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EU 4.0 – The Debate on Digitalisation and the Labour Market in Europe

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Zusammenfassung

In den vergangenen Jahren ist eine intensive Diskussion in Politik, Wissenschaft, Wirtschaft und Gesellschaft um die Wirkungen der Digitalisierung auf die Arbeitswelt entstanden. Von dieser Entwicklung wird ein teils tiefgreifender Einfluss auf den Einsatz menschlicher Arbeit erwartet. Allerdings gehen die Einschätzungen dabei weit auseinander. In den umfassenden Debatten zu „Industrie 4.0“ und „Arbeit 4.0“ in Deutschland geht es vor allem um Auswirkungen der Digitalisierung auf Wirtschaft und Arbeitsmarkt, Substituierbarkeit von Jobs sowie Bedingungen, Qualifikationen und Regulierungen für eine neue Arbeitswelt. Dabei ist die Diskussion vielfach von noch großen Unsicherheiten über die weitere Entwicklung geprägt und hat dementsprechend in Teilen auch den Charakter des Erkundens statt nur eines Abgleichs festgefügter Positionen. Gerade das lässt es wertvoll erscheinen, zusätzliche Informationen und Ideen in die nationalen Debatten einzubringen. So lohnt sich ein Blick in andere Länder: Wie ist hier der Stand der Digitalisierung, wie wird die Betroffenheit der Arbeitswelt eingeschätzt? Welche politischen Positionen und Maßnahmen sind in der Diskussion? Welche Programme und Projekte wurden etabliert, sind bereits Ergebnisse sichtbar? Dieser Bericht gibt dazu einen Überblick für verschiedene europäische Staaten sowie die Ebene der Europäischen Union. Inhaltlich werden im Hinblick auf die Digitalisierung die Bereiche wirtschaftliche Entwicklungen, Tätigkeiten und Kompetenzen sowie Arbeitsbedingungen und Änderungen der Arbeitswelt betrachtet.

Abstract

In the recent years an intensive discussion in politics, research, business and society on the influence of digitalisation on the working world has evolved. This developmentis expected to exert profound effects on the use of human labour. However, judgements widely diverge. The comprehensive debates on “industry 4.0” and “labour 4.0” in Germany are concerned with influences of digitalisation on the economy and the labour market, substitutability of jobs as well as conditions, qualifications and regulations for a new world of employment. Thereby, the discussions are characterised by large uncertainty regarding the future development and thus often focus more on exploration rather than on confronting firmly established positions. This inparticular makes it valuable to feed additional information into the national debates. In this, it is worth looking into other countries: Which is the stance of digitalisation, how is the influence on the working world evaluated? Which political positions and measures are discussed? Which programmes and projects were established, are results already conceivable? The underlying report gives an overview for several European countries and for the level of the European Union. Regarding digitalisation, it considers the areas of economic developments, tasks and competences as well as working conditions and changes of the world of employment.

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1 Introduction

In recent years the effects of digitalisation and "Industry 4.0" on the working environment have been under intensive discussion in politics, science, economy and society. The technological innovations are connecting virtual-digital and the physical world as well as machine learning. It involves machines, products, information and communication systems, and people. The goal is the entirely digital control or self-organised control of the value added chain, including beyond the company.

This development is expected to have some profound effect on the use of human labour. However, the assessments vary greatly (on this topic e.g. Brynjolfsson/McAfee 2012, Frey/Osborne 2013 or Autor 2015): On the one hand is the fear of massive job loss if networked robots make today's jobs redundant, and on the other hand there is hope for great gains in employment and innovation. On the one hand is the fear of additional pressure and overloading employees, on the other hand there is hope to make physically demanding or monotonous work easier (also cf. Weber 2016a/b).

In Germany, "Industry 4.0" and "Work 4.0" has become very intensively discussed. This particularly focuses on the effects digitalisation will have on the economy and the labour market (Bauer et al 2014, Wolter/Mönnig et al 2015, 2016, Hammermann/Stettes 2015, Weber 2016a/b, Vogler-Ludwig et al 2016), substitutability of jobs (Bonin et al 2015, Dengler/Matthes 2015) as well as the conditions, qualifications and regulations for a new working environment (BMAS 2015, Ittermann et al 2015, BDA 2015, Weber 2016a/b, DGB 2016, Wolter/Bellmann et al 2016). These sources can only be representative of broad debates at various levels.

Germany's requirements for successful digitalisation of the economy are considered ambivalent: On one hand the strong industrial structure and the high quality dual vocational training are a good basis, on the other hand there still is catching-up to do in terms of e.g. commercial use of large data volumes or training in digital comprehensive competences. The substitutability of jobs is assessed as considerable, yet substantially less than in other studies (such as Frey/Osborne 2013). The results on macroeconomic affects vary, e.g. with regard to overall employment effects. It is stressed, however, that the turnover of jobs and qualifications as well as the competency requirements will be higher. Lastly we discuss rules, organisation and burden sharing, e.g. in working time flexibility, further education, co-determination or social security.

However, one should also remember the debate is frequently also shaped by the still great uncertainty on the future development. Accordingly, in some areas it has an explorative nature instead of a mere comparison of firm positions. This is particularly makes it seem reasonable to introduce additional information and ideas to the nationwide debates. For example, it's worth looking at other countries: What is the state of digitalisation, how is the effect on the working environment assessed? Which

political positions and measures are included in the discussion? Which programmes and projects were established and are already showing results?

This report provides an overview on this aspects for various European country as well as at a European Union level. We looked at France, Austria, Italy, Spain, Finland, Poland, Great Britain and the Netherlands to exemplify this. We use studies, Green Papers or policy papers and official documents to answer these questions. We further obtained information from the responsible ministries. Of course we cannot claim it to be complete. With respect to digitalisation, the contents examine economic developments, duties and skills as well as working conditions and changes in the working environment.

Below the report describes digitalisation and labour market on a European level as well as the select countries. Here we always differentiate between the progress of digitalisation, the political discussion and specific measures. The conclusion then introduces a chart intended as an overview of key information on digitalisation in the individual countries.

2 Digitalisation in the EU

2.1 Progress of digitalisation and potential developments

As a supranational protagonist, the European Commission tries to encourage EU member states to increase utilisation of economic and social potentials of digitalisation. Its digital agenda of 2010 among other things defined the goals of creating a digital single market, adapt ICT standards, and strengthen infrastructure and digital expertise (cf. European Commission 2010). The annual Digital Economy and Society Index of the European Commission uses several weighted dimensions to survey the capability and situation of various countries with respect to digitalisation of the economy and society. So the index serves as a gauge to review progress and measures connectivity, human resources – so PC and internet skills of the population at large, as well as the percentage of ICT specialists among the population, internet use, the integration of digital technologies in business processes and the availability of digital public services (cf. European Commission 2016h). In the 2016 Index of the European Commission describes the following general trend: Although digital infrastructure in various countries and the integration of digital technologies in business processes is advancing, the improvement of human potential is stagnant in many countries and unable to keep up with the infrastructure (cf. European Commission 2016h).

In spring of 2016 the European Commission published a communication on the European digital single market. In it the European Commission emphasises the importance of a better IT infrastructure and increased use of said infrastructure. In various initiatives named it explicitly addresses cloud computing, working on and with supercomputers, quantum technology, adapting standards in the IT sector, the Internet of Things – so smart devices and rooms, as well as e-Government strategies. In this context the commission names the economic potential of the ICT industry

which, at four percent of the gross domestic product in the EU area, an added volume amounting to 580 billion Euro and six million employees in member states has become a key economic factor. The commission references studies which state strong growth could be expected future due to digitalisation, and reports an amount of 110 billion Euro in additional annual proceeds digitising the European industry could produce respectively over the next five years. The commission floats assessments according to which about a third of the current economic growth in the European industry is now already building on digitalisation processes. It also references studies which state manufacturing companies can use digitalisation processes to offer additional services. This would increase their profit margins by more than five percent and the number of jobs by about 30 percent (cf. European Commission 2016g).

The commission notes the EU overall is in a good position to shape digitalisation. After all it has a strong industrial basis and companies which can manufacture and distribute the parts for a digitalised and networked economy: This would include e.g. robots, automation electronics, sensors. However, the European industry, particularly small and medium-sized companies has not been adequately utilising this potential, the commission states. It points out that 60 percent of big corporations and 90 percent of small and medium-sized companies have felt overwhelmed by the progress of digitalisation thus far and ill prepared (cf. European Commission 2016g).

In reference to the expertise workers will need in a digitalised economy, the commission states that 40 percent of Europeans have insufficient knowledge and skills in handling the digital infrastructure. According 2014 Eurostat figures cited, at that time just about a third of the working population in the EU still had little digital knowledge and skills (cf. European Commission 2016g). A study of the European Parliament shares the findings that a large percentage of Europeans still has poor digital expertise. The authors of this study do not believe the effects of digitalisation on the number of jobs in the European labour market can be clearly projected. Some studies assumed a high level of automation (in 40 to 60 percent of jobs in Europe) and humans being replaced. Others in turn predicted digitalisation yield considerable net increase in jobs, albeit in different occupations and industries than before (cf. de Coen/ Valsamis/ van der Beken/ Vanoeteren 2015). The commission also emphasises the gap between the skills required in the labour market and those workers actually possess. It assumes that by 2020 up to 800,000 jobs cannot be filled. Thus fit specialists with special ICT skills may therefore be in short supply for all these jobs. Furthermore, job requirements will also change in all other jobs outside the ICT sectors and that today's European workers do not have the skills or training to be adequately prepared.

With respect to the future the European Commission instead apparently imagines workers will adapt ideally to the digitalised working environment and titles one sub-chapter in its communication: "A human capital ready for the digital transformation with the necessary skills." In the future, machine operators, engineers and administrative staff will be supervising and designing processes, and intelligent

machines actually carry these out. Furthermore, more business, creative and technical design skills will be required at all levels. So workers of the future would need a mix of specialised as well as basic social and technical skills (cf. European Commission 2016g).

In a 2014 study on behalf of the European Commission the authors analysed the economic effects improving ICT skills among the working population will have on the efficiency of the allocation of resources – and consequently on productivity – for the entire economy. The authors examined developments in the manufacturing, construction, trade, tourism and the business-related services sectors in the EU for the period 2000 to 2010.

The findings: The percentage of workers with specific ICT skills and the figures for allocation efficiency and productivity correlate positively, namely according to the model increasing the percentage of ICT skilled workers by one percentage point will increase the allocation efficiency by 1.2 to 1.3 percentage points, and labour productivity by 0.9 percentage points. For the 27 EU countries examined, the increase in ICT skills among the working population from 2008 to 2012 hence yielded a total increase in productivity of almost 0.5 percentage points. In one projection the authors for example calculate the effects of EU initiatives which are to produce 900,000 new ICT specialists by 2020, who could then in turn fill newly created jobs. This could therefore yield an overall increase in labour productivity of 0.362 percentage points by 2020. Between 2008 and 2020 this would result in a total increase in labour productivity of almost 0.9 percentage points. The authors of the study predict a long-term economic growth of 0.44 percent of the gross domestic product of the EU based on the growing number of ICT specialists.

Another aspect examined in the study are potential increases in productivity from increasing online sales: For example, 33 percent of small and medium-size businesses reaching the 2015 goal for online sales (actual figure 16 percent), then based on their calculations, this trade innovation would be able to increase productivity throughout the EU by 0.91 percent compared to 2010. The authors further calculate an increase in consumer welfare of 1.13 percent of the GDP per year between 2009 and 2012 due to falling prices.

Overall, based on its calculations the planned increase in online sales should increase the EU GDP by 1.89 percent in the long term. Italy, Romania, France and Estonia will see particularly strong effects of over 2 percent (cf. Lorenzani/Varga 2014).

2.2 Political Discussion

In reference to various national digitalisation agendas, the European Commission reminds all the support for national initiatives should not overly split the European market. Otherwise the individual countries could become isolated and the respective companies located there could then no longer survive against the competition from large markets such as the USA. Standards would therefore need to be adapted and

cooperation between the different companies and industries in the EU increase (cf. European Commission 2016g).

The EU would need to become more appealing to investors with respect to automation or sensor technology and networking in order to secure sufficient capital for innovations and position itself on the international markets through the use of modern technologies. This could push the development of a networked economy, the commission states. It also calls upon the individual companies to contribute to the success of the digital single market: In addition to being open to new technologies, investments in training the workforce would also be required: Many of those already working would require retraining and continuing education. It is the commission's view companies play a big role, the private sector and public educational institutions should work hand in hand with respect to continuing education (cf. European Commission 2016g).

At the European level the business representatives addressed are organised through the Business Europe trade association. In 2011 they welcomed the 2010 Digital Agenda of the European Commission. After all the digital single market holds a similarly high economic potential such as creating the general single market in 1992. This means a potential GDP increase of four percent, so 500 billion Euro by 2020. At that time the association appealed to act quickly and create the digital single market in order not to lose out on advantages (cf. Business Europe 2011). In 2014, Business Europe then demanded better foundations for growth in the digital economy beyond its previous share of seven percent in the EU-wide GDP. So the EU and its Member states would need to create an environment which promotes private investments in the infrastructure. Start-ups in the digital area should specifically be supported with EU funds. Furthermore, a good balance would need to be created between protecting the data of EU citizens and utilising the economic potential this data holds (cf. Business Europe 2014). In 2015 Business Europe wrote to the European Commission, noting the digital single market could only be fully effective if there are no hasty and inflexible regulations for the economy. It would be better to draft evidence-based rules after the fact than to draft strict ex-ante regulations (cf. Business Europe 2015). For a long time business representatives were concerned about not seeing sufficient support for transforming the European industry – and accordingly welcomed the strategy of the European Commission on this matter published in spring 2016 (cf. Business Europe 2016). As the Director General of the association, Markus Beyrer, stated: "The strategy focuses on the correct priorities. It aims at mobilising investments in the amount of 50 billion Euro to encourage companies – SMBs in particular – to wider use of digital technologies. The is important support for the competitiveness of Europe and an important measure in keeping jobs in Europe and creating new ones. The European Commission provided a coordinated EU-wide approach for eliminating the current regulatory fragmentation." (Business Europe 2016: 1). In this context the association speaks in favour of high international data flow without excessive regulation. All in all, Business Europe advocates a common digital policy on a European, not national level (cf. Business Europe 2016).

However, digitalisation is not progressing equally in all EU states, as a study for the European Parliament points out. On one hand not every country will benefit equally from the innovations, on the other hand disruptive and risky effects on the economy will not upset every country and its economy equally. After all there are countries which are already highly digitalised now and those which have not yet established the infrastructure this requires (cf. Valsamis/de Coen/Vanoeteren et al 2015).

Not only will various countries benefit from digitalisation differently, the same also applies to various groups of people, the study states. The authors indicate that more digitalised forms of job search and job placement would exclude workers with poor digital skills. To reduce these risks of exclusion the principles of academic as well as lifelong education would need to be fundamentally changed and focus more on teaching digital skills. Furthermore, as recommended by the parliament, particularly low income persons with a low level of education would need to be purposefully supported by politics and guided through the change in the working environment through aid programmes (cf. Valsamis/de Coen/Vanoeteren et al 2015).

In September 2015 the European Economic and Social Committee, representing workers' and employers' organisations and other interest groups, took a position on the effects of digitalisation on both the service as well as the industrial sector. In it, the committee first establishes: "On one hand the innovative services and business models created by digitalisation enabled growth in service productivity which had previously been inconceivable and improve choices for consumers. On the other hand they significantly impact the labour market and the work organisation, e.g. greater income differentials and curtailing access to social security, which could prove to be negative for certain groups of workers unless addressed adequately." (Greif/Leo 2015: 2)

The committee does not see a suitable social element in the Digital Agenda of the EU thus far and criticises: "The Digital Agenda for Europe and the initiative for the digital single market does not provide the EU with an active part in digital policies. However, most of the effects digitalisation has on employment remain disregarded and has therefore not seen many relevant policies thus far." (Greif/Leo 2015: 3) The European trade union federation Uni Europa agrees: "Although Uni Europa welcomes the efforts of the commission to respond to the digital development – however, we do find the approach of the commission to close-minded and focuses too much on consumers whilst not focusing enough on workers and the industrial and services sector. (...) Although it is expected for the European society, the labour market and jobs to undergo a fundamental transformation, the package on the digital single market is lacking serious proposals on how to shape this transition to the advantage of Europe's workers and citizens." (Uni Europa 2015: 1.2) So workers' organisations and the Economic and Social Committee stress the commission primarily aims at covering the working environment with strategies to build expertise, but does not take a position on the required social protective mechanisms and regulations. Instead, the several initiatives even exert pressure according to the trade union association: The

commission wants to squeeze logistics costs for trans-European online sales – even if the logistics sector is already seeing extreme price erosion which affects workers negatively. Uni Europa demands for the commission to create a programme together with social partners which takes these aspects into account. Neglecting the protection of standards, an exclusive strategy in the individual states and a cohesion of the various countries with respect to digital development could result in even greater imbalance within the EU. The negative effects of this could be seen in the continuing economic crisis in Southern Europe. The EU would therefore need to use funds even more specifically to provide countries with a less advanced development with additional support (cf. Uni Europa 2015).

The European Economic and Social Committee provides several proposals on how to create good conditions for a digital labour market. For example, examining whether European measures are needed to introduce common qualification standards and apply measures from one country at a European level. And to furthermore examine whether uniform EU regulations are required in the interest of privacy and to protect employees from constant availability. To which extent this would also include the self-employed would also need to be examined (cf. Greif/Leo 2015). The committee also addresses the problem that worker rights on mergers could be compromised if they are now considered self-employed due to new contractual forms and their coalition would then be considered a cartel. They could then have a brush with EU laws on anti-competitive practices. "These concerns which could compromise this fundamental right needs to be taken into account, or needs to be eliminated. We need a guideline for applying competition laws to quasi-subordinate employees", the committee finds. (Walker-Shaw 2016)

To have a better decision-making basis in politics, in the future there should be routine statistics on the proliferation of new forms of work such as crowdworking, sourcing models such as crowdsourcing, and economic forms such as platform economy. The legal status and liability of online platforms e.g. for job hunting should be clarified, also a request from the European Agency for Safety and Health at Work (cf. Greif/Leo 2015; cf. Walker-Shaw 2016; cf. European Agency for Safety and Health at Work 2015). The committee believes European platforms should be actively supported to prevent being fully dependent on the USA with respect to this new economic form (cf. Walker-Shaw 2016).

Social partners should contemplate how to expand the scopes of tools such as collective agreements to new forms of employment to the digitalised working environment. Politicians in turn would need to work on also expanding fundamental protection under social security legislation to non-typical labour conditions – a request which also follows the study of the European Parliament and the European trade union federation (cf. Greif/Leo 2015; cf. Valsamis/de Coen/Vanoeteren 2015; cf. Uni Europa 2015). Uni Europa explicitly demands equal treatment of solo self-employed workers with respect to their status under social security legislation (cf. Uni Europa 2015).

In a statement on the effects of technical innovations on the social security system and labour law, the Economic and Social Committee in the spring 2016 also brought into play adding labour laws on a European level to prevent casualisation: For example, requiring employment contracts at the start of employment and a minimum number of work hours to prevent so-called zero-hour contracts would be conceivable. In these, workers could be employed on an on-call basis (cf. Walker-Shaw 2016). The committee further recommends for the European Commission, OECD and ILO to establish regulations to guarantee humane working conditions and protection standards for mobile and ICT-based employees (cf. Walker-Shaw 2016). The study of the European Parliament also believes new regulations are required on a European level to prevent complete blurring of work hours and protect employees from being available at all times – a demand the trade union federation Uni Europa supports (cf. Valsamis/de Coen/Vanoeteren et al 2015).

On the tax treatment of new business sectors the Economic and Social Committee notes: "Reforms of the tax systems must be thoroughly reviewed so both the income generated by conventionally organised industries as well as the "Sharing Economy" are taxed at comparable rates. To also ensure the social systems remain sustainable in the future and to provide relief for the labour factor, one consideration could be to use part of the digitalisation dividends for this purpose." (Greif/Leo 2015: 5)

Do the newly created, technology-based jobs offer high quality employment opportunities? What are the associated risks? The European Foundation for the Improvement of Living and Working Conditions deals with these questions and examines the specific working conditions of ICT specialists such as programmers or IT-related consultants. The findings: The working conditions for this type of specialists are better than for many other specialists in other occupations in the EU, although it does not specifically examine the extremely flexible labour conditions addressed in the above paragraphs. Although this occupational field is subject to frequent, quick changes, the employers also do provide an above-average amount of vocational training and continuing education. Furthermore, on average the work-life balance for these workers is better than in other sectors. Although the intensity of labour is relatively high, so is the autonomy of the workers (cf. European Foundation for the Improvement of Living and Working Conditions 2012).

The European Agency for Safety and Health at Work singles out the potential side effects of increasing crowdsourcing may have on workers as a specific aspect. It points out several problems: Whilst in a secure job at a company employers are responsible for adequate equipment, in crowdsourcing the responsibility is shifted to the individual contractor, the agency states. Namely, there aren't adequate inquiries into the conditions in this type of job. However, the risk for independent crowdworkers having workstations with poor ergonomics and an inadequate computer infrastructure, possibly in overly noisy, poorly air conditioned and inadequately lit rooms, thus endangering their health, is high (cf. European Agency for Safety and Health at Work 2015). Even offline crowdsourcing tasks would pose risks – such as taxi drivers hired

through chauffeur services being at risk of a hold-up without having employer coverage. Add to this the often lack of knowledge about the work hazards along with legal requirements the crowdworkers need to comply with and may otherwise be held liable. As employment through crowdsourcing increases it would also be extremely difficult for workers to prove that work-related accidents and occupational diseases are caused by work. Crowdworking could also have negative psychological effects. For example it could be difficult if workers are uncertain about the next day's workload and further can't be certain they will actually be paid for their work – since the client pays based on the quality of work. Various crowdworkers competing for jobs could result in permanent readiness and few breaks due to the fear to miss out on a job. The potential isolation of workers could also result in psychological problems.

2.3 Political and public-private measures

In his State of the Union address in September 2016 Jean-Claude Juncker, President of the European Commission, brought the development of the digital European economy to the fore (cf. European Commission 2016r). The president expressed the objective of all companies and households in Europe having access to faster internet connections. In order to facilitate the required investments of 500 billion Euro and close the projected gap of 150 billion Euro, a so-called codex is to be established for electronic communication. The president hopes a simplified legal framework will result in a boost in investments and a GDP growth of 910 billion Euro by 2025 along with 1.3 million new jobs. Among other things, as a first step authorities in the EU are to receive 120 million Euro to provide more public internet access in their areas to also establish better public internet coverage (cf. European Commission 2016r).

In 2014 in a study for the European Commission 2014, Think Tank Empirica already recognised the agenda of the European Commission launched in 2007 had a clear impact on digital skills: Many EU countries had already achieved a substantial improvement in skills training measures. Yet many EU countries were lacking a consistent strategy and a master plan, particularly also in developing excellence in the area of digitalisation. The efforts to adapt the education systems to the growing need for knowledge-based workers were often minimal. In contrast, pushing ahead training ICT specialists is being neglected. Empirica also criticises that for example preliminary projects to introduce more women into ICT professions are oftentimes very short lived and geared towards the media without having any long-term effect. Given the economic crisis, several southern countries hardly paid any attention to the population's digital skills or other long-term needs (cf. Gareis/Hüsing/Birov 2014)

In order to respond to these deficits, in the aforementioned communication in spring 2016 the European Commission announced over the next few years it intends to invest 500 million Euro of the project funds from the Horizon 2020 agenda in centers of excellence for digital innovation and development. Furthermore, in collaboration with the private economy 20 billion Euro are to be invested in research and development of European companies on digital applications by 2020. The

commission requests member's states to contribute an additional three billion Euro annually (cf. European Commission 2016g).

In 2013 the commission already founded the so-called Grand Coalition for Digital Jobs, through which about 100 companies, educational organisations and research institutions have arranged 60 projects to date. These educational initiatives are to get hundreds of thousands of people ready for a digitalised working environment. EU citizens are to be introduced to ICT and sold on jobs in this sector. After all in the future 90 percent of occupations will require at least basic training on digital applications. Although Europe for one does have a lot of workers available, on the other hands there also are a lot of vacancies. However, due to the lack of specific technological skills, several of the jobs opened up due to digitalisation cannot be filled. Therefore the coalition is to coordinate the labour supply and demand better than before.

The respective protagonists in the EU initiative have promised non-binding contributions intended to advance digital skills and job opportunities in Europe (cf. European Commission 2016i). This is to provide a brief highlight with select pledges to provide a rough overview.

One pledge has come from e.g. the British Computer Society, the professional association for the IT industry. The BCS wants to reach at least 10,000 persons with their Digital Literacy for Life programme. These are to be made aware of the importance of lifelong digital learning through information events and workshops. By summer 2016 BCS had reached 25 percent of the target number of persons. A subgroup of the society is also working on policy counselling for the British government to support them in their policies on digital skills and to realise improvements (cf. European Commission 2016j).

IT specialist Cisco is targeting a specific field in their pledge. They want to use their Smart Grid Training to provide technology installers with an opportunity to train in a field with a promising future: Learning material created specifically for this purpose is to provide them with special knowledge on intelligent grids. More specifically, Cisco created an 80 hour online course with other partners. Furthermore, teachers at vocational institutions were trained, and as of Summer 2016, 200 of the 500 teachers targeted had been attained. In total, of the 20,000 persons to be trained, 900 were actually attained (cf. European Commission 2016k.

The Council of European Professional Informatics Societies (CEPIS) intends to provide yet another form of contribution: The organisation created a website where IT specialists can check the actual market demand for their current skills and what they need to do to adapt to the current changes. The organisation seeks to reach 2000 persons in the ICT sector in the 28 EU member states with their self-assessment portal, and as of summer 2016 the number was at 2200 (cf. European Commission 2016l).

Italy's NGO DIDASCA on the other hand has a more domestic focus. It intends to provide digital literacy work in Italy to better prepare two million Italians for the requirements of a modern working environment by 2020. NGO uses two programmes for this purpose, the "Internet for Minds" (target group: school) and the "Internet for Jobs" (target group: working population). This is intended to provide participants with better skills in searching for information online, in electronic communication and in working with more complex computer applications such as cloud spreadsheets and documents. The project only launched in 2015 and has reported no preliminary results by summer 2016 (cf. European Commission 2016m).

The University of Sheffield is also focusing more on regional initiatives. It aimed at training 45 pupils and six teachers in programming languages such as Python, app development programmes or in data analysis and in the competent use of social media. This took place in 2014 using learning modules created by the university which schools and teachers are able to use afterwards. This is intended to enhance the effect (cf. European Commission 2016n).

The educational institution Digital Skills Academy intends to train 20,000 unemployed persons in Europe on digital applications whilst using proprietary programmes which, according to the organisation, were developed in cooperation with the industry. To date, about 2600 persons have been trained since early 2014, 30 of the targeted 200 teachers trained, and 1700 of 12,000 planned job placements attained (cf. European Commission 2016o). Internet giant Google on the other hand had already fulfilled its pledge, thus completed its first project for the Grand Coalition. Google cooperated with educational institutions in the area of computer and ICT training, provides training programmes and the necessary infrastructure in 2013. This was intended to reach 500,000 persons throughout the EU, with 750,000 persons having been reached in 2014, although it is unclear whether these persons then also received specific training or merely attended an information event. According to Google, the company spent four million Dollars on this. Furthermore, in cooperation with universities by the end of 2013 Google had started about 25 so-called Massive Open Online Courses on topics in the fields of maths, computer science and online legal issues (cf. European Commission 2016p).

In addition to the Grand Coalition for Digital Skills, in early summer of 2016 the EU renewed its New Skills Agenda for Europe, which was started in 2008. This is intended to provide incentives to adapt educational projects and structures to the new requirements of a digitalised working environment. This will focus on critical thinking, business skills, creativity and digital skills. Works such as EntreComp, a guideline on training business skills, or DigComp for proficiency in digital applications, are to provide a suitable framework. In addition to this there will be a qualification guarantee to provide low-skilled adults with a minimum of digital training (cf. European Commission 2016q).

3 Country chapters

3.1 Finland

3.1.1 Progress of digitalisation and potential developments

3.1.1.1 Integration of technology and economic effects

In its 2016 Digital Economy and Society Index of the European Commission rated Finland as a "declining pioneer", so a country which had previously achieved good progress in terms of digitalisation of economy and society but is currently showing little progress.

Finnish companies overall utilise digital applications extensively, primarily RFID chips and cloud applications to link different components and social media for marketing: In these area they are above the EU average. In online sales (16th place), primarily also across borders (21st place) the companies are doing rather poor compared to other EU states, and are apparently still hesitant (cf. European Commission 2016a).

The already high portion of the employed with web-enabled computers in the workplace again grew from 74 to 80 percent between 2009 and 2013 (cf. Eurostat 2016b). With respect to using mobile applications for work, Finland outpaces all other EU countries: At 74 percent of companies employees surf the web from mobile devices, at 73 percent of companies employees use e-mail on mobile devices, 55 percent of companies use mobile exchange services and at 44 percent of companies employees access specific online applications from mobile devices – putting Finland far ahead of all other countries in this respect (cf. Eurostat 2016a).

So far the use of industrial robots on the other hand has not been important in Finnish production, as the rate is only about 120 multifunctional industrial robots per 10,000 employees (cf. International Federation of Robotics 2016).

According to an Index on the Aptitude Effect of Information and Communication Technologies (ICT) according to Evangelista/Guerrieri/Meliciani (2014), Finland has the highest index ranking across the EU and was able to again improve significantly between 2004 and 2008, i.e. purposefully integrate ICT in business processes, job placement or in education.

Several observers, however, consider Finland's current situation dire after Nokia's fall in this area. In a publication by the Friedrich-Ebert-Stiftung, researcher Antti Alaja of Finland's Kalevi Sorsa foundation outlines the somewhat unsettling developments after Finland performed well in innovation and skills development for years: Public research and development expenses, for example, continuously decreased between 2011 and 2014, and the budget for 2016 has also shrunk by another 157 million Euro, thus actually 9.4 percent in this area (cf. Andersson/Alaja/Buhr et al 2016). Furthermore, according to Alaja the innovation fund Teker lost almost a quarter of its budget for 2016. So during times when theoretically a lot of money would be required for shaping technological change, Finland is therefore investing less than before.

According to the EU Innovation Scoreboard 2015, Finland is further only achieving relatively little economic effects with its innovations, for example in terms of growing jobs in knowledge-intensive activities, sales increases based on innovations and gaining new patent rights for technologies. The primary negative item noticed was that Finnish high-tech exports, which in 2005 still made up over 20 percent of all exports, only made up seven percent in 2014 – and that Finland has meanwhile become a net importer of technology products (cf. Andersson/Alaja/Buhr et al 2016). The Finnish Ministry of Economic Affairs and Employment self-critically also acknowledges this trend in IT services, where exports have been decreasing since 2008 whilst imports are growing by 9 percent annually (cf. Ministry of Employment and the Economy 2015).

Another analysis on behalf of the government states the performance of the Finnish industry has been rather poor between 2008 and 2014. If nothing is done, a lot of jobs could be lost. Most Finnish companies are too fixed on their old business models and failed to pay attention to new companies in their industry. They are not recognising potentials, are not applying successful concepts are not entering into promising cooperations. This however, is gaining importance in a business environment which is changing rapidly due to digitalisation (cf. Collin/Halén/Juhanko et al 2015).

The analysis conceptualises various scenarios. Great strides in the digitalisation and networking of the industry, by 2023 nine billion Euro in additional added value along with 48,000 additional jobs could be possible – the so-called industrial internet could then become the "new Nokia". On the other hand – with weak growth – a three billion Euro decline in added value and losing 16,000 jobs by 2019 would also be conceivable. Getting on a positive track would require commitment from the private sector and the public authorities to ensure better market access, new business models, skills, new technologies and new platform models (cf. Collin/Halén/Juhanko et al 2015). So far the Finnish economy has lacked flexibility. Rigid labour market and employment structures as well as dominant interests behind older business models are standing in the way of change. One advantage of the Finnish economy with respect to establishing new companies, on the other hand, are the solid and not easily corrupted environment where new companies will find a high degree of security and stability. Finns have furthermore traditionally been good problem solvers, another quality which could become more important in the digitalised business world (cf. Collin/Halén/Juhanko et al 2015).

Finnish economist Matti Pohjola of Aalto University also states a serious decline in the ICT industry due to the Nokia crisis. In 2002 the industry meanwhile held ten percent of the national added value due to Nokia's booming business – and a mere four percent in 2014. However, Pohjola states, the data processing sector had recently grown and compensated part of the decline in the electronics and mobile service sector. He also sees additional opportunities for growth in this area provided the Finnish economy is fully committed to digitalisation. He points out that ICT had also most recently been the key factor for Finland's economic growth. In 2013, for

example, about 40 percent the GDP growth and about half of the country's labour productivity had been ICT-based, just as a majority of the increases in productivity between 1998 and 2012 (cf. Pohjola 2014). The Ministry of Economic Affairs and Employment pointed out the – despite the Nokia crisis – continued importance of ICT services as a growth engine since the turn of the millennium. The portion of IT service jobs among all jobs in the private services sector (except health and education) had thus grown from 21 to 26 percent between 2003 and 2013 (cf. Ministry of Employment and the Economy 2015). And with respect to exports, software-based products are still essential for Finnish companies despite the recent negative trends: Referencing the Research Institute of the Finnish Economy ETLA, in 2013 the ministry stated a third of Finnish exports were in this product category. So information and communication technologies continued to be very important for the country's economy (cf. Ministry of Employment and the Economy 2013).

For the coming years the economist Pohjola sees potentials in the Internet of Things and the industrial internet to increase productivity similar to the first wave of information technology in the 1990s and early 2000s: This could mean an increase in productivity of 1 to 1.5 percent per year, however Pohjola does not state a specific reference period. In addition to the manufacturing industry, the sectors in energy management, health management and transportation could benefit from this, he predicts. In a 2014 analysis the European Commission assumed that if all vacancies in the ICT sector are filled by 2020 merely based on this measure, Finland could achieve a total increase in labour productivity of 0.355 percent (cf. Lorenzani/Varga 2014).

Whilst Finland lost its comparative advantages in electronics from 2008 on, according to economist Pohjola in some industrial sectors it still holds benefits in cost and quality compared to other countries, such as in the paper industry or mechanical parts. In the service sector Finland is primarily well-positioned in data processing services over other countries. Referencing the 2012 European Competitiveness Report, Pohjola analyses these are the sectors where investments Finnish companies had made in modern ICT had been particularly high (cf. Pohjola 2014).

Also with respect to Finland, in 2014 the European Commission's research group Joint Research Center examined possible connections between the employment trend and the use of ICT. Same as with other countries examined, Finland showed no significant effect of ICT components on employment – so this is primarily an overview of the development in the infrastructure:

In Finland the broadband coverage for employees in the manufacturing sector grew from 46.7 to 52.5 percent between 2007 and 2010, the provision of web-enabled mobile devices grew from 34.6 to 48 percent of employees. During this time the portion of online sales among all sales grew rather moderately, from 9.2 to 10.8 percent, the average number of employees per company in this sector grew by 3.8 percent during this same period. In the service sector, between 2007 and 2010 the

broadband coverage grew from 70 to 76.4 percent of employees with this type of connection, 69.3 instead of 48.5 percent of employees had a web-enabled mobile devices and online sales increased from 6.1 to 7.7 percent of all sales. The average number of employees per company grew by 0.4 percent in this sector (cf. Pantea/Biagi/Sabadash 2014).

3.1.1.2 Education and Skills

The European Commission rates Finland's human resources, i.e. basic digital skills among the population and the percentage of IT specialists, as positive despite Nokia's recent problems. According to the 2016 Digital Economy and Society Index of the European Commission, 91 percent of Finland's population is regularly online (rank 5, EU-28: 76 percent) and 75 percent of the population at a minimum have basic digital skills (EU-28: 55 percent). At 6.7 percent, the percentage of ICT specialists among the total working populations is also by far the highest in the EU (EU average: 3.7 percent). However, a large portion of these workers were associated with Nokia and greatly affected by the telephone manufacturer's crisis. However, Finland's investments in improving and changing the skills of its ICT workforce was below average compared to other EU countries, the European Commission states (cf. European Commission 2016a).

Finland not only has a high percentage of ICT specialists among the entire workforce. Until recently the same phenomenon was also seen with the percentage of ICT specialists in the manufacturing sector: Here the percentage of ICT specialists among all workers grew from 3.5 to 5.5 percent between 2008 and 2012, although Finland had by far reached the highest value (cf. Lorenzani/Varga 2014). However, this data probably does not extensively reflect the problems Nokia has been facing for several years.

At least with respect to general computer skills among the employable population, Finland has continued to make progress between 2006 and 2014. For example, the percentage of the employable with advanced computer skills had grown from 32 to 52 percent, whilst the percentage of those with moderate skills remained steady. With respect to internet aptitude, the percentage of the employable population with moderate or advanced skills grew from 38 to 69 percent (cf. Eurostat 2016d). According to Eurostat, in 2015 the percentage of the employable with no or little digital skills was only 15 percent, a very small percentage compared to the EU average of 25 percent (cf. Eurostat 2016f). However, the 2012 Survey of Adult Skills and its analysis of problem solving skills of persons in technologically-based fields drew a very different picture: In Finland only about 35 percent of subjects were at the two highest aptitude levels, whilst almost 40 percent of persons had no or very little, so not even basic, problem solving skills in working with computers and IT (cf. OECD Publishing 2014).

Finland's educational system is currently under reform with respect to digitalisation, as of autumn 2016 a new curriculum will become effective to also increase covering

digital skills (more on this later). On enquiry the Ministry of Education and Culture references its study from May 2016 (cf. 2016 Ministry of Education and Culture). According to this, 60 percent of Finland's teachers feel their respective schools have insufficient digital devices and applications to prepare children for working with digital applications. 50 percent report inadequate internet connection. Furthermore, ICT applications are so far only being used by the teachers themselves, teacher centred – pupils on the other hand are still hardly using the schools' digital devices and projects such as programming units are rare, according to the teachers. According to the study, 75 percent of teachers were in favour of using ICT and digital applications at school and for work. However, not all teachers consider themselves fit to use the new technologies in their lessons competently, based on a self-assessment about half the teachers had only basic ICT skills, 30 percent rate their ICT skills as advanced. However, quite a lot of those surveyed – namely 20 percent - even felt they had enormous deficits and felt they were ill equipped for their new tasks. Half the teachers state the challenge of being required to work with the new technologies is cause for stress – despite the generally positive tenor toward the new technologies.

3.1.1.3 Digitalisation and change in the working environment

Last year the Finnish institute Turku Centre for Labour Studies held a "Work 2015" conference. During this conference speaker Esko Kilpi, representing Finnish innovation fund Sitra, drew a picture of the work organisation of the future which we will try to summarize here to illustrate conceivable changes. The core thesis: Soon the working environment will no longer consist of fixed employer-employee relationships. Kilpi believes that based on the changes in the work organisation along with the decreasing commitment to employers, workers would need to organise and develop their individual human resources throughout their professional career: After all they may need to consistently be equipped for new challenges and prepare for life long learning.

It may become more important for individual workers to adapt to the requests of clients or cooperation partners on the market, just as solo self-employed have been, and less to the ideas of the employer. Work would therefore become an interaction between various interdependent individuals who will be using various apps, platforms and their own mobile devices as a means for decentralised contact, Kilpi believes (cf. Kilpi 2015).

These potential changes described may appear a bit abstract at this time. However, even other observes such as the Ministry of Economic Affairs and Employment believe there may be substantial changes in the working environment. Among other things it bases this on a report by business consultancy firm McKinsey for the ministry: According to this, about 20 to 30 percent of the service sector will be directly affected by digitalisation and based on this assessment, overall this sector will be affected more than the manufacturing sector. One reason: An increasing number of services are transferred to customers, which would eliminate a number of jobs. The authors furthermore assume increases in productivity which would dispense with the need for

workers, and global price fights which may put pressure on smaller Finnish companies. The latter trend may therefore particularly affect geographically flexible services such as IT services or information services and retail, whilst in the financial, insurance and media sector a great increase in productivity should be important. The current similar trade and sales infrastructure may decrease greatly according to the authors' assessment. There should also be an increase in mobile product customisation by customers in place of centralised product design. The business consultants also believe fully automated processes will threaten jobs requiring higher levels of qualifications (cf. Ministry of Employment and the Economy 2015).

3.1.2 Political Discussion

3.1.2.1 Integration of technology and economic effects

As already implied above, several observers are sceptical about the current political support for digitalisation in Finland. Analyst Antti Alaja of the Kalevi Sorsa foundation criticises there are no stringent political agenda to support innovations in Finland. Unlike previous governments, since 2011 the responsible politicians have rather been working against innovative strengths. The current government for example is weakening institutions such as the Science and Innovation Policy Council established in 2007 in its competencies and even looks to completely phase out the so-called Strategic Centres for Science, Technology and Innovation (SHOKs); in the future this type of policy may also discourage companies and qualified researchers. A structural crisis and these obstacles for potential for innovations had led to Finland only being able to realise comparably low growth rates in productivity in recent years, Alaja continues. However, the analyst shares the assessment of Finnish economist Matti Pohjola cited above that Finland could develop new economic potentials and build international competitiveness in the area of the industrial internet. However, in the past Finnish companies have made too little use of digital applications in business, for example too few companies were selling online – so it's still a long road until the country is able to position itself strategically in the digitalised value added chain. Alaja recommends for the government to increase investments in research and innovations - primarily in the areas of digitalised economy – again, and to increase spending in this area instead of austerity programmes (cf. Andersson/Alaja/Buhr et al 2016).

In 2015 an analysis for the Finnish government mentioned above appealed to first create a common narrative on the structure of a Finnish networked industry between companies, politics and authorities. A national coordination should be appointed to lead pushing the digitalisation of the industry, manage distribution of public funds, and manage the action plan and choose pilot projects. The public procurement law should also be updated and further be used as an incentive to implement new technologies. The analysis also suggests to establish an independent intermediary for using large data volumes. The so-called Databazaar Finland could manage data and provide companies and other interested parties with controlled access based on previously agreed rules. Regulations and tax models should also be adapted to new digitalised business models. This could for example promote establishing an industry of

autonomous cars the same way regulations were adapted in the 90s for the mobile phone market to work. It's important for companies to not only operate digitally within the company but to become a truly industrial internet - so productive exchange with other companies (cf. Collin/Halén/Juhanko et al 2015).

Economist Matti Pohjola also sees good opportunities for the Finnish economy. He reminds of the strong economic progress among Finnish industries which most recently increased investments in modern ICT. He appeals the corresponding companies would now need to master the challenge to use the digital infrastructure creatively to open up new income opportunities. A strategic combination of product offering and services or the innovative use of internet solutions in industrial production for example is promising. Know-how, and particularly engineering expertise in the ICT sector could also become an export product in high demand during times of global digitalisation, which is where Pohjola opportunities also sees potential for Finnish companies. The economist does believe, however, that as yet, few decision makers in the Finnish economy have recognised the potentials digitalisation holds for both the industrial as well as the service sector. Thus not enough is being invested in the respective development, and applications such as cloud services or electronically controlled supply chains are not being utilised well (cf. Pohjola 2014), an assessment the Finnish innovation fund Tekes also shares: With the exception of Nokia's past successes, Finland has no ground-breaking IT developments and companies only view ICT as a tool for adapting traditional production processes, not as a game changer. The skills of workers are therefore hardly being used to establish international advantages. Failure to change this with specific strategies on the use of technology would result in missing out on growth potentials and demoralise workers (cf. Alasoini/Lyly-Yrjänäinen/Ramstad et al 2014).

However, economist Pohjola not only sees problems at the decision-maker level but also in building adequate skills among the wider population to develop creative digital applications. So far many Finns do not have adequate computer skills to facilitate this. It would therefore require a new industrial strategy based on digitalisation which fully thinks along and primarily relies on developing ICT skills in Finland as a business location, the economist demands (cf. Pohjola 2014).

Obviously the "Information Society Advisory Council" of the Ministry of Transport also believes that to date the Finnish economy has been poorly prepared for digitalisation. In its "Digital Agenda for Finland 2011 to 2020" the council advisory council appealed to companies and decision-makers to rethink and adapt their past management and decision-making processes to be able to respond to customer and employee feedback faster. This would require reducing hierarchies and utilising all the available digital networking options to gather the most complete information possible for the most customised production possible (cf. Ubiquitous Information Society Advisory Board 2011).

The ICT task force of the Finnish Ministry of Economic Affairs and Employment assesses the starting position a bit differently. In 2013 members of the committee attempted a fundamental vision for a digitalised economy to ensure a transition into the digital age without painful failures. The authors of the paper believe that so far, Finland is in a good position to be among the global top in the digital age as well as reference "success stories" such as Nokia and the makers of the Angry Birds app, who grew up in Finland. The first successes from these protagonists had successively also drawn research and investments from companies such as Ericsson, Intel, Electronic Arts, Huawei and Samsung to Finland. In order to maintain and grow these types of advantages the committee considers this the need to act and launch an ICT research programme to continue until 2023. There should further be a financing programme for companies interested in starting in the ICT sector. The authors appeal an adapted environment for innovations and business would need to be established now for the ICT industry similar to what was seen in the 90s for the mobile phone industry. This could be based on the experience gained with this industry (cf. Ministry of Employment and Economy 2013).

Business consultancy firm McKinsey, however, believes the intended change for the Finnish economy will involve great challenges, primarily for the service companies. In a publication for the Finnish Ministry of Economic Affairs and Employment it assumes that Finnish companies will need to be very specialised and position themselves in niches. This would be the only way to keep up globally despite the ICT and business services not being bound to specific locations much. The companies would therefore both need to utilise all options for digitalised business management in order to automate all processes, reduce costs and remain competitive, as well as to fully utilise knowledge of local preferences among customers to ensure their offerings are more targeted than foreign companies. The revolutions could also bring great opportunities, since Finnish companies could also orient their online offers and networked value added chains outward, toward other markets. The business consultants are therefore recommending for Finnish companies to already conduct market analyses now. Also to explore in which areas of the increasingly complex networks and value added chains they will be able to make the most money in – and to then penetrate these (cf. Ministry of Employment and the Economy 2015).

The Ministry of the Employment and the Economy also commissioned Finnish Think Tank Digile, an advocate of digitalisation, with an analysis. It primarily warns that Finland could be outpaced in the field of growing platform economy. Finland has not produced any noteworthy platform ventures such as Airbnb or Uber and therefore also has not been able to build expertise in this type of business and the technical and infrastructural fundamentals. This cold result in Finland being confronted with massive unemployment rates and a declining added value in a few years, Digile warns. The Think Tank also does not assess Finland's position very positively with respect to service-related ICT skills which are extremely relevant in a platform economy: To date Finland has missed this opportunity to set up international data centres, nor is it currently making any efforts to create these. With respect to platform services Finland

has not produced any new cloud applications or platforms with international reach since creating the open-source software Linux and the MySQL database system – a great risk for the entire Finnish economy.

The analysts recommend for Finland to set up its own platforms, namely as a cooperation between public bodies and private companies. In the future these platforms should be used to offer public and private services. With these platforms it should also be expected that Finnish (and possible other) citizens will no longer wish to just leave their data in the hands of Google and Facebook – so attractive competition should be established through stricter and better data protection standards (cf. Ministry of Employment and the Economy 2015).

3.1.2.2 Education and Skills

The "Information Society Advisory Council" of the Ministry of Transport emphasises that although Finland generally has a very high rate of internet use, important groups are still excluded from using or at least from its routines and competent use: Persons 65 and up and persons with little schooling. The members of the advisory council consider this insupportable and therefore propose for e.g. basic digital skills to already be included in early formal schooling, in early grades (more about steps in this direction later). This would require a fundamental change in the academic infrastructure and learning culture including teacher training, media literacy training for pupils, ICT core themes in tertiary education and more learning without location and time constraints through e-Learning materials. Employers should further be encouraged, and if necessary even be required, to also include social innovations for their employees and customers in new media and technologies employees, for example through new dialogue forms through social media in customer employee contact (cf. Ubiquitous Information Society Advisory Board 2011).

In 2013 the ICT task force of the Ministry of Economic Affairs and Employment set the objective to make Finland a competence centre in developing and applying digital products and services. This would require more than just a few individual experts, but rather broad networks of competent workers in various companies and sectors. For one, this would require incorporating ICT skills as an integral part of school curriculums. Furthermore, skills in the unemployed, and primarily among ICT specialists who have become unemployed, would need to be maintained and advanced better than before, and there would need to be more investments in special training for these groups of people, so the committee. Likewise, the skills of former Nokia employees should be utilised with respect to mobile interfaces: The members of the task force appealed to quickly create retraining for these specialists in order for them to not lose their skills.

A special nationwide programme would be required to product more ICT specialists through higher training courses which should focus on the fields big data and data evaluation, designing algorithms, programming languages and other skills in high

demand on the market. Here, universities and companies should intensify their cooperations to improve training and to put research results into practice sooner.

In order to better serve the rapidly changing skill requirements in the technologised working environment, in the future the respective projections should be met with action plans in education much quicker – which would also require more direct cooperation between decision-makers, researchers and education institutions **(**cf. Ministry of Employment and Economy 2013).

Business consultancy firm McKinsey also shares the assessment that investments in the ICT infrastructure and the respective (continuing) education, e.g. programming, are required for pupils and workers in the service sector. The authors recommend shifting money to these fields of education and for tertiary education institutions to specifically promote work in areas such as big data, cloud computing and the Internet of Things (cf. Ministry of Employment and the Economy 2015).

The Finnish Ministry of Education responded to the demands for better support of ICT skills with a new curriculum to be introduced in autumn 2016. Early this year the Finnish national education council presented a document which examines the intention and the objectives of the planned new curriculum. According to this, ICT skills will be among the fundamental basic skills every pupil will be taught. Teachers are to incorporate more ICT as well as inter-cultural education and various languages in school lessons as a cross-sectional issue. Furthermore, business formation and direct prevocational contents are to be included in lessons more: This would also be a mandatory basic skills, which could be an interesting approach in light of an uncertain employment outlook in the future labour market.

The ability to conform in cooperations and networks, using decentralised knowledge as well as organise it across various media, and managing rapidly changing technology or information flows is also specified as a future required skill. The Ministry of Education does not consider the purposeful use of learning aids and ICT infrastructure as trivial, but these would instead continuously need to be adapted to new technological developments and forms of organisation. This would also include testing learning methods without location and time constraints (cf. Finnish National Board of Education 2016).

An analysis for the government on the networked industry proposes specific training programmes on using networked structures between companies for managers and those responsible for business operations. In addition, there would be tax incentives related to continuing education in a digital context for the entire working population. Even higher secondary education should be adapted to develop programming skills and managing complex situations into core competencies (cf. Collin/Halén/Juhanko et al 2015).

3.1.2.3 Digitalisation and change in the working environment

In 2012 the Ministry of Economic Affairs and Employment presented its vision of a working environment in Finland changed by technology but centred around humans by 2020.

In it, the ministry assumes that in the future, Finnish companies would need to manage involving employees on all hierarchical levels and to incorporate their suggestions in the work organisation in order to be innovative. The potential of new technologies can only be fully exploited if ICT solutions are purposefully incorporated in business processes and employees are also proficient in their use, the ministry states. In this context it would be important to make decisions about changes in the workplace together and to motivate the working population to learn and advance themselves. With respect to developing the necessary skills, the goal of the ministry is to not only provide advanced training to already well educated persons and those willing to learn, but to also include the educationally alienated. In times of technological change, their manpower would also need to be maintained. This would require a good basic education, as well as continuous further training at work – a system which would first need to be developed yet and then expanded. The ministry indicates using laws and programmes as proper incentives for life long learning, adapt the educational system to requirements in the working environment more, and to offer more online courses. In addition to the developing skills, the ministry also believes it to be absolutely necessary to create laws to protect the health which are adapted to the modern working environment – although the ministry does not go into more details on this (cf. Ministry of Employment and the Economy 2012).

In addition to these general, conceptual deliberations on the change to the working environment there also are very specific proposals on what work should look like in a technological environment. This also includes a specific sector of the Finnish economy which, along with the business highs and lows of the mobile phone sector, is often overlooked: The very active and internationally renowned Finnish gaming industry. The ICT task force of the Ministry of Economic Affairs and Employment also sees an opportunity here with respect to digitalisation of the working environment. The committee advocates general "gamification" of the entire economy in order to make business interfaces and applications as user-friendly as possible. This would also enable developing new skills hands-on. Experience from the gaming industry would be used for this purpose. In order to accomplish this, e.g. universities and other research institutions should work closer with the gaming industry when developing new interfaces. There should furthermore be pilot projects in various cities and companies to incorporate gaming components in processes (cf. Ministry of Employment and Economy 2013).

At its annual congress in June 2016, the Central Organisation of Finnish Trade Unions SAK challenged the domestic industry to develop creative and innovative application solutions for new technologies to benefit workers. Workers would need to be involved in the development, as without a good understanding of the new technologies on their

part it would not be possible to achieve optimal results for production: After all, the workers could be the first ones to see shortcomings as well as new potentials for production in various areas (cf. SAK 2016b).

The Central Organisation of Finnish Trade Unions SAK also reminds that for one, digitalisation is progressing very rapidly compared to previous technological revolutions, yet it's virtually impossible to foresee where exactly technological evolution is leading, which products may be in demand and what role people may play (cf. SAK 2016a). SAK therefore pleads with politicians to consider in their labour regulations that for many workers, having a single job with only one company for life is no longer realistic. It is conceivable workers will need to adapt to more flexible labour conditions. "The working population therefore needs security nets to help them manage career changes and transitions between jobs and in the process bring their skills up to date", Juha Antila, Head of Development for the Trade Union, comments. Workers should not be caught in grey zones after this type of change throughout gainful employment (cf. SAK 2016b).

Business consultancy firm McKinsey also believes one duty of politicians is to implement the respective laws to facilitate worker transitions between different forms of work and employment in response to the increase in more flexible forms of work. Special training programmes should be established for individuals during times of unemployment to then be able to better integrate in the changing labour market. The authors appeal the appropriate programmes to organise job transition and continuing education would already need to be in place before there's a need on a massive scale - so preferably before digitalisation is in full effect. In the process politicians should cooperate with both companies as well as with investors and local authorities and establish coordinated programmes. Politicians should further promote former workers starting new companies as a type of transition, in which case venture capital is particularly important to the founders.

McKinsey calls on companies to plan the employment of labour for foresight instead of simply cutting jobs. For IT- and business-related services for example, where business consultants primarily expect those with low qualifications to lose jobs, McKinsey advises: There should be a greater shift of workers who are replaced by automated processes into those business processes generating the highest added value and which are too complex to be automated (cf. Ministry of Employment and Economy 2015).

The association The Federation of Finnish Technology Industries argues there is no turning back from digitalisation and that protagonists in society cannot hide from it. Even regulations and bans can no longer preserve old working methods; instead, protagonists holding on to it would lose competitiveness and be harmed.

In this context the association consider the activities of the European Commission, whose spring 2016 communication on the digital single market finally also reflects

how important digitalisation is to the industrial sector, as positive. The association is convinced future growth and new jobs can only be generated through digitalisation of the sector. As the commission also stated, it would be even more important for national states to invest in digitalisation – which is where Finland is currently falling behind, according to the association: Since Finland greatly cut back on public spending on research and development in recent years and private investments were also decreasing, where would be a risk of also having less innovation. Digitalisation and its potentials could therefore pass the country. The association warned associated companies it is alarming if digitalisation and the associated changes are not routinely part of the agenda in meetings at these companies – since this means missing out on shaping the trends. (cf. The Federation of Finnish Technology Industries 2016).

3.1.3 Political and public-private measures

As with many other countries examined, Finland particularly also has initiatives in the area of education and skills related to digitalisation. As mentioned earlier, Finland intends to establish a new curriculum in autumn 2016 to make the use of ICT core content. Among other things, programming would be taught starting in first grade, as the Ministry of Education stated on enquiry. It further launched a public-private partnership: The so-called EduCloud Alliance to promote eLearning applications in schools.

According to a 2015 report by European Schoolnet, an organisation specialised in education, despite the planned new educational content the Ministry of Education does not plan for state organised teacher training. This should therefore be a task for local and regional authorities in the field of education, although the national education council could provide financial support for individual initiatives and projects. Part of the task is also being handled by universities through educator training offerings (cf. Balanskat/Engelhardt 2015).

On enquiry the Ministry of Education provides the following assessment: Of course in addition to the infrastructure, teachers and other educations would also require support – after all, digitalisation in and of itself is of no value but would only be valuable if this takes lessons and skills development to a new level. Support would be available to schools: in establishing new learning environments and platforms, for ICT training for teachers, as well as in designing new teaching and lesson concepts. They could request grants from public funds offered by the Ministry of Education. It does state specific amounts for advanced teacher training, as according to the Ministry of Education a total of 50 million Euro area available for so-called "spearhead" projects for continuing education.

In the 2014 eSkills report, Think Tank Empirica also analysed extracurricular educational initiatives related to digitalisation for the European Commission. In it, Empirica considers Finland among the countries with an already high level of digital literacy and ICT skills but rather modest actions to advance these (cf.

Gareis/Hüsing/Birov et al 2014). According to it, the companies surveyed in 2009 stated they see a gap in skills emerging, e.g. due to a lack of IT workers with specific specialisation or a future need for different skills – and Finland would therefore need to continue working and investing despite the already high standard (cf. Empirica 2014c). However, the countries actions have at least increased between 2009 and 2013; just as other Scandinavian countries, Finland has been trying to specifically train ICT workers for those jobs with the highest demand at the respective time. This shows efforts to address the changed dynamics in the IT sector better than before. Furthermore, the generally skills-based learning system in Finland well as has a positive impact, as it generally promotes developing skills in the digital area for life (cf. Empirica 2014c).

One relevant programme with respect to digitalisation is "Spirit ICT Future", which supports ICT specialist who are now unemployed in the various regions and specifically prepares them for new jobs, benefiting both companies seeking specialists as well as the individuals. Most recently another programme was planned to also address the unemployed with a different background and advances their ICT skills to where they could potentially even work in a high-tech job (cf. Empirica 2014c).

The ICT task force launched by the Ministry of Economic Affairs and Employment in 2012 is further working on several initiatives to strengthen digital skills. It would for example support cooperation between higher educational institutions with the gaming industry to establish more and improved ICT training for workers and to improve technology applications. It will further promote training and research on data integrity and Big Data. Post-docs specialised in ICT employed by SMBs could receive support from the Finnish Funding Agency for Technology and Innovation. Among other things, the investment programme Vigo Accelerator provides young ICT start-ups with the necessary venture capital for the start-up phase: From 2009 to 2013 it provided young ICT and internet companies which could potentially develop modern, digitalised value added concepts with about 60 million Euro (cf. Empirica 2014c).

Whilst the crisis at Nokia resulted in significant problems for former employees, according to the assessment of Think Tank Empirica, this also brought about new opportunities for many: The Nokia Bridge Programme funded by Nokia itself and the European Globalisation Adjustment Fund allowed employees who lost their jobs due to Nokia plant closures, to start their own business. It also allows for continuing education through specific skills training for current requirements in the labour market in the ICT sector. According to Nokia, between 2011 and 2012 it resulted in about 1000 start-ups by former Nokia employees – though it does not evaluate sustainability (cf. Empirica 2014).

Between 2014-2018, the Industrial Internet Business Revolution Programme by Finnish innovation fund Tekes provided 100 million Euro for business projects and cooperations aimed at establishing new business models and work organisations through digitalisation. The projects presented by the fund primarily involve big data

applications, machine networking and custom production using digital applications (cf. Tekes website).

3.2 France

3.2.1 Progress of digitalisation and potential developments

3.2.1.1 Integration of technology and economic effects

France takes 16th place in the Digital Economy and Society Index of the European Commission in 2016 and according to the commission declined compared to the previous year, as it hardly made any progress in connectivity, human resources and public authorities. The commission classifies France as "falling behind", thus placing the country in the group of countries falling behind.

In integrating digital applications in business processes in particular, France performs even worse, only taking 18th place among all EU states. Only 2.7 percent of companies are using RFID chips to network their production or other processes (EU average: 3.8 percent), only twelve percent are using social media (EU average: 18 percent) and only 7.5 percent are using cloud applications. (cf. European Commission 2016a).

In the aforementioned Index on the Aptitude Effect of Information and Communication Technologies (ICT) according to Evangelista/Guerrieri/Meliciani (2014), France has indeed made progress compared to previous years, for example in the rational use of ICT in business processes, job placement or education. By doubling its index rating in the ICT aptitude effect between 2004 and 2008, France outperformed Germany and was in sixth place among all EU countries.

Mobile applications in business processes, also part of a networked economy and working environment, saw rather moderate use among French companies in 2012: At 35 percent of companies mobile devices were used to surf the internet, at 40 percent these were used for e-mail, at 27 percent these were used to access cloud applications or exchange servers from outside the companies (cf. Eurostat 2016a). Even with respect to integrating multifunctional industrial robots, France was not among the leading EU countries in 2014. At 120 industrial robots per 10,000 production employees there in fact were relatively few of these network-capable machines for automated production (cf. International Federation of Robotics 2016).

In 2014 the research group Joint Research Center of the European Commission used data from seven countries - including France - to examine if there were indications of jobs lost due to ICT for the period 2007 and 2010. Researchers examined the manufacturing as well as the service sector for this purpose. They were looking for statistical connections between the ICT components broadband internet connection, the use of mobile devices among employees, as well as online sales in the industry seeing the respective employment trend. After reviewing the changes in wages, capital resources and general profits among the companies, the authors concluded that none of the countries examined showed the factor ICT to have a significant impact

on employment. Although there were isolated variations, according to the authors these could not be considered replacement phenomenons.

However, it further also provides a broader overview of developments in the technical infrastructure and employment in the various sectors. For France it yielded the following data: Contrary to trends in other countries, the broadband coverage in the manufacturing sector decreased from 44.7 to 38.8 percent of employees between 2007 and 2010, and the provision of mobile web-enabled devices on the other hand increased from 24.3 to 37.3 percent of employees, and the percentage of online sales among all sales in turn decreased from 15.4 to 11.5 percent, another unusual trend when comparing the countries. During the same period the average number of employees per company in this sector decreased by seven percent.

In the service sector broadband coverage decreased from 57.3 to 48.1 percent of workers with this type of connection, but 42.4 instead of 27.3 percent of employees had a web-enabled mobile device. Online sales also decreased here, from 7.9 to 6.0 percent of all sales. The average number of employees per company in this sector increased by 27.3 percent (cf. Pantea/Biagi/Sabadash 2014).

With respect to the effects of ICT and employment for the respective specialists had on labour productivity, in a 2014 analysis the European Commission assumed that filling all vacancies in the French ICT sector emerging by 2020 could yield an increase in labour productivity of 0.36 percent in total (cf. Lorenzani/Varga 2014).

In a report on the future of employment by 2022, government political consulting agency France Stratégie, which advises the prime minister, prepared three different scenarios in 2015. These were based on numbers from the national statistical office. In one of the scenarios, the so-called "target scenario", the authors explicitly also include the effects of digitalisation and strong technological progress. This scenario assumes optimal economic conditions, technological innovations due to a massive increase in research investments, creative, digitalised value added concepts and investments in promising business concepts. Based on the use of new technologies and innovations they expect an increase in productivity by one percent per year and a GDP growth of 1.8 percent per year until 2022. The employment rate would then increase by 0.8 percent per year and the unemployment rate drop from just about ten percent in 2016 to seven percent in 2022. The authors of France Stratégie consider an industry's level of internationalisation and technological innovations important for the growth potential of the individual industries, emphasising the education sector as outstanding and particularly effective (cf. Aboubadra / Argouarc'h/ Bessière et al 2015).

3.2.1.2 Education and Skills

When focusing on the population's basic and advanced computer and internet skills France performs just above average in the Digital Economy and Society Index of the EU. 57 percent of the population have basic computer and internet skills (EU average:

55 percent), but IT specialists only make up 3.5 percent of the population, with an EU average of 3.7 percent – and according to the European Commission, most recently France has not made any considerable progress in this area. In contrast, at 2.3 percent there is an above average number of STEM graduates among all 20-29 year olds (EU average: 1.8 percent), which can be advantageous in a technologised working environment. However, according to the European Commission progress here is also stagnant in recent years (cf. European Commission 2016a).

Workers in the manufacturing sector having specific ICT knowledge could be helpful in networked production. At only about 1.8 percent of all workers, France performed below average in 2012 with respect to the percentage of ICT specialists in this sector and further showed little improvement between 2008 and 2012 (cf. Lorenzani/ Varga 2014).

With respect to general computer skills among the entire employable population, on the other hand, France made rather good progress between 2006 and 2014, for example the percentage of persons with moderate to advanced computer skills grew from 57 percent to 69 percent. With respect to internet skills, progress was primarily moderate, the percentage of the employable with this level of internet skills grew from 29 percent to 41 percent between 2007 and 2013, whilst the percentage of the employable with advanced internet skills was practically stagnant (cf. Eurostat 2016d). In 2015, 29 percent of the French employable had no or only little digital skills, so average skills in using a computer and the internet. On an EU average this share is merely 25 percent (cf. Eurostat 2016f).

3.2.1.3 Digitalisation and change in the working environment

According to the government Think Tank France Stratégie, there has been a casualisation of employment since the 80s and even more so since the turn of the millennium due to the increasing use and shortening of limited term employment. In addition, the percentage of persons with multiple parallel jobs has increased. Furthermore, the pressure on workers has increased due to the new organisational structures of labour – such as so-called "lean production" – has increased significantly since the 80s. More workers are subject to several parallel external necessities. Thus more employees than in the past are stating automated machine processes are setting the pace for work. In 2013 about 60 percent of workers stated outside enquiries requiring immediate response to be a determining factor in their work rhythm (1984 this was still less than 30 percent) and over 45 percent of workers specify having to meet specific standards and requirements in their daily output (1984 this was still just about 20 percent). Whilst employees need to manage growing uncertainty and more pressure, since the turn of the millennium the percentage of solo self-employed among the employable population has grown again after being low for years. Their average income situation has therefore declined compared to previous years (cf. Jolly/Prouet 2016). Although this could be the result of numerous reasons, an increase in this type of development is frequently discussed in connection with technological progress and digitalisation.

Developments of more pressure and less security appear negative. In fact, the above necessities in the workplace, such as prompt response to customer enquiries, may in some way also protect many workers against automation. At least this is the belief of France Stratégie experts, who argue it is still quite difficult to have these types of tasks performed by machines (cf. Le Ru 2016). The number of jobs in France with these not easily automated requirements have grown by 33 percent from 1998 to 2013, to 9.1 million total. However, according to experts the occurrence of these types of requirements vary from occupation to occupation. Hence, in surveys 25 percent of French industrial workers and industrial technicians indicate having to strictly adhere to specifications and having practically no leeway. In the service sector it was only 13 percent of employees. France Stratégie considers these percentages of work as automatable – however the Think Tank does not assume that all of these jobs will then be automated in every sense. Changing customer requests and global developments were making this difficult to predict (cf. Le Ru 2016). The economic advisory council for the French government shares this assessment. It primarily considers labourers, office workers, bank employees and salespeople, as well as less creative elite professions such as certain types of physicians or solicitors threatened by digitalisation and learning algorithms. However, digitalisation would not simply drive the working population to unemployment but could also free them from routine tasks and have them perform new tasks which require more interaction with people or individual requests and cannot be automated. In this respect the economic advisory council references the tasks of individual tourist drivers or complex, custom repairs (cf. Colin/ Landier/ Mohnen/ Perrot 2015).

Whether digitalisation would result in a net elimination or creating additional jobs is not yet foreseeable, France Stratégie believes (cf. Jolly/Prouet 2016). In the medium term in its report on "Employment in 2022", which only includes digitalisation as one of many components, the government analysis entity assumes an additional 177,000 jobs per year by 2022 ("central scenario"). The aforementioned technology-driven "target scenario" even predicts 212,000 new jobs per year – though under idealised assumptions with optimal use of new technologies. In the "central scenario" new jobs would primarily be created for those with higher qualifications and in the service sector (94 percent of additional jobs by 2022), the health management, social and education industries could particularly benefit, whilst the construction industry would be stagnant and the public sector and the agricultural sector would decrease (cf. Aboubadra / Argouarc'h/ Bessière et al 2015).

From a purely numbers perspective, newly created jobs in the health-care sector and nursing sector for example would more than compensate for losses in administration, for example among clerks, in the "central scenario", the authors state. These newly created jobs may not necessarily be filled with the same persons or even only persons from the same qualifying group. The authors of France Stratégie expect France to have less intense polarisation of the labour markets than other countries such as the USA. And yet they paint a picture of job profiles drifting apart severely: Clear growth could be expected in jobs for the highly qualified, along with a strong decrease in

workers and skilled workers with average qualifications and growth among occupations for those with little qualification.

The aforementioned "target scenario" also sees more room for coordinating occupations with average qualification requirements, thus would entail an attenuation of the tendency towards polarisation. But even in this scenario, which assumes active utilisation of digital applications and technological innovations, the authors see the higher qualified to have a clear advantage in all business sectors. Demand would be supported by a growing rate of university graduates among the working population and along with this could result in employment soaring (cf. Aboubadra / Argouarc'h/ Bessière et al 2015).

The economic advisory council the government also assumes further polarisation of the labour market. This would primarily leave management or creative jobs for well trained persons and non-routine jobs for the less qualified.

The advisory council refers to a clear U curve which already shows the thinning of average qualifications in France between 1990 and 2012 (cf. Colin/ Landier/ Mohnen/ Perrot 2015). Other studies also refer to the existing trend toward more jobs for the highly qualified on one hand and for persons with only an elementary basic education on the other hand (cf. e.g. Jolly 2015). In specific terms, the percentage of employment with only fundamental education requirements in France increased from just under 8 to 10 percent of all employment between 1993 and 2013. Executives and workers in intermediary positions have been the ones who benefited the most from the developments in the labour market since the 90s, the percentage of these types of jobs grew from about 30 percent to 45 percent total (cf. Jolly 2015). Many jobs for easily automated occupations have already been eliminated or changed according to enquiries. Only about 15 percent of French employees work in these types of routine jobs with repetitive processes and no potential external influences, although experts see this to not only be due to technological changes, but primarily those in work organisation. Despite these developments and despite overall increasing qualifications, however, an increasing number of employees consider their work to be routine: This was stated by 40 percent of employees in 2013, and only 20 percent in 1984 (cf. Le Ru 2016).

In a specific report on polarisation France Stratégie, however, points out that the thesis on technological progress and digitalisation is not the only explanatory pattern for polarisation. Instead, globalisation (by outsourcing jobs to low-wage countries), less ability for social partners to negotiate and deregulation as well as changing into a service society are often listed as the key drivers for polarisation. France is particularly better equipped in terms of social dialogue and deregulation than perhaps the USA, and would therefore be able to prevent overly uncontrolled polarisation.

Even if France Stratégie itself assumes further polarisation tendencies, the authors note there also are other opinions: They refer to the thesis that with expedient co-

evolution of man and machine, new opportunities could arise for average qualification levels. Combining monitoring of automated machine processes with customised service activities, for example, could also revive the labour demand for average qualifications. The exact developments, however, are not be foreseeable, France Stratégie states (cf. Jolly 2015).

In 2015 French labour minister Myriam el Khomri assigned the personnel manager at Orange, Bruno Mettling, was assigned with a report on the effects of digitalisation on the working environment. Mettling involved both employer and employee representatives in creating the report.

The report assumes that in a few years a high percentage of workers will be working on a mobile basis, not at a permanent office workstation. The Mettling report also believes that digitalisation will result in a massive change toward collaborating and cooperating more, which could get companies to break with the previous rigid and hierarchic forms of control and reporting. The authors primarily also expect major changes for managers with respect to occupations and the necessary skills. In order for their work to be just as effective, for example the greatest possible potentials would need to be unleashed among the team, managers would need to work differently: They would need to think even more project-based, hold together a very scattered team of employees and further be even better at being an enabler for employees (cf. Mettling 2015).

3.2.2 Political Discussion

3.2.2.1 Integration of technology and economic effects

In autumn 2015 the economic advisory council for the French government outlined the state and potential future changes to the economy due to digitalisation. In this context it also made proposals on how to support these with regulations (cf. Colin/ Landier/ Mohnen/ Perrot 2015).

By reference to the OECD Digital Economy Outlook 2015 the authors criticised that in France the ICT sector only makes up 4.33 percent of the gross domestic products, with an OECD average of 5.5 percent. In 2014 only 63.6 percent of companies had a website, wit the OECD average already at 76.2 percent – which the authors also assessed critically, just as the circumstance that compared to other countries, France has relatively few ICT specialists among its workforce.

Whilst France altogether does have adequate funds, according to the advisory council, there is a lack of venture capital for business formations. For example, the starting conditions for many small start-ups which could push digitalisation for the French economy are not good.

France is for one lacking institutional investors such as the pension funds in the USA to ensure an efficient investment structure for forming digital start-ups, and on the other hand is lacking an acquisition culture for promising start-ups. This is only being

mitigated by several programmes to support founders which were launched during the crisis.

The infrastructure conditions in France – e.g. broadband access – are actually good, according to the advisory council. However, regulations of the French economy are by no means ready for a digitalised or even internet economy. Start-ups and emerging companies such as BlaBlaCar, Airbnb and "auto écoles 2.0" (online driving schools) are being thwarted by bureaucratic hurdles since they do not fit into any of the existing rigid business categories.

The authors also determined: "In order to prevent and face competition problems in the digital economy it's essential to monitor the costs a company incurs and the allocation of these costs, just like the strategic use of free offers and exclusive contracts with certain contracting parties as well as data transfer contracts. It would be wise for competition regulators to gain additional skills to meet these requirements." (Colin/ Landier/ Mohnen/ Perrot 2015: 8).

In 2014 the French Ministry of Labour assigned the National Council for Digitalisation with discussing several specific problems related to digitalisation. In the report published in early 2016 this committee also provided several economic assessments. It argues, for example, that large, medium-sized and small European companies would need to work together closely for successful digital transformation. Compatible cloud systems, communication and computer programmes for networking various components should therefore take priority and possibly also be subsidised. They advocate e.g. systematic support for research networks and their projects in the automobile, health-care, biotechnology and robotics sectors. The authors also recommend pass and actively promote joint research results from different companies using open data systems to draw new investments. They further recommend for companies to use more resources for scouts and supervisors who could determine new potentials in business procedures as well as suitable talent to implement these.

At the same time patent law and copyright would need to be adapted so as to appropriately regulate the commercial use of open-source and open data options and compensate contributors. There should generally be more structural support for organisers of open-source options, e.g. through European or national investment funds (cf. Conseil National Numérique 2016).

3.2.2.2 Education and Skills

In addition to its recommendations with respect to the economy the National Council for Digitalisation also provided predictions on education during times of digitalisation and the effects on the working environment. Here the pivotal questions were: Which new occupations will emerge from digitalisation, which new skills will be required, what support can be provided for the transformation within companies? And how will automation affect the professional world and working conditions (cf. Conseil National Numérique 2016)? The committee first recommended conducting a systematic

analysis on which skills will be needed in which industries in a digitalised economy. Based on this, new forms of training should then be developed to promote creativity, abstraction and interpretation skills better than before and focus less on selective knowledge.

In addition to such rather general suggestions the report also includes a call for a right to training and continuing education not directly related to the occupation: This would provide employees with an opportunity to develop new skills. This could for example be arranged using a personal education account for each person and recorded in a professional mobility plan. They should furthermore generally make it easier for workers to take leave for improving digital skills, e.g. by introducing "digital practical training" (cf. Conseil National Numérique 2016). The council further argues that such continuing education efforts should be recognised more than before as well as rewarded by employers.

According to the recommendations of the council, employment agencies should also take personal skills as well as aptitudes into account more. The individuals should be given more say in which of the acquired skills they want to emphasise most and which they want to improve in the future. Mentor structures within companies should also be promoted to help new workers becomes acquainted with business processes and learn skills.

To improve early vocational orientation there should further be more interaction between schools and companies, representatives from the professional fields should be invited to events at schools and hold Q & A sessions with pupils to provide the youth with a vivid impression of the vocational world (cf. Conseil National Numérique 2016).

The aforementioned Mettling report, also on behalf of the Ministry of Labour, among other things also addressed topics related to education and skills. The report recommended: In order to prevent a painful structural change with major turning points for the population it would be necessary to structurally incorporate continuing education and special training on the use of digital applications and ICT in the educational system. Both user skills as well as IT skills should also be developed starting in basic school education and then continuously advanced at work and adapted to new developments: To date the use and utilisation levels of many workers are far from adequate, and at many SMBs in particular the skills are below average (cf. Mettling 2015).

Better options for continuing education or reorientation would also need to facilitate transitions between occupations. The vocational training through strategic human resource planning within companies should focus on developing the digital skills of employees just as much as retraining through public providers, and should particularly address the low-qualified.

Motivation to acquire digital skills would not only need to be improved for women but also in general, for example by explicitly including how much effort an employee is putting into skills related to the use of new technologies in the wage structure (cf. Mettling 2015).

The association of trade unions Force Ouvrière believes past (continuing) education efforts have been inadequate: In a 2015 position paper Force Ouvrière references a survey which shows 79 percent of French workers feel the current system does not offer adequate training on the use of new technologies. These options would therefore need to be systematically expanded (cf. Force Ouvrière 2015).

In its aforementioned report on employment in 2022, government analysis institute France Stratégie also demands: In light of the massive decline in employment opportunities to be expected for persons with average qualification it would be necessary to improve vocational training conditions in all sectors and further facilitate entry-level career opportunities at a relatively high qualification level. This could prevent precarious career starts many young people would otherwise be faced with (cf. Aboubadra/ Argouarc'h/ Bessière et al 2015).

3.2.2.3 Digitalisation and change in the working environment

As mentioned above, last year the economic advisory council for the French government predicted a widespread automation development in many industries. In addition, voluntary and free online services such as TripAdvisor, Wikipedia and blogs would at a minimum put pressure on occupations such as travel agents, encyclopedists or journalists. The digital economy would therefore affect the core of society and force it to reform, the advisory council believes.

However, in addition to certain occupations being eliminated, working modes would also change considerably in a digitalised economy: For example, occupations for the low-qualified would rather be offered in form of freelance work, the economic advisory council believes. It again points to drivers for tourist taxis, who are already self-employed drivers. Its assessment: Digitalisation would facilitate coordination between the client and external service providers as solo self-employed and this cooperation would therefore increase. For the workers the advantage would be that they could hold several parallel jobs at once, the advisory council states. However it would be extremely difficult for social security systems or even lending criteria to be completely based on employment, which is no longer appropriate and would need to change. They specifically call for taxes to improve for the solo self-employed compared to the past and to facilitate transitions between different forms of work (cf. Colin/ Landier/ Mohnen/ Perrot 2015), a challenge the National Council for Digitalisation also shares in its aforementioned report (cf. Conseil National Numérique 2016). The digitalisation council further believes that solo self-employed which rely on a principal client to be protected better than in the past. The council generally advocates re-discussing social security and collective representation for the self-employed. Better protecting these workers would also include requiring the providers of commercial platforms for placing

crowdworkers and other contributors to make their revenue and fees system more transparent to contributors to allow these to adjust their requirements if necessary. (cf. Conseil National Numérique 2016).

In its report, the National Council for Digitalisation further addressed the effects of digitalisation on the working environment with a lot of specific questions, which we can only highlight here**.** Among other things it addressed which place and role human labour could hold in tomorrow's society, whether digitalisation will result in worker emancipation or subordination, whether it segregates and polarises labour markets, how to handle platform work, and to which extent to disconnect income and social security from a person's employment status.

The members of the council criticised the scenarios from some of the studies which they believe are alarmist and difficult to substantiate, such as the popular Oxford study of Frey/Osborne, which assumes a wide-scale elimination of jobs. The authors emphasise newly created jobs also need to be included and cite a study by McKinsey, according to which in the medium term 1.5 million jobs in France could be based on digitalisation (cf. Conseil National Numérique 2016).

Nevertheless the authors do believe the working environment will change substantially as crowdworking increases and decentralised production structures, as already seen now in the so-called maker movement. They therefore feel the need for politicians as well as the actual companies to actively support the changes and make a number of recommendations.

For example, the council quite generally recommends gearing high-tech everyday work at companies more towards people again. With respect to advancing automation strategies should be developed which assume the complementarity and co-evolution between humans and machine, not replacing people with machines. An international cooperation with countries such as e.g. Germany would be wise to develop appropriate concepts (cf. Conseil National Numérique 2016). Whilst the National council is rather open minded about this aspect and advocates active creation, unions such as Force Ouvrière (FO) warn that people could easily be degraded to a servant of technology. The unionists call not to create new forms of contract or employment for the man-machine interaction to prevent degrading people in this system and to maintain securities for workers. FO also stresses that people in fully automated fully automated processes in some cases merely managing emergencies is not a trivial matter. Just as possibilities for full control due to networked machines, this would impose psychological stress. FO demands for politics to set tight limits for employers on how much they are allowed to monitor employees with the available technologies – this cannot be handled by the court on a case by case basis (cf. Force Ouvrière 2015).

The National Council for Digitalisation also wants to see a focus on the human factor by for example including criteria such as the average employee health being included

in the assessment of the performance of management. The commitment of individual employees in relaying knowledge and skills to colleagues "on the job" should also explicitly be rewarded to promote cooperation between employees (cf. Conseil National Numérique 2016).

Workers should further be granted extended leave or working part-time for periods for the purpose of research, continuing education, social commitments, to work in commons or form a business to allow for professional advancement and adjust to new challenges.

The National Council for Digitalisation further sees the need to adapt employment agencies, which should adjust to the changed employment and contract forms at companies and to use data evaluations and digital simulations to reflect the labour demand in specific sectors more precisely. There should further also be platforms where workers can simulate how a change in their work status will affect their income and their coverage (cf. Conseil National Numérique 2016).

With respect to the companies' increasing need for flexibilisation, the council recommends promoting contracts for so-called "travail en temps partagé", which have existed in France since 2005. These allow a worker to simultaneously work for several companies or institutions through a contract with a group of employers – and is paid through the group. For one, this form gives companies more flexibility, as they can request workers temporarily; on the other it gives workers a certain level of security, as their utilisation is flexible but have a secured income. So farm this form is used by few companies and workers, but the National Council for Digitalisation obviously believes it to be a trend-setting model (cf. Conseil National Numérique 2016).

The authors believe new digital media could also revive social dialogue, as they for example bring collective online consultations prior to collective bargaining into play to better involve the working population. New organisational structures for employees – such as through the German platform "FairCrowdWork Watch" by IG Metall – and new organisational levels – such as project-related – would also be conceivable. At the same time changes due to digitalisation would explicitly be made regarding the content of collective bargaining between social partners, for example balancing work and free time during times of telecommuting and crowdworking.

In addition to all these initiatives it would also be necessary to consider serving those who despite all adjustments are no longer able to work. The members of the council demand adding more data and reliable information to discussions on alternative forms of financing such as unconditional basic income. A feasibility study should first be conducted on this with a detailed analysis of the economic effects, potential labour displacement and the supply of labour when introducing a basic income. The authors also suggest launching government-backed basic income pilot projects in individual regions to collect practical experience (cf. Conseil National Numérique 2016).

With respect to the technological changes, the union Confédération française démocratique du travail (CFDT) stresses that these could only be utilised optimally if the employees could make a conscientious decision on digitalisation and the use of digital applications. There would still need to be the option to also decide against the use of modern technology in some situations. Furthermore, so the position of the union, the technology used in the workplace would need to be developed with much greater involvement so the workers will then also be able to use these optimally. The union Force Ouvrière (FO) demands new regulations to limit availability and to set boundaries between work and family time. FO also stresses that digitalisation should not result in massive crowdsourcing of work with every contractor being responsible for himself (cf. Degryse 2016). Bruno Mettling was not quite as critical in this point in his 2015 report for the Ministry of Labour. However, he also warned: One should already contemplate now, how to better incorporate crowdworking as well as voluntary work in economic and social processes than in the past without unlegislated areas arising to the detriment of workers or other companies (cf. Mettling 2015).

FO even fears more flexible and decentralised "normal" employment to hold disadvantages for the working population. Although it does recognise advantages for employees in these forms of work, it also refers to studies which state that telecommuters have to manage higher workloads and increasingly also having to work at night and on weekends. There further are problems in separating the private life from work, all the way to working "always and everywhere" (cf. Force Ouvrière 2015). Telecommuting would therefore need to remain voluntary and despite employees being able to work without location and time constraints, there would also need to be guarantees that this employment is also equivalent to all other employees. There would further need to be safe zones without digital availability, with FO touching on the right to digital disconnection (cf. Force Ouvrière 2015).

In light of the changes in the working environment to be expected, the French advisory council for economic, social and environmental issues, which advises parliament and the government, suggests there should be standards and general conditions beyond individual provisions with respect to companies commissioning so-called migrant workers. Politicians should further arrange a big dialogue on Industry 4.0 between various stakeholders, the advisory council demanded last year (cf. Kotlicki 2015).

In the aforementioned report for the Ministry of Labour, Bruno Mettling and his team target the assessment of working hours and workloads and recommend modifying these for digital jobs. With uncharacteristic and increasing contractual relationships and employment or work modes one can no longer only use fixed working hours in calculations. Instead, the workload also needs to be included (cf. Mettling 2015). The Mettling report demands adding a disconnection "duty" to the right to disconnection, which includes that workers at all hierarchy levels learn to use media more deliberately – and companies should offer trainings on this.

In addition to the effects mobile and decentralised forms of work have on the work-life balance, deliberations on occupational health and safety should also include the risks of isolated ways of working according to Mettling. In order to prevent or minimise feeling isolated, employees should further be informed of decisions and included in the voting process outside of the core company. Including telecommuters or mobile workers would also include protecting them against accidents at work. The team around Bruno Mettling further calls for using the planned personal activity account (more on this in the next section) to equip each worker with a certain base of rights based on his social contributions which they would then not lose when switching between forms of employment (cf. Mettling 2015).

3.2.3 Political and public-private measures

In spring 2015 French president François Hollande announced that in early 2017 a so-called personal activity account (compte personnel d'activité, CPA) would be launched for every French citizen age 16 years and up. This account is intended to prevent breaches in the rights of the employable, for example when changing from being employed to solo self-employment or other forms of employment. The account is intended to take new, less steady employment, which is increasingly being seen. The account is not a response explicitly related to digitalisation, but is specified as a key instrument in most discussions on the digitalisation of the working environment. It is in fact intended to address several problems which are frequently raised in line with digitalisation. A paper by France Stratégie on the objectives of the account states: "Protection for all workers, whether in precarious or stable employment, self-employed, employed or civil servants, in small or large companies." (France Stratégie 2016: 2) The employable can thus collect points in their account – for example through work activity, and government institutions can award points. The points can be used for e.g. educational activities, financial assistance for business formations or leave for family obligations or social commitments. The points will not be lost if a person's employment status changes, so persons will still be able to have access to benefits such as maternity leave during less stable periods of employment. Authorities can use the points system to also provide the deprived with training or continuing education or offer other types of self-help.

Simulations in the online profile under their account will further provide workers with the ability to calculate their rights and coverage by employment form (cf. France Stratégie 2016). The National Council for Digitalisation recommends to also involve partners from social dialogue in designing the account functions to both protect the interests of the employees as well as practicability in a company's daily routine (cf. Conseil National Numérique 2016).

Even prior to the personal activity account, in 2015 the personal education account and the personal account to prevent occupational hazards entered into force, both of which are also specified in the discussion on changes in the digitalised working environment. Employees can use the latter to collect points for exposure to hazards throughout their working life and then use these for specific qualification for less

hazardous positions within the company, for shorter working hours, or for early retirement (cf. Compte Prévention Pénebilité website). In addition to employees and trainees, the education account also allows the unemployed to use points collected for continuing education or for their professional future. Although the points are not lost when switching occupations, they are not available to solo self-employed, civil servants or entrepreneurs (cf. Mon compte formation website).

On enquiry the Ministry of Labour points out the Mettling report and the report of the National Council for Digitalisation reflect the current state of political discussions – therefore there do not appear to be regulations other than those specified or suggested in these.

In addition to these planned measures France, as other countries, has yet primarily responded to digitalisation in the area of building skills. One of the results of these efforts: As of September 2016 programming will be implemented in primary schools and secondary education at public schools – thus far there are only optional courses at the secondary education level and in specific school tech ed groups. More specifically, upper secondary education level grades will have a subject named Exploring Computer Sciences and Digital Work (enseignement d'exploration d'informatique et de création numérique). However, according to a European Schoolnet report, teachers are not provided with training to master these new challenges directly through the Ministry of Education. Although the ministry does set up the continuing education agendas and requirements, regional and local universities, NGOs and educational institutions in turn will need to organise training at large, the authors found (cf. Balanskat/Engelhardt 2015).

According to a 2013 report by Think Tank Empirica, an elective named "Digitalisation Sciences" was already added to sixth form curriculums several years ago – which introduces pupils to the fundamentals of ICT and particularly user skills, which the report states about 1500 teachers were specifically trained for.

Since spring 2015 the Ministry of Education has been monitoring the "Digital Curriculum" launched by the president, which has a budget of one billion Euro over three years. In July last year the ministry announced in this context that 500 schools of all types, i.e. 70,000 pupils and 8000 teachers will be connected to the digital infrastructure to allow for new teaching and learning methods (cf. Vallaud-Belkacem 2015). The ministry stated teachers are receiving special training for this purpose – however we were unable to obtain information on the status of this training.

In its 2014 report for the European Commission, Think Tank Empirica placed France in the group of countries with relatively advanced skills in the use of digital applications and moderate to high rates of activity for advancing these (cf. Gareis/Hüsing/Birov et al 2014). Overall, it rates France at the lower end of countries with both strong competence initiatives as well as overall being ready for digitalisation. France's 2013 agenda for digital skills did show relatively strong political initiative, the authors stated

at the time. However, prior to that, it had taken quite some time to even develop a concept in response to the EU's 2007 eSkills agenda (cf. Gareis/Hüsing/Birov et al 2014).

The so-called Internet Usages Delegation (DUI) formed in 2003 has launched many initiatives primarily aimed at more digital literacy and reducing digital exclusion in France (cf. Empirica 2014b).

The DUI for example built over 5000 public internet locations where users were not only able to access the internet and use media, but also take IT and media literacy tests. The DUI trained the personnel at these locations for this, and in 2013 there were about 2000 of these so-called "Jobs for the Future". The DUI's so-called "Ordi 2.0" programme further provided socially disadvantaged persons with access to computers and other infrastructure to participate in digital life – by organising repairs and distribution of used computers (cf. Empirica 2014b). On enquiry the responsible French Finance Ministry stated that according to a 2012 evaluation, the Ordi 2.0 programme was providing about 100,000 scrapped and refurbished computers for needy individuals. About 100 companies were involved in repairing the computers. According to surveys of the Finance Ministry, participating companies are assuming that 300 to 500 computers processed per year equal one full time job.

In September 2016 the successor programme Ordi 3.0 will be set up to further expand Ordi 2.0 activities, the Finance Ministry states.

The "Portal of Internet Jobs" on the other hand can be considered an initiative for ICT specialists. Coverage, however, appears limited: On enquiry, the French Finance Ministry writes that 22,000 persons per month visited the portal from July 2015 to June 2016. The budget for 2015 was 20,000 Euro and thus far has been 6500 Euro for 2016. The specific benefit in placing jobs has not yet been evaluated.

In 2013 the Ministry of Education in line with the EU Grand Coalition for Digital Jobs wanted to create an action plan for how to draw more young people to ICT degree programmes and jobs. In 2013 there further was to be an agreement between companies and the Ministry of Labour on ICT training for the employed or those entering the workforce – both measures combined were to prepare 3000 persons per year for digital jobs. On enquiry with the ministries we were unable to determine progress. Beyond these relatively new plans, there already are the B2i training and certification programme for youth and C2i for adults, which teach digital skills. According to Empirica (2014b), the national agency for vocational training further offers various training programmes ranging up to a master's degree and actual professional qualification programmes for IT specialists.

In 2013, Think Tank Empirica criticised the educational system is still not paying enough attention on more specific skills for using computers and the internet, and that the system is also too tailored to marks in specific subjects in place of more comprehensive skills. In light of the high unemployment rate in France in 2013 the

authors remark it would probably take far more efforts to prepare workers for the job requirements demanded in the market and to place them in ICT-related occupations.

The so-called Grand École du Numérique is committed to primarily introduce uneducated and low-qualified persons to ICT jobs. This is not an actual physical educational institution but rather a construct to support educational institutions and companies in educational projects and initiatives: 170 so-called "digital plants", so Grande École certified educational institutions in various regions throughout the country, are to teach skills for the future digitalised labour market: These are particularly intended to reach uneducated persons with few ties to the labour market and prepare these for future job market requirements. The goal is to reach at least 30 percent of females and 50 percent of youths with low qualifications who are unemployed (cf. Grande École du Numérique 2016).

The Grande École is to provide financial support for the individual institutions, for which according to the Ministry of Economy five million Euro was provided for training during the first half of 2016, and in autumn there will be a new call for tenders with a volume of ten million Euro for ICT training. So according to the Ministry of Economy about 10,000 persons who are uneducated and removed from the labour market will be trained in ICT by the end of 2017 to improve their employment outlook. On the other hand the Grande École du Numérique will also provide know-how and link up the individual protagonists, the Ministry of Economy states.

To specifically prepare French industrial companies for increased networking and more modern business models, the French president launched the Alliance for the Industry of the Future in 2015. The alliance consists of industry representatives, scientists and worker representatives. It is intended to for one push pilot projects, as well as design a general concept for the entire economy to meet the following requirements: Developing work processes and form of work using both state of the art technologies as well as the unlock and promote the specific potentials of people working in production. In addition to technology development and pilot operation of network plants, one of the six action angles of the alliance is therefore also "Humans and Industry of the Future", and the alliance stresses that measures to build skills are key. The goal of the association is to reach 2000 SMBs with its expertise and education programmes by 2017, and according to the association in early 2016 it had reached 1200 of these types of companies. The website "Osez l'industrie du futur" and events are intended to address young people and enthuse these for jobs in the industry of the future. Further results, e.g. on workers, the role people play in the industry of the future, are not yet available (cf. Alliance Industrie de Futur website).

3.3 Great Britain

3.3.1 Progress of digitalisation and potential developments

3.3.1.1 Integration of technology and economic effects

Since Great Britain has recently made little progress than other countries in some key aspects for digitalisation other countries, in its 2016 Digital Economy and Society Index of the European Commission considered the country a "declining pioneer". The commission considers British companies rather weak with respect to integrating new technology applications, only 1.6 percent of companies use RFID chips to network components (27th place) and only 17 percent systematically use electronic data transmission, furthermore only 9 percent of SMBs sell internationally online (12th place). Great Britain is on the other hand scoring well in social media use (3rd place) and domestic online sales (7th place) (cf. European Commission 2016a).

The Index on the Aptitude Effect of Information and Communication Technologies (ICT) according to Evangelista/Guerrieri/ Meliciani (2014) rates Great Britain rather average, the role of ICT in advancing business processes, job placement or education, however, grew considerably between 2004 and 2008.

Great Britain is showing rather high figures in companies using mobile applications, in 2012 at 49 percent of companies employees used mobile devices to access the internet, at 54 percent they used mobile e-mail, 35 percent used mobile exchange services and 23 percent used specific job-related online applications outside company buildings (cf. Eurostat 2016a).

The use of industrial robots, however, is not very relevant in British production, in 2014 80 multifunctional industrial robots per 10,000 production employees, which corresponds to the worldwide average and is just about a fourth of the respective number of robots in Germany (cf. International Federation of Robotics 2016).

According to an analysis of the Joint Research Center of the European Commission, the broadband coverage in the manufacturing sector increased from 39.9 to 50.1 percent of employees in Great Britain between 2007 and 2010, the provision of mobile web-enabled devices grew from 30.1 to 45.4 percent of employees and the percentage of online sales among all sales increased from 9.3 to 23.6 percent. In the service sector, broadband coverage grew from 50.5 to 60.3 percent of employees with this type of connection, 56.4 instead of 42.3 percent of employees had a web-enabled mobile device and online sales grew from 7 to 11.4 percent. In both sectors the average number of employees per company grew considerably parallel to this increased use of technology – however the authors did not determine a significant correlation between ICT and the employment trend for Great Britain or other countries (cf. Pantea/Biagi/Sabadash 2014).

With respect to the increased use of ICT and the growth of associated jobs, in a 2014 analysis the European Commission assumed that filling all vacancies arising by 2020 in Great Britain's ICT sector could yield a total increase in labour productivity of 0.357

percent (cf. Lorenzani/Varga 2014). In late 2015 the Ministry for Business, Innovation and Skills responsible for digitalisation assumed the economic output in Great Britain could be increased by 145 billion pounds per year through the integration of digital technologies, e.g. a high level of online purchases among the population. If the digital single market planned by the EU is fully functional, it could even increase leverage in the coming years (cf. Vaizey 2015).

3.3.1.2 Education and Skills

Great Britain is performing well in the European Commission's Digital Economy and Society Index dimension on human capital, taking third place among all EU countries. Based on this, Great Britain has advanced basic digital skills among the population and a relatively high percentage of ICT specialists among all workers. The specific data: 90 percent of the population regularly uses the internet (EU-28: 76 percent), the commission credits 67 percent of the population as having basic digital skills (EU-28: 55 percent) and 4.9 percent of the working population are ICT specialists (EU-28: 3.7 percent). The percentage of graduates in natural sciences among 20-29 year olds is also above average. However, building new skills will not suffice to cover the economy's need for ICT specialists, the commission states. Furthermore the percentage of the respective graduates at universities are still low compared to the 2000s, as it is only 60 percent of the 2003 share. The commission is playing at that in the middle of the first decade of the 2000s, Great Britain had experienced a break and had since been fighting against the decreasing interest among young people in courses focused on technology (cf. European Commission 2016a).

In an analysis of British digital skills, Think Tank Empirica noted an already large gap between the demand for ICT specialists in the labour market and graduates and will probably grow in the coming years. However, primarily software developers and managers in ICT professions are needed – which is where the gap is primarily due to poor matching within the industry. After all, primarily the experienced are being hired here, not university graduates. Here, Empirica experts see the problems companies are experiencing in adequately staffing jobs to stem from within the industry (cf. Empirica 2014d).

With respect to the percentage of ICT specialists among workers in the manufacturing industry, after reaching 2.5 percent in 2008, Great Britain even reached 4.1 percent in 2012, a substantial growth (cf. Lorenzani/Varga 2014). With respect to general computer skills among the employable population on the other hand, Great Britain hardly made any progress between 2006 and 2014, as the percentage of the employable with advanced computer skills grew minimally from 33 to 38 percent, whilst those with average skills remained at 31 percent. With respect to internet skills the percentage of the employable population with average skills grew from 25 to 48 percent between 2007 and 2013, data on the percentage of the employable with advanced skills is only available for the period between 2011 (16 percent) and 2013 (18 percent) (cf. Eurostat 2016d). According to Eurostat, the percentage of the employable with no or hardly any digital skills in 2015 was 22 percent, just under the

EU average of 25 percent (cf. Eurostat 2016f). In the 2012 OECD Survey of Adult Skills Great Britain does relatively well in an EU comparison in the analysis of problem solving skills of persons in technology-based environments: About 40 percent of subjects rank among the two best aptitude levels, whilst about 13 percent of persons have no or very little problem solving skills with respect to using computers and IT (cf. OECD Publishing 2014).

3.3.1.3 Digitalisation and change in the working environment

At a Trades Union Congress (TUC) event in late 2015 chief economist for the Bank of England, Andrew Haldane, drew a picture of technological change which this time is changing the working environment faster than ever before and may increase social imbalances: This time machines may not only replace manual but also mental work for workers (cf. Haldane 2015).

Haldane stressed that in addition to all the jobs created in recent years, several problematic developments have also occurred on the labour market: There is more uncertainty, as at 6.4 percent the share of workers with limited term employment contracts is higher than before and since 15 percent of workers are self-employed instead of the twelve percent in 2005. Although these developments provide several options for flexibilisation for some companies, this uncertainty is very stressful for many workers. Add to this that wages are not yet back at the previous levels and that for example the earnings of 5.8 million workers is below the breadline – 700,000 more than 2013. Whilst employment has increased, the percentage of secure and well paid jobs has decreased**.** Haldane explains the polarisation of the labour market in Great Britain due to new technologies has already increased substantially in recent years, although new jobs have primarily been created for the highly qualified and at a slightly lesser degree also for the low-qualified, whilst workers with average qualifications have been replaced. At the same time part of the workers replaced have achieved better qualifications and have advanced, many have also declined and are working beneath their actual qualification levels – and potentials have been lost. In this context it's also concerning that recently the higher qualified have been enjoying wage increases whilst the low-qualified have seen little improvement. Furthermore, the gap between income from investments and from wages is also increasing – which tends to result in increased income disparities.

All this would is further being expedited by technological progress (cf. Haldane 2015).

The Bank of England, created its own study on the future of work in Great Britain based on the methodology in the Oxford study of Michael Osborne and Carl Benedikt Frey, which is highly disputed in science. It distinguishes between occupations with high, average and little probability for automation. According to this, 37 percent of jobs in Great Britain have a low probability for becoming automated, 28 percent moderate, and a whole 35 percent a high probability of becoming automated. Of these, machine operators and factory workers, salespeople as well as higher qualified retail employees as well as – particularly – secretaries and administrators would be affected

the most. Overall, 15 million jobs in Great Britain would be in jeopardy due to automation, prompting Haldane to warn the erosion process in the labour market could challenge their entire functionality (cf. Haldane 2015).

A while back, the Ministry of Business, Innovation and Skills commissioned the Government Office for Science to project the future of the manufacturing industry in 2050. In the report issued in 2013 the office assumes that workers will be facing new challenges in practically all business sectors: Manager qualities would also become more important for the less qualified in the flight and transport sector as well as the plastics and electronics industry or biotechnology, and would also increasingly need to be combined with technical know-how (cf. Foresight 2013).

Production would no longer take place in central locations as in the past, but there would instead be various forms. The spectrum could range from "super factories" with extremely sophisticated manufacturing structures, to mobile manufacturing units in the areas along the value added chain where they're needed, all the way to micro-units in single producers or even the customers at home. Big data applications and science-based algorithms could handle many tasks for people and would also take the volume of information and data involved in a production process to a new level. On one hand this would enable understanding customer preference much better than before – on the other hand people in these production systems would be faced with completely different tasks. The authors of the government's scientific service believe in the future there will be much less need for cleaning staff, healthcare providers as well as surgery staff, as well as manufacturing staff with routine tasks. In the manufacturing sector specifically, the authors do see an additional decrease in jobs – about six million jobs have already been eliminated between 1966 and 2011 – although more moderately: They anticipate an additional 170,000 jobs to be lost by 2020 compared to 2010. At the same time, about 800,000 jobs would become open for those entering the workforce due to retirements and other exits, opening up new opportunities (cf. Foresight 2013). Other observers assume that routine tasks in production will vastly be eliminated and replaced with more analysis work, jobs requiring more interaction or monitoring capacities and problem solving skills (cf. UK Commission for Employment and Skills 2014).

The Government Office for Science particularly sees good opportunities in the manufacturing sector for the higher qualified: "For 2020, 80,000 new jobs will be created for managers, qualified specialists and technicians in the manufacturing sector. Many jobs in the manufacturing sector will require an academic degree, additional vocational training and qualifications in natural sciences." (Foresight 2013: 174) The others believe developed countries such as Great Britain with a well-equipped educational system will have an advantage over other international competitors with respect to new technological developments.

In its latest ten-year prognosis, the employer influenced British Commission for Employment and Skills, which also includes worker representatives, assumes a

growth of 1.8 million additional jobs by 2024 (Basis: 2014). Technological developments are only one of several components this prognosis accounts for. The need for replacement should create twelve to 13 million additional vacancies over time. The commission concludes that in the medium term, job opportunities will even remain in fields with a less promising future. The commission assumes that none of the occupational fields examined will have less jobs requiring replacements by 2024 than eliminated by technological change and other factors. And yet there will be winner and losers: Civil service, healthcare and educational professions would lose due to reduced government spending, whilst administrative officers with average qualification, commercial employees and machine operators or factory workers and their skills will be in less demand (cf. UK Commission for Employment and Skills 2016). On the other hand the commission expects new jobs due to new technical application options, e.g. for highly qualified data analysts. Many occupations could further be relieved of routine and dull elements. Instead, a new focus on interpersonal skills could emerge – for example a change from a purely medical diagnosis to hospital staff being more empathetic toward patients (cf. UK Commission for Employment and Skills 2014).

Less qualified workers could still fall by the wayside in this development. The commission is basing this less on a polarisation of the labour markets but rather a substantial growth in jobs for highly qualified workers such as managers and qualified technical specialists, to the detriment of the other two qualification groups. However, the number of these new jobs for the highly qualified created should be the same as the growth in the employable in this qualifying group. This may in part result in people being unemployed despite better training. On the other hand the qualification level in fields of work with previous low qualification requirements and a good education could become a requirement for entering this field. And yet the commission assumes that jobs for the low-qualified, e.g. in the food service industry, will still exist, as these are difficult to automate (cf. UK Commission for Employment and Skills 2016).

In a working environment which is increasingly shaped by technology, cross-activity and interdisciplinary skills would become more important, the commission states in another report in 2014. Chances for qualified scientific specialists such as engineers and primarily specialists at the interface between natural sciences and management would be good, as they would be able to turn technical innovations into specific applications benefiting business.

One of the key messages of the commission: Those who do not want to learn for life in the future will be left behind. More independence and autonomous decision-making would be important – both in daily work as well as in continuing education (cf. UK Commission for Employment and Skills 2014).

In their report the commission also outlined various scenarios, two of which we intend to describe in more detail here, which assume a highly technology-driven working

environment: the so-called "skills activism scenario" and the so-called scenario of "innovative adaptation" (cf. UK Commission for Employment and Skills 2014).

In the first scenario the authors assume that extensive automation will also eliminate many jobs for university graduates and government and employers recognise the need to redirect through requalification. IT skills as well as programming specifically, would be added as a basic skill in school and in vocational training for many different occupational fields to prepare workers. Based on promoting skills publicly and privately, this scenario yields a project-based economy where employers will also be offering specific training and continuing education due to a shortage of specialists in certain areas. In this scenario, in addition to skill building initiatives the government responds with strict regulations to limit the power of employers over workers (cf. UK Commission for Employment and Skills 2014).

In the "innovative adaptation" scenario the commission assumes that although the economy will be weak in the years before 2030, however investments in new ICT applications will yield gains in efficiency which will help companies during difficult times. There will be more mobile, web-based and project-based work which will also be utilised by larger companies reducing their permanent staff to a minimum. They will increasingly use project or short-term contracts and divide jobs into mini assignments split among several employees. In this scenario this results in permanent uncertainty among workers with various skills certificates who would then need to work for several parallel employers. At the same time the government invests in continuing education initiatives, online course options will increase, independent continuing education will become easier. For many workers among the lower qualification levels these become the only option to adapt to new labour market demands in this scenario, whilst continuing education options with personal support will be reserved to higher-income earners. Data analysis skills and using new technologies on a routine basis will gain importance in almost all industries, e.g. in the building sector in form of home automation, which will require even the low-qualified to have a certain level of knowledge to install these in building (cf. UK Commission for Employment and Skills 2014).

3.3.2 Political Discussion

3.3.2.1 Integration of technology and economic effects

In the 2013 Information Economy Strategy the government stresses the economy will experience substantial changes due to technological progress. In the document it assumes that in several years the markets will be ruled by companies which are yet entirely unknown or have not even been founded yet (cf. HM Government 2013). This is not an area to simply sit back and wait for change to come. Instead it is up to politicians, science and the economy to shape the change and technological innovations and prepare for their implications. Here it can be expected that ICT will penetrate all business areas and shape these instead of only being a separate individual sector. Without the right physical and virtual infrastructure it would be

difficult for companies to continue to advance and remain successful in international competition. In order to create these infrastructure the government plans for 98 percent of the country to have broadband coverage by 2017 to ensure businesses and customers everywhere will have a fast internet connection (cf. HM Government 2013). So far, the Ministry for Business, Innovations and Skills stated in 2015, this is on schedule (cf. Vaizey 2015). Parallel to this, work at national research institutions to develop the next generation network (5G) is being pushed ahead (cf. HM Government 2013).

It's essential to improve nationwide skills and options in terms of cyber security for customers and companies to develop the necessary trust in new technologies to use these optimally. The government would also need to respond to potential cases of market failure. It's important for British companies to actively utilise opportunities, including international online sales, and for Great Britain to pit its excellence in the ICT sector to increase exports and open up new markets. SMBs in particular are to receive support in setting up the necessary concepts, as in 2013 only about a third was selling online. This is to change and by 2018 about 1.6 million SMBs are to be reached with related measures. At the time the Information Economy Council, which includes politics, economy and science, was formed to coordinate this work with SMBs (cf. HM Government 2013).

Future economic growth could particularly be promoted through the increased use of data analyses, the government states. Great Britain would need to take on an international leading role in exploiting data and become a pioneer in handling large data volumes, which is only possible by investing more in high-performance computer and servers. The to date good position of national universities in working with algorithms would need to be strengthened. Public bodies would further need to work on making data more transparent and easier to access (cf. HM Government 2013).

In its digital strategy for 2015 to 2018 the British government states it intends to support small and medium-sized companies with setting up data systems and starting in platform business. However, it is not very specific about the measures (cf. Innovate UK 2015).

Ed Vaizey, as the Minister for Business, Innovation and Skills in the British cabinet until the switch in July 2016 also responsible for digital economy, stressed in late 2015: The British government also has its hand in British companies being able to get started in new business sectors. After all, the government had most recently provided public access to about 20,000 data sources which e.g. small credit card companies can now based their products on. For early 2016 Vaizey at the time announced a new digital strategy for the country (cf. Vaizey 2015). However, this was delayed by the Brexit referendum and still had not been published in summer after Vaizeys was replaced (cf. The Register 2016b).

The Government Office for Science sees a great opportunity for British companies, particularly in the future increase in the willingness of consumers to pay more for custom products. After all the domestic companies are well equipped with respect to qualitatively individualised work (cf. Foresight 2013).

However, the authors recommend for the government to increase assistance for technological advances. The so-called UK's High Value Manufacturing (HVM) Catapult Centre – a competence cluster in the technology sector – would particularly need to be included more.

The authors expect the new technologies to also draw some business sectors back to Great Britain, which could create jobs – if the government and local politicians help create good set-up conditions for new industrial structures and for example also encourage foreign investments (cf. Foresight 2013).

The labour organisation Unite the Union was less optimistic about this last year. In a position paper on digitalisation it wrote more investments to build a competitive ICT economy in Great Britain would be required, both in innovative ideas as well as building skills. This would be the only way to maintain a successful industry and for workers from other industries who could lose their jobs due to digitalisation to also be provided a new outlook. Although the organisation welcomes the growth programmes the government has planned for the sector – however criticises that worker representatives are not being involved in designing it, which could cause problems (cf. Unite's Charter for Workers in UK Information Technology and Communications Industries 2015).

3.3.2.2 Education and Skills

The British government already published the so-called Digital Britain Final Report in 2009. It raises the key questions on how the population's skills can be adapted to the requirements of the future digital working environment. In the 2013 strategy on information economy the government then states: Long-term success is only possible with a digitally skilled workforce which would need to supply both ICT specialists to develop, as well as competent users for optimal use of new technologies (cf. HM Government 2013). In 2014 the strategy on digital skills was published by the Information Economy Council which was based on this. The key points from the strategy of the committee with representatives from politics, science and economy: Optimal conditions should be created to develop young talent in the ICT sector, which should particularly also include more women. School curriculums should be adapted to this and teachers provided with separate support, and there should further be industry-financed training and retraining programmes.

More special training programmes for university graduates in ICT degree programmes would accelerate transitioning into suitable jobs. The status quo at the time was obviously quite different: According to the Information Economy Council, 16 percent of ICT university students were unable to find unemployment in the first six months

after graduating, whilst the percentage in all industries for university graduates was only nine percent according to this. The strategy stresses it would be necessary to particularly develop skills in the areas of cyber security, big data and the Internet of Things (cf. Information Economy Council 2014).

The employer-led commission for employment and skills also recommends developing skills based on their employment projections. With respect to companies it calls for much greater commitment to developing the skills of employees and potential future employees than in the past. However, the individual workers would also need to do more and approach work differently: They would need to be willing to work more location-independent, more network-oriented, more project-based and more independently, that each individual would need to continuously review their qualifications. Employees would need to determine for themselves which additional qualifications they need and how to study further. Workers should furthermore be generally open to new training options such as online courses. They would continuously need to polish up their technological knowledge as well as other important skills such as communication skills. The commission called for politicians to provide incentives for private funds to flow into training skills (cf. UK Commission for Employment and Skills 2014) – a demand the Government Office for Science shares (cf. Foresight 2013). The government should further allow companies more influence on educational opportunities and shape them more based on demand. Administration would also need to provide individuals with better information on professional requirements in specific industries and also provide them with more opportunities for personal continuing education, the Commission for Employment and Skills states (cf. UK Commission for Employment and Skills 2014).

The Government Office for Science urges: In order to build and expand the advantages of British workers over workers in other countries there would need to be more incentives for young people to enter into qualified occupations in the industry and start training in the STEM sector. This would explicitly also need to promote managerial positions in future production systems (cf. Foresight 2013).

Unite the Union points out the British workforce shows considerable gaps and deficits in the areas of project management, system development, advanced Java and SAP programming skills, and in cloud and mobile applications. Unless the politics takes countermeasures, jobs which will be created in the future cannot be filled whilst others will be eliminated and people could therefore become unemployed.

(cf. Unite's Charter for Workers in UK Information Technology and Communications Industries 2015).

3.3.2.3 Digitalisation and change in the working environment

In a current analysis the European Trade Unions Institute remarked that the British government's strategy on digital economy for 2015 to 2018 hardly addresses matters related to employment in the digitalised working environment or the necessary

changes (cf. Degryse 2016). The strategy in fact primarily focuses on potential business use, consumer protection and eGovernment. In the strategy the government only rather briefly touches on the aspects of education and digital inclusion. It states new technologies could create gaps in skills and with the increasing importance of digital applications those population groups without access to or knowledge of it would be excluded more and more. This would need to be considered and reduced (cf. Innovate UK 2015).

Whilst the strategy hardly addresses questions related to general labour regulations, Britain's trade union federation TUC obviously even fears cost savings considerations could even be behind the government's plans to increase eGovernment services. Which would not only be problematic in terms of workers. Minorities among the population such as the elderly and handicapped who would have difficulty or even be unable to use these services could encounter problems. Employee cutbacks in civil service and citizen's service as well as in ticket sales for local public transport could also cut off these disadvantaged groups (cf. Degryse 2016).

Chief Economist for the Bank of England, Andrew Haldane, stressed in his aforementioned speech to the trade union federation TUC the changes in the labour market could possibly also require political measures: One option for politics would be to reduce working hours for individuals and create new regulations on regular leaves – however this would only be a somewhat helpful solution, as work is also fulfilling and people also need it beyond its financial aspects in order to remain healthy and content. In addition training would therefore be added to prepare the employable for new challenges in the labour market. This should focus on skills where people can prove their advantages over machines, which for example includes building relationships and networking, empathy, and mediating and negotiating skills. The respective jobs should specifically be created. Haldane also adds that with growing income gaps between owners of capital (or robots) and workers, redistribution measures should be reviewed to prevent massive impoverishment. Modes for a fair distribution of profits would be easier to determine in business forms granting workers a voice, Haldane believes. Whether politicians should promote such business forms or whether this is a call for companies to choose these types of companies is left open (cf. Haldane 2015).

The trade union Unite the Union points out the concerns among workers regarding job security and future workloads. E.g. employer tendencies to save money from the employees' mobile and flexible work should be considered. These new forms of work could for example affect employee health due to feeling isolated, the union states. Crowdsourcing with by trend less pay and protection for the individual contributor are also a more common and unsettling phenomenon.

In the eyes of the organisation it would be important for companies and the government to better understand that designing the technological change without worker involvement would entail major social and economic problems: After all, as

unemployment and a lack of prospects grows, the buying power will decline, which will harm the companies in the long term, and furthermore the risk of illness would increase. The union is therefore calling for the government to protect job security and basic social and organisational laws. For example preventing qualified high-quality work from being replaced by phenomenons such as crowdsourcing or voluntary work and traineeships (cf. Unite's Charter for Workers in UK Information Technology and Communications Industries 2015).

The Union of General and Municipal Workers also fears trends towards precarious work via platforms and in July 2016 sued before London's labour court the ride service Uber should provide drivers with basic employee rights such as minimum wages, holiday, coverage for illness and accidents: The union believes drivers to be under the control of Uber, not self-employed (cf. The Register 2016a) and also points out that individual drivers have already been reprimanded by Uber for addressing these aspects (cf. European Observatory of Working Life 2016). For unions, platforms such as Uber also entail the fact that they in part represent both sides – platform subscribers and employees at competing companies who feel threatened by platform work. This raises the incentive for unions which demand stricter regulation of platform activities: Raising the standards for those employees could also lessen the tension between the various members (cf. European Observatory of Working Life 2016). The Digital Economy Council UK, an association of about 900 technology companies in Great Britain, takes a fundamentally different view with respect to platform economy. CEO Julian David calls the debate on platforms such as Uber and Airbnb in part "hysterical", as it is an example of how innovative business ideas are being fought in favour of old, outdated systems. David stresses there shouldn't be any regulatory overkill of the digital economy or new rules just to force preserving old industries and the associated jobs which would otherwise be perish in fair competition. He supported a subsequent regulation approach responding to shortcomings and needs and does not attempt to eliminate all potential risks through prevent, David states. He instead calls to use the platforms for the own economic development and for example base App developments on this. With respect to working conditions and opportunities, David primarily aims at building skills – which had been the biggest problem in Great Britain in recent years. It is now slowly being addressed with a new curriculum which includes programming. In this context David also praises the Grand Coalitions for Digital Jobs and eSkills weeks of the EU, which are by far not enough to compensate for the neglect in recent years. It would therefore be important to now primarily use funds for developing the skills which will be needed in the future instead of preserving old industries and ways of working; if politicians now use false incentives, the economy could also be harmed by digitalisation (cf. David 2016). The Commission for Employment and Skills on the other hand believes it is the government's duty to design labour laws to prevent a "Race to the bottom". Employers would need to prevented from exploiting flexibilisation potentials without considering the employees. Politicians would further need to develop a long-term strategy on how to also integrate

the low qualified in the rapidly changing labour market (cf. UK Commission for Employment and Skills 2014).

3.3.3 Political and public-private measures

In Great Britain, occupation-based skills training in the ICT sector is among other things also supported by the state approved and certified competence council for digital skills Tech Partnership. The network of employers among other things organises and licenses special training options within companies for prospective ICT specialists, supports women seeking to enter technical professions and develops specific degree programmes such as a programme at the interface between IT skills and management, so-called ITMB Masters (cf. Website Tech Partnership a). This programme is a collaboration between 60 employers and 15 universities, and is intended to teach university students analysis and strategy development skills for future management and leading positions in ICT. It provides university students with the opportunity to exchange with practitioners from cooperating companies and be inspired. According to Tech Partnership, over 1000 university students completed the programme in 2005, as the organisation stated on enquiry. On average, 33 percent of these university students are female, an unusually high rate for the ICT sector (cf. Empirica 2014d). Exports praised this programme for this reason and for teaching students based on the needs of the labour market (cf. e.g. Empirica).

Tech Partnership also became involved in schooling through its Tech Future Classroom programme. In collaboration with universities and schools the competence council developed a lesson guideline and a collection of lesson materials and handouts for teachers for programming courses at schools. According to Tech Partnership the materials are being used by about 1000 teachers at 750 schools (cf. Tech Partnership website b).

Another initiative of the competence council which in the past has been praised by observers for focusing on the employed has meanwhile been discontinued: In 2009 the council had opened the so-called National Skills Academy for IT. It was intended to improve leaving ICT skills and until 2013 offered about 1000 online courses for independent ICT learning. The National Skills Academy IT was one of 17 nationwide skills academies. It was regulated by the British government and regularly audited by the skills funding agency (cf. Empirica 2014d). After just over three years, Tech Partnership on enquiry, the National Skills Academy for IT was closed – the competence council did not disclose the reason.

Working with and on computers (computing) has been mandatory at public schools in Great Britain for several years, at other schools it varies by the individual initiatives of those responsible. The course at public schools teaches how a computer and networks work and children learn programming. Since a 2014 curriculum reform the lessons focus more on the latter, so on programming and developing skills**.** During the 2014/15 school year the Ministry of Education offered about 3.5 million pounds to prepare teachers to the challenges of the new curriculum introduced in 2014. This

was accompanied by special financing options for continuing education for primary school teachers, and in cooperation with and in cooperation with the Ministry of Industry funds to develop suitable teaching materials for computer lessons. In 2015/16 the Ministry of Education provided the organisation British Computer Society with another 1.1 million pounds to arrange special ICT training for teachers and training 400 so-called "master instructors" through their "Computing at School" programme: Teachers learn programming and other PC and ICT skills and will then pass their knowledge on to schools as multipliers (cf. Balanskat/Engelhardt 2015; cf. Gibbs 2014). The Ministry of Education further invested 500,000 Euro in a fund for private companies such as Microsoft to prepare these teachers for the new contents (cf. Gibbs 2014).

Among other things the industry is involved in the new curriculum by hearing protagonists such as the certified competence council Tech Partnership. Companies such as Google and Microsoft provided input and were involved in train programmes for teachers (cf. Gibbs 2014).

In its 2014 report on digital skills for the European Commission, Think Tank Empirica counted Great Britain among the countries with high skills rates and moderate to high activity rates to improve these. Great Britain had seen large public and private investments in ICT skills a while ago, which has become more difficult due to the economic crisis. And yet Great Britain is a model in this area, as it had developed a distinct dialogue with stakeholders and public-private cooperations which could fill the gaps. The aforementioned Information Economy Council and its strategy for an Information Economy Council, for example, are a strong public-private partnership. Thanks to their initiatives education providers had begun to launch programmes at the interface between ICT and management skills (cf. Gareis/Hüsing/Birov et al 2014). Empirica generally also believes the public-private partnership structures with the competence councils supported by companies to be a powerful structure which can provide tailored education and continuing education (cf. Empirica 2014d). However, despite all initiatives there have not yet been more women entering into ICT professions – which still requires additional action (cf. Empirica 2014d). Furthermore many British activities for digital skills are still designed too much for school and university education and not enough for life long learning. This could become a problem, as many older workers will still remain in the market and the technological change would not go smoothly without these groups having suitable skills (cf. Empirica 2014d).

According to the Information Economy Council strategy on digital skills, starting in 2014 a fund for technical skills training was to encourage employers to offer their employees and trainees such training (cf. Information Economy Council 2014). In 2012 the government already provided companies operating in this field with a converted 300 million Euro for this purpose (cf. Empirica 2014d). The same should be used to boost special training in the IT sector through funding. The government has therefore been granting companies more say on the contents of subsidised training

programmes in cyber security, software development and network engineering since 2014. The goal was to increase the number of these special IT trainings, 26,000 of which existed between 2011 and 2014, in subsequent years (cf. Information Economy Council 2014).

Using the so-called "Hour of Code" campaign with free online coding courses the Information Economy Council states it was able to reach about 2.9 million young people in Great Britain between March and July 2014. The initiative was to introduce participants to basic programming skills – however, according to the Information Economy Council the programme only contained six minute long exercises. What comes of the basic skills after that is not documented.

As of 2014 more of these so-called Massive Online Open Courses were to also be used by cooperations between companies and universities to address unemployed ICT specialists, drop-outs and career changes from other industries and to build their ICT skills for entering back into the labour market.

Even before this, the government supported the network of the so-called UK Online Centre with 3800 partners to introduce people with poor access to the internet and digital applications to new technologies. The initially state-run initiative "Go On UK" played a key role in these activities intended to reduce digital exclusion. (cf. Information Economy Council 2014): It is was intended to encourage companies to be digitally active, along with giving the entire population an understanding of the advantages of digital applications and train the population in these (cf. Empirica 2014d). Today the initiative is merely a civil society under the name "Doteverywhere" (cf. Doteverywhere website). The government did not respond to our enquiry regarding any evaluations of these initiatives.

In addition to government institutions and employers the trade union federation TUC offers members ICT training and training to improve problem solving skills. TUC also cooperates with other protagonists for this purpose, such as the state subsidised Online Centers or initiatives committed to digital inclusion. Die unions for example also train so-called Digital Champions, which are to function as multipliers to ensure more competent use of digital technologies within their companies and their personal environment (cf. Unionlearn with the TUC website).

3.4 Italy

3.4.1 Progress of digitalisation and potential developments

3.4.1.1 Integration of technology and economic effects

In its 2016 Digital Economy and Society Index of the European Commission classifies Italy as one of the weakest countries with respect to the progress of digitalisation. Among other things this is due to continued poor broadband access in some regions. Italy is also below average with respect to how Italian companies integrate digital applications in their business processes: Only 14 percent of companies use social media for marketing, taking 18th place in the EU, only 6.5 percent of SMBs sell online

(25th place in the EU) and only 5.2 percent of SMBs also sell internationally online (22nd place in the EU) (cf. European Commission 2016a). Modern technologies further have not been integrated in schools much: In 2011 only about 30 percent of 8th-graders regularly used ICT in natural science lessons, whilst the OECD average at the time was already 48 percent. During the 2011/12 school year this was only 9 computers per 100 pupils at Italian schools, the worst rating behind Greece – whilst Scandinavian schools had 30 PCs per 100 pupils.

In the Index on the Aptitude Effect of Information and Communication Technologies (ICT) according to Evangelista/Guerrieri/ Meliciani (2014), Italy performed rather poorly compared to other countries, although here the role of ICT in carrying out business processes, job placement or education also grew considerably between 2004 and 2008.

So far Italian companies have made rather moderate use of mobile applications, which are often described as an essential part of a digitalised economy: For example, in 2012 employees at 41 percent of companies used mobile devices to surf the internet, 43 percent of companies used mobile e-mail, 24 percent of companies used cloud or other exchange services from mobile devices (cf. Eurostat 2016a).

With respect to the use of multifunctional and network-capable industrial robots, on the other hand, Italy is more of a pioneer: The Italian manufacturing industry had about 160 of these robots per 10,000 employees in 2014 – the highest percentage in Europe behind Germany (cf. International Federation of Robotics 2016). According to a study by business consultancy firm Staufen, however, only 20 percent of Italian industrial companies are already experienced in networked production, whilst 70 percent of companies state not yet having paid much attention to Industry 4.0 (cf. Oriani 2015). According to the assessment of observers this could be because Italy has a lot of SMBs which are not able to invest as much as larger companies (cf. Swiss Business Hub 2016).

The Staufen study showed that Italian companies consider a lack of knowledge and politicians lacking willingness to take action to be the biggest hurdle on the way to Industry 4.0. According to it, the companies primarily hope politicians will provide a better internet connection, steady and clear responsibilities yet restraint in terms of regulations. The majority of companies surveyed expect digitalisation to bring production benefits for the industry, although many companies have not developed a concept and have little faith in political support in this matter (cf. Oriani 2015).

The Italian Technology Cluster "Intelligent Factories", a cooperation of business and science representatives, still assesses the situation in Italy as positive. Italy is already making above average investments in building modern factories, and in the EU-wide research programme "Factories of the Future" (EFFRA) ranks about second in resources on a European comparison, the cluster states. Italy is currently on the way to revive its manufacturing sector with state of the art technologies in the area of

hardware and software (Key Enabling Technologies) (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente 2015).

In one projection the European Commission in 2014 assumed that filling all vacancies in Italy created in the ICT sector by 2020 could increase labour productivity by 0.363 percent total (cf. Lorenzani/Varga 2014).

3.4.1.2 Education and Skills

In its Digital Economy and Society Index of the European Commission reports the percentage of people in Italy who have never used the internet is still high. Italy takes 24th place in Human Capital, only 63 percent of the population regularly uses the internet (EU-28: 76 percent), 43 percent of the population have basic digital skills (EU-28: 55 percent) and only 2.5 percent of the working population are ICT specialists (EU-28: 3.7 percent), and furthermore a below average percentage of natural science and technology students among 20-29 year olds. The commission sees the Italian population vastly lacking fundamental digital skills as one reason for the low use of broadband infrastructure, which according to the report is still far below the connection rate.

The commission believes the Italian school system to be the primary reason for the lack of digital skills, as it only produces 42 percent of the population with attaining education beyond the first year of secondary school, the fourth lowest percentage within the EU. Therefore the percentage of ICT specialists and scientists among the entire employable population is also low (cf. European Commission 2016a). The percentage of ICT specialists among employees in the manufacturing sector is also rather low, as the figure for Italy was only just over 2.5 percent in 2012, and about 1.75 percent in 2008 in this area (cf. Lorenzani/Varga 2014).

With respect to computer skills among the vast employable population Italy is also showing rather low number and only moderate progress: Between 2006 and 2014 the percentage employable persons with average or advanced computer skills grew from 43 to 56 percent. The percentage of employable persons with advanced internet skills grew at a low rate, from 9 to 18 percent, between 2006 and 2013, whilst the percentage with average skills grew from 20 on 34 percent (cf. Eurostat 2016d). The percentage of employable persons with no digital skills was 2 percent in 2015, the percentage with hardly any digital skills was 23 percent, whilst the EU average was 1 resp. 24 percent (cf. Eurostat 2016f).

The national Italian statistical office provides a slightly more detailed overview of ICT use among the Italian population in 2013: The authority points out that 14.8 percent of the elderly, 65 and up, have a computer and 12.5 percent with internet access are almost completely digitally excluded. However, there also are regional differences: Whilst in Northern Italy 65.4 percent of households have a PC and 63.3 percent have internet access, in the south it is only 57.2 resp. 55 percent. This discrepancy is also seen in the use of mobile devices. In the north, 47.6 percent of households have

mobile internet access, in the south it's only 36.1 percent. There further are gender gaps: Whilst 60 percent of the male population use a PC and go online, for women this is only 49 percent. Relative to other groups, manufacturing or industrial workers (57.5 percent PC use, 58.8 percent online use) and housewives (21.7 percent PC use, 21.6 percent online use) come into contact with computers and digital technologies less. For this group of persons there is a risk of hardly building skills in the use of digital applications due to lack of contact (cf. Istat 2013).

Not only the European Commission considers this a problem. In its aforementioned study, business consultancy firm Staufen broaches the issue that the low qualifications of personnel at many companies would be a primary obstacle on the way to Industry 4.0. In this context, very few companies arranging for employee training would be a problem in this context: About three fourths of the companies surveyed stated they offer no specific employee training (cf. Oriani 2015). The author of the study commented that Italian companies are obviously not very interested in actively pursuing the potential advantages of digitalisation. In light of this the author is sceptical whether it would be able to optimally utilise the potentials of digitalising the industry (cf. Oriani 2015).

Observers also see problems in other areas. Research platform ISIGrowth attests Italy is having general problems in creating sustainable research, development and innovations: 2013 and 2014 there had bee considerable tendencies toward cutbacks in higher (including university) education and in public research funding. There are serious signs that the educational system is producing less highly educated persons and that there is a considerable brain-drain among the well educated. On principle the investments of companies and public institutions in the research area are far behind the EU average. This is hindering the innovative strength in using new technologies (cf. Lucchese/ Nascia/ Pianta 2016).

According to OECD analyses, Italy has also long been trailing behind other industrialised countries in school education of digital skills (cf. Avvisati/Hennessy/Kozma/ Vincent-Lancrin 2013). Italy's politicians have long been aware of these deficits, which is why the National plan for Digital School was already created in 2007. An OECD analysis considers this plan, which for example provides for equipping classrooms with whiteboards, as positive. These projects are generally easy to integrate in the school routine, the OECD states. The budgets for this plan, however, are so small they hardly leave any room to implement these goals. This may possibly also be a reason for the use of ICT in schools still being rather sporadic in 2012. According to OECD the majority of Italian teachers state they never, hardly ever or only use ICT in their lessons a few times a month. And this although 50 percent of teachers had spent at least six days at ICT training prior to the study so the continuing education level in 2012 was higher than the average for European states. Due to the low use of ICT at schools Italy has far less supported ICT experience than other OECD countries, the OECD states (cf. Avvisati/Hennessy/Kozma/ Vincent-Lancrin 2013).

3.4.1.3 Digitalisation and change in the working environment

As in most other European countries, in recent years Italy has already seen somewhat of a change in the labour market due to digitalisation, for example by new, primarily management tasks being added and other occupations being eliminated (cf. Novero 2014). Economist Serena Novero of the catholic university Sacro Cuore, however, criticised the authorities regulating the labour market had taken a long time to adapt to the change and due to the vast bureaucratic hurdles had not changed the labour conditions accordingly (cf. Novero 2014). The 2014 labour market reform under the current employment secretary Giuliano Poletti was the first to also include ICT solutions as a tool to create new job opportunities – such as through endeavours to specifically digitalise sectors and connect these with ICT, where Italy is the international most competitive in an international comparison.

Novero believes the Digital Agenda and ongoing changes in the labour market to be creating new jobs and other relatively young scopes of activity to be growing, listing for example the growing importance of social media managers in companies; furthermore experts to process and protect the increasing data volumes in companies; online shop managers – where employment had grown by 18 percent in 2012; ePublishers as the final editors for online publications, and cloud computing specialists.

Novero comments: Digitalised economic processes not only require workers to be more flexible, but often also require interdisciplinary and cross-subject skills In organising work within companies and institutions this requires various experts to exchange and learn from each other. The author believes the companies are already responding with the trend of an increasing number of companies therefore already being present in international networks. This is said to entail new conference formats using video and other technologies, as well as new, less location-dependent forms of jobs (cf. Novero 2014).

The changes in the working environment due to new technologies is raising the question whether suitable workers are actually available for these new job requirements. The ICT sector, which is key in digitalisation, is specifically questionable. A 2015 study financed by the Italian Ministry of Labour and the EU Social Fund revealed that in terms of skills, workers in the Italian ICT industry have not been able to keep up with the speed of technological change in recent years. Certain skills in demand on the market are lacking - primarily cross-topic or cross-application and problem solving skills (cf. Excelsior 2015).

According to this study it was particularly to companies for people to also be team workers, working independently, creativity and planning skills. An increasing number of companies in the ICT sector are therefore having problems finding specialists with these key skills. In Northern Italy more than 27 percent of ICT companies had recruiting problems in 2015, in southern Italy, where fewer ICT companies are found, this was 23 percent of companies.

47 percent of companies surveyed believe gaps and lack in training and vocational training are the reason for staffing problems. However, only several of the companies also responded with their own measures for the gaps observed: 36 percent of companies in the ICT sector stated having arranged internal or external skills training for employees. Among companies with 250 employees and more, 71 percent invested in this type of staff training for skills to be tailored better. At 25 percent for the ICT sector, the percentage of companies offering traineeships and similar offerings, however, is far higher than the entire Italian economy at a rate of 14 percent according to the study – so based on the study companies are also trying to fascinate and draw in more workers (cf. Excelsior 2015).

A projection of the European Centre for the Development of Vocational Training (CEDEFOP) provides a general outlook on the future employment situation in Italy. According to this, in 2020 employment in Italy will be back to the level prior to the crisis. Overall, more jobs would need to be restaffed by 2025 due to retirement than due to newly created jobs. Employment in business-related services and the civil service sector will particularly grow by 2025. Furthermore, the logistics and transport sector would generate new Jobs, as CEDEFOP states in one projection, which includes technological change as one of several components. Whilst manufacturing and construction companies would be able to maintain employment at a steady level, employment in the primary sector and in energy would decrease by just about 1.5 percent per year between 2013 and 2025 (cf. European Centre for the Development of Vocational Training 2015). Most employment opportunities in Italy by 2025 will therefore be created for highly scientists, engineers and for higher education teaching staff: 22 percent of new jobs to be staffed would fall into this category, whilst 17 percent would be for skilled worker and specialists, e.g. in engineering, health management or civil service. According to the prognosis, 16 percent of new jobs to be filled, however, would not require more than basic education and are therefore aimed at the low-qualified, whilst only two percent of new employment opportunities would be for machine operators and assembly line workers.

CEDEFOP sees the following trends among employment opportunities for Italy created in coming years: The low-qualified would therefore also find the lowest absolute numbers of employment opportunities in the future, whilst persons at an average qualification level would see strong growth in employment opportunities of about 6 million jobs by 2025 based on the retirement numbers. The greatest net increased demand in workers would be seen among jobs for the highly qualified, where about 3 million additional jobs should be created by 2025. This would be supported in this respect that according to the CEDEFOP the qualification level of the employable population will also noticeably improve by 2025: By 2025 the percentage of employable persons with high qualifications would increase to 30 percent, an enormous growth compared to the 15.6 percent in 2005 and 20.7 percent in 2013. At 46.7 percent, however, most of the employable would still have average qualifications, with this percentage instead being stagnant (2013: 45.4 percent). According to the CEDEFOP projection, the low-qualified will only make up less than 22.5 percent of

the employable (cf. European Centre for the Development of Vocational Training 2015).

3.4.2 Political Discussion

3.4.2.1 Integration of technology and economic effects

The research platform ISIGrowth criticises that Italian politicians had caused the economic situation to decline over the past 20 years due to failed technology and industrial policies. This was for one due to complex bureaucratic structures, and on the other hand a cooperation form between politics and the economy is having negative effects allowing for little control over activities of private protagonists, as no accountability structures were put into place. The authors demand that decisions on the future of industrial structures would need to be brought back to the public domain in the future and placed under supervision of the broader society – by for example also including unions and worker representatives (cf. Lucchese/ Nascia/ Pianta 2016).

It would also be important to revive the economy through modern and progressive integration of ICT in economic processes and to build networked production systems to increase productivity. The authors believe Italy still has a long way to go in these matters. To support a modern economic structure, ISIGrowth proposes a new public investment bank to acquire the holdings in start-ups during the uncertain starting phase and to promote new innovation networks between individual economic protagonists (cf. Lucchese/ Nascia/ Pianta 2016).

Former technology secretary of the last Berlusconi cabinet, Lucio Stanca, recently made a statement on the years Italy in his opinion lost out on. Stanca questioned why his country remains far behind in terms of digitalisation, why it is always at the tail end in the EU Digital Economy and Society Index – and provided a three-part explanation: There is a lack of public-private partnerships and coordination between individual protagonists; it is further lacking a political concept and coordinated action from the competent authorities in this respect. There furthermore is no long-term planning. In order to make headway in terms of broadband expansion the activities of local, regional and national protagonists would need to be coordinated better and preferably controlled centrally, Stanca stated. However, the competences are not clearly assigned, Stanca criticised. There further is no continuity, as every new government pursues its own agenda and there is no structure to ensure long-term support for the technological change with the appropriate financing and programmes (cf. Stanca 2016).

The Italian government itself also does not appear quite satisfied with past political approaches. In its 2014 strategy on digital growth the new Renzi administration also states that previous efforts have often been uncoordinated so that a lot of money was used ineffectively without truly advancing the economy and society in digitalisation. This criticism seems aimed at the previous governments, just as the remark that this would be handled better in the future (cf. Presidenza del Consiglio dei Ministri 2014).

The discussion then continued undaunted. In June 2016 a study on Industry 4.0 in Italy by the Production, Trade and Tourism commission was presented to the Italian Camera. It includes several recommendations for the government which the authors believe it should heed for optimal utilisation of digitalisation: Industrial centres should be better connected to broadband or ultra high speed internet. Companies and research institutions should cooperate batter to better recognise and utilise the potentials of new technologies. The government should further create a supervisory body which includes business representatives, the Ministry of Economy, as well as the Ministry of Education, local administrative units, scientists and unions to appropriately support the process of the technological change (cf. Corriere Comunicazioni 2016a).

In line with the presentation of the study, the president of the trade association Confindustria, president of the Employer Association, Vincenzo Boccia, declared a networked industry to be a great opportunity for Italy, as domestic companies are generally good at producing tailored, personalised and high quality products – which is gaining importance as technology advances. However, Boccia believes the structure of the Italian economy would also need to change in order to realise the new industrial revolution, that there would need to be more large companies instead of the thousands of micro-enterprises.

In line with the presentation of the study, the Minister of Economic Development, Carlo Calenda, stated he wants to present a plan by August 2016 on how politicians can support and push ahead networking the domestic industry – which would include a steering committee consisting of political advisors and business experts and who will finalise the plan. Calenda clarified that massive investments in modernising the industry would be required in the coming months and years (cf. Corriere Comunicazioni 2016a).

In 2012 the aforementioned Italian Technology Cluster "Intelligent Factories" (Cluster Tecnologico Nazionale Fabbrica Intelligente) was formed and government accredited as an association of companies, scientists and non-government organisations. In 2015 it outlined a schedule for transforming the economy (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente 2015).

With reference to the Horizon 2020 agenda of the EU and the goals this defined for Italy the cluster declares the following action items: The employment rate among 20 to 64 year olds should be increased from 67 to 69 percent by 2020, research and development spending should be 1.53 percent of the gross domestic product, Italy should have 15 to 16 percent less drop-outs and not over 2.2 million persons at poverty risk. In order to achieve this, the cluster wants to modernise the manufacturing sector and increase employment in this sector to the level from before the crisis 2007, and the protagonists involved further want to change Italy's position among the international value added chains to put domestic companies in profitable positions (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente 2015).

3.4.2.2 Education and Skills

In 2014 the Italian government created a strategy for digital growth which also addresses developing digital skills among the Italian population between 2014 and 2020 (cf. Presidenza del Consiglio dei Ministri 2014). With respect to Industry 4.0, the government according to this strives to re-ignite the younger generations' interest in manufacturing. Overall the knowledge and the educational level educational level of workers would need to improve, as it would require high quality work to be a match for low-wage countries in international competition. New continuing education options aimed at the entire workforce should also be created. The government would further like to see more postgraduates working with modern manufacturing systems.

The government notes that too many Italians do not use the internet or only use a computer, and that particularly the elderly and residents in regions such as Basilicata and Campania were having major problems. But problems with skills are not only seen among individuals but also among SMBs, which is having a significant impact on opportunities for economic growth. The government even assumes that at some small and medium-sized companies, internet use and data transmission is less professional than in private use among families. This is disastrous to the country's competitiveness. The government intends to counter this inertia by only offering certain civil service offerings digitally in the future to force companies to joint this sphere. With this the government also justifies its vast eGovernment programme (more on this later).

Problems could only be eliminated through targeted options for developing digital skills. The government would need to participate just as much as companies which would be able to achieve results among employees faster through training options than the educational system would be able to. The efforts would be required to both introduce workers in all sectors to the working structures as well as to provide ICT specialists with the right environment to develop innovative products and services.

The government intends to measure success by whether it can increase digital literacy among the entire population and digital skills among the working population, whether in the future ICT and digital skills will be a routine part of the curriculum, whether more digital skill training are also being offered outside of schools, and whether more university students are graduating with ICT degrees. Whilst it intends to spend about 4.5 billion Euro on its entire digitalisation programme from 2014 to 2020, the government only intends to provide 30 million total on digitalisation in Italian schools during this period and 120 million Euro for developing digital skills among the entire population. 750 million Euro each are to be spend on digital healthcare services and digital citizen services (cf. Presidenza del Consiglio dei Ministri 2014).

The OECD already believed the amounts previously spent on modernising school education in Italy to be too low. In its aforementioned 2013 evaluation of the plans on digital education in Italy it already criticised the 30 million Euro budgeted *per year* at that time. This was only about 0.1 percent of all spending for school education, the

OECD states – which wouldn't accomplish much. Both the public and private sector would need to considerably increase investments, the organisation demanded at the time.

Representatives for civil society also see a need for change and the respective investments: OECD also interviewed and spoke with national protagonists for its analysis on ICT use in Italian schools. Here both teach as well as parent organisations had declared the need to adapt the school environment and general living environment of young people to technology. Pupils would otherwise engage in unsupported and potentially negative media experiences. Furthermore, schools are not preparing them for the requirements of an ICT based work life this way (cf. Avvisati/Hennessy/Kozma/ Vincent-Lancrin 2013). OECD adds its assessment that the digital infrastructure – once it's been set up – may automatically change teaching methods: A critical mass of coordinated infrastructure would encourage teachers to spontaneous use in lessons.

The OECD also considers progress through the National plan for Digital Schooling as urgent. If increased investments cannot be made due to the economic crisis, parts of the plan would need to be prioritised, the OECD stated in 2013. For one, a broad ICT infrastructure would quickly need to be established in schools. After all at the speed at the time only 22 percent of Italian classrooms were equipped with whiteboards in 2012 and it would take at least ten more years to reach 80 percent of classrooms. In addition to learning progress of pupils, this is also hindering teachers from using ICT in lessons. In addition to funds for infrastructure it would also be important to also invest in training teachers to ensure they are able to use the new technologies optimally. Government offerings and initiatives until 2013 had not been adequate in this respect. OECD recommends loosening the strict requirements for schools a bit to allow them to use training options more efficiently and divide these among the staff. The organisation further calls for some pilot schools to develop specific educational concepts for integrating ICT into lessons which could then be used nationwide.

OECD recommends linked financing tools to improve financial power: The government should add funds if local protagonists (schools, communities) raise funds locally or from third parties (cf. Avvisati/Hennessy/Kozma/ Vincent-Lancrin 2013).

The aforementioned study on Industry 4.0 recently presented to the Camera further advocates a thorough education reform. Both schools as well as vocational training protagonists would need to be involved in technological changes better in order to adapt their training to requirements (cf. Corriere Comunicazioni 2016a).

3.4.2.3 Digitalisation and change in the working environment

The Italian Technology Cluster "Intelligent Factories" also includes social aspects in its roadmap for future industrial production: The manufacturing sector should be upgraded by creating better occupational health and safety and rewarding the

individual performances of employees more fairly (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente 2015).

The Cluster devised guidelines for action on the following topics, among other things: For new tools for process planning, for simulations and projections of production development, integrating ICT in all kinds of process steps, and for technologies to create people-centred production. Implementing these would attain the goals to modernise and improve production:

The Cluster for example brings up micro-factories for final manufacturing close to customers for greater product customisation and personalisation. Facilitating decentralised, small and flexible production units which can be used practically anywhere (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente 2015).

Under "Factories for People" the authors outline a vision of employee-friendly factory entirely tailored to workers. In light of the demographic change this should for example focus on changing jobs so that older individuals can also remain working there longer. It should enable all workers to perform sophisticated and complex tasks with a high potential for added value through the use of new technologies and applications. This would require correctly assessing and analysing synergies between people and machines and to assign tasks effectively – also to ensure job satisfaction among the workers involved. People would therefore need to become the focus of the production process, meaning: For one it would require working on enabling technologies which allow people to easily communicate with the machines around them and particularly be able to control these well. It would further require working on automating tedious routine tasks as quickly as possible to free up manpower for other tasks. New technologies such as Augmented Reality applications could also be used to continuously and safely (since it's a simulation environment) train workers for new labour situations.

To also integrate a variety of people – such as the elderly and handicapped as well as people with different cultural backgrounds - in the workplace there should be research and development for highly individualised, adaptable and mobile work interfaces so practically anybody can work from anywhere.

The targeted use of new technologies and materials should improve occupational safety for people (e.g. work wear equipped with sensors) and continuously inform workers of the status of the work process and also provide them with other related information (e.g. using smart glasses). Here the authors of the Cluster also stated that augmented reality applications could of course be used for various purposes – for employer process and labour control, as well as for specific worker training. Under high-efficiency production systems it becomes clear the cluster also envisions new tasks for manpower: It primarily addresses mechanical solutions, full automation and production with a zero error rate (cf. Cluster Tecnologico Nazionale Fabbrica Intelligente, 2015).

Research platform ISIGrowth considers investments in new technologies and innovation efforts in Italy essential. However, the organisation believes new rules are required to appropriately control technological progress: Although collaborative open-source applications should be promoted to propagate social and technological innovations. On the other hand, approaches to replace as much manpower as possible with broad automation in the networked industry would need to be accompanied with regulation to protect labour and social law (cf. Lucchese/ Nascia/ Pianta 2016).

In this context the Italian union CGIL criticises the most recent labour market reforms in Italy – among other things the 2014 Job Act aimed at flexibilisation introduced by Renzi's government. These tools had not contributed to creating a work environment where changes due to new technologies would be incorporated in processes in a healthy manner. Instead of only increasing flexibilisation it would also be necessary to offer more vocational training and include the population more in the changes and innovations within companies to fully utilise their potentials (cf. CGIL 2016).

3.4.3 Political and public-private measures

One tool for shaping the digitalised working environment currently under discussion in Italy is the planned legislation to regulate mobile work regardless of location and time in the age of the fourth industrial revolution (bill 2229). The president of the Senate Commission for Labour and Social Affairs and former labour minister during the last Berlusconi cabinet, Maurizio Sacconi, presented the bill to the senate.

The reasoning for the bill explicitly mentions new requirements due to digital technologies and industry networking: without the accompanying political strategy the technological development would result in massive unemployment, it states. Thus a law would be required to support the emerging new forms of work which cannot be stopped in any case. Workers have less fixed forms such as working hours and jobs, but rather work cycles – whether a project, a specific mission with a defined objective or even in continuing education (cf. Senato della Republicca 2016a). The law is to account for this.

The law is intended to regulate work provided by employees and regularly commissioned self-employed outside of defined working hours and outside of company workplaces via digital platforms or other exchange channels. It should therefore provide more flexibility for the working population and companies. The law is not intended to cover contract workers with a term of less than one year and workers with an annual income of max. 30,000 Euro. Mobile labour conditions could either be stipulated in individual or collective contracts at company level (cf. Senato della Republicca 2016a).

Article 2 of the bill provides that even individual contracts would need to account for the standards and agreed targets of collective agreements at a company-wide basis. Assessment of the work quality would need to be based on objective criteria, and

furthermore the health of workers would also need to be protected during work stages. Article 3 addresses employee health: The employment or contract relationship should ensure workers could be examined by a competent physician every four months, and to define measures and conduct to ensure and monitor mental physical performance. Employers and potential end customers are to be prohibited from monitoring workers with technical devices. The article further specifies a worker's or contract's right to limit their mobile connection for specific reasons (e.g. for necessary relaxation under worker protection law) without direct consequences for employment.

Article 4 provides for workers to be insured against accidents and work-related illnesses during times of work and whilst commuting to a workplace. The following Article is intended to ensure that mobile workers to be granted the right to life long learning at a collective and individual contract level and for their qualifications to regularly be reviewed and certified. These costs would be payable by the employer or by the end client for an assignment.

In Article 7 opens up the connection to digital literacy of the entire workforce and population, part of the funds provided by the Italian government for this purpose along with funds from the interprofessional funds provided by social partners should be used for vocational training in the use of new technologies and ways of working (cf. Senato della Republicca 2016a).

Another current proposition with respect to digitalisation which is now being treated collectively with bill 2229, was penned by current labour minister Giuliano Poletti. Bill 2233 is intended to both protect solo self-employed (non-entrepreneurs) as well as regulate forms of so-called agile work (including for employees). Unlike mobile work this can also at times be carried out within the companies, but is also flexible with respect to time and location (cf. Senato della Republicca 2016b).

The law is intended to prevent the client or customer from unilaterally modify the contract terms with a solo self-employed contractor. It is to prevent self-employed contractors from quickly losing an assignment due to illness or contracts being terminated at short notice.

The second chapter addresses agile work, which can be performed in part within a company and in part at any other location: Workers in agile jobs should therefore not be subject to different financial or other labour conditions than any other employees in fixed jobs within the company. Employers are to also protect the health of the respective workers and ensure that commendations for the worker's method of operation which may maintain the worker's health are established at least once a year. The employer is to insure the respective workers against accidents and illness during stages of work (cf. Senato della Republicca 2016b).

Unione Generale del Lavoro made a statement during a parliament hearing for the bills on mobile work (2229) and protection for independent non-entrepreneurs and flexible work modes (2233). The union primarily criticises bill 2233, as the propositions

do not answer important questions of employees. For example there is no convincing concept on how the self-employed will be able to achieve better access to training and continuing education; there further is no conclusive regulation on how social security contributions will be better spread out for the self-employed than before, how to ensure fair fees and how to secure the self-employed during times of involuntary unemployment. It is further left open what support the self-employed would receive in the event of disputes with clients and how to resolve these disputes. It is furthermore creating unexpected hurdles for deducting continuing eduction from taxes.

The union believes that on principle an arrangement on agile work pursuant to bill 2233 could result in disadvantages for the workers. For example, there is no compensation for a worker no longer being able to use the cafeteria or company exercise rooms and other benefits. There is also a risk that workers will no longer be included in individual reward systems such as bonuses due to insufficient presence at the company site. Employers could also purposely rely on forms of work outside of company grounds to avoid accommodating spaces for handicapped or chronically ill employees, which would violate employee rights.

Despite the planned equality clause employers would be able to assess performance different in agile work or rate it as less valuable, resulting in financial consequences.

Bill 2229 would after all be allowing collective negotiations on rights for mobile work at a local and at company level, a positive factor. The union is rather critical of additional individual negotiating options.

However, the bill further does contain quite notable components. For example, the union welcomes routine investigations for non-stationary employees and their health, and that employers will not be permitted to remotely monitor employees using certain technological applications. It further sees the employees' right for insurance against accidents whilst working outside the company grounds as well as the right to disconnect and for life long learning as positive.

However, the quality of implementation is questionable, for example as too little is being invested in life long learning options, or since companies would not be using the available funds as they are not being pressured by the government to take measures to train employees (cf. Unione Generale del Lavoro 2016).

In June the president of the business association for ICT- and consumer electronics, Christiano Radaelli, joined public discussions: He criticised that Italian companies – both public and private – show a great dislike for modern ways of working, which is a big problem. Instead of being sceptical of digital applications, all the advantages should be utilised to connect with colleagues even far away. It would likewise also need to be natural for employees at various companies to respond to electronic requests quickly and promptly. However, Radaelli relents, people should be the focus when developing "smart" work along with finding suitable solutions to balance work and personal life. Radaelli appeals it is important for persons to no longer be assessed

based on presence but by performance – regardless of the location (cf. Corriere Comunicazioni 2016b).

To lay the foundation for changes in the working environment and to advance overall digitalisation of the economy, the Ministry of Economy published a Digital Agenda in 2014 to primarily promote core technologies for digital change and the change in the working environment. In 2014 about IT vouchers for SMBs were introduced, to be used to procure a modern IT infrastructure (cf. Lucchese/ Nascia/ Pianta 2016). The latest initiative from the Ministry of Economy is the plan "Manifattur@ Italia Digital per competere". This plan is aimed at advancing new applications such as cloud computing, big data and 3D printing through tax incentives for research projects on innovative technologies and supporting doctoral programmes in networked production. This would overall allow annual government spending in the amount of up to ten billion Euro by 2025 (cf. Lucchese/ Nascia/ Pianta 2016).

Like most European countries, Italy is further also active in developing skills in the use of digital applications. One initiative in this area, for example, is the "Digital School and University" programme – which among other things aims at replacing paper in schools and universities with electronic learning tools and to create the electronic student file to improve data exchange between universities. Various projects are to provide schools with interactive whiteboards and digital learning packages. The Italian Ministry of Education in this respect generally aims at adapting the learning structures to individual skills and the needs of individual pupils through self-determined learning and in line with their skills. Since 2012/13 pupils in outlying areas with very low enrolment and class numbers can connect to far away classrooms via digital educational centres. The programme Scuala 2.0 for example creates and distributes digital learning material for distance learning (cf. Empirica 2014e).

In its 2014 report for the European Commission on initiatives for digital skills, Think Tank Empirica described Italy as a country with a relatively low degree of digital skills. Between 2009 and 2013, however, the country had become noticeably more active in advancing these skills (cf. Gareis/Hüsing/Birov 2014). Empirica notes that due to large gaps and the need to catch up, most government initiatives will initially emphasise on basic digital literacy among the population, teachers and pupils, and on initial digital steps among small companies (cf. Empirica 2014e). However, so far little has been done to develop more advanced skills, e.g. in ICT specialists. Industry- and service companies, schools, universities and other educational institutions would need to independently arrange suitable cooperations and programmes to train suitable specialists for the digitalised labour market, Empirica states. One example is the Generazioni Digitali project, funded by non-government organisations, foundations and schools in Calabria between 2011 and 2013. 1500 pupils and 240 teachers introduced about 8000 people over 60 to multimedia and using the internet.

This type of ICT skills training could be supported by so-called interprofessional funds accredited by the Ministry of Labour and funded by social partners. However, Think

Tank Empirica criticises the options are not well known and therefore not being utilised much. On the other hand the financial scope is also too limited for the high demand, for example a one million Euro fund for e-commerce and digital innovations had been faced with project applications with a volume of three million Euro, leaving most applicants empty handed. Additional funding sources are lacking here.

Empirica further criticises that several of the training and skill advancement options are lacking quality and do not provide companies and trainees adequate guidance in the "course jungle". The fundamental ICT literacy initiatives are further not sustainable, as they are rarely included in long-term plans. Employees in the ICT sector, just as other Italian professional sectors, are generally lacking a culture of lifelong learning, which could become a problem in times of rapid technological change (cf. Empirica 2014e).

In order to change this the Italian government most recently became active through the Agency for a Digital Italy (Agencia per l`Italia Digital). The agency is to play a key role through coordination of the so-called National Coalition for Digital Skills. This coalition modelled after the EU initiative Grand Coalition for Digital Jobs has existed since late 2014 and according to its own statement includes 145 members, 37 of which are governmental institutions, 20 are universities, 15 are companies and 73 are business or other professional associations (cf. Agencia per l´Italia Digital 2016a).

The goals of the coalition seem ambitious: According to the respective project page of the European Commission the initiative specifically aims at digital literary of about five million persons by 2020 (cf. European Commission 2016d). According to the project website as of July 2016 it has reached 860,000 persons, with a total of 810,000 persons having been introduced to regular internet use (cf. Agencia per l´Italia Digital 2016a). The plan explicitly states four million persons will be reached through Massive Open Online Courses for digital continuing education (to date 602,000 people have been reached). A total of 20,000 teachers are to be trained in using and utilising modern ICT in lessons (to date: 0) and 200,000 pupils and university students reached through training and awareness programmes (to date 15,000 have been reached). Furthermore, digital training and other measures are to place 50,000 persons in new jobs (40 placements to date) and 250,000 SMBs are to be included in ICT training (cf. European Commission 2016d). According to the coalition, 16,670 SMBs have been included in ICT training to date through 22 projects, however only 1250 SMBs new technologies have incorporated new technologies in their processes (cf. Agencia per l´Italia Digital 2016a).

The coalition was formed in 2014, however it has only recently become more active (cf. Agencia per l´Italia Digital 2016b). Last winter and in spring 2016 an agenda and timelines were presented on how to develop skills for jobs of the future in the coming years (cf. Agencia per l´Italia Digital 2016b). The initiative initially intends to consolidate its activities from 2015 and focus on areas such as using social media, data evaluation and cloud computing, better utilise synergies between local, regional

and national protagonists and optimally utilise funding opportunities through the EU. Furthermore a platform is to be created to guide and encourage companies in the technological adaptation of production. Digcomp, the competence framework for a digitalised world developed by the European Commission is to be established as a national guideline in its Italian counterpart. The plan for summer 2016 was to launch at least 100 projects to improve digital skills (cf. Agencia per l´Italia Digital 2016b).

3.5 The Netherlands

3.5.1 Progress of digitalisation and potential developments

3.5.1.1 Integration of technology and economic effects

The Netherlands take second place in the overall ranking of the 2016 Digital Economy and Society Index of the European Commission and is classified as "pioneering".

Overall the European Commission also assesses the integration of digital applications in business processes in Dutch companies as positive, both with respect to the current state and recent progress. Dutch companies are pioneers in using social media for marketing and customer contact purposes, and are also leading in electronic data transmission in business. However, merely 3.1 percent of Dutch companies use RFID chips, which is below the EU average (3.8 percent). 8.3 percent of Dutch SMBs sell online, also putting the Netherlands below the EU average of 9.4 percent in this area. In this respect companies could still improve, the commission states (cf. European Commission 2016a).

According to Evangelista/Guerrieri/ Meliciani (2014) between 2004 and 2008 the Netherlands increasingly incorporated digital technologies in retail and services, job search and education. This clearly increased the strengthening effect of information and communication technologies (ICT) on the economy and society: In the authors' aptitude index The Netherlands take fourth place among all EU countries.

At 78 percent of workers, in 2013 a high number of Dutch worked in jobs with web-enabled computers compared to other countries (cf. Eurostat 2016b).

According to a 2014 analysis by the Joint Research Center of the European Commission, broadband coverage in the Dutch manufacturing sector grew from 41.1 to 45.4 percent of employees between 2007 and 2010, provision of mobile web-enabled devices grew from 16.4 to 29.8 percent of employees and the percentage of online sales among all sales increased from 5.8 to 12.2 percent. The average number of employees per company in this sector decreased by 8.8 percent during the same period. In the service sector broadband coverage increased from 65.3 to 66 percent of employees with this type of connection, 45.7 instead of 32.3 percent of employees had a web-enabled mobile device and online sales increased from 6.7 to 14 percent among all sales. The average number of employees per company in this sector grew by 0.4 percent. Upon reviewing the change in wages, capital resources and sales in the companies, the researchers did not see any significant correlation between

developments in ICT and the trend in the number of employees at the companies (cf. Pantea/Biagi/Sabadash 2014).

In 2012 there was relatively high use of mobile devices and applications throughout the Dutch economy: Although mobile devices were only used to surf the web at 37 percent of companies (EU-28: 41 percent), 45 percent (EU-28: 42 percent) used mobile e-mail programs and employees at 33 percent of companies used mobile connections to exchange or edit files (EU-28: 27 percent); 23 percent of companies used online software applications (EU-28: 22 percent) (cf. Eurostat 2016a).

Multifunctional industrial robots, however, were not important in Dutch manufacturing in 2014: The ratio was only a little over 100 of these robots per 10,000 employees in this sector – a third of the figure for Germany (cf. International Federation of Robotics 2016).

In a 2014 projection the European Commission assumed that filling all vacancies in the Netherlands created in the ICT sector by 2020 would increase labour productivity by a total of 0.36 percent (cf. Lorenzani/Varga 2014).

3.5.1.2 Education and Skills

In its 2016 Digital Economy and Society Index the European Commission determines: The development in human capital, i.e. fundamental and specific digital skills, has recently been slower in the Netherlands than the EU average. The biggest problem here, however, may be the number of graduates in natural sciences and technology-oriented fields of study. At 91 percent of the population the rate of regular internet use is very high on an EU comparison, and the percentage of the population with at least fundamental digital skills of 72 percent is far above the EU average of 55 percent.

However, the European Commission sees a disproportion between existing skills and the skill required by Dutch companies: Five percent of Dutch workers are ICT specialists (EU-28: 3.7 percent). However, the demand is far greater, as in 2015 about 53 percent of companies in search of ICT workers complained they were not able to find enough suitable applicants. Yet only 18 percent of Dutch companies provided advanced training in the ICT sector for employees to brush up on their skills – the EU average on the other hand was 21.5 percent.

According to a study of the European Commission, the 2012 percentage of ICT specialists among workers in the manufacturing sector in the Netherlands was rather low compared to other countries (below 2.5 percent, EU average was just over 2.5 percent) and had also hardly grown compared to 2008 (about 2.1 percent) (cf. Lorenzani/Varga 2014).

Computer skills among the vast employable population did not improve in recent years according to Eurostat, on the contrary: Whilst according to these statistics 41 percent of the employable Dutch advanced computer skills in 2006, it states in 2014 this was only 33 percent – a development contrary to trends among most European countries.

The percentage of persons with average computer skills was almost stagnant during this period. This was quite different with respect to internet skills, where the percentage of the employable with advanced skills grew from 10 to 24 percent between 2006 and 2013, whilst the percentage the persons with average skills grew from 33 to 44 percent (cf. Eurostat 2016d). According to Eurostat 2015 the percentage of the employable with no or poor skills in PC and internet use in the Netherlands was only 16 percent, which is rather low compared to the EU average of 25 percent (cf. Eurostat 2016f).

In 2015 an interdisciplinary team of Dutch scientists, business representatives and representatives of the Ministry of Economy published the so-called Human Capital Agenda for ICT. In it the authors state that no other occupational field had as few competent workers per open jobs as occupations in the ICT sector**.** They particularly see shortages of ICT specialists holding degrees from a university or technical schools. There are too few of these academics for future challenging tasks in ICT management, process management, cyber security and web development. After all in the past many workers have entered ICT professions through education. The authors expect these to be in less demand in coming years in coming years, which may result in an imbalance (cf. Dutchdigitaldelta, Team ICT 2015).

In the OECD 2012 Survey of Adult Skills the Netherlands ranked rather average in the investigation of problem solving skills of persons in highly technological environments: About 35 percent of subjects attained the two highest aptitude levels, a relative high number demonstrated basic skills, but 16 percent of subjects demonstrated no or very little problem solving skills in this scenario (cf. OECD Publishing 2014).

3.5.1.3 Digitalisation and change in the working environment

In 2014 a team of Dutch scientists (TNO), representatives from the economy and politics (Ministry of Economy) presented a report on the development of a Dutch digitalised industry. The report assumes a decreased need for routine tasks and generally for the low-qualified. "Driven by the quest for reducing costs and improving quality, in the future primarily low-paid jobs could become fully automated in some industries (devoid of humans)." (Smart industry project team 2014a: 31) The authors also see less need for persons with average qualifications in some areas, however they do not assume an consistent development. Instead they expect that simplification of certain occupations through technologies could also create new employment opportunities for workers with average qualifications. New jobs for this group of people could also be created in distribution and marketing innovative products, the authors for the project team reckon.

The report also sees job opportunities arising from automated machine processes still requiring programming, software updates, operation and, in the event of technical problems, troubleshooting and emergency action, which would provide new jobs for

those with average to high qualifications. However, these would require advanced technical knowledge and flexible planning skills.

The authors are relatively certain the demand for highly qualified specialists to reorganise business processes will increase (cf. Smart industry project team 2014a). More brain workers such as managers, sales strategists and process engineers, but less craftsmen – to summarise the projection. As having access to more data on customer requests will allow for increasingly shorter notice and more customised product planning, the authors of the report further believe many industries will have increasing demand for data evaluation specialists. They believe outside of the production area there will particularly be growth potential for ICT specialists and specifically network specialists, in education and design, as even if 3D printers are available, somebody will still need to design the product (cf. Smart industry project team 2014a).

In the "Mastering the Robot" report published in 2015 on behalf of the Ministry of Labour the Science Council for Government Policy (WRR) assumes that negative employment scenarios such as the one in the controversial Oxford study by Michael Osborne and Carl Benedikt Frey are unrealistic. These projections ignored that the expected increased productivity through modern technologies may also create new jobs. The crux would be better coordinating the labour supply and demand – which also includes adapting the training system to the needs of the labour market.

As in most other countries, the Netherlands has most recently seen a polarisation which primarily resulted in eliminating jobs at the average qualification level and dividing workers into high and low qualifications, the science council states: Several workers have been scaled down into jobs which pay less with less challenging non-routine work, whilst others had found jobs which paid better and were more varied. However, in the future more jobs requiring higher skill levels would be automated and workers replaced due to digitalisation and integrating algorithms – which would depend on the progress of so-called deep learning and cloud robotics (computers learning from others) of computers and machines. Based on the general automatability of many occupations, technological changes could eliminate the previously assumed advantages for the better qualified. Instead, some experts now primarily assumed advantages for those who own and control the machines and technology. This would result in a greater imbalance in income and wealth among the society, the science council explains (cf. Went/Kremer/Knotterus 2015).

Other observers, however, assume that workers with specific technical skills would also benefit from digitalisation and automation. Due changes to business processes in various industries will also cause more demand for ICT experts outside the ICT sector (cf. CA ICT Stichting 2016). In 2014 there were about 34,000 vacancies for ICT specialists, in 2015 it was already 54,000 vacancies and experts assumed a shortage of 7000 ICT specialists (cf. Dutchdigitaldelta, Team ICT 2015).

Observers such as the CA ICT foundation, which is specialised in ICT research, described increasing competition for ICT specialists. Meanwhile 70 percent of ICT workers are working outside the ICT industry, a trend which has intensified in recent years (cf. CA ICT Stichting 2016). Several job profiles, however, are also experiencing declining demand, such as technicians, system administrators and trained network specialists without university education, with furthermore less demand for system architects. According to surveys there is less demand for project managers due to a trend toward small, self-organised teams of developers (cf. CA ICT Stichting 2016).

CA ICT notes that universities are currently offering a lot of training options focused on IT support and that not enough is being done for skills in software development and programming. This is a problem, as the need for these skills have recently grown considerably and should also be seeing more growth in the future than the need for so-called secondary IT skills such as support (cf. CA ICT Stichting 2016).

The research centre for education and the labour market at the University of Maastricht provides overview of general future developments in the Dutch labour market by 2020. Here, researchers see the greatest shortages of skilled workers in the ICT sector, the engineering sector, the teaching and educational fields (here primarily due to many exiting jobs) and generally for staffing manager functions. Researchers estimate many ICT specialists will not be able to keep up with the rapid technological developments in terms of their skills, for example cloud applications or big data applications. This may primarily be seen in the duties of software and app developers, the researchers believe. According to them, two big trends would determine the demand for specialists: The increasing need for specialists at the interface between ICT and business administration skills and the increasing need for specialists in big data – as well as data analysis. The scientists appeal: Workers in the ICT industry and in ICT professions outside the industry would need to become more and more agile and stay up to date, so learn for life, or they would quickly be outpaced by technological change.

The research centre sees negative growth trends in jobs for individuals with pure on the job training and no additional qualifications – such as print shop staff, craftsmen, machine operators, secretaries and accountants, which would be relatively easy to replace with machines and algorithms. However, not all skilled occupations are replaceable, for example social workers, nurses or caregivers. They therefore estimate the polarisation of the labour market will probably be less considerable than often argued (cf. Research Centre for Education and the Labour Market 2015).

The researchers also comment on what contributes to jobs being destroyed in certain fields and to some job profiles becoming extinct. They examined the correlation between an occupation's development (growth or cutbacks from 1996 to 2014) and worker computer and problem solving skills through technologies in the respective occupational field. For the period from 1996 to 2014 researchers determined a significant positive correlation between job growth and problem solving skills in the

technical environment of workers in the respective occupational group. They did not find this significant correlation in computer skills alone. Problem solving skills using computers and other technologies are particularly important as data processing and communicating information requires a strategy. Their data generally shows that occupations with growth developments tend to be complex, whilst simpler occupations are declining, the researchers state (cf. Research Centre for Education and the Labour Market 2015).

Overall the research centre assumes an annual employment growth of 0.8 percent per year by 2020, so that in 2020 there will be about 400,000 employees more than in 2015. During this phase the researchers initially expect the highest growth in the building industry with 2.2 percent per year, and also expect strong growth in the information and communications industry and business-related services. In agriculture, the chemicals industry, civil service and in financial services the authors however predict noticeable job losses (cf. Research Centre for Education and the Labour Market 2015).

A large portion of the available jobs will result from other workers exiting the labour market: From 2015 to 2020 about 1.5 million jobs would need to be restaffed, whilst according to their projections only about 1.6 million new workers would be entering the labour market. Many jobs will particularly open in transportation logistics and agriculture – so employment opportunities would still exist in industries with a less promising future.

According to projections the overall training level of workers will see a strong increase. The researchers predict there will be more graduates with special dual training for leadership positions and more with degrees, and the number of individuals completing special technical training will also increase. Hence a longer term trend will continue: After all the average educational level among the Dutch had already increased by the equivalent of 0.8 years of training between 1996 and 2014 (cf. Research Centre for Education and the Labour Market 2015).

3.5.2 Political Discussion

3.5.2.1 Integration of technology and economic effects

The Smart Industry project team primarily considers a networked industry positive from economic perspectives. In the aforementioned 2014 report the authors connect the use of sensors, distinct data analysis as well as 3D printers with an opportunity for cost-effective, flexible, zero-defect and custom production. A customer focus and managing the information to analyse customer needs will be key in the future. According to the assessments of the project team, smaller companies would be playing a bigger role in the industry of the future, as they can be flexible in meeting specific requirements (cf. Smart industry project team 2014a).

A networked industry could also allow Dutch companies in industries such as the high-tech industry, the chemicals industry, logistics and agriculture to keep up on an

international level and claims shares in key markets such as Asia. In order to maintain or carve out advantages even more, the project team believes the Netherlands should collaborate with other initiatives such as the German Industry 4.0 initiative. This would require adapting technical and communication standards in the various industries, which has not yet been implemented adequately. However, the project team also considers global adaptation of the economic standards as a risk, as increasing standardisation would also make it easier for outside companies to enter the Dutch market. Overall in the networked age the Dutch industry is facing having to serve volatile customer requirements and fluctuating demand for highly customised products whilst at the same time competing with low-wage countries (cf. Smart industry project team 2014a).

The project team considers a lack of communication and a lack of coordination between the ICT and manufacturing industry to be one of the big obstacles in a digitalised industry (cf. Smart industry project team 2014a). On the other hand, Dutch industrial companies are generally open to interdisciplinary cooperations and generally open to change, which is advantageous in transitioning to a networked industry. Another problem on the other hand would be a lack of venture capital to fund promising start-ups (cf. Smart industry project team 2014a).

The action agenda of the Smart Industry project team expressed the main objective with respect to the lack of understanding the importance of a networked industry as fist increasing awareness for this topic: According to it, in 2018, 80 percent of companies in the Netherlands would first understand the term smart industry, 40 percent of all companies would be using it – as a comparison: In 2015 it was only 14 percent (cf. Sol 2015).

3.5.2.2 Education and Skills

Unlike many other countries, thus far the Netherlands has not had a shortage of ICT specialists – Think Tank Empirica concludes in its 2014 analysis of digital skills for the European Commission. However, this does not safeguard the country for the future, as the requirements change. There also are several workers in the market who would not have net been able to transition from older to state of the art information technologies. So there could be a shortage of suitable workers in the future unless this is supported with additional and continuing education. Government initiatives to promote technical degree programmes and continuing education for technical specialists could be a first step, Empirica states (cf. Empirica 2014g).

In its 2014 report the Smart Industry project team urges that many companies already showing shortages in certain technological expertises, and according to employers workers are furthermore lacking a business and creative mentality. This would become an even bigger problem, as the competency requirements would quickly change with further technological advances – and adapting the educational system is taking a long time. The project team further ascribes the Dutch society to have a certain aversion for risk, which could thwart rapid and dynamic adaptation. The

authors of the report consider this perilous, as this prevents the potentials to create new jobs from being utilised and may thwarted digitalisation of the industry. Pursuing a policy of "continue" along the current path would result in job losses, the project team writes. It therefore calls for politicians to actively increase technical, computer and web-based, creative and collaborative skills among (future) workers. Specifically the ICT sector would need to primarily train process engineers in the coming years. Breadthwise, good computer skills and networked thinking would be essential for all workers. National and regional educational projections should therefore focus on training these basic skills with respect to ICTskills, the project team recommends (cf. Smart industry project team 2014a).

The science council for government policy pleads the training systems should further focus more on skills for occupations where it is difficult to replace people with machines, such as the social field. In addition to routine use, solving complex problems in combination with technology would also need to be taught. The educational system would also need to enforce the ability to abstract the functions of technology and then apply these to the respective situation (cf. Went/Kremer/Knotterus 2015).

To adapt education breadthwise the Smart Industry project team calls for a new school curriculum which incorporates creative thinking along with more technology lessons in schooling and adapt these to the needs of the industry (cf. Smart industry project team 2014c).

About four years ago the Dutch Ministry of Education already intended to draft a new curriculum for schools to better show the skill requirements of the future. In early 2016 the assigned project team presented its report. According to this, in the future all academic learning will be based more on the creativity and curiosity of young people and further allow more freedom and more personal responsibility in learning.

All available new technologies are to be used in future training. In addition to languages and maths, it will also better teach digital literacy and interdisciplinary skills and include these in the core curriculum. This would also ensure that pupils will be taught basic ICT skills, learn computer-oriented and logical thinking, systematic information search and dissemination of information using the internet, as well as basic programming skills. This will provide them with a feel for how to use media and information as well as technologies wisely.

The authors of the project report stress that in fact most young persons are already exposed to digital applications a lot in their free time. However, that does not mean they are also skilled in using them. It's not a given they're able to independently find valid information or distribute contents outside casual communication. This is primarily the case among pupils in less challenging training courses. They would therefore be taught more skilful use of ICT, as they would need these in almost all future occupations and duties.

The report divides the educational content into four components: One being Basic ICT skills, and these lessons are to ensure pupils are well aware of the opportunities the latest technologies provide – whether for work or for leisure. Pupils will further be taught a certain sense for subjects such as cyber security and privacy.

Under information literacy pupils are to learn how to find reliable sources among the masses of online information published by just anybody. Media literacy lessons are to enable pupils to consciously control their own media consumer behaviour and that of others. Computer-oriented thinking will teach pupils how to use or combine the respective ICT for problem solving. These lessons would for example teach pupils how to use large datasets. The authors of the report could also picture programming lessons or experimenting with 3D printers in lessons.

To prepare teachers for the new contents they will need to teach the authors suggest the schools cooperating with professional educational institutions for teachers which would continue to provide teaching graduates with support for several years after graduating (cf. Bureau Platform Onderwijs 2032 2016).

The Human Capital agenda defines higher education objectives. For example it plans to add more pupils to technical training at universities and polytechnics and make this training even more practical. Furthermore, life long learning should also become a greater focus among the actual workforce and more relevant training options are to be developed. The agenda envisions improved placements could train young junior staff directly in the industries which will have the most future demand (cf. Dutchdigitaldelta, Team ICT 2015). In order to improve contact between pupils and their future potential employers, according to the Human Capital agenda there will be more ICT specialists speaking at schools (cf. Dutchdigitaldelta, Team ICT 2015). A new university degree programme for big data is to be created and there will be new aid programmes for outstanding students in the ICT sector (cf. Dutchdigitaldelta website).

The Human Capital agenda states a great shortage of competent ICT teachers at universities and polytechnics. This could be compensated by training more ICT specialists seeking jobs to teach, the agenda proposes. A "hybrid teacher" could also be contemplated, which spends half the time teaching at universities and half the time working for companies (cf. Dutchdigitaldelta, Team ICT 2015). Specific labour market research on the needs of market will also be added to adapt placement (cf. Dutchdigitaldelta website).

3.5.2.3 Digitalisation and change in the working environment

In 2014 the Smart Industry project team among other things discussed the effect transitioning to Industry 4.0 could have on the number of jobs. The Team does not believe a precise projection possible, as there are too many imponderables: Even if automation initially causes lost jobs, it could later also create new jobs. In this respect the authors refer to increased need for design services and production plants possibly

returning to the Netherlands (cf. Smart industry project team 2014a). Humans – including the low-qualified – would further remain a flexible production factor so that massive robotisation and displacement of manpower should not initially be expected in the coming years. Instead, cooperation forms between humans and machines would develop, where machines will also take over some routine jobs for humans. However, the project team believes there is still great need for research, as many potentials and specific effects of robotisation cannot be adequately assessed yet.

The Rathenau Instituut, which analysed the effects of robotisation on the working environment for the Social and Labour Committee of the Dutch House of Representatives notes that many tasks will be automatable in the future. To date technological changes in the Netherlands had resulted in more employment, yet this type of change often does not come without failures and problems: politicians would need to invest in the necessary infrastructure and building stills in this context to cushion hardships (cf. Kool/van Est 2015).

The Smart Industry project team also believes it to be perilous for politicians and the domestic economy to wait instead of actively supporting the transition. This would allow other countries to pull clear in the competition for market shares and the best workers – which would certainly result in lost jobs (cf. Smart industry project team 2014a). With respect to potential changes to the working environment the project team advocates preparing less qualified workers to common changes in the work life: They should now already work more in independent project teams and learn to be more independent (cf. Smart industry project team 2014b).

The previously cited "Mastering the robot" report by Science Council for Government Policy (WRR) on behalf of the Ministry of Labour overall emphasises a technology policy centred around humans (cf. Degryse 2016). The science council criticises that public discussion is primarily focused on pushing developing new skills for the digital age. The WRR authors also believe this to be quite important but not sufficient. It would instead be important to also ensure the technological changes are controlled and regulated, and to create inclusive jobs, centred around humans. They stress that technology doesn't just fall in your lap but is developed by people and can therefore be controlled. This would also need to be done responsibly (cf. Went/Kremer/Knotterus 2015).

One concept highlighted in the report is that of "inclusive robotisation", which corresponds to the school of intelligent automation: Robotisation should only be pushed in terms of cooperation and as an extension of humans and machine. Humans should not be serving technology, but machines should aid people increase productivity and make work easier. Complementarity is the core concept for successful digitalisation, the WRR states. Furthermore, not only possible automation potentials but also concept for in which jobs human labour could be increased and improved should be contemplated. It would therefore be necessary to enquire more where people wish to actually have people performing tasks and providing services.

Another important item in the WRR report is the decision-making authority for work – the form, time, intensity – which would need to remain with the workers. The science council advocates creating an inclusive automation and robotisation agenda which includes employer and worker representatives equally (cf. Degryse 2016; cf. Went/Kremer/Knotterus 2015), and the recommendations of the Rathenau Instituut are along similar lines (cf. Kool/van Est 2015).

For this type of inclusive technology design it would be helpful for engineers to coordinate and base developing new technologies on the potential future users. The government and public administration could provide incentives by purposefully awarding companies contracts which implement these inclusive concepts, so the science council. Although the council does not openly advocate an unconditional basic income, it does stress there would need to be networks and backup instruments for those unable to keep up even in a complementary working environment between machines and people (cf. Went/Kremer/Knotterus 2015).

The Rathenau Instituut states the digitalisation progress in recent years had certainly entailed a trend toward limited, looser labour conditions. There likewise is more self-employment, which also involves more uncertainty for the individual workers – and in the case of involuntary self-employment in some cases also financial problems and great discontent (cf. Kool/van Est 2015). Politicians would therefore need to create regulations to ensure that contact between the self-employed and clients would also be subject to healthy working hours and conditions in the future, along guaranteeing fair compensation and access to continuing education (cf. Kool/van Est 2015).

3.5.3 Political and public-private measures

One demand frequently expressed in the Netherlands is, as described, to adapt the educational system more to the industry's needs for ICT skills. In 2016 networking companies and schools was specifically addressed in this context: A total of about 100 general guest lectures on ICT topics as well as 25 specific guest lectures on cyber security and big data are planned for this year (cf. Dutchdigitaldelta, Team ICT 2015).

To advance both research as well as the vocational training the action agenda by the Smart Industry project team is planning professorships on "New skills for a smart industry" in five regions. These professorships are intended to among other things create social innovations in a digitalised industry. In 2015 ten field laboratories were already set up where scientists come into contact with workers from industrial workplaces (cf. Smart industry project team 2014c). This is intended to involve the working population more in creating the transition by enabling them to exchange on training needs, working conditions and using the technologies amongst each other and with scientists. The field laboratories are also to develop electronic learning modules from the findings, which can then be used by various protagonists nationwide. Work at the field laboratories is to provide findings for long-term educational development and social innovations on the job (cf. Smart industry project team 2014c).

In its 2014 report on activities for digital skills in the individual EU states Think Tank Empirica rates the Netherlands as a country with high skills and average to high activity to improve these. According to Empirica, between 2009 and 2013 the Netherlands have both progressed in these activities as well as the general willingness for digitalisation. Empirica particularly attests the Netherlands strong political leadership in developing digital skills. According to Empirica it is further one of few countries also demonstrating activities to improve digital skills among senior staff. This category focuses on improving imagination and strategic aptitude among senior staff on how incorporating and the efficient use of digital programmes and IT applications in business processes. (cf. Gareis/Hüsing/Birov 2014).

The country intended to use a so-called Digital Champion to reduce the number of the digitally illiterate between 2009 and 2015 - The programme was provided with 2.8 million Euro in 2012 alone which came from the Ministry of Economy and in part from companies. For a long time the task force e-Skills Nederland, which resided with the Ministry of Economy, was a relevant protagonist in the Netherlands for a long time and among other things compiled reports on the state of digital skills (cf. Empirica 2014g). Empirica, however sees problems among the actual companies, as their wages offered specialists are too low, resulting in workers being available but some jobs remaining vacant (cf. Empirica 2014g).

In 2013 the Dutch government issued a so-called technology pact in response to the imminent shortage of technicians and technical specialists primarily also to be expected with further technological advances (cf. Waasdorp 2014).

In it the government states the objective to add 30,000 new technical specialists to the labour market both in the practical as well as the conceptual area in the future through a cooperation between universities, the economy and politics. By 2020 more pupils would therefore be studying technical disciplines. The percentage of pupils and university students with the respective training which will then also be working in technical occupations, is to grow from 50 to 60 percent. Furthermore, older workers with this educational background are to be reactivated in the technical field to keep their skills in the labour market longer. According to these plans, 7000 primary schools in the Netherlands would have added natural sciences and technical sciences to their curriculums by 2020. The government wants to use 100 million Euro to add more science teachers to secondary schools and to promote more technology units in lessons through targeted training programmes. Companies are further to provide 1000 placements annually in their technical departments (cf. Waasdorp 2014).

Until late 2015 the initiative "Digitally skilled and digital secure" (Digivaarding – Digiveeiling) served as a national alliance for digital skills among the Dutch working population. In public-private partnership between companies and the Ministry of Economy, programmes teaching digital skills were provided to pupils and university students, the working population and the unemployed since 2010 (cf. European Commission 2016e). The goals of "Digitally skilled and digitally secure" listed on the

EU commission's website were to provide 20 persons with advanced training in ICT and to provide 160 placements in this field (actual per commission website as of July 2016: 0), and 1000 teachers were to receive advanced training in using ICT (actual per commission website as of July 2016: 0). ICT training was also to be provided for 2000 pupils and university students (actual: 1000). On enquiry the project coordinator stated no enrolment numbers were recorded for "Digitally competent and digitally secure", so it is unknown how many the project actually reached. The effects participating in the training has on the individuals' job opportunities or whether it then enables better placement is also not being evaluated.

The initiative also supported the programme "smart and secure entrepreneurship in one minute", an online crash course for (prospective) entrepreneurs launched in 2012. This course was intended to teach the wise use of IT applications for their start-up / their companies. According to the project coordinator, a total of 12,000 have taken the course. How it affected the success of the respective start-up was not evaluated. However, in surveys many participants stated the programme was helpful.

On enquiry the project coordinator states they are currently working on a follow-up project for "Digitally competent and digitally secure" to improve the digital skills among the vast population.

3.6 Austria

3.6.1 Progress of digitalisation and potential developments

3.6.1.1 Integration of technology and economic effects

In its 2016 Digital Economy and Society Index the European Commission considers Austria a "progressive" country, as it had made great strides in recent years with respect to establishing a digital infrastructure, and particularly also developing skills for using computers, other IT and the internet (cf. European Commission 2016a). With respect to the five fundamental indicators, which include internet infrastructure, Human Capital and the integration of digital technologies, the European Commission considers Austria to be mid-table among the group of so-called pioneering EU countries (cf. European Commission 2016b). In integrating digital applications in companies, however, it only rates Austria ambivalently, as whilst many companies use e.g. electronic invoicing and an above average number uses RFID chips, at 14 percent a below average number of Austrian SMBs sell online (EU average: 16 percent) (cf. European Commission 2016a).

According to Evangelista/Guerrieri/ Meliciani (2014) between 2004 and 2008 Austria was further able to strengthen the effect of information and communication technologies (ICT) on the economy and society through increased integration of digital technologies in trade and services, job search and education: Austria doubled its results in its aptitude index.

A 2015 review of the European Working Conditions Survey (EWCS) 2015 shows: Just about 60 percent of Austrian workers constantly or almost constantly work with computers compared to the EU average of 52 percent. Whilst an EU average 44 percent of those surveyed report constantly or almost constantly using internet and e-mail, at 46.6 percent these numbers are also higher for Austria (cf. Schönauer 2016). This coincides with that according to Eurostat the percentage of jobs with web-enabled computers grew from 55 to 64 percent between 2009 and 2013 (cf. Eurostat 2016b). According to Eurostat, Austria's use of mobile applications for work is also widespread in an EU comparison; at 47 percent of companies mobile devices were used to surf the internet, at 46 percent mobile devices were used for e-mail and cloud or exchange services were used in 32 percent of companies (Eurostat 2016a). 45 percent of workers state they have been exposed to new technologies at their companies between 2007 and 2010 (cf. Schönauer 2016). With respect to digitalisation, and industry specifically, it is also interested how automated a production industry already is. One indicator among many is also the number of industrial robots per 10,000 employees in the manufacturing industry in a country. Here Austria has 120, a rather low figure compared to e.g. Italy or Germany (cf. International Federation of Robotics 2016).

Particularly strong growth in labour productivity compared to the 90s – probably also due to other cyclical factors – has not been achieved in recent years despite the increased use of technology use of technology, between 2008 and 2015 productivity per man hour increased by 5.9 percentage points (cf. Eurostat 2016e). The European Commission still perspectively assumes the development of digital technologies and the ICT sectors actually has positive effects on labour productivity: In one projection in 2014 it for example assumed that filling all vacancies in the ICT sector created in Austria by 2020 cold increase labour productivity by 0.36 percent total (cf. Lorenzani/Varga 2014).

3.6.1.2 Education and Skills

In the Digital Economy and Society Index of the European Commission Austria takes 8th place for Human Capital 2016. This ranking includes both the incidence of basal skills such as surfing the web or using chat among the vast population along with the percentage of actual ICT specialists among society. Digital skills among the vast Austrian population is above the EU average: 81 percent of all Austrians use the internet and about 64 percent of the population at a minimum have basic digital skills (EU average: 55 percent). Four percent of Austrian employees are ICT specialists, a little more than the EU average (3.7 percent). The percentage of graduates in STEM disciplines is above average (cf. European Commission 2016 a). According to a EU study the country doubled its percentage of ICT specialists in the manufacturing sector from about 1.5 to 3 percent of workers between 2008 and 2012 – which could be advantageous for developing a networked Industry 4.0 (cf. Lorenzani/Varga 2014).

Looking at the digital skills of the entire employable population during over time there is no uniform picture. The percentage of workers with average to advanced computer

skills for example only grew slightly, the percentage of workers with average and advanced internet skills on the other hand grew significantly, from 30 to 52 percent (cf. Eurostat 2016d). In 2015 only 20 percent of the employable in Austria had no or little digital skills, with the EU figure still at 25 percent (cf. Eurostat 2016f).

The OECD provided research on more complex skills in using ICT in its 2012 Survey of Adult Skills, which for example examines how advanced problem solving skills are among persons in technologically advanced environments. Here Austria scores quite well with 45 percent of subjects reviewed having level 2 and 3 skills compared to other countries, however about 13 percent of subjects were unable to solve tasks due to a lack of computer and technical knowledge (cf. OECD Publishing 2014).

3.6.1.3 Digitalisation and change in the working environment

One phenomenon literature (see e.g. Autor/ Levy/ Murnane 2003) has associated with new technologies and digitalisation for some time is the polarisation of the labour markets due to losses in occupations for workers with an average education. Profile statistics show that this type of tendencies toward polarisation in Austria arose with respect to formal qualifications, not in its pure form in recent years. Instead, those with high qualifications were primarily able to benefits, whilst both jobs for those with average and low qualifications recently saw cutbacks. The percentage of low-qualified workers among employees decreased from just under 30 to just over 10 percent between 1990 and 2015, whilst the percentage of high-qualified workers grew from just under 10 to almost 20 percent. At the same time, at 17 percent in 2014 compared to 12 percent in 2000, an increasing number of the working population is overqualified for their jobs – losing out on potentials (cf. Bock-Schappelwein 2016).

Projections on the overall employment trend and in certain occupations in Austria include technological advances as one of several components, e.g. in addition to demographic changes. The Austrian Institute of Economic Research (WIFO) primarily expects strong growth in the service sector of up to 211,300 jobs by 2020 (overall +222,600), with particularly strong growth in the healthcare and social sector (+2.1 percent annually) and educational professions (+1.3 percent annually) (cf. Fink/Horvath/Huemer 2014). However, the IT sector (+4.4 percent annually) and consulting, legal and tax services (+2.5 percent annually) should see the strongest growth (cf. Fink/Horvath/Huemer 2014).

Information and communication technologies and associated occupations will not only play a key role in the digitalisation of the entire economy, which is just starting, they have already gained significant importance in past years. Between 2008 and 2012 the number of ICT companies in Austria grew by ten percent, and the employment by 4.5 percent. From 2011 to 2013 the employment number in the industry even grew by 7.5 percent, whilst at 0.8 percent, employment across all industries saw far less growth due to the crisis (cf. Haberfellner 2015). And in this trend toward IT professions the less qualified could be losing out: The ICT sector already proportionately employs significantly less low-qualified than other industries – so there may be much less room

in this significantly growing sector for the low-qualified. Experts are in fact assuming further and much more rapid shift from occupations for IT workers with low and average qualifications toward management tasks such as e.g. at the business architecture level (cf. Haberfellner 2015). With respect to these projections only part of the Austrian IT workers appear well prepared: Out of 142,000 Austrian IT workers, 94,000 work at a management or specialist level, 48,000 of workers could be facing cutbacks and automation based on their simple tasks (cf. Haberfellner 2015).

The WIFO overall further assumes a positive work dynamic will particularly be seen in occupations at an academic level, particularly in technical, medical and socio-scientific occupations, where they expect an average job growth of at least 2.5 percent per year (cf. Fink/Horvath/Huemer 2014). "The employment trend will be ambivalent in occupations with an average qualification level: The demand for technical specialists and service occupations will grow above average, growth in for office occupations and trades will be weak, whilst the demand for systems and machine operators will continue to decline considerably." (Fink/Horvath/Huemer 2014: 11) The reasons being the demographic change which would increase healthcare occupations and the technological change which will initially also stabilise occupations at average levels in the technical field. WIFO attests bad prospects for office clerks and workers in accounting along with those in materials management: Pure writing jobs would definitely be displaced, just as machine operators, assemblers and textile workers will have to expect considerable cutbacks (cf. Fink/Horvath/Huemer 2014: 12).

3.6.2 Political Discussion

3.6.2.1 Integration of technology and economic effects

Discussions on the effects, potentials, opportunities and risks of digitalisation are very controversial in Austria. One important protagonist for example is the Austrian Economic Chambers representing companies. It primarily sees potentials and advantages in digitalisation. For example with 3D printers and their potentially "infinite" applications helping to substantially reduce waste in production or allowing for "custom mass production" and even faster production. The association speaks of practically optimally manageable automated production processes (cf. Pannagl 2015).

The Economic Chamber stresses that at a revenue of 27 billion Euro, the ICT sector, which is becoming more important along with digitalisation, is already nearing the tourism sector and for example in 2012 provided over 100,000 jobs (cf. Pannagl 2015).

The Austrian federal government also sees digitalisation as an opportunity for Austria as a business location, but utilising this and focusing on strong technological development would be vital. After all, all economic sectors will be affected, the analysis shows: From agriculture which will eventually have automated, networked harvesters, or the manufacturing sector and trade with new applications such as 3D printers, and service with potentials in technical consultancy, and in eTourism. Fields

where the economy should specialise in the future are cloud computing, data management, smart industrial applications and cyber security. To also increase the country's appeal for investors and specialists, in its Digital Roadmap of early 2016 the government announced its plan to specifically advertise the high quality training opportunities, data protection and environmental standards and to improve conditions for starting a business and creating jobs – for example by reducing bureaucratic hurdles (cf. Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016). The options listed in the Roadmap: "ICT specialist training, increasing vocational advanced training options, increasing qualifications in general – particularly in STEM disciplines" (Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016: 19).

However, the federal government also sees problems - for example that due to being better known, international online sales platforms could even eliminate domestic merchants if these finally also start selling online. With respect to Share Economy it writes it intends to ensure fair practices with new regulations, including "fair competition and particularly fair working conditions and compensation, along with similar obligations with respect to taxes, (...), social security" (Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016: 24).

3.6.2.2 Education and Skills

During a public consultation on ICT, in 2013 the so-called basic considerations for developing an ICT strategy 2014-2018 was created, lead by the Internet Society Competence Center appointed by the federal government. This addressed both infrastructure as well as competence matters with respect to using new technologies, e.g. through integration in school education (cf. RTR GmbH 2013). In the consultation document the authors criticised: "In Austria, ICT would first need to be recognised and utilised as part of the education and training process." and "an opportunity for integration must be created at the curriculum level." (RTR GmbH 2013: 46). After all the 2013 status quo was obviously quite different: "In technical methodology the internet – if at all – is often only used for visualisation to support classroom lecture. More active integration of this medium in lessons is rare and often fails due to ideas on educational implementation. (…) the youth is taught very little about the internet in schools which can in part also be attributed to responsibilities being unclear. There is no multidisciplinary curriculum to teach this knowledge and this topic is often not assigned to a specific school subject." (RTR GmbH 2013: 46) Building on its analysis of the current state the Internet Society Competence Center devised the goals to teach all pupils a defined minimum standard of ICT skills and to use ICT in secondary school grades at least three times a week. In 2018, 90 percent of Austrians are to be regularly using the internet, the maximum for people who have never used the internet should be 8 percent – in 2011 this was still 18 percent (cf. RTR GmbH 2013).

On enquiry the Ministry of Education advised these were basic considerations and the federal government has not yet committed to this as the target. The Federal Chancellery with the associated State Secretariat for Digitalisation which focuses on

this topic inter-agency, refers to its Awareness Campaigns intended to help reach these goals and e.g. is separately aimed at women, girls, the elderly and SMBs. There furthermore are various training projects for the vast population and for teachers as multipliers.

Instead of basic considerations on an ICT strategy since early 2016 the Digital Roadmap had been the basis for action for the Austrian government. According to this, "standardised digital skills" and job-related IT skills will be taught in school and an adapted form of it also in preschools, as well as in vocational training of course. Educators are to be trained in using ICT, for example to also teach younger children computer sciences in an age-appropriate format, "particularly in algorithmic and computational thinking". Girls and women are to particularly be supported. At the university level new models such as massive open online courses and open educational resources will be increased and be granted clear legal protection. Adult education will also be using new digital formats, such as webinars and serious games, along with using digital learning aids and resources to include the disabled or illiterate (cf. Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016).

The Association for the Electrical and Electronics Industries is also greatly focusing of qualification, as there was no alternative. After all, according to the assessment of the association there soon will in fact be hardly any jobs for the low-qualified. New skills would need to be developed for new job profiles, and e.g. machine operators would soon also need to be able to use 3D printers (cf. FEEI 2015).

The unions see similar needs – however worries that some could be excluded from (continuing) education options. It therefore demands that workers with all types of contracts and forms of employment must be offered advanced training, including crowdworkers or solo self-employed – to be paid by employers and the government, not the individual employees (cf. ÖGB/GPA-DJP 2015). Since digitalisation reduces the half-life of knowledge and it often comes down to direct application-specific knowledge for the respective job, there would also need to be more "training on the job" to accelerate knowledge transfer. But the structures are still missing and significantly more would need to be invested, e.g. the Union of Salaried Private Sector Employees, Graphical Workers and Journalists criticises. A minimum entitlement for paid leave for education purposes would also need to be established at an EU level (cf. Fritsch/Greif/Schenk 2015). The Federal Chamber for Employees particularly warns that some people could be left behind in the digital progress (Federal Chamber for Employees Vienna 2015). It calls for investments in placing digital skills during all stages of life and preparing schools and dual vocational training.

3.6.2.3 Digitalisation and change in the working environment

With respect to how digitalisation will change the working environment, the technology association FEEI points out employment potentials created by e.g. the new networked production. Here it refers to the example Infineon with its production site in Villach, where an Industry 4.0 pilot room was dedicated. Here, people and robots are working

closely and investments are particularly being made at this facility due to new developments in smart technology: By 2017, 380 new jobs are to be created, many in research and development, so FEEI. FEEI president, Brigitte Ederer, stated in December 2015: "It's not a matter if, but how we will be shaping a digitalised production and working environment. Without Industry 4.0 production will not stay in Europe." FEEI cites projections which state 40,000 new jobs will be created in the STEM sector in Austria in the coming years and networking the industry will even create 13,000 new jobs per year - which will then primarily require people with dedicated knowledge in the use of automated machines, as well as knowledge at the interface between ICT and process as well as speciality service knowledge (cf. FEEI 2015). The Austrian Economic Chambers also depicts flexibilisation potentials of a digitalised economy to be positive for workers: "Progressive digitalisation holds (…) potential for change in processes, the working structure and labour organisation within companies. On one hand the use of ICT would allow for more flexible and family-friendly forms of work (work-family balance) and therefore a better balance between work and private life, as well as more flexible assignments within the company. On the other hand, the integrating smart systems could also relieve employees of routine tasks along with maintaining productivity of older workers by being able to stay with the companies longer." (Pannagl 2015: 7).

However, this is countered by Benjamin Herr of the Department of Sociology at the University of Vienna, referencing a 2012 Eurofund study that many Austrian employees are not happy with the technological changes in their working environment: Just as Macedonia, Albania or Kosovo, Austria is ranking below the European average in this respect. Potentials are being missed: "When designed appropriately, computerisation of e.g. production, could yield positive effects in Austria. It could improve the quality of work and increase the percentage of excellent jobs – and fall into line with frontrunners such as Denmark, Cyprus, the Netherlands, Norway or Sweden. It further is an opportunity to continue Austria's trend to reduce the intensity of labour." (Herr 2016: 11).

Austria's trade union federation ÖGB also took position on this topic. Its "Digitalisation and its economic and social potentials" conference in autumn 2015 brought about a final declaration. It is the unionists among other things demand fair distribution of profits, e.g. in place of earned income, profits from business activities should have higher tax rates, as in the future employers will see even greater profits from the digitalised economy (cf. Degryse 2016). The Federal Chamber for Employees also stresses the need to actively improve the employment conditions in the digitalised working environment. This applies to e.g. reducing and limiting working hours, broad protection in terms of health and data and social security on a wide base (cf. Federal Chamber for Employees Vienna 2015).

Among other things, Austrian unions demand regulating the implications of digital technologies in the working life to also maintain a work-life balance for workers including for work irrespective of time and location and protect them from constant

accessibility (cf. ÖGB/GPA-DJP 2015). Furthermore, the phenomenons of potential downgrading of workers with low and average qualifications amidst smart technology, as well as increasing stress for the higher qualified due to increasing complexity and intensity of labour in their jobs would also need to be considered and addressed (cf. Fritsch/Greif/Schenk 2015). In addition, regulations on atypical employment and contract conditions which are increasingly being seen due to digitalisation would need to be improved: For example, those working from home or the self-employed would need to be legally protected against occupational hazards/accidents, and the self-employed would require better social security and self-organisation rights (cf. ÖGB/GPA-DJP 2015). Although the unions acknowledge there will be a growing number of new contract forms, they also demand preventing the current normal labour conditions from being undermined by crowdworking jobs. At the same time there would need to be suitable standards on the treatment of crowdworkers: "In this context we would need to find new ways on how to expand the scope of social norms and protection under labour law to the new and increasing forms of employment emerging with digitalisation." (Fritsch/Greif/Schenk 2015: 31).

The Austrian unions along with their European partner organisations also criticise the Digital Agenda of the EU for not containing any noteworthy social elements (cf. ÖGB/GPA-DJP 2015). Instead, the Digital Agenda of the EU only addresses the need to modernise educational systems to make them "digitally compatible" – and pays little regard to the impact of digitalisation on working conditions, the number of jobs and work organisation. Yet consistent European support for digitalisation from the political field is absolutely essentials, for example as crowdworking would easily allow jobs to be outsourced from regulated to less regulated countries (cf. Fritsch/Greif/Schenk 2015).

Representatives from business and politics have in fact so far been primarily focusing on qualification concepts. In preparation of Austria's 2016 Industriekongress in spring, Gisbert Rühl, CEO for Europe's largest steel distributor Klöckner & Co, for example commented on the effects of digitalisation in an interview. In it he states his company will be setting up a digital platform to primarily become a coordinator for supply streams. This would certainly eliminate more jobs than it will create, Rühl states. When questioned how he intends to involve his employees, Rühl stated: "In order to give all employees with the opportunity to be among the winners in these exponential developments, we offer our employees suitable training concepts. This is intended to ensure that Klöckner & Co-employees will acquire the necessary skills to survive in a digital Welt – and I am saying this deliberately now: including outside of Klöckner." (Industriemagazin 2016: 11).

Qualifications to survive on the labour market on their own – this is also a key element of the Digital Roadmap of the Federal Government, which promises better financial resources for (re-)qualification and better access through more online continuing education (cf. Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016)

On enquiry the Austrian Ministry of Labour stresses that to date the training programmes for the unemployed on using the new technologies offered by the Public Employment Service Austria (AMS) are far below the level of IT specialists. This is based on the "relatively low qualifications among the majority of the of the unemployed". "Training the unemployed for low to average qualification levels (application and distribution, more simple occupations in the ICT industry strictly speaking), however, could be defined as a crucial core of the AMS contribution to reducing the shortage of specialists. (…) Particularly the AMS funding for continuing education in IT for current workers heavily used by companies is gaining importance."

However, politicians believe qualifications alone would soon obviously not be enough, as evident in the Digital Roadmap: "Early focus on appropriately adapted training and continuing education requirements is becoming (…) essential. A shift to new and other business models and forms of employment also calls for discussions with respect to financing the public security systems." (Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016: 20)

For quality of working conditions with regard to technological changes the Roadmap defines the objective as: "Ensuring the lines between private and working life are observed; ensuring that employment in all new forms will guarantee minimum standards, particularly with respect to wages, fees, billing and social security including (collective) participation. Reviewing current social security standards for other forms of employment with economic dependence." (Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016: 26). This would also need to address how working standards can also be protected in business forms such as Sharing Economy. A fundamental reform of the social security systems is also not being ruled out: "(…) the debate on if and how both short-term and long-term negative employment effects can be cushioned or how to handle each employee excluded from the labour market and unable to find employment is therefore also inevitable." (Federal Chancellery/ Federal Ministry of Science, Research and Economy 2016: 26).

3.6.3 Political and public-private measures

Specific measures are primarily found in education and developing skills, both at a school level as well as in vocational training and adult education. As a 2015 analysis by the organisation European Schoolnet showed, thus far programming or applied computer science has only been integrated in lessons at some Austrian schools (pilot projects or regional initiatives). Special training and continuing education in programming for teachers is only offered at some universities; the Ministry of Education further has options for independent continuing education and awareness campaigns, but according to the report there is no widespread training program which could reach teachers breadthwise (cf. Balanskat/Engelhardt 2015). On enquiry the Austrian Ministry of Education writes that digital education is now already a "interdisciplinary material" and a mandatory element in all curriculums. On the 2nd secondary level there also are separate lessons on it. There also are new options in educator training, e.g. through the so-called Virtuelle Pädagogische Hochschule,

which is seeing increasing enrolment. The 2012 ICT Security Strategy of the Federal Chancellery adds a new element, the plan to make ICT training mandatory in teacher training and generally making ICT security a core component of adult education (cf. RTR GmbH 2013).

In its 2014 eSkills report for the EU commission research and consultancy firm Empirica provides further indications of specific measures in the field of education. According to Empirica, between 2009 and 2013 Austria was able to improve considerably with respect to its e skills activities, putting it among the group of countries demonstrating both strong eSkills activities along with being generally well prepared for digitalisation based on the Networked Readiness Index of the World Economic Forum. Austria had particularly ensured it was improving qualifications among groups which had previously been vulnerable and left behind in the IT sector, e.g. by adding more women to the respective degree programmes as well as introducing the elderly to the internet. Like Denmark, for example, Austria is introducing e-skills initiatives in almost all policy areas, but primarily in the education sector (cf. Gareis/Hüsing/Birov 2014).

An analysis and assessment of individual skills and educational initiatives Empirica stresses the importance of the Internet Society Competence Centre, which is to act as a coordinator and provide guidance for the digitalisation process (cf. Gareis/Hüsing/Birov 2014). A planned ICT Master degree programme, which the competence centre wanted to launch as a highlight along with the private Internetoffensive Österreich, however never materialised. On enquiry, Internetoffensive states this is due to the university landscape in Austria being shaped by autonomy and having shown no interest in an ICT Master.

"Sparkling Science" was a cooperation program between schools and universities launched in 2007, which initiated joint projects. As of July 2016 a total of 260 projects have been funded since 2007, with 60 projects currently under way, and the Ministry of Science had spent a total of 29.4 million Euro to date. Over 24,000 pupils and 1780 teachers from just about 450 schools directly participate in cooperation projects through it, along with 2830 scientists (cf. BMWFW 2016). On enquiry the Ministry of Science informed: There is no direct evaluation of the effect these projects have on participants' professional orientation and successful entry into the workforce. However, a strong multiplier effect is assumed, as long-term networks had frequently been formed between participating teachers, researchers and pupils and following the Sparkling Science projects some final school exams had also been tied to research projects. These are supported through the theme platform www.youngsience.at.

All initiatives of the Ministry of Education related to digitalisation have meanwhile been clustered under the umbrella brand "efit21". The Internet Society Competence Center has also established special structures, such as the priority lists issued twice a year, which among other things show progress and plans for digital projects in the field of education. It currently also lists the project "Centre for Digital Education Services".

This focuses on public schools offering learning portals and contents on digital lesson plans (cf. RTR GmbH 2016). According to the Ministry of Education, 70 percent of federal schools were already regularly using the platforms in 2015 to network, to work across classes or with digital teaching materials. Another important programme is the so-called "Mobile Learning" programme: This is currently used for e-Learning at about 95 school sites with little or low use of technology. Schools are for example being supplied with a total of 2000 tablets – up to 20 tablets per school - with a total of 1.06 million Euro being spent during the first round, and starting in 2017 the programme will be expanded to new sites (cf. BMB 2015). On enquiry the Ministry of Education writes: "The goal of the project is to increase eLearning using an interscholastic peer-learning approach and to utilise the education potential of the technologies in lessons and learning. Expert schools are supporting novice schools with no to little prior technology use. Educators exchange educational and didactic models and networking."

The initiative "digi.komp" on the other hand is serving as more of a guide. It provides an overview of the skills and qualifications pupils should have by the end of eighth grade and according to the Ministry of Education provides compact learning packages to use in lessons. Coordinated modules via seminars and e-Lectures support educators in their training and continuing education (cf. RTR GmbH 2016).

As of autumn 2016 there will be the "Big Data Tutor" for the tertiary level: This will specifically introduce university students to big data and the required skills through a five-part module "Data Science" at the Vienna University of Economics and Business (cf. RTR GmbH 2016). In this point it is exemplary how private protagonists are becoming active in preparations for digitalisation: The privately organised "Internetoffensive Österreich" co-created the programme, from providing advise on contents to supplying software and suitable datasets as well as finding suitable visiting lecturers. The Internetoffensive will further handle marketing the degree programme (cf. RTR GmbH 2016).

In 2014 the Empirica authors criticised that Austria is primarily focusing on schooling and not providing enough options for those already working – and the labour supply is therefore taking a long time to adapt to the new skill requirements. However, politicians responded with the Agenda for Life Long Learning launched in 2011, which also includes Maths and computer skills (cf. RTR GmbH 2013).

Politicians are now also working on the gender gap in professional ICT skills. To somewhat close this gap, in addition to general continuing education in IT for e.g. workers, the Ministry of Labour is also offering the "Women in the crafts and technical occupations (FIT)" programme. Through this programme the Ministry aims to ensure from the outset that more women will also be entering into promising occupations. Participants can receive funding for specific preparatory training, entry-level vocational requirements, as well as specific schooling programmes – however the Ministry does not provide specific numbers on enrolment and budgets. Potential IT

qualifications previously for example also included in the advanced vocational training programme "New Skills" were recently eliminated according to the Ministry of Labour – which contrary to the expected trends limits digital qualification opportunity through public programmes. On enquiry the Federal Chancellery states the Digital Roadmap Austria of early 2016 would now be used to better coordinate activities in the area of developing skills for digitalisation and then promote these more effectively.

In addition to education programmes, since 2015 Austria has also had an initiative dedicated to networked production, the "Industry 4.0 Platform", which is organised as an association. This is co-supported by the Austrian Ministry for Technology, employers' associations and employees' associations. The platform provides an overview of pilot projects in the networked industry supported by the Ministry for Technology. The association uses task forces to also address "people in the digital factory" and "qualifications and skills". Results of the task forces were not yet available as of August 2016, but the self-description of the first task force provides a prospect: "This task force therefore focuses on the human and his needs in the digital work environment. Technical possibilities should be shaped so both companies and workers view them as beneficial. The central themes are: Work organisation, data protection, organisation at the plant level, working hours, health and occupational safety." The other task force aims at identifying and eliminating gaps in the training system so employees are able to follow the digital change (cf. Industry 4.0 website).

When the platform was launched all parties involved expressed hoping to be able to collectively support the technological change through it and using the acquired findings. Rudi Kaske, President of the Chamber of Labour, for example called for involving workers in the technological development: "For employees Industry 4.0 means a big adjustment. With these initiatives we want to focus on exploring and supporting additional growth and employment opportunities. My particular concern is the required changes in education. Life long learning is expected from employees more than ever before. Our educational system needs to better prepare people for this." (Industriemagazin 2015).

3.7 Poland

3.7.1 Progress of digitalisation and potential developments

3.7.1.1 Integration of technology and economic effects

In its 2016 Digital Economy and Society Index the European Commission considers Poland "falling back", as it performs poorly in most categories such as connection, internet use, human capital or integrating new technologies in business processes in its investigation, and further showed little progress (cf. European Commission 2016b).

In the use of digital applications in companies the commission believes there is a lot of catching-up to do, as Poland is among the bottom ranks in almost all criteria: 2.8 percent of companies use RFID chips for networking (22nd place), 8.4 percent systematically use social media (27th place), 4.4 percent use cloud applications (27th

place) and only 9.6 percent of SMBs sell online (22th place) – with respect to international online sales, only offered by 3.8 percent of SMBs, Poland takes 25th place (cf. European Commission 2016a). The Think Tank Polytika Insight also assesses the integration of electronic means of transmission and digital applications for processing transactions as well as Poland's performance in term of online sales as negative. The latter is primarily due to consumers not showing much interest in online shopping (cf. Polityka Insight Research 2016).

In its analysis, Think Tank Polityka Insight states the Polish economy is only showing digitalisation above the European average in a few areas, namely the finance and insurance industry. These sectors had acted early with coordinated marketing tools and mobile payment systems and attracted customers as well as international investors. Business-related services are also well positioned. In the Polish building sector, the logistics/forwarding industry and in retail, on the other hand, digital applications are hardly being incorporated in business processes. Instead, the predominantly small companies are largely using outdated technology, Polityka Insight states. Even so, companies in the building industry had shown recent improvement with respect to digital infrastructure, which was also made possible through EU funds. In commerce there are many small, independent protagonists, which are also lacking assets to invest in a digital infrastructure and business processes (cf. Polityka Insight Research 2016). In the energy industry, primarily small, local companies with little capacity in renewable energies are pulling the overall average for the industry in digitalising business downward – which is also thwarting Poland's energy industry overall. The authors overall also rate digitalisation in the manufacturing sector rather poorly – industrial production is still vastly analogue (cf. Polityka Insight Research 2016).

Overall the low digitalisation performance of the Polish economy is also due to that at 12 percent of the working population, a high percentage of workers are still working in the agricultural and fishing industry – where digitalisation is still negligible (cf. Polityka Insight Research 2016).

Another main problem is that compared to competitors from other countries, Polish companies still have poor access to a network infrastructure and that outdated hardware and software is still widely being used (cf. Polityka Insight Research 2016). A publication of the Joint Research Center of the European Commission shows at least some improvement in the infrastructure facilities among Polish companies for the 2007 to 2010 period: Between 2007 and 2010 Poland's broadband coverage in the manufacturing sector grew from 16.4 to 25.6 percent of employees, access to mobile web-enabled devices grew from 9.4 to 16.6 percent of employees and the percentage of online sales among all sales increased from 5.2 on 7.4 percent. The average number of employees per company in this sector dropped by 7.1 percent during this same period. Here the Joint Research Center assumes a highly significant negative correlation between mobile devices and the number of employees, however does not interpret this, as it believes this is an isolated incident.

In the service sector broadband coverage grew from 38.1 to 47.3 percent of employees with this type of connection, 30.9 instead of 22.9 percent of employees had a web-enabled mobile device and online sales increased from 3.4 to 4.8 percent of all sales during the same period. The average number of employees per company in this sector dropped by 4.8 percent – here scientists did not determine any significant correlation (cf. Pantea/Biagi/Sabadash 2014). In 2014 Polish companies again dropped back in providing employees with mobile devices compared to other countries, although dissemination grew from 23 to 64 percent of companies between 2011 and 2014: In 2014 Finland had already achieved 89 percent, whilst in Denmark and in Estonia the percentage was still at 77 percent (cf. Lundblad/Andersson 2015).

Overall the percentage of companies in Poland with broadband connection is still low relative to other countries – in 2013 77 it was percent, in 2014 85 percent of companies had a broadband connection, whilst in 2014 the number in Denmark was already 98 percent, 100 percent in Finland and 96 percent in Lithuania (cf. Lundblad/Andersson 2015).

Mobile applications were recently also used less on the job in Poland than in other countries: In 2012 mobile devices were used to surf the web at 39 percent of companies, mobile e-mail was used at 37 percent, and 20 percent exchanged data on the road, 13 percent accessed special applications from mobile devices (cf. Eurostat 2016a).

Although broadband coverage for the vast population in Poland is similar to other countries within the region and in Scandinavia: Over 85 percent of households could have broadband in 2014. However, only 60 percent of these households actually subscribe to it. Demand is restrained, possibly because the average cost per household of 32 Euro per month is still comparatively high. With respect to mobile internet via smartphones on the other hand, access to faster networks appears to be the problem, in 2014 only 67 percent of households reported being able to access LTE networks from their mobile, which was about 99 percent of households in Sweden and Denmark. This may be why only 5 percent of the Polish used their mobile to surf the web in 2012. However, as observers state, with Poland being the largest country in this region, it is also facing the biggest challenges with respect to connecting all parts of the country and is making great progress considering the very low base level (cf. Lundblad/Andersson 2015).

According to Evangelista/Guerrieri/ Meliciani (2014) between 2004 and 2008 Poland had experienced the strengthening effects of information and communication technologies (ICT) on society due to increased integration of digital technologies in commerce and services, in job search and in education: In the authors' ICT aptitude index Poland doubled its figures during this period – and yet the country remains among the tail third of countries examined.

The European Commission assumes that upgrading digital technologies and the ICT sector will also have positive effects on labour productivity in Poland: In one projection in 2014 it assumed that filling all vacancies in the ICT sector created in Poland by 2020 could increase labour productivity by a total of 0.365 percent (cf. Lorenzani/Varga 2014).

3.7.1.2 Education and Skills

In its 2016 Digital Economy and Society Index the European Commission states the Polish population is rather hesitant in using digital applications, as only 65 of the population regularly uses the internet (EU-28: 76 percent) and only 40 percent of the population had basic digital skills (EU-28: 55 percent) – Poland takes 24th place among all EU countries in both cases (cf. European Commission 2016a). The European Commission further does not see Poland well positioned in the percentage of ICT specialists among the working population, which is 3 percent (EU-28: 3.7 percent) (cf. European Commission 2016a).

With respect to the percentage of ICT specialists among employees in the manufacturing sector, at about 1.6 in 2012 Poland scored relatively low and showed moderate growth compared to the 2008 value of about 1.1 percent (cf. Lorenzani/Varga 2014). With respect to the generally expected modernisation and digitalisation of the industry the business-related perspective seems interesting: The percentage of Polish Production companies, employing ICT specialists dropped from just over 15 to only just over ten percent between 2007 and 2014 (cf. Lundblad/Andersson 2015).

With respect to computer skills among the vast employable population, Poland made noticeable progress in recent years, e.g. the percentage of the employable with advanced computer skills grew from 12 to 24 percent between 2006 and 2014, the percentage of the employable with average to advanced computer skills grew from 33 to 51 percent. With respect to internet skills the percentage of the Polish employable with average skills grew from 18 to 39 percent between 2006 and 2013, whilst the percentage with advanced skills grew from six to twelve percent (cf. Eurostat 2016d). According to Eurostat, in 2015 32 percent of the Polish employable still possessed no or hardly any digital skills, so skills in using a PC and internet applications. The EU average was 25 percent (cf. Eurostat 2016f).

The 2012 OECD Survey of Adult Skills further showed: 25 percent of Polish subjects had little to no problem solving skills in a technology environment, and only just over 30 percent of subjects fell into the two highest aptitude levels (cf. OECD Publishing 2014).

Referencing the Eurostat data, Think Tank Polityka Insight remarks that every tenth Pole is unable to perform more complex online transactions or even use online applications. Although the Polish have attained higher educational levels than before, digital and technological literacy is not growing at the same rate, Polityka Insight

states. The authors criticise, that according to Eurostat, so far most Polish have been teaching themselves computer knowledge and skills or learn these from family members (with internet use seeing similar results). Only two percent have therefore learned from explicitly trained teachers. One reason for the overall low level of digital skills in Poland may be that better ICT skills have little effect on wages in this country – providing little incentive for continuing education (cf. Polityka Insight Research 2016).

This could also result in Polish citizens hardly using the internet themselves for online learning according to surveys. Online courses are practically not used at all – in Lithuania and Finland on the other hand about 15 percent of those surveyed used these courses.

Poland only has 0.5 higher educational institutions offering ICT and natural sciences courses per 100,000 residents (Latvia: 6.4, Estonia: 5.5, Finland: 5.7). However, due to its size, at about 45,000 STEM graduates in 2012 Poland is still the largest educator in ICT within the region. However, the innovative potential this may bring for new start-ups in future fields obviously can hardly be utilised in Poland compared to the other states. In 2012 it was only 15 start-ups in the ICT industry for every 100,000 workers in the overall economy (Latvia: 37, Sweden: 36, Finland: 32). At about 2700 start-ups in the ICT sector (1300 in the programming sector) Poland still had the highest percentage of these companies in the region in 2012.

The low budget for research and development in natural sciences and technological science also appears to be a big problem in Poland – both among private investments from companies as well as in the public sector: Whilst this spending was about three percent of the GDP in Finland, Sweden and Denmark in 2013, in Poland it was only about 0.25 percent of the GDP. Poland's public spending in this area in 2013 was also only 0.15 percent of the GDP (cf. Lundblad/Andersson 2015).

With respect to specialists of the future who could shape a digitalised working environment, the discussion often also involves integrating new technologies and skills in school education. To date Polish schools only offering programming in isolated cases and as an elective. However, this will be changing with the 2016/17 school year (more on this later).

3.7.1.3 Digitalisation and change in the working environment

With respect to die digitalisation, the focus is often – such as in the so-called eSkills report of the European Commission (cf. Gareis/Hüsing/Birov et al 2014) – on the employment trend in the ICT sector. Others, however, point out that a digitalised economy would not simply have a higher demand for ICT workers, but this would need to be distinguished (cf. e.g. Lundblad/Andersson 2015). Eurostat data on ICT production, installation and ICT-related services showed no notable growth in employment for any country between 2000 and 2010. Poland also had hardly any fluctuation, however it becomes apparent: ICT production in particular had seen

significant losses in employment percentages between 2000 and 2010, in Poland the percentage of workers in these areas compared to all workers decreased from 0.6 percent in 2002 to about 0.2 percent in 2010. ICT-related services on the other hand increased slightly to 1.3 percent of workers.

Overall the broader category of knowledge-intensive business-related services, which also includes ICT services, would gain importance in a digitalised economy. In Poland the percentage of workers in this field grew from 25 to 31 percent between 2004 and 2013. Here, services combined with ultramodern technologies play a key role, along with information and communication services: About two percent of all workers in Poland work in these two fields. It is further interesting that the majority of workers in business-related services are now working in a field which doesn't fit in with any of the current Eurostat categories. This could be a sign that the technological changes in the economy also changes the job categories (cf. Lundblad/Andersson 2015).

Overall, Poland still seems far from a working environment shaped by ICT: In 2014, at 36 percent a below average number of employees used computers and other ICT on the job (Sweden, Denmark, Finland: each over 70 percent). At six percent of the population, the percentage of persons who have already written a program related to work is very low in Poland (Lithuania: 9, Estonia: 11, Finland: 28). Observers presume that considering the current situation, the Polish labour supply will not be able to serve new interface needs – such as combining ICT skills with business administration skills or ICT skills with specific thematic expertise – well (cf. Lundblad/Andersson 2015).

Scientific discussions on digitalisation in the working environment usually consider banking occupations to potentially be significantly affected by automation and job losses (cf. e.g. Dengler/Matthes 2015). Poland - along with other countries - is now already seeing considerable change due to technological innovations, particularly in the banking sector: There have been significant cutbacks for several years, in 2013 the number of workers dropped to a five year low (cf. Sala 2014) and from 2013 to 2014 another approximately 2200 jobs were eliminated (cf. Boczoń 2015). In addition to mergers and stricture regulations from the European Banking Authority, observers believe one reason to be the increased use of online banking and the increasing number of automated tellers, which are eliminating an increasing number of jobs in customer service (cf. Sala 2014, cf. Boczoń 2015).

Some of the banks with the most cutbacks is BZ WBK: In 2014, 500 jobs and 50 branches were already eliminated. Late last year, its chairman Mateusz Morawiecki commented the growth in mobile business was also calling for gradually adapting to the new needs. Other Polish banks took similar steps and in addition to their online services also focused more on fully automated terminals e.g. in shopping centres (cf. Boczoń 2015).

Many banks on the other hand had outsourced the growing demand for data processes and analyses to other service providers simultaneously providing these

tasks for several banks, thus saving staff. The trend is toward customer service representatives at banks only conveying and supporting complex, sophisticated products – for which there is little demand. Process design, managing operational risks and the ICT infrastructure, human resources, data and product management and the business customer area hold better employment prospects. Particularly workers demonstrating cross-functional thinking and not only being well versed in one field would generally have better chances (cf. Sala 2014).

With respect to the general employment trend in Poland, the European Centre for the Development of Vocational Training (CEDEFOP) assumes that economic growth in Poland will not be effective enough to raise employment by 2025 to the same level as before the 2008 crisis. According to the CEDEFOP projection almost all new employment opportunities for the job seeking will analytically correspond to the number of replacements after former workers exiting jobs (cf. European Centre for the Development of Vocational Training 2015b).

According to the projection, the most employment opportunities in Poland by 2025 will be created for highly qualified scientists, engineers, workers in the health-care sector or educators in higher education: 34 percent of jobs should be for these groups of individuals. Employment opportunities requiring only fundamental qualifications on the other hand would hardly exist any longer in Poland by 2025: According to the projection these would only make up six percent of all vacant jobs (cf. European Centre for the Development of Vocational Training 2015b).

Overall, according to the CEDEFOP the most employment opportunities by 2025 by absolute numbers will be for the highly qualified, where there will be both a great need to replace exiting workers as well as high demand for additional workers. This resulted in about 5 million jobs to be filled between 2013 and 2025 for this group of workers. Whilst the need for workers with average qualifications is declining, many jobs will also need to be filled due to people exiting the workforce. By 2025 the need for replacements will only be about 50,000 jobs over the decline in overall demand. For the low-qualified the numbers will almost offset (cf. European Centre for the Development of Vocational Training 2015b).

An overall considerable increase in the qualification level among the Polish population will cover these changing requirements to some degree: CEDEFOP for example assumes that by 2025 about 56 percent of the employable in Poland will have a high level of qualifications, which was still at 35 percent in 2013 and only 21 percent of the employable in 2005. The percentage of highly qualified will therefore outnumber the employable with average qualifications, and according to these projections the latter should be at 36 percent in 2025 (2013: 53.3 percent). At under 8 percent the low-qualified employable would become a small minority. However, CEDEFOP does not assume the increasing qualification levels will be solely responsible for employment rising in Poland. Many, including highly qualified workers, will not be part of the labour market due to illness, not being able to work due to family obligations or a lack of

confidence in their job search. These would require targeted options such as training for entering the workforce or options to reconcile family and work, so CEDEFOP (cf. European Centre for the Development of Vocational Training 2015b).

3.7.2 Political Discussion

3.7.2.1 Integration of technology and economic effects

In order to prepare for and shape digitalisation of the economy, Poland published the so-called Operative Programme Digital Poland for 2014-2020 in 2014. This programme supported by EU funds in many areas (2.17 of 2.5 billion Euro are from the EU) the Polish government drafts a rough plan for digitalising the country. Through the Operative Programme 2014-2020 it among other things plans to also massively increase broadband access in remote regions, expand eGovernment services and improve digital skills among the population.

In the programme objective the government clarifies that information technologies are key for the Polish economy and all social processes will be dynamised. On one hand it could provide citizens with access to culture options and help improve their creative and intellectual abilities. Overall the new technologies hold many opportunities to save time, inconveniences and money, and to instead direct resources at the personal and professional development of the citizens. They could create new occupations and new job opportunities. On the other hand the new technologies could also further split society in the country, e.g. if parts of the society remain digitally excluded. With increasing application options of state of the art technologies the effects of non-use would also become more serious, so that active support and design of the technological transition will be required.

The government particularly sees potentials for the Polish, e.g. in programming algorithms, where Polish specialists only ranked behind Russian and Chinese specialists, placing them among world leaders in international rankings. These skills would need to be fully utilised to grow the Polish economy (cf. Ministry for Infrastructure 2014).

One of the previous programmes was the strategy to grow the information society in Poland by 2013, which also aimed at improving the infrastructure and digital skills. According to the Ministry for Digitalisation, however, it was never fully implemented. On enquiry the ministry did not specify a reason and instead stated the Operative Programme 2014-2020 is now being used.

Polish Euro-MP Michal Boni – former Minister for digitalisation in Poland (2011-2013) and data expert in the EU Parliament – recently criticised precisely this erratic digitalisation policy. Boni believes, Polish politicians do not understand that digitalisation will not only affect the ICT industry but that ICT should be meaningfully incorporated in all industries and all business processes. Unfortunately this understanding is in part also lacking in commerce, the politician states. Furthermore the competent authorities are not using a coordinated approach but are instead each

trying to push their interests – was had already hindered some projects such as public info portals and caused mistrust among the population. The anti-corruption agency regularly warning of bribery via digital applications is further adding to this and causing negative associations with the term digitalisation among the public.

To be able to use the potentials better in the future Boni for one calls for better coordination of political activities. Poland would further need to play a bigger international part in technological development to develop high performance networks and other infrastructure to even enable an industrial Internet of Things (cf. Boni 2016).

On an economic level networking and information exchange are beginning. The conferences of the Initiative for Polish Industry 4.0 for example are aimed at this (cf. Inicjatywa dla polskiego przemysł 4.0 2016). However, surveys such as those by ASTOR or LNS Research show the implementation of Industry 4.0 technologies are not as advanced, particularly in smaller companies (cf. WNP.PL 2016).

3.7.2.2 Education, skills and change in the working environment

Improvements in digital skills among the society, in addition to expanding broadband, is one of the action angles of priority in the Digital Poland Operative Programme for 2014-2020. In order to improve eGovernment, eLearning structures and digital inclusion, developed and less developed regions are also to receive money from the European Fund for regional development. In its justification of these measures the government points out that despite advances in the digital infrastructure, a lot of the Polish still do not use online applications. In 2013 this had still been 32 percent of the population – a percentage the government considers too high. Furthermore, 30 percent of computer users did not even possess basic computer skills and only used the devices to go online. Competent and effective internet use on the other hand is primarily being seen among the young, well educated in big cities.

A lack of appreciation for the advantages digital applications is one of the main reasons for people not using these or developing skills in its use. The programme would change this among the vast population by 2020. At the same time, in addition to fundamental digital literacy, excellence in the ICT sector – e.g. among young programmers and software developers – would require better support. After all, the country would not be able to improve without highly qualified persons with specific ICTskills (cf. Ministry for Infrastructure 2014).

To accompany the Operative Programme by 2020 the Polish government assigned scientists with compiling a catalogue of desirable digital skills. These will then be the basis for national initiatives to improve skills. The outlined skills in the catalogue also provide insight into expectations a digitalised economy and working environment.

The catalogue initially describes Poland as a country where new technologies would push and advance many innovative projects, but at the same time in 2014, 12 million still had never worked with new technologies for various reasons: These individuals

were "digitally excluded". The catalogue stresses this is rarely merely due to lack of finances. Instead, these persons are unmotivated or do not understand the opportunities they're missing out on. Otherwise, the catalogue suspects, these persons without their own fixed access to the respective infrastructure would be using computers and going online from libraries and other public facilities (cf. Jasiewicz/Filiciak/Mierzecka et al 2015).

The catalogue stresses, digital skills and digital applications should not be considered as separate from other skills such as flexibility and creativity. They would need to be combined with these stills to also yield digital skills advantages e.g. in working life. The competence framework is intended comprehensively and therefore also extends to almost all areas of life: Digitally skilled citizens should develop vocationally, but also independently find help for health problems online, continue education online and find information or become involved in politics.

With respect to professional use of digital applications the authors are referring to both basic applications such as job search and locating job-related information online, as well as the ability to e.g. use cloud applications to work in flexible teams regardless of location or time and work without fixed employment at a company. This also includes opportunities to establish their own companies with the respective online presence and contact opportunities. Citizens should also be able to use eLearning options for independent advanced training including certificates**.** They should further be aware of suitable actions to ensure more cyber security (cf. Jasiewicz/Filiciak/Mierzecka et al 2015).

The Think Tank Polityka Insight pleads that in light of the slow progress Poland has shown in digital skills to date, primarily the younger generations should be trained in the use of digital technologies more systematically and through specific strategies. Otherwise, the recent strong economic growth in Poland could not be maintained in the medium to long term (cf. Polityka Insight Research 2016). Euro-MP Michal Boni quite specifically calls for introducing programming at all grade levels as fundamental educational content (cf. Boni 2016), which will now in fact be done (more later).

To primarily also improve and adapt worker placement to new requirements, the Polish government aims to clearly bundle job services on an online platform through the Operative Programme 2014-2020. Furthermore, requests for job proposals in civil service are to be made more transparent and more accessible, and electronic applications allowed – the government thus considers the previous paper form to no longer be timely (cf. Ministry for Infrastructure 2014).

3.7.3 Political and public-private measures

In 2014 Think Tank Empirica determined in an analysis for the European Commission that Poland has increased activities to develop digital skills between 2009 and 2013. However, the country overall remains among the lower middle field among EU states with respect to skills activities as well as with respect to previous progress of

digitalisation (cf. Gareis/Hüsing/Birov et al 2014). Empirica explains the Polish government has recently put forth a lot of effort to acquire trainees for ICT and natural scientists, starting in 2008 for example there was a programme to increase the appeal of STEM disciplines at universities. In 2012 fields of study in ICT had been the most popular specialisation in Poland, however Empirica makes no statement on the role of the programme.

The vast population would benefit from the so-called eCenters, as they are attempting to improve the employment outlook for individuals by improving digital skills. According to Empirica, there were about 8000 of these assisted centres with internet access nationwide in 2013.

The Mazovia region with its economic centres of Warsaw and Plock according to Empirica had further programmes to specifically develop data analysis and programming skills among workers in medium-sized companies. There also were special training options for IT specialists – including the self-employed – to keep their skills up to date (cf. Empirica 2014f). Despite enquiries with Polish authorities, we were unable to obtain information on enrolment and the current status of these programmes.

The Empirica analysis only shows part of the Polish initiatives to develop digital skills based on the time, others only culminated later.

In 2012 the Polish Ministry of Education for example started the Cyfrowa Szkola (Digital School) programme, which was only implemented gradually. The programme aims at promoting ICT and electronic teaching materials in Polish schools. However, unlike previous initiatives, the main focus should not only be on the infrastructure, but also on conveying modern skills to use these.

The programme therefore consisted of a four-part package: In addition to equipping schools with network and computers, a canon of 18 textbooks was to be created over three years by 2015 to reflect the core curriculum and be freely available with the Creative Commons license (cf. Centrum Cyfrowe 2013). A converted 11 million Euro was provided for this purpose. Schools were to start receiving the first funds starting in September 2015 (cf. Adamowski 2015). In addition to this, the Digital School programme also plans to train teachers in ICT use through the so-called e-teacher programme. E-Student on the other hand is aimed at pupils threatened by exclusion and specifically introduce them to digital learning materials (cf. Centrum Cyfrowe 2013).

The National Centre for Advancing Education (ORE) is heading the Digital School programme on behalf of the Ministry of Education. It was most recently criticised, as in 2014 it had unexpectedly replaced those in charge at the team for creating digital textbooks and in the eyes of some observers had therefore jeopardised the success of the project (cf. Adamowski 2015). The Polish Euro-MP Michal Boni criticised in early 2016 the plan for a Digital School could not be implemented successfully in

Poland due to lack of concepts and funds from the Ministry of Education (cf. Boni 2016). However, there also were other protagonists who added to complicating the project: For example, in 2012 the publishing sector tried to fight books among other things being created by university employees and being made publicly available under Creative Commons license. They launched a media campaign and – however to no avail – lodged at complain with the EU (cf. Centrum Cyfrowe 2013).

Observers had also repeatedly demanded for schooling to also include skills such as programming. This will now actually take place. Starting the 2016/17 school year, programming will be incorporated in the current computer science subject at all school levels. This was previously only available through optional subjects such as the elective "Advanced Computer Science", which is only taught at some secondary schools. This subject is to teach both computer skills as well as programming skills and skills such as abstract thinking and working with data. To prepare for the introduction of the new contents in the new curriculum, according to the report teachers in Poland have already been receiving training since 2015 on how to use programming and PC units in education. However, the special training is not offered by the Ministry of Education, but through universities and NGOs at a local and regional level. Part of the funds for this are coming from EU project funds (cf. Balanskat/Engelhardt 2015).

The Digital Poland Operative Programme for 2014-2020 also includes a budget for the Digital School programme. With the Operative Programme the Polish government furthermore pursues the following other specific goals with respect to skills: By 2023 81 percent of the Polish will be using the internet at least weekly (2013: 60 percent), a maximum of twelve percent of the Polish will never have used the internet before (2013: 32 percent) and 54 percent will have average to advanced internet skills (2013: 42.8 percent). This is to be accomplished by 2023 using online training for over 370,000 persons in rural areas and another about 27,000 persons in developed areas. These trainings are to be arranged by non-government organisations, communities and educational institutions. To further promote excellence in digital applications, at least 245 programmers in less developed regions and another about 40 programmers in urban areas will receive financial aid. The government pays particular attention to supporting multipliers, such as developer projects, enabling new forms of digital learning through applications and in turn encourage their users to develop their own new digital applications. Furthermore, particularly programmers or web developers will be supported if their projects contribute to solving social problems (cf. Ministry for Infrastructure 2014). Poland is receiving about 135 million Euro for ICT training and other skill training for people in less developed regions from EU funds such as the European Regional Development Fund, and another 10.15 million for measures in developed regions by 2023 (cf. Ministry for Infrastructure Poland 2014). On enquiry the Ministry for Digitalisation advises the success of these measures had not yet been evaluated, as these are still in the implementation stage. In its correspondence the ministry primarily stresses the development of eGovernment and digital public services it is promoting – which is where recent activities have focused.

In 2013 Poland was one of the first countries in the EU to create a national Broad Alliance on Digital Skills modelled after the European Commission's Grand Coalition for Digital Jobs (cf. Alliance website). This coalition of about 50 publicly funded educational institutions, companies and non-government organisations aims at encouraging trainees and workers to learn digital skills – through specific activation measures and long-term options for life long learning. The skills are to be better adapted to the requirements of the labour market through the alliance and primarily practical experience of the companies involved (cf. Alliance website). The individual partners have made specific commitments, to be coordinated and reviewed by a separate council in the alliance.

According to the summary page of the European Commission on the Polish alliance, by July 2016 fractions of the goals the alliance had proposed in 2013 have been reached: Out of the 200,000 persons which were to be trained in ICT, according to the commission by July 2016 about 46,000 persons had been trained; out of the 10,000 educators which were to be trained in using new technologies in lessons, 1000 have been trained. According to this overview, until July 2016 the initiative has overall primarily been limited to conferences and seminars, but hardly established any long-lasting programs (cf. European Commission 2016e).

The figures from the initiative itself contradict the figures from the European Commission: The head project coordinator points out that 100,000 persons per year alone were being trained through a coding program at public libraries. Furthermore, the Samsung's "Coding Masters" project through the alliance had overall provided a total of 1550 teachers and about 55,000 pupils at 750 schools with special computer lessons in 2014 and 2015 (cf. Szerokie Porozumienie na rzecz Rozwoju Umiejętności Cyfrowych 2015).

And yet even protagonists from the alliance do not appear satisfied with their results. On enquiry the project coordinator stated there is mistrust and public authorities are generally lacking understanding of how important digital skills are for the employable. Authorities are therefore hardly investing any money in the alliance. Though the alliance was launched under the auspices of the Ministry for Administration and Digitalisation and according to the project coordinator the individual protagonists hoped for more support from politicians in the long term. The lack of funds on the other hand is limiting the alliance's capacity to act so that few actions could be implemented. It mostly comes down to initiatives of individual alliance members at a company and organisation level. However, there is no overriding evaluation on these individual projects, the project coordinator states. Findings on what the trainings on digital skills changed for participants or even for the specific employment outlook of those individuals is not yet available.

At a labour market policy level there have been two turns in 2015 which may be of interest in light of the potential changes in the labour market due to digitalisation: Last summer the constitutional court overturned the practice which had been established

due to the trade union law which was in effect until that time to deny the self-employed without regular employment contract with one client the right to trade union organisation. The Sejm further proposed legislation which limits the permitted term of concurrent limited contracts to 33 months. After such time, under current law the employee is entitled to an open-ended employment contract (cf. Czarzasty 2015).

On for other specific labour market policy plans within the context of digitalisation the Ministry of Labour writes effective 1 September 2016 a special committee will be established to draft new bills. These are to particularly aim at atypical forms of work and suitable legal protection for workers without regular employment contract and draft proposals.

3.8 Spain

3.8.1 Progress of digitalisation and potential developments

3.8.1.1 Integration of technology and economic effects

In the 2016 Digital Economy and Society Index the European Commission describes Spain's situation in terms of digitalisation as ambivalent: Whilst companies are in part being resourceful and bold in the use of new digital applications, the general population is rather poorly positioned with respect to digital skills and using digital applications (cf. European Commission 2016a). Overall the commission considers Spain on the cusp between gaining and pioneering countries (cf. European Commission 2016b).

With respect to integrating new technological applications in business processes, for example in the use of RFID chips, with 6.5 percent companies using this technology for networking, Spain is in third place among the entire EU. Furthermore, 21 percent of companies use social media for customer contact (3rd place). However, the European Commission stresses that for a tourism-based economy, Spain is making relatively little use of social media and is therefore foregoing potentials. Ten percent of companies strategically use cloud applications in their business processes (13th place). At 5.9 percent, Spanish companies are only performing poorly in international online sales, taking 20th place (cf. European Commission 2016a).

In the Index on the Aptitude Effect of Information and Communication Technologies (ICT) according to Evangelista/Guerrieri/ Meliciani (2014), Spain attains rather average values, and ICT therefore already have a significantly greater impact on business processes, job placement or education in 2008 than in 2004: The index value has doubled.

In 2012 the national authority monitoring telecommunication and information technology credits the cloud service sector with about three billion Euro of added value, and creating 65,000 jobs in the respective year alone and taxable gains of 678 million Euro. Based on an estimate of business consultancy firm Deloitte it further assumes that in 2012 every Euro invested in cloud applications contributed 1.63 Euro to the country's gross domestic product.

According to the analysis, the overall level at which cloud applications were established throughout the economy varied greatly. For example, at the time just about 20.5 percent of Spanish companies had advanced knowledge in this application. 24.7 percent were at least familiar with the term and with examples. 54.9 percent of companies on the other hand had no exact idea of what cloud applications are and how they could use them. Among small businesses, a whole 60 percent of companies hardly knew anything about the technology. Only 15 percent had advanced knowledge and skills in using it. So the analysis showed: Only 21.7 percent of companies knowledgeable in cloud applications also used this technology.

The key benefits Spanish companies see in using the cloud according to the analysis, is saving time based on simple and flexible access, cost savings and general improvements in productivity. Overall the investigating authority determines a lack of awareness of the potentials of cloud applications, which is keeping companies from making this purchase far more frequently than budget restrictions. However, the authority also states understandable concern among some companies, such as becoming too reliant on the individual providers of cloud applications or that their data would not be secure or remain confidential (cf. Observatorio nacional de las telecomunicaciones y de la SI 2012).

In 2014, Spain had about 140 multifunctional industrial robots per 10,000 employees in the manufacturing sector, placing Spain in the European mid-table (cf. International Federation of Robotics 2016). Employees at 40 percent of all companies used mobile devices to search for information online, and mobile devices were used for e-mail at 43 percent of companies. Online exchange and software applications were each only used at 24 percent of companies (cf. Eurostat 2016a).

In 2014 the European Commission estimated that filling all vacancies for ICT specialists in Spain by 2020 would increase labour productivity by 0.363 percentage points (cf. Lorenzani/Varga 2014).

3.8.1.2 Education and Skills

According to the 2016 Digital Economy and Society Index of the EU commission, 75 percent of the Spanish population regularly use the internet (EU-28: 76 percent), 54 percent of the population at a minimum have basic digital skills (EU-28: 55 percent) and 3.1 percent of the working population are ICT specialists (EU-28: 3.7 percent). Spain therefore performs below average with respect to human resources in the digital area. Spain only performs slightly above the EU average in the percentage of graduates with natural science degrees. The commission states it therefore hopes the digital Agenda for Spain drafted in 2013 will soon bring about progress (cf. European Commission 2016a).

In the percentage of ICT specialists in the manufacturing sector who could push a digital industrial revolution, Spain showed relatively little progress between 2008 and 2012: The Spanish industry grew this percentage of specialists among all employees

from under 1.5 percent to about 1.8 percent (EU-28: 2.6 percent) (cf. Lorenzani/Varga 2014).

With respect to overall computer skills among the working population Spain showed moderate progress. Although the percentage of employable with advanced computer skills grew from 28 to 39 percent between 2006 and 2014, the percentage of those with average skills on the other hand was stagnant at 24 percent. With respect to internet skills, on the other hand, the percentage of employable with advanced skills grew less – from 5 to 15 percent – whilst the percentage of the employable with average skills grew by 16 percentage points to 38 percent (cf. Eurostat 2016d).

In 2014 the national authority monitoring telecommunication also provided insight into the state of ICT use in schools, educational institutions and among teachers. This focused on developing basic skills for a new technologised working environment and aimed at specifically reflecting the assessments of teachers: 57.4 percent, thus a majority of teachers, specified the lack of time to incorporate digital applications in lessons and implementing the respective exercises with pupils to be a obstacles in using ICT. Additionally, 52 percent obviously do not believe to possess adequate ICT skills to teach these. On the other hand, far less teachers consider problems with the technical infrastructure to be a major obstacle**.** The lack of confidence may initially be astonishing considering 72.7 percent of Spanish teachers have had special ICT training. However, the investigation also shows: Only 23.7 percent of teachers possess advanced or average ICT skills, whilst about just as many only possess basic ICT skills. According to the investigation, teachers primarily show noteworthy deficits in understanding the technical processes, using multimedia applications and the using ICT for education.

The school complexes are obviously attempting to take countermeasures: 68 percent now offer their employees special continuing education. After most of the parties involved from the educational system consider the use of digital technologies such as interactive whiteboards to be beneficial: During the investigation most pupils and teachers stated these whiteboards make it easier to visualise facts and circumstances and involve pupils in lessons. 91.7 percent of teachers believe sensible use of ICT to facilitate teaching. 86.4 percent believe it encourages pupils to be more involved in the lesson and 57.9 percent believe ICT promotes autonomous learning. However, 71 percent of teachers only consider digital applications to be complementary, not the basis for lessons – whilst 14 percent would even only use it sporadically in addition to other forms and contents. According to the study, whether digital contents and technologies are being used sensibly still greatly depends on the respective individual teachers at 70 percent of schools than from the national education policy. For one this means there still is no stringent overriding strategy, and on the other hand a national master plan for all schools without involving the teachers in the respective councils appears to make little sense according to the study (cf. Observatorio nacional de las telecomunicaciones y de la SI 2014).

3.8.1.3 Digitalisation and change in the working environment

Labour lawyer Eusebi Colàs Neila specialises in the effects of digital applications on both companies as well as employees. His opinion is ambivalent: For one, productivity of companies could be increased and many processes can be simplified – which holds many advantages for workers. However, workers could also abuse electronic data transmission and communication technologies for unproductive, personal purposes. This in turn could encourage employers to monitor all employee communication and encroach on their rights on a massive scale.

Overall, Neila and other experts (cf. e.g. (González Ortega, 2004;) believe companies have gained more power over employees in recent years as new technologies are providing them with more monitoring options and could even use ICT to create detailed employee profiles.

Companies were working multinational and with scattered production responsibilities, jobs as well as operating procedures are changing drastically, Neila states. Unions on the other hand had not sufficiently adapted to the new technologies and the associated opportunities for more flexible working, Neila and other experts stated (cf. Stone 2006). Yet the technologies also provide the opportunity to revive connecting employee interests and spread these through new channels. One important tool, in addition to communicating via social networks and websites, would also be the new right for unions to contact employees at companies via their company e-mail and notify them of activities. Furthermore, actions and strikes could now also be supported and pushed promoted through media if the traditional mediums are greatly ignoring actions. Here, Neila references successful actions of Spanish employees in 2012 who documented their actions on Twitter and YouTube, attracting a lot of attention.

However, Neila states, not all aspects of new media and technologies are beneficial for workers. Digital applications could also undermine the organisational goal of workers, as it would be easier to maintain operating processes even if workers are on strike. The solicitor points out how for example in 2012 the telecommunications company Telefonica Movistar used their digitalised databases and networked systems to divert a service under strike to a different department. So the strike came to nothing. Neila sees this form of breaking a strike a new challenge for worker representatives. Strategies which could previously be used to exert pressure are now only somewhat effective – unions therefore need to develop new concepts. However, Neila also assumes the overriding regulation to protect employment rights would need to be adapted (cf. Neila 2013).

The European Centre for the Development of Vocational Training (CEDEFOP) aims its projections at the general employment situation and occupations potentially in demand in Spain by 2025. New technological developments are only one of several determining factors. According to this, employment still would not reach the level from before the crisis by 2025 – which will generally be achieved in the EU by 2020 according to the projection (cf. European Centre for the Development of Vocational

Training 2015c). Spain would therefore see minimal job growth, namely in transport, specifically in goods logistics and in business-related services, whilst production will thus decline.

Overall the majority of new employment opportunities is calculated to be coming from replacements, so CEDEFOP: In addition, by 2025 the number of jobs requiring new staffing would be nine times higher than true job growth. In absolute terms CEDEFOP expects the greatest additional need, thus most additional jobs to be filled by 2025, for workers with average qualifications, which is rather unusual on a EU comparison – the highly qualified are usually in greatest demand. A high need for restaffing however, would also create the absolute most employment opportunities for the highly qualified in Spain. Among low-qualified the overall decline in demand for workers will only be compensated by the high restaffing need, however at a little over two million vacancies by 2025 this group will also see the least absolute new employment opportunities.

Whilst labour market participation in Spain will decline to 54.4 percent by 2025 according to CEDEFOP (2013: 58.5), the qualification level of the employable will grow moderately. According to the projection, the highly qualified will then make up 37.8 percent of the employable by 2025, which was at 35.5 percent in 2013 and 31.2 percent in 2005. The percentage of workers with average qualifications, however, will see stronger growth: From 26.4 percent in 2013 to 31.1 percent in 2025. At 31.1 percent, there will be less low-qualified (2013: 38.1 percent) (cf. European Centre for the Development of Vocational Training 2015c).

3.8.2 Political Discussion

3.8.2.1 Integration of technology and economic effects

In 2013 Spain's government established the so-called Digital Agenda for Spain. The government aimed at the domestic economy participating more in the international competition in cloud computing, big data, smart cities and cyber security than before. The government believes this would require transforming business processes among companies and worker skills. The government therefore plans to establish campaigns and training to increase awareness for cyber security among the population. This aims at improving citizen trust in digital applications. Spain would further be made a competence centre for cyber security. The government further stresses that disadvantaged groups such as women and the disabled would be included in digitalisation processes more. One of the objectives from this: Specifically promoting entrepreneurship among women in the ICT sector (cf. Ministry of Industry, Energy and Tourism/Ministry of the Interior 2013).

In 2015 a platform named "Networked Industry 4.0" was created in Spain. According to the Ministry of Industry the initiative has three objectives: Increasing the added value of the industry (including through increasing export), securing qualified employment and developing digital solutions for specific local application. In a policy brief the main protagonists around the Ministry of Industry and telecommunications

group Telefonica presented the initiative and its plans for the coming years. In it the authors stress Spain would imperatively need to develop its own networked industry and its own concept for transforming the economy to prevent being outpaced internationally.

The Spanish model would be: Initial initiatives should focus on industries and production sectors which are generally pivotal to the Spanish economic output and are competitive on an international level. The focus should be on the applications which can best be implemented in existing processes among Spanish companies. SMBs should receive particularly strong support. The focus should be on technologies which enable companies and employees to utilise the production potential optimally: This could be e.g. collaboration platforms, data evaluation tools or new web-based forms of negotiation. The platform calls for developing a concept which could set long-term, cross-industry change in motion. In addition to training for digital skills in the industry, cooperation platforms are to be established to distribute digital application solutions across sectors – so it is calling for individual companies to cooperate, not compete (cf. Ministry of Industry/Telefonica/Santander/Indra 2015).

Spanish unions also see potentials in the new industrial revolution: Digital applications would allow for reacting to customer requests on short notice and with flexibility, as the Industria CCOO union states. The changed business models could macroeconomically yield added quality and lower costs. One weak point in the Spanish economy, however, is in knowledge management, which would need to be improved if Spain wants to take advantage of Industry 4.0 optimally. Only 38 percent of Spanish companies actually having an explicit digitalisation strategy is a problem (cf. Industria CCOO 2016d). In the industry it's merely ten percent of companies, a rate which is too low from a trade union perspective.

Observers further criticise: Many Spanish companies still have not understood that digitalisation could and will change not just a portion of but typically whole business models. They would need to develop even more digital services in the coming years, including for mobile devices, in order to be used where potential customers are found (cf. Corrizosa, Susana 2016).

3.8.2.2 Education and Skills

To allow for implementing the technical and economic goals of the Networked Industry 4.0 platform, according to the government's plans more multipliers for digitalisation and innovations will be placed with companies (cf. Ministry of Industry/Telefonica/Santander/Indra 2015).

In a 2014 analysis for the European Commission, Think Tank Empirica concludes that companies in Spain showed less personnel shortages than companies in other countries based on their specific requirements for digital skills (cf. Empirica 2014h). So the Think Tank does not see problems for the Spanish economy with respect to digitalisation yet. Statements from company representatives in the Spanish press,

however, looked quite different: Although Spanish companies are headed toward a digitalised working environment – there was a shortage of appropriately qualified workers for a digital revolution. These had emigrated due to the long economic crisis. Company protagonists state not being able to find adequately qualified workers and therefore actively seeking talent with digital skills beyond the typical advertising means. They are seeing a shortage of people with multidisciplinary skills in the technical and business management field (cf. Corrizosa, Susana 2016).

The Industria CCOO union also sees a vast difference between education among the population and the skills required in the labour market. Companies which want to be pioneers in an industrial revolution are hardly finding suitable staff – at five million unemployed and a high unemployment rate this dissonance between skills and need is particularly tragic. Unless changes are made in the educational system across the board, further segregation among the Spanish society would be imminent, as several population groups without basic digital knowledge could be completely left behind (cf. Industria CCOO 2016d).

Several company representatives are not stopping at complaining about a lack of specialists and are announcing initiatives. Certain IT companies have declared the goal to allow workers more time for the respective advanced training in ICT to adapt their skills to needs – and call for the entire economy to do the same (cf. Corrizosa, Susana 2016).

The Spanish government is also reporting deficits in the educational level among the population and self-critically states in the 2013 Digital Agenda: A country where about 30 percent of the population has never used the internet cannot possibly be modern and fit for the future. To revive the economy there should be far more ICT training in direct relation on the job applications for both the working population as well as for job seekers. The government considers this to be the duty of public employment agencies – so they should coordinate training is specifically offered in areas with the greatest current demand for workers. In this correlation the government for example refers to the growing need for ultra high-speed network technicians and installers which needs to be served.

Furthermore, university and vocational training should be adapted to the vocational requirements such as designing eCommerce, digital marketing and cloud computing. Targeted cooperations between universities and companies are to be established for this purpose.

The government not only wants to address digitalisation with respect to adult education, but the entire school education and improve the skills of pupils early (cf. Ministry of Industry, Energy and Tourism/Ministry of the Interior 2013; cf. Ministry of Industry/Telefonica/Santander/Indra 2015). The industrial union Industria CCOO still sees weak points in this area. It does acknowledge the Spanish industry would need to make massive investments in new technologies to keep up on an international level.

However, the same level of investments would be required in suitable personnel training. The continuing education system has been rather weak to date. Here the government would need to spring into action with training options to protect employees from casualisation, and furthermore new laws on education and continuing education would need to be established to ensure worker skills are developed. Likewise, the Spanish industry would need to invest in continuing education for employees. This has been gravely neglected thus far, CCOO states – but without the employees there would be no digital revolution (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015).

3.8.2.3 Digitalisation and change in the working environment

First we will highlight a company frequently considered as the symbol of a digital economy: Uber. Just as in other countries, unions in Spain argue in favour of strict regulation for Uber. The union UGT for example demands Spanish authorities to take action against Uber, as the company is "an illegal activity which opens the way to an underground economy and its duties and responsibilities to workers and users are still unclear" (European Observatory of Working Life 2016). These activities jeopardise thousands of jobs in the transport sector, the union continues. The industrial union Industria CCOO also believes platforms such as Uber and Airbnb to have the potential to cause a "labour anarchy" as in past centuries – without occupational health and safety, without employment rights (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). In autumn 2014 the Commercial Court in Madrid ruled that Uber is engaging in unfair competition against taxi drivers and prohibited the company from operating in Spain, which Uber in turn is trying to appeal. However, Uber would first need to cease their ride service in Spain. Instead since 2015 there has been Uber EATS in Spain, a restaurant delivery service. This domain was less regulated (cf. European Observatory of Working Life 2016).

Further deliberations of the union Industria CCOO, who has been dealing with this topic since 2015, is offering a broader look at the opportunities and risks of digitalising the working world. The union is drawing on the controversial thesis (cf. e.g. Frey/Osborne 2013; cf. Bowles 2014) that over half the jobs in the EU by 2020 are in jeopardy due to digitalisation (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). Compared to prior revolutions, the new aspect of the imminent technological revolution is that in addition to manual work, mental work would also be replaced and that specific computer skills will be required in practically all occupations. This would be a revolution for educated, highly adaptive, workers learning for life with a multidisciplinary profile of scientific, technical, engineering and mathematical knowledge. Workers of the future would need to be able to collaborate, posses good time management skills and be able to solve a vast variety of problems (cf. Industria CCOO 2016d). The working environment would further change to such an extent that the working population would be spread out more with less options to organise and be more isolated than in their former fixed jobs. The union fears competition between workers around the world will increase since most task can generally be performed

remotely via telecommuting and therefore the outsourced. Crowdsourcing and pseudo-self employment could transform typical employment contracts into contracts for specific services between workers and the client sooner. There also is the risk of zero hour or one-hour contracts, so that workers would never be able to accurately assess when they will be needed. CCOO acknowledges the need for lifelong learning, however stresses this would also mean additional stress and inconveniences for workers – who would therefore need to be protected from overly high expectations. Older workers in particular may otherwise encounter big problems, as they are not able to adapt as well. However, the union also points out that since they are experienced in the processes within companies, older workers could particularly contribute to developing good work technologies and organisational structures for the modern working environment. A lot of potential could also be lost here by proceeding improvidently (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015).

CCOO accuses employers of having reduced expenses for continuing education and adapting skills to new requirements for some time instead of adequately involving workers in developing new technologies (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). A modern industry, however, should not be aiming to only train workers only for very specific occupations within the respective companies: Companies would instead need to invest in advancing the general skills of employees to also equip them for more unsettled employment (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). Thus far the country's educational structures are not yet providing this (cf. Industria CCOO 2016d).

Contrary to these primarily negative associations with digitalisation, the union also considers Industry 4.0 to have the potential to draw more young people to the industry than ever, as digitalisation could give the sector a "cleaner" image, thus make it more appealing. However, caution would be required in order to also realise this appeal: Whilst many workers expect a networked industry to provide more autonomy and better duties, there would also be new, still unknown options for employers to monitor the quality and speed of work. These tools would particularly be problematic if the result monitored by the employers do not in fact show the effort put forth by workers (e.g. due to vital failed attempts).

In addition to this, the union also exposes the problems of legal uncertainties which still exist with respect to insuring workers against accidents outside the company when telecommuting (cf. Secretaria de Estrategias Industriales, Industria CCOO 2015). Business consultancy firm Cornerstone on the other hand points out that many Spanish companies are not yet faced with these heavily discussed risks: Telecommuting from home for example is only tolerated at 68 percent of companies, a rather low percentage when compared on a European level. Whilst there are tendencies to use mobile devices on the job and flexible jobs within the companies, a flexible work culture has not yet been established for the entire work organisation (cf. Cornerstone 2016).

With respect to technical innovations the union CCOO generally demands for workers would need to be informed prior to and during this type of process. The social dialogue would therefore also need to include technological change so employees can provide their feedback. With respect to politics, new work time models which ensure suitable standards for forms such as telecommuting would further need to be discussed and developed. Furthermore, there also is a need for security structures for those who despite all continuing education were unable to adapt to the digitalised economy and lose their jobs (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). It would be the responsibility of the government to ensure there will be no economy without jobs or without suitable specialists (cf. Industria CCOO 2016d).

These types of issues were also discussed during a round table under the auspices of the Spanish Ministry of Industry on digitalisation of the industry last summer which in addition to unions, business associations and experts for labour law and social security also participated in (cf. Secretaría de Estrategias Industriales, Industria CCOO 2015). The action plan for the Networked Industry 4.0 platform which was subsequently composed among other things established workers developing skills suitable for a digitalised working environment as one of the goals (cf. Ministry of Industry/Telefonica/Santander/Indra 2015). CCOO subsequently demanded establishing a permanent round table with all the stakeholders and partners in the social dialogue to shape the digitalisation of the working environment (cf. Industria CCOO 2016a). However, beyond building skills, this topic initially does not come up in the publications of the Ministry of Industry.

This may have prompted the union to now take action themselves: In summer CCOO announced it will be starting a monthly discussion format on the digitalisation of the economy in September 2016 (cf. Industria CCOO 2016b).

The union also infers need for action from a large study on this topic, which it presented in July 2016 (cf. Industria CCOO 2016c; cf. Industria CCOO 2016d): After all digitalisation would not only change the working environment, but also all social, educational, cultural and democratic processes. In this respect there would need to be an approach for including the various social groups. It would be the job of the unions to ensure preserving and advancing worker autonomy, creative and strategic options for action. The greatest challenge for unions would be skilfully managing workers and human resources in synergy with technologies, not the technological change itself: It would be a matter of negotiating new rights for a new working environment whilst covering new forms of work and tasks in a digital scope yet also hold workers together in collective negotiations (cf. Industria CCOO 2016d).

The President the union, Maximo Blanco, also stresses that based on the great changes in the labour market it would still be possible to adhere to the previous labour law, though this would now need to be adapted soon (cf. Industria CCOO 2016f).

3.8.3 Political and public-private measures

According to the report on digital skills among EU member states published by Think Tank Empirica in 2014, Spain made relatively little progress between 2009 and 2013 and remained among the group of countries with low skills and low competence initiatives. Training activities in the digital area – among other things due to the economic crisis – have hardly increased. Empirica suspects that during times of high unemployment rates and other consequences of the crisis, politicians are not spending a lot of time thinking about a future labour shortage. However, the Think Tank is calling to now address expanding competencies, since countries like Spain would not be able to recover economically if they do not keep up with current technological trends (cf. Gareis/Hüsing/Birov 2014).

Spain therefore compares unfavourably with Europe despite the country already having published the first strategy for shaping the information society around the turn of the millennium. In 2005 the so-called progress plan (Plan Avanza) was published, a program specifically aimed developing the digital society. In it, ICT-related business were to reach a volume of at least seven percent of the gross domestic product (cf. Colmenero-Ruiz/Pérez-Lorenzo 2015). ICT should generally be used to both achieve economic progress and increase productivity, as well as raise the general standard of living and reduce social inequality. In 2010 Plan Avanza 2 was published. Like the first plan, it centred around training citizens and workers in the use of ICT, but also focused more on the development of the ICT sectors and the infrastructure along with training for ICT specialists. The plans aimed at transforming the economy. In 2013 the progress plans were replaced by the Digital Agenda for Spain – a result of the 2011 change of government (cf. Colmenero-Ruiz/Pérez-Lorenzo 2015). It laid out nine subprograms including a technology training program with a budget of over 120 million Euro; an infrastructure and connectivity program with 11.1 million Euro to connect the population to the internet; as well as programs for wise ICT integration in the business processes of small and medium-sized companies – for which a total of 1.87 million Euro was provided (cf. Empirica 2014h). A sub-plan on digital inclusion and employability aimed at improving the population's digital literacy and skills for using ICT on the job (cf. Colmenero-Ruiz/Pérez-Lorenzo 2015). According to the government, companies have since trained 50,000 persons primarily from the disadvantaged demographic groups in the use of ICT and digital applications through this sub-plan (cf. Ministry of Industry, Energy and Tourism 2015b).

Due to the wide influence of regional entities and the autonomy of regions, Spain also has a lot of important regional initiatives. The 2010-2015 plan for literacy and digital training in Barcelona for example stands out in this respect. This aims at training 12,500 workers in technology and ICT skills and further support 12,000 young people with their vocational orientation by providing information and insights into the technology sector. 22,000 of the unemployed were to receive technology training and 1200 above age 55 were to complete special ICT courses. Furthermore, 30,000 citizens from the vast population were to receive basic ICT courses. A total of 6.4

million Euro was provided by these measures under the auspices of the Barcelona city council.

In autumn 2015 the Spanish Centre for the Development of Industrial Technology (CDIT) presented the country's current progress of digitalisation, specifically digital development of the industry. According to this, in addition to the Networked Industry 4.0 initiative various other platforms have come about aimed at developing solutions for intelligent factories and suitable human-machine cooperations (cf. Garcia 2015). One of these is Manu Ket, a public-private partnership between the Ministry of Economy and various companies aimed at exploring technological requirements in a smart factory.

Spain's autonomous regions have various special initiatives, such as in the Basque region with its technology transfer program "Basque Industry 4.0". In 2015 the region had invested a total of about 5.2 million Euro in research and development for networked industry solutions, CDIT states. Politicians and businesses are using public-private partnerships to among other things try to determine sensible sectors for the Basque economy to specialise in with respect to smart industry (they identified energy and ultramodern production). Catalonia also has its own concept, the Catalan Industry Program 2014-2020 with a chapter on industrial systems (cf. Garcia 2015). Various Spanish regions have further subscribed to Manunet, the network for progressive production launched by the European Commission. This provides funding for national both research and development projects (cf. Garcia 2015). Pilot projects for a networked industry in the textile and automobile sector are currently planned through the Networked Industry 4.0 platform (cf. Garcia 2015), which probably have not yet quite gotten off the ground due to an uncertain political situation in 2016 for months.

The Spanish Ministry of Industry obviously now wants to advance progress now and in April 2016 announced it will be investing a total of 177.5 million Euro in the Networked Industry 4.0 initiative to support companies during the transformation. A first contribution to achieve these goals was the website for the initiative, aimed at networking potential partners and providing information, including 20 so-called training videos which explain various aspects of digitalisation and its effects on the industry. Furthermore a so-called self-diagnosis service will be started to show entrepreneurs which areas of their production to update and the level of maturity of technology in their value added chain. There would further be specific advice for companies what specifically they can improve. This service had not yet been established as of July 2016 and should therefore still be in its development stage (cf. Ministry of Industry, Energy and Tourism 2016).

In order to adapt the training system the Ministry of Industry wants to allow companies more influence on school and university education. However, they would also need to create more jobs for average qualifications and allow more placements for university students in cooperation with universities. Creating post-doctoral positions within

companies would further also be government subsidised in the future, particularly for researching new technologies and sensible uses for the companies to later also use (cf. Ministry of Industry, Energy and Tourism 2015a). The government intends to specifically channel money from funds for life long extra occupational training in continuing education for ICT specialists to ensure they always stay up to date with technology (cf. Ministry of Industry, Energy and Tourism/Ministry of the Interior 2013).

In the school sector 330 million Euro from the EU fund will be used for regional progress in the coming years to expand the infrastructure. This will provide 6.5 million pupils at 16,640 schools with more ICT in lessons (cf. Ministry of Industry, Energy and Tourism 2015b). The Ministry of Education along with the steering committee for ICT already launched the Programme Escuela 2.0, so School 2.0, in 2009, which set up an ICT plan for schools: These were to receive digital classrooms and be connected to the internet to systematically integrate ICT and digital applications in lessons. From 2009 to 2011, 650,000 pupils were provided a laptop as learning material, 30,000 digital classrooms were set up and 160,000 teachers were trained in using and applying ICT in lessons. The ministry also set up more courses on ICT networks and experimental, innovative advanced ICT training (cf. Empirica 2014h).

On the hand, whether these teach advanced skills such as programming varies greatly by the respective regions. In Catalonia, computer lessons is an elective in the last mandatory year of secondary school, in the cities of Madrid and Navarra, however, this subject is mandatory. In Navarra basic programming for example is part of maths in sixth form. In Madrid some primary schools already offer computer lessons as an optional extra-curricular activity.

Teachers are offered ICT and programming training through the central state as well as through initiatives in the regions such as Catalonia. The Ministry of Education for example offers an online and an analogue training course to introduce teachers to programming (cf. Balanskat/Engelhardt 2015).

One relevant private initiative is the FTI Foundation of the Spanish Electronics Business Association AMETIC. It offers IT training for workers at ICT companies and user companies and provides both job seekers training based on the needs of the industry – which according to the Think Tanks Empirica entails high employment opportunities. The programme is 100 percent financed by the Spanish employment agency and an evaluation in 2013 showed that of the 11,000 persons trained, 60 percent were then able to find work in the ICT sector. However, in 2013 the programme was put on hold for now due to financial restrictions in Spain (cf. Empirica 2014h).

Spain has several coalitions for digital skills modelled after the European Commission's Grand Coalition for Digital Jobs. The Basque region for example has its own regional coalition which primarily aims at setting up a self-assessment tool for digital skills. There further are said to be various options for advancing digital skills

among the population. On a national level there is the Coalition for a Digital Economy which for one aims at promoting digital business forms, and to on the other hand also support developing vocational skills in the use of digital applications. According to the European Commission's website the coalition has to date provided advanced digital training for 7000 persons of the planned 6500, and furthermore reached 150,000 instead of the 80,000 originally planned through so-called Massive Open Online Courses – which addressed topics such as JavaScript programming, HTML5, online sales, web analysis and cloud applications.

The coalition further intends to provide 3400 placements (to date: 2400) and 3600 jobs (to date: 3000).

According to the European Commission's website the government spent about 8.7 million in 2013 and another 9 million Euro in 2014/15 to subsidise ICT courses for various population groups (cf. European Commission 2016f).

The Spanish Telecenters, which have also joined to form a coalition for digital jobs are also found throughout the country but operate on a local level. According to the European Commission these coalitions will provide 13,370 persons with training in the use of digital applications and ICT (to date: 12,700), and 600 teachers are to be prepared for using new technologies in lessons (to date: 570) and furthermore create awareness among other persons. One example for the work of the local Telecenter is the FIT4Jobs project, which recently trained about 40 young persons in Catalonia and Andalusia in Java Script programming and data evaluation over 164 hours of training with support from regional governments. 30 of them were able to find work with Everis after completing this special training (cf. European Commission 2016f).

Regarding specific regulations to protect workers in the digitalised working environment, the Spanish Ministry of Labour on enquiry writes the national government agency for occupational safety (INSHT) primarily advises small companies and project team as well as the self-employed with respect to occupational safety and prevention. The institute is further actively collaborating in the Spanish strategy for occupational safety and health 2015-2020 - with investigating and responding to the risks and effects of new technologies being a priority of this strategy. The ministry did not provide specific information on regulations in correlation with the digitalised working environment.

4 Conclusion

The topic digitalisation is well-established in the EU and its member states, and all nations examined have specific concepts on how to deal with the new technological development. More recently an increasing number of discussion platforms have evolved which deal with digitalisation and its relevance to the working environment with the participation of various protagonists. The EU concept of the Grand Coalition for Digital jobs, which is also intended to pool specific projects, also plays a role in this.

However, as of yet the tenor in most countries has been: There's still a lot to do. Hardly any country already believes themselves to already be a winner in digitalisation now, most assume large investments in a technical infrastructure and building skills are still required. Italy for example is setting up a billion-Euro program to promote technological developments, and Germany for digital equipment for schools. Finland has traditionally shown an extremely involved in digital developments, however also needs to process the setback from the Nokia crisis. Investments in technology and sills are also being made or coordinated on an EU level.

After examining various countries we can determine several commonalities in the discussion: There is a consensus that Europe could economically fall behind if it does not become involved with new technologies and its potentials. This could cost a lot of jobs – there are very different assessments on exactly how many jobs could in turn be in jeopardy due to digitalisation itself. Improving digital expertise is considered one of the key instruments in preventing massive unemployment. Most countries want to establish new education and qualification structures both in schools and universities as well as work. These aim at preparing the population for new challenges.

In addition to this there also are discussions on alternative backup mechanisms for people unable to adapt well. In France for example the National Council for Digitalisation proposes devising and examining pilot projects for an unconditional basic income. Likewise, in many countries improved social security for the self-employed and for other workers not gainfully employed are not only being demanded by worker representatives. They should not bear the risks of an economy potentially increasingly aiming at freelancers, crowdworkers and opportunity contracts alone. Poland recently formed a committee for protecting employees in atypical jobs. The French personal activity account also aims at protecting unstable employment history.

Among other things, the unions in the various countries intend to limiting the dissolution of work boundaries digital technologies could cause (e.g. with a right to disconnection). Whilst most protagonists in various countries call for being open to new business models, at the same time many demand evaluating the risks of e.g. a platform economy and minimise these through effective regulation: For example there should be transparency for crowdworkers on the business practices of their clients and agents, and adaptive models are to also impose tax liability for platforms. The respective government propositions have been issued by e.g. Austria in its Digital Roadmap among other things. Italy is already working on specific bills for wider regulation of flexible work.

From 2013 to 2016 many countries issued new plans specifically for the areas of technical infrastructure and building skills along with also establishing some new institutions, such as the Agency for a Digital Italy or the Grande École Numérique in France. Many countries created new curriculums which are gradually being implemented since 2014. They shift the focus on skills for a digitalised working environment, such as programming, networked thinking or problem solving with

assistive technology. France added computing lessons to primary and secondary schools starting with the 2016 school year, the Netherlands are discussing information literacy as a school subject. Great Britain recently expanded the computer lessons which were already part of the curriculum and focused it more on programming and technical skills.

So activity has increased everywhere, but progress and the approaches vary greatly between the countries. Whilst the population in some countries such as Finland, Great Britain and the Netherlands already use digital applications as a matter of course, other nations still have a long ways to go: Poland, Spain and Italy growing groups of the population are not yet using the internet. Italy and Spain are therefore first primarily addressing teaching basic digital skills. They're working round to topics such as a digitalised industry, e.g. with their own internet platforms on this topic, which other countries such as the Netherlands have clearly already had for some time.

Poland is making efforts to expand the digital infrastructure and improve digital skills, but there also are signs that political support is still being considered inadequate and public and private protagonists are not collaborating optimally. The government in Great Britain on the other hand is heavily relying on private protagonists. Large portions of developing skills are left to the private organisations Tech Partnership and British Computer Society. In addition to public-private partnerships, France is focusing on initiatives of the Ministry of Education and the Ministry of Economy, such as the newly established Grande École du Numérique. There generally also are opportunities for lobbying: In Great Britain, IT corporations exerted influence on shaping the new curriculums and lesson plans, in Poland Samsung is arranging the central Coding Initiative in many schools which trained about 66,000 pupils by summer 2016. In many countries such as Great Britain, the Netherlands and Spain, companies are to have greater say in school and university education overall, particularly in IT.

On principle many states are currently conducting many campaigns providing publicity, such as through so-called eSkills weeks and coalitions for digital jobs. However, the effects of previous initiatives have hardly been evaluated, making it difficult to make any statements on the success of various campaigns and programmes.

The table below again summaries the key points for the countries examined. Just as with the respective actions, we have picked out several characteristics to discuss which are specific to the countries. The table is therefore not intended to shed complete light on the topic but instead provide interesting and relevant highlights

5 Brief Overview

Country	Progress of Digitalisation (esp. 2016 Digital Economy and Society Index)		Particularities in the discussion	Measures
Finland	**Society:** *strong* **Regular internet use:** 91% **Basic digital skills:** 75% **No / poor digital skills (employable pop.):** 15% **Percentage of ICT specialists (employable pop.):** 6.7% **Teaching staff:** 50% of teachers feel too stressed by the trend toward IT in schools	**Companies:** *ambivalent* **RFID chip use:** 5.8% **Electr. information transmission:** 37% **Social media:** 21% **Cloud use:** 37% **SMBs with online sales:** 15 % **SMBs with intl. online sales:** 5.8% **Since 2005:** Massive decline in technology exports **Scenario:** Up to 49.000 new jobs with high network access	**Skills: Various protagonists:** Particularly discussion retraining older ICT workers following the Nokia crisis **Formation of the digital working environment: Ministry of Labour:** Opportunities in the traditionally strong Finnish gaming industry: General "gamification" of the economy = user-friendly interfaces and applications within companies. **Infrastructure/business: Government:** Many companies are too fixated on old business models, missing out on the potentials of new digital approaches	**Skills:** Moderate expansion activities based on strong digital skills; as of autumn 2016: New School curriculum incl. programming lessons; 50 million Euro to train teachers; retraining programmes for unemployed ICT specialists **Infrastructure/business:** Industrial Internet Business Revolution Programme 2014-2018 of 100 million Euro (Tekes innovation fund) funds company projects for new business models and work organisations through digitalisation.
France	**Society:** *ambivalent* **Regular internet use:** 81% **Basic digital skills:** 57% **No / poor digital skills (employable pop.):** 29% **Percentage of ICT specialists (employable pop.):** 3.5% **More pressure on employees:** External enquiries and machine processes dictate the pace of work more than ever	**Companies:** *ambivalent* **RFID chip use:** 2.7% **Electr. information transmission:** 39% **Social media:** 12% **SMBs with online sales:** 16% **SMBs with intl. online sales:** 7.9% **Unusual trend in broadband coverage:** At times declining coverage among employees in the service sector	**Skills: National council for digitalisation:** Civil rights for education and continuing education + digital practical training **Mettling report:** wage-based incentives for advanced digital skills training **Formation of the digital working environment/social security: Economic advisory council:** Tax relief for solo self-employed **National council for digitalisation:** Adapt social security systems to the need for protecting the solo self-employed; pilot projects for an unconditional basic income; employee health as an evaluation criterion for management	**Skills:** Moderate to strong expansion activities based on strong digital skills; as of autumn 2016: Programming in primary schools and secondary school; since 2015: Digital curriculum (1 billion Euro) → ICT training for 70,000 pupils + 8,000 teachers **Social security:** Early 2017: Launching the personal activity account → Cushion gaps in employment history (e.g. transition from employment to solo self-employment) = to account for new, more unsettled employment; principle: Points account, rechargeable with e.g. work activities; used for educational activities, financial aid for business formations or leave for family obligations

Country	Progress of Digitalisation (esp. 2016 Digital Economy and Society Index)		Particularities in the discussion	Measures
Great Britain	**Society:** *strong but room for improvement* **Regular internet use:** 90% **Basic digital skills:** 67% **No / poor digital skills (employable pop.):** 22% **Percentage of ICT specialists (employable pop.):** 4.9% **Observer projection:** In the medium term a higher shortage of workers with ICT skills, particularly software developers and IT managers	**Companies:** *ambivalent* **RFID chip use:** 1.6% **Electr. information transmission:** 17% **Social media:** 34% **SMBs with online sales:** 20% **SMBs with intl. online sales:** 9% **Government projections:** digital technologies could increase GDP by 145 billion pounds annually	**Skills: Commission for Employment and Skills (ties to companies):** Companies need to train workers in more comprehensively; government should provide incentives; employees need to be willing to learn for life; individual responsibility for suitable continuing education **Formation of the digital working environment: Unions:** The government's strategy on the digital economy hardly addresses matters related to the modern working environment; important: the education system should focus on human skills such as empathy/networking **Infrastructure/business: Government Office for Science:** Mode customised production in the digital age is an opportunity for British quality production; **Business representatives:** Threat of excessive regulation of new business models such as shareconomy	**Skills:** Based on strong digital skills strong expansion activities, though decreasing recently; since 2014: New school curriculum = computer lessons with strong focus on programming (influence of IT corporations); since 2005: ITMB masters programme as an employer-designed interface between management and ICT expertise; Tech Partnership competence council developed options for the school curriculum, IT corporations attempt to shape education **Formation of the digital working environment:** Tech Partnership competence council tries to create new opportunities for employment and entering the workforce in the IT sector through the national coalition for digital jobs
Italy	**Society:** *weak but gaining*: **Regular internet use:** 63% **Basic digital skills:** 43% **No / poor digital skills (employable pop.):** 25% **Percentage of ICT specialists (employable pop.):** 2.2% **Lack of funds:** Skill building plans are not funded adequately	**Companies:** *ambivalent* **RFID chip use:** 4.8% **Electr. information transmission:** 36% **Social media:** 14% **SMBs with online sales:** 6.5% **SMBs with intl. online sales:** 5.2% **Multifunction robots in production:** Strong use at 160 units per 10,000 employees **Skills gaps:** Recruiting problems in a quarter of ICT companies	**Formation of the digital working environment/social security:** **Italian Technology Cluster "Intelligent Factories":** Micro-factories for flexible production close to the customer; adapt jobs to include older or handicapped workers through "adaptive" technology **Infrastructure/business: Sustainability network ISIGrowth:** New investment bank for start-ups with innovative ideas in the digital field **Italian Trade Commission (Camera)**: Supervisory body from politics, business, science and unions to accompany technological change **Government:** wide eGovernment initiative to encourage more business to use digitalised business processes	**Skills:** Only slow increase in activities to develop skills with to date rather poor digital skills **Formation of the digital working environment:** Plan for a law to regulate mobile work without location and time constraints; objective: Regulate work for employees and solo self-employed outside defined working hours and outside of workplaces within companies, incl. working hours, right to disconnect and health protection; also interesting: Plan for a law on agile work. **Infrastructure/business:** Government's plan Manifattur@Italia digital per competere: Up to 10 billion Euro per year for tax relief, research and supporting post-graduates in the digital sector to 2025

Country	Progress of Digitalisation (esp. 2016 Digital Economy and Society Index)		Particularities in the discussion	Measures
The Netherlands	**Society:** *strong* **Regular internet use:** 91% **Basic digital skills:** 72% **No / poor digital skills (employable pop.):** 16% **Percentage of ICT specialists (employable pop.):** 5% **Wrong focus:** ICT training aimed at support, not on sustainable fields	**Companies:** *strong* **RFID chip use:** 3.1% **Electr. information transmission:** 45% **Social media:** 37% **SMBs with online sales:** 17% **SMBs with intl. online sales:** 10% **Working with web-enabled PCs:** At 78% unusually high percentage of workers **Competition for specialists:** 70% of ICT specialists worked outside the special sector in 2015	**Skills: Science council for government policy:** Focus on building skills for tasks where humans cannot be replaced **Platform Ons Onderwijs:** Plan for information literacy as a school subject = teach pupils to recognise "good" information **Formation of the digital working environment/social security: Science council for government policy:** Engineers are to design technical innovations in a dialogue with workers; guarantee social security for the employable which cannot be integrated **Infrastructure/business: Smart Industry project team**: Standard alignment with companies in other EU countries to develop joint competitive edges without opening the door too wide to international competitors	**Skills:** Strong expansion activities with so far already strong digital skills; 2013: Technology pact launched, objective: Add 30,000 new technology professionals to the labour market per year; initiative "Digitally Competent and Digitally Secure" (2010-2015)= digital training for pupils, university students, workers and the unemployed; initiative "Smart entrepreneurship in one minute"(2012-2015)= online course for founders **Formation of the digital working environment**: Plan for professorships for "New skills for a smart industry" in five regions: social innovations in the digitalised industry; launched 2015: 10 field laboratories = networking scientists - clarify workforce, need for continuing education and need to use technology; use to develop nationwide learning modules
Austria	**Society:** *strong* **Regular internet use:** 81% **Basic digital skills:** 64% **No / poor digital skills (employable pop.):** 20% **Percentage of ICT specialists (employable pop.):** 4% **Technology driven:** Almost half the workforce experiences technological change in the daily work routine	**Companies:** *strong* **RFID chip use:** 5.6% **Electr. information transmission:** 41% **Social media:** 16% **SMBs with online sales:** 14% **SMBs with intl. online sales:** 10% **Mobile business:** Business use of mobile applications above average	**Skills: Government:** Digital education for adults through e.g. Serious Games **Unions:** Publicly funded continuing education, including for solo self-employed and crowdworkers **Trade associations:** Train and make workers fit for greater job insecurity **Formation of the digital working environment/social security: Government:** Require shareconomy companies to pay taxes and provide fair social standards; use new technologies to better integrate the handicapped and elderly; reform social security systems **Unions:** Warns of downgrading people in the midst of technology	**Skills:** Strong digital expertise and strong expansion activities; targeted cooperation with new technologies between schools and universities; increased use of new technologies in schools through various funding programmes + develop suitable educational programmes **Infrastructure/business:** 2015: Industry 4.0 platform launched (politics, business, worker representatives); pilot projects for networked production as well as for "Humans in the digital factory"; Objective: Jointly steering technological change

Country	Progress of Digitalisation (esp. 2016 Digital Economy and Society Index)		Particularities in the discussion	Measures
Poland	**Society:** *weak but gaining* **Regular internet use:** 65% **Basic digital skills:** 40% **No / poor digital skills (employable pop.):** 32% **Percentage of ICT specialists (employable pop.):** 3% **OECD assessment**: Poor problem solving skills in a technical environment **Forsaken:** Digital skills are typically learned through family members	**Companies:** *weak* **RFID chip use:** 2.8% **Electr. information transmission:** 21% **Social media:** 8.4% **SMBs with online sales:** 9.6% **SMBs with intl. online sales:** 3.8% **Exceptions:** Highly digitalised financial and insurance sector **Companies lament problem:** Lacking network infrastructure	**Skills: Broad Alliance on Digital Skills:** Government does not understand the importance of digital skills, therefore little support for initiatives (unusually fierce criticism); **Government:** Many citizens are lacking basic digital skills - first requires basic development work, however only wise combined with creativity training **Infrastructure/business: Former members of the government/ business:** Polish government does not understand digitalisation to be a comprehensive economic concept	**Skills:** Rather poor expansion activities with to date average digital expertise; since 2008: Recruiting programme for STEM university students; regional training options for workers in SMBs: Data analysis and programming; refresher for employed/self-employed IT specialists; 2012: Digital school programme launched to expand the digital infrastructure and disseminate new teaching methods; 2016: Programming introduced as a school subject + respective teacher training; Broad Alliance on Digital Skills (50 companies and institutions) → Preparing the population for a digitalised working environment **Formation of the digital working environment/social security:** September 2016: Launched a committee to among other things protect workers in atypical jobs such as crowdworking
Spain	**Society:** *weak but gaining* **Regular internet use:** 75% **Basic digital skills:** 54% **No / poor digital skills (employable pop.):** 27% **Percentage of ICT specialists (employable pop.):** 3.1% **Teaching staff:** Half of teachers feel they are not equipped for ICT-based lessons	**Companies:** *strong* **RFID chip use:** 6.5% **Electr. information transmission:** 35% **Social media:** 21% **SMBs with online sales:** 16% **SMBs with intl. online sales:** 5.9% **Cloud economy:** Considered a hope with a prospect of billions in profits and tens of thousands of jobs	**Skills: Business representatives:** Lack of digitally skilled workers as they emigrated during the economic crisis; demanding: Granting employees more time for continued training in ICT **Unions:** Vacant jobs due to lacking skills pitted against 5 million unemployed; task for the government: Establish a civil right for education/continuing education; due to the risk of losing the job not only train for a specific job **Formation of the digital working environment: Unions:** Danger of telecommuting: Even more jobs can become flexible with respect to location and outsourced; opportunity in digitalisation: Making "clean" industrial jobs attractive again	**Skills:** Only slow improvement in developing skills with to date rather poor skills; since 2009: Increased use of new technologies in schools and related continuing education; as of 2005: Two government "progress plan" aimed at among other things improving digital skills among the population and companies; 2013: Digital Agenda for Spain → among other things 120 Million Euro technology training program and plan for digital inclusion; **Particularity:** Great importance of regional initiatives in autonomous regions (Barcelona, Madrid, Basque region) **Formation of the digital working environment:** Grand Coalition for Digital Jobs = government subsidised ICT training and placements

				<u>Infrastructure/business:</u> 2015: Introduction of Networked Industry 4.0 initiative; new plan 2016: Government invests 177 million Euro in Networked Industry initiative

Country	**Progress of Digitalisation (esp. 2016 Digital Economy and Society Index)**		**Particularities in the discussion**	**Measures**
Germany	**<u>Society:</u>** *strong but room for improvement* **Regular internet use:** 84% **Basic digital skills:** 66% **No / poor digital skills (employable pop.):** 20% **Percentage of ICT specialists (employable pop.):** 3.7% **Survey shows 2013 company assessment:** 70% of companies: Applicants lack a combination of business and IT skills, 57%; applicants lack IT skills	**<u>Companies:</u>** *strong* **RFID chip use:** 4% **Electr. information transmission:** 56% (1st place) **Social media:** 15% **SMBs with online sales:** 25% **SMBs with intl. online sales:** 9.2%	**<u>Skills:</u> Overall:** Importance of the German dual vocational training, discussions also through central "Industry 4.0 Platform" through Ministry of Economy, overall strong involvement from social partners **<u>Formation of the digital working environment:</u> Ministry of Labour:** "Work 4.0" initiative with "white paper" by late 2016 **Unions:** Ensuring participation and tariff commitment, right to continuing education **Business:** Less restrictive allocation of weekly working time **<u>Infrastructure/business:</u>** **Company:** Promoting rapid broadband expansion	**<u>Skills:</u>** Based on a high skill level moderate to strong expansion activities; "DigitalPakt#D": 5 billion Euro for digital equipment in schools; educational partner program of the Federal Employment Agency for using SAP: Vouchers for the unemployed among other things providing access to continuing education in IT (Evaluation 2011: 900 persons advised, 14,000 trained, subsequent rate for entering into the job: 70%); set up several discussion platforms, among other things on "Education and research for a digital future" in line with the IT summit process plus "Concept for new innovations" of the Ministry of Economy → Basis for better ICT training/ training models for advanced vocational training; **Shortcoming per observers:** No agency clearly in charge **<u>Infrastructure/business:</u>** Special start up funding (such as INVEST) and adapted tax models; programs to support specific technology (such as Smart Data, web-based services, ICT for electromobility)

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