

# World Sustainable Development Outlook 2020

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## Disruptive Technologies, Livelihoods, and Education



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## **Abstract**

### **Purpose**

This study provides a model to analyse how disruptive technologies impact work and workers in the US; it also generates equitable solutions.

### **Research Methodology**

Analysed recommendations from three national roundtables with thought leaders, policy makers, employers and workers to investigate:

1. Which disruptive technologies are changing how work is performed?
2. How these disruptions affect skill needs required?
3. How education and training systems are responding to these skill needs?

### **Findings**

1. Disruptive technologies (automation, AI, digital fabrication, block chain) demand higher skills in seven major industry sectors;
2. Current education and training systems cannot keep pace with skill requirements;
3. Continuous lifelong learning systems are needed and will require blended financing.

### **Originality/Value**

1. Findings have implications for four SDGs;
2. Blending different perspectives across National Governors Association, MIT's Fab Foundation, and FHI360 to generate innovative solutions;
3. Demonstrates applicability for responding to disruptions like COVID-19 and climate change.

### **Keywords**

**Disruptive technologies; Livelihoods; Impact on work and workers; Education and training; Policy and policymakers; Skill needs; Equity; Industry sectors; Continuous lifelong learning; Blended financing**



## Executive Summary



The challenge of reimagining workforce policies confronts many countries whose education, training, labour and employment policies were designed for a different time when knowledge was stable, careers, jobs and skills were well understood, and industrial development followed a more predictable trajectory. Predictions regarding the impact of disruptive technologies on developing countries differ widely (Frey et al., 2016). It is likely that “a combination of new disruptive technologies and increasingly uneven playing fields in capital and product markets pose a fundamental threat by removing the middle rungs of the development ladder”. According to the Center for Global Development (CGD), “deep research and associated policy responses are required to meet the needs of the

hundreds of millions of young people coming into the job markets in Africa and South Asia over the coming decades” (CGD Panel, 2019). The additional impact of COVID-19 disruptions on employment, coupled with the youth unemployment crisis in many countries, will potentially wipe out a decade of poverty reduction (Sumner et al., 2020).

This paper describes an action research (Hult and Lennung, 1980) project called *Future Workforce Now: Reimagining Workforce Policy in the Age of Disruption*. This project was carried out during the past two years and involved three organisations, Family Health International 360 (FHI 360), the National Governors Association Center for Best Practices (NGA Center), and Fab Foundation, a technology and education non-profit spin-off from the Massachusetts Institute of Technology (MIT). Their task was to help state governors and their policy teams reimagine their current workforce policies so that current and future workers (those still in school) could participate productively and equitably in their states’ economies. Workforce policies intersect with a number of policy arenas such as employment laws and regulations, job training, compensation, insurance, credentials, labour market information, and education and training. The partnership the three organisations formed demonstrates SDG #17 (Partnerships) as it brought together three different perspectives: disruptive technologies (Fab Foundation), education, training and livelihoods (FHI 360) and workforce policies, governance, and application of data (NGA Center) (Ash et al., 2020).

The goal of this paper is to share research findings and recommendations in hope that these will catalyse new conversations among key stakeholder groups and policymakers in other countries. Many of the issues our action research in the US uncovered are similar to what other countries may be experiencing. Our intention is that other countries can draw on the findings and recommendations to design a similar process of inquiry, resulting in policies that are suitable for their own populations.

# Problem Statement

Disruptive technologies (i.e., automation, advanced manufacturing, 3D printing, and AI), are accelerating and rapidly changing how work is performed in the US and other countries. Work, careers, jobs, and knowledge are no longer stable due to increasing disruptions; this is because much low and middle-skilled work will be replaced by algorithms. Ever shorter innovation cycles disrupt existing business

models. Education, training systems and workforce policies that were designed for a world where knowledge, careers and work were far more stable and predictable, have not kept up with changes in workplaces, technology development and how work is being performed.

# Project Description

*The Future Workforce Now* project's focus on workforce development confronted policymakers with a "wicked problem", a problem that intersects 7 of the 17 Sustainable Development Goals (SDGs: Education, Work and Economic Growth, Industry, Innovation and Infrastructure, Reduced inequalities, and Sustainable Cities and Communities, and Partnerships). Developing workforce policies is an example of a "wicked problem" because solving one SDG alone is likely to cause unforeseen negative consequences in other SDGs (Camillus, 2008). For example, investing primarily in education and training will reduce inequalities but not produce new jobs, while investing primarily in industrial development or innovation does not produce a more skilled workforce whose income can sustain communities. Wicked problems often occur when organisations or governments face constant change or unprecedented challenges. They occur in a social context: the greater the disagreement among stakeholders, the more wicked the problem. It is the social complexity of wicked problems as much as their technical difficulties that make them particularly difficult to solve (Camillus, 2008).

Recognising the importance of sharing multiple

perspectives and professional expertise among diverse stakeholders, project organisers engaged 100 subject matter experts together with 80 top policymakers, civil society leaders, trade union representatives and employers from 26 states. Participants were grouped into interdisciplinary teams. They were presented with a set of critical questions regarding the impact of technology disruptions in their states on their current and future workforce. Their responses built on each other over three successive roundtables that were conducted over nine months.

As the 180-plus participants learned and worked together, they concluded that a Continuous, Lifelong Learning (CLL) ecosystem would ensure that all current and future workers have an opportunity to participate productively and equitably in their states' economies. They concluded that producing such a CLL ecosystem would require three major transformations in how states develop policies to support a productive workforce:

1. aligning the different "policy silos" (i.e., separate government departments for Labour, Workforce, Education, Economic Development) and developing interoperable data systems that could produce better integrated decision making;
2. embedding technology into all aspects of education and training, shifting curricula and training strategies to support learning-by-doing and retraining teachers so that instead of only delivering content they could focus on facilitating learning and skills acquisition; and
3. Supporting all individuals with the financial resources, time, and career information they need to learn continuously over their lifetimes, as well as developing a system of portable and stackable credentials that can be recombined by individuals as needed over a lifetime.

## Global Context

World Economic Forum (WEF) founder Klaus Schwab coined the term the Fourth Industrial Revolution to describe the fast-paced global upheaval the world is experiencing, largely driven by new digital technologies (Schwab, 2015). The technologies of the Fourth Industrial Revolution are radically and rapidly disrupting the world of work, using advanced sensors, feedback loops, generative design, automation, robots, the Internet of Things (IoT) as well as a myriad of other new tools that integrate the digital, biological and physical worlds (Boisvert, 2018). These disruptive technologies have enormous impact on traditional, low-skilled and middle-management work that can be automated, and further contribute to current inequities in income and productive economic participation.

When the three partner organisations initiated this research, they focused on the upheavals caused by disruptive technologies on work, workers and workplaces in the US. We never imagined that a global health pandemic would cause a second, more catastrophic disruption and bring about a massive economic downturn brought into even sharper focus by the deeply disruptive events in the

US around systemic racial injustice and violence. In the US and throughout the world, COVID-19 has profoundly disrupted access to livelihoods and employment. The combined impact of these two global upheavals exacerbates existing inequalities in education and the workforce across gender, race, and demographics throughout the world.

It is likely that COVID-19 will accelerate the adoption of productivity-enhancing technologies in the workplace. Automation has historically increased during economic downturns as industry replaces less-skilled tasks with technology, as businesses seek cost-savings through minimising labour expenses. Manufacturing, for example, often responds to the global supply chain impacts of recessions by accelerating the adoption of productivity-enhancing technology. Low-skilled workers, as well as middle managers, will be the hardest hit by this crisis as many of these white-collar jobs will be replaced by algorithms (Lassiter, 2020). Some estimates predict that between 200-305 million people throughout the world will become unemployed (Clarke, 2020).



# Research methodology

Leaders and staff from the three partner organisations developed three core research questions.

1. What specific disruptive technologies are changing the way work is performed in each of the eight industrial sectors important to the US states, and to what extent do these disruptions require different skill needs?
2. How well are education and training systems responding to these skill needs?
3. What are the implications for reimagined workforce policies?

Our theory of change was that, rather than prescribe innovative workforce policies to state policymakers, it would be more effective to engage the very policymakers who would be instrumental in producing the new workforce policies in their respective states. The partners selected an action research model that engaged the nation's leading experts together with state policymakers in a process of learning-by-doing. Throughout the project, participants engaged in a process of shared inquiry, gathering information, reflecting on what was learned, and concluding with a policy forum.

In addition to learning from the 180 roundtable participants, the partners also conducted interviews with some 60 key experts in the fields of emerging technologies, innovation, industrial and economic development, workforce development, employment, public policy and education and training. Education experts represented Kindergarten to post-secondary levels of schooling. Industry experts included leaders in employer-based training and labour unions.

## Research Findings

### What disruptive technologies are changing work in eight industry sectors?

There are five technologies that are most significantly disrupting the US workforce today. Taken together, these technologies reinforce and build on each other, accelerating changes that cross many different industry sectors:

- 1) automation, including robotics, robotic process automation in Fintech and self-driving transportation;
- 2) additive/advanced manufacturing and 3D printing;
- 3) artificial intelligence and machine learning;
- 4) Internet of Things (IoT);
- 5) Cloud-based technology.





*What are examples of impacts of disruptive technologies?*

What follows is a high-level summary of what we learned by investigating the impact of disruptive technologies on eight industry sectors important to the economies of US states. This list is intended to illustrate the kind of impacts that are occurring in each of the eight sectors; it is not intended to provide a detailed comprehensive list (Ash and Rahn, 2020).

- **Advanced Manufacturing:** Artificial Intelligence is replacing human labour in language, imaging, and decision-making processes in the manufacturing sector. Additive manufacturing, for example, is experimenting with digital factories to expedite their design processes, reduce manufacturing errors with autonomous repair tools, and increase product speed to market;
- **Agriculture:** Traditional agriculture processes, including harvesting, fertilising, and milking, are becoming automated, and autonomous vehicles (e.g., tractors and mapping drones) are replacing human labour;
- **Energy and Mining:** Digital and cloud-based tools are being used for data management, equipment monitoring, and to improve productivity and safety in field service. In recent years, the mining and drilling industries have begun employing autonomous vehicles to reach previously inaccessible resources;
- **Aerospace:** 3D printing allows aerospace design and manufacturing professionals to reduce weight and increase strength of modern-day flight materials. Meanwhile, autonomous vehicles, fuel-free rockets and drones are pushing exploration beyond previous limits to expand our frontiers in space;
- **Education and Training:** Learning management systems and digital teaching and learning on easily accessible online platforms is dramatically shifting how educators present new information to students and families;
- **Health Care:** Automation is replacing many traditional health care roles. Electronic health tools and telemedicine are changing health care delivery in rural communities and across the globe. 3D printing is also increasing the availability of prosthetics, surgical models and dental devices to improve healthcare outcomes and reduce the cost of medical supplies;
- **Transportation and Logistics:** Autonomous vehicles may soon replace human drivers. The proliferation of electric vehicles will have a positive impact on climate change, but at the same time this will also significantly decrease fuel tax revenue for states across the country.
- **Financial Services and IT:** The term Fintech is used to encompass several disruptive technologies that are transforming work in financial services (Sraders, 2020). These technologies include the application of artificial intelligence, cloud computing and blockchain to improve transparency and efficiencies in sectors such as retail banking, asset management, insurance and compliance (ICAEW, 2020).





### *What is the impact of disruptive technologies on skill needs for work and jobs?*

Disruptive technologies are shifting jobs and skills away from manual repetitive tasks towards services and cognitive tasks (Autor et al., 2003). The OECD estimates that 37% of existing jobs in the US are likely to disappear or change rapidly in the next decade (OECD, 2019). Numerous studies of 'skills needs' conducted before COVID-19 estimate that, within the next decade, disruptions could lead to the automation or transformation of between 33% and 46% of current jobs worldwide (Manyika et al., 2017; OECD, 2019). This year's World Economic Forum's Annual Meeting concluded that by 2022, "75 million jobs will probably be displaced across

20 major economies, while 133 million new ones will spring up in industries that are only just gaining traction". Regardless of the precise number, it is clear that people will need to exit the formal education system with new skill sets and to re-skill continuously to keep pace with the changes in technology. In addition to digital literacy skills, disruptive technologies increase the demand for skills such as complex problem solving, critical thinking, creativity, collaboration and team skills, skill sets that are likely to continue to be in demand in the future (Wagner, 2015; Wightman, 2020).

## **How well are traditional education and training responding to new skill needs?**

Education and industry experts agreed that formal education is not equipping students with the skills needed to keep up with the pace of technological disruptions. Moreover, educational experts emphasised the need for a CLL ecosystem in the face of the exponential expansion of human knowledge. Since the first Industrial Revolution, knowledge has doubled every century. It is now expected that within a decade, human knowledge will double daily (Russell-Schilling, 2013). Current traditional education is "front-loaded", investing primarily in the first 12-20 years of formal education. After completing high school, and especially university level education, it is assumed that students are fully capable of adapting and directing

their learning throughout their lifetime in response to changes in the workplace. Instead, policymakers will need to invest in a CLL ecosystem for current and future workers (students still in school), to bring about a technology literate, agile, and innovative workforce. Rather than ending formal schooling after completing K-12 or K-20, students will need to have multiple educational entry and exit points throughout their career to assist them in updating their skills and knowledge in a variety of settings, including on the job training. Finally, education experts in our project agreed with WEF estimates that nearly two-thirds of children who started school in 2016 will go on to have jobs that do not yet exist (Wightman, 2020).



## What are the implications for Reimagined Workforce Policies?

State policymakers participating in this study recognised that their current workforce policies and education systems were largely developed for an earlier age. They recognised the need to rethink how to prepare their state's current and future workforce. Participating states presented a range of readiness regarding the extent of policy changes they were considering prior to this study. Most agreed that current policies are organised in

various agency (ministry) "silos" that often did not plan, coordinate, or communicate with one another. These silos maintain separate data systems that are not interoperable across the multiple departments. Most policymakers believed that leadership on the part of the state's top executive - the Governor - is required to bring about cross-departmental collaboration and data sharing.

## Recommendations Based on Findings

The following are specific recommendations based on the action research findings. These recommendations are expanded upon in greater detail and can be found in *Reimagining Workforce Policy in the Age of Disruption: A State Guide for Preparing the Future Workforce Now* (Ash and Rahn, 2020).

1. develop an inclusive, continuous lifelong learning system and infrastructure to prepare and support the future workforce:
  - a. align stakeholders around a shared vision, plan and set of priorities;
  - b. facilitate and promote use of actionable, high quality integrated data/information for decision-making by individuals, employers, policymakers and civic leaders;
  - c. develop innovative and sustainable financing to align the systems;
  - d. develop transparent credentials that effectively communicate skill acquisition to employers, learners, and training providers;
2. develop an agile, tech-ready workforce that stays ahead of the curve:
  - a. improve digital and technical literacy across k-12 and university systems;
  - b. promote innovative teaching and learning models for career and life skill development;
  - c. engage employers in providing demand-driven training;
  - d. develop quality assessment and accountability systems for education and training programmes;
3. support individual engagement in lifelong learning and high-quality employment:
  - a. labour market information: connect learners with high-quality labour market information and career advice;
  - b. money for learning: enable individual learners and workers to access and fund their education by a mix of public and private financing mechanisms to support learners throughout their lifetimes;
  - c. time for learning: ensure learners and workers have time to learn through state and employer provided support services;
  - d. equity: ensure equity in terms of access to the above through targeted outreach and wraparound supports.



# Recommendations beyond the US

The authors recognise that the above recommendations are US-specific and, because of that, highly context dependent. They cannot be automatically translated to the contexts found in other countries. However, we believe that other countries can learn from this action research process in that they can embark on a process to:

1. convene a multi-stakeholder forum composed of employers, educators, government leaders, policymakers, trades unions, and leaders from civil society to:
  - a. learn which disruptive technologies are impacting their key industries, at what scale, and over what time scale;
  - b. ascertain the immediacy of the impact of disruptive technologies in terms of jobs and, where relevant, informal work;
  - c. assess what skill needs are increasingly in demand;
  - d. determine how to best help current and future workers acquire these skills, recognising that they will have to be continually upgraded over a lifetime;
2. identify which workforce-related policies need to be in place so that all workers can acquire the skills they need to gain work or remain employed;
3. make the necessary policy changes and evaluate their impact over time.





## Further Implications to Consider

**Equity:** equity differs from equality in that equity assures that all workers have the opportunity to participate productively in their society and economy based on their proportional needs.

Unlike equality, equity concerns itself with “providing more for those who need it” (Mann, 2014). In the US and many other countries, the impacts of disruptive technologies land most severely on those **least** able to adapt, and who are also most vulnerable to job loss. In countries where this is the case, governments will need to create new workforce policies that address the needs of the most vulnerable. These new policies should

ensure that the **benefits of technology are shared by all**, rather than continuing to deepen existing inequalities. For many of the world’s countries where high inequality and resulting social inequities persist, the SDG goal of reducing inequalities is critically important for social and economic stability and well-being; for example, a 2018 World Bank study found that despite economic growth, inequality was substantial and wealth per capita in high-income OECD countries was 52 times greater than in low-income countries (World Bank, 2018). This is in part attributed to a pattern of jobless growth, a global phenomenon.

## Reforming outdated traditional education systems

in many countries, traditional education, training and workforce policies are outdated, designed for a different time in history where knowledge, careers, and jobs were known, remained stable over time and were far more predictable than they are today. Education experts in particular argued that higher education will face the most drastic need to reform and become far more flexible in terms of length of courses and access to multiple entry and exit points. Only a few countries, notably in Scandinavia, have completely redesigned their secondary education system to focus on learning-by-doing, shifting the roles of secondary teachers from content delivery to facilitating project-based learning in teams. The implications of outdated traditional education systems are even more severe for developing countries. A 2015 Brookings report states that students in poor countries are now some 100 years behind students in wealthy countries. The

study points out that if nothing changes, this 100-year gap will widen ever more rapidly (Winthrop and McGivney, 2015). For that reason, many countries may need to find alternative ways to bring about continuous lifelong learning and upskilling ecosystems.

In some countries, the need for rapid upskilling may be urgent and require faster upskilling strategies. Trying to change existing educational systems can be a very slow process. Bangladesh is one example where gaming programs are being used for rapid upskilling of garment workers to adapt to new technological changes in the industry (Wightman, 2020). While there are a few countries that have successfully reinvented their education systems, such as Finland and a few other countries (Wagner, 2019), this has not been the case in most countries.

# Employment, jobs and work

The twin impacts of disruptive technologies, and now COVID-19, will significantly change the way work is performed in nearly all major industry sectors between now and 2030. In the US, for example, the 2019 Southern Regional Education Board reported that if nothing is done to improve workforce training in the 16 states they represent, some 18 million people between the ages of 25 and 45 will be “unemployable” (Raney, 2019). This pattern is likely to be similar in other countries, although the pace of change may be less rapid in some countries at this time. The challenge of aligning education,

training and workforce policies will require greater levels of coordination and collaboration than what is currently in place in many countries. The economic downturn caused by COVID-19 makes it even more important to align and coordinate the work of the multiple Ministry “silos” charged with developing their country’s workforce and education systems. These include, for example, the Ministries of Education, Labour, Economic Development, Youth and Planning, who will need to coordinate and integrate their programmes and data more effectively.

## Conclusions

This paper identifies the critical changes and challenges that disruptive technologies are having on major industry sectors in the US and abroad. We present recommendations for how to deal with these challenges. COVID-19 represents a different kind of global disruption that is also changing work, livelihoods, and workplaces. There is an urgent need to develop the workforces of countries so that current and future workers can participate fully in the opportunities of the 21st Century. A workforce that can continue to upgrade their knowledge and skills to stay abreast of global disruptions will be in a better position to add value to their families and

societies when facing the uncertainties of the future.

The scope of these challenges presents a truly “wicked problem” and goes far beyond what any one workforce policy, such as Labour or Education, can fulfil. Instead, what will be required is a process of systems-wide transformation that engages the support of stakeholders or social partners in the public and private sector as well as civil society. While countries have different priorities and different levels of disruptive technologies, what is at stake is a world where all can thrive.



## Limitations of Research

This paper reports on the action research completed in the first phase of what was originally planned as a multi-phase initiative. The recommendations have not yet been tested and this is one of the limitations of this action research project. The next phase of work is being planned with a focus

on the implementation and evaluation of policy recommendations. A second limitation is the potential bias among the selected sample of 180 industry, government, education and civil society thought leaders.

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## Biography

**Monika Aring** is an Independent Consultant, Senior Policy Advisor for Fab Foundation and FHI 360 (former). She helped design and launch a recent initiative to reimagine workforce policies responding to disruptive technologies. Ms Aring has 35 years' experience working for many international donor organisations, foundations, and corporations to develop multi-stakeholder programmes that produce needed workforce skills and better jobs in 50+ countries throughout Asia, Central Asia, Africa, Latin America, Europe, and the US. She graduated Magna Cum Laude from Brooklyn College, and has a Master's degree from Harvard's John F. Kennedy School of Government. Ms Aring participated in leadership development programmes at Harvard's Kennedy School and Harvard Business School. She speaks English, German, Spanish, French.

**Larry Hulbert** is a Senior Advisor with Fab Foundation, FHI 360 and Aravind Eye Institute in India. He has 50 years of experience in international development with the WHO, major universities, and policymakers. With a focus on healthcare and education in Africa and Southeast Asia, and introduced, facilitated and supported major change initiatives to improve basic healthcare services and educational programmes. Mr Hulbert is experienced in strategic planning, leadership training, teacher training, curriculum development and programme evaluation. Consulting clients have included heads of state, government ministries, university vice-chancellors and corporate leaders. He holds an undergraduate degree from DePauw University (Magna Cum Laude), and a graduate degree from Northwestern University.