



Work 2050: Three Scenarios.

New Findings of an International Delphi
Study by the Millennium Project.



The Millennium Project

FUTURE IMPACTS

| BertelsmannStiftung

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Introduction

Why We Should Think in Scenarios and Dare to Look to 2050 When It Comes to the Future of Work

The Future of Work Is a Global Talking Point

In the global media, headlines are flying thick and fast and many of them focus on the threat robots and automation pose to jobs. Some industry leaders have voiced their support for a tax on robot work and universal basic income schemes¹, while trade unions launch or support programs on the future of work (cf. verdi 2018). Barcamps, conferences and meetups on the future of work have been held almost everywhere, huge numbers of studies on the subject have been published. Companies are transforming offices and work pro-

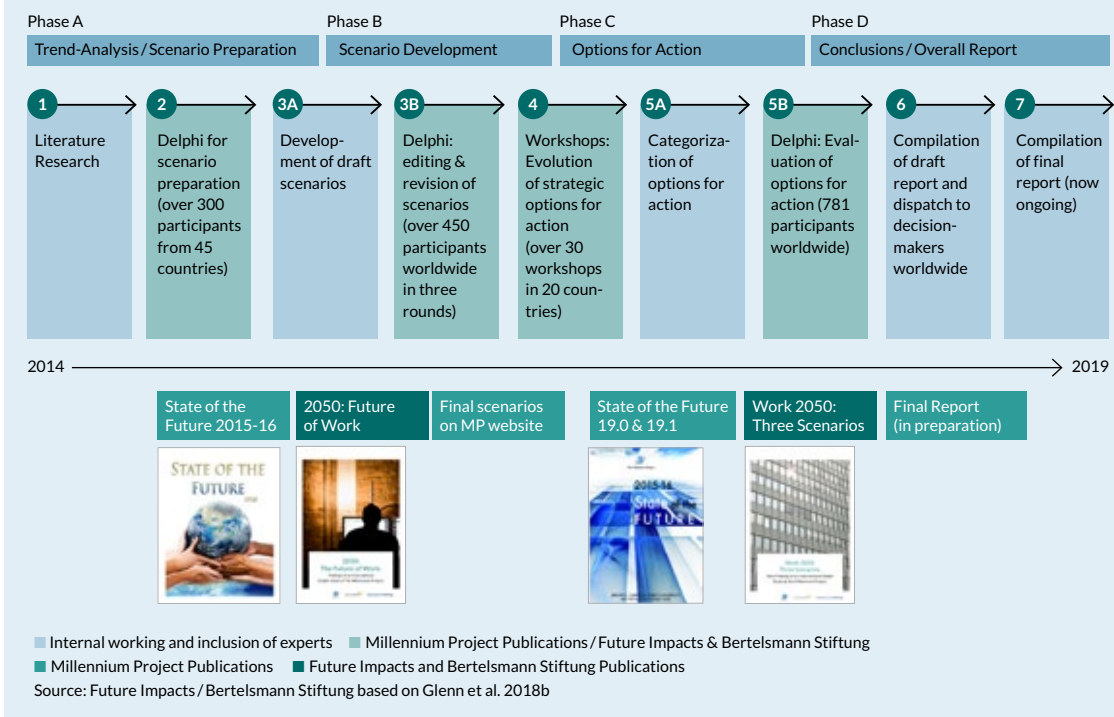
1 For instance, Bill Gates and Frank Appel, CEO of Deutsche Post, have come out in favour of a "tax on robots" while Joe Kaeser of Siemens, Götz Werner of dm and the philosopher Richard David Precht are all advocates of a "basic income" (comp. Mader 2018).

cesses or transferring whole departments to co-working spaces. The public sector is trying to keep up and in many countries, ministries of labour have set up specific working groups or even entire departments. Similar to Germany's efforts after several years of its *Arbeiten 4.0* (Work 4.0) process, they now focus on scientifically monitored experimental spaces for new forms of work (cf. BMAS 2018), adapting the legal framework for advanced training and, with the *Digitalpakt* (Digital Pact for Schools) and *Digitalklausur* (Cabinet Resolution on Digitalization), on a comprehensive digitalization strategy (cf. Bundesregierung 2018).

Against this backdrop, it would be easy to question the need for yet another study. However, most studies are limited theirto a horizon of the next five, ten or fifteen years (see CFC 2018; Manyika et al. 2017; WEF 2018a & 2018b). Hence, **to complement public discourse on these long-term perspectives – and to do so from a global, not national or regional standpoint** – the Millennium Project (in two publications supported by the Bertelsmann Stiftung) has carried out its own project on the subject. Since the distant time horizon and the unpredictability of possible technological developments result in a great degree of uncertainty, we opted for the methodology of scenario development. The latter always offers alternative visions of the future and, whilst paying close attention to how the main lines of development are shaped, never loses sight of other conceivable development paths (detailed explanations of the chosen methodology are given in the appendix).

Drawing on an analysis of specialist literature, a total of **three Delphi surveys (each involving several hundred international experts) and some 30 workshops across the world** were conducted by the project in a process which

FIGURE 1: The Sequencing of the Overall Project Future Work / Technology 2050



lasted several years and involved the participation of experts from all over the world, scenarios up to the year 2050 and corresponding options for action.

We have already published **interim results of the project based on the findings of the first Delphi survey in 2050: *The Future of Work*** (Daheim & Wintermann 2016). Given the great resonance this report attracted, we now wish to present **our further new findings**. Once more we remain true to our principle of placing the focus squarely on debates among experts, letting their perspectives and their **original voices speak directly in the Delphi Engine Room**, and highlighting key findings selected from such discussion lines. In doing so, we are, as it were, once more opening the door to the *backroom* of the expert survey. In our experience it is backroom talks that best reveal the complexity of the expert view of the future.

Our last publication *2050: The Future of Work* (Daheim & Wintermann 2016) was particularly concerned with the open questions posed by the future of work (such as the debate on the universal basic income or the transformation of the education system towards education portfolios) in which each of the perspectives on the future was more implied than given a specific concrete form. The project now takes a decisive step forward by presenting three highly **specific alternative visions of the future and potential options for action**. As both these elements, and this paper build on earlier steps and findings, we shall not repeat them here but refer readers to our previous publications (Glenn et. al. 2015; 2018a; 2018b; Daheim & Wintermann 2016). What we are aiming to do with the present publication is threefold: to make a contribution to the general debate on the future of work; to make the findings of the project more accessible and better-known; and above all to **focus attention on both the long-term and global perspectives**. For the Bertelsmann Stiftung – which itself is researching the future of work at company level in a large-scale project² – it is particularly important to **focus minds on the opportunities involved** (as the third scenario does) since enough has been said already about the dystopian future of work. What needs to be done now is to develop and realize specific concepts for action tailored to industry and government.

2 The Workplace under the Impact of Digitalization at <https://www.bertelsmann-stiftung.de/de/unsere-projekte/betriebliche-arbeitswelt-digitalisierung/> and the Blog www.zukunftderarbeit.de

Key Statements at a Glance

- Discourse on the future of work requires a long-term view of the future. A view limited to the next ten years is by no means adequate since the possible effects of aggregated rapid progress in a broad spectrum of technology fields may only be revealed within a much longer time horizon.
- On the one hand, setting a much longer time horizon involves a high degree of uncertainty because, on the other, the exact course of technological developments and their impact on work and society cannot be precisely calibrated. Thus thinking in terms of alternative scenarios is useful because it enables the specification of potential developments paths and advances the present discussion on possible forms of action by focusing not only on risks but also on opportunities.
- The project has drawn up three visions of the future to posit how interactions between work and technology could play out by 2050.
- All three scenarios are based on the premise that technological change will be rapid (and actually much more rapid than many people believe today), and that it will radically transform the ways people work. On the one hand, because some forms of work will be replaced by machines but also because in all three scenarios the skills and aptitudes called for are other than those in demand today, and because collaboration between humans and machines will be much closer, in some cases extremely close.
- The scenarios show the need for a new redistribution of opportunities and, in particular, a new redistribution of income and wealth.

- Simultaneously, the scenarios show that from the standpoint of the experts, successfully mastering the challenges posed by the nexus of work and technology requires far-ranging political measures for a new definition of the social and economic systems.

- What we can do today: Five selected avenues of action
 - **Economy and Work:** new rules or a new social contract are needed for a changing world of work, in particular the introduction of framework conditions tailored to new forms of work and self-employment, for instance, the equivalent of trade unions for freelance professionals.
 - **Government and Governance:** The state also has to change institutions and processes and become more closely aligned to long-term perspectives and more proactive in anticipating and shaping the future (and not just the future of work and technology).
 - **Science and Technology:** Strengthened forms of cross-institutional and international cooperation are needed to prevent the break-neck pace of new technological development from eluding both our understanding and our control.
 - **Media, Culture and Art:** We need appealing and specific representations of positive forms of work and use of future technology that could be nurtured by a new alliance in the cultural sector.
 - **Education and Learning:** We should teach skills and not (just) knowledge, and promote meta-skills (such as the capability for cooperation, creativity and problem-solving) to prepare the way for (more) multi-track employment biographies.

- If we consider the current rapid pace of technological transformation in conjunction with a host of global and complexly interrelated challenges (from climate change to cybersecurity), then we also need to view the future of work from within this context. In terms of the actual substance of the discourse on the future of work, if we speak only of the advances of technology or digitalization, home offices, cultures of new leadership, or driverless cars, in many respects this means that we are taking far too limited a view. What is now needed are long-term target visions of a sustainable economic and social order in which technology serves as a means for solving global societal challenges. If we succeed in bridging intercultural value differences, such target visions – supported by far-reaching redistribution – can aid in making work good and meaningful for a much larger part of the world population than is the case today.

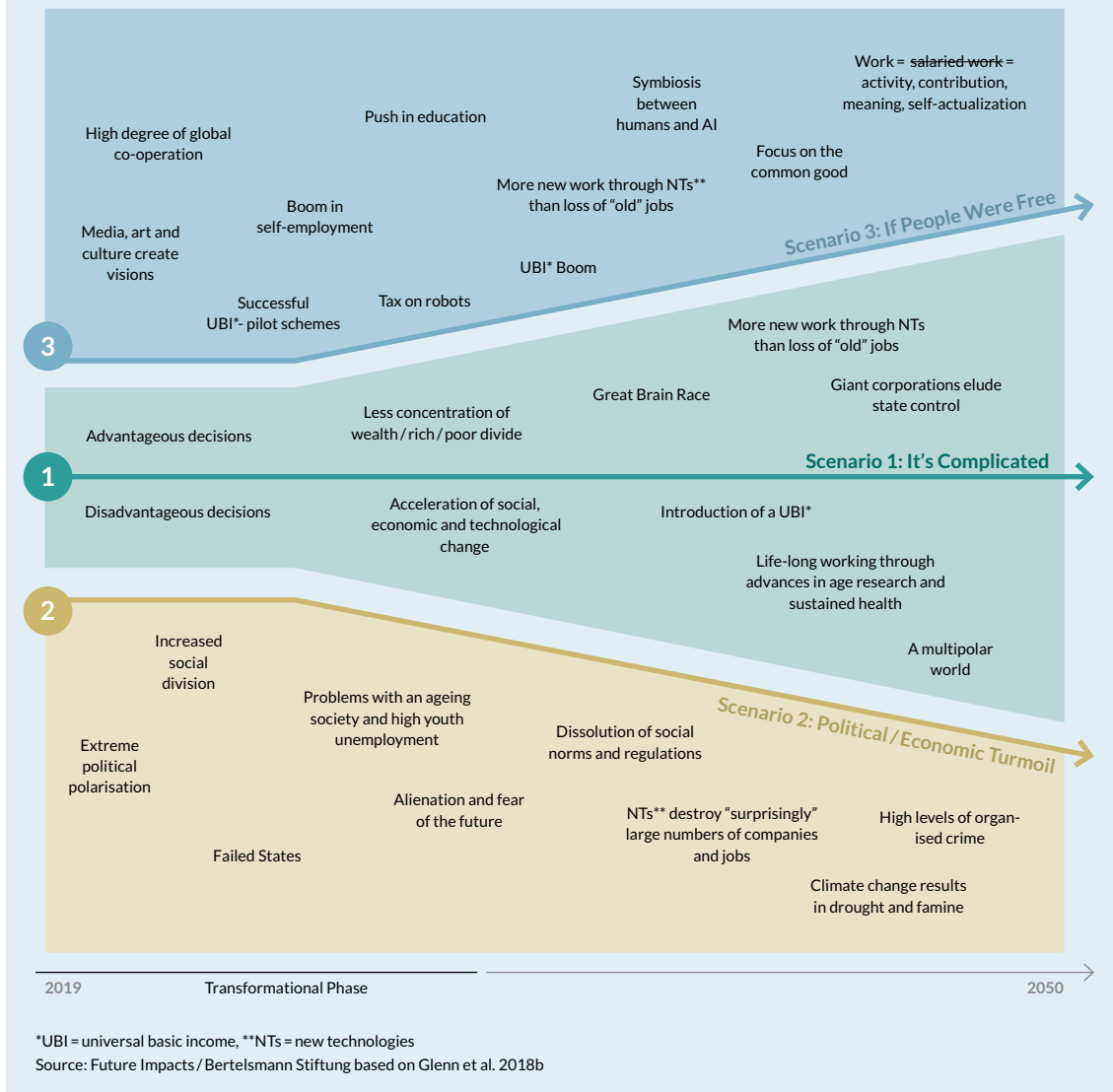
The Three Scenarios in Brief

It's relatively easy to paint a picture of the long-term future of work as problematic and conflict-ridden under the influence of permanent rapid technological change. Yet it's much more difficult when the picture you're producing is neither totally negative nor totally positive, but rather one of positive development that emphasizes opportunities.

It is roughly these three types of scenarios that the project and its participating experts have produced. All three scenarios assume that **there will be rapid technological change**, and at a significantly faster pace than many people today would expect, and that it will have a **radical impact on work**. This will happen because, on the one hand, **human labour will be replaced by machines** but also because, as all three scenarios posit, **the future in-demand skills and aptitudes will be unlike those in demand today, and that human-machine cooperation will be much closer, in some cases extremely close**.

When reading scenarios, we always have to keep in mind that these are **not forecasts**. In other words, **we have to remind ourselves that the scenarios are not intended to present what will inevitably happen; rather, they are show three alternative visions of how things could be**. By its very nature, this approach assumes that other scenarios could also be imagined. What these three visions of the future are seeking to do is to open up a discourse about what is imaginable, plausible and conceivable in the long-term, what risks and opportunities each vision implies – and what is to be done today.

FIGURE 2: The Three Scenario Paths at a Glance



Below, the three scenarios are presented as summaries to make them more readily accessible. Jerome C Glenn, head of the Millennium Project, who wrote these abbreviated versions specifically for this publication, calls them a distillation. We hope that the short version will encourage readers to seek out and read the scenarios in their unabbreviated form which provide much more details on causal relationships and time sequences than the present condensed form would enable (cf. The Millennium Project 2018).

Scenario 1: It's Complicated – A Mixed Bag

Increasing acceleration of social, economic, and technological change with both intelligent and stupid decisionmaking has characterized our intensely complex world. **Massive unemployment did not occur** due to growth in synthetic biology, AI/robotic training and support systems, urban construction in Asia and Africa, retrofitting for eco-smart cities in Europe and the Americas, conscious-technology fields merging humans and AI, virtual reality (VR) educational tourism, personal connection and development services, and other maintenance needs of civilization.

Today's global workforce of six **billion has two billion employed, two billion self-employed, one billion in the informal economy, and one billion unemployed or in transition**. About three billion people were employed in the early 21st century. **Today, there are four billion, either employed by others or self-employed**. Hence, **new technologies** over the last several decades **created as much or more new kinds of employment than they replaced**. Yet, The Great Brain Race during the 2020s laid the foundation for the development of artificial general intelligence (AGI) and **public quantum computing in the cloud in the 2030s**, which accelerated unemployment making self-employment an aspirational norm for many. Nevertheless, **about a billion people have not made the transition as successfully as others**. As a result, some **basic income guarantee plans** have helped to reduce what many thought would lead to social chaos triggered by neo-luddites and other anti-technology movements. The **concept of retirement is receding** around the world with each breakthrough in longevity research, letting people tele-work and pay taxes rather than being financial liabilities. Continued expansion in crowd sourced investment helped **reduce the rich-poor gaps and concentration of wealth**.

Unfortunately, **online fraud continues to be widespread and complex**. Information warfare continues among nations, businesses, and social movements. Brain-to-brain-interfaces can be hacked at any time and organized crime manipulates government decisions, leaving many unsure whom or what to trust as the world continues to merge mind and machine. **Sporadic mass migrations due to failed states, periodic world recessions, and climate change continue to threaten global security**.

The **powers of giant corporations have often grown beyond government control due to extraordinary synergies among NTs** (Next Technologies: AI, robotics, synthetic biology, 3D/4D printing, nanotechnology, IoT, autonomous vehicles, brain augmentation, VR/AR, blockchains, quantum computing, cloud analytics, and conscious-technologies). India is now the most populous country in the world, although China's economy is still stronger with greater global influence in this government-corporate, virtual-3D, multi-polar world of 2050.

Scenario 2: Political / Economic Turmoil – A Future of Despair

During the early 21st century, political leaders were so mired in short-term political conflicts and me-first, selfish economic thinking that they **did not anticipate how fast NTs would eliminate jobs and make business obsolete beginning dramatically in the late 2020s and early 2030s. The concentration of wealth and rich-poor gaps continued to worsen.** The number of employees per production of services and products has dramatically fallen. Even though these problems were clear to leaders as early as the mid-2010s, the increasing polarization in many forms (progressive vs. conservative; executive vs. legislative; augments vs. naturals; taxpayers vs. unemployed; Sunni vs. Shia; fundamentalist vs. liberal; urban vs. rural; debtor vs. creditor nations; scientists vs. populists; and rich vs. poor) around the world had become so bad that by the mid-2020s intelligent discourse about economic policy was dead. People listened only to their online identity groups that reinforced their ideologies and prejudices. As a result, **year after year important decisions were not made** weakening education, the economy, and the social fabric of society.

Today's global workforce of 6 billion has only 1 billion employed, 1 billion self-employed, 2 billion in the informal economy, and 2 billion unemployed or in transition. About 3 billion people were employed in the early 21st century. Today there are only 2 billion, either employed by others or self-employed. Hence, NTs over the last several decades did not create more new kinds of employment than they replaced. As a result, two thirds of the world's workforce is either in the informal economy or unemployed. Weakened economies and financial systems cannot support aging societies and massive youth unemployment. Since guaranteed income systems were not in place, social strife and the growth of cybercrimes, terrorism, corporate militias, and organized crime dominate much of world affairs. **The periodic and ad hoc mergers of organized crime and terrorist/separatist sabotage have made the IoT a nightmare.** When devices on the IoT malfunctioned or the occasional system collapses, people did not know if it was just a new software bug or sabotage and by whom or for what reason. **This has increased a general sense of malaise and paranoia.**

Wave after wave of unemployed youth from *failed states* migrated to relatively more stable North Atlantic countries triggered nationalist political victories in North America and nearly destroyed the EU. **Global warming has created environmental migrations due to droughts, famines, and coastal sea water seeping into former freshwater agricultural lands.** Changing ocean acidity, temperature, and currents have added to climate irregularity, loss of coral reefs, and release of ocean-trapped methane gas.

The gap between machine intelligence and what human's understand about what is happening is so wide many feel alienated and approach the future with despair. This **post-Future Shock anomie seems to be increasing with no end in sight.** There are rumors that some political, business, and AI leaders are quietly working to create a kind of **hybrid AGI-TransInstitution as a new**

kind of governance system able to turn around the global situation. Even if true, no one really knows how this and artificial super intelligence that sets its own goals independent of humans will relate. **Global order has deteriorated** into a combination of nation-states, mega-corporations, local militias, terrorism, and organized crime.

Scenario 3: If People Were Free – the Self-Actualization Economy

The **transition to the Self-Actualization Economy** has begun. For the first time in history, humanity is engaged in a great conversation about what kind of civilization it wants and what we, as individuals and as a species, want to become. **Movies, global cyber games, TV shows, UN Summits, VR News, flash mob cyber teach-ins, and thought leaders probe the meaning of life and the possible future as never before.** The historic shift from human labor and knowledge to machine labor and knowledge is clear: **humanity is being freed from the necessity of having a job to earn a living and a job to achieve self-respect.** This is initiating the transition from the job economy to the self-actualization economy.

In the early 2020s, governments anticipated the impacts of artificial general intelligence and other NTs, conducted extensive research on how to phase in universal basic income (UBI) systems, and promoted self-employment. **UBI experiments in the early 21st century showed positive effects in Brazil, Finland, Switzerland, and the Basque region of Spain.** Earlier experiments in India, Liberia, Kenya, Namibia, and Uganda showed that the majority of people used the money more wisely than critics expected, income was used to make more income, health increased, crime decreased, education improved, and self-employment increased contrary to the view that guaranteed income would make everyone lazy. **Cash flow projections showed that UBI could be sustainable around 2030 as the cost of living decreased (due to NT and lower labor costs) and new income to government increased (due to taxes on financial transfers, environmental damage, robots and other NT, plus reduction of tax havens).** The timing was fortunate as this is when artificial general intelligence began to have greater impact on jobs than artificial narrow intelligence. Also by the 2030s synthetic biology and other longevity applications make aging bodies more resilient and de-plaque the brains; **hence, the elderly is now a source of income more than a financial liability.** The distinctions between human consciousness and AI in its many forms have become increasingly blurred or meaningless. Every possible Turing Test was passed years ago. **Our interaction with AI is so complex and continuous that it rarely matters which is which. Civilization is becoming a continuum of consciousness and technology.**

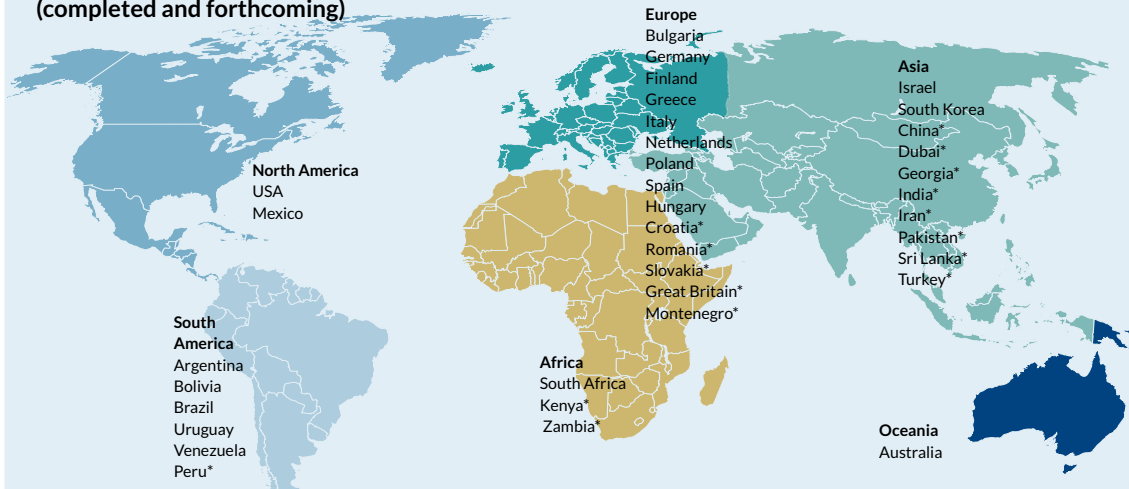
Today's 6 billion world workforce has 1 billion employed, 3 billion self-employed, 1 billion in the informal economy, and 1 billion in transition to self-employment. About 3 billion people were employed in the early 21st century. Today there are 4 billion, either employed by others or self-employed. Hence, NT over the last several decades created as much or more new kinds of employment than it replaced. **The concept of unemployment has lost its meaning to the new "Globals" generation.** By 2050, the world had **finally achieved a global economy that appears to be environmentally sustainable while providing nearly all people with the basic necessities of life and the majority with a comfortable living.** Some believe that NT was the key to this relative success, others that the development of the human potential in the self-actualization economy was more fundamental, and still others that political and economic policies such as various forms of universal basic income made the difference. **All three themes were important, synergizing, and mutually reinforcing.**

Options for Action Today: Selected Impulses

Work in progress on these scenarios produced reactions on a great many levels: some of the drafted developments seemed desirable, some, it was said, should be prevented at all costs while yet others were deemed unimaginable. This is exactly as it should be. And so the next phase of the project turned to **questions of the meaningful measures needed today**. Once the round of workshops held in over 20 countries across the world had discussed the scenarios and identified avenues of action, these were clustered and compacted. Building on this, in the third round of the Delphi project, each portfolio of options for action for the **five fields (Economy and Work/Government and Governance/Science and Technology/Media, Culture and Art/Education and Learning)** was discussed and evaluated by around 150 experts worldwide.

The result of this stage is a **set of options for actions that have been evaluated by experts in terms of their effectivity and feasibility**. In the following we present the top five – the best evaluated options – **for each of the five fields in a spectrum ranging from more concrete to abstract impulses**. We also give keynote expert statements for each of the five fields followed by key points in the discussion in Real-Time-Delphi (sometimes with reference to other options for action in the same field).

FIGURE 3: Worldwide Workshops on the Scenarios and the Generation of Options for Action (completed and forthcoming)



* Workshops in these countries are now in planning | Source: Future Impacts / Bertelsmann Stiftung based on Glenn et al. 2018b

FIGURE 4: The Top 5 Options for Action for each Field in all 5 Fields

Economy and Work

Finding a way for companies and employees to create ethical, aesthetic and social values in addition to economic and material ones.

Introduction of new technologies in work, business and government; skills for future professions and further development of databases.

Definition of a new social contract for workers' rights in a globally situated and functioning economy

Creation of an online platform for the monitoring and analysis of trends in the world of work and technology development that includes the possibility of exchanges and discussions.

Company management as a network of professionals and not a static hierarchy.

Government and Governance

Introduction of state-run independent authorities to advise the legislative, judiciary and executive parts of government in questions of future technologies and their possible

Cooperation between government, employers and trade unions to create models of life-long learning including forecasts from futures research

Studies to pre-empt future conflicts between technologically augmented people (via AI, genetics, electronics etc.) and non-augmented people

Further education programmes for politicians before they start to govern

Introduction of a global platform for the sharing of knowledge in the fields of science and technology up to 2050

Science and Technology

The leadership of state-run research institutes and the extended science and technology community should invest more energy into explaining current developments and future technologies to all people in ways they can understand

Establishment of national regulations and standards for the internet of things (IoT) that in future will cause problems for cybersecurity

Forecast of synergies for the whole spectrum of new technologies (NTs)

Leading figures from science and technology should form part of the state groups which regularly implement cutting-edge science in research strategies

Players from science, technology and legal communities should collaborate on a national and international level to clarify the future need for liability in legal frameworks and treaties, and avoid pitfalls.

Media, Culture and Art

Realignment of libraries, movie theatres etc. for life-long learning, cultural exchange as a point of convergence for new technologies

New films, TV programmes and computer games that show how technologically augmented people can co-habit with non-augmented people free of prejudice and without conflict

Support for communal cultural activities that enhance those values that help in the transition to a rapidly changing future

Establishment of an alliance between art and media, focussed on specific topics: self-employment as a new standard; technology that rather supports than replaces people; the self-actualization economy - "Invest in what replaces you"

Broader concept of work to include self-actualization

Education and Learning

A stronger focus on developing creativity, critical thinking, human relationships, philosophy, entrepreneurship, art, self-employment, social harmony, ethics, values and the ability to build yourself and lead a meaningful working life.

"Possible Futures" as a course subject to be integrated next to history on the school curriculum

Free e-learning, ubiquitous and life-long

Training of abilities rather than preparation for a profession

Along with MINT subjects, a hybrid system for individual training for self-actualization, further training of teachers as mentors in the use of artificial intelligence by students

Source: Future Impacts / Bertelsmann Stiftung based on Glenn et al. 2018b

Economy and Work

New rules are needed for a changing world of work, in particular the promotion of adequate framework conditions for new kinds of work and self-employment

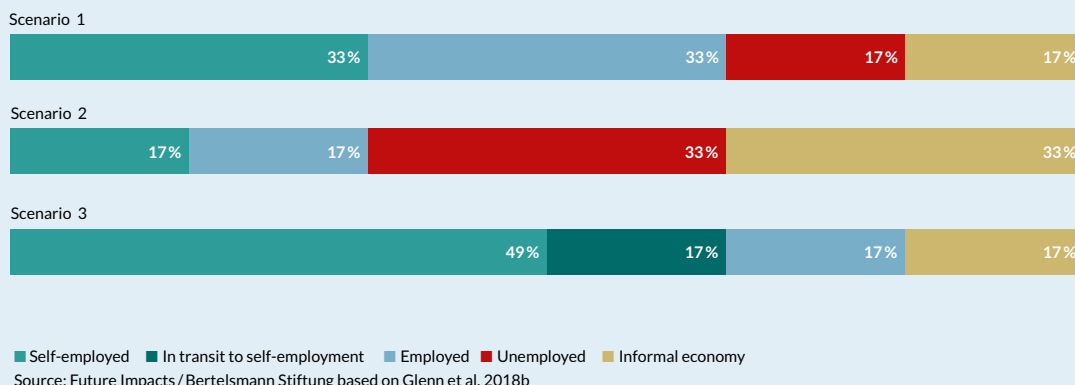
Voices from the Delphi Engine Room:

- ➔ If the population grows to 9 billion by 2050 and we are all connected to one another by the internet, then we all will have access to this market of 9 billion people. Artificial intelligence will help us find those whose services we wish to use and those to whom we wish to offer our services.
- ➔ We have to fundamentally change our concept and definition of the economy so that these include all kinds of value-added performance
- ➔ Look at the nature of the new technologies and it's clear that companies have no chance of surviving as hierarchical entities, only as professional networks.
- ➔ It's obvious that the basic idea (and role) of trade unions will have to undergo a radical transformation by the year 2050. Because it's perfectly unclear how trade unions should function in a world where technology does the work.
- ➔ New phenomena like blockchain need new legal frameworks which are an essential requirement to enable alternative economies to function in a constructive environment.
- ➔ I think that it's commercial companies that will draw up the new social contract. From there it will spread to communities across the world. Governments, on the other hand, have always failed to tackle the question of what kind of new social contract is needed.

If we assume that in future **ever more working biographies will display switches between various kinds of work** – be they switches between full-time and part-time work, salaried employment or self-employment, or hybrid forms of salaried and self-employment – and if we are also confronted with a **rising proportion of self-employment and greater numbers of globalized working biographies**, then it becomes apparent that not only the education system needs to be changed but also **social security mechanisms such as worker protection**. It is noteworthy that all three scenarios ascribe an important role to self-employment while in two of them the role it plays is much more central than it was before.

However, in many places today's working world is still largely patterned on the labour relations of the 19th and 20th centuries in which organized factory workers fought for workers' rights, and the social system too is still largely based on salaried employment. Accordingly, the urgent need for a new framework or even a new social contract in relation to work can be explained by two reasons: Firstly, the present framework fails to do justice to today's working biographies, let alone those of the future. For instance, both present regulations governing working hours and rest periods and the approaches taken by healthcare management run wide of the mark in a world where knowledge work has become mobile and increasingly takes place not just in the home office but third-party places. Secondly, considering the pressure of demographic change, a social, healthcare and pension system based on salaried employment will no longer pay off in the future in its present form but will

FIGURE 5: Composition of Employment 2050 in the three scenarios



totter even more than it is doing today, and in the worst case completely collapse.

Future work thus needs new framework conditions which offer people on the one hand freedom and autonomy, and on the other security, and which optimally recognize not just the usual material or economic contributions people make but also the ethical and social ones. Yet specifically – and quite apart from these long-term far reaching goals – it is now a matter of urgency to **regulate new emergent forms of work like click-work and crowd-work and to create greater social security for the self-employed and freelancers**. At this juncture some people believe that the state would react (too) slowly and that new solutions will be first developed in individual companies and then spread globally. At the same time, however, there is also a vocal call for a **new and much more active role on the part of trade unions** which many experts see in need of radical reform. Here what is particularly needed is a **new form of interest representation for the self-employed and freelancers** – in other words the equivalent of what trade unions were for factory workers in the 19th century.

Government and Governance

State institutions must become more proactive in anticipating and shaping the future (not just the future of work and technology)

Voices from the Delphi Engine Room:

- ➔ Now is the time for consideration and resolution of these issues, before strong conflicts arise.
- ➔ Implementation needs to happen soon to have the desired impact.
- ➔ The role of the government, employers and labour unions may be expected to undergo some radical changes in the light of the new technologies, especially widespread use of AI and digitisation. Be that as it may, creating lifelong learning models (especially for knowledge economies) will be highly desirable. Even inevitable.

- ➔ All tools that would assist in helping better decision-making should be utilized if feasible.
- ➔ Making rapid and frequent predictions about the future, both near-term and long-term, even if most of them turn out not to be true, is one of the primary advantages of the human brain. (...). It relates to everything we do, whether it is for walking through the house without bumping into the walls or planning for future generations.
- ➔ One would think that a civilization with a future-oriented consciousness would be at least as important to building a better future as a civilization with an historically-oriented Consciousness.

The technological transformation of the past few years with all its impacts on society and the economy has been rapid and in many fields, like that of artificial intelligence for instance, much more rapid than many people expected. Given the synergy-effects of progress in multiple technology fields (from digitalization to synthetic biology to robotics, artificial intelligence and 3D printing) experts **anticipate yet a further acceleration of the pace of change** in the coming decades. The first Delphi study found that the education system in particular was failing to keep pace with technological transformation, and this diagnosis can now be extended to apply to other state systems as well. **While technology moves forward at breakneck speed, the state in its present form often reacts sluggishly. The overall picture is one of dillydallying or kicking the can down the road.** Consequently, issues are first tackled when faint signals have grown into major problems. What is then needed are quick fixes - expectations are high and pressure to solve such urgent problems is enormous, yet there is no time to sit back and think. Given the possible far reaching impact of new technologies like artificial intelligence, this challenge is particularly acute at present since there is still time to take fundamental decisions.

What is called for here is a return to the principle that the state should anticipate the course of future developments - in terms of their opportunities and risks - so promptly and so comprehensively that it can take on itself the role of futures-maker. To realize this, it has been proposed that research and discourse on the future should be more strongly institutionalized. In specific terms, for instance, it has been proposed to **set up independent authorities on the future or ministries of the future while other voices find that the implementation of methods of systematic forecasting within existing structures** would be more expedient. The common goal here is the realization of the *future principle* or the establishment of much more extended time horizons across all parts of the state. Examples cited include approaches adopted by the European Commission, the United Kingdom, Dubai, and Finland and the Office for Technology Assessment of the German Bundestag. Yet it is equally clear that such approaches need to be **greatly extended and consolidated** as, on the one hand, they require **long-term financing and independence from the party politics of the day-to-day parliamentary agenda** yet, on the other, must exert considerable influence on current decision-making and thus should be **closely aligned with political decision-makers**.

Science and Technology

Stronger forms of cross-institutional and international cooperation are needed to prevent the break-neck pace of new technological development from eluding both our understanding and our control

Voices from the Delphi Engine Room:

- Getting into agreements when things are not yet stable and inequalities are common is not an easy job.
- Maybe when AI or AGI will get to replace policy-makers, it will develop some codes of conduct – for better or worse.
- The future cyber security systems would be greatly affected by the way the national policies and standards of IoT are shaped. These would very much impact the way our long-range work-technology prospects are shaped. There will be enough time for these to work out by 2050.
- Future legal arguments will need new rulings to establish who or what is a legal entity and what are the legal responsibilities of such entities in a world that includes AI.
- Many public forums already exist, but attendance is generally very low and attendees are almost always people who also work in the same area of science and technology. I've never seen a futurist and rarely do I see members of the public attend such meetings. Instead, they attend meetings held by self-interested venture capitalists and political organizations, who are biased about the outcomes..
- It will be quite hard to envision the combinations these technologies bring about and what their impact will be. Furthermore, I believe we're not placing enough emphasis on keeping the human factor in our sights.
- Too often science has kept too much to itself, at the expense of society. [We need to] establish "open" procedures to avoid an "enlightened" despotism.

Technological development and its consequences are an extremely complex topic, one also coloured by the rapid speed of change. **Yet equally the sheer potential of the new technologies and their synergies is so enormous and globally effective that we need a coalition of equal magnitude to tackle the consequences and the legal questions they entail.**

Critically, it will not be possible to deal with such questions within existing institutional boundaries nor within go-it-alone national initiatives. **Therefore all actors must come together on the trans-institutional and international level.** This is the only way to ensure that the issue is dealt with in its whole breadth and depth, and the only way to **activate and involve the whole cast of actors.** The goal is to evolve framework conditions that are so adequate and so continuously updated that they allow us **to make use of the potential of NTs without losing control over them.**

For instance, in a **world of artificial intelligence and influential algorithms, issues of what constitutes a legal person or entity and liability need to be rethought.** Many such issues are already being dealt with in academic circles **yet what is lacking here is their rapid transfer and realization.** The onus is now on science which should monitor and promote new forms of collaboration and above all else, must assume responsibility as an active partner in the regulatory process – **because where public discourse fails to apply or find**

solutions, a vacuum is created that is filled by lobby associations which tend to pursue their own interests rather than the long-term interests of all people. **In this context the principle of Open Science will play a key role** – many experts insist that science should fundamentally open itself up and become more understandable in a move that goes hand in hand with the evolution of a new understanding of the role that it plays.

In some fields of traditional technologies and their consequences there are now cases of international collaboration, regulatory bodies and processes of targeted control of technological developments, such as in the chemical industry (for instance the case of CFC emissions). **Yet when it comes to the new technologies, such developments are still very much in their infancy.** If we don't want to arrive at a digital ozone hole, we need strong trans-institutional and international collaboration – and we need it as quickly as possible.

Media, Culture, and the Arts

We need attractive and specific visions of positive forms of work and technology use which could result from a new alliance in the cultural sector

Voices from the Delphi Engine Room:

- ➡ We should create new areas of interactions between art institutions and the ICT professionals. A lot of new ideas and initiatives can be generated and from the first be creatively visualized through such interactions.
- ➡ Art and engineering schools already work with business schools to design new products and to create visual and other sensory representations of future products and how people use them.
- ➡ Reading a book can alter your state of consciousness. Studies already show that Virtual Reality enables people to see how their actions affect other people and the environment around them. Religions will, no doubt, be fast followers in the use of VR to enhance, if not also to control the religious 'spiritual experience,' as they have done with every form of new media for centuries.
- ➡ Art schools and engineering schools produce the product designers who are already designing the human-technology interface. I have hired them many times to visualize the future of how people will work with futuristic products. Design thinking consultants also use such techniques in their projects.
- ➡ Anytime we can come together on a global level is a powerful opportunity for getting attention to this type of convergence. Look at sports - imagine the Olympics of Human Potential!

When it's a question of the future, there are always a great many voices representing individual interests on the scene. These are then concerned about their own future and lose sight of the much bigger picture. On the way to a more sustainable future, for instance, in some sectors like the coal industry there's a widespread fear of job losses. Faced with the spread of globalizing tendencies, localists become anxious about their traditions while, should

localizing tendencies become more pronounced, globalists start to worry about isolation and lack of exchange.

New technologies are one of those fields that quickly attract a choir of sceptical voices. They are certainly entitled to join the debate, but the situation does become critical when the media and cultural landscape is mainly shaped by dystopians who – by picking out single aspects of current developments – allow negative representations to dominate the discourse on the future.

For along with a critical debate on the risks, we also need a critical debate on the potential of current and future developments. In order to be able to look beyond our own self-interests, what we need here is a **new alliance in the cultural sector that weaves the aggregate of self-interests into a much bigger picture that reveals the larger contexts.** Obviously, **intercultural differences** play a special role here. We Europeans, for instance should be aware that many Chinese values and their cultures of dealing with new technologies and markets are different from our own. In the long-term, therefore, we need to address the question of how we want to, and how we can, deal with such differences in a time when we need much greater global cooperation. **Bridging cultural value differences will thus become a key lever (for which in turn we will probably need new competences)** for enabling the productive shaping of joint global work within such an alliance.

Yet however we succeed in overcoming intercultural hurdles, such an alliance will have as its set goal **the creation of attractive and specific visions of the future that broaden our imaginations to consider positive forms of development** and show that positive “utopian” futures are also conceivable and not just dystopian development paths. What we need here, for instance, are detailed visions of a world in which machines take on the soul-destroying unpleasant work previously done by people, thus freeing people up for more satisfying activities – **visions of a self-actualization economy.** In other words, what we need are visions which focus more on positive collaboration rather than competition between machines and humans, and which also emphasize the positive effects for humans.

This is an ambitious project. Yet we already have similar pioneering projects like the STRP Festival which takes an open, critical and optimistic view of the future, encourages the dialog between people, technology, society and the future, and has a prize competition that honours outstanding projects in this field.

Education and Learning

Teach capabilities and (not) just knowledge and promote meta-skills to prepare the way to (more) multi-track working biographies

Voices from the Delphi Engine Room:

- ➔ The introduction of forms of education and educational technologies will also result in teachers seeing a reorientation of their own role. Rather than sources of knowledge, they will become “guides” towards a specific direction – in particular if consider the exponential growth in knowledge!
- ➔ We already see a certain shift from the traditional modes of learning and evaluation following the onset of digital technologies. Creativity and critical thinking would be of supreme importance in a regime where AI and other data processing machines will play an increasingly role by overtaking the traditional applications of brain power.
- ➔ It is not a matter of choice. It is imperative that curricula at all levels shall have to undergo multifarious changes, including the one impacting self-employment by 2050. Its implementation is not just feasible but inevitable.
- ➔ Skills are context specific, while capabilities transcend context. What is (...) required is the ability to operate in several contexts - (the) adaptability across multiple contexts may be a better mode than trying to specialize in any one profession.

As occupations rapidly automate and work and jobs requirements rapidly change, the time is now over when teachers served their students pre-set packages of knowledge in order to prepare them for their future professions. Instead of teaching knowledge or focusing on preparing students for particular professions – which could well not exist in their present form in ten years’ time – much greater attention should be paid to the **development of abilities**. The learning and educational worlds of the future will by no means be merely fixated on teaching yet more IT skills or skills from the portfolios of the widely praised MINT disciplines, but will put a premium on what are known as meta-skills. **These social and entrepreneurial competencies and skills – such as self-control, problem-solving, creativity, critical thinking, ability for group work and communication in changing multicultural groups** – prepare people for more varied working biographies and kinds of work. **Lifelong learning, for the most part self-conducted or with the assistance of learning coaches**, helps people keep pace with the continually expanding and developing level of knowledge whilst also helping them to **find their own ways through more varied working biographies**. They will also be aided by **new kinds of learning** that draw on technological possibilities such as a (desirable) system of *distance learning* that’s generally available with free access for everyone. Before this can be achieved, however, **the learning and education systems must first be adapted so that they really can provide barrier-free access for everyone** – and especially for those for whom this is not or only partially the case today. Support is also particularly needed, given that in future more people will probably be or could become self-employed than is the case today, and will need to acquire such skills as enable them to be comfortable in this form of work – be it permanent or temporary – and to ensure income, safeguards and a life-work balance.

Conclusion

The scenarios show those development paths the experts can imagine for the future of work and technology up to 2050 – even though other scenarios are equally conceivable. At the same time, they also imply various field of activity that need to be brought forward yet again along with the selected options for action. One of these is certainly the needed **redistribution and reallocation of opportunities but also, and in particular, the redistribution and reallocation of income and wealth**. In this context the scenarios also show that from the standpoint of the experts, **wide-reaching political measures for the redefinition of social and economic systems** will also be required if challenges at the work/technology nexus are going to be successfully tackled – examples here range from universal basic income to taxes on robot work and closure of tax loopholes. Considering the results of the study, the Millennium Project concludes that, “long-term and large-scale strategies are needed to address the potential scope and spectrum of unemployment and income gaps in the foreseeable future due to the acceleration, globalization, and integration of technological capacities and population growth” (Glenn et. al. 2018b). In arguing this, the project stresses that a plethora of further approaches to action will also be needed in conjunction to the – absolutely indispensable – refurbishing of the education system, in particular with IT skills and MINT disciplines (math, informatics, natural sciences and technology) which are often hyped as the answer to the challenges of a transforming labour market.

The options for action selected here indicate that existing national and supra-national institutions and processes for dealing with current and future change are thus far lacking in teeth. What is primarily needed – with respect to the various options for action – is on the one hand **significantly stronger international and trans-institutional cooperation**. And on the other hand, we need **a new kind of decision-making process, one that pays heed to the long-term interests of the public in general**: in other words, a balancing act between

long-term orientation to the common good and the need to take quick action. After all, there is already a solid near-unanimous consensus that the time window in which we could still set course for a positive future could very soon close.

These present results make it plain that in order to cope with the complexity of the numerous challenges, we need a **global systematic perspective which takes full account of the diversity of interrelations and issues**. Nonetheless, discourse on the future of work is often surprisingly focused on single – obviously relevant – issues. If it remains fixated there, however, even only in respect to home offices, new cultures of leadership and the possibilities of automation, then in many respects it is taking far too short-sighted a view. Instead of this, we need **long-term comprehensive target visions of a sustainable economy and social order in which the potential of new technologies as a means to solve global challenges is fully leveraged**.

Such joined-up thinking on global challenges from climate change to cybersecurity opens up new perspectives in the debates about the future of work. We hold the “positive” scenario of self-actualization that paints a picture of a **possible future with a new paradigm of work** to be particularly central to the present results. Such **work (and such an economy) oriented to the common good** makes a substantial contribution to ensuring not only that a significantly larger part of the world’s population in 2050 will have good and meaningful work but also that global challenges can be successfully tackled.

To answer the question of what steps should be taken towards such a target vision, what we would like to see is a speedy action-oriented debate together with the first international level measures for realization.

The Background to the Study on “The Future of Work and Technology 2050”

The three scenarios and the five Delphis, including that on the options for action, form part of the long-term global study on the *Future of Work and Technology 2050* by the Millennium Project of which the Bertelsmann Stiftung is a member as part of the German Node. Preparation of the scenarios and development of proposals for decision-makers took place or is taking place in the following study phases:

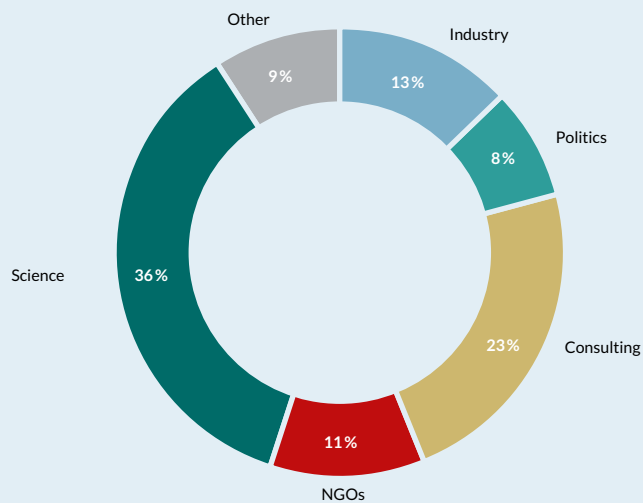
- Literature research on issues touching on the future of work and technology up to 2050 that have not been addressed or only insufficiently addressed thus far in order to provide the groundwork for a first international Delphi study.
- Over 300 experts from technology (AI in particular), industry, government and society from over 45 countries pooled their knowledge in the first Delphi for the construction of alternative work/tech scenarios (Delphi refers to a multi-stage procedure of expert surveys, often called “Real Time Delphi/RTD” because of their real-time exchanges).
- Three draft versions of the Work/Technology Scenarios 2050 were written, and then reviewed and edited by over 450 experts from across the world in a second Delphi. The outcome is the three scenarios published here.³
- The three scenarios were (and shall continue to be) used in over 30 workshops in approximately 20 countries worldwide as the basis for discussions on the future of work and for drawing up options for action. The aim was to identify long-term-oriented strategic options for action for decision-makers in government, industry, society and education.
- The options for action so identified were categorised in the following five fields: Economy and Work; Government and Governance; Science and Technology; Media, Culture and Art; Education and Learning. A (third) Delphi was devoted to the options for action in each of these respective fields. In these field-specific Delphis an average of some 155 experts evaluated a total of 93 options for action in each respective field (this present publication pays special attention to the findings of this Delphi and the scenarios).
- The results were analysed and prepared as thematic reports which were then shared with decision-makers in over 50 countries.
- In the final stage a full final report on the *Future of Work and Technology 2050* will be prepared and published by the Millennium Project (current on-going project stage).

³ For the full version of the scenarios go to: <http://www.millennium-project.org/future-work-technology-2050-global-scenarios/>.

The scenarios and options for action were also widely aired and discussed, for instance, in a joint symposium held with the University of Harvard. Likewise, experts from leading institutions have contributed to the Delphis and the workshops. They come from universities and institutes like the Free University of Berlin and the Russian Academy of Sciences; from the public sector like the European Commission; and from centres of research on the future like the Institute for Alternative Futures and the Interdisciplinary Center for Technology, Analysis and Forecasting, as well as from consultancy and industry.

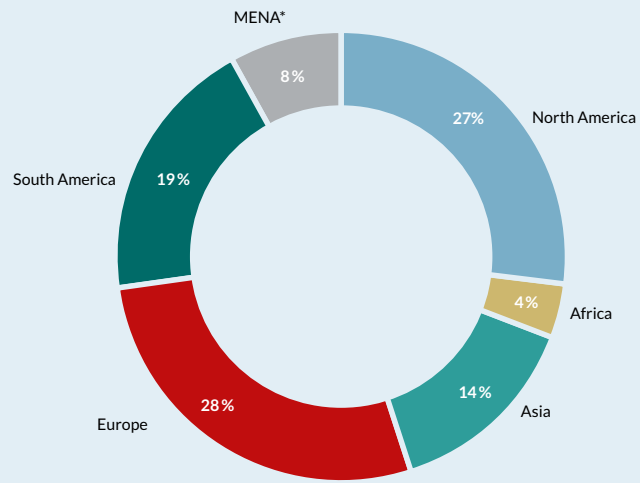
In the following we shall take a closer look at the key data and avenue of approach adopted for the options for action Delphis (5th project phase). The Delphis on the options for action were conducted in the second half of 2018. Even though the greater majority of experts came from academia, experts from industry, government, consultancy and NGOs also took part.

FIGURE 6: Participants in the Options for Action Delphis Per Professional Context (Mean Average for All Five Delphis)



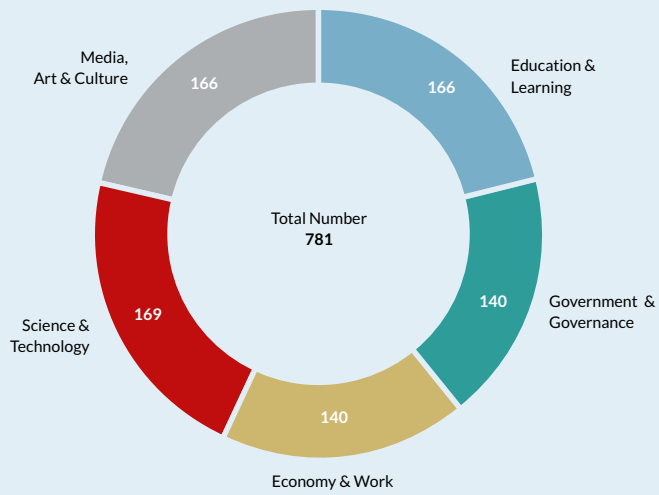
Source: Future Impacts / Bertelsmann Stiftung based on Glenn et al. 2018b

FIGURE 7: Participants in the Options for Action Delphis Per Region (Mean Average for All Five Delphis)



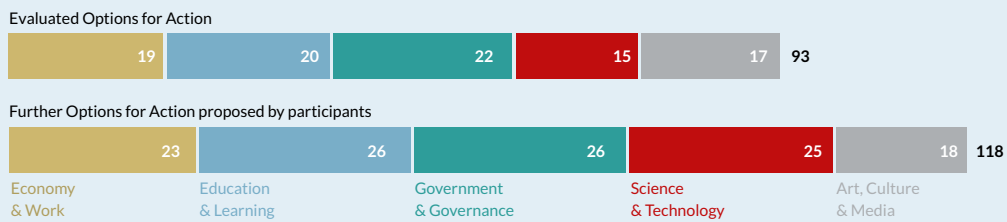
*MENA = Middle East and North Africa
 Source: Future Impacts / Bertelsmann Stiftung based on Glenn et al. 2018b

FIGURE 8: Number of Participants in the Options for Action Delphis



Total Number = sum total of those taking part in individual Delphis without adjustment for those who could have taken part in several Delphis
 Source: Future Impacts / Bertelsmann Stiftung based on Glenn et al. 2018b

FIGURE 9: The Numbers of Evaluated and Additionally Proposed Options for Action in the Delphis



Source: Future Impacts / Bertelsmann Stiftung in Anlehnung an Glenn et al. 2018b

In the first part of the five Delphis the options for action gathered in the fourth project phase were evaluated or assessed by the experts in terms of their “effectiveness” and “feasibility” (on a scale of 1 to 5 or 1 to 10). 93 options for action (an average of 19 per Delphi) were discussed and evaluated.

Apart from rating the options for action on a scale, experts were generally free to broaden and discuss both their estimations of *effectiveness* and *feasibility* and of the options for action themselves as well as to propose further ones. Consequently, in tandem with the quantitative results of the scale ratings, a great number of qualitative insights were also produced from the free-ranging answers and commentaries. Some of these comments are highlighted in the *Voices from the Delphi Engine Room* in this publication.

The outcome of the Delphi phases presented here is a ranking of the total of 93 evaluated and a further 118 proposed options for action for the attention of decision-makers in industry, government, education / research and society. In this publication we have presented one option in greater detail for each of the respective fields and give an overview of the 5 top options in each respective field in Figure 4.

The Bertelsmann Stiftung Project “*The Workplace under the Impact of Digitalization*”

Die The Bertelsmann Stiftung is committed to ensuring that everybody can take part in social life. To this end it adopts an operational approach, conceiving and conducting its own autonomous projects. This report is published within the framework of the Bertelsmann Stiftung’s project on *The World of Work under Digitalisation* and its companion *Future of Work* blog which are dedicated to exploring the ways in which the global megatrend of digitalisation is changing the nature of our daily work and familiar business models. The project aims to provide both employees and businesses with help and support during such digital transformation.

Digitalisation presents major challenges to commerce, civil society, political institutions and industry alike. Together with the megatrends of demographics, economic global networking and governance challenges for companies and entire states, it will play a pivotal role both as a driving force and a potential solution for global challenges. Yet what distinguishes digitalisation from previous social changes is the exponential speed of its transformations, the multiplicity of quantum leaps in technological advancement it brings about and its impact which radiates beyond all borders and institutional boundaries.

It is thus essential to create awareness of this unprecedented quality of development and to offer a space or a platform for discussion of possible approaches to solutions for these challenges that go beyond the scope of conventional paradigms. The internet of things, cloud-based work, and thinking in the economic dimension of such platform economies as Airbnb and Uber are turning familiar work and business paradigms on their heads, and call for greater agility in adaptation by all players. In view of the qualitative leap in economic development, mere continuation of the logic of increased efficiency falls way short of the mark. Digitalisation means disruption, not mechanisation; means dealing with the unfamiliar, not embracing a new planning paradigm; and means ex-post learning, not ex-ante certainty.

For more information go to: www.bertelsmann-stiftung.de/de/unsere-projekte/betriebliche-arbeitswelt-digitalisierung/ and www.zukunftderarbeit.de.

About *The Millennium Project*

The Millennium Project is an internationally active think-tank in the form of an NGO dedicated to the investigation of global issues and perspectives of the future. Founded in 1996 by Theodore J. Gordon and Jerome C. Glenn, and since then run jointly by them and Elizabeth Florescu, the Millennium Project publishes regular State of the Future reports and conducts projects and studies on selected themes with bearing on the future. For some years now, the NGO has also been operating the *Global Futures Intelligence System*, a collaboration and scanning platform on issues of the future. The results of the project's work deliver insights with a high degree of relevance for the future that assist the strategic work of decision-makers in government, industry, education/research, and society, and their mid-term to long-term perspectives.

The Millennium Project operates globally in over 60 *Nodes*. Each Node consists of a group of forward-looking individuals and organisations and connects global and local perspectives. For more information on the Millennium Project, go to: <http://www.millennium-project.org>.

The *German Node* as the National Organisation of the *Millennium Project* in Germany

The German Node of the Millennium Project was founded in 2003 by Cornelia Daheim, (now of Future Impacts Consulting) and has been chaired by her ever since. In 2017 Christian Schoon, (also of Future Impacts Consulting) joined the Node as vice-chair. One of the main activities of the German Node is to organise and moderate workshops on issues of relevance to the future. Such workshops put the global insights, implications and options for action they have evolved on specific issues such as the future of work at the disposal of regional players and organisations from industry, government, education/research, and society. The following is a list of members active in the German Node:

- Dr. Alper Alsan, Siemens;
- Dr. Günter Clar, c3-solutions;
- Dr. Kerstin Cuhls, Fraunhofer Institute for Systems and Innovation Research (ISI);
- Sascha Dannenberg, Free University of Berlin, Futures Institute;
- Bitá Daryan, Volkswagen, Futures Studies and Trend Transfer;
- Dr. Lars Gerhold, Free University of Berlin, Public Safety Research Forum;
- Dr. Heiko von der Gracht, KPMG AG Wirtschaftsprüfungsgesellschaft;
- Sabine Hafner-Zimmermann, Steinbeis-Europa-Zentrum (SEZ);
- Cornelius Patscha, Z_punkt The Foresight Company;
- Dr. Gereon Uerz, Arup;
- Dr. Ole Wintermann, Bertelsmann Stiftung;
- Prof. Dr. Dr. Axel Zweck, VDI Technologiezentrum GmbH.

For more information go to: www.future-impacts.de and www.millennium-project.org and www.zukunftderarbeit.de.

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