2050:
The Future of Work.

Findings of an International
Delphi-Study for The Millennium Project.

The Millennium Project

FUTURE IMPACTS

Bertelsmann**Stiftung**

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Addressing the Bigger Picture

In 2015 the debate about the future of work gained a great deal of traction, not least due to the growing number of critical voices expressing their concerns about robotics, algorithms(beware of Google et al) and automation. In early 2016 the issue was a regular fixture on the conference calendars of political and economic decision-makers in Germany. And judging by the tone of published opinion, the front lines already seem pretty well drawn.

The good guys – to take the media-amplified view prevalent in Germany – are on this side of the Atlantic. They are concerned with protecting the employee or freelancer for reasons which evidently have nothing to do with their own self-interest; they do battle with the global players of Silicon Valley in the belief that they are promoting the cause of the hardware-focussed mechanical engineering industry in Germany. The bad guys are on the other side of the pond. They whip up turbo-capitalism to new heights (platform digitisation, digital Taylorism, dictatorship of data), threaten the domestic taxi and hostelry trades and the German automobile industry and they stand for the ascendancy of algorithms.

Yet these front lines drawn up in German media seem imbued with the distrust of innovation and aversion to technology marking a society which in demographic terms is the second oldest in the world. How else to explain the fact that even though pursuit of a digital agenda has seemed to figure largely on the political order of the day, Germany is now making much greater strides than ever before on its way to becoming a digital developing nation (in terms of WLAN coverage, interference liability, lack of broadband, and its position as international leader in YouTube blockages and so on).

We believe that the German debate around digitisation (and not just work) has now become too much of a navel-gazing exercise. The currently popular trips of individual decision-makers to Silicon Valley, reported on an almost weekly basis, cannot suddenly conjure up the fully fledged and comprehensive culture of work and enterprise needed to allow innovation in internet-based services and digital working methods to flourish over and beyond hardware, hierarchies, cars with combustion engines and other relics of the past industrial age.

With the present publication whose content appears for the first time in German, and in association with the German Node of The Millennium Project international think tank, we are seeking to enrich the domestic debate on the future of work with the results of a global Delphi Study. In this study too, the experts surveyed came to the conclusion that we must reckon with an increase in unemployment on a global scale. However, this change unfolds in a larger context which is often overlooked. Employers and their employees whose digital skills must keep abreast - or even in advance - of the wave of digitisation; education systems which must prepare their students for a radically transformed labour market; a globalised understanding and a globalised distribution of "work"; and the transition of existing social security systems to systems of unconditional basic income are just a few examples of the different perspective that can be gained from this future study, and which policy-making circles and civil society need to embrace in an age of globalised megatrends.

With this special analysis of the Delphi Study on The Future of Work for The Millennium Project, the authors and editors hope to contribute to a less parochial and more technology-friendly view of the future of work.

The Future of Work
We need open questions not overhasty answers

When a great number of factors congeal and the future of a complex system is dependent on a multiplicity of actors, there is never only one possible future. This also holds true for the debates around the future of work in Germany which since the publication of the study by Osborne and Frey and the dialogue on Work 4.0 initiated by the Federal Ministry of Labour and Social Affairs (BMAS) have garnered increasing attention (Frey & Osborne 2013, BMAS 2015). Even if we must relinquish all hope of absolute certainty in our forecasts, it is still vital that we deal with the future and make long-term plans. This can only succeed if we simultaneously hold alternative courses of future development in our minds and ask ourselves two key questions: **What kind of future do we want? And how can we act so as to achieve it?** The aim is not to make forecasts that are bound to be realised, but rather to identify new options for taking present action. This makes it much more important to understand what the key drivers of development are and to question our basic suppositions about what might be needed in order to find new perspectives for solutions. It's more about identifying and formulating open questions and less about an exact forecast for the labour market and future work.

Consequently, with this paper we are opening up the findings of an international study on the future of work for debate in German-speaking countries. What is so unusual in this study by The Millennium Project, a non-profit think tank for questions regarding the future, is that it brings together experts from across the whole world to offer an international global view of a key global issue.

At the same time, it takes an exceptionally long-term view of the future state of work up to the year 2050, and thus offers a perspective of fundamental

long-term development options without, however, laying any claim to holding the truth about the state of work in 2050.

To date this project has given us the results of a Delphi-method-based survey of experts which has gathered findings on key drivers and development perspectives. In the following stage, these will be compounded to alternative scenarios and options for action. A total of 298 experts took part in the survey who used a collaboration platform to exchange and at the same evaluate their assessments (for more details, see the appendix).

So what did the international community of experts covered in the survey consider noteworthy in terms of the future of work?

To answer this question we not only show the aggregated responses to individual questions of the Delphi Study as has already been shown in the latest Millennium Project State of the Future Report (Glenn & Florescu 2015), but we also go further by evaluating the discussions of participants around this issue as given in over 1000 commentaries and discussion threads in the Real-Time Delphi Study. This will give a view into the "back room" of the expert survey, so to speak, and we do so because in our experience we have often found that it's the "back room talks" that make visible another, more inquiring view of the experts about the future.

The talk is then about the organs of the future and also about unbridled enthusiasm for new opportunities but above all about a great number of unanswered questions. In the free exchange of opinion that takes place in the back room each word is not so carefully weighed and everything that's said is not so politically correct as it is in all the official statements about the future with which we're confronted on a daily basis. The same effect is apparent in discussions and events held under rules of confidentiality like the Chatham House Rule (which for this same reason is being ever more widely applied) and in the anonymised discussion forums of the Real-Time Delphi. More often than not, the final version of a study is its condensed form containing a summation of the new insights gained which means that discussion of the truly critical issues often remains concealed. However, it is precisely these discussions that we want to reveal here with our perspective on the back room – some people also call it the "engine room" – of the Delphi Study.

We are not seeking to deliver definitive answers and certainly not safe predictions on the future of work up to 2050; rather we are much more focused on questions which still need answers so that starting today we can begin to shape the future of work as far as possible in a long-term, sustainable and meaningful way. After all, even the most confident expert would never claim – at least in the honesty of the back room ambience – that all these questions have already been answered.

The Key Statements at a Glance

▐ **We don't know exactly what's coming, but we can shape it:** There is a high degree of uncertainty about the course of future development – because it is dependent on the political framework and the collaboration of actors. Even so, it still holds true that we are capable of shaping the course of development.

▐ **The global unemployment rate could rise to 24 percent (or more) in the year 2050.** If we do nothing or nothing fundamental to adapt to the new realities of work, the social gap will continue to widen.

▐ **More and more jobs can be done by machines. There is no way round this technological transformation: robotics, artificial intelligence and technology convergence are what drives development.** The central driver of transformation (considered as certain) is rapid continuing technological progress under the banner of digitisation which encompasses nearly all professional groups and whose pace is likely to accelerate still further.

▐ **We should first expect a transformational phase stretching over the next ten to twenty years.** This is where the previous transformation of work in the sense of digital Darwinism continues as more and more professional groups and activities are replaced by automation. **This will be followed by the transition to a completely new system of working and running the economy to which social systems will have to change and adapt, and where the principle of wage labour might well become completely obsolete.**

▐ **Even today work is mobile and multi-local; tomorrow it will be virtual and take place in the metaverse (the collective virtual space). Employers are**

lagging behind this development. The pace of transformation is likely to quicken even further yet to date employers and employment regulations have been incapable of keeping abreast of it

▐ **New forms of work are being created in the leisure, recreation and health-care sectors, in technology-related fields and with job profiles from empathy interventionist to algorithmic insurer.** New fields of work and professions are emerging in which basic human aptitudes like empathy and creativity are at a premium.

▐ **From MOOC toP2P: Individual people move ahead while the overstrained education system must revolutionise itself and move in the direction of self-managed learning portfolios.** Occupational training and education have not (thus far) kept pace with the speed of technological change whilst individuals have long been living out new forms of learning and working.

▐ **It seems as though we all should learn programming if we're not going to be helpless when confronted with algorithms.** The technological skills that will be urgently required in future are basic skills. They include so-called meta-skills which enable navigation in volatile labour markets and changing environments.

▐ **Perhaps nobody will need to work: After the transformation phase new economic and social systems will be required. 60 percent of experts speak in favour of an unconditional basic income.** After the transformation phase a completely new system will be created in which, for instance, wage labour might no longer figure or where most people are supported by the basic income. It is a matter of urgent necessity to identify new forms of generating income for all demographic groups outside of classical wage labour.

▐ **Global megatrends doom national solutions to failure.** Purely national or regional approaches and perspectives come up too short because, for instance, scientific work will soon be nearly completely independent of specific locations.

Findings of the Delphi Study

Global Unemployment could increase by 24 Percent or more by 2050

Voices from the Delphi engine room

➥ **Everything that can be automated will be automated.**

➥ **There will be an acceleration of pace as ever more people are put out of work "by technology" when artificial intelligence masters vision – and how to learn.**

➥ **The question of how high unemployment will be, well, unemployment per se will be irrelevant. Because our ideas about work will have so fundamentally changed that our present notion of unemployment will have disappeared.**

➥ **Unlike in the Industrial Revolution, we cannot expect a plateau of development here that will allow people to "catch up".**

➥ **In each place today where people are personally serving customers, tomorrow we will find a touchscreen equipped with a voice interface.**

The first question posed by Delphi concerned the extremely controversial extent of unemployment feared or expected from technological transformation. **Nearly unanimously, and independent of the age of respondents or from which region they came, the experts anticipated a globally rising unemployment** rate on average from today's circa 6 percent (Allen 2015) to 11 percent in 2020, with a continual rise up to 24 percent by 2050.

However, it is important to remember that the above figures are all averages of the responses. **Some respondents expect an unemployment rate of up to 50 percent by 2050 or even a state of "nearly total unemployment".** Equally, the more experience respondents have with forecasting, the higher their estimates are pitched. The expectations of the less experienced experts as to the extent of the anticipated unemployment rate were on average 21 percent while the more experienced among them levelled out at 27 percent. By the same token, those experts with more competence in the fields of artificial intelligence and technology development also made higher estimates (for example, respondents with greater expertise estimated the global unemployment rate at 14, not 11, percent by 2020). In other words, **the more respondents knew about predicting the future and the evolution of technology, the larger their estimates of expected unemployment were.**

Development of the Unemployment Rate up to 2050 in Percent
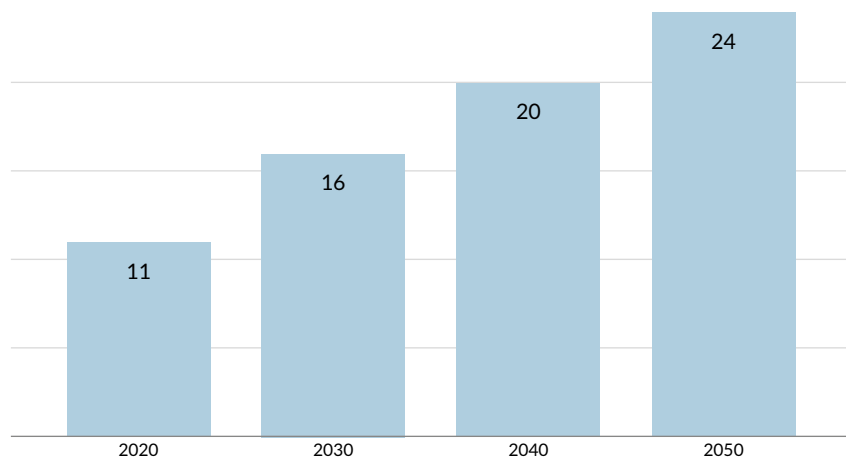

Figure 1   Bertelsmann**Stiftung**

Expected Unemployment Rate by 2050 in Percent according to the Origin of the Experts Surveyed

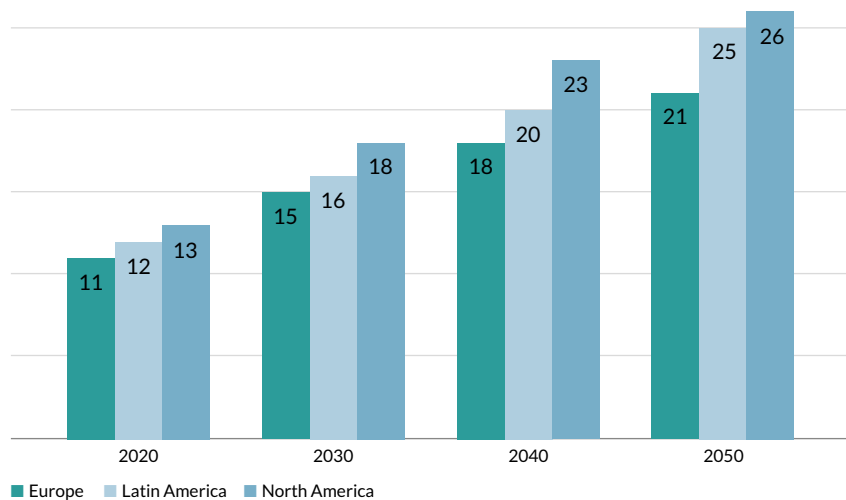■ Europe   ■ Latin America   ■ North America

Figure 2   Bertelsmann**Stiftung**

It is also worth noting with regard to the extent of expected unemployment that the question assumes scarcely changing framework conditions, for instance as far as social systems and the design of work are concerned. Should appropriate changes take place, the picture could become a lot more positive (and perhaps even render the question itself superfluous as the estimates below show).

Incidentally, it is the European experts who are the most sanguine about the extent of expected unemployment – they only anticipate global unemployment of on average 21 percent by the year 2050 whereas the average expectations of North American experts lie at 26 percent. Even so, we should note that in the opinion of the experts we will be dealing with a rapidly rising unemployment rate if we do not adapt the systems comprehensively to the new and coming realities of work.

Robotics, Artificial Intelligence and Technology Convergence drive forward Development – while Employers lag behind.

Original voices from the Delphi engine room

➥ **What actually happens is up to us to decide, and is not irrevocably pre-determined by the direction technological development takes.**

➥ **Technological development is irreversible - everything that can be automated will be automated. Consequently we need to be quick off the mark in starting a discussion about what a world without work might look like.**

➥ **Technology improves human performance at work, a symbiosis between human and machine is created.**

➥ **At some point we will no longer be able to distinguish between these technologies because they will all have fused with one another. And they all are contributing to the creation of a "global brain" that will render our work superfluous. .**

➥ **I don't think that self-learning artificial intelligence is to be expected in this time horizon. If this were the case, it would change everything.**

Robotics, convergence and synergies between various technologies, and artificial intelligence were cited as the main drivers of rapidly rising unemployment, directly followed by the problematic issue of the failure of further training and education to keep pace with the speed of technological change. At the same time, the key technological developments were identified as 3D printing in all fields of production, networked production ("Industry 4.0"), digitisation and networking, and the technological "enhancement" of the human-machine interface through to brain-to-brain interfaces and self-replicating robotics. The answers assume that increasing numbers of simple jobs will be automated by artificial intelligence yet also underscore that in future increasing numbers of "white collar" jobs – jobs in the traditional academic sector – will be affected as already can be seen today with regard to journalism.

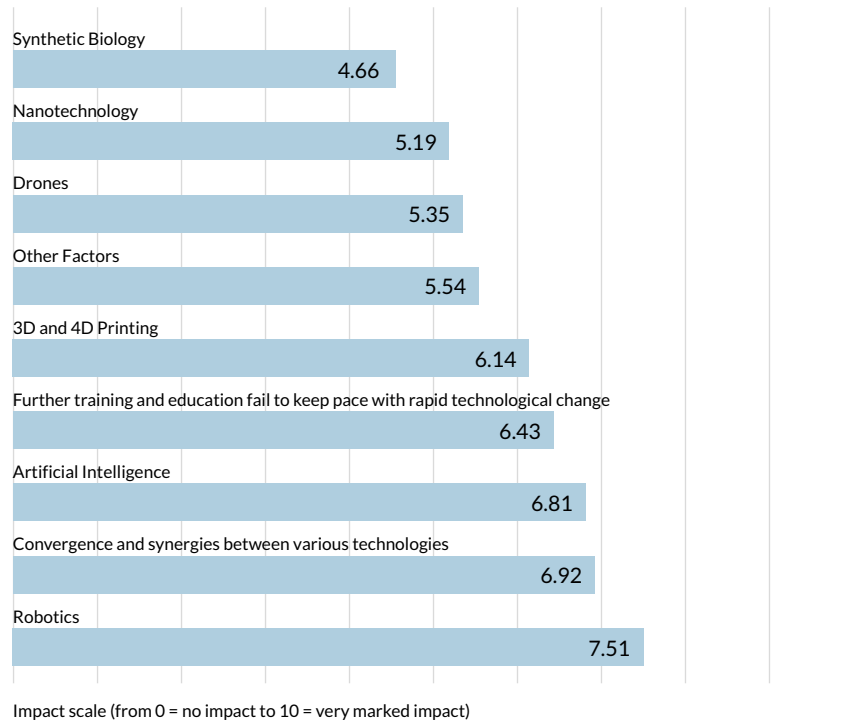## Driving Factors behind Technology-related Unemployment

Factor	Impact
Synthetic Biology	4.66
Nanotechnology	5.19
Drones	5.35
Other Factors	5.54
3D and 4D Printing	6.14
Further training and education fail to keep pace with rapid technological change	6.43
Artificial Intelligence	6.81
Convergence and synergies between various technologies	6.92
Robotics	7.51

Impact scale (from 0 = no impact to 10 = very marked impact)

Figure 3   Bertelsmann**Stiftung**

The pace of transformation and the course it is taking are two highly contro-versial subjects that were particularly hotly debated. Many respondents stressed that with regard to automation and artificial intelligence we cannot expect a development plateau to materialise any time soon, and that on the contrary **the mutual influence exerted by these two technologies will only serve to accelerate their rate of development.** On the other hand, some respondents held that the pace of change has been exaggerated and consider that true (self-learning) artificial intelligence which would fundamentally change the rules of the game (because it impinges on a host of knowledge-based professions) would only make its appearance at the end of the given time horizon or later. Yet analysis of what was said about the timetable of development across all the questions of the Delphi Study, shows that the majority of respondents confidently expect **a transformation phase stretching over the next ten to twenty years.** They say that what is awaiting us is an incremental development as **increasing numbers of professions are affected by automation as its technologies continue to evolve.** And that after this transformation phase, when a great number of professions have been affected by automation, a completely new system must and will come into being (for more on this, see Chapter 6).

Yet one thing is clear even though the exact course future transformation will take still remains contentious: **even today digitisation and technological transformation has fundamentally changed the world of work and signs of this are apparent everywhere. It is this type of change – in an accelerated form – that will also mark the transformation phase.** The examples by which present-day transformation can be recognised are familiar from everyday communication and range from trailblazing emails replaced or enriched by

integrative and real-time communication tools like Slack, to the information flood and the general opening up of institutions and organisations which embrace, for instance, the principle of "open innovation". **Even so, the majority of experts agreed that the major employers in particular are still very far from understanding the true extent of the digital-technological revolution in the workplace and from acting on its consequences.**

Work Today: multi-local and mobile; Work Tomorrow: virtual and metaverse-centric

Original voices from the Delphi engine room
➡ **We have to ask ourselves if "more unemployment" is the real crux of the matter.**
➡ **Perhaps it also has to do crucially with the way in which less and less work is now regulated by a contractual relationship between employee and employer.**
➡ **The key ability will be the ability to teach YOURSELF something. And best of all other people too. As part of the regular work process.**
➡ **So do we want to have work at all, do we need work? Or do we need another form of work?**
➡ **We should teach kids early on in school what individual enterprise means.**
➡ **A large part of work in the future will be work for knowledge nomads.**
➡ **The end of the 40 hour week is now approaching which anyway was made for the Industrial Age. What about if we all had one weekday a week free?**

So how will work be changed in this transformation phase? The majority of responses expect that **the transformation phase will see a decrease in the number of fixed employment contracts and an increase in the number of people working on a freelance or self-employed basis, and that the form and content of work will change more quickly** than it does today and has done over the past decades. They believe that even today the notion of training for a particular profession which you follow for the rest of your life as an employee with all the benefits of social security in a "normal employment relationship" with one or two employers is largely discredited. This means that the educational institutions which provide the training for such a trajectory will in the long-term themselves be rendered obsolete, at least in their present form. **What we need to do, therefore, is to prepare ourselves for patchwork careers, more frequent switches of job, life-long learning, switches from one form of work to another (such as a change from a fixed contract form of employment to self-employment and back again). A major part of knowledge-based work will take place in projects and in teams of changing composition** which increasingly come together in virtual space and derive their membership from across the globe. Learning will thus become an integral part of work as work and learning fuse together. Furthermore, the identified consequences of such transformation will be the demise of hierarchal management culture, the possibility of flexible and location-independent forms of work, a culture of cooperation and self-organised collaboration in increasingly virtual teams and a rapid rise in the relevance of new forms of self-determined learning.

The Change in Knowledge-based "Office Jobs"

Aspect	Yesterday / Today	In Future
Legal form	Mainly fixed contract employment	Self-employed and freelance forms ore widespread much more prevalent
Choosing / changing work	Choice of a profession and employer "for life" / for as long a period as possible	Multiple, frequent changes of job, both voluntary and involuntary
Place and faorm of work	Standards pre-set by employer, mainly in centralised offices	Multi-local work Free choice of place of work by knowledge workers Mobile offices, co-working spaces Minimal or no "team presence time" Virtual collaboration in the "metaverse" (collective virtual space)
Training periods	Formally mainly before entering work, thereafter on an intermittent basis for fixed and limited periods	When taking up a new profession or new job Needs driven and self-directed "Ongoing" = permanent learning during work even without changing job or activity
Characteristics of learning for and on the job	Mainly bound up with learning times, places of learning and educational institutions Geared to certification / qualifications. Handled by institutions	Independent of time, place and major educational institutions Peer-to-peer On demand, mobile, "on the go"= part of work, inseparable from work Determined by the individual

Figure 4   BertelsmannStiftung

The issue of the place of work is often cited as a prime example of this transformation – and of the reluctance of most employers to embrace it. While digitisation makes it possible for a large part of the work done in most office jobs to be carried out in any place having electricity and internet access, many employers are still wondering whether the option of people working one day a week in their home office is truly viable.

At the same time the majority of knowledge workers have long been working multi-locally – or at a variety of places and sites – no matter whether their employers officially support such a move or not. In many places tacit regulations about working elsewhere than in the office have long been introduced without, however, any clarification of the legal consequences this might entail for labour law or any attempt to introduce transparency into the legal framework. Thus, to a very large extent, reality has surpassed existing labour law and its common standards and formal regulations.

In this context the recent legal reform in the Netherlands seems a promising example of an adequate response to these new realities. This new law offers employees the right to work from home and, should this not be granted, stipulates that employers must substantiate their refusal within a strictly defined

framework. (Dürr 2015). **The legal principle has been turned on its head as now employees have a legal claim to choosing their place of work.**

Yet what is needed for this new form of work with its fluid choice of working place and times is not just appropriate changes to labour law or a new culture of management but, critically, completely new skills and aptitudes of a kind that are not taught in most of today's study courses and training programmes. And the lever to which the experts turn to rectify this is the lever of education.

The Education System must move in the Direction of Self-managed Education Portfolios

Original voices from the Delphi engine room
➥ **We have to teach people what they're really going to need: critical**
➥ **thinking, basic technological skills, data analysis, the ability to learn, the ability to work independently and entrepreneurial skillsets.**
➥ **What is needed is a massive shot of investment in education, particularly in threshold and developing countries – in education infrastructures and access, in better vocational and further training, and in primary education for everybody with a solid focus on information and communication technologies.**
➥ **We are now developing a second intelligent species (…), with which we humans will not be able to compete because their abilities will far outstrip our own while their (work) costs are far lower than ours. Thus at some point education too will prove to be irrelevant.**
➥ **The first thing that's needed is a fundamental rethink of the education system away from learning a profession to the development of a portfolio of abilities and skills.**
➥ **We have to begin to develop technological skills as early as the pre-school stage.**

The central element in the broad purview of all the issues and discussions is that nearly all the experts are at pains to underscore the importance of education – no matter whether they expect that technological development will rapidly eliminate a great number of jobs or whether they tend to see new kinds of work arising, and regardless of the pace of change they expect. But what kind of education will his be?

Primarily of course initiatives are cited that are preparing for the new growth sectors, that is, on the one hand, the leading technology fields and on the other the leisure, recreation and healthcare sectors. **Furthermore, basic technological skills in dealing with technology – or better put, in understanding and controlling technology – are becoming decisive.** In this context the experts stress that even today individuals are feeling the wide-ranging consequences of transformation. **Technological education for nearly all professional groups is a matter of necessity. In short, the first thing we all need to do is learn programming and develop a basic understanding of algorithms if we're not going to throw up our hands in despair when confronted with them.**

Apart from these areas of education, talk often turned to so-called **meta-skills which support adaption to rapid change and navigation in volatile employment markets and changing environments.** What is meant here are skills which are relevant in a broad range of different fields and which become even more important when professions themselves are subject to rapid change.

They include, for instance, the ability to deliver results in "unstructured working environments" – where the goal being worked towards frequently changes, where the path leading to results is not clearly defined, and where no predefined methods underpinning the way forward are given. The autonomous creation of functioning structures in such a setting will be one of the abilities that must be taught in the new education system under meta-skills.

Most of the experts, however, emphasise that, quite apart from the forthcoming changes, the existing system of education and further training is already unable to cope with the changes that are now being introduced and even now cannot keep pace with the speed of change. For instance, they view as alarming the great amount of time needed by most of the big universities before they moved to embrace open virtual education in such forms as MOOCs (Massive Open Online Courses), virtual micro-courses, or peer-to-peer learning, and they note that even today many universities still do not regard such offerings as self-evident parts of the curriculum. Since the major systems are so rigid and resistant to change that they themselves are scarcely capable of effecting rapid change, the experts believe that they are already out of step with the present-day rate of change, and are completely incapable of realising with the necessary speed what trailblazing transformative technologies are offering. **Consequently, they assert that if the major institutions of education do not catch up, there will be the looming threat of a growing asymmetric (and in particular technological) education that will only serve to exacerbate the present social divide.**

For signs of transformation that are already apparent today, the experts repeatedly refer to contemporary individuals who are already adapting more rapidly to change than the major systems. These are individual people, albeit part of a growing group, who have long since being living out new forms of work and learning – on the one hand because they dispose of the resources needed to do so, and on the other because they are no longer willing to put their labour at the disposal of those rigid models which thus far have been predominant. The demand for meaningful work and better reconciliation of professional and private interests – claims particularly associated with the millennial generation – are exemplary for such a group as are new models like the social entrepreneurship. And new forms of education have long been lived out – whether in the boom of MOOCs or in the movement for self-managed peer-to-peer learning (see the Peer 2 Peer University). Even so, many experts insist that it's still an open question as to how major institutions and companies are going to do their catching up, and how the system can be designed so as to enable access for all to the new forms of work and learning. **Ultimately the experts are demanding nothing less than a revolution in the education system. They must take their leave of an orientation to study and training courses, to certification and in general to preparation for predictable career paths.** And they must move to **support flexible needs-based education in education portfolios** as is increasingly being practiced in small needs-based units in parallel to professional life.

So I'll be an Empath: Future Professions. Where Technology needs the Human Element.

Original voices from the Delphi engine room

➡ **How many people do you know who would deal with a paper jam in the printer? And how many who would rather let the next user take care of it? So you see, even today we've got plenty of work that no one's willing to do.**

➡ **Artificial intelligence will create work but perhaps it will create fewer jobs.**

➡ **The winners are the self-employed and the makers.**

➡ **We're seeing the rise of professions based in virtual reality and the metaverse.**

➡ **Everybody will be doing something or other. Only much of what they do won't be in the realm of gainful employment. But everybody will produce or make something – even if it's just joy or noise.**

➡ **The place where work is created could be different from we now might imagine it to be.**

Driving Factors that create more Jobs than they replace

Job growth in the the leisure, recreation and healthcare sectors

6.67

Self-employment, freelancing, DIY and related support systems, incentives and training

7.07

New economic concepts and concepts of work

7.17

Impact scale (from 0 = no impact to 10 = very marked impact)

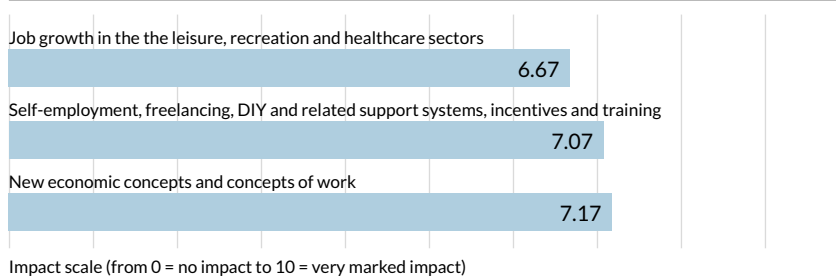Figure 5 | Bertelsmann**Stiftung**

Even today most 3D shops employ more people to revamp the confused designs users bring in than employees responsible for tending the machines. If we all now start to use 3D printing to produce many of our products, we're all going to need assistance. And if we all have multiple robots at home, someone is going to have to repair them.

So if we're going to be facing what the experts say will happen – that every activity that can be automated will be automated – where does this leave work? Will the ability to be creative or to feel empathy be the last remaining enclaves of activity purely reserved for human beings? In terms of what produces more jobs than it replaces, and thus helps in combatting technology-induced unemployment, the top factors are in descending order of importance: new economic concepts (present-day examples include platform concepts and the sharing economy), and new concepts of work, self-employment and freelancing along with education and training but also growth of jobs in the leisure, recreation and healthcare sectors.

If we pursue the lines of thinking in some of the experts' discussion threads, we can see that many new professions are being created outside of the boom sectors of leisure, recreation and healthcare – and this is perhaps what they could look like:

Mini-Scenario: When inexplicable human extraordinary behaviour drives the next job boom.

Just why people get so heated so often about such trivialities is just as much of a puzzle today to many people as it has always been. Today in the year 2025, it's a question asked both by people who scratch their heads in wonder at their fellow citizens and by algorithms which seek to explain human behaviour. In the past few years human-machine interfaces have become the general standard and support people in all prosperous nations in nearly all areas of their lives. In 2025 nobody has any notion of how daily life could function before the widespread use of personal digital assistants.

Yet just why even today there are so many elderly people standing in front of their home robots and muttering angrily "You're really getting on my nerves today!" is a conundrum that is simply inexplicable – even to the latest versions of the best machine learning systems. "This is the point where even the best algorithm throws in the towel." Yet this giant white spot on the growing roadmap of machine learning has created one of the biggest job growth sectors in recent years: the sector of the empathy interventionists. These are the people the machines call in for assistance when they can no longer account for human reactions on the interface – in other words when the phenomenon of what is known as "inexplicable humanoid extraordinary behaviour" kicks in. All reactions are monitored because sensors nowadays are so cheap, and, for instance, facial expressions, gestures, speech acts and a broad diversity of biosignals from the user are directly evaluated at the interface. Generally speaking, the root of the problem can usually be quickly identified. The next step is not intuitively recognisable or users should be asked to make too many decisions – all this has long been known by autonomous machine learning interfaces which can adapt themselves accordingly. Even so, there still remain white spots that the machines cannot explain and this is where the human element once more comes into its own. These people's job is to explain highly inexplicable human behaviour to machines and make appropriate adjustments to the algorithms and interfaces. And so it happens that more and more psychologists have taken additional training in machine learning and when asked at parties what they do for a living, answer, "Me? I'm a professional empath. I explain people to machines."

And that is just one of the future professions that the experts can imagine.

Potential Future Professions

- Interior decorator for virtual space
- Creativity coach
- Personal healthcare consultant
- Empathy interventionists
- Algorithm insurer
- Biosignal trainer
- Education portfolio optimiser
- Extreme geneticist / syn-biologist
- Metaverse janitor
- Translator for human-machine & machine-human
- Leisure-time designer / Occupation broker
- Virtual team assistant
- Personal learning coach
- Ethics algorithm expert
- Estate agent for homes for knowledge workers

New Economic and Social Systems required -60 Percent of Experts in favour of the Basic Income

Original voices from the Delphi engine room

➡ Most highly developed western countries have long shown the world that a kind of guaranteed minimum living standard is the safest way to better education, less crime, and a higher quality of life. (…) And in contradiction to what many cynically claim: No, this does NOT lead to parasitical behaviour or widespread poverty.

➡ The basic income is no solution; it only makes the problem worse.

➡ I expect that in 2050 we will be facing an extremely high unemployment rate. A basic Income is one of the few measures that could turn this into a situation where life is worth living.

➡ If this were tried, it would slow down economic growth and exacerbate poverty.

➡ A basic income is indisputably needed but it must be properly implemented. We shall have to create micro-incentives that work in society, and create positive feedback loops. Some of this is already happening, but on too limited a scale to be effective.

What remains to be done after rapid adjustment of the framework conditions governing work and a revolution in the education system? And what type of development do the experts anticipate over and beyond the transformation phase?

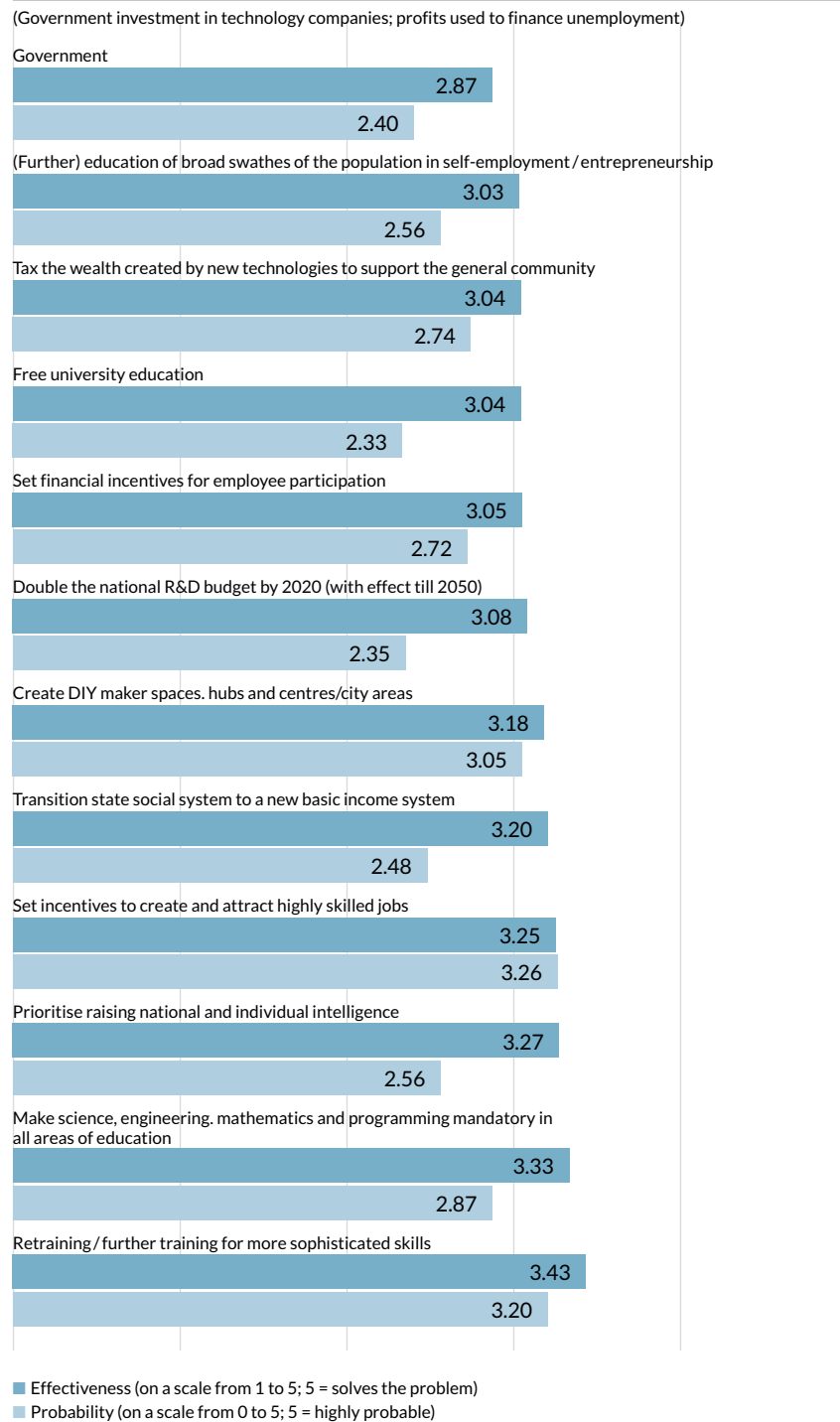## Probability and Effectiveness of Options for Action

(Government investment in technology companies; profits used to finance unemployment)

Government
2.87
2.40

(Further) education of broad swathes of the population in self-employment / entrepreneurship
3.03
2.56

Tax the wealth created by new technologies to support the general community
3.04
2.74

Free university education
3.04
2.33

Set financial incentives for employee participation
3.05
2.72

Double the national R&D budget by 2020 (with effect till 2050)
3.08
2.35

Create DIY maker spaces. hubs and centres/city areas
3.18
3.05

Transition state social system to a new basic income system
3.20
2.48

Set incentives to create and attract highly skilled jobs
3.25
3.26

Prioritise raising national and individual intelligence
3.27
2.56

Make science, engineering. mathematics and programming mandatory in all areas of education
3.33
2.87

Retraining / further training for more sophisticated skills
3.43
3.20

■ Effectiveness (on a scale from 1 to 5; 5 = solves the problem)
■ Probability (on a scale from 0 to 5; 5 = highly probable)

Figure 6   BertelsmannStiftung

What is significant here is that in terms of options for courses of action, none of the options cited received the highest score for effectiveness or probability. In other words, there is not the least unanimity or certainty about what will probably be done and what should be done.

To summarise, four groups of action may be identified from the options proposed and across all discussions:

- Funding of those areas in which new jobs are expected to be created (technology-related professions and the healthcare, recreation and leisure sectors were particularly frequently cited, as were forms self-employment and freelancing)
- Broad education measures in the technology fields considered as crucial and in the teaching of meta-skills such as self-organised learning, working in self-employment, working in virtual teams etc.
- Funding of innovation / research and development
- Restructuring of social systems / redistribution of wealth / creating new sources of income

Many experts anticipate that the middle class will soon be threatened with unemployment on an unprecedented scale, and emphasise how important it is to create new sources of income that are not couched in traditional gainful employment in a contractual relationship. New forms of generating wealth and meeting basic needs are seen by most experts as alternatives that now need to be urgently discussed and investigated. In this context the only specific model that is repeatedly cited is the basic income, and just under 60 percent of experts consider this to be "indispensable" or "very important" in the long-term.

Yet despite the clear basic endorsement given by the experts, the issue of basic income still generates controversy when its feasibility and the sense of it are discussed. Even so, a consensus seems to be forming that we do now need to draw up alternative systems to avoid being caught unawares. In terms of the basic income this could mean, for instance, developing well-founded comprehensive specimen calculations and simulations alongside those pilot projects that are already up and running or in the pipeline.

Consequently, what the exact shape the new system as a whole might take after the transformation phase remains a contentious issue. But what specific ideas are there apart from the basic income?
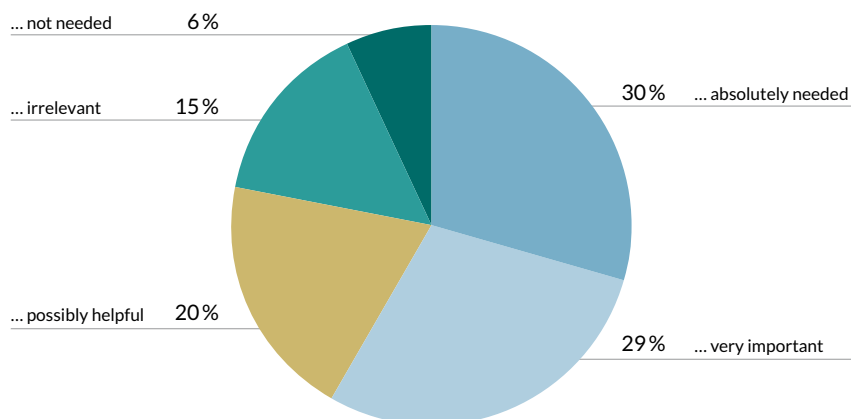
Up to 2050 the Basic Income is …

… not needed	6 %
… irrelevant	15 %
… possibly helpful	20 %
… absolutely needed	30 %
… very important	29 %

Figure 7   Bertelsmann**Stiftung**

Possible Scenarios of Civil War and the Sufficiency Economy

Original voices from the Delphi engine room

➥ **Work is now about (self-) fulfilment, self-actualisation. It's no longer about income.**

➥ **Our understanding of employment will change from the ground upwards – from something that you have to do in order to survive or live decently to something you do voluntarily to get a feeling of self-worth or more luxuries.**

➥ **There should be a global organisation supported by most governments that takes a global view of development, analyses it and steers it mindful of its long-term consequences.**

➥ **When artificial intelligence develops into a network of services that improves everyone's abilities everywhere and at all times, this will lead to a very great number of more positive outcomes than we expect today.**

➥ **I have little hope.**

➥ **Sufficiency will be the solution, inside small communities which produce their goods themselves, transport them, use them and recycle them.**

➥ **Other than the basic income there is no other solution in sight at present.**

➥ **Democratic governments also act within a foreseeable more short-term time horizon. They prefer the quick fix to meet the expectations of the public. This means that they're reluctant to invest in long-term goals and programmes. And non-democratic regimes couldn't care less about the needs of the broad mass of people. The upshot is that it's simply extremely rare to find governments including issues that are important in the long run in their programmes.**

➥ **The goal of work will be self-actualisation; the goal of the economy will be the well-being of humans.**

➥ **The most sought-after good will be meaning, the meaningful job.**

If we search the findings for further potential scenarios for the new system in 2050 (apart from the basic income), what becomes apparent is how little we have been able to imagine such a system thus far and what a wide discrepancy lies between the various strands of thought and scenarios proposed. Some experts wonder whether we will indeed want or need to work in the new system that might materialise while others underscore that only the form and type of work will change and that many new types of work could arise, only there would be no more employers. In this context grandiose visions are articulated such as a totally **new orientation for society and the economy based on individual self-fulfilment,** the common good and self-actualisation, in other words on personal development

What's more, discussion of possible solutions takes place from diametrically opposite poles. On the one hand, **localisation ("a re-localised and highly networked economy") and on the other global control.** The "localisation fraction" often sees a **switch to self-sufficiency or a move away from consumerism** and a focus on the question "What is enough?" as the new guiding principle. This is frequently associated with regional / re-localised

economies, a technology-based DIY culture which could render traditional forms of work as "jobs" superfluous, and very often with the principles of the recycling or closed loop economy. Equally, there is also a group of "optimists" who expect, for instance, that artificial intelligence will lead to significant improvements in our quality of life. These are often the self-same people who put their faith in the power of education and who believe that the focus of many human activities will move away from paid employment to meaningful self-chosen activities precisely because we will no longer have to work.

What is also striking is that hardly one of the experts mentions national governments, the EU, the UN or any other of the major political actors as the possible author of a solution. A pall of disillusionment hangs over the – uncontradicted – concluding remark of one of the experts, "Most of these things will be "tried" and most will fail due to the lobbying of partisan inter-est groups". An alarmingly high number of experts concur in this view or elsewhere formulate similar concerns about the ability of major political institutions to act.

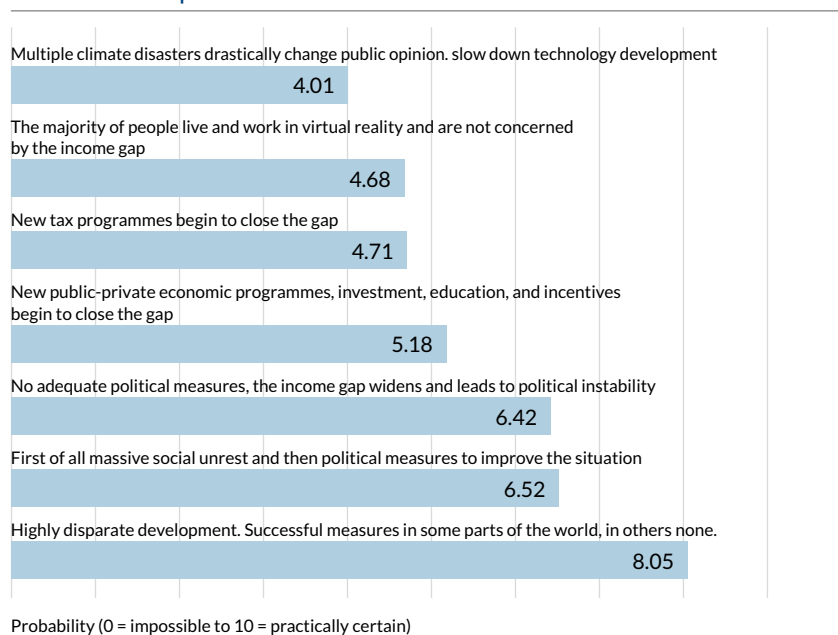### The Probability of Future Developments that address the Income Gap

Multiple climate disasters drastically change public opinion. slow down technology development

4.01

The majority of people live and work in virtual reality and are not concerned by the income gap

4.68

New tax programmes begin to close the gap

4.71

New public-private economic programmes, investment, education, and incentives begin to close the gap

5.18

No adequate political measures, the income gap widens and leads to political instability

6.42

First of all massive social unrest and then political measures to improve the situation

6.52

Highly disparate development. Successful measures in some parts of the world, in others none.

8.05

Probability (0 = impossible to 10 = practically certain)

Figure 8 Bertelsmann**Stiftung**

The experts think that in all probability the course of development will be very uneven on a global level since some countries will succeed in taking appropriate political control measures to resist it, and others won't. Another very sizable group of experts considers it equally probable that **today's indus-trialised nations will first see massive social unrest including long-term civil war before consistent action is taken.** Or even that no kind of appropriate countermeasures are taken so that the social gap will widen even further.

No Labour Market is an Island: How Global Megatrends cause National Solutions to fail

Original voices from the Delphi engine room

➥ First of all, unemployment in the industrialised countries will rise while (more) new jobs are created in developing countries.

➥ At the end of the day, it's all about whether we can distribute wealth, not just within a country's borders but on a global scale.

➥ This is how I see the global roadmap: 2020, – rising unemployment that an economic upswing manages to offset; 2030: more and more people who want to work are replaced by machines; 2040: the richer countries have introduced the basic income and people are no longer dependent on gainful employment (the notion of unemployment no longer exists) ; 2050: the basic income has been adopted by most countries.

➥ If much of what we're just discussing here actually happens, we'll be dealing with widespread political instability and civil war in most countries.

➥ There will be a technology race. Some countries will seek competitive advantages through investment in human-machine interfaces and human augmentation. This in turn will accelerate the pace of technological development whose winners will be those in the forefront of artificial intelligence.

In their discussions the experts constantly refer to the way in which technological developments interact with one another and the impact that they, together with other global development and megatrends, have on work. This means that we need to take account of a plethora of changes that intermesh with work – from demographics (not just the growing world population but the ageing and shrinkage of western industrialised nations and the associated ageing of their workforce) to the possibility of sustained major migratory movements (associated with security, war, and conflict and destined in future to be increasingly caused by the fall-out effects of climate change) and globalisation (which exacerbates still further the rapid spatial shifting of work through digitisation and automation). Other factors cited by the experts in the global context are security /data security including a "data Fukushima" as a possible disruptor of the expected course of development and a particular focus on bio-terrorism; political instability; decentralisation and a worldwide switch to renewable energy sources; a shift of values towards a non-materialists outlook; and a massive increase in life expectancy and the productive and intellectually active period of life.

Thus there is not merely a higher degree of linkage between developments as a whole together with much more complex interdependencies but specifically **much higher competitive pressure for the individual. Because when knowledge-based work is decoupled from a specific location, then any job can be filled by people from anywhere in the world.** This would mean, for instance, that the job of an innovation manager in a company in a rural area of the state of Hesse would no longer just be suitable for German-speaking professionals who wish to relocate to the area but would be thrown open to experts from anywhere in the world as long as they can meet the very limited working time expected of them at company headquarters.

Megatrends relevant for the Future of Work

Field	Factors cited / Megatrends with a high degree of relevance for the future of work
Technology	Technological progress as a key driving factor of transformation of the future of work Critical Technology Fields: ▪ Robotics ▪ Artificial intelligence ▪ Technology convergence and synergies ▪ Digitalisation and networking ▪ Networked production / "Industry 4.0" ▪ 3D printing and decentralised production ▪ Human-machine interfaces ▪ Technical enhancement of the human being (Human Augmentation such as use of headsets in production)
Society	Demographic change (growing world population; shrinking or stagnating population figures in most developing countrires in most developing countries; rapid worldwide ageing with increasing life expectancy and falling birth rates) Increasing migration flows Continuing shift of values and value pluralism A new search for meaning Changing types of families and lifestyles
Policy-making	New rules and regulations for work (also as proposed solutions) Change of social systems Increasing global networking Security, in particular data security and cyber-security, terrorism Political instability
Economy	Economic globalisation Closed-loop economy and regionalisation (also as proposed solution) Monopolisation / concentration of power in key technology fields Decentralisation (e.g. the energy supply)
Environment	Climate change and its consequences Sustainability as the new guiding principle Increasing switchover to renewable resources

Figure 9   Bertelsmann**Stiftung**

This means in turn that individuals are faced with an exponential increase in the number of their competitors. **Yet at the same time individuals also have a much greater degree of freedom in choosing their own centre of life independently of where their employer or contractor is located.** And a third perspective is also cited: **In the competition to attract the "knowledge elite", the winners will be those countries which can offer positive framework conditions to these multilocal knowledge workers who are free to choose where they wish to work and live.** Such conditions can be anything from social benefits to co-working spaces and support for entrepreneurship. It is also worth noting in this context that western industrialised nations in particular find it difficult to change their established systems whilst emerging threshold or developing countries can leapfrog this step and move directly to the next stage and new form of work.

Conclusions from the Engine Room

The view from behind the scenes of the Delphi survey makes one thing particularly evident: against the backdrop of a volatile and globally networked world economy in interplay with accelerated technological development, the question of what "new work" is and how we can positively shape it is always bound to be a global question. Just as the present influx of refugees into Europe shows us that the growing global disparity of conditions of life (from income to security) is also a European problem, other megatrends will increasingly make us realise that the world has long since become a "village" where the problems facing other countries are also our own. As the consequences of climate change become ever more apparent – and are first expected to manifest themselves with particular severity in the poorest countries of the world - it will become evident, for instance, how what seems today an abstract problem can change into a specific factor that leads to growing migration. And when the digital form of knowledge work is practically decoupled from the constraints of being tied to a specific place, the labour markets of the knowledge society will no longer be national ones. Consequently, all purely nationally or regionally based responses and solutions are doomed to failure in the long term. Thus it is vital for us to look beyond national frontiers when seeking to give the work of the future a more positive shape.

When considering the findings of the Delphi study as a whole, it is troubling to see the widespread scepticism of political institutions voiced by respondents who view them as caught in a trap of systematic inertia and fixation on short-term popular measures. In contrast, the majority of experts considers that a wide-ranging political response to the changes ahead is needed, one

which recognises the danger of growing social division and adapts the social framework and the legal framework governing work to the new realities of

the transformation phase in the form of a comprehensive new "digital deal" (see Ast et al. 2015) and does its best to prepare and secure citizens for the coming challenges. What exactly these new framework conditions will be and what the new system will look like is still a matter for conjecture. Even so, it now seems certain that a revolution in the education system on the one hand and support for the individual on the other – for instance with adapted social conditions and promotion of meta-skills – will be the two mainstays of the transformation phase. The only specific measure now at hand for the realisa- tion of the completely new system that will be needed after the transforma- tion phase is the basic income. And here we need to look much more closely at specific ways of implementing and financing it. But not only that: we also need to take a fundamental look at possible alternatives to the present system of generating income and further refine them.

Even if the Delphi Study is (as yet) not intent on analysing individual solu- tions in greater depth but rather seeks to identify the major themes in the field of future work which we must address to arrive at solutions, one thing is clear – that at the moment most of the experts pin their hopes on the indi- vidual. They consider the individual to be more flexible and much smarter than the big systems which in their system-conditioned inertia only react sluggishly to rapid change instead of taking a proactive role in shaping it. Whilst clear warnings are sounded about the ever widening social gap, the experts hope that even today, when the major political markers needed for a change of course are still nowhere in sight, it will be individuals that change course and prepare themselves to begin to embody the new reality of work. The hope is that a multiplicity of individual instances will succeed in changing systems to make them future-proof. Whether it be MOOCs or the trend to social entrepreneurship in Generation Y – these are points where tomorrow's world is manifest today. What still remains to be done is to gain an under- standing of the more far reaching consequences of transformation, or even global society, and to implement comprehensive solution options on the level of employers and major institutions. And we need to tackle this as a matter of urgency.

Appendix

Background to the Delphi Study

The Delphi Study Work 2050 is part of a much bigger overall project on Future Work/Technology 2050 that The Millennium Project conducted until 2016. The overall project is structured in the following phases:

- Literature and related research review
- Real-Time Delphi international survey
- Road maps and scenario drafts
- Real-Time Delphi feedback on the draft road maps and scenarios
- Final scenarios, implications for policy-making and production of first formal report
- First report as input to national and regional workshops on the basis of the first report
- Analysis of results from the national/regional workshops and activities
- Final report

Stages 1 and 2 are now concluded. The questions asked in the survey of experts were based on the analysis of literature. The survey was conducted as a Real-Time Delphi (RTD), using a collaboration platform on which each expert could see the results of the others in real-time, debate with other experts and adjust his or her own assess-

ments. The scenarios of the following stage were based on the results of the first Delphi.

A total of 298 experts participated in the first Real-Time Delphi which forms the focus of the present publication. A large number of them (37%) came from Europe and North America (33%) and from an academic or business context and there were four times more male than female respondents. They had all been identified by the national and regional Nodes of the project as the leading experts and trailblazing thinkers in the areas of concern. Each participant was also requested to make a self-assessment of the amount of experience and expertise he or she had in the respective fields of interest to the study.

Based on the findings of the literature research review, the following key questions were identified and posed by the Delphi:

- If socio-political-economic systems stay the same around the world, and if technological acceleration, integration and globalisation continue, what percent of the world do you estimate could be unemployed – as we understand being employed today – during each of the following years. 2020, 2030, 2040, 2050?

- More jobs were created than replaced during both the Industrial and Information Age. How-
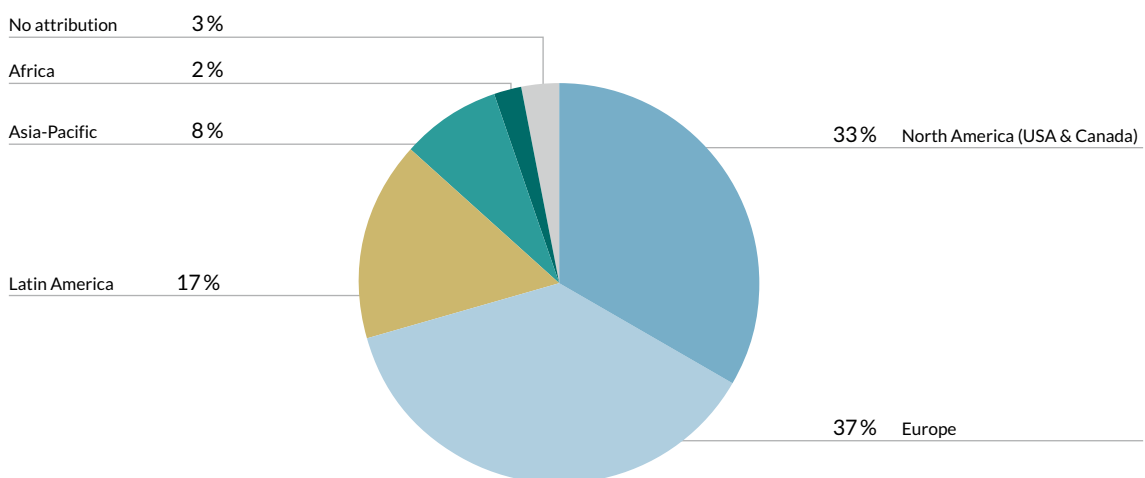
Real-Time Delphi Participants by Region

No attribution	3%
Africa	2%
Asia-Pacific	8%
Latin America	17%
North America (USA & Canada)	33%
Europe	37%

Figure 11   BertelsmannStiftung

Delphi Participants by Profession

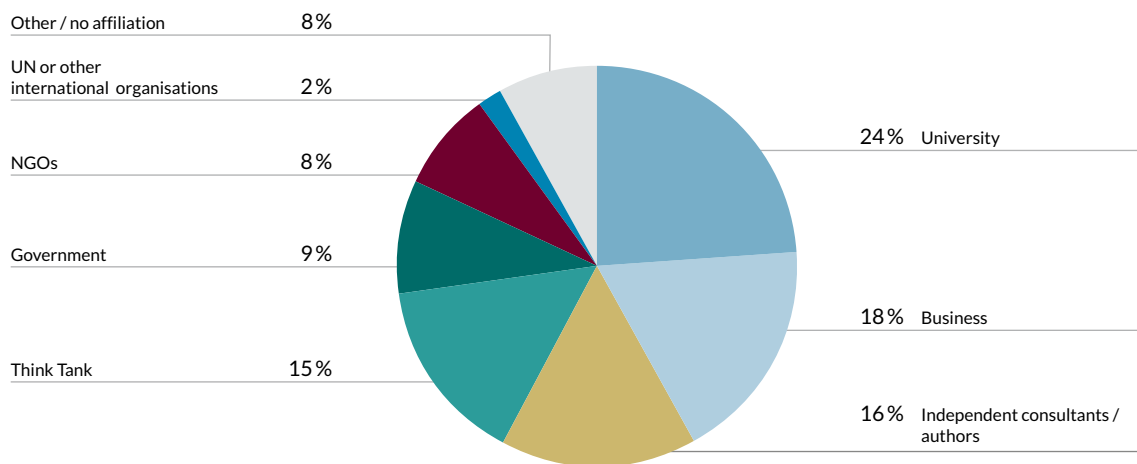Figure 12 | Bertelsmann**Stiftung**

ever, many argue that the speed, integration and globalisation of technological changes of the next 35 years (by 2050) will cause massive structural unemployment. What are the technologies or factors that might make this true or false?

▌ Do you expect that the cost of living will be reduced by 2050 due to future forms of artificial intelligence, robotic and nanotech manufacturing, 3D/4D printing, future internet services, and other future production and distribution systems?

▌ What big changes by 2050 could affect the future of work/technology? What questions have to be resolved to answer whether artificial intelligence (AI) and other future technologies create more jobs than they eliminate?

▌ How likely and effective could these actions be in creating new work and/or income to address technological unemployment by 2050?

▌ Will wealth from artificial intelligence and other advanced technologies continue to accumulate income to the very wealthy, increasing the income gap?

▌ How necessary or important do you believe it is that some form of guaranteed income be in place to end poverty, reduce inequality, and address technological unemployment?

▌ What alternative scenario axes and themes should be written connecting today with 2050, describing cause-and-effect links and decisions that are important to consider today?

Respondents all had the liberty to give free-ranging answers to each of the questions and make general comments. In particular the hypotheses which are at the centre of this present publication are drawn from, and informed by, the ensuing discussions. The next stage in the overall project involves drafting scenarios based on the results gained so far – if you would like to participate or be kept informed about the progress being made, you could subscribe to the Newsletter of the global Millennium Project: www.millennium- project. org/millennium/listserv.html or write directly to Cornelia Daheim (daheim@ future-impacts.de). Regional and national workshops will also be planned on the basis of results which will investigate the issue of the various options for action, and for which the project is still seeking sponsors.

The Millennium Project

The Millennium Project is a participatory global think tank in the form of an NGO whose mission is to investigate global futures. Founded in 1996 by Theodore J. Gordon and Jerome C. Glenn and run since then by them together with Elizabeth Florescu, The Millennium Project publishes an annual State of the Future Report. For the past two years the Project has also been running the Global Futures Intelligence System – a collaboration and scanning platform on issues of concern to the future.

The Millennium Project operates on a global basis with its 56 "Nodes". Each Node consists of a group of individuals and organisations and connects global and local perspectives. The German Node of The Millennium Project was founded in 2003 by Cornelia Daheim of today's Future Impacts Consulting, who also runs it. The members of the German Node are:

▌ Dr. Alper Alsan, Siemens;
▌ Dr. Jan Arpe, Bertelsmann Stiftung;
▌ Dr. Günter Clar, c3-solutions;
▌ Dr. Kerstin Cuhls, Fraunhofer Institute for Systems and Innovation Research (ISI);
▌ Sascha Dannenberg, Free University of Berlin, Futures Institute;
▌ Bita Daryan, Volkswagen, Futures Studies and Trend Transfer;
▌ Dr. Lars Gerhold, Free University of Berlin, Public Safety Research Forum;
▌ Dr. Heiko von der Gracht, Incore Institute for Corporate Education;
▌ 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 Technology Center, Future Technologies Division.

For more information, go to:
www.future-impacts.de and
www.millennium-project.org/index.html.

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