FUTURION

Future skills

in a digitalized worklife

English short version

THE SKILLS OF THE FUTURE

Something that can be defined can also be programmed and by extension, automated. This is more or less how Carl Benedikt Frey usually summarises is world-leading research into the effects of automation on the labour market. Together with Michael Osborne, a colleague at Oxford Martin School in the United Kingdom, he has investigated which jobs may be taken over by computers in the future. Their research indicates that 47 percent of everything we do today can be replaced by robots and this is often interpreted as a threat to all routine jobs. In actual fact it concerns the replacement of repetitive routine tasks in various types of occupations.

As this report shows, the automation of monotonous jobs is nothing new. In historical terms, it has been the rule rather than the exception and is therefore no longer regarded as a threat. Instead, it is artificial intelligence, machine learning and an entirely new generation of robots that now challenge us. If machines are able to teach themselves, think and feel, what will then be left for us humans to do?

Research and history have shown that every technical and industrial leap forward has done away with heavy, monotonous and dangerous tasks while making more time available for creative, complex and analytical assignments. And in particular, more undertakings that require empathy and social skills. So in one way or another, machines have actually made working life more human. New technology has meant that we humans have increased our productivity, created new services and new jobs. The labour market is constantly evolving and changing. In fact, 65 per cent of children beginning school today will have types of jobs that do not exist yet.

Today's rapid technical advances pose new questions. What jobs will we have when robots are both smarter and more efficient than people? And how can we train for jobs when we do not yet know what they are? But the challenge today, in the wave of digitalisation and robotisation we see around us, resides as before in finding and interaction between man and machine. We must therefore identify tomorrow's skills. What are they; where and how can we acquire them? What characteristics and knowledge must we as parents foster in our children?

This report is a summary of what research has to say about automation and unique human skills. But anyone looking for simple training manuals will be disappointed. In an increasingly digitised and automated labour market, flexibility and constantly learning new things will be more important than trying to find training that will lead to jobs that do not yet exist. Learning must be a lifelong pursuit – both at school, at work and in leisure. The report provides a few pointers about what we should invest in. I'm certain that our conclusions will be a surprise. Among other things it concerns our view of children and youths devoting time to online games.

History is full of examples of circumstances, often in the form of technical innovations, that fundamentally change the conditions of working life. In our time too, developments of this type take place nonstop with constant technology shifts, computerisation, automation, robotisation and artificial intelligence, and at a faster rate than ever before. A large number of occupations and jobs have disappeared and many are endangered as a result of this development, while new jobs have been created.

In the acclaimed academic publication from 2013, *The Future of Employment: How susceptible are jobs to computerisation?,* Oxford scientists Carl Benedict Frey and Michael Osborne found that almost half of all existing jobs may be replaced by robots or computers in the next few decades. Examples of endangered occupations and industries mentioned include telemarketing, switchboard operators, watchmakers, engravers, seamstresses/tailors, machine operators, library technicians,

radio operators, cashiers and receptionists – i.e. occupations whose operations are in large part so governed by well-defined and repetitive patterns that they can be subsumed in an algorithm. Work that requires distinctly human skills such as social competence and creativity are significantly more difficult to codify into software and are thus considered safer in this regard.

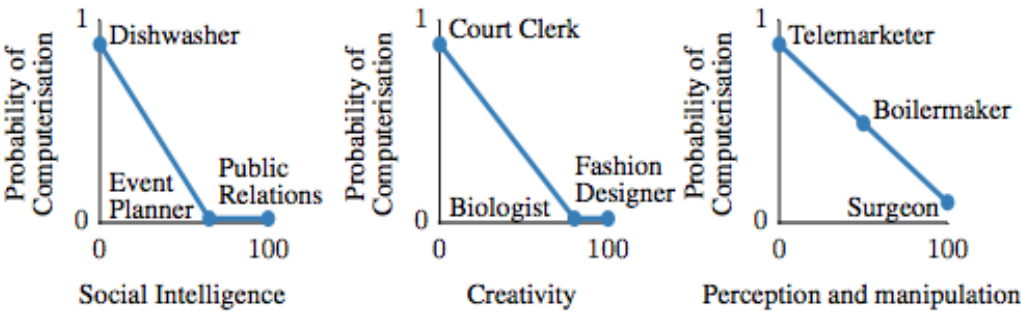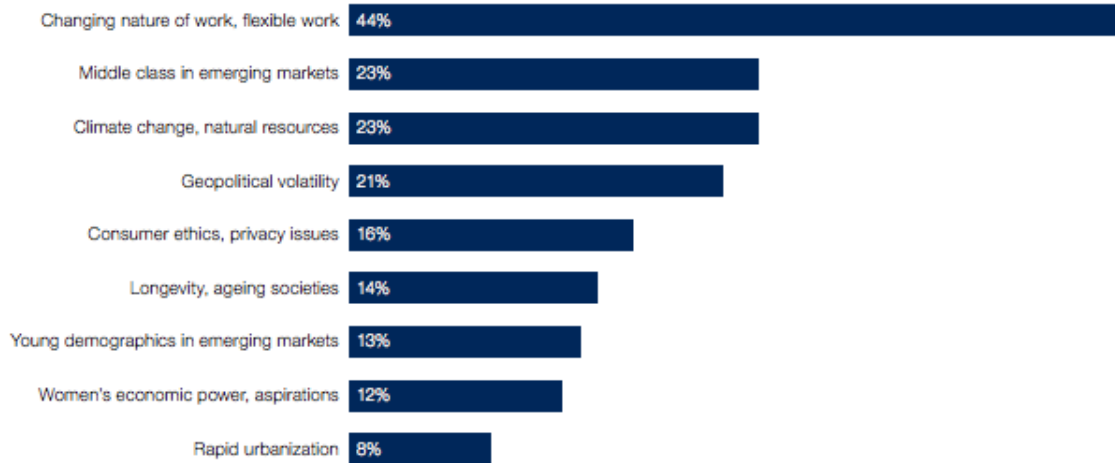This is an example for different kind of occupations:

FIGURE I. A sketch of how the probability of computerisation might vary as a function of bottleneck variables.
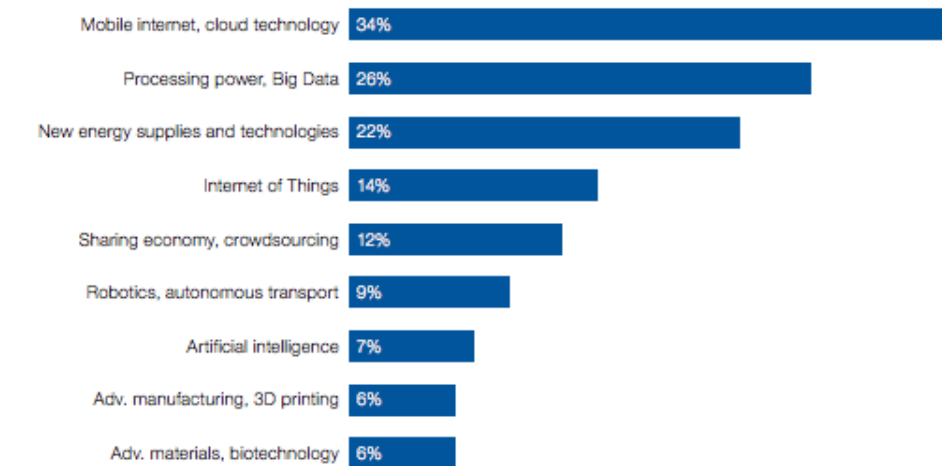
How will digitisation, robotics, artificial intelligence and associated developments affect working life and the labour market, and what are the factors behind the changes we face in the immediate future? A re-current term in the English language literature that has touched on the subject in recent years is "drivers of change". These driving forces may be of a demographic, socio-economic, and also of a technological nature. In its report entitled *The Future of Jobs – Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, the World Economic Forum conducted a comprehensive survey of chief human resources officers (CHROs) and other senior HR managers in 371 global employers with a total of over 13 million employees across nine broad industry sectors in 15 industrialised and emerging economies. In the survey, they had to answer questions about the changes they predict in the next few years in their respective industries.

Drivers of change, industries overall
Share of respondents rating driver as top trend, %

DEMOGRAPHIC AND SOCIO-ECONOMIC

Driver	%
Changing nature of work, flexible work	44%
Middle class in emerging markets	23%
Climate change, natural resources	23%
Geopolitical volatility	21%
Consumer ethics, privacy issues	16%
Longevity, ageing societies	14%
Young demographics in emerging markets	13%
Women's economic power, aspirations	12%
Rapid urbanization	8%

TECHNOLOGICAL

Driver	%
Mobile internet, cloud technology	34%
Processing power, Big Data	26%
New energy supplies and technologies	22%
Internet of Things	14%
Sharing economy, crowdsourcing	12%
Robotics, autonomous transport	9%
Artificial intelligence	7%
Adv. manufacturing, 3D printing	6%
Adv. materials, biotechnology	6%

Source: Future of Jobs Survey, World Economic Forum.
Note: Names of drivers have been abbreviated to ensure legibility.

In the opinion of the respondents, the professional categories where the most jobs will disappear as a result of these drivers of change are office/administrative jobs followed by manufacturing/production. There are also categories where the number of jobs is expected to grow, such as in financial services, management, computer science/mathematics, architecture/engineering, sales and education. However, the net outcome of the surveyed HR managers' prognoses is negative, i.e. jobs will disappear to a greater extent than new ones will be added.

There is a strong consensus that technological progress entails major changes that will have implications for the labour market and make new demands on the skills of the workforce. It is thought that above all unique human characteristics will continue to enjoy demand in a future labour market. But what are the characteristics referred to, and what are the skills that will be in demand?

Frey and Osborne note that occupations requiring higher education are generally less likely to be automated. Researchers predict that a major proportion of the jobs in the field of transport and logistics will disappear, as will most administrative office work. This is consistent with how technological development has been documented in research literature in recent years. Future skills Somewhat surprisingly, Frey and Osborne conclude that a sizeable proportion of the service industry is likely to be automated, a trend that will accelerate with the emergence of service robots, while formerly unique human mobility skills and dexterity will face increasing competition. On the other hand, analysts like Gunnar Karlsson, professor at KTH, say that in the foreseeable future, robots will be too expensive to economically justify the replacement of people to any appreciable extent. It rather concerns performing relatively qualified work cheaply through computerisation and cloud services.

When machines began to take over jobs that once required physical strength, education was the solution – if workers could no longer make a living using their muscles, they would instead have to provide for themselves using their brains. History shows that it worked. The better-educated work force was able to get more qualified jobs and higher pay. Or as Claudia Goldin and Lawrence f. Katz, authors of the book entitled *The Race between Education and Technology*, put it: "The industrial revolution started a race between technology and education--a race that education won for most of the 20th century". But the race is now in a lap characterised by entirely new conditions.

These days machines not only replace human muscle power, but also their brains. This development is likely to accelerate at an increasing pace in the coming years as machines with more advanced artificial intelligence are not only able to understand and perform what technicians used to program them to do, but also practically anything that they themselves are able to learn.

Frey and Osborne has also identified a number of "bottle necks" to computerization:

Computerisation bottleneck	O∗NET Variable	O∗NET Description
Perception and Manipulation	Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.
	Manual Dexterity	The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.
	Cramped Work Space, Awkward Positions	How often does this job require working in cramped work spaces that requires getting into awkward positions?
Creative Intelligence	Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.
	Fine Arts	Knowledge of theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.
Social Intelligence	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
	Negotiation	Bringing others together and trying to reconcile differences.
	Persuasion	Persuading others to change their minds or behavior.
	Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as coworkers, customers, or patients.

Accordingly, it is the extent or level to which one or more of these bottlenecks exist in a given occupation that has been assessed as low, medium or high. For example, in the case of manual dexterity, a low level is represented by the manual dexterity necessary to screw in a lightbulb. Medium is exemplified by packing oranges into boxes as quickly as possible, while high is the equivalent of performing open heart surgery using surgical instruments. This provides an indication of the level of manual dexterity computer-controlled equipment would need to display to perform a particular occupation as well as a human.

History has taught us that it is seldom wise to be uncooperative and oppose progress. These days hardly anyone mourns the arduous, monotonous and in some cases dangerous work that machines delivered us from during the first three industrial revolutions. The third of these gave us the computer, which has since come to utterly dominate within repetitive, often mindless information processing. The aforementioned Brynjolfsson and McAfee, the foremost thinkers concerning the man-machine relationship, point out that a computer (compute = calculate) was once a profession whose work consisted in adding up long columns of numbers.

While computers have led to the disappearance of a market for human number crunchers, the ability to analyze huge amounts of data has given rise to entirely new jobs in return. Today, we tend to see the computer as an essential tool – indeed an absolute necessity for the lion's share of modern

working life – that has to the fullest extent contributed to the prosperity we are accustomed to. It is the continuation of this trend that we are now facing. In all likelihood, the key to success is in learning to work with machines and not against them.

So how can we prepare ourselves for a labour market in transition? On the face of it, the predictions about the skills required in the coming years are sweeping and abstract. The most evident, and that which most analysts seem to agree on, is that the work force must be prepared to adapt quickly and effectively to whatever the prevailing situation happens to be. However, for now higher theoretical education seems to be the most favourable option both in terms of employability and earnings potential.

Digital skills are likely to become even more essential in the next few years, practically regardless of the industry concerned. The prognosis for Europe is not only a significant lack of people with basic skills, but also of digital specialists. Findings from an OECD study suggest that as many as one in ten adults in Europe today lacks basic computer skills such as scrolling through a website. Eurostat data from 2016 paints a similar picture, with one individual in four in the 28 member countries lacking skills or only having weak skills. However, the variation between EU countries is great and Sweden is in a relatively good position. There are calculations that show a lack of labour with digital skills in Europe will result in more than 750,000 vacancies in 2020, of which almost one third at management level. Therefore, we should be able to conclude that those who want to future-proof their skills should acquire IT skills, the more the better.

Furthermore, it would be wise to foster our own (so far) unique human skills, such as creativity and social intelligence – something that is not entirely easy to capture as it largely concerns so-called tacit knowledge. Tacit knowledge is naturally characterised by being difficult to verbalise, formalise or codify and thus also to teach, not only to human beings but also to machines. New research shows that (American) labour market demand for social skills has increased significantly. During the period 1980-2012, the number of jobs with high demands on social skills increased by almost ten per cent while more theoretical, less socially oriented jobs decreased their share by three per cent. The same research shows that social skills also lead to higher salaries, especially when combined with cognitive skills.

Table 4. Examples of skills required in New and Emerging occupations

Skill	Description	Skill	Description
Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.	Programming	Writing computer programs for various purposes.
Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making.	Management of Personnel Resources	Motivating, developing, and directing people as they work, identifying the best people for the job.
Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.	Service Orientation	Actively looking for ways to help people.
Instructing	Teaching others how to do something.	Systems Evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.

Source: O*NET, https://www.onetcenter.org/supplemental.html.

Perhaps it's reasonable to assume that children and young people who engage in online games – something that exasperates many parents – are in fact preparing for tomorrow's job market by learning technology while also getting practical training in virtual socializing with people from different cultures and parts of the world.

Change is seldom painless and there are many reasons to suggest that technological development may cause labour market problems, at least during a transitional period. Historically, technological innovation has not done away with labour; on the contrary, by increasing productivity, any form of automation that renders the use of labour more efficient also raises incomes. This generates demand for new products and services, which in turn create new jobs. At least, this is how things have worked so far. But we do not know too much about the types of jobs that will eventually be created. According to a frequently cited estimate by Cathy Davidson, a professor at Duke University, 65 percent of the pupils starting school today will be employed in jobs that do not yet exist.

According to Ray Kurzweil, director of engineering at Google and one of the leading experts on the technologies that are transforming our society, we may not need to worry too much that some jobs will disappear. In conjunction with a conference at Singularity University in the autumn of 2014, he described things as follows: "We are destroying jobs at the bottom of the scale ladder. We add new jobs at the top of the scale ladder. The scale ladder moves up. In order to keep up with that rising scale ladder, we need to make people more skilled." Brynjolfsson and McAfee are also fairly optimistic and believe that there has never been a better time for the entrepreneurs than now as technology acts as a multiplier for practically every invention or idea.

According to them, the response to how a new and growing robotised labour force should be treated is not to try to put the brakes on technological progress, but to speed up our institutions so that entrepreneurs, managers and employees can grow and thrive.