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BETTER POLICIES FOR BETTER LIVES

Putting faces to the jobs at risk of automation

Key facts about the risk of job automation in OECD countries
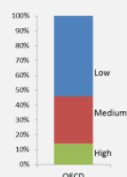
About 14% of jobs in OECD countries are highly automatable. Another 32% of jobs could face substantial change in how they are carried out.

The highest risk is concentrated in **routine jobs** with low skill requirements and often low wages WHILE the lowest risk applies to a broader range of jobs from **professionals to social workers**.

Automation mostly affects the **manufacturing industry** and **agriculture** BUT some service sector jobs are highly automatable too.

Training is not working to offset these risks as participation in training is significantly lower for workers in jobs at high risk of automation than for other workers.

Entering the labour market may become more difficult for **young people** as student jobs and entry-level positions have a higher risk of automation than jobs held by older workers.
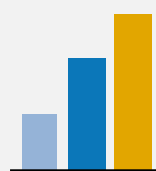
These estimates are subject to considerable uncertainty. Moreover, not all jobs that are technically automatable will disappear. Other jobs will also be created and so employment in total may continue to rise.

The tasks that AI and robots cannot do are shrinking rapidly

New technologies such as robotics and artificial intelligence are rapidly changing people's jobs and lives. They have the potential to free up workers to do more productive, less routine tasks and to provide consumers with access to more and better products and services. However, technology will likely change many of the existing jobs, requiring workers and companies to adjust. Some jobs may become entirely redundant although the extent of automation will likely depend on policy, institutions and social preferences.

There has been considerable public debate about the extent of job destruction and whether automation and digitalisation are leading to mass technological unemployment, in which many jobs will be done by computers and robots. This is fuelled by the perception that technological change is faster paced and broader based than in the past, making many more jobs automatable than previously thought. While only 15 years ago computers performed poorly in non-routine cognitive and manual tasks (Autor et al, 2003), cutting-edge technologies now open the possibility for tasks as diverse as medical diagnosis, insurance brokerage and driving to be automated.

While only one in seven jobs may be lost to automation, many others will change significantly

Given the current state of knowledge about the tasks that cannot be automated (the so-called engineering bottlenecks, see the Box below), new research by OECD suggests that 14% of all jobs across the 32 countries analysed have a high risk of automation (Nedelkoska and Quintini, 2018). A further 32% of jobs may experience significant changes to how they are carried out (Chart 1).

What are engineering bottlenecks?

The seminal work by Frey and Osborne (2017) identified three sets of tasks which currently cannot be easily automated, as their codification is challenging. These have become known as 'engineering bottlenecks':

1) Tasks related to perception and manipulation, in particular where they are performed in unstructured, complex situations such as operating in cramped work spaces.

2) Task related to creative intelligence, such as coming up with original ideas.

3) Tasks related to social intelligence, such as understanding other people's reactions in social contexts or assisting and caring for others.

☐ High risk of automation (>70%)   ■ Risk of significant change (50-70%)
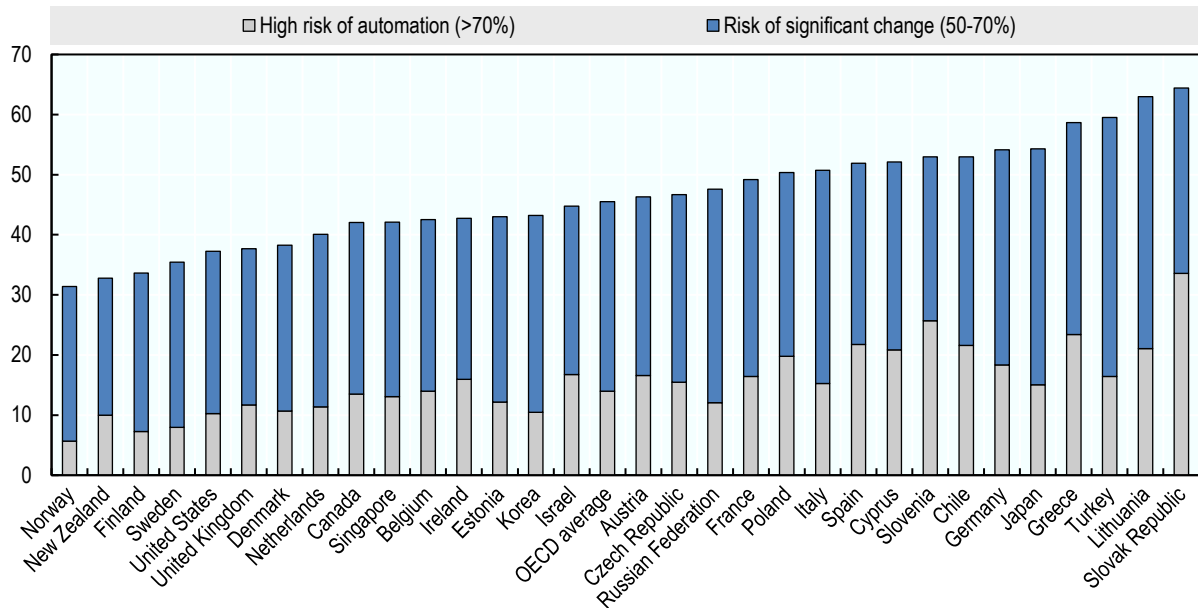
Notes: High risk – more than 70% probability of automation; risk of significant change – between 50 and 70% probability.

Source: OECD (2018), Survey of Adult Skills (PIAAC) 2012, 2015.

Whether workers lose their job as a result of automation or have to adapt to new tasks and job content, the challenge for adult learning systems is considerable. At present, about 40% of workers participate in job-related training, on average across OECD countries, but participation often amounts to just a few hours per year. In addition, there are substantial differences across countries and socio-demographic groups. For instance, data from the OECD Survey of Adult Skills shows that only 16% of workers in Turkey and Greece participated in job-related training in the year preceding the survey, compared with almost 60% in Denmark and New Zealand (Chart 2). At the same time, in all of the countries surveyed, the low-skilled receive much less training than their more skilled counterparts: only 17% participated in training on average in a 12-month window.

The training challenge is amplified by the fact that the risk of automation is not distributed equally among workers, making existing differences in access to training even more problematic.

Low-skilled people and youth are among those most at risk

Despite recurrent arguments that automation may start to adversely affect selected highly-skilled occupations, this prediction is not supported by the Frey and Osborne (2017) framework of engineering bottlenecks. If anything, Artificial Intelligence puts more low-skilled jobs at risk than previous waves of technological progress, whereby technology replaced primarily middle-skilled jobs creating labour market polarisation.
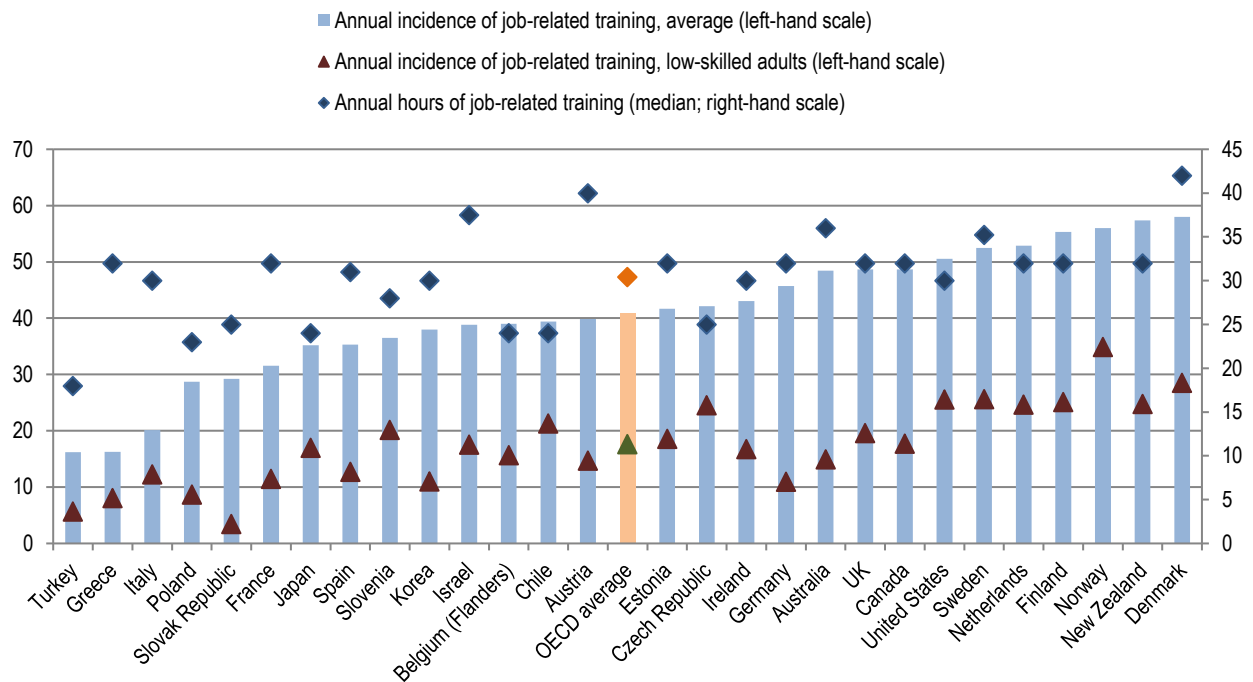
With the exception of some low-skilled jobs that, for instance, involve caring for and assisting others, the risk of automation declines as educational attainment and skill levels rise. Occupations with the highest risk of automation are predominantly low-skilled, such as food preparation assistants, cleaners and helpers, and labourers in mining, construction, manufacturing and transport. Occupations with the lowest risk of automation all require professional training and/or tertiary education, and include teaching, management and health professionals.

Looking at the risk of automation by age group, young people are most at risk, followed by older workers. Youth often combine studying with work in elementary occupations such as unskilled labourers, cleaners and in food preparation. In addition, even highly-educated youth tend to enter the labour market in junior and routine roles which are more prone to automation before progressing to positions that make better use of their cognitive and social skills. On the policy side, these developments suggest that new ways must be found to help youth obtain work experience while studying. In addition, the potential disappearance of entry positions would have implications for career progression in some professional areas such as law or accounting.

Chart 2. Low-skilled adults receive little training in most countries
Participation in training, OECD countries

■ Annual incidence of job-related training, average (left-hand scale)

▲ Annual incidence of job-related training, low-skilled adults (left-hand scale)

◆ Annual hours of job-related training (median; right-hand scale)

Notes: Figures refer to training undertaken in the 12 months prior to the interview.

Source: Survey of Adult Skills (PIAAC) 2012, 2015.

Automation may also be putting downwards pressure on wages and working hours

Automation is not a far-flung reality, but is already reflected in employment outcomes, such as unemployment, hours worked and earnings. Today, workers in occupations with a high risk of automation display much higher unemployment rates than those with low risk. Further, workers in the most automatable jobs work approximately eight hours less per week than workers in the least automatable professions.

Turning to wages, workers in jobs with a high risk of automation have lower hourly earnings in most countries. On average, a 10% higher risk of automation corresponds to a 4.3% decrease in hourly earnings. This suggests that those at risk of automation are often already in a vulnerable position in the labour market, which may be exacerbated as automatisation progresses.

There are reasons why the future may not be jobless

While the prospect that every second job in the OECD may be impacted by automation is daunting, it is only a technical possibility. The actual implementation of full or partial job automation will depend on a range of other factors such as technology penetration and

adoption, the cost of human labour relative to the new technologies and the social preferences for automating certain tasks. Take-up of new technologies lags behind their technical feasibility and some innovations are never widely implemented. For example, even if care services for the elderly could be automated, people may continue to attach a value to these tasks being performed by humans (Arntz et al, 2016).

Moreover, even if technology makes certain jobs redundant, it also creates new jobs and complements existing ones (Autor, 2015, OECD, 2017). Historical examples include the introduction of automatic telling machines (ATMs), which performed routine tasks handled by human bank tellers, but freed up their time for more productive tasks such as non-routine marketing and individualised customer services, ultimately leading to an increase in employment numbers (Bessen, 2015). Similarly, jobs are likely to be created for the development, implementation, maintenance and use of new technology.

Key policy priorities

The unequal distribution of the risk of automation raises the stakes involved in policies to prepare workers for changing job requirements.

Education systems will need to adapt to the changes brought about by automation and teach children and youth the skills that allow them to take full advantage of the current wave of technology adoption. This includes skills such as cognitive and social intelligence but also extends to the skills needed to work effectively in a digital context, both as specialists and users of digital technologies.

For those already in the workforce and whose jobs are being affected by technology, adult learning is a crucial policy instrument. Unfortunately, the likelihood of participating in any type of training, on-the-job and outside the job, is found to be significantly lower among workers in jobs at risk of being automated. Workers at the highest risk of automation are more than three times less likely to have participated in on-the-job training, over a 12-month period, than workers in non-automatable jobs. These differences also apply to training duration: individuals in jobs with the highest risk of automation spend 29 hours less in job-related training annually than those in non-automatable jobs, ceteris paribus. These findings point to the importance of training provision outside the workplace, particularly for workers whose jobs have the highest risk of being automated.

Effective and well-targeted adult learning opportunities for re-skilling and up-skilling workers are not all that is needed. For the smaller group whose jobs may disappear entirely, requalification must be accompanied by reinforced help from labour market and social policies. Newly created jobs may require very different skills from those that are being destroyed and may be located in a different region. These displaced workers would need adequate social protection, including income support, and tailored re-employment assistance.

Much of the variation in the risk of automation between industries and occupations reflects the way jobs are organised. Jobs with a smaller proportion of routine tasks or a more-balanced mix of routine and non-routine tasks have a reduced risk of automation. Hence is it is crucial to promote good practice in work organisation within firms and across industries.

Further information

This policy brief is based on Nedelkoska, L. and G. Quintini (2018), "Automation, Skill Use and Training", *OECD Social, Employment and Migration Working Papers*, No. 202, OECD Publishing, Paris, http://dx.doi.org/10.1787/2e2f4eea-en, which was prepared with the financial assistance of the European Union.

References

Arntz, M., T. Gregory and U. Zierhahn, (2016), "The Risk of Automation for Jobs in OECD countries: A Comparative Analysis", *OECD Social, Employment and Migration Working Papers*, No. 189, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlz9h56dvq7-en.

Autor, D., (2015), "Why Are There Still So Many Jobs? The History and Future of Workplace Automation", *Journal of Economic Perspectives*, Vol. 29, No. 3, pp. 3-30.

Autor, D., F. Levy, R.J. Murnane, (2003), "The Skill Content of Recent Technological Change: An Empirical Exploration", *The Quarterly Journal of Economics*, November, Vol. 118, Issue 4, pp. 1297-1333.

Bessen, J. (2015), "How Computer Automation Affects Occupations: Technology, Jobs and Skills", *Boston University School of Law and Economics Working Paper*, No 15-48.

Frey, C. B. and M.A. Osborne, (2017), "The Future of Employment: How Susceptible are Jobs to Computerisation?", *Technological Forecasting and Social Change*, Vol. 114, Issue C, pp. 254-280.

Nedelkoska, L. and G. Quintini (2018), "Automation, Skill Use and Training", *OECD Social, Employment and Migration Working Papers*, No. 202, OECD Publishing, Paris, http://dx.doi.org/10.1787/2e2f4eea-en.

OECD, (2017), *OECD Digital Economy Outlook 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264276284-en.

Violante, G.L., (2008), "Skill-biased technological change", in: Durlauf, S.N and L.E. Blume (eds.), *The New Palgrave Dictionary of Economics*, Second Edition, Palgrave, London.

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