowdsourcing. For the case of Switzerland, this study aims to clarify the following questions which yield from this transformation: What are the consequences of this change for the significance of work in society? To what extent are the characteristics of the new forms of work covered by the present legal framework? And which macroeconomic consequences can be expected?

In order to achieve this, a persona-based approach was used: Based on an extensive literature review and an in an interdisciplinary panel, five different personas were constructed which cover the diverse new forms of work (e.g., teleworking, mobile work, part-time work, entrepreneurship, crowdworking and freelancing work). The five personas were then used to answer the aforementioned research questions. The following points represent the core results of the study:

1. The significance of work in society is undergoing a transformation, stemming from a trend to combine temporal-spatial work flexibility and employee entrepreneurship (“entrepreneurship”). This transformation brings with it a lot of benefits, but also some problems.
2. The legal situation in Switzerland is generally adequate to cope with the ongoing change. However, balancing between additional regulations and voluntary self-regulation by employers and unions is necessary. Furthermore, virtual work-exchange ("crowdsourcing") platforms should be scrutinized.
3. Regarding macroeconomic consequences, few slight improvements are accompanied by relatively many (slight to considerable) deteriorations. However, these projections are based on extreme scenarios of flexible work.

The study thus represents a broad, general “map” of the new forms of employment and showcases the ongoing flexibilization of work and its consequences for society and economy.

Further reading:
ta-swiss.ch/en/projects/information-society/flexible-new-world-of-work/

Virtual platforms, power structures and Edupunks

(Ayad Al-Ani)

Crowdworking is slowly becoming more relevant and many signs indicate that this new occupational setting will become a standard form of employment for a large part of the population. The analysis of the relationship between the crowd worker, platform owners and customers hints towards unequal power structures on these entities; favouring owners

of platform algorithms and their customers, leaving many crowd workers with the bitter sweet experience of being in the position to learn, gain credentials and generate some additional income, while knowing that they cannot collaborate freely any longer and face dominating customer centric processes governed by algorithms and artificial intelligence (AI). Self-organization is something the crowd workers are clearly feeling very much at ease with, basically a natural skill enabled by social media. At the same time indications show that this self-organization is not sufficient enough to gain sustainable political strength. In principle, unions and political parties could help to reinforce this self-organization but instead seem – due to limitations inflicted by neoliberalism – to focus on their traditional role as a regulator, which is deemed useless in cyberspace. The crowd – so it seems – is now enlisted in prolonging the final phase of the company, which due to rising input costs is becoming less and less interesting for the capitalist. The individual supported by a myriad of personal AI may come to the conclusion that he or she is acting based on free will, responding to ever changing skill requirements with an Edupunk approach generating individual digital learning paths, but is actually driven by these tools to follow a predictable path. How can workers gain the upper hand on this long and bumpy exit from traditional capitalism into a world, where in the end virtual or actual tribes instead of the nation state rule and AI will manage the robot factory? The question whether robots will be children of humans or rather a dominating species might depend on this issue.

Further reading:

Al-Ani, A. & Stumpp, S. (2016). Rebalancing interests and power structures on crowdworking platforms. Internet Policy Review, 5(2). DOI: 10.14763/2016.2.415

Crowdsourcing and technology platforms

(Lars Bo Jeppesen)

The presentation provides insights on the role of crowdsourcing in innovation. Governments and companies have long used crowdsourcing (prize-based contests) to find solutions to such diverse issues as industrializing land, controlling infectious diseases, and mass-producing and conserving food. For instance, in 1869, Napoleon III offered the Margarine Prize to anyone who could overcome the era's butter shortage. Over the past decade, online crowdsourcing contest platforms have emerged to solve problems for the commercial sector, and companies increasingly use such platforms to access and leverage knowledge from individuals around the globe. As an alternative to extensive traditional search to identify and contract with potentially suitable problem solvers, contest-based crowdsourcing offers a novel approach to finding high-performance solutions to challenging problems from untraditional and unexpected problem solvers with diverse knowledge, skills, and experience.

Crowdsourcing sets new requirements for the management, organization, and the capabilities of R&D. With crowdsourcing R&D departments' role shifts away from internal solution efforts to instead defining problems, finding crowds to work with, setting up incentives for participants, and selecting the best ideas or solutions.

Crowdsourcing most often functions through a winner-takes-all reward model, which means that the companies and organizations seeking solutions pay for the best solutions only, and not for entire effort expended by the crowd. By design, crowdsourcing gives rise to a type of contest-driven work with relatively high competition and with resulting low probabilities of success (winning) for the crowd worker. There is a variety of non-monetary

motivations at work, which may explain participation and problem-solving efforts made by crowd workers under these conditions.

Further reading:
Jeppesen, L.B. and Lakhani, K.R., (2010) Marginality and Problem Solving Effectiveness in Broadcast Search, Organization Science, 21 (5) 1016-1033; Lakhani, Karim R., and L.B. Jeppesen. Getting Unusual Suspects to Solve R&D Puzzles. Forethought. Harvard Business Review 85, no. 5 (May 2007)

The Robot Society. A Rathenau study

(Rinie Van Est)

In January 2015, the Dutch Parliament asked the Rathenau Instituut to draw up a report to clarify current scientific knowledge concerning the impact of technological developments on the labour market, and on prosperity over time. In particular the Parliament showed an interest in lessons from the past. The Rathenau study compares the first machine age, which involved machines that provide muscle power, with the current second machine age, in which machines also supply thinking power. History shows a continuous search for new forms of organization that is usually driven by the quest for greater efficiency and control. The first machine age was characterized by (mechanical) Taylorism: splitting work processes into simple tasks, thus allowing certain physical tasks to be mechanized and later automated. In the second machine age, the services sector since the 1980s came under the influence of (digital) Taylorism, which allows the automation of cognitive work. Over the last two decades thinking about new and more efficient ways of organizing things has received fresh impetus, owing first to the arrival of the internet, big data, artificial intelligence and robotics. This broad development is captured in terms such as the Internet of (Robotic) Things. The big question now is how do we, as a society, handle this new phase of the IT revolution?

History offers some clues to this question: technology does not just happen to us, but takes shape in all kinds of social practices. During the recession of the 1970s, concerns grew about the loss of jobs as a result of automation. Public debate and research created awareness that the IT revolution had entered a new phase: a transition from the mainframe to the personal computer. The debate thus broadened into the question of how the small computer society should look like. As a result, the mobilizing concept of the information society arose, which was deliberately used throughout Dutch society to free up money and energy for the use of computers. The response to the advent of the robot internet may thus be something like the ‘robot society’. In many areas of society, active policy is required to shape a ‘robot society’ so that it can be a positive prospect for all Dutch people. In this context, three aspects deserve our attention: socially responsible innovation, training, and prosperity for all, that is, ensuring that the benefits of digitization are shared as widely as possible.

Further reading:
Rathenau Instituut (2015) Working on the robot society,
rathenau.nl/en/publication/working-robot-society

Sociological perspectives of digital labour: qualifications, labour relations

(Jörg Flecker)

Information and communication technologies (ICT) have proven to be enablers of far-reaching changes in work and employment. Currently, the debate focuses on automation in both manufacturing and services. In addition, ICT are used to overcome temporal and spatial boundaries in mobile work or offshoring. We can also observe the blurring of paid and unpaid work in particular when it comes to consumption work and contributions by internet users. Taken together, these developments raise severe issues regarding the number of jobs available today and in the future. But attention should also be paid to the quality of work. Today, there is a polarisation of forms of work including both upskilling and deskilling, increasing autonomy and neo-Taylorism. What is more, digitalisation and spatial dispersal of tasks contribute to the precarisation of wage labour. While it is crucial to understand current technological developments, when drawing political conclusions a focus is needed on societal developments and challenges such as the appropriation of productivity gains, the distribution of paid work, the reversal of the secular trend of working hours reduction, the contestation of forms of employment or the struggle for decent work. The contribution will focus on policy recommendations that follow from the interrelationship between these issues and the digitisation of work.

Further reading:
Flecker, Jörg (ed.): Space, Place and Global Digital Work, Palgrave Macmillan 2016
palgrave.com/us/book/9781137480866

Legal challenges for ubiquitous robotics

(Erica Palmerini)

Robots are meant to play several roles in our lives, leading to different kinds of interaction with humans. A rough taxonomy will distinguish robots that assist, help or serve humans (robots companion, surgical robots, household robots, educational robots), robots that integrate or augment humans (prostheses, exoskeletons), and robots that replace humans (autonomous vehicles, robo-advisors, expert systems in the healthcare field).

While some types of interaction can be placed within the current legal systems without creating regulatory disruption, others may challenge current assumptions or rationales on which legal rules are based. The interaction that leads to the replacement of humans with robot in performing expert functions is one of the sort. The social goals of improving road safety or the quality of healthcare may one day require delegating tasks such as driving or diagnosing to machines, because they perform critical functions better than humans. The problem then become how delegating expert tasks to robots impacts on the issue of determining responsibility when decisions based on robot expertise produce undesirable outcomes. Since the replacement of humans at critical functions will have a bearing on the rational underlying the current models of liability, alternative models have been advanced to frame accountability.

Among the options that will be discussed are to apply to robotic products the most severe responsibility scheme associated with the undertaking of dangerous activities and activities; or, on the contrary, to limit liability, as a way both to boost innovation in the robotic industry, and to exclude producers having to bear responsibility for risks that cannot be avoided. Another approach would be to increase the owner's responsibility, applying a

strict liability instead of a negligence standard, given that the owner is a beneficiary of technology and can obtain additional advantages in introducing robots into his/her organization. A more radical solution, building on the argument of robots' autonomy, is the attribution of legal personhood to robots in order to make them responsible for any damage they may have caused.

Further reading:
Palmerini, Erica et al., *Guidelines for Regulating robotics,* robolaw.eu

Technology and the labour market

(Mark Keese)

Digitisation is changing the types of jobs needed in our economies. Many new markets and jobs will be created as result of further advances in digitisation, but many existing jobs will also be destroyed or will have to be significantly re-tooled in the process. For several decades now, the demand for routine and manual tasks has been declining while the demand for problem-solving, caring and interpersonal skills has been rising.

These trends have raised concerns about technology's potential to create mass unemployment. Some previous estimates by researchers have suggested that up to 50% of jobs in the United States and selected European countries could be automated. However, OECD estimates based on the Survey of Adult Skills (PIAAC) show that, on average across countries, only around9% of workers are currently in jobs at high risk of being automated. Nevertheless, an additional 20-30 per cent of workers hold jobs where a substantial proportion (50-70%) of the tasks they perform could be automated. This implies that continuous skills development will play an increasingly important role in adapting to the digital economy.

Digitisation has also led to the emergence of new forms of work. Though the 'platform economy' may bring greater efficiency and flexibility in matching workers to jobs and tasks, it raises questions about wages, labour rights and access to social protection. Looking forward, inequality could increase further given skills polarisation across jobs and increases in non-standard work arrangements. Employment, skills development and social policies need to be overhauled to turn these challenges into opportunities for greater prosperity and well-being for all.

Further reading:
OECD's website on the Future of Work: oecd.org/employment/future-of-work.htm

Digitalisation and the Future of Work: Macroeconomic consequences for tomorrow's employment, unemployment and wages

(Melanie Arntz, Terry Gregory and Ulrich Zierahn)

In recent years, there has been a revival of concerns that automation and digitization might after all result in a jobless future, fueled by studies which argue that a substantial share of jobs is at "risk of computerization". These studies follow an occupation-based approach proposed by Frey and Osborne (2013) and assume that whole occupations rather than

single job-tasks are automated by technology. This might lead to an overestimation of job automatibility, as occupations labeled as high-risk occupations often still contain a substantial share of tasks that are hard to automate.

Our study serves two purposes. Firstly, we estimate the automatibility of jobs for 21 OECD countries based on a task-based approach where we take into account the heterogeneity of workers' tasks within occupations. Overall, we find that, on average across the 21 OECD countries, 9 % of jobs are automatable. The threat from technological advances thus seems much less pronounced compared to the occupation-based approach. We further find heterogeneities across OECD countries. For instance, while the share of automatable jobs is 6 % in Korea, the corresponding share is 12 % in Austria.

Secondly, we argue that the estimated share of "jobs at risk" must not be equated with actual or expected employment losses from technological advances for three reasons: First, the utilization of new technologies is a slow process, due to economic, legal and societal hurdles, so that technological substitution often does not take place as expected. Second, even if new technologies are introduced, workers can adjust to changing technological endowments by switching tasks, thus preventing technological unemployment. Third, technological change also generates additional jobs through demand for new technologies and through higher competitiveness.

The main conclusion from our study is that automation and digitization are unlikely to destroy large numbers of jobs. However, low qualified workers are likely to bear the brunt of the adjustment costs as the automatibility of their jobs is higher compared to highly qualified workers. Therefore, the likely challenge for the future lies in coping with rising inequality and ensuring sufficient (re-)training especially for low qualified workers.

Further reading:
Arntz, Melanie, Terry Gregory and Ulrich Zierahn (2016), The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis, OECD Social, Employment and Migration Working Papers No. 189, Paris. oecd-ilibrary.org/social-issues-migration-health/the-risk-of-automation-for-jobs-in-oecd-countries_5jlz9h56dvq7-en

Policy challenges. Results from the COST action 'Dynamics of Virtual Work'

(Ursual Huws)

Technological change has transformed where people work, when and how. Digitisation of information has altered labour processes out of all recognition whilst telecommunications have enabled jobs to be relocated globally. Some jobs have disappeared through relocation or automation, but others have appeared. Digitalisation has enabled the creation of entirely new types of 'digital' or 'virtual' labour, both paid and unpaid, shifting the borderline between 'play' and 'work' and creating new types of unpaid labour connected with the consumption and co-creation of goods and services. These changes are not experienced evenly, but affect people differentially, for example depending on their gender, their age, where they live and what work they do. They have also had unintended consequences, for instance when the 'dark Internet' is used for criminal purposes, accidents are caused by robots, drones used to smuggle contraband or online platforms used for money laundering. The impacts of these changes have been profound, not only changing the nature of work, and the skills required to do it, but also affecting people as consumers and in their private lives.

Until recently, coherent frameworks for understanding and analysing these developments have been lacking, in a highly fragmented academic context. Aspects of these changes have been studied separately by many different academic experts including sociologists, economists, geographers, political scientists, psychologists, organisational theorists and people working in such diverse fields as gender studies, management, innovation, development studies and industrial relations but gaps between different disciplinary perspectives, theoretical frameworks, national and institutional scholarly traditions have made it difficult to bring them together into a coherent whole.

The COST Action, Dynamics of Virtual Work brought together, for the first time, researchers from many of these fields in 31 European countries and many other parts of the world to compare results, survey the evidence and develop an understanding of how these changes in work take place and what their impacts are. In doing so, they developed new understandings on innovation and the new businesses developing in online environments, the impacts of automation and value chain restructuring on the location and quality of jobs, changing skill requirements, the explosive growth of the platform economy and a range of other issues.

In dialogue with policy makers at International, European and global levels, they developed a new research agenda to address the emerging policy issues. Key research questions concern the measurement and regulation of the 'gig economy', the sustainability of jobs in a digitalised global world, how to address mismatches between rapidly restructuring labour markets and social protection systems, the employment status of digital workers and the challenges posed by online monitoring of the workforce, standardisation of performance indicators and the privacy of consumers and workers in the era of big Data.

The presentation concludes by reflecting on how creativity and innovation can be nurtured and the positive potentialities of digital technologies can be harnessed for social benefit, sustainability and inclusion in the context of a global digital economy.

Further reading:
U. Huws (2014) Labor in the Global Digital Economy: the Cybertariat Comes of Age, Monthly Review Press, monthlyreview.org/books/pb4635/

Annex 2: Glossary of key terms

Additive manufacturing is the official term used to describe the process of joining materials layer upon layer such as by using 3D printing methods. It is commonly used in product design and modelling to assess fit and function of prototypes[391].

Collaborative economy, also sometimes referred to as *sharing economy* or as collaborative consumption, is a term used to describe the horizontal nature of online transactions, referring to distributed power across communities[392]. It originated in the open source community as peer-to-peer sharing of information and resources (see peer-to-peer definition below), but is now increasingly used to describe transactions in other sectors, that may have less to do with sharing than market mediation which occurs online[393].

Crowdwork is a term used to describe the carrying out of work tasks via mediation through online platforms. It is a process by which work is sourced from a crowd to create a service or a product.

Cyber-physical systems: see *Industry 4.0* and *Internet of Things*.

Digital integration in business refers to the alignment of ICTs capacities with the operations and processes in firms. The degree of digital integration in business reflects how well firms are absorbing ICTs in their business functions[394].

Digitalisation refers to the use of digital technologies such as computer processors to convert diverse forms of data such as signals, text, sound or images to provide information.

Edupunk is a term used to describe a deviation from traditional teaching towards student-centred thinking and learning processes (do-it-yourself attitude to learning). It distinguishes itself from commercially sourced education.[395]

Electronic personhood refers to the EU draft report on motion for a European Parliament resolution on the designation of robots as “electronic persons”[396]. It focuses on the questions of liability of and responsibilities for electronic persons.

Entreployeeship generally refers to employees who are also entrepreneurs, and the formal inclusion of freelancers and independent workers into the actual company they freelance for[397].

Flexibilisation: In the context of this report this term refers to flexibility of workers to freely manage the time and place to carry out their work tasks. In the scientific literature flexibilisation is mainly used to refer to a range of processes known as labour market flexibility, which is governed by companies and institutions (not workers) who with their strategies manage the supply and demand of labour based on the business cycle[398].

Industry 4.0 is a term used in Germany to describe changes in manufacturing sectors that are expected to generate the magnitude of a 4th industrial revolution. It refers to a variety

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391 wohlersassociates.com/additive-manufacturing.html.

392 Hamari, J.; Sjöklint, M.; Ukkonen, A. (2016). “The Sharing Economy: Why People Participate in Collaborative Consumption”. Journal of the Association for Information Science and Technology. 67 (9): 2047–2059. doi:10.1002/asi.23552.

393 “The Sharing Economy Isn't About Sharing at All”. Harvard Business Review. 2015-01-28.

394 searchcio.techtarget.com/definition/business-integration.

395 en.wikipedia.org/wiki/Edupunk.

396 europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+COMPARL+PE-582.443+01+DOC+PDF+V0//EN&language=EN.

397 bizcommunity.com/Article/196/22/100264.html.

398 Atkinson, J. (1984) Flexibility, Uncertainty and Manpower Management, IMS Report No.89, Institute of Manpower Studies, Brighton.

of changes driven by self-governing systems (also known as cyber-physical systems) that communicate across very large distances, with the goal of improving overall productive efficiency in manufacturing (see also *real-time production*).

Internet of Things: This term was coined by Kevin Ashton in 1999 to describe an infrastructure sharing technical similarities and characteristics of cyber-physical systems (similar to the underpinnings of Industry 4.0), but relating more directly to general connections across a wide variety of devices at a global scale. For example, connections between smart metres, energy providers, self-driving vehicles, and health monitoring devices, underlying visions such as smart cities[399].

Peer-to-peer (P2P) refers to computer based networking in a flat hierarchical model or egalitarian network (between peers) in which every participant provides resources such as processing power or disk storage for the benefit of other peers, creating a virtual community which is able to collectively achieve greater tasks than each individual on their own[400].

Platform economy: This term is sometimes used to refer to the growth of firms in various sectors offering capabilities that are created and mediated via online platforms for services such as for example innovation (app communities), transactions (for example between people and organisations offering accommodation services or taxiing services), or a combination of these functions[401].

Prosumer: The term prosumer refers to an individual who both consumes and produces media. It was coined by Alvin Toffler, derived from the term "prosumption" referring to computing-based "production by consumers"[402], and has since spread to other sectors such as the energy sector where the term is used to refer to households which both consume and produce energy and possess the ability to sell surplus energy to the grid[403].

Real-time production: The term real-time is derived from computer processing context in which data is processed at a pace that is fast enough to keep up with an outside process. In a production context, the term denotes a responsiveness of production systems at the same time it is required based on intelligent systems, as implied by the term Industry 4.0. The goal is the maximisation of efficiency.

Robolaw is the title of an EU Project ("Regulating Emerging Robotic Technologies in Europe: Robots facing law and ethics") which concluded in May 2014 and investigated the regulation of robotics in Europe.[404]

Robot society: The robot society concept is based on the idea of 'distributed' or 'group' robots, that carry out tasks designed by the user or 'socety controller'. The robot society must be externally controlled and the society must be able to communicate with the external controller. The connection can for example be built to the information system of the society, rather than to each individual.[405]

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399 en.wikipedia.org/wiki/Internet_of_things.

400 en.wikipedia.org/wiki/Peer-to-peer.

401 blogs.wsj.com/cio/2016/02/12/the-rise-of-the-platform-economy/.

402 en.wikipedia.org/wiki/Prosumer.

403 Parag, Y. and Sovacool, B. K., (2016) 'Electricity market design for the prosumer era', *Nature Energy*, 12 March. researchgate.net/profile/Benjamin_Sovacool/publication/299354793_Electricity_market_design_for_the_prosumer_era/links/574d607d08ae061b330205b2.pdf.

404 robolaw.eu.

405 Halme, A., Jakubik, P., Schönberg, T. and Vaino, M., (1993): "The Concept of the Robot Society and its Utilization", Proc. of the 1993 IEEE/Tsukuba International Workshop on Advanced Robotics – Can robots contribute environmental deterioration? – Tsukuba, citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.49.6059&rep=rep1&type=pdf.

Robotification refers to the completion of tasks normally performed by humans then performed by mechanical or electronic devices such as robots.[406]

Roombarisation: This term is derived from the well-known vacuum cleaner robot brand Roomba and refers to the changes one makes in the household to fit the requirements of the robot (e.g. choosing the kinds of furniture the robot vacuum cleaner can clean under).

Sharing economy see *collaborative economy*.

406 wired.com/2015/01/robotification-society-coming/.

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