G20 INSIGHTS

G20 GERMANY 2017
THINK 20 DIALOGUE

POLICY AREA:
Digitalization

Accelerating labour market transformation

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June 26, 2017

Abstract

Digitization is driving massive labour market transformation across the globe. This policy brief looks at the effects of automation on businesses, current workforces and communities especially in developed nations and suggests interventions to tackle the unprecedented challenges. Even though complexity and exponential developments in the world can be daunting and counter-intuitive, the authors suggest that policymakers resist the urge to tread carefully and instead actively accelerate this transformation, even if partially blindfolded. Immediate and ripple effects, some likely to have negative impact in the short to mid-term, are inevitable. However, the net long-term benefits for society are compelling. Freeing up resources at community and regional levels will be paramount to solving challenges beyond pure technology-driven disruption - i.e. aging populations, climate change and ending poverty, whose windows of opportunity are rapidly closing. If critical velocity can be achieved, digitization and automation can be turned into key drivers for prosperity worldwide instead of being a mere threat.

Challenge

Whereas most of the current technological breakthroughs mainly affected B2C relations (user applications, internet trading, social media), the next wave of digitization affects B2B relations and will focus on productivity gains. As an effect, digitization is driving massive labour market transformation across the globe. This policy brief zooms in on advanced technologies such as Artificial Intelligence and Robotics and their replacing work currently done by humans. Most research in this field is focused on closing the digital divide in societies and allowing the less educated and less well off to catch up and

acquire the necessary skills to participate in an IT driven labour market. A very recent example is the White Paper "Arbeiten 4.0", published in May 2017 by the German Federal Ministry of Labour and Social Affairs.[1] Digital skills acquisition is viewed as the dominant solution, demonstrated by investments in STEM education at all levels of education. Societies today are hardly taking into account how fast and intense the replacement of work traditionally done by humans is happening. Advanced Analytics, Artificial Intelligence and Robotics applications are widely in use already and tested across many fields in all sectors. It is therefore important to look at effects on, and the role of, businesses and their current workforces and communities, especially in developed nations – as they are most dramatically affected in the short term – and to identify ways to tackle the radical change they are facing whilst machines are taking over.

It is a challenge of its own to see the speed and dimension of the change in the first place – for three reasons: 1) As technology advances across many fields of application the systems we use to operate the planet are becoming increasingly complex. Taking on a "systems of systems" view is necessary, but becoming harder and harder. 2) Every so often there is a surprising event posing a massive challenge or threat to existing systems – examples include the financial crisis at the end of the last decade, or, more recently, the rise of populist and protectionist movements such as in the Brexit decision. Black Swans are likely to occur, but very hard to predict. 3) Just like practically every technology development over the past five to six decades, the proliferation of technologies geared towards replacing today's work is happening at exponential rates. Exponential developments (e.g. Moore's Law) are often underestimated. Perception of such phenomena is driven by relatively weak signals occurring over relatively long periods of time, hardly showing any impact on real life at all. Once beyond critical mass though, change happens with a snap. Overly generalizing Moore's Law one would argue that technology capacity doubles at a yearly rate. That means that in only ten years capacity availability will be a thousand fold compared to today, with 75 per cent of the total capacity growth only happening in years nine and ten. That is post retirement for most of today's CEOs and approximately two election periods away for politicians. Most research into labour market effects of technology advancements clearly demonstrates that substantial disruption is at play affecting more and more jobs across all segments of work and employment. So, societies at all levels – global, national, regional, local – will need to adapt and take steps today.

Proposal

The following specific proposals are structured in four deep dives including concrete steps geared towards understanding the challenges and preparing for solutions:
1) Tackle complexity
2) Understand job-/labour-market related impact,
3) Focus on human-machine interaction,

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[1] Federal Ministry of Labour and Social Affairs, Weissbuch, 2017, available at: http://www.bmas.de/SharedDocs/Downloads/DE/PDF-Publikationen/a883-weissbuch.pdf?__blob=publicationFile&v=4

4) Acknowledge acceleration as a path to prosperity.

Concluding points address management of the transition.

Proposal 1: Tackle complexity, black swans and exponential developments

Policy makers should learn to embrace the unprecedented capabilities that technology makes possible. More importantly, policymakers must be open to update legacy norms and ways of governance in line with 21st century trends and capabilities.[2] How can technology complement the policy-making process just as it is helping medical professionals diagnose cancer more accurately[3], enabling multinational companies share ideas across teams and territories at the speed of light[4], empowering industries to analyse big data and scale-up processes in near real-time[5], and crowdsourcing thousands of individuals to communicate and collaborate seamlessly, asynchronously and coherently on projects in a manner that has never been possible before[6]? And therefore: what should a government of the 21st century look like? This is the question that policymakers need to ask and answer, sooner rather than later.[7]

Complex systems have many interdependent moving parts, whose activities can give rise to nonlinear and emergent behaviour patterns such that aggregate outcomes cannot be directly inferred from the activity of individual components. The socio-technical civilization we live in now is a complex system in many ways, featuring black swan events, systemic cascades and exponential trends, among other phenomena. In short, the world is VUCA – volatile, uncertain, complex and ambiguous. As counter-intuitive as it may sound, we recommend that policymakers embrace uncertainty and complexity beyond the current comprehensible but narrow frameworks to understand and act on the issues at hand.

First and foremost, this requires a shift in mindset on how problems are approached and solved.[8] It requires policymakers and business alike to go beyond one-dimensional KPIs (a trend engendered by "financialisation") and instead work out the entire network of stakeholders and processes that influence and are influenced by the issue at hand. It is necessary to identify the incentive mechanisms that power these processes and their self-strengthening feedback loops. Finally, policymakers must acknowledge that every change to a complex system triggers a new set of emergent behaviours, and therefore must commit to continuous course-correction.

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[2] M. Bonchek, How to create an exponential mindset, 2016, Available at: https://hbr.org/2016/07/how-to-create-an-exponential-mindset

[3] I. Steadman, IBM's Watson is better at diagnosing cancer than human doctors, 2013, Available at: http://www.wired.co.uk/article/ibm-watson-medical-doctor

[4] A. Hesseldahl, Three million people now use Slack every day, 2016, Available at: https://www.recode.net/2016/5/25/11772938/slack-usage-numbers-scale

[5] L. Winig, GE's big bet on data and analytics, 2016, Available at: https://sloanreview.mit.edu/case-study/ge-big-bet-on-data-and-analytics/

[6] C. Metz, How Github conquered Google, Microsoft and everyone else, 2015, Available at: https://www.wired.com/2015/03/github-conquered-google-microsoft-everyone-else/

[7] C. Cheney, Exponential thinking: a revolutionary mindset for development?, 2016, Available at: https://www.devex.com/news/exponential-thinking-a-revolutionary-mindset-for-development-88696

[8] J.A. Curtatone and M. Esposito, A systems-thinking approach to public policy eschews linear model for more holistic understanding of decision-making, 2014, Available at: http://blogs.lse.ac.uk/impactofsocialsciences/2014/09/25/systems-thinking-approach-to-public-policy/

Commitment from stakeholders is necessary due to the interdependence of their vested interests. This seems all the more relevant considering the trust erosion at the community level that has been caused by globalization and the inequity it is driving. And finally, this process creates resilience by aligning stakeholders beyond transactional ties. If and when black swan events arise, resilient networks with strong ties are more likely to adapt quickly to trying conditions.

Finally, we recommend that policymakers truly understand and harness the implications of exponential technology trends. The past two decades have seen multiple paradigm shifts in technology – from industrial to personal computing, from desktop to portable, from laptops to mobiles, from mobile-first to AI-first application development. And with each cycle, the pace, scope and scale of change have only accelerated. It would have been nigh inconceivable ten years ago to predict how far we have come based on historical data alone. This trend will only continue to defy linear intuitions of future possibilities. For example, a current-generation smartphone (circa 2017) is an order of magnitude more powerful than a CRAY-2 supercomputer from 1985.[9] Consider then that billions of people already have these devices in their pockets, with an expected 6.1 billion users worldwide by the year 2020.[10] This level of global connectivity and information access is previously unheard of, and is profoundly changing expectations, value systems and even cultures. Policymakers need to take this new cybernetic dimension of societal dynamics into account when crafting new policies.

An interesting model to achieve a future-oriented policy outlook is to establish a dedicated "Ministry of the Future" as Sweden has recently done.[11] The goal of such a Ministry is to provide considered thought leadership that is deeply embedded in strategic investments and actions of government.[12] A specific mandate would be to envision the future that citizens will want to live in, and realistically map how to get there from now.[13] The Ministry may also spend significant effort in risk engineering, anticipating classes of Stakeholder management is a critical element in responding to complexity for multiple reasons. Since many parties with varied goals and vested interests are involved or affected by changes in the system, it is necessary to bring all these stakeholders to the same table to discuss the best path forward. Such deliberation is markedly slower than unilateral action, but, firstly, it allows for all stakeholders to air out perspectives and generate win-win solutions as priorities shift from individual benefit to group benefit. Secondly, it is more likely to get buy-in and black swan events that might threaten the fabric of society and building safeguards to minimise catastrophic cascades.[14] And finally, such a Ministry would be invested in citizen outreach with regard to controversial issues[15] such

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[9] Experts Exchange, Processing power compared: visualizing a 1-trillion-fold increase in computing performance, 2015, Available at: http://pages.experts-exchange.com/processing-power-compared/

[10] I. Lunden, 6.1b smartphone users globally by 2020, overtaking basic fixed phone subscriptions, 2015, Available at: https://techcrunch.com/2015/06/02/6-1b-smartphone-users-globally-by-2020-overtaking-basic-fixed-phone-subscriptions/

A. [11] Mucci, Sweden's Minister of the Future explains how to make politicians think long-term, 2015, Available at: https://motherboard.vice.com/en_us/article/swedens-minister-of-the-future-explains-how-to-make-politicians-think-long-term

A. [12] Fletcher, Public Policy and Exponential Technology, 2017, Available at: https://www.youtube.com/watch?v=x1EVCOCPou4

[13] UN Conference on Sustainable Development, About the Future We Want (campaign), 2011, Available at: http://futurewewant.org/about/

[14] Global Catastrophic Risk Institute, About the Global Catastrophic Risk Institute, Available at: http://gcrinstitute.org/about/

[15] American Association for the Advancement of Science, Why Public Engagement Matters, 2017, Available at:

as increased automation, possibility of superintelligent AI, lab-grown cellular meat and nuclear energy, providing the facts while engaging emphatically with the concerns of citizens.

The G20 specifically should consider to encourage the foundation of such a foresight institution at the global level - and mandate it to provide research capabilities at the local level in order for communities to better understand and manage their individual challenges in increasingly complex and interdependent environments.

Proposal 2: Understand the job-related and labour market impacts

Comparable to the shift from agriculture to industrial and from there to service society, digitization is currently leading us into a new era of work, shifting existing working models to new ones. With one difference: In the past it has always been a shift from humans to humans, with the evolution of new types of work as the "blue collar", representing manual, non agricultural labour within industrialisation, and the "white collar" defining administrative, office work in the shift towards service society. Although work tasks have blurred, technology remained a facilitator making human work easier and more efficient. With the rise of smart machines and systems, almost every business model and by this any task within almost any value chain is being disrupted, nudging blue and white collar workers out of repetitive tasks.[16]

To truly understand the effect of digitization on jobs and economy, consider these examples: AirBnB is currently valued twice as much as Hilton Worldwide Holdings, but with only one per cent of the latter's workforce and no asset holdings anywhere in the world.[17] Economies of scale for digitization also work on exponential scales. Once an AI system is trained to perform specialised analytics (e.g. cancer diagnosis), the cost and speed of replicating that specialisation digitally is much lower than educating multiple human beings over decades to perform the same task. A seminal Oxford study on the future of employment estimated that 47 per cent of American jobs were at high risk of potential automation[18]; subsequent studies show that for Britain and Japan, the figures are about 35 per cent and 49 per cent respectively[19].

Machine capabilities increasingly define and prevail the way work gets done, introducing a completely new type of labour. Coining a phrase for the phenomenon, the "silver collar" worker represents a cyber physical system including all kinds of work that either gets done autonomously or in collaboration with humans: Robots for example not only execute tasks within production processes,

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https://www.aaas.org/pes/what-public-engagement

[16] http://www.iftf.org/futureworkskills/

[17] M. Kosoff, Why AirBnB is now twice as valuable as Hilton, 2017, Available at: http://www.vanityfair.com/news/2017/03/why-airbnb-is-now-almost-twice-as-valuable-as-hilton

[18] C. Frey and M. Osborne, The future of employment: how susceptible are jobs to computerisation?, 2013, Available at: http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

[19] The Economist, Special Report: Automation and Anxiety, 2016, Available at: http://www.economist.com/news/special-report/21700758-will-smarter-machines-cause-mass-unemployment-automation-and-anxiety

but they are actually taking over entire planning cycles. Artificial intelligence solutions automate administrative tasks - from ticketing to scanning documents to tax declaration. Software influences communication and opinion forming within social networks impacting elections, political and business decisions as well as buying and consumption habits at large scale. And the replacement of manual labour meantime touches the most sophisticated work as, for instance, intelligent systems are becoming able to do complex surgeries which only a few human beings are able to perform.

This change is substantial. It not only substitutes human labour, but brings labour output to a new quality level. While businesses stand to gain a lot from automating and digitising labour-intensive manufacturing processes, this poses a massive threat to manual labour and therefore workforces and their compensation.

Businesses thrive when they capitalize opportunities. This also holds true for an economy or community as a whole. Whilst we acknowledge the replacement of many jobs by automation or digitization, many opportunities also arise from these. It is important to create a constant influx funnel of new tasks that machines cannot do yet. There is a natural "lifecycle of tasks": We have seen many tasks that have been performed manually or individually being first standardized, then outsourced (driven by labour arbitrage), then digitized and automated, before eventually disappearing. It is important to understand and accept that there will be many challenging and rewarding tasks to be performed by humans – as long as we keep innovating and filling up the funnel of such tasks[20]. Examples of areas presenting new job opportunities include so called "last mile services", which are very complex and/or require intuitive interaction with the user – tasks machines will not be able to perform well for a long time.

Communities and nation states at large need to carefully observe and tackle any upcoming mismatch between available work and available resources to do the work. To date this is largely done by looking at the rear-view mirror, analyzing unemployment data. Looking through the windshield instead must include more than hypotheses, conviction and belief which tends to dominate public debate, as social media coverage of e.g. re:publica17 shows[21]. Instead, it has to be based on data, insight, sophisticated prediction models and reliable decision support. In short: To understand and respond to the dynamics caused by the latest technology proliferation, we must apply the latest technology.

Therefore, the G20 should establish a common framework for research to understand dynamics and projections of labour markets across all geographies, societal layers including the community level, as well as industries, and continuously validate the long-term outlook. Specifically this would include the development of big data analytics solutions that cater for the complex labour market dynamics imposed by globalisation, digitization and financialisation, and their interdependencies.

Furthermore, the G20 should ensure that such big data analytics is commonly accessible for local communities to develop customized solutions and share best practices. The key objective would be to

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[20] Note: This applies not only to developed countries but (as labour arbitrage decreases more rapidly through digitization) also to developing countries – albeit at different speed.

[21] https://mobile.twitter.com/BerlinDigital/status/861905105288916992

enable communities at all levels to address their individual weaknesses, strengthen their strengths, invest in their most promising opportunities and apply these strategies across the fields of education and training, attracting investment, supporting start-ups, and to all sorts of policies that allow their economies to thrive.

Proposal 3: Focus on human–machine interaction

The biggest challenge for businesses is not technology - it is the people. People will continue to want to create value (aka work). Thus, the skills of blue and white collar workers will need to contribute to value creation alongside the silver collar worker, aka a robot, and vice versa. Recognizing this duality implies for businesses to transform their current workforce while adapting structures and processes that allow for continuous business success in the digital age.

As machines and software will replace the better part of the work currently done by humans in a more efficient manner, employees are reluctant to engage with the silver collar worker. The main reasons for this behaviour are the perceived competition for work, the complexity of systems accompanying the introduction of the silver collar worker, as well as the lack of trust in cyber physical systems. It is imperative for digital leaders like the CEO, CTO, or CIO to define, lead, and communicate the transformation.

Firstly, businesses have to acknowledge that while entire job categories will vanish, new ones will evolve: No one could have imagined profiles such as "Social Media Manager" or "Chief Digital Officer" 15 years ago. The change in job profiles will happen in breathtakingly short cycles and needs to be addressed by businesses to remain successful. It is very challenging to predict specific job categories and labour requirements and to keep those predictions ahead of the curve. Rather than focusing on future jobs, businesses need to abandon conventional job categories and increasingly look at future work skills, proficiencies and abilities required across different jobs and work settings. To quote from one suggested set of such skills: Sense making, adaptive thinking, cognitive load management, design mindset, and virtual collaboration.[22] However, businesses have to be considerate of the fact that radical disruption usually is not comfortable to go through. Therefore, change management will be highly critical, too.[23]

Second, as humans will remain part of the process, even in automated working environments in which systems adapt their parameters to changing conditions, the question is: How will companies master the transition in an economically successful and humane way? Businesses have to address the lack of trust with regard to the silver collar worker by developing a framework that combines the best of two worlds: The unique creative, sensory and motoric skills of the human worker, and the efficiency of

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[22] http://www.iftf.org/fileadmin/user_upload/images/whatwedo/IFTF_FutureWorkSkillsSummary.gif

[23] https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf

digital solutions. Nevertheless, humans can differ extremely in their characteristics and behaviours. They are, unlike machines, highly unpredictable in their behaviour. But these characteristics can actually be of great value for intelligent systems that require more frequent product and skills changes as they allow humans to respond to unusual situations, thereby supporting the flexibility of a system. Since workforces become more mobile and diverse, the inclusive design of intelligent systems to improve their capability for interpreting and responding to human requirements has to be guaranteed. Therefore, user-centered design of digital solutions including the skills, acceptance, and trust of the human, become critical to success. [24] [25] Moreover, the acceptance of the silver collar worker could be enhanced by adapting behaviour patterns of complex systems to fundamental aspects of human behaviour. For instance, it is empirically proven that human workers could predict anthropomorphic robot movements implemented in assembly processes better than conventional robotic movements.[26] Therefore, more research on anthropomorphizing technical systems needs to be conducted.[27]

Focus on a digital skills set along with a framework to coordinate the interaction with the silver collar worker are essential, but more so is the understanding that these will continue to evolve. The speed and complexity will force businesses to become and to remain agile. Enhancing organisational structures by putting adaptability at their core expedite the transition to a future workforce.

To enable these shifts, policymakers need to take initiative.
First, the educational landscape needs to change. Even in developed countries, technical skills are still optional. In a digital, automated world no one should leave school without the STEM background needed for a work environment that includes interacting with the silver collar workers. Whilst school curricula could be adapted locally, it is more important to **ensure long-term validity and global acceptance of skills for one interconnected labour market.** Digital skill sets including IT as well as social competencies, as proposed by the T20 Task Force on Digitization[28], need to be co-designed and constantly tested in close cooperation with businesses, mutually supporting the necessary aspiration with regard to lifelong learning.

In addition, **defining standards for man-machine interaction needs to be on top of the G20's agenda, considering an ethical paradigm that communities at all levels, local to global, find acceptable.** It is the G20 countries that will first be confronted with short-term optimization and consequential loss of millions of jobs as human skills get widely replaced by the silver collar worker. It is exactly this

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[24] Billings, D.R., Schaefer, K.E., Chen, J.Y.C., Hancock, P.A.: Human-robot interaction: developing trust in robots. In: Proceedings of the 7th ACM/IEEE International Conference on Human-Robot Interaction, Boston, Massachusetts, USA, pp. 109–110 (2012)

[25] Oleson, K.E., Billings, B.R., Kocsis, V., Chen, J.Y.C., Hancock, P.A.: Antescendents of Trust in Human-Robot Collaboration (2011)

[26] Kuz, S., J. Bützler, and C. M. Schlick. 2015. Anthropomorphic design of robotic arm trajectories in assembly cells. Occupational Ergonomics, 12(3): 73-82.

[27] Duffy, B. R. 2003. Anthropomorphism and the Social Robot. Robotics and Autonomous Systems, 42 (3): 177-190.

[28] http://www.g20-insights.org/policy_area/the-digital-economy/

transition phase that requires the start of a thorough ethical debate now, requiring both governments and businesses to come up with solutions for a humane transition into the digital age, re-aligning business, economics and society.

Thirdly, the change of work through digitization will change the relationship between employer and employee. A decade ago, workers worried about jobs being outsourced overseas; today companies can assemble teams "in the cloud" to do sales, customer support, and many other tasks. The necessary adaptability and agility of businesses described above will lead to a setup in which special skills are needed at certain points in time. Therefore, the **G20 should promote the use of global social recruiting**, allowing global accessibility of jobs, while at the same time work on regulations which allow more flexible working models in all dimensions to support businesses in acquiring critical resources to the point. Commonly agreed upon, standards could ensure communities' fair participation in the global labour market, eventually turning into the key measure against protectionist behaviour.

Proposal 4: Acknowledge acceleration as a path to prosperity

At first glance, accelerating the current tides will appear contrarian. The more natural impulse is to attempt to control or slow down this progression, given the highlighted risks and uncertainties. However, once we understand the current trend to be an emergent phenomenon involving the convergence of multiple technological, business and societal changes it should be clear that attempts to control or slow down the progress of digitization are most likely to be futile, and immensely complex. Technology must be regarded as the main enabler for future progress and businesses must take advantage of these advances in order to stay competitive in an increasingly global business environment. At the society level, younger generations of consumers and business professionals are more accustomed to interacting using the cyber infrastructure. As a result, there is ever increasing expectation of near instant satisfaction, and with "free as a business model" lower cost to services and products. The reasons for accelerating the progress of digitization are manifold:

First, complexity and interdependence of multi-dimensional factors are high. Regulators will struggle to analyze and understand the impact of artificially slowing down the progress, whether through penalizing one path will have unintended consequences and still likely to fail. The economic incentives to adopt and advance these technologies are too high to ignore: It is clearly rational for businesses to react to these incentives. Rational economic agents will often emphasize their roles in their business, trusting or hoping free market economics and human adaptation to follow suit. Limiting their ability to innovate and optimize processes will render businesses less competitive with clear negative impact to society.

Second, collaboration of all agents cannot be guaranteed. Regulations are great if all agents in a system are to abide by them. However, as this cannot be guaranteed, it becomes higher risk to passively observe or hope to observe the progress of non-cooperating agents. In many of these challenges, the bottleneck is not the mere investment required in infrastructure but is largely gated by the human factor.

At a global level, there is a strong case towards global progress. Lowering mortality rates, lifting more people out of extreme poverty, access to clean water are all among indicators of the progress of humanity. However, a more localized view in more advanced economies is not as optimistic. In a way, the more advanced societies behave as if they had reached the epitome of progress within the grasp of the human race. As such, optimism about the future is dropping among the younger generations in these nations. With more advanced technology, we can inspire these societies to tackle even harder and more complex problems as well as reach into a new space of opportunities to innovate and further advance our societies, which will in turn serve as newer and higher standards that the global community can thrive for. The risk then is not that these technologies proliferate. **The real risk is that we do not succeed in building them as fast as we need to**. Instead, an acceleration position will enable us to both address our challenges and thrive for a new era in human history where **moonshots become the new normal**.

The G20 should encourage investments in research and development activities in collaboration with universities and smaller private companies, as these will likely create new employment opportunities that are focused on higher value economic activities and more rewarding social experiences.

Moreover, the G20 should encourage and drive fundamental and high-risk research, often ignored by privately funded research that is more short-term ROI focused. Although technology has advanced dramatically in the past 50 years, it is often the case that the harder and more challenging aspects of any problem are not solved. In essence, there is a short-term focus on getting something that works "well enough". This is where "good enough" is the enemy of "great". Engaging in long-term fundamental research sets us up for creating more human-oriented technology powered solutions.

The G20 should also encourage adopting innovative and emerging technologies within public sector services and agencies, which would help to accomplish three things: Provide economic incentives to create and improve these technologies with government agencies being the customer, learn and establish quicker feedback on the state of the technology and progress, and lower the adoption barrier between private citizens and emerging technologies and increase the level of trust on the rewarding aspects of technology in daily life.[29]

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[29]

https://medium.com/@ma7madsayed/life-ai-and-life-with-ai-9594b1e02ab8,
https://medium.com/@ma7madsayed/the-knowledge-leak-or-why-we-need-ai-asap-c3d1477fccef

Conclusion

Call to action: Manage the transition

The main question from an individual and collective business perspective is how to utilize the opportunities offered by these new developments. The answer to this question, however, cannot be found by businesses only: The above discussion has shown many different aspects of the challenges driven by digitization and its effects on the labour market - and beyond. The dimensions that have to be thought of in terms of managing these challenges are manifold – technological, economical, cultural or regulatory-related aspects are at the forefront. When discussing possible solutions or measures it is important to bear in mind that these dimensions differ with respect to the time needed to evolve, i.e. technology might develop rapidly, whereas culture takes a long time to adapt.

In essence, a long-term orientation at both business and government institutions is needed, whilst at the same time accepting the need to accelerate the adaptation to a changing environment. It is important to take into account both these seemingly paradoxical points at the same time. And in all of these dimensions it is important to effectively manage the transition needed to implement the different measures/solutions outlined above.

Whilst we have to accept that in a rapidly changing environment the transition also is a moving target, we set forth to outline some areas which are important to this transition period:

Seeking the opportunities offered by the changes: To achieve this, it is important to work on the measures explained above: Education (both in terms of school and university curricula and lifelong learning) focusing on creativity, innovation and nonlinear thinking and co-creation of ideas in man-machine interaction.

Seeking participation and buy-in of the people affected: No transition will be successful that does not focus on the needs and wants of the people affected by the change described. This requires a new focus on development (rather than output-orientation) from two sides: First of all, it requires businesses to take their employees on a journey and help them transfer into new roles while transferring (parts of) their former role to a robot, thus filling the funnel of meaningful work described above. Secondly, it requires an increased level of individual responsibility - an ongoing motivation and commitment to lifelong learning and a clear vision for oneself.

Building resilient societies: As explained above, black swans are likely to occur - possibly even more often and even less expected. Economies need to become more agile in adapting to new and unexpected developments. This should be in the focus of policy makers. Still, this is not necessarily a question of more rigid regulation, but rather a focus on education and training as mentioned above.

Behavioural economics: One size does not fit all. Every community's business environment is different

– and so are the opportunities available in a rapid and agile development. This requires more granular analyses at community level to find solutions best suitable. Yet, this is not adequately embedded in current economic models. Following the financial crisis of 2008, economists started challenging their models to a greater extent than seen in the decades before, looking e.g. at the elements of irrationality in decision making. Behavioural economics need to become a primary focus of researchers and change the thinking about and modelling of an economy and the behaviour of its participants. This in turn needs then to be incorporated by policy makers in their regulatory efforts, thus supporting building more resilient economies.

Finally, **strong leadership** is needed. This calls to business managers and policymakers alike. In times of increasing uncertainty and unease with developments as fundamental as described above, it is important to convey a motivating and unifying picture of where we want to be. There can be no "muddling through" – clear messages are required and a focus on opportunities rather than a retrospective or pessimistic view. It seems to be time for grand visions again. Visions that summon people behind them, motivating entire communities. The solutions proposed in this paper in our view form a solid basis to underline such visionary thinking with specific answers to the challenges encountered.

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