Powering Fast Forward Thinking

Editorial

Using past experience to anticipate probable future is at the core of insurance. At the same time, as an investor and asset manager, we know that past performance is no guarantee of future results. Societies', companies' and individuals' fates may be overturned, for better or worse, by an unexpected combination of existing trends, by major scientific breakthrough or by a "black swan" event. Foresight is not about the extrapolation of existing trends, it is about the identification of potential disruptions.

At AXA, day-to-day management matters but we also have the conviction that true achievements are founded on long term visions. We feel that a foresight effort is important to build our strategy but might also be useful to tackle many public debates. This first Trendbook is a modest contribution to answer this need to broaden our horizons.

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Jad Ariss
AXA GROUP HEAD OF PUBLIC AFFAIRS & CORPORATE RESPONSIBILITY

With this publication, we hope to provide more than a simple compilation of "trending topics": exploring substance beyond buzzwords and, based on latest scientific evidence, sharing visions and options for decision-making. Indeed, we believe that concepts such as "slashers", "affective computing" or "genetic engineering" will change the way we think, live and work.

Our research initiatives, notably through the AXA Research Fund, are focused around four pillars: Environment & Climate change, Health, New Tech, Socio-Economics. This Trendbook is structured around the same four topics, exploring emerging signals that might have a significant impact by 2025 on society, our lives and our businesses. A specific angle has been explored for each theme: environmental resiliency, community-based health management, enlarged sensorial experiences through technology, the new "personae" on the socio-economic scene.

I hope you will enjoy the reading of this Trendbook and find it surprising, enriching and inspiring.

AXA Foresight
Who are we?

The Foresight Team scout the horizon of emerging trends and weak signals to power AXA's vision for the future, to make sure that the Group is equipped to anticipate & innovate, and to continue to cater to our customers of tomorrow.

When thinking about the long-term future of AXA not only as a company and employer, but also as a responsible societal player, we try to eradicate potential blind spots and cultural biases. Seeing the global nature of challenges, working with a diverse network of foresight experts of major companies and public institutions ensures that the full spectrum of views is weighed. We exclude no new concept, nor any new idea.

This Trendbook strives to convey a representative picture of current foresight consolidated from reports, press readings, podcasts and documentaries.
Additionally, sci-fi depictions of our society's future challenges found in art, novels, series, films or video games provide us with keen creative insight.

On the basis of this global forward-looking watch, we have identified and finally selected the trends that we find have the highest potential to stir up the world of tomorrow.

Cécile Wendling
GROUP HEAD OF FORESIGHT

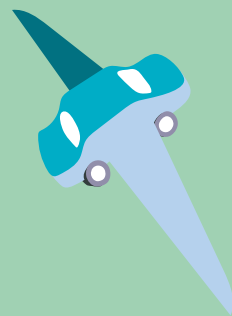**Olivier Desbiey**
SENIOR FORESIGHT ANALYST

Environment

Health

New Tech

Socio-Economics

What do we already know?

Pollution, climate change and migrations

Human activities keep fueling climate change. With global warming, extreme weather events are becoming **more frequent and cost even more** every time they occur. Adaptation to global warming has a cost: the United Nations Environment Program (UNEP) estimates that these costs could reach $150 billion a year in 2025-2030, and up to 250 to 500 billion in 2050.

Meanwhile, climate change **creates new forced migration** flows. By 2050, **143 million internal climate migrants** are expected in emerging countries already facing extreme weather events. This will **increase the urbanization movement** and cities will get overcrowded. Those climate migrants will come mostly from Sub-Saharan Africa (60%), South East Asia (28%) and Latin America (12%).

Between glut & scarcity of resources

From water (by 2025, 70% of the world's population may face water shortages) to rare Earth metals, access to resources is becoming a geopolitical issue. To mitigate these risks, governments and corporations are increasingly focused on adopting circular economy principles or finding alternative resources.

10 years ago, experts were claiming that we had reached the "oil peak" and that we would face oil scarcity and extreme price increases. However prices have known an unprecedent drop (below $30 in 2016) before stabilizing to levels around to $70-75 dollars. The risks are not linked to the lack of fossil resources but to their impact on the environment and the cost of exploiting new oil fields.

Decline in biodiversity & ecosystem collapse

The rate of animal extinction is accelerating: 58% of vertebrate animal population has disappeared since 1970, mostly due to human activities.

Protection measures are starting to be implemented, especially as nature and ecosystems increasingly **inspire scientific progress through biomimetics**.

Renewables & energy storage

Renewable energy solutions such as solar panels and wind turbines are getting less expensive to use. Nuclear fusion techniques are also being tested.

Simultaneously, and in part due to the development of electric cars, better energy storage and better energy distribution through smart grids are changing the way energy is produced. But it also entails new sustainability challenges. Indeed, by 2040 1 in 4 cars will be powered by batteries. As these batteries are made of non-recyclable raw metals whose extraction involves high economical, ecological and health costs, electricity storage engineers will need to develop cost-saving and sustainable solutions.

Future of urbanization

By 2050, almost 70% of the world's population will live in cities, **compared to 55 % nowadays**. Cities will concentrate socioeconomic, energy, pollution and climate change risks.

The mobility in cities will also be redefined: how will more people move into less space? **New shared mobility services** are designed to address this issue, offering solutions **through platforms**. For instance, Uber joined l'Ecole Polytechnique to create a chair designed to address the transport needs of the future.

What could impact AXA on a 2025 horizon?

From the local to the global scale, the question of our society's resilience in the face of major environmental change is at stake. This trendbook focuses on resiliency from 5 angles: biomimicry, climate engineering, the collapse movement, the doughnut metaphor and the question of time in mobility.

Biomimicry: what if nature inspired cities?

Cities are ecosystems with interconnected risks, falling into five categories, which are urbanization, climate hazards, migration flows, impacts on human health and infrastructure. The risks do not come alone, they are intertwined and can turn cities into chaos.

Cities are at the heart of the world's economy, generating 80% of global GDP, meaning that any risk impacting cities has major economics repercussions. For instance, major flooding of the Seine River similar to the flood disaster of 1910 could affect up to 5 million residents in the greater Paris area and cause up to €30 billion worth of damage, according to an OECD report. Therefore, it is crucial to design solutions to make cities resilient, so that they can overcome hardships and recover despite difficulties. As political and economic centers, but also as magnets for both the world's richest and most in need, cities stand at the forefront of the challenges and opportunities of the 21st century.

Biomimicry is becoming a concrete reality

Biomimicry consists in drawing inspiration from the living structures and properties to answer a problem that our society faces. It should not be confused with actions such as the revegetation of urban plots or roofs: although very visible, they do not constitute a biomimetic approach.

What's at stake? Tomorrow's world will be urban. However, living conditions in cities are increasingly difficult, especially because of constantly increasing temperatures, but also because of the growing threat of extreme weather events.

Biomimicry is therefore a sustainable way of reconciling biodiversity and the human way of life. Whether it is to improve the ventilation and insulation of buildings, the solidity of structures or the quality of materials (drawing inspiration from bone structure), many architects and designers are no longer observing nature just as a space to be protected, but also as a model to follow. Let's focus on three examples:

- The shopping center of Harare: while Harare, the capital of Zimbabwe, is experiencing significant temperature differences between night and day, architect Mick Pearce came up with the idea of mimicking the sophisticated system of mound galleries to design a huge shopping mall that would not does not require the use of air conditioning to stay cool;

- Sponge cities in China: China is developing 30 sponge cities (including Shanghai). By 2020 the objective is to make 80% of the urban zones able to absorb and reuse rain water (just as sponges are able to absorb up to 20 times their weight);

- Abuja Centenary City in Nigeria: the project is to build a smart eco-city, using biomimicry on a system level. Scheduled to be operational and occupied by 2024, the city is being modelled on nature's systems in terms of transportation, water and waste management and energy production.

Leaders are starting to see the interest of biomimicry. For instance, the 100 Resilient Cities network was created after Hurricane Sandy. The goal is to share experiments, some of which are based on biomimicry. As of today, more than 30 Resilience Strategies have been published along with an inventory of more than 1,600 action-oriented initiatives - from discrete social programs to ambitious infrastructure projects.

Overriding trends:

1 THE WAY FOREST ECOSYSTEMS THRIVE CAN TEACH URBAN PLANNERS HOW TO BUILD CITIES CAPABLE OF WITHSTANDING EXTREME WEATHER EVENTS.

2 ARCHITECTS ARE DESIGNING MORE AND MORE SKY-SCRAPERS MODELLING THEM ON DESERT TERMITE MOUNDS, THAT STAY COOL.
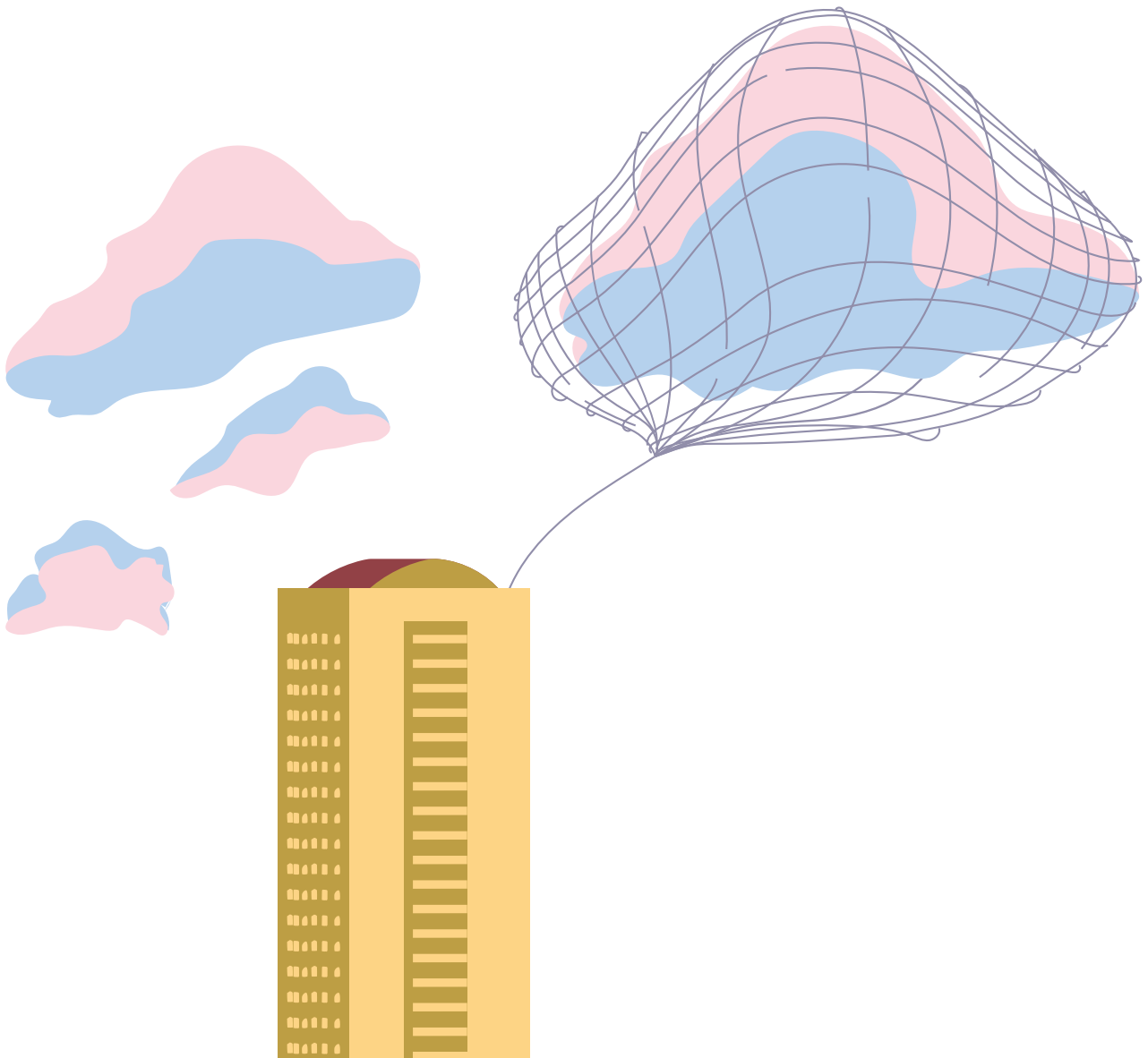
3 RESEARCHERS ARE LOOKING INTO HOW TO REPLICATE BONE GENERATION SO AS TO MAKE NEW BUILDING MATERIALS THAT ARE BOTH STRONG AND LIGHT.
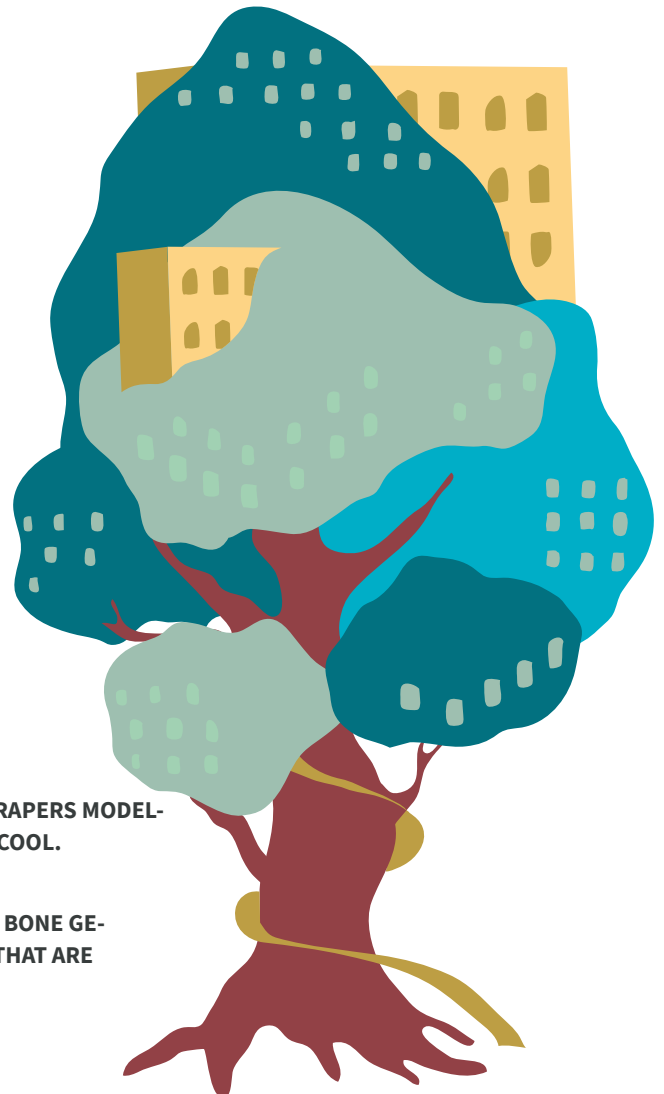
Climate engineering: is it too big a risk?

Climate Engineering (also referred to Climate Geoengineering or Geoengineering - GE) is defined as large-scaled, deliberate intervention in the Earth system to counteract climate change.

Two major sets of techniques are usually included: Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM). Those technologies are not substitutes for cutting greenhouse gases (GHG). They are supplements to the efforts in adaptation and mitigation that countries might implement in order to meet the goal of keeping temperature below the 2°C limit set during the Paris Agreement.

The unwillingness of scientists and governments to move ahead to finance research and experimentations is rooted in numerous reasons. First, uncertainty: there is no way to know the response of climate for certain. Second, there is an ethical issue in modifying the way climate works. How could a particular country justify their need to use SMR and alter the climate of others? This point raises the issue of governability: research needs to provide more insights so people are aware of the risks of using one technology in a certain place and the effects it could have in another location. Finally, by affirming that geoengineering technologies are on the way to being implemented, it creates a moral hazard which could weaken the global efforts to control GHG emissions.

Will climate engineering be generalized?

As of today, the first experimentations that have been realized were small scaled (in 2011 in California and in Russia in 2009).

This is because the legal framework does not allow such large-scale experiments since the signing of a UN resolution in 1977 – in the wake of the Vietnamese trauma – which prohibits "Military or Any Other Hostile Use of Environmental Modification Techniques".

However, the intergovernmental Panel on Climate change (IPPC) released its Fifth Assessment Report, in which out of 204 scenarios (holding atmospheric temperatures below 2°C by 2100), 184 incorporated GE techniques. It therefore does seem that the insurance business could be impacted as more and more powerful countries (United States, China) are looking into those technologies. Scientists found a cheap way to do carbon capture. The cost decreased 6 fold from $600/ton to $94/ton. It could be deployed at large scale starting from 2021 depending on the results of the ongoing experiment in Squamish (British Columbia).

China has invested $3 million in federal funds to support the GE research, focusing on the impacts of GE on polar ice sheets, sea levels, agriculture and human health. China has been using GE technologies for a while, deploying cloud seeding technology by peppering clouds with catalysts (like silver iodide or dry ice) to relieve droughts.

Overriding trends:

1   CHINA IS CONTINUING TO UP ITS FUNDING OF RESEARCH IN GEOENGINEERING TECHNOLOGIES.

2   THERE IS A GROWING ETHICAL DEBATE ON HOW FAR WE CAN EXPERIMENT WITH TECHNOLOGIES TO FACE GLOBAL WARMING.

3   GEOENGINEERING SOLUTIONS WILL RAISE NEW LIABILITY ISSUES FOR GOVERNMENTS AND COMPANIES.

The collapse theory: is it still sci-fi?

Admittedly, when it comes to the future of the environment, pessimistic opinions are commonplace.

They are fueled by the city and countryside landscapes proposed in distopian series and movies, whose aim is to reflect what capitalism would reserve for humans in a near future when pushed to its limits. But some theorists go much further than average people's pessimism and seriously develop collapsology theses. The idea defended by the collapsologists is radical: they believe that it is now too late to hope to reverse the process of destruction of nature and depletion of resources. According to them, we are simply heading for the collapse of our civilization. They are in favor of what they call "deep adaptation", promoting drastic measures. This movement is now being taken quite seriously by many private and public players as one of the credible scenarios for the evolution of our societies in the coming decades or centuries.

The scenario of collapse is based on three sets of arguments:

The resource argument: according to collapsologists, the first cause of the collapse of our civilization will be the lack of available energy. Not only can we no longer rely on finite resources, but collapsologists say the transition to green energies will not change the game, since they still require rare earths for their production and fossil resources for their exploitation;

The climate argument: the human specie is responsible for a major disturbance in the earth's climate (what the IPCC still underlined recently) as well as for an unprecedented extinction of the living species. We now live in the Anthropocene era, where the impact of man on the biosphere has reached an all-time level, shattering everything that once equilibrated our ecosystems and compromising our own long-term survival;

The human argument: collapsologists believe that men simply are not able to react to these threats. On the one hand, because of their globalized values (consumer and competitive society, short termism, individualism). On the other hand, because of the impossible coordination of institutions on a global scale (the announced failure to achieve the objectives of COP 21 is the latest example). In response to such ideas, one can establish three categories of people that react differently to this gloomy prospect:

1. The Skeptics: some people do not act at all, either because they are not convinced of the risks, or because they feel that it is futile to act at the individual level;

2. The Survivalists: a minority is preparing for disaster, especially in Western countries (the USA and Canada come to mind, but also in Germany or France), by building bunkers, constituting large reserves of food and weapons. This community lives in perpetual tensions and suspicions, they do not trust each other - even less so the State – and are getting prepared on their own.

3. The Pragmatists: between the two previous categories, some people are taking action against climate change at their micro level, by installing solar panels or biking to work. However people taking actions against climate change can also be at risk. For instance, in France, malicious companies have sold abusively overpriced solar panels to thousands of families following the "Grenelle de l'Environnement".
Still in France, the number of cyclist deaths rose by 22% since 2010. Society must therefore adapt to the new risks associated with eco-friendly behavior by offering tailored solutions and services.

Overriding trends:

1 THE COLLAPSE THEORY IS GAINING MOMENTUM THROUGH A LOT OF BOOKS, DOCUMENTARIES, PODCASTS AND PRESS CO-VERAGE: PABLO SERVIGE AND RAPHAEL STEVENS' POLICY MAKER AND BUSINESS LEADER AUDIENCE IS GROWING.

2 "ANTHROPOCENE" AND "CAPITALOCENE" ARE NEW TERMS DENIGRA-TING MANKIND'S IMPACT ON THE ENVIRONMENT.

**3** SURVIVALISTS ARE EMERGING AROUND THE WORLD, STOCKPILING FOOD AND WEAPONS AT HOME AND TRAINING FOR THE POST-DISASTER SOCIETY.
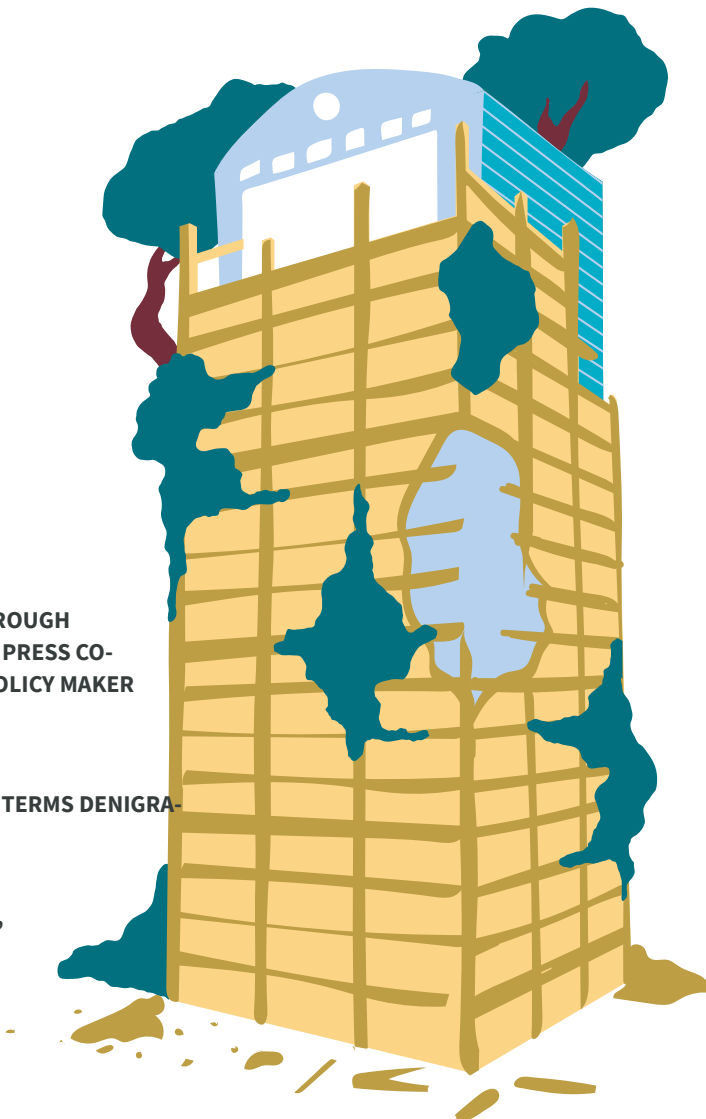
The doughnut metaphor: bringing social and climate issues together

The Doughnut metaphor is a useful tool for thinking about the overall well-being of society. For a long time, it was thought that social inequality and the brutal exploitation of ecosystems were inevitable conditions for economic progress.
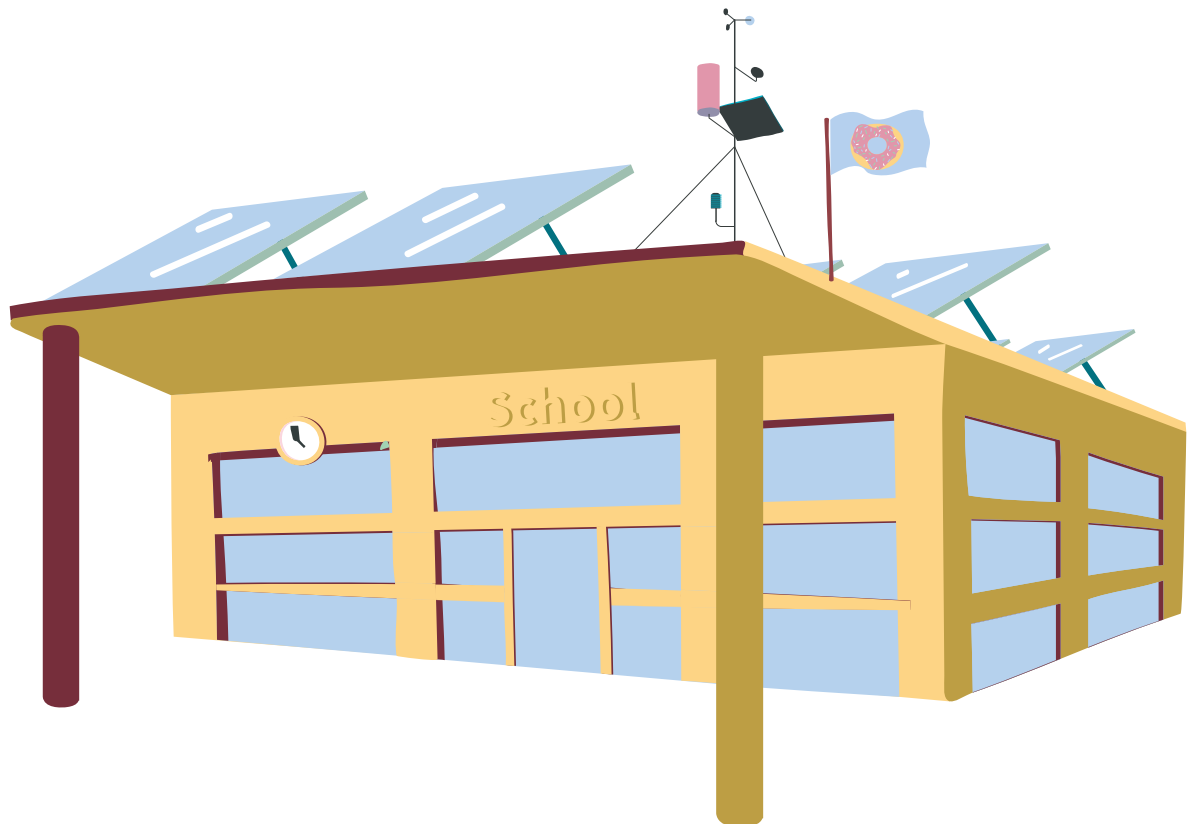
But now the challenge is to rethink the economy by bringing together social and environmental issues in one sphere. This is the idea of the doughnut: it shows how human well-being (inside the doughnut) depends on the well-being of the planet (outside the doughnut).

"Humanity's 21st century challenge is to meet the needs of all within the means of the planet". We need to ensure that no one falls short on life's essentials (from food and housing to healthcare and political voice), while ensuring that collectively we do not overshoot our demand on the Earth's life-supporting systems, on which we fundamentally depend for a stable climate, fertile soils, and a protective ozone layer. In other words, the search for our individual material well-being must not result in excessively consuming the common resources of the planet. The Doughnut of social and planetary boundaries is an approach to framing that challenge and acts as a compass for human progress this century.

Yet, we have to highlight a paradox. How could humanity have surpassed the ceiling of planetary limits to this extent, while keeping billions of people under the social floor? The answer is that the world has developed according to an unsustainable pattern of inequalities.
Thus, more than 800 million people suffer from hunger (a number increasing for the third year in a row) while only 3% of the world food production would be enough to feed them. Similarly, almost half of global CO2 emissions are caused by 10% of the population. Therefore, reducing extreme inequalities in access to resources and promoting sobriety in their use are the keys to making progress on the two boundaries of the doughnut.

The doughnut metaphor therefore invites us to think systemically, integrating social and environmental issues into one framework. But the very feasibility of this systemic thinking rests on two factors. On the one hand, the fundamentals of economics are sometimes far from this mode of reasoning, which has a direct impact on the reasoning of researchers and leaders. On the other hand, it is not always clear which indicators to use to measure changes in the environment in real time. While specifically measuring greenhouse gas emissions is fairly straightforward, this is not the case for broad biodiversity measures. What exactly should we measure first? What is to be prioritized between corals and mangroves? Between deforestation and overfishing? This is called "environmental accountability" and is now a growing discipline among economists and consulting firms.
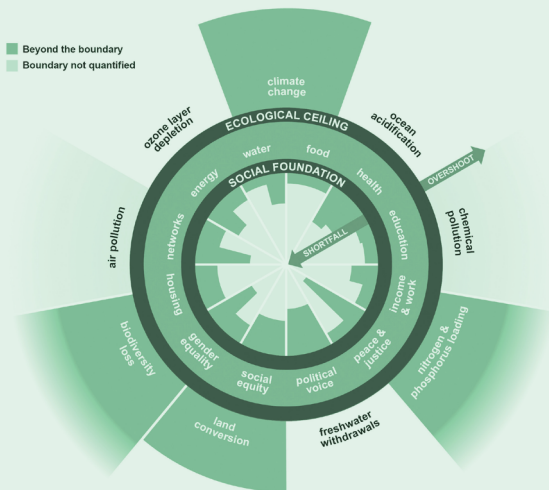
Overriding trends:

1   THE DOUGHNUT METAPHOR HELPS US RETHINK THE ECONOMY BY BRINGING TOGETHER SOCIAL AND ENVIRONMENTAL ISSUES INTO ONE SPHERE.

2   IT ENABLE US TO IMAGINE HOW TO LIVE WITH RESOURCE SCARCITY AND HOW TO MOVE TO CIRCULARITY BY DESIGN.

3   A VISION OF AN EQUITABLE SUSTAINABLE FUTURE, THE DOUGHNUT SERVES TO INVESTIGATE ALTERNATIVE PATHWAYS FORWARD.

The future of mobility: is time the new distance?

Over the past 50 years, there has been a movement of urban sprawl, aimed primarily at facilitating people's access to housing. But it also has had the effect of increasing the use of motorisation. Consider this number: today, the average American drives 80km a day, compared to 4 back in 1880.

It's true that the speed gains generated by the improvement of transport networks made it possible to move away from urban centers with a constant time-budget: this is the Zahavi conjecture, developed by the eponymous World Bank researcher. But in spite of this progress, there has been a phenomenon of automobile disenchantment for two decades. The congestion effects related to the democratization of the private car have given rise to an opposition between the individual interest (increase the speed) and the general interest (lower the speed to be able to increase the flow).

In cities, the demand of citizens is that the duration of daily transport does not exceed 15 minutes each way. This might become the norm: in some Chinese cities such as Chongqing, you already have to use different sidewalks depending on your pace and whether you want to text while walking or not.

However, time saving is too weak a goal when it comes to shaping the future of mobility. The search for speed can be in contradiction with other issues, particularly the ecological and economic ones. In short, speed is not proportional to its price. Others goals than speed must be thought of, among which the sharing of means of locomotion and the depollution of cities.

The mobility thematic is wide

To ease traffic flow in automobile-centered cities, it is necessary to transform the mobility patterns and develop new business models, based both on a better quality of service and on shared models, rather than ownership and personal use of vehicles.

The image of public transport needs to be upgraded.The goal is to make it simpler, available to the greatest number, but also to replicate the sense of freedom and safety associated with the automobile in other means of collective locomotion. In Switzerland, for example, the regularity of trains and their reliability makes their massive use feasible. As a result, freedom is preserved but in a less individualistic and more ecological way.

Moreover, mobility also depends on practical aspects. Regarding electric vehicles, for instance, the possibilities of energy storage, the installation of electrical terminals, the possibility to use bus lanes – like in Norway – and the regulatory environment are the determining factors for the development of the sector. In other words, major innovations in transport will no longer be solely technological, but also fiscal and regulatory. In addition, there are significant inequalities in terms of mobility. The capacity to be mobile varies according to the level of income and the social class. In this respect, the emergence of Uber and other private transport platforms has led to the extension of a service formerly exclusively reserved for the better-off to new categories of population.

Finally, recent developments often lead us to reconsider how we perceive travel time. While travel time to work (85 % of journeys in France) is usually considered as a tedious, lost time, this could radically evolve. Blablacar, for example, turns trips into social times that enables us to meet and discuss with people.

Even further: tomorrow, with connected cars and new applications (that insurers could co-develop), travel times might be used to do upskilling or health checkups.

Overriding trends:

1   THE SENSE OF FREEDOM AND SAFETY ASSOCIATED WITH THE AUTOMOBILE NEEDS TO BE EXTENDED TO OTHER MODES OF TRANSPORTATION.

2   THE MOST IMPORTANT INNOVATIONS IN MOBILITY COULD BE FISCAL OR REGULATORY RATHER THAN TECHNOLOGICAL.

3   THANKS TO NEW TECHNOLOGIES AND APPLICATIONS, WE COULD USE TRAVEL TIMES TO DO USEFUL THINGS, SUCH AS UPSKILL OR GET A CHECKUP.
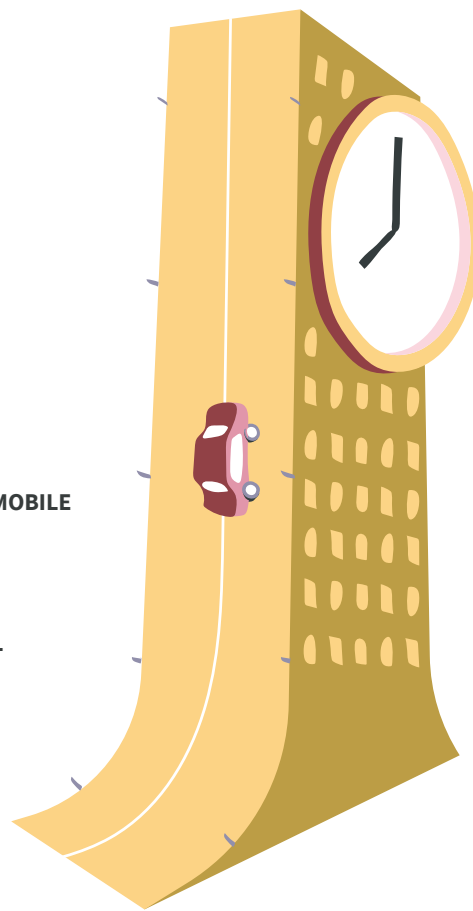
Environment

Health

New Tech

Socio-Economics

What do we already know?

Democratic shifts

Aging is an ongoing process at the world level, which is changing the health needs of populations. Between 2015 and 2030, the number of people in the world aged 60 or over is projected to grow by 56%.

Meanwhile, as more and more individuals move to cities, new health risks appear, and the distribution of healthcare evolves with a growing concentration of providers in cities and lack of specialists in rural areas. As people move to cities, we will see an increase of Non-Communicable Diseases (NCDs) because of changing lifestyle especially in low and middle-income countries where more than three quarters of global NCD deaths (32 million) occur.

Environmental shifts

Environmental factors are recognized as health hazards pushing health policies to incorporate such risks. 23% of all deaths can be attributed to environmental factors.

Climate change will generate new health risks, from heatwaves to epidemics.

Rising antibiotic resistance pressures public and private institutions to find alternative treatments.

Changes in healthcare financing

Healthcare systems face increasing cost pressures. Healthcare reforms and technology adoption will improve efficiency and cost reduction.

With development, emerging markets' healthcare systems grow. Health risk sharing is brought into the formal economy through public and private actors.

As treatments increasingly focus on prevention, the nature of healthcare costs evolves, questioning the need to shift towards value-based care systems.

Social evolutions

Patients are taking more control over their health, as medicine increasingly focuses on prevention and as patients have easier access to medical information. Development of MedTech and Internet of Medical Things (IoMT) will improve the health of patients with chronic conditions such as diabetes where we can see the use of non-invasive glucose monitoring. Development of IoMT will help to address the dependency of older people as it can delay the loss of autonomy.

Patient engagement and understanding of their care is increasingly seen as a key component of successful and effective care.

Patients require more and more coordinated care, as the health burden shifts towards chronic diseases. Multimorbidity should grow in the long term and represent a major health challenge.

Technological & scientific advances

With digitilization, increasingly integrated digital platforms connect patients, doctors and all care providers and improve data sharing.

Developments in genetics combined with analytics, pave the way for P4 medicine (Participative, Preventive, Predictive, Personalized).
The global genomics market is expected to reach USD 27.6 billion by 2025.

What could impact AXA on a 2025 horizon?

Health is moving from individual aspects to community-driven concerns. Indeed, the DNA information of any one individual will impact a community of DNA cousins, meaning the community level will make more and more sense for people sharing similar health risks.

Many patients suffering from the same disease(s) already join online communities to exchange their experiences. Communities of people sharing the same health characteristics such as synesthetes appear. We have now learning health communities where experiences of patients and caregivers are collected, aggregated and shared.

In addition, governments are creating national health data hubs to work on prevention and these data hubs are in turn presenting another way of promoting the emergence of data-sharing communities.

Health data hubs advancing disease management

We can see a trend to increasingly integrate the medical data from providers, practitioners and all care delivery actors in order to create health data hubs in many countries. These public-private hubs enhance the level of data access to develop new AI tools to better foster medical research and accelerate health prevention.
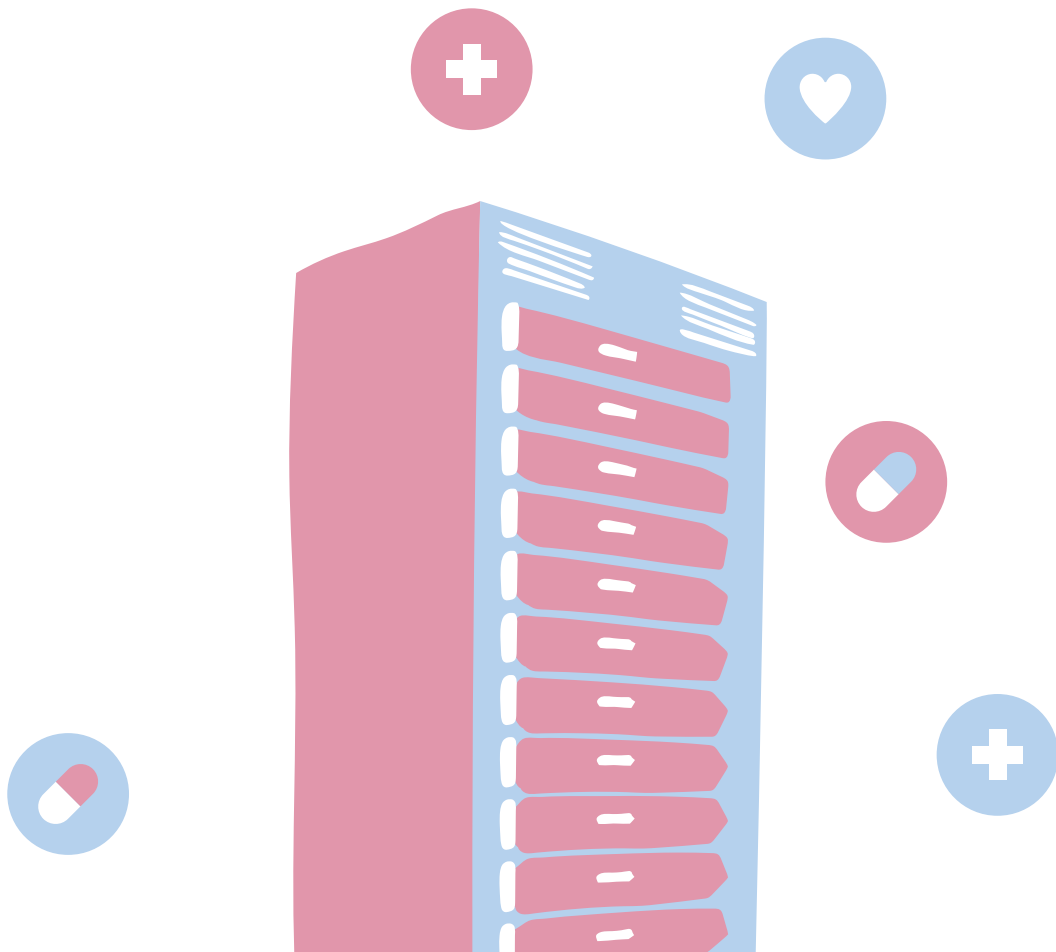
For instance, in the United Kingdom, the NHS has created an open health data platform. These data can be accessed, used and shared, by anyone, for any purpose. In France, after the Villani Report on Artificial Intelligence, the French President announced the creation of a Health Data Hub as part of the French AI strategy. In Israel, the government will invest nearly 1 billion shekels ($287 million) in a project to make the health data of its population available to researchers and private companies.

Many actors are involved in integrating and gathering medical data. McKinsey highlights that in the US healthcare sector, companies offering analytics and platforms integrating healthcare services are among the fastest growing companies in healthcare.

Community-focused treatments

With the development of Health Data Hubs, subpopulations of patients can be identified (such as those with gluten allergies). In this situation, anonymizing data collected is pivotal. Physicians then rely on these data and on evidence-based medicine to identify the best treatments. A coordinated approach becomes feasible and treatments become community-focused. In addition, improvements are made in prevention and cost reduction.

For example, with the launch of its integrated data collection system, Kaiser Permanente has made it possible to improve outcomes in cardiovascular disease and achieved an estimated $1 billion in savings from reduced office visits and lab tests.

Community of practitioners

Not only Health Data Hubs make it possible to identify the best treatments for patients, but they also facilitate identifying the best practitioners for specific diseases. In fact, professionals with strong performance records can be identified in some countries and this can help patients select the right providers hence creating a community of good practitioners with the best skills and abilities.

In addition, Health Data Hubs give the opportunity for different actors to work together on specific health issues. We have the example of La Paillasse, an interdisciplinary collaborative research laboratory which has created the first participative research program dedicated to understanding the epidemiology of cancer through an Open Big Data in collaboration with the pharmaceutical group Roche.

We have also the example of Flatiron, a startup which offers products connecting community oncologists, academics, hospitals, life science researchers and regulators on a shared technology platform to fight against cancer.

Overriding trends:

1   THE HEALTH DATA HUB OPTIONS BEING EXPLORED BY A GROWING NUMBER OF COUNTRIES COULD BE LEVERAGED FOR RESEARCH AND BUSINESS PURPOSES IN THE FUTURE.

2   INTERCONNECTEDNESS BETWEEN NATIONAL DATA BASES AND OTHER DATA FLOWS IS BEING QUESTIONNED (MEDICAL DEVICE, ETC.)

3   THOUGH PRIMARY, DATA CAN ONLY BE OF BENEFIT WITH THE RIGHT USE CASES ANALYZED BY THE RIGHT DATA SCIENTISTS.

The Age of healthcare communities

As AI develops, new forms of work in the health industry emerge. The rise of health platform like Uber health where healthcare organizations can book transportation for their patients is an emblematic example. It improves both cost efficiency and service as patients can benefit from the service 24 hours a day wherever Uber is available in the US.

Alternatives to traditional kinds of care are emerging like the Shared lives schemes in the UK. This system supports adults with learning disabilities, mental health problems or other needs by matching them with an approved carer. Anyone can become a carer; people just have to register at the Care Quality Commission to receive training and get vetted.

These changes are affecting patients as well. In fact, the expression "people-powered health" expresses how simple citizens are gaining more of a voice in the health system. A good example is the UK's NHS Citizen Assembly, a platform where people can voice their ideas and opinions directly to the board of the NHS.

Community involvement in healthcare

The notion of community involvement in healthcare is gaining momentum. In a way, the development of new healthcare jobs is binding communities and creating new communities of healthcare workers. The use of community health workers has been identified as one strategy to address the growing shortage of health workers in rural areas but also in low-income countries. A key challenge lies in institutionalizing and mainstreaming community participation.

A new structure of healthcare delivery will have to be elaborated as para-professional healthcare workers can also be subject to new liabilities.

Creation of a patient community

Patients are becoming more and more involved in the healthcare system. Apart from self-medication or even self-treatment with AI and new medical tools, there is an involvement of patient communities in the system. The Healthy 'n' Happy Community Development Trust is one example. The latter is a community-led health organization which engages with local communities and responds to the issues they identify as priorities in health in the local communities of Cambuslang and Rutherglen in Scotland.

However, we also observe new communities of patients sharing the same diseases. These patients through their communities can exchange experiences and create solidarity. An illustration of this trend can be found in health platforms such as Patientslikeme (600 000 members) or Carenity (165 000 patients registered) where patients can exchange stories, treatments and symptoms.

Patientslikeme even connect people who may share biological characteristics to help them exchange. The institution conducts researches as well based on data collected from patients. Patient engagement is becoming essential. In fact, patients need to understand their disease but also their treatments.

Overriding trends:

1 NOT ONLY MEDICAL EXPERT KNOWLEDGE BUT ALSO PATIENTS' LAY KNOWLEDGE CAN BE LEVERAGED TO INNOVATE. TECHNICAL INNOVATION IS BOUND TO COME HAND-IN-HAND WITH SOCIAL INNOVATION.

2 ANALYTIC PRODUCTS CAN BE MADE ACCESSIBLE TO PATIENTS TO EMPOWER THEM TO CHANGE BEHAVIORS. THESE PRODUCTS WILL IN TURN FOSTER BETTER PHYSICIAN-PATIENT RELATIONSHIPS.

3 AS WE SEE A GROWING NUMBER OF NEW PARAPROFESSIO-NAL HEALTHCARE WORKERS, THEIR LIABILITIES MUST BE CONSIDERED.

When communities address women's health

Women's health accounts for only 4% of the overall funding for research and development of healthcare products and services. The bulk of spending on other diseases has a male-specific research focus despite the fact that women represent half of the world population.

As healthcare becomes personalized and patient-centric, women's health and its positioning are becoming central questions. The development of AI and the rise of what we call "Femtech" may change things for the better.

With the development of new tools (Mobile ODT) such as ultrasound devices working with smartphones, it is becoming easier for women to get access to medical support. They can get easier access to physicians through telemedicine. Marven Clinic in the US, for example, is a digital clinic that enables women to get medical support anywhere at any time.

These innovations will significantly improve women's access to health, particularly for those living in rural areas or developing countries where specialists are missing. The example of Modern Fertility is very interesting. This startup sells DIY (Do It Yourself) kits to simplify fertility tests for women. The price, however, remains an issue as these solutions can be costly. Research is being conducted in this area to reduce costs and offer more affordable devices.

Community of specialists in women's healthcare

With over $1 billion in funding between 2015 and 2018, Femtech is set to be the next big disruptor in the global healthcare market. Femtech involves the use of digital health applications such as software, diagnostics, products, and services to improve women's health.

The development of femtech is accompanied by communities of startups and researchers specialized in women's health.

Networks of innovators in women's healthcare are sprouting up such as the FemTech Collective, a network connecting those female-focused in health technology. This organization now includes more than 200 startups, established companies, investors, and industry professionals, which demonstrates how much this community aspect weighs.

Community of engaged people for women's health

As the number of communities of healthcare actors increases in women's health, communities of simple citizens willing to accelerate research and findings on women's specific diseases emerge as well. Let's take the example of Seintinelles, a platform where people can volunteer to help researchers in their work and to push research around breast cancer or ovarian cancer.

We can also take the example of Women's health in women's hands (WHIWH) which is a community health center providing primary healthcare to women from «African, Black, Caribbean, Latin American and South Asian communities» in Toronto and surrounding municipalities. It shows that there is a growing concern about women's health and the diversity of women need to be taken into account.

Overriding trends:

1   FEMTECH COMPANIES' DECISION TO COLLABORATE WITH RESEARCHERS AS OPPOSED TO PHAR-MACEUTICALS REDUCES THE RISK OF RESULTS BEING SKEWED FOR FINANCIAL GAIN.

2   RESEARCH AND FINDINGS ON HEALTH ISSUES SPECIFIC TO WOMEN WILL GROW AS AWARENESS DRIVES ENGAGEMENT.

3   AS WOMEN REPRESENT A GROWING PROPORTION OF THE ELDERLY. SOCIETIES MUST TAKE INTO ACCOUNT THEIR SPECIFIC HEALTHCARE COSTS.

Genetic Engineers and bio-hackers, the new DNA explorers

Genomic testing amounts to analyzing large amounts of DNA sequence data to locate variations that affect health, disease or drug responses. It is through the technical advances in DNA sequencing and in computational biology that this field has come about.

In 2003, at a cost of around $3 billion, the first human genome was completed. Since then, next generation sequencing (NGS) has dramatically decreased in cost, recently breaking the barrier of $1,000 per human genome. It is becoming possible to predict certain diseases as well as which drugs people could have reactions to thanks to genomics.

Synthetic biology encompasses the concepts, approaches and tools that enable the modification or creation of biological organisms. It is for instance possible to modify a gene to reduce the probability of becoming sick, or to produce bacteria able to absorb plastic waste and do so by using AI-automated bio-factories.

The development of cheap gene-editing techniques (namely CRISPR/CAS9 technology) has brought about synthetic biology. Nevertheless, the development of new practices such as biohacking will set off major changes.

Everyone now has the possibility to explore and experiment with biology in small labs. That could mean figuring out how the DNA in plants affects their growth, or how to manipulate genes. Some researchers are even applying it to their own bodies, like Josiah Zayner, a biochemist who is the first to have used CRISPR to edit his own genes.

Community of people with the same DNA family
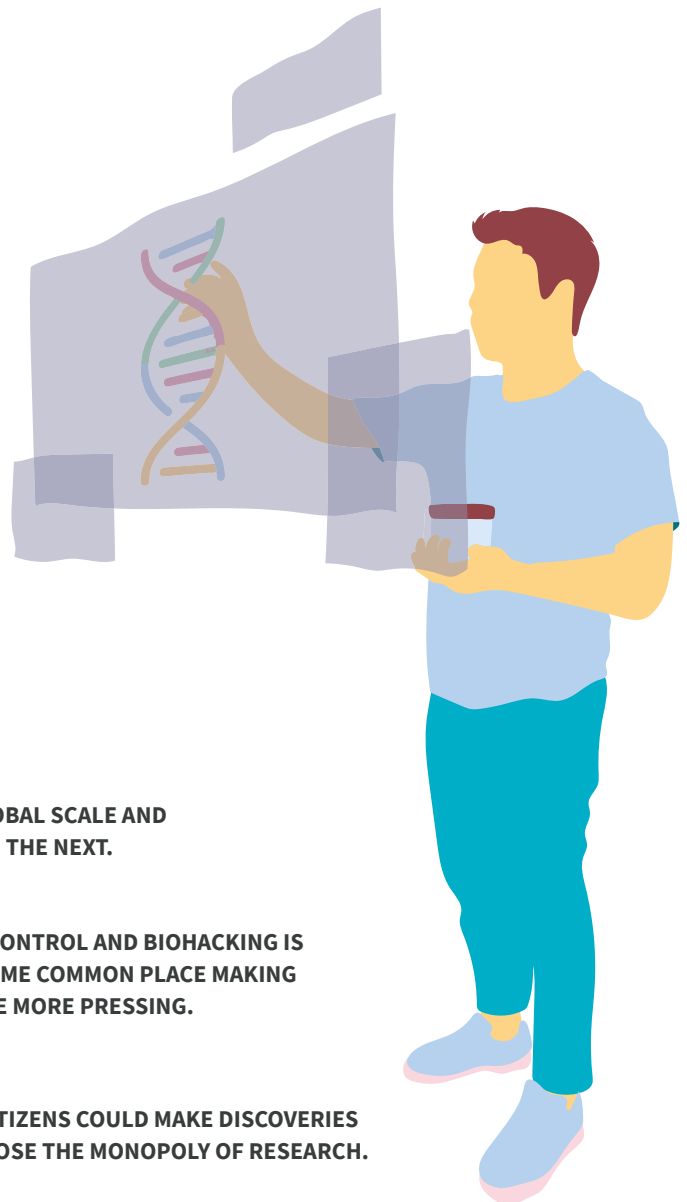
With recent advances in genetics, it is becoming feasible to track down one's genetic origins and ancestors. Companies like 23andMe have become specialized in analyzing DNA. This company enables people to discover their family history. It proposes a DNA test with which it traces people's ancestry thus providing them with their DNA family group and the opportunity to contact its other members. This makes it possible to create DNA Communities and for its members to connect.

Community of biohackers

With the development of Biohacking, new communities are emerging. Essentially, people from multiple backgrounds collaborate on some biology projects in small community laboratories. The experiments conducted in these labs could be for example about genetic engineering. These small community labs run without the support of universities.

We have today networks of biohackers such as Syntechbio, an online community of more than 4000 people working to support Biohacking in certain regions that need access to these technologies. The SyntechBio Network already includes groups from Argentina, Brazil, Colombia, Chile, Ecuador, Ghana, Mexico, Peru and Spain.

Questions on the safety, ethics and regulation of biohacking abound as people can be involved in experiments transforming their body.

Overriding trends:

1 ANALYZING DNA IS A GROWING BUSINESS ON A GLOBAL SCALE AND YET REGULATION DIFFERS FROM ONE COUNTRY TO THE NEXT.

2 AS CITIZEN LABS CURRENTLY OPERATE WITHOUT CONTROL AND BIOHACKING IS SPREADING, DANGEROUS PRACTICES COULD BECOME COMMON PLACE MAKING NEED FOR GOVERNANCE AND REGULATION ALL THE MORE PRESSING.

3 THROUGH BIOHACKING EVEN COMMUNITIES OF CITIZENS COULD MAKE DISCOVERIES AND CAUSE SPECIALISTS AND LABORATORIES TO LOSE THE MONOPOLY OF RESEARCH.

Towards new health ecosystems

Healthcare systems are set to change considerably in the coming years because of aging, economic development, and genomics. In aging economies, to fight increasing healthcare costs, digital and innovative tools are gaining momentum.

In developing economies, a rapid transition to digitalization will lead to leapfrogging and begs the question of how healthcare systems will be built.

The Lancet, a general medical journal, estimates that global healthcare costs will rise by 10 trillion dollars between 2015 and 2040, with faster increase per capita in mature markets. In the meantime, half the world lacks access to essential health services, and 100 million are still pushed into extreme poverty because of health expenses.

Changing the healthcare system

In response to growing health costs, there is an alternative called Value-based care where reimbursement mechanisms are based on value rather than volume. These systems focus on improving health outcomes and paying healthcare providers only when they succeed in improving a patient's health rather than whenever they perform a medical procedure. Then, the patient is interrogated to evaluate health outcomes.
This will reduce outcome variation between providers and will develop increasingly customized interventions and ever more precise treatment pathways, improving value for each type of disease or health issue over time.

This will, however, require higher levels of cooperation among different healthcare actors. Specialists in key disease areas need to agree on the most important outcomes to measure. Providers need to work more closely with patients to help achieve the most important outcomes.

Clinical specialists at different points along the treatment pathway need to come together in interdisciplinary teams to create more integrated and customized interventions. And payers will need to work closely with providers, drug companies, and medical-device manufacturers to develop the most cost-effective modes of treatment. We will see a community of diverse actors working together to determine the best treatment outcomes.

Building a healthcare system through a community of health facilities

Healthcare in developing countries is undergoing rapid changes. Fast population growth and rising healthcare costs are among the most important challenges the healthcare system faces in developing countries. In addition, since Universal Health Coverage has been added as a Sustainable Development Goal, delivering healthcare services to populations is increasingly urgent for these countries.

India provides us with an example of how to cope with the issue. In this country, highly specialized physicians are concentrated in well-equipped facilities in urban centers and these hubs are connected to clinics in rural areas that provide cheap basic care. These clinics refer patients to larger hubs when difficult, specialized interventions are required, and the hub physicians use telemedicine to advise rural patients. Another separation of health worker roles exists, as the clinics providing basic care are also connected to major hospitals with highly qualified physicians.

Overriding trends:

1 AS PUBLIC-PRIVATE PARTNERSHIPS MULTIPLIES IN EMERGING COUNTRIES, FAR GREATER HEAD-WAY CAN BE MADE BY THEIR INTEGRATING HEALTH COMMUNITIES. THIS WILL IN TURN PROMOTE MORE TRUST AND INNOVATION.

2 THE DEVELOPMENT OF APPS AND NEW TOOLS COULD CAUSE PATIENT-DOCTOR TRUST TO ERODE AS PATIENTS START RELYING MORE ON MACHINES AND AI.

3 GREATER TRANSPARENCY ON DATA COLLECTED WILL CONTRIBUTE TO FOSTERING TRUST AND UPGRADING HOW THESE DATA ARE EXPLOITED.

Environment

Health

New Tech

Socio-Economics

What do we already know?

Data availability multiplying

Thanks to the Internet of Things' (IoT) growing cost-efficiency, it has become far easier to collect data through sensors.

IDC forecasts that by 2025 the global datasphere will have grown to 163 zettabytes – meaning a trillion gigabytes. That is ten times the amount of data generated in 2016. The volume and multiplicity of this data will open up a new world of business opportunities and unique user experiences.

Regulations around this data may be a challenge to keep up with especially on a global scale.

Blockchain rebuilds trust

Brought into the spotlight in 2018 with money transfers and smart contracts, bitcoin's underlying technology is now being experimented with in new fields, such as identity verifications, philanthropy and even elections.

Built on the premise of maintaining privacy and sharing data, blockchain is intrinsically designed to foster trust.

Cybersecurity

Cyber-risks are getting more diversified in type and as well as in hacking's physical impact.

Cyberattacks with increased offensive capacity can also be state sponsored.

Cybercriminals will use new technological advancements like AI and IoT to conduct more widespread attacks.ks.

High quality fake news/information will persist and have real-world impacts, like election rigging/influencing, like the mob attacks in India based on fake WhatsApp messages.

Attacks on the integrity of information will become more common, these are difficult to detect.

AI advances

This flood of available data also provides abundant raw material to fuel a new set of technologies such as machine learning, natural language processing, and what is more generally known as artificial intelligence. It turns data analysis - from an uncommon retrospective practice - into a proactive driver of strategic decisions and actions. Cognitive systems step up the frequency, flexibility, and immediacy of data analysis across a range of industries, circumstances, and applications.

Computer vision is making progress every year with new possibility of precise and detailed image analytics.

New AI trends emerge daily such as adversarial networks, a class of algorithms that tend to train themselves without human supervision.

Simultaneously, as stronger AI systems emerge, the scope of activities that can only be performed by humans shrinks, forcing companies to rethink the future of work and how they will re-skill/upskill their employees.

What could impact AXA on a 2025 horizon?

In analyzing foresight reports, we decided to take the angle of the "senses" to illustrate how technologies will perceive the world and make it better.

Numerous human-senses-based tech trends have been identified such as: the "cobots" (collaborative robots). This translates into an opportunity for humans and robots to join forces, through the new potential of laser communication to capture and transmit information, the development of nanotech and the infinitely small as well as biotechnologies that are, by design, linked to the human body.

We have decided to focus on five of these in the areas of emotions, language and perceptions.

Voice centric UX: what if keyboards disappeared?

Will voice-user interfaces (VUIs) replace smartphones as smartphones have partially replaced the computer-screen-keyboard combo? With non-graphic machine interfaces emerging, the voice is expected to become the new standard for enabling "natural" interactions.

VUIs encompass far more than voice recognition/voice generation technologies. VUIs make fluid seamless human machine interaction possible. According to Ovum, the number of "native" or pre-installed digital assistants is set to exceed 7.5 billion devices by 2021, which is, according to the US Census Bureau, close to the forecasted world population at this date. Will we migrate towards a unique or multitask voice interface if voice becomes a fully immersive experience?
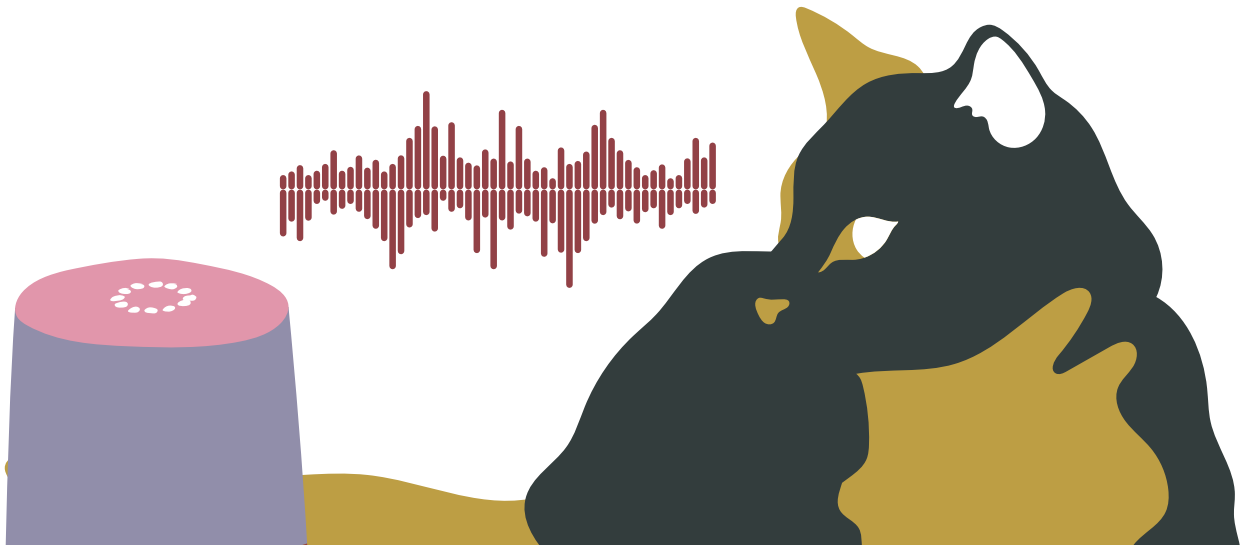
New Platform Markets

Though VUIs have, up to now, mainly been embedded in smartphones and smart speakers, in the coming years, they should proliferate in other everyday objects such as earbuds, vehicle dashboards and even more business-oriented environments. Apple's Siri, Microsoft's Cortana, Amazon's Alexa and Google's Assistant are competing to become "the" voice interface provider.

There is an underlying platform war that goes far beyond devices. What is really at stake for players such as Amazon or Google is winning out in getting the majority of other device makers to use their free software. This allows them to keep on building up their data, to induce network effects and to reach quality at scale.

Design & Control

Switching from Graphic User Interfaces (GUIs) to VUIs significantly impacts how services are designed. Whereas a graphical user interface clearly shows the options available, voice-user interfaces, when screen-less, are listening, mute and provide no visual affordances. This makes their discoverability features all that much more important as VUIs make it possible to extend the power of computing to users challenged by screens and keyboards.

The convenience of these new kinds of interactions however comes with greater opacity on data processing and the results they provide.

How can one browse the "next results" when the interaction is designed to provide just one single answer? Where can one click to find out more? This opacity on the user's side enables platforms to "manipulate" the data in a new way, by making it possible to favor certain answers or results.

From a business standpoint, could voice interface providers with stakes in other markets not be tempted to favor their markets and thus generate unfair competition? Search Engine Optimization (SEO) significantly differs from voice search and virtual assistant optimization and that is an issue.

Trust

If we factor in these aspects, how likely are consumers to trust voice recognition devices? It has been found that people more readily trust objects capable of conveying human-like "contingent interactions". Thus, could a trust-based relationship be built on other mechanisms such as tone of voice, the rhythm of interactions, the promise of data protection or privacy?

Voice assistants are somewhat like a new Joan of Arc, they can and do hear sounds that the human ear can in no way perceive. This could become a serious threat as this 'feature' could be exploited to send ultrasonic audio commands triggering actions, known as "dolphinattack", leaving the device owners completely in the dark.

Lastly, it is worth noting that the human voice carries a lot of information that can be used to authenticate a user through biometrics and/or infer someone's characteristics (gender, age range) and even their mood, intentions or emotions.

Overriding trends:

1 AS BOTS INTEGRATE HUMAN HABITS, IT'S BECOMING INCREASINGLY DIFFICULT TO DIFFERENTIATE VOICES FROM THOSE OF BOTS.

2 BEING EASIER TO GET AN «AUGMENTED VOICE» THROUGH ADDED FILTERS, AUTHENTICITY AND TRUST COULD BECOME QUESTIONED.

3 VOICE WILL THUS BECOME AN ESSENTIAL PART OF A BRAND'S IDENTITY: HOW WILL BRANDS HANDLE IT AND FIND THE RIGHT "TONE".

Affective computing: should we fear our emotions? ://

Affective computing refers to all the systems and devices that can recognize, interpret, process, and simulate human experiences, feelings or emotions. It is an interdisciplinary field spanning computer science, psychology, and cognitive science.

In effect, this technology both detects and triggers emotions among users interacting with machines.

Different technologies are involved to detect and perceive human emotions:

— Emotional speech processing technologies exploit computational analysis of speech features to recognize users' emotional state;

— AI-driven analytics exploit facial expression and gestures or other data points to guess users' emotions.

The new bases for humain-machine interaction

New "smart" devices are incorporating voice or body gestures in human-machine interaction. With this new grammar comes the promise of building a more seamless/ natural relationship between humans and machines.

Being able to detect human emotions and making machines mimic emotional reactions is key to developing more instinctive relations.

Affective computing technologies can be used in many applications to:

— Detect when a learner is experiencing difficulties in E-learning programs;

— Help doctors assess levels of stress or levels of pain / or for Robot caregivers to detect emotions that are not explicit;

— Help people with disabilities such as autism to interact with the rest of the world;

- Conduct market research or measure the impact of advertising, political speeches and consumers' emotional engagement; - Enable security companies to pick out individuals in a crowd presenting a potential threat.

Don't panic, I can read your mind

Through its AI program Watson, IBM is supporting these markets and allowing easy API integration of its "Tone Analyzer", a dedicated feature designed to enhance customer service by analyzing their emotions on social media, or to enable chatbots and detect customer tones.

Emotion is at the heart of the insurance business. As much as customers can experience emergency or critical situations when they most need to be assisted, understanding their anxiety and knowing how to best help them is pivotal for insurers.

Affective computing enables us to re-humanize automation and AI by integrating users' experiences. Affectiva figures among the insurance specific business cases with its approach on autonomous vehicles and driver behavior exploiting emotion-detecting technologies to mitigate risks. These technologies measure the driver's state and trigger actions in consequence. In semi-autonomous vehicles, detecting the level of awareness can also help resolve the "handoff" challenge. They can suggest route alternatives, a stop or even play a soothing playlist to monitor driver anger.

Can emotions lie?

One of the hypotheses on which affective computing is built is that our emotions can in no way lie. Although significant opportunities can be envisioned with the building of new emotion-based services, serious concerns are also on the rise as to how emotions can actually be computed, their veracity and users' ability to control them. Is it fair to read people's emotions? To what extent would it be fair to read their minds too?

Finally, affective computing is not an exact science, emotions can always be manipulated or hacked.

Overriding trends:

1 THE MORE MACHINES' INFLUENCE GROWS AND THE LESS HUMANS ARE AWARE OF IT, THE GREATER THE POTENTIAL FOR SO-CALLED «BRAIN HACKING» A DESIGNED MOLECULE/HORMONE PRODUCTION.

2 "EMODITIES", A TERM TO DESCRIBE THE NEW BUSINESS OF EMOTIONS WHERE, JUST AS COMMODITIES MAY FACILITATE THE EXPERIENCE OF CERTAIN EMOTIONS, EMOTIONS ARE THEMSELVES TRANSFORMED INTO COMMODITIES.

3 MIXING REALITY WITH TECHNOLOGIES LIKE AI OR VR CAN LEAD TO NEW PREVIOUSLY UNFELT EMOTIONS.

Geo-Intelligence: our future eyes?

Geo-intelligence was originally used by the army and the defense sector to obtain precise satellite images of the enemy's military bases. The rise of new technologies like small satellites, drones and even ground sensors and the subsequent decrease in data collecting costs enabled other sectors, such as insurance, to collect, analyze and use these data.

Geo-intelligence improves the efficiency of insurance in times of crisis

Geo-spatial data could help insurers tackle climate-related disasters by better mapping their exposures, bringing down their costs, better supporting clients in times of crisis and thus reinforcing their trust.

Geo-intelligence provides insurers with three principal benefits:

Real-time monitoring: geo-intelligence data can be used to better predict natural disasters such as earthquakes, floods, or hurricanes. In getting access to the most advanced real-time data available and leveraging their past data and current trends, insurers possess a global view to assess risks.
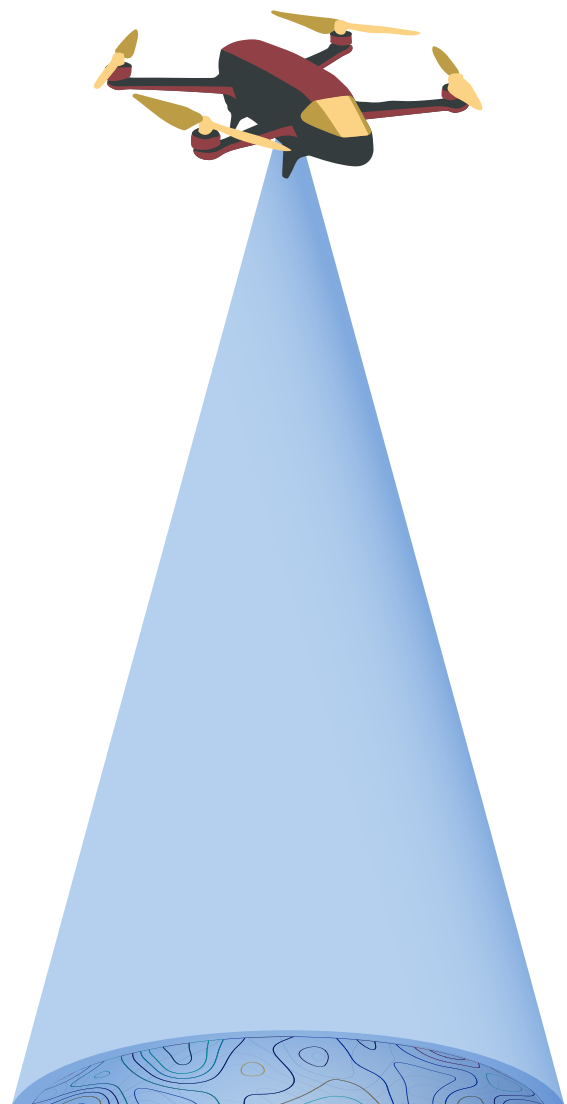
More precise risk assessments: the new collected data would upgrade underwriting in processes such as calculating P&C premiums. In using satellites and drones to gather information about a property, insurers could better assess its initial state before issuing a policy, or even decide to refuse to issue one because the area is too exposed.

Better claims management and fraud prevention: Fraud represents about 10% of P&C insurance losses and loss adjustment expenses every year ($32 billion). As there is a lack of precision in assessing climate-related events, most insurers (57%) predict an increase of claims when such events occur. Satellite and drone images make it possible to detect fraud before paying claims by comparing a property's initial and current states and by getting real time data to anticipate the amount of losses.

How to avoid being linded by so much data?

Thanks to the development of smaller affordable technologies and sensors, new players are entering the geo-intelligence business – putting an end to the public sector's former monopoly.

Planet, for example, has over 150 small satellites able to capture a full picture of the Earth every single day and it is estimated to have the largest fleet of micro-satellites in the world.

As geo-intelligence generates more data, humans are outmatched to analyze it all. Consequently, more and more companies plan to apply artificial intelligence to geo-intelligence data. Microsoft partnered with Esri (a company providing geo-data) to combine it with analytics. Earthcube has created a Deep Learning AI that, thanks to training their algorithms with detailed images (30 cm precision), detects any changes in a given area with great precision.

Finally, geo-intelligence is being deployed in an increasing number of different sectors, from construction to agriculture. The start-up TerraNIS proposes high resolution images (inferior to 1m50) in visible and infra-red spectral bands, which are processed to provide leaf area maps. Farmers can use these maps to decide on which parts of their fields to focus on thus avoiding the time-consuming overall inspection of their crops to identify lack of water, infestations, or other problems. This could pave the way for the development of parametric insurance products personalized to clients' needs. Faster compensations and precise assessments could both enhance customers' trust and satisfaction.

Overriding trends:

1   COMBINING REAL-TIME IMAGERY WITH ANALYTICS MAKES IT POSSIBLE TO ASSESS PRE/POST DISASTERS.

2   NEW NANOSAT AND DRONE STARTUPS ARE OPENING UP ACCESS TO THE GEO-INTELLIGENCE TECHNOLOGY MARKET.

3   SHARPER IMAGES TAKEN FROM SPACE POSE A POTENTIAL THREAT TO PRIVACY.

New brain: will Quantum computing rethink compexity?

Quantum computing consists in using the weirdness properties of Quantum theory (i.e. the abilities of subatomic particles to exist in more than one state at any time) to create next generation computing platforms that are significantly more powerful than today's most powerful classic computer systems.

Indeed, quantum computers operate on completely different principles from existing computers: unlike a classic computer solving problems in sequence one after the other, a quantum computer is designed to solve multiple problems simultaneously (using qubits). After decades in the labs, this technology is starting to be used for rudimentary prototypes sparking interest in fields as diverse as chemistry and banking.

The area of qubits: a new generation of computers

According to IBM or Microsoft, quantum computing's first tangible benefits could be seen within 5 to 10 years. Several companies have set up plans to develop and commercialize quantum devices: - In 2016, IBM gave researchers the opportunity to conduct a number of experiments. In 2017,

IBM announced it was experimenting a 50-qubit quantum computer. It is however still far from being practically viable. - In 2018, Google's quantum project with a 72-qubit computer called Bristlecone intends to reach quantum supremacy. At the same time, the company is investing to make programing quantum computers easier enabling developers to create algorithms without any specific background in quantum physics.

— Some start-ups like D-Wave are using these types of architectures to work on certain classes of problems such as optimization.

With quantum algorithms providing the ability to crunch and process huge datasets and models in an infinitely shorter amount of time, its potential commercial use creates an unpresented opportunity for transforming businesses in the financial and insurance sectors.

A few countries like China, the UK, the US and Germany are competing in investing heavily, and in commercializing this groundbreaking technology.

The promise of solving problems in real time

Machine learning, banking and more generally all the fields that deal with complex optimization and many variables represent the future of real world applications.

While Quantum computing could provide great benefits to the insurance industry (fast learning neural networks, etc.), it will also pose significant threats. On one hand, it could help insurers process vastly greater amounts of information than they do today and calculate risks in real time – from instantaneously modelling the impact of a natural disaster to modelling life expectancies. On the other hand, quantum computing could threaten cybersecurity as it could easily crack most of the current encryption protocols that are used to keep our online information secure.

Researchers are already working on developing quantum-based cryptography to find a way to ensure the absolute unassailability of data transmission in 'unhackable systems'.

The future of intelligence?

To continue with the metaphor of human senses and technology, quantum computing is finally challenging the future of intelligence. When tackling a complex problem, humans can rely on a mix of experience and intuition. Yet, in a recent contest between the world's top player of the board game Go and a computer program (AlphaGo), it has surprisingly been demonstrated that computers can beat humans in thinking "outside the box".

With the promise of exponential gains in computing power, such examples could become widespread.

Overriding trends:

1   FOR CRYPTOGRAPHY AND CYBERSECURITY, QUANTUM TECHNOLOGIES ARE A KIND OF PHARMAKON MAKING IT POSSIBLE TO BUILD UNHACKABLE SYSTEM WHILE CONVERSELY THREATENING ENCRYPTION PROTOCOLS.

2   COUNTRIES' SOVEREIGNTY IS BOUND TO TIE IN WITH THEIR MASTERY OF QUANTUM TECHNOLO-GIES THUS REQUIRING PURSUING RESEARCH AND DEVELOPMENT WITH BOTH ACADEMICS AND BUSINESSES IN THIS DOMAIN.

3   QUANTUM COMPUTING PROMISES TO REDUCE THE PERSISTING GRAY AREAS IN HUMANITY'S UNDERSTANDING OF THE UNIVERSE BY SOLVING SOME OF SCIENCE'S TOUGHEST PROBLEMS AND BRINGING ABOUT NEW FORMS OF KNOWLEDGE.

Empathy: what if caring was data driven?

Tech for good is a movement in which people and organizations transcend organizational boundaries to use technologies to improve society for the public good. Data is now everywhere: most human activities produce data, which is the "oil" of the digital economy – especially for big tech companies whose business model is data-driven.

On the premise that the more data is shared the more value it brings to society, data is in effect at the heart of the tech for good movement. It is seen as a public good to be used for social purposes.

Some of this data may be public or collected and generated by public-sector agencies and then made available to the public as part of an open-data initiative. But some may also come from private-sector organizations, which are increasingly making their data available to researchers, nonprofits and NGOs.

Data sharing: the new way to demonstrate empathy

A growing number of initiatives are emerging, often linked to more global issues such as digital ethics. Data-sharing-for-good projects generally address climate change, improving life in cities, unemployment, health or the like.

A NGO like the Open Data Institute is investing in several projects such as open geospatial data or innovation and transparency in agriculture and nutrition. These projects bring together government agencies, researchers and private companies.

Other forms of data-philanthropy are exploited by big tech companies in an effort to combine public benefits and their public affairs agenda:

— Uber Movement: through this platform, the ride-hailing giant is making aggregated data available to some cities to contribute to the future of mobility and "play a role in helping cities grow in a way that works for everyone". In its regulatory issues with cities, this transportation data is becoming the new currency;

— Facebook Safety Check: this feature is activated when a natural or man-made disaster and terror-related incident occurs. In 2017, the social networking company decided to share anonymized location data through "disaster maps" with organizations like the UNICEF or the International Red Cross. These up-to-date data can be beneficial in determining where to set up emergency shelters. Facebook Safety Check has been used in a more effective way than, for example, the short-lived application SAID launched by the French government in case of alert bombing;

Commercial organizations can also make the most of data-sharing with external entities. In sharing data with other commercial or noncommercial entities, they can come to an agreement on how to best use data for social purposes – and even on how to share the data with public entities or NGOs to explore further uses of this data in support of social good.

Give data back!

In the future, every company should be able to explain their (open) data strategy and how they contribute to society by giving data back. While firms are being redefined around social responsibility principles, data is becoming a major asset. This should encourage companies to be proactive in defining openness and data granularity standards before new data regulations step in to make a broader perimeter mandatory.

Overriding trends:

1   DATA FOR GOOD IS AT THE HEART OF THE TECH FOR GOOD MOVEMENT, BUT MANY OTHER FIELDS SHOULD INTEGRATE THIS DIMENSION: BLOCKCHAIN FOR GOOD, AI FOR GOOD ETC.

2   SOCIAL ENTREPRENEURS WILL BE INCREASINGLY TECH-DRIVEN IN THE ERA OF IMPACT INVESTING.

3   PROGRAMS SUCH AS "MÉCÉNAT DE COMPÉTENCES" (UPSKILLING SPONSORSHIPS) COULD BECOME A DIFFERENTIATING FACTOR IN CORPORATE RESPONSIBILITY STRATEGIES SUPPORTING TECH FOR GOOD INITIATIVES.

Environment

Health

New Tech

Socio-Economics

What do we already know?

Demography & generational shifts

Longevity is one of the main drivers of the generational shift: the global population over 60 is expected to reach 1 billion by 2020 and to double by 2050.

With mature markets ag(e)ing and younger populations growing in emerging markets, the power balance between generations is changing and disrupting traditional social structures: **by 2060 the ratio of caregivers to seniors aged 80 or over will be 1 to 50 in Europe**. The gap between the required number of caregivers and the existing supply is widening dramatically, **calling for new, innovative care solutions and the rise of a "caring economy"**.

Africa will continue to be the leading continent in its demographic growth and in the size of its young population, which will make up 20% of the global population by 2030 thus fueling migrations.

Fourt industrial revolution

Enabled by **major technology advances merging the physical, digital and biological world**, this fourth industrial revolution has brought about a fundamental change in the way we live, work and relate to one another.

It **could help states better govern by making them more accessible, transparent and trusted** in times when trust is in jeopardy. It also conversely creates governance challenges, as technological advances in some cases threaten the social contract between governments and its citizens, such as in countries where they are assessing and scoring their citizens.

Platform economy

As **many jobs in the traditional economy are disrupted and unemployment rates are high**, people turn to **odd jobs** in the platform economy to maintain their income.

As more and more people rely on asset-light platforms such as Uber or Airbnb, companies try to change how they organize themselves and a**dapt to increase mobility for workers**.

Social protection, housing and insurance change accordingly: not being "employees", the majority of workers in platform-economy companies have no access to health protection, retirement, unemployment, or other such benefits that typically come with full-time employment. Subsequent to the success of several lawsuits in different countries, a number of gig economy contracts were converted. **It will now consequently be harder for employers to formally classify their workers as independent contractors rather than employees.**

Platforms seem to fuel trust with consumers, as they allow both the workers and the consumers to rate each other. They are also reshaping the future of mobility (all transport services gathered in one app) and the way we share space (Airbnb, We Work) among others.

Future of globalization

Over the next 50 years, as many as **1 billion people could be on the move**. These migrations can substantially benefit the 40 countries needing to replace their workforce in the 2025-2050 horizon. The challenge will reside in matching labor market needs to migrant skills.

Traditional public institutions (ONU, etc.) now directly compete with corporations, NGOs, cities, philanthropic organizations, trade associations The latter are **more influential and efficient on global issues** such as health (Gates Foundation) or climate change (C40 cities). In parallel, harmful organizations emerge such as organized **crime syndicates, terrorist networks** and paramilitary organizations which also **benefit from financial globalization and digitization** and put companies at risk.

Rise of inequality

In 2030, the top 1% will hold 64% of the world's wealth. Inequality within most countries is increasing and it is getting even worse in countries enjoying economic growth.

It remains a key source of political and social tension fueled by concerns that globalization and automation only benefit a small part of the population.

What could impact AXA on a 2025 horizon?

Meet our five personae of 2025 ! There are many personae which can depict the world of tomorrow. Let's focus on five of them that are expected to be particularly pervasive in the future.

Scorers: what if we had underestimated the power of scoring?

We can attribute a score when we eat, we attribute a score to the driver when we take Uber, Taxify or Lyft, and <u>are getting a score as a client at the same time</u>. We also give a score to our Airbnb housing when on holiday and once again we get a score as a client: were you a good a bad tenant? Can you be trusted with someone else's home?

Such scoring is intended to guide users, to reassure them through the experience of other users and to provide a historical record where none existed before. As interactions between people have become almost completely digitalized, these ratings seem to provide the new basis on which to build a feeling of trust for people, companies, or products.

Scoring originally comes from the banking sector where a credit score – a statistical analysis of a person's credit history – was attributed to assess the creditworthiness of individuals. Lenders use credit scores to evaluate and mitigate the potential risks posed by lending money to consumers.

A social Credit System – in the roll-out phase today – will enter into force in China by 2020 attributing its 1.4 billion citizens a personal score for their behavior. It is intended to standardize the assessments of citizens' and businesses' economic and social reputation. It is designed to reach into every on and offline aspect of a person's existence. Consumer behaviors, activities on social media, real-world infractions are monitored and integrated into an algorithm. It then determines a "sincerity score" which will unlock (or lock them out of) premiums for loans, rentals and the right to travel. George Orwell's 1984 dystopia where Big Brother deters people from talking to anyone because of perpetual monitoring or the Black Mirror episode on social scoring may both be on the way to becoming realities.

From social media to digital footprint, new foundation for scoring

Following in Ebay's footsteps, one of the pioneers in setting up a rating system of its sellers, many data-gathering startups are now exploring how to leverage scoring with algorithms that analyze social media activity. PeerIndex, acquired by Brandwatch, provides social media analytics based on user footprints on major social media services such as Facebook, LinkedIn, Quora, and Twitter. It tracks approximately 45 million Twitter profiles and is one of the leaders in this market.

Beyond social media new sources of data linked to IoT devices or digital footprints are becoming easily available to feed algorithms and thus can be used to infer personality traits.

In the future, we could leave the era of "If you are not paying for it, you are the product" in the sense that paying with data may not guarantee of being able to access a service. While consumers' data access is becoming the new price to pay, the scores they are attributed are also becoming a new currency to get access to some necessities: over 11 million people have been blocked from taking the train or plane in China because they have been assessed as untrustworthy by the Credit social score experiment. Assessing the personality and risk profile on these bases raises ethical issues about privacy and transparency on the mechanisms involved. What should be the basis for considering that an individual is trustworthy? Can algorithms be subject to manipulation? For what purposes would it be fair to use this type of data?

Overriding trends:

1   WHETHER PERSONAL OR PROFESSIONAL ARISING NUMBER OF ACTIVITIES WILL BE RATED.

2   DIGITAL FOOTPRINTS AND SOCIAL SCORING WILL PREDOMINATE AMONG THE NEW DATA SOURCES.

3   ALONGSIDE PEER-TO-PEER EVALUATIONS, WILL FIGURE ALGORITHMIC SCORING SYSTEMS WHOSE TRANSPARENCY CAN BE QUESTIONED.

Makers: what if Do-It-Yourself becomes mainstream?

Maker Media CEO Dale Dougherty describes Making as: "creating, producing, crafting, shaping, tinkering, composing, and building. It covers many areas of interest and many skills, and projects often combine several of each.

Making sits at the intersection of art and science, and at the crossroads of technology and design". All together, they represent a growing community:

the Maker Movement is made up of individuals from many disciplines and backgrounds, composed of "hobbyists, tinkerers, engineers, hackers, and artists who creatively design and build projects for both playful and useful ends". Put simply, they are crafts people who derive their identity through their creations.

From 3D printing to hackerspaces: a new way of prototyping

The expansion of the maker community has been facilitated by the development and lowering costs of technological advances such as 3D printing for instance. The democratization of production means has enabled a more open and collaborative production environment (fablabs, makerspaces, hackerspaces).

The Atmel Corporation – Worldwide leader in the design and manufacture of microcontrollers – has calculated that there are approximately 135 million adult Makers in the United States. It is hard to determine the exact number of Makers around the world being that they are DIYers (Do It Yourself) and people who create things from their homes; there could be as many as 7.6 billion.

The Fab City global initiative, a group of leaders, organizations and projects dedicated to exploring the present and future of key fields for the development of productive cities, aims at rethinking the way cities and manufacturers work by sharing knowledge with people and empowering them to create. According to them, the "power of making" is a response to the challenge posed by the rate at which humans consume planetary resources. In so doing and by becoming institutional and creating strong networks, Makers have an impact on the Future of Manufacturing.

For instance, Etsy, a global e-commerce market, connects over 29 million users with over 40 million artisanal, handicraft products from all over the world. Jorgenson, a senior at the University of Nebraska, built his own self-driving car for $700. He downloaded the plans and software from Internet (start-up Comma.ai opened its software) and added $700 in parts.

Makers were already such a growing movement in the US that the White House held its first inaugural Maker Fair "Today's D.I.Y. is tomorrow's Made in America" after the launch of the Maker City program in 2014. The federal Department of Health and Human Services is sponsoring its own specialized maker movement through the platform E-NABLE. The National Institutes of Health also has its own maker platform, 3D Print Exchange, which provides open-source data and tools to discover, create, and share 3D-printable models of low-cost prosthetics and assistive devices on-demand.

According to the Fablab foundation there are 1,975 hackerspaces / makerspaces around the world. In 2018, the size of the market was estimated at $43.7 bn and it is expected to reach $93bn by 2025 – with 3D printing reaching $8bn by 2020. The development of the 3D printer market and that of platforms or online resources for downloading models, added to the rising number of hackerspaces, contribute to the structuring of an ecosystem for makers – not only in developed countries but also in those emerging where makers are supporting low tech.

Overriding trends:

1 INCREASINGLY IN NEED OF LOCAL PRODUCTS, CITIES ARE BETTING ON MAKERS TO DEVELOP SELF-SUFFICIENCY AND AUTONOMY.

2 MAKERS ARE ENTERING THE HEALTH SECTOR WITH 3D PRINTING OF BIOMATERIALS TO MAKE TISSUES AND ORGANS.

3 MAKERS ARE ALSO CHANGING THE WAY WE WORK BY PROVING PROTOTYPING IS POSSIBLE THROUGH EARLY & AGILE EXPERIMENTATION.

# Connected Migrants: is technology affecting migration?

In talking about migrants one can refer to extremely different situations both in the causes of migration and the conditions in which they are received.

Migrants: people moving from country to country for diverse personal reasons.

Immigrants: people establishing residency either legally or illegally in a country other than their own and usually for economic reasons.

Refugees: people who have been forced to flee their country due to persecution for their race, religion, nationality, political opinion, or membership to a social group. Two-thirds of all refugees worldwide come from just five countries: Syria, Afghanistan, South Sudan, Myanmar and Somalia and they are concentrated in three countries: Turkey, Pakistan and Lebanon.

Climate migrants: more than 143 million people are expected to migrate to escape crop failure, water scarcity, and rising sea-levels.
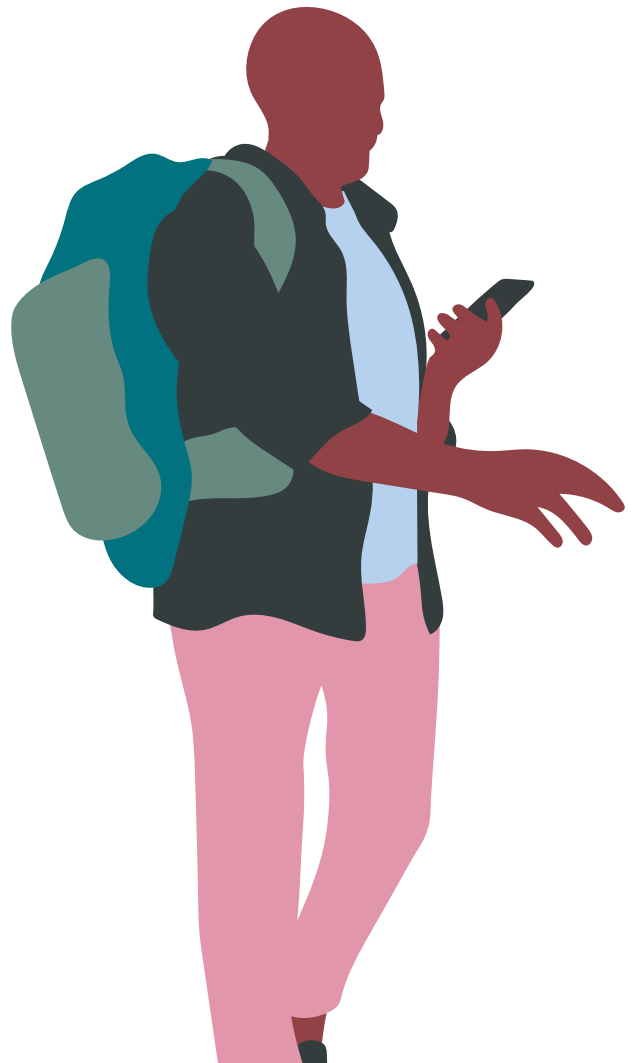
What these four immigrant segments have in common is that, at a time when they may be exposed to situations of vulnerability, they are generally not covered by any social protection or insurance policies upon arriving in a "host country".

When technologies make the groups on the move visible

The "refugee crisis" puts some pressure on these European countries' social support and their political systems, and, in some cases (e.g. Hungary and some Balkan countries), nations consider closing their borders as the pressure mounts.

In a fully digital age, Syrian forced refugees have emerged in public media carrying smartphones and taking selfies upon safely reaching dry land. Their images were mobilized to be instrumental in a new form of symbolic border challenge.

The appearance of digitally connected refugees and migrants is new and challenges people's assumptions. The role of digital technologies in increasing and expanding migration processes, ranging from top-down governmentality and bottom-up practices is undeniable.

Immigrants provide for their family back in their home country, but they obtain no insurance in case of an unfortunate event that would prevent them from working. If something happens, the immigrants family back home faces high risks. As a matter of fact, developing countries

rely on immigrants' remittances to offset government's social protection gaps, where governments fail to fulfill their role, immigrants seek to find solutions. This creates an informal form of social protection.

Amounts of their remittances have increased more than threefold since 1995 from $100.1 bn to $379.6 bn in 2015. In some cases, this represents one of the main sources of income in a country's GDP.

Women are more impacted and bear a greater burden as they spend 2.5 times longer on unpaid care and domestic work than men on average. It prevents them from getting empowered as they must not only work, but also care for the family, their parents and children.

Families do not bank in a traditional way: in Africa the average share of the population with a bank account stands at 15.7%. In Asia, it represents 460 million people. They mainly use mobile banking, which leaves them off the radar of traditional insurance companies yet easily reachable for MNO companies.

Migrants' financial activity can in no way be reduced to the expression of an informal family contract honored by money transfers. It is also about their "drive for self-sufficiency". Immigrants contribute positively to GDP growth in the countries where they live as they are new consumers and pay taxes. Put simply, they spend more than what they receive in the form of social assistance.

Overriding trends:

1   A GROWING MOVEMENT FOR RECOGNIZING MIGRANTS' SKILLS TO ENABLE THEM TO CONTRIBUTE TO THEIR NEW COUNTRY'S ECONOMIC PROSPERITY AND BECOME ASSETS.

2   INCREASINGLY CAPITALIZING ON THE USE OF BLOCKCHAIN FOR REMITTANCE MONEY.

3   CLIMATE CHANGE WILL PRIMARILY DRIVE OUR FUTURE GLOBAL MIGRATION PATTERNS.

Perennials: a society without retirement?

In most mature economies, the population is aging. People live longer, grow old later, and remain active longer. The age structure of the labor force is expected to keep shifting, amounting to substantial changes with potentially dire consequences on pension systems.

To stabilize pension systems in terms of the dependency ratio (the same ratio of retired over working individuals), a recent OECD study found that it would require increasing the retirement age by 8.4 years. However, splitting one's life between an active working life and an idle life as a retiree is less and less representative of how many older adults behave.

The decision to retire is often reversed. As shown by a 2015 RAND survey, 39% of American workers over the age of 65 had retired before going back to work and 56% of retirees aged 50 and older said they would consider unretiring. A similar study in England found that 25% of Britons reversed their decision to retire and started working again (about half of them did so in the first five years of retirement). One of the overriding reasons to continue working into old age is that of finding meaning in work.

Researchers have found that the decision to unretire was not linked to a greater financial need, and that it was more common among men and highly educated individuals. Even when older adults leave the workforce, they still contribute heavily to the economy in Europe a study by Harvard researchers concludes. The study showed that employment represents only half of the economic contribution made by adults 60 and over in Europe. By volunteering or caring for grandchildren, older adults generate significant value though they do so informally as this activity goes unreported in official economic statistics. One key determinant of the amount of contributions, whether formal or informal, was good health, as acute health shocks were associated with decreases in both types of contribution.

Is unretirement the next step in today's aging societies?

Remaining active increases social interactions and overall happiness, which in turn improves health. Helping older workers find meaning in work or other activities, such as volunteering, is thus vital to ensuring they remain in good health. Furthermore, in promoting unretirement, policy-makers could reduce stress on pension systems. Romania, for example, launched its "Un-retirement Initiative for Teachers and University Professors", to ensure that the skills and knowledge of this workforce were transferred to the next generation of workers.

Moreover, because of unretirement, tomorrow's workforce is expected to be more diverse, with older workers bringing different perspectives from those of their younger counterparts.

In addition, to equip older workers willing to keep working with all the necessary skills to do so, shifting towards a lifelong learning process is even more vital. As a result, unretirement also highlights how people's lives are organized less and less linearly (study – work – retire) and how much harder it will be to group people by demographics in the future (hence the latest neologism invented to characterize today's individuals, the Perennials).

Overriding trends:

1   **"PERENNIAL" DESCRIBES A MINDSET THAT DENIES GENERATIONAL DIVISIONS AND GROUPS AND FITS IN NO SPECIFIC CATEGORY.**

2   **THE FUTURE OF LONGEVITY WILL MAKE TODAY'S AND TOMORROW'S GENERATIONS THINK ABOUT TIME AS A NON-LINEAR PROCESS.**

3   **UNRETIREMENT IS A CONCRETE ILLUSTRATION OF PERENNIALS' MINDSET.**

Slashers : what if we were leveraging gig-worker power?

Slashers are workers with multiple paid activities in parallel such as a shop-owner/private driver, nurse/yoga teacher and the like.
The examples are numerous and their numbers are growing reflecting a major societal trend and new work patterns: with a 45% increase since 2004, they are the fastest-growing segment in the EU labor market. In 2016, they were 162 million in Europe and the United States, in other words, 20 to 30 % of the working-age population.

Slashers are increasingly linked to the gig economy as gig-working was introduced and facilitated by an ecosystem of platforms providing large-scale efficient marketplaces where customers meet workers with near zero margin costs.

Work thus becomes more flexible, decentralized and knowledge-based.

A new ecosystem of platforms amid a traditional work infrastructure

In its survey on independent work, McKinsey established a typology of four worker profiles.

Independent workers by choice, report greater satisfaction with their work life than those who do it out of necessity (financially strapped). Free agents also reported higher levels of satisfaction with the multiple dimensions of their work life as opposed to those who had chosen traditional jobs. This indicates that many people place increasing value on the nonmonetary aspects of working on their own terms.

It should lead to rethinking the existing distinction between workers. Under current laws, people are either employees, entitled to all benefits, or contractors, entitled to (almost) none. This is being challenged, as the examples of 'contractors' being requalified as 'employees' in certain countries show. Governments are pushed to change labor legislation and need to create an intermediary category between employees and contractors, to allow for more

piecemeal benefit access. It could mean broadening social safety to include benefits currently provided by employers with a cleaned-up tax code for gig-income workers for instance.

Independent work can attract high-skilled, high-paid workers as well for flexibility is what draws people to the gig economy and this does not always mean vulnerability. Gig work can enable people to earn a living and a high quality of life if we consider independent consultants or freelancers. However, pay levels on the platforms are significantly lower than the national minimum wage rates across European countries and the U.S., ranging from a 54% gap in France to 3.4 % in the United States.

When it exists, social protection is typically provided from a job outside the platform economy. This is an issue as it presupposes that the other source of income comes from a standard job that gives access to social protection. Platform work needs to be more carefully regulated to prevent it from producing a wider landscape of insecure low paid work.

In August 2018, New York became the first major American city to set a cap on ride-hailing vehicles and to set pay rules for gig drivers. This has set a precedent that other cities could follow and that could spell trouble for ride-hailing firms. This is especially bad timing for Uber, as the company intends to go public next year.

Overriding trends:

1   IF SLASHERS GO BACK TO TRADITIONAL COMPANIES:
WILL THEY TAKE UP THE CORPORATE CULTURE?

2   IT AND HR SHOULD BE MORE INTERWOVEN TO MANAGE
THESE NEW RESOURCES.

3   A GREATER NUMBER OF WORK PLATFORMS LIKE UPWORK ARE EMERGING WHICH
MIGHT BE WELL PLACED TO ACT AS NEW INTERMEDIARIES FOR COMPANIES.

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