

The Future of Work: How G20 countries can create the conditions for digital-industrial innovations to create stronger high-quality employment as well as faster economic growth

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A new wave of innovation is beginning to disrupt industry on a global scale. It constitutes a tremendous opportunity for faster productivity growth, but also a potential disruption to job markets. The G20 should champion a comprehensive approach to leverage digital-industrial innovations for faster job creation and growth, with measures to re-align demand and supply of skills, labor market reforms, redesigned social safety nets, measures to promote digital innovation and facilitate the adoption of skills-augmenting technologies. Private sector companies should strengthen training programs. International cooperation, standards harmonization and interoperability will be essential to maximize the benefits and minimize the disruptions—the G20 can therefore play a key role.

Challenge

A number of G20 countries face high unemployment rates, especially among the young. Technological change has already displaced some sections of the workforce, though global competition and, in some cases, market rigidities have also played an important role.

In the coming years, technological innovation is likely to have a much more significant impact on the workforce. We are in the early stage of a digital-industrial revolution, as new digital technologies are beginning to transform industries: traditional industrial assets become intelligent interconnected devices; new production techniques like additive manufacturing revolutionize the way we design and build products; the widespread use of sensors and big data transforms the way that work is carried out on factory floors. Advances in robotics and artificial intelligence will further propel this transformation.

These changes have already fueled concerns that innovation will cause permanent mass unemployment and a significant further widening of income inequality. Bill Gates recently [argued](#) that it might be desirable to slow the pace of innovation; others have advocated the adoption of Universal Basic Income schemes.

We believe that slowing the pace of innovation would be misguided and counterproductive. Innovation remains the key to sustained economic growth and rising living standards. We also believe that technological change will ultimately result in more and better jobs—as it always has in the past. Accordingly, rather than slowing it down, it is important to continue fostering and enabling innovation, and stay ahead of the curve by anticipating technological changes that are bound to occur. This time, however, it will be even more important to manage the transition effectively, because this new digital dimension promises to make innovation in industry faster and more disruptive than in the past. This will require action on two fronts: (a) measures to enable the employment- and wealth-creating potential of new technologies; and (b) measures to cushion the social impact of inevitable transitory disruptions.

The digital-industrial revolution is already changing the demand for skills that the workforce needs to succeed in manufacturing and other areas of economic activity. Moreover, to capitalize on this revolution and turn it into a competitive advantage, it is important to better prepare the workforce to promote the quick absorption of this new technology in the economy. The challenge ahead is to understand this

prepare the workforce to promote the quick absorption of this new technology in the economy. The challenge ahead is to understand this evolving trend, accept its inexorability, and design a system of education and training able to endow workers with the necessary abilities, and to equip our economies with the appropriate flexibility and support mechanisms to allow companies, workers and societies to adapt quickly and successfully to the faster and deeper changes in front of us.

Coordinated action by the G20 in this area would be particularly useful, given the interdependent nature of the economies, and the need to foster a level playing field to allow the benefits of this revolution to benefit all stakeholders. Moreover, G20 countries should promote common standards in the measures to adopt to benefit from this development, given the need to ensure interoperability across G20 markets. These new technologies are based on platforms, ecosystems and collaboration frameworks—international cooperation, standards harmonization and interoperability will be essential to maximize the benefits and minimize the disruptions.

Proposal

This brief suggests that to meet the challenge, the G20 should study, promote and coordinate a multi-pronged approach, encompassing a range of concrete measures to enable societies within and beyond G20 countries to take advantage of the new industrial-digital paradigm. In the absence of concrete action in this area, there is a risk that the benefits of technological innovation will be negated by the same forces that are opposing the demonstrated overall benefits of open markets, free flow of ideas, information, people, capital, goods and services.

The proposed approach would involve the following elements:

1. **The G20 should initiate a study of the changing demand for skills brought about by technological innovations** so as to internalize the need to build the right pipeline of talent and to more closely align the demand and supply of skills. The study should be coordinated across member countries, with a unified methodology aiming to yield comparable results. It should be leveraged both to inform new policies and to actively promote better understanding of the issues among the broad population with an objective, evidence-based G20 public awareness campaign. The impact of technology on work is a fundamentally important issue that will require informed decisions at the policy, company and individual level; these decisions should be built on a stronger basis of knowledge and understanding of the issues.

The academic literature has identified a visible decline in the need for “routine” tasks, defined as activities that can be well described by a codified set of instructions. By their nature, these tasks are more likely to be successfully executed by a computer—in the case of “cognitive” tasks—or by a robot—in the case of “manual” tasks.

[Autor, Levy and Murnane \(2003\)](#) showed how a decline in jobs involving routine manual and cognitive tasks became apparent in the 1980s and has continued since. They also noted a stabilization in the number of jobs involving non-routine manual tasks, that is jobs that require interpersonal interaction, situational awareness and the need to respond flexibly and rapidly to changes in the environment. [Autor and Price \(2013\)](#) confirmed an increase in these jobs starting about 2000. Both studies also showed a stabilization in the number of non-routine cognitive tasks, those requiring managerial or analytical skills; though Autor and Price note a marginal decline between 2000 and 2006, followed by a modest rebound through 2009.

Studies of the likely future impact of technology have often been limited to individual countries (for example Frey and Osborne ([The Future of Employment](#), 2013) on the U.S. market) or by international organizations such as the OECD. They have often provided material for sensational alarming headlines, rather than being leveraged to actively promote public understanding of the issues. The G20 could coordinate a rigorous analytical effort on the part of member governments, which would help provide a common baseline and share best practices, laying the ground for a coordinated—and therefore more effective—policy and awareness effort.

2. **The G20 should openly and actively promote policies to facilitate the progress of innovation in industry, and especially encourage the development and adoption of skills-augmenting technologies.** These can help augment the efficacy and productivity—as well as the safety—of workers at different levels of the skills distribution; and they can facilitate and accelerate the learning of new skills on the job as well as the transmission of knowledge and expertise across the workforce.

Debates on the impact of technology on the workplace tend to center on the risk that greater automation will displace workers, increasing unemployment—the “[race against the machine](#)” view that often leads to dystopian predictions of mass unemployment, and to proposals for much stronger policies of income support, such as instituting a Universal Basic Income.

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The interaction of humans and technology on the workplace, however, is much more nuanced. Recent [research](#) by the McKinsey Global Institute has recognized that in many instances technology will replace or automate some specific [tasks](#) within an existing job description, rather than the entire job.

An especially powerful example is the development of upskilling technologies: portable and wearable digital devices that can augment the abilities of workers at different levels of the skill distribution, and that are already being deployed on factory floors. For example, augmented-reality smart glasses can be used in manufacturing and field services to provide workers with just-in-time step-by-step instructions on how to perform specific procedures. Such devices can give workers instant on-the-job training, and allow them to tap the support and accumulated expertise of their colleagues.

These upskilling devices have already been deployed by General Electric in its Renewable Energy and Healthcare divisions, as well as other companies. [Abraham and Annunziata \(2017\)](#) show that the use cases so far have demonstrated an average productivity improvement of over 30%; and the improvement can be realized already from the first use and with almost no need for prior training.

These upskilling tools are especially powerful when combined with software analytics able to provide a much more sophisticated view of the functioning of industrial equipment—from an individual electricity generation turbine to an entire power plant—and advise technicians and management in real time on alternative courses of action. Artificial Intelligence tools will prove increasingly powerful in providing clear information on the technical and economic trade-offs of specific decisions (for example the intensity of use of a piece of power generation equipment at a determined point in time based on demand and supply on the grid as well as overall market pricing).

These innovations are part of a broader wave of digital innovations in manufacturing, which includes the concept of a “digital thread”, the ability to link workers and equipment through sensors and analytics, and to link the manufacturing floor to supply chains and distribution networks. This results in a greater ability to predict and to react to changes in market conditions. It yields significant increases not only in efficiency and productivity, but also in workplace safety.

The G20 should promote an effort to analyze the feasibility and desirability of measures targeted to incentivize and accelerate the adoption of skills-enhancing technologies; this could speed up the integration of new technologies in a way that would benefit both workers and overall productivity. A G20-coordinated approach to these measures would help not only to promote best practices, but also to offset the risk that they might fuel international tensions in the current environment of rising protectionist pressures.

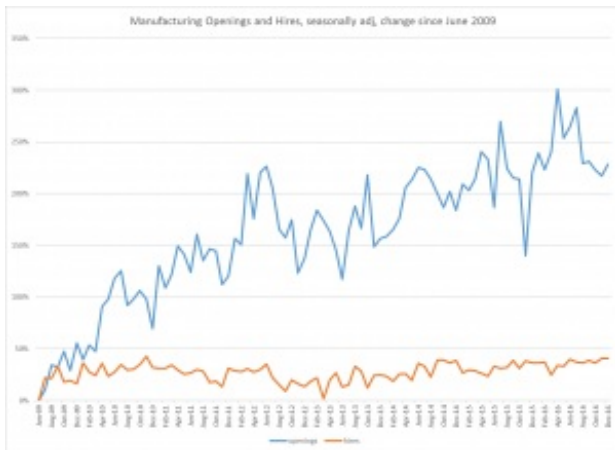
- 3. The G20 should promote a coordinated effort by governments to bolster education and training to help align the supply of skills to the shifting demands of the economy.** This will require greater emphasis on Science, Technology, Engineering and Mathematics. As we have argued above, workers stand to benefit from the introduction of new technologies in the workplace. An increasing number of new opportunities, however, will hinge on workers’ abilities to understand and interact with new technologies. Note that this does not imply that most workers will need to have degrees in engineering or computer science—upskilling technologies will be increasingly accessible thanks also to improvements in user interfaces. But it does mean that workers will need to acquire a greater degree of familiarity and comfort with new technologies. **The bar on scientific and digital literacy needs to be raised.**

While young people’s attitudes to science cannot be changed overnight, governments should urgently take concrete measures to ensure that a greater proportion of the workforce is equipped with Science, Technology, Engineering, and Mathematics skills. These measures include:

1. implementing hard-nosed curriculum reforms,
2. creating strong fiscal incentives for companies to partner with schools and universities,
3. developing active labor market policies with training for unemployed to tackle STEM shortages, accompanied by more Vocational Education Training in STEM.

At the same time, **countries need to redouble their efforts to increase the supply of traditional manufacturing skills/vocational education, apprenticeships, and company-provided training programs can all play an important role.** This is especially important because of evidence that even as employment levels remain lower than desired, companies in a number of countries are having difficulties filling job vacancies for lack of qualified candidates. In the U.S., for example, this “skills gap” is highlighted by the growing divergence between the number of job

lack of qualified candidates. In the U.S., for example, this skills gap is highlighted by the growing divergence between the number of job openings and the number of hires:



Manufacturing Openings and Hires, seasonally adj, change since June 2009. Source: US Bureau of Labor Statistics

A 2015 report by the US Manufacturing Institute projects that as many as 2 million US manufacturing jobs will remain unfilled in the coming decade due to an insufficient availability of skills.

Addressing this problem requires acknowledging that traditional technical abilities in, among others, electrical and mechanical skills remain of fundamental importance even as new digital technologies transform the work environment. Encouraging a closer dialogue and cooperation between the education system and the world of industry can play a fundamental role, helping to shape a system of vocational education and apprenticeships that provides a rapid and targeted path to high quality jobs. The German system already provides valuable examples in this respect.

While most of the relevant policy measures will be taken at the individual government level, **the G20 can play a key role in:**

1. Setting common standards for STEM curricula that can guide individual governments' education reforms efforts; convergence towards common, G20-promoted standards would also facilitate the mutual recognition of skills that could in turn enable better worker mobility (see recommendation 5 below).
2. Coordinating a cross-country analysis of the existing gaps in traditional manufacturing skills. In most countries, evidence of skills gaps remains anecdotal. It would be greatly beneficial to have a coordinated effort to understand the true extent of the existing need for both engineering and non-college educated technical skills. This could then inform education reform efforts.
- Tasking the B20 with an assessment of the efficacy of vocational and apprenticeship programs implemented in key countries, with the intent of identifying best practices as well as possible further improvements. The G20 should then undertake an effort to encourage individual governments to adopt the programs best suited to their individual challenges.

Private sector companies should not stay on the sidelines, and can act both through increased investment in training programs and with efforts to improve gender balance and promote more women in engineering and technical roles. GE, for instance, today has 14,700 women in engineering, manufacturing, IT, and product management positions, but announced recently its goal its goal of having 20,000 women in STEM roles at the company by 2020, and to achieve a 50:50 gender balance in technical entry-level positions. Improving the gender balance, especially in technical roles, can have substantial benefits in terms of better performance and competitiveness for individual companies, and faster economic growth and job creation at the macroeconomic level. [Annunziata and Chase \(2017\)](#), highlight these benefits and argue that improving the gender balance will be fundamental to realize the full growth-enhancing potential of new digital-industrial innovations.

4. **The G20 should decisively underscore the importance of pursuing more aggressive labor market reforms; G20 countries should lead by example.** Countries where labor markets remain tepid, characterized by rigidities, and with a high cost for companies to attract talent, will not be able to leverage the full job-creating potential of new technologies.

It is worth noting in this respect that the EU countries suffering from the highest youth unemployment rates are not the ones experiencing faster rates of technological development and adoption. Moreover, youth unemployment rates in these countries have remained at extremely high levels for the last forty years, as shown in [Annunziata \(2012\)](#); this suggests that in these countries at least, structural rigidities play a much larger role than technology in reducing job opportunities. Eliminating these rigidities should be a priority; left unaddressed they would render ineffective all other efforts to boost employment.

5. **The G20 should actively champion efforts to facilitate the flow of workers across countries** While this seems to run counter to the current political climate, a sufficient degree of labor mobility is essential to enable the efficient allocation of talent, allowing countries to more easily and quickly address skills gap, and allowing workers to seek the best job opportunities.

EU Member State governments should take the lead on this front, and set the example by working together to eliminate barriers and adopt measures to promote the flow of workers across the EU. These include

- providing for equivalence in national social security and pension programs, and
- adopting programs that incentivize young workers to seek employment outside of their home country.

The G20 should identify essential steps to ensure a sufficient degree of international labor mobility, and encourage their broad adoption

These measures could include:

1. Mutual recognition of educational and professional qualifications meeting internationally recognized standards
 2. Points-based visa systems for highly qualified workers
- Permanent and time-bound visa and work permit programs for low-skilled workers

6. **The G20 should coordinate efforts to rethink, redesign and strengthen social safety nets** Technological innovation will inevitably continue to be disruptive, and will adversely affect some sectors of the workforce. If the adverse impact is not cushioned, it will provoke negative social consequences and trigger a fierce backlash against technology.

While there is no scarcity of research on the impact of automation and digitization on employment, there is as yet limited clarity on which sections of the population are most likely to be affected—beyond the broad result that low-skilled workers in routine jobs are most at risk. A better understanding of where the impact is likely to be most severe, in terms of both social groups and geographies, would help design more targeted cushioning measures, but also anticipate the potential political backlash and the attendant impact on policy-making efforts.

The G20 should therefore sponsor an international study mapping the potential impact of technology on jobs onto different socio-demographic characteristics of the populations, so as to better understand the socio-economic ramifications, which are likely to extend well beyond job losses. This study could build onto and be coordinated with the study on the impact of technology on jobs suggested in recommendation 1.

This study would provide the basis to design upgraded targeted mitigating measures; these could include:

- Retraining and career-counseling programs, designed so as to be targeted at the most at risk segments of the population;
- Time-bound unemployment benefits programs, fine-tuned to yield the right combination of support and incentive for a rapid re-entry into the labor force;
- Long-term income support mechanisms for workers who might find it prohibitively hard to re-enter the labor force—notably specialized workers disrupted at a later stage in their careers;
- Support measures for small and medium sized companies and their employees, to enable them to access retraining measures otherwise limited to large companies.

Here as well, EU countries could play a leading role in the G20: the European continent has a long tradition of strong social safety nets, and this uniquely positions Europe to ensure that particularly the short term social cost to technology advance are managed effectively. Europe's multi-layered political structure could also provide a useful testing ground to design and deliver policies at the appropriate level—central, regional or local.

7. The G20 should study and help design measures that can maximize the potential for more entrepreneurial and flexible forms of work that will be increasingly enabled by new technologies. Digital-industrial innovations lower the threshold for becoming self-employed and engaging in entrepreneurship. At the same time, new technologies allow for more flexible and agile work because more people are now better connected and can be set up for digital work through home offices. These new forms of employment offer a real answer to unemployment, and can open up a new set of opportunities especially for younger workers. Access to this type of work should be encouraged and facilitated, rather than regarded as a threat or a last resort. New manufacturing technologies such as Additive Manufacturing (or '3D printing') could open the way for a new generation of 'hardware startups' and a new sector of high-tech artisan activities, similarly to what we have seen already in the software space. Affordable 3D printer could play the same democratizing role as affordable personal computers.

Employment legislation should better reflect the rapidly changing nature of the world of work. The G20 could design recommended guidelines to help national governments adapt labor market and other legislation and rules that were originally designed for a completely different phase of industrial and economic development. Allowing businesses to better adapt to shifting demand will in turn further promote innovation and entrepreneurship and provide increased employment opportunities, particularly for young people.

8. Last but not least, the G20 could design and promote new-generation funding programs for digital industrial innovative projects.

There is no shortage of fundamental research activity in the G20, but several countries are lagging behind in developing products and solutions that digitize manufacturing assets and increase manufacturing productivity. Europe is a case in point. One notable exception is France, that has since some time successfully operated an attractive system of tax credit towards investments in R&D. G20 countries and the EU overall should resolutely opt for increased resources in their R&D funding programs, both as a percentage of the total budget and in absolute figures.

Allocating sufficient public funds is only part of the challenge. Equally important is designing programs that can

1. leverage additional funding sources, with private sector participation, including possibly new forms such as crowdfunding, and enacting legislation that can facilitate the creation of venture capital investment
2. identify appropriate targeting strategies that can ensure funds are efficiently allocated to the best opportunities.

These programs should recognize that innovation projects will be subject to a higher degree of risk than traditional public infrastructure projects. Funding programs should therefore be designed with a view to allow for a 'natural' rate of project failure, but in such a way that failures can be identified at an early stage, reducing the capital expense. Private sector best practices would provide a useful blueprint in this respect.

Existing Initiatives & Analysis

Existing Agreements (1)

2016 G20 Digital Economy Development and Cooperation Initiative

[More Information](#)