SCOR
The Art & Science of Risk

2022 EMERGING RISKS REPORT

SCOR's 2022 Emerging Risks Radar shows the relationships between "Trends" (long term patterns) and "Emerging Risks" (the varied consequences of these Trends). In particular, the radar attempts to highlight the interconnections at play in the risk universe and the potential for the materialisation of events with systemic impacts.

The eight Trends identified by SCOR are "Global Climate Change", "Deterioration of the Environment", "Evolving Health Trends", "Changing Demographics", "Shifting Social and Geopolitical Landscapes", "Hyperconnectivity" and "New Business and Finance Models". Descriptions of these Trends are provided in chapter two.

Current themes that stand out in the Emerging Risks landscape are those relating to major ongoing environmental issues - namely Global Climate Change and Biodiversity Loss. The Covid-19 pandemic and its aftermath are also recurrent subjects in many of the themes addressed in the report. These include the ongoing health impacts, such as those related to substance abuse, concerns around long Covid and mental health. Societal inequalities that have been exposed during the pandemic and the related tendencies for increasing social uprising are also discussed. The increase in the hyperconnectivity of society during the lockdowns has been positive in terms of maintaining normal aspects of life, such as social interactions and for the continuation of professional activities for many people. However, there has been a huge increase in cyber criminality exposing cyber security issues for individuals, businesses and public infrastructures.

The report concludes with brief descriptions of the risks that feature on SCOR's 2022 Emerging Risks Radar.

Fabian Uffer, Group Chief Risk Officer

COMBINING THE ART & SCIENCE OF RISK TO PROTECT SOCIETIES

I am pleased to present SCOR's 2022 Emerging Risks Report, which provides our view of the current Emerging Risks landscape.

Humanity is currently navigating a formidable array of challenges. These span the twin crises of climate change and biodiversity loss, the issues related to entrenched societal inequalities, the risks related to the rapid digitalization of our industries and everyday lives, and the volatile geopolitical climate that has most recently culminated in the current conflict in Ukraine. The interconnected nature of the risk universe cannot be ignored; while being a crisis in its own right, the Covid-19 pandemic has both influenced, and been influenced by, current major risks. For example, we have seen that the pandemic has both illuminated and exacerbated societal inequalities, and catalysed rapid digitalization. Conversely, pandemics could also be influenced or triggered by other major risks such as climate change and the environmental degradation that is eroding the planet's biodiversity. While the current war in Ukraine is first and foremost a tragic humanitarian crisis, there are also serious implications for ongoing geopolitical relations and the global economy – already weakened by the fallout of the Covid-19 pandemic.

Although the (re)insurance industry cannot provide the solutions to all of these challenges, it is our mission to contribute to societal resilience by providing financial protection in the face of unexpected events. To fulfill this mission in the context of today's turbulent environment, the industry needs to be able to prepare for and respond to this increasingly complex and interconnected risk universe.

2022 marked a third year under the influence of the Covid-19 pandemic, reminding us that certain events do not always evolve in the way that might be expected; hence the value of reflecting on emerging risks. A company's emerging risks process provides a space to consider both new and developing risks, and the unexpected ways in which they could impact our businesses and operations. Investigating such unexpected outcomes will require the industry to develop more awareness of the connected nature of the risk landscape, so that we are better equipped to respond to both the risks and opportunities of the future; the interconnections illustrated in SCOR's 2022 risk radar aim to contribute to this process.

I hope that you will enjoy reading this report and will find its insights both thought-provoking and useful.

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CHAPTER 01

TRENDS & 2022 EMERGING RISKS RADAR

—The Emerging Risks process endeavours to identify those Emerging Risks that are likely to have a direct impact on SCOR and the (re)insurance industry at large. For SCOR, "Emerging Risks", include both new (i.e. previously unknown) risks and also changing risks which are known but rapidly evolving.
SCOR also identifies eight «Trends», that are longer-term patterns that can generate individual risks.

Interpretation of SCOR's Emerging Risks radar (shown overleaf)

- Trends (i.e. long term patterns) are shown to the left of the risk radar.
- Emerging Risks (i.e. the potential consequences of the Trends) are shown as bubbles. The size of the bubble reflects the expected impact for SCOR of the worst-case scenario: low critical, critical, or highly critical.
- Linkages between the Trends and individual Emerging Risks are indicated by the coloured disks on the outside edge of the emerging risks bubbles.

Emerging Risks are placed on three different orbits

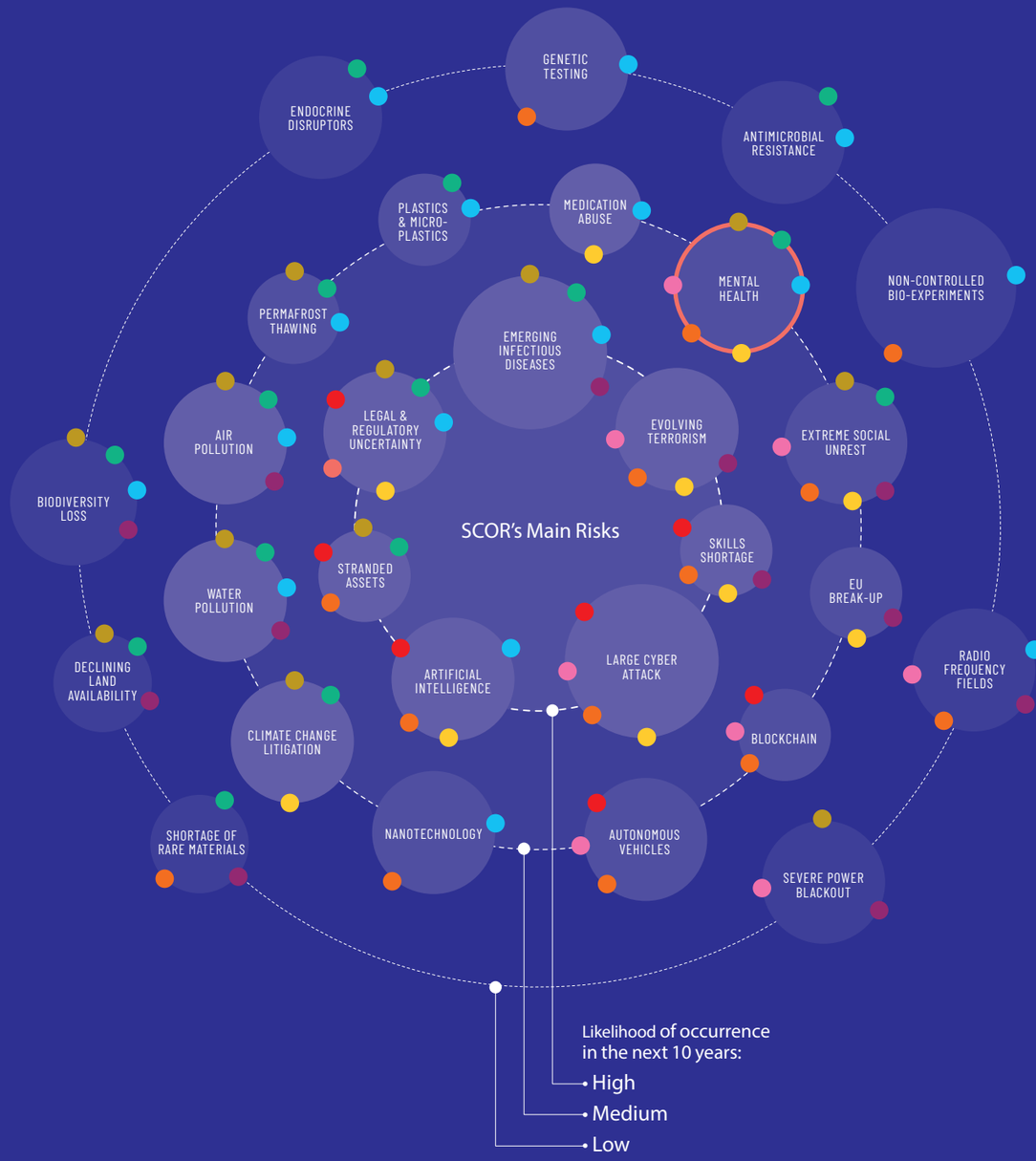
- The inner orbit represents a worst-case scenario with a high likelihood of occurrence.
- The middle orbit represents a worst-case scenario with a medium likelihood of occurrence.
- The outer orbit represents a worst-case scenario with a low likelihood of occurrence.

The time horizon for all the above scenarios is any time within the next 10 years.

For the 2022 radar, the risk «Mental Health» has been assessed and added. Society's mental health became a major topic of concern in the wake of the restrictions placed on people's lives during the Covid-19 pandemic. However, the issue has been under the surface for a number of years, fuelled by factors such as the use of social media platforms, increasing social inequalities and a lack of hope in the face of major environmental issues. For (re)insurers, poor mental health has operational implications (e.g. employee absenteeism) and also potential impacts on both Life & Health and P&C portfolios.

2022 Emerging Risk Radar

- GLOBAL CLIMATE CHANGE
- SHIFTING SOCIAL AND GEOPOLITICAL LANDSCAPE
- DETERIORATION OF THE ENVIRONMENT
- EMERGING TECHNOLOGIES
- EVOLVING HEALTH TRENDS
- HYPER CONNECTIVITY
- CHANGING DEMOGRAPHICS
- NEW BUSINESS & FINANCE MODELS



LOW CRITICAL

CRITICAL

HIGHLY CRITICAL

Potential impact for SCOR

NEW IN 2022

CHAPTER 02

TRENDS: BRIEF DESCRIPTIONS

— Trends can create both risks and opportunities for the insurance industry. For example, new business and finance models as well as emerging technologies offer a whole range of potential innovations and opportunities for those players that keep pace with their developments.

The relationships between Trends and Emerging Risks are shown in the Emerging Risks Radar, which attempts to illustrate the many interconnections which exist in the risk universe. Many of the Trends are linked to a greater or lesser extent; for example, the following four Trends are linked: Global Climate Change - Deterioration of the Environment - Evolving Health Trends - Changing Demographics (e.g. as the climate warms and ecosystems are increasingly damaged, new infectious diseases are likely to emerge and people could be forced to migrate). Similarly, individual risks in the risk universe are often influenced by one another, especially if they have a number of Trends in common.

From a risk management perspective, the relevance of highlighting these interconnections, is that it illustrates the potential for systemic tendencies in the risk universe. An example is the Covid-19 pandemic, which has had a number of secondary impacts leading to risks beyond those on people's physical health.

The Trends shown on SCOR's Emerging Risks Radar are described below:

GLOBAL CLIMATE CHANGE

— Anthropogenic emissions of greenhouse gases - particularly carbon dioxide - have initiated a global change in Earth's climate and the risks created are likely to have profound and varied consequences for societies, including impacts on the economy, on geopolitical stability and on human health. Added to this, are the broader threats that climate change creates for the natural environment. Climate risks include physical risks, which comprise both changes to the frequency and severity of natural catastrophe events, and the risks associated with changes to longer term trends such as increases in average global temperatures and sea levels. Transition risks will also arise from the actions that are necessary to steer society towards a future net-zero carbon economy, including changes to government policy, business models and the adoption of new technologies. In addition, litigation risks are increasingly resulting from the failure of various public and private stakeholders to adequately address the climate crisis or to disclose the true extent of climate risks. Equally, transitioning to a low-carbon economy will generate new opportunities, for example from the adoption of renewable sources of energy, the generation and support of new technologies and more generally, the societal benefits of moving towards a more sustainable way of living.

DETERIORATION OF THE ENVIRONMENT

— Addressing the consequences of environmental degradation is one of the major challenges currently facing humankind. Issues of increasing urgency include the various types of anthropogenic pollutants that are contaminating the land, sea and air, and accelerating rates of biodiversity loss. In particular, biodiversity loss is eroding the provision of essential ecosystem services that are responsible for maintaining the global availability of freshwater sources, clean air, fertile soils, nutritious and varied food sources and other essential raw materials such as novel medicines and fibres. Such sources of environmental deterioration are largely caused by human population expansion and the unsustainable use of resources, including the development of natural or semi-natural habitats to make way for intensive agricultural systems and/or urban settlements. If left unchecked, such trends threaten human quality of life and the livelihoods of many at best, and at worse, threaten the continued existence of life on the planet. This trend is closely inter-linked with the trend 'Global Climate Change'.

EVOLVING HEALTH TRENDS

— Fundamental biometric variables linked to mortality and morbidity have always been strongly influenced by developments in medicine and technology, human behaviour, and public health measures, but also by the socio-political environment. The future pace of these developments will likely increase in step with new breakthroughs in science and discoveries of new technologies in prevention, diagnosis and treatment. Such developments are likely to change the landscape of medicine, with upsides expected to dominate; however, at the same time, the uncertainties related to novel techniques may cause additional risks. The relevance placed by society on individual health and well-being is increasing, which can lead to more willingness to incur costs to improve and protect health and lives, as witnessed during the early stages of the Covid-19 pandemic. However, external environmental factors such as the risks related to climate change and pollution, are creating new threats for human health, very often disproportionally affecting less affluent or otherwise vulnerable parts of the population. Trends in human behaviour such as increasingly sedentary lifestyles, low-quality diets, medication or

other substance abuse, in addition to the prevalence of digital media and interfaces, are also influencing the future trajectory of human health, impacting both chronic diseases and mental health. Finally, the interaction between humans and their environment are creating feedback loops that can negatively impact human health, such as antimicrobial resistance and the occurrence of zoonotic diseases.

CHANGING DEMOGRAPHICS

— Most recent demographic analyses from the United Nations are forecasting the overall global population to continue to grow in the period to 2100[1] but at a slower rate than in the past. While the population of Africa is projected to almost double by 2050, the total population outside of Africa is expected to start declining before 2050 as a direct result of the decreasing fertility rates in many countries.

The US, Europe and more mature insurance markets in Asia (e.g., Japan and Korea) all have low birth rates and ageing populations, with increased longevity due to medical advances and improvements in the quality of life. As the workforces in these countries age and contract, there will be implications for economic productivity and hence, on the affordability of welfare payments, such as pensions and healthcare. Countries will need to consider innovative ways to mitigate the decline in their working age populations e.g. using digital solutions to increase productivity or to extend people's working lives. Meanwhile in African countries such as Nigeria, Kenya and Angola, the middle classes are expected to grow rapidly, leading to increasing disposable income. As social security systems are less developed, this could provide a larger protection gap for insurers to fill. Another demographic trend is increasing rural to urban migration, often of younger sections of the population. This has implications for the age distribution of the populations served by rural and urban insurance markets, and could place strain on urban infrastructure with potential impacts on living standards, particularly in developing countries.

This trend is influenced by other significant trends including climate change, social and geopolitical landscapes and environmental deterioration. All of these factors contribute to the migration of people both within and between countries, which has implications for ongoing societal stability.

SHIFTING SOCIAL & GEOPOLITICAL LANDSCAPES

— Increasing wealth inequalities within societies and between countries as well as the weakening of international governance and cooperation, have the potential to generate lingering social and geopolitical instabilities. In the most extreme cases, these instabilities can result in wars. Global topics such as climate change and environmental degradation continue to influence these trends. An unequal Covid-19 recovery and inequalities made more visible by social media and potentially influenced by disinformation, are likely to lead to growing resentment and fuel extreme political views. The increase in insurance losses caused by legislative, judicial, social, and economic developments results in "social inflation"[2]. The result of social inflation is increasingly higher monetary court awards as social discourse seeks to find a party to blame for accidents, illnesses and wrongdoing. A general anti-corporate sentiment has been fuelled by the financial crisis. Shareholder actions are also potentially exacerbated by social inflation factors. Geopolitical tensions are increasingly playing out in the technology, information and digital spaces, posing a complex regulatory and cyber threat to personal, corporate and governmental data and infrastructure security.

EMERGING TECHNOLOGIES

— Innovative technologies have the potential to disrupt industrial development, production and entire business value chains due to the fast growth and the substantial impacts they could potentially trigger. Research and development of advanced technologies are increasingly important in manufacturing industries, but also in the fields of education, information technology and medical advancement - many practical applications remain unrealised even if advanced technology exists. Convergence brings previously separate technologies together to share resources and interact with one other, creating new efficiencies (e.g. bringing voice, data and video together in productivity applications). The 4th industrial revolution[3] includes breakthroughs in fields as varied as automation, autonomous mobility, artificial intelligence, augmented reality, robotics, new materials, energy use, "Big Data", data life cycle management and communication. The effects of breakthroughs range from changing the status quo (e.g. providing platforms for people to express opinions more widely, irrespective of status), to creating ethical issues of distributive justice due to discrimination resulting from undetected algorithm bias. Other ethical implications could involve existential risk to humanity itself, touching on the more complex and less certain implications of AI, such as those regarding the interface between artificial and human intelligence[4]. The early stages of the 5th industrial revolution, where humans and machines combine, are set to alter how people work, play and live. While machines can already assist humans with decision-making, in time, these and more sophisticated developments building on current technologies, could bring about the displacement of the human workforce to an extent usually associated with industrial revolutions. First steps include machines performing menial administration tasks, increasing automation of public transportation, widespread use of implantable technologies leading to a healthier, longer-living population, 3D printing becoming more prevalent and chatbots being a routine part of the customer experience. These tendencies have both positive and negative implications for human well-being and self-esteem.

HYPERCONNECTIVITY

— Hyperconnectivity results from the rise in the cyber dependency of individuals, critical infrastructure and organisations. Hyperconnectivity incorporates many topics such as the explosion of social media, wearables and other health-monitoring devices, and the Internet of Things (IoT). The degree of hyperconnectivity is projected to strongly increase until 2030 due to the introduction of autonomous driving with e.g. peer to peer communication of cars and automatized supply chain management. Hyperconnectivity offers many opportunities but has also resulted in the heightened vulnerability of society, governments and organisations to increasingly sophisticated cyber-attacks committed by individuals or informal groups of hackers, but also by more organised criminal groups or rogue states. The Covid-19 pandemic has further reinforced the reliance of society and organisations on digital media to maintain social activities and contact, but also for the maintenance of essential services such as healthcare consultations and to allow increasing numbers of companies to switch to a mode of operation that facilitates remote working. However, this has led to an increase in the number of cyber-attacks and highlighted cyber security issues for many organisations.

NEW BUSINESS & FINANCE MODELS

— As new technologies change customer behaviour, changing needs are met through new industries, new products, or new services. Successful disruptive business models often place a focus on the customer with freemium[5], on-demand, subscription and limited free offering/trial models models, while the sharing economy sells limited access-over-ownership rights, which appeals to younger generations who are no longer interested in owning homes or cars. Intangible assets such as software and licences are also shared based on usage requirements while on the other end of the scale, customers are willing to pay higher prices for customised and high-end user experiences. "Digital ecosystems" successfully lock customers into their full range of services and product offerings, so the customer does not need to leave their chosen single digital provider. For years, the world of finance has been undergoing radical change. Business models are moving from closed systems to crowdsourcing, open innovation and open-source platforms. Insurtech initiatives and decentralised finance models are multiplying. Blockchain technology could lead to fundamental shifts in business models and the creation of new payment solutions.

1. The UN projects the global population to increase from 7.8 billion in 2020 to 10.9 billion by 2100.
2. Social inflation results in higher jury awards and is driven by third-party litigation funding (enabling a party to litigate or arbitrate without having to pay for it) and broader concepts of tort and negligence. Without tort reform, non-pecuniary and punitive damages remain uncapped in many states already vulnerable to jury composition impacts.
3. "The fourth industrial revolution". Klaus Schwab - World Economic Forum Founder and Executive Chairman of the World Economic Forum, 11 January 2016.
4. The ethics of Artificial Intelligence: Issues and initiatives. European Parliament STUDY Panel for the Future of Science and Technology. March 2020.
5. Freemium (a combination of «Free» and «Premium») models allow upselling to occur after attracting customers with a first free service or product

CHAPTER 03

SELECTED HIGHLIGHTS ON TRENDS

GLOBAL CLIMATE CHANGE AND ENVIRONMENTAL DETERIORATION

6th UN IPCC Assessment report and COP-26

— The Working Group I contribution to the 6th assessment report (AR6) of the UN Intergovernmental Panel on Climate Change (IPCC), which summarises the current physical science basis for climate change since the 5th assessment report, was released in August 2021. The report covers the current state of the Earth's climate, outlines possible climate futures based on different greenhouse gas (GHG) emissions trajectories, gives different regional responses to climate change, with information on regional risk assessment and adaptation, and outlines the actions necessary to limit future climate change.

The report highlights the unequivocal link between human activity (i.e. the rapid increase in GHG emissions since 1750s) and climate change, stating that *"humans have warmed the atmosphere, ocean and land, causing widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere"*. The report also states that the scale of recent changes to the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many hundreds to thousands of years[6].

The observations from AR6 on the consequences of human activity on different aspects of the climate system include analysis of the occurrence of weather and climate extremes. Hot extremes (including heat waves), heavy precipitation and both agricultural and ecological drought events have become both more frequent and intense since the 1950s, with cold extremes (including cold waves) becoming less frequent and severe. To a greater or lesser extent, human-induced climate change is playing a role in these observations[7].

In relation to the different future climate scenarios discussed in the report, it is projected that global surface temperature will continue to increase well into mid-century under all the scenarios considered[8] and that global average temperatures of 1.5°C and 2°C will be exceeded during the 21st Century, unless deep reductions in the emissions of CO_2 and other greenhouses gases are made in the coming decades.

Against this reality, the UN climate change conference (COP-26) took place in Glasgow in November 2021, with the central aim of securing ambitious emissions reductions targets from countries by 2030, in order to reach net-zero emissions by 2050. Although the UK presidency of the COP at Glasgow had set itself the goal of keeping the Paris agreement's limit of an average 1.5C rise in global temperature alive, there is doubt that the commitments made at Glasgow were sufficient to achieve this goal. However, one of the major successes of the conference was the adoption of the "Glasgow Climate Pact", which commits to doubling climate finance and requests countries to present more ambitious climate pledges in 2022.

Recent developments in climate change litigation

— Public awareness of the seriousness of climate change and the increase in the formal commitments taken by governments to reduce GHG emissions, coupled with advancements in the science linking human activity to increases in the frequency and severity of certain catastrophic events (e.g. drought, flooding), has contributed to a rapidly growing trend of climate change-related litigation, especially since 2015. Growing pressure - and in some cases requirements - for organisations to make public disclosures on their exposure to climate risks and how they intend to manage them, is also making external stakeholders more aware of potential shortcomings in the climate strategies of certain sectors.

A landmark climate litigation case was witnessed in the Netherlands in December 2020, filed against Royal Dutch Shell by a group of seven environmental organisations and over 17,000 individual claimants. The case claimed that Shell's current emissions reductions targets were insufficient to reach the target set out in the Paris agreement and in breach of two articles of the European Convention on Human Rights. In May 2021, the court ruled that Shell's current sustainability policy was insufficiently concrete and that its emissions were greater than that of most countries. In view of this, Shell was ordered to reduce its CO_2 emissions by 45% by 2030 (from 2019 levels) as compared to the initially planned target of 30% by 2035 (from 2016 levels). The verdict had immediate effect ; even though Shell stated that they would appeal the court ruling in July 2021, the company will have to work towards meeting its obligations pending the appeal's outcome - which could take several years.

6. According to IPCC AR6, in 2019, atmospheric CO_2 concentrations were higher than at any time in the last 2 million years (high confidence); global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years (high confidence); in 2011–2020, annual average Arctic sea ice area reached its lowest level since at least 1850 (high confidence); global mean sea level has risen faster since 1900 than over any preceding century in at least the last 3000 years (high confidence).

7. According to IPCC AR6, role of human-induced climate change in temperature extremes = High confidence, in heavy precipitation events = Likely, in drought events = Medium confidence.

8. The report considers five illustrative GHG emissions scenarios, ranging from two with high and very high levels of GHG emissions, an intermediate GHG emissions scenario and two with low and very low GHG emissions.

The case verdict is considered a landmark in environmental law related to climate change, based on being the first to hold a corporation to the tenets of the Paris agreement. As such, the case is expected to set a precedent for similar lawsuits against large emitters of GHG in jurisdictions outside of the Netherlands.

Biodiversity initiatives

— After climate change, acting to protect biodiversity has become the next big sustainability preoccupation. The importance of biodiversity has many different facets. From a purely utilitarian perspective, biodiversity provides a number of 'services' that maintain an environment conducive to sustaining life on the planet, from the regulation of climate, to maintaining freshwater supplies, clean air, fertile soils and varied food sources. For all life forms on the planet, biodiversity is therefore essential for maintaining healthy and sustainable populations. From a human perspective, however, biodiversity is also culturally and spiritually important for many societies. Even if this link has been lost in many western cultures, biodiversity (whether people realise it or not) plays an important role in maintaining a sense of well-being. As one eminent ecologist put it, *"maybe we could be clever enough to survive in a greatly biologically-impoverished world; it would, very likely, be akin to that of the world in the cult movie, "Blade Runner". The question arises, who would want to live in such a world?"*.[8]

In terms of global political action on biodiversity, the UN Biodiversity Conference took place in October 2021 in Kunming, Yunnan Province, China. The objective of the conference was to define the need for an integrated approach to ensure that action is taken to reverse biodiversity loss and its impact on ecosystems, species and people. One of the main outcomes from the conference was the adoption of the Kunming Declaration, which commits countries to develop and implement an effective post-2020 biodiversity framework that would enable biodiversity recovery by 2030. Further negotiations are expected to take place during 2022.

From the perspective of the financial services industry, the importance of integrating Environmental, Social and Governance considerations into business practices is now widely accepted, with the protection of biodiversity currently becoming a paramount objective. In view of this, the Task force for Nature-related Financial Disclosures – an equivalent reporting framework to the Task force for Climate-related Financial Disclosures – will be implemented during the course of 2023.

Specifically for (re)insurers, the European Commission delegated act integrating sustainability risks (including climate change and biodiversity) into the Solvency II framework will be applicable at the beginning of August, 2022.

EVOLVING HEALTH TRENDS

Opioid crisis update

— In 2020, the United States had 93,331 drug overdose deaths, which is the highest ever recorded in a single year. A main driver of these overdoses is from synthetic opioids, accounting for 60% of the deaths. Although opioid-related deaths have been increasing steadily up to 2019, the spike suggests the Covid-19 pandemic played a key role. In part, the rise in overdoses is due to downstream impacts from Covid-19 lockdowns, as there was increased financial stress, decreased social interactions, and a reduction in access to support resources. Canada also saw an uptick in opioid overdoses during the Covid-19 pandemic, reporting 6,214 apparent opioid-related deaths in 2020.

The opioid crisis is especially visible in North America, but also an issue in other regions of the globe. The World Health Organization reported that approximately 350,000 deaths are attributable to opioid-related deaths globally. The illegal opioids Fentanyl and Tramadol are the key drivers of the opioid crisis in North America and Africa, respectively. In the past, a main driver of opioid abuse stemmed from medically prescribed opioids, as studies found that up to one in four patients receiving long-term opioid medications develop opioid addiction. Legal action has been taken over the past decade to fight the over-prescribing from doctors and intense marketing by manufacturers. Note that opioid overdoses typically occur when other substances are combined with opioids, such as alcohol and/or other substances that suppress respiratory function. People at higher risk of opioid overdose are males, people of older age and people with lower socio-economic status. Increased awareness of the opioid crisis during the Covid-19 pandemic has sparked advocacy for additional resources and accessibility to support in many areas. The opioid crisis trend should continue to be monitored, as uncertainty continues for future pandemic surges and potential lockdowns.

For the impact on P&C lines in relation to ongoing opioid litigation, refer to the section 'Shifting Social and Geopolitical Landscapes".

9. Why should we be concerned about loss of biodiversity? R.M. May. C.R. Biologies 334 (2011).

Mental health

— Prior to the Covid-19 pandemic, mental health had already moved into the spotlight as a significant and largely unaddressed health crisis with a wide range of impacts. It is becoming increasingly clear that poor mental health leads to an underperforming immune system and reduces life expectancy. The high position of suicide as cause of death in the US – number 10 for the general population and number 2 in the age-group 10-34 in 2019 – is a strong indicator for extreme outcomes of this risk materialising.

Another outcome of poor mental health can be that workplace productivity suffers via increased absenteeism and lower quality of work. In the other direction, low employee mental health can also be caused by certain work-related factors, for example, excessive working hours, harassment and job insecurity.

While impacts on society and the wider economy can be broad and difficult to attribute, insurers covering occupational disability as well as those covering employers' liability need to be especially aware of this risk.

Long Covid

— There are reports that a significant proportion of patients surviving a Covid-19 infection continue to suffer from health problems months after the acute phase of the disease is over. These prolonged consequences of Covid-19 are often referred to as "long Covid" or "post Covid-19 condition". At this stage, no precise definition of the symptoms of long Covid exists; however, case reports indicate that the long-lasting health implications include a number of conditions such as severe fatigue, pulmonary problems, heart conditions, neurological and muscular problems. WHO is supporting an initiative to standardize data collection around long Covid symptoms to build a basis for better understanding of the condition[10].

From a (re)insurance perspective, the prolonged consequences of Covid-19 infections might lead to increased cost in health care, increased cost in incapacity insurance if patients are not able to resume their normal work life, and potentially long-term implications on mortality.

CHANGING DEMOGRAPHICS

Population trends in Africa

— Africa will drive world population growth in the 21st century with its population expected to double from 1.3 billion in 2020 to 2.5 billion by 2050 (UN). This trend is exemplified by the projection that Nigeria's population will increase from c.200 million in 2020 to 400 million in 2050 meaning that it will overtake the United States as the world's third most populous country.

Declining infant and child mortality rates are forecast to lead to increases in the proportion of working age adults across the continent and a consequential fall in dependency ratios[11]. These favourable demographics mean that the continent has the potential to benefit from a demographic dividend such as was seen in some east Asian countries from the 1960s to the 1990s. If this demographic dividend materializes, it should lead to new opportunities for insurers. However, much of the population growth is in poorer countries where population growth brings additional challenges in efforts to eradicate poverty, achieve gender equality, combat hunger and malnutrition as well as improving health and education systems. For these countries to fully benefit from their potential demographic dividend, continued investment and improvement is required in areas such as literacy rates, educational access for all and healthcare services.

Urbanisation is also moving at a rapid pace in Africa. In Eastern and Southern Africa, the urban population is projected to triple in the period from 2020 to 2050[11]. This could represent an opportunity for insurance market growth. However, it should be borne in mind that as cities become larger, it may become harder to maintain living standards. This may result in an increase in the number of slums.

US health gap

— The US spends more on healthcare as a share of its economy (almost twice as much as the average OECD country) yet has worse health outcomes and the lowest life expectancy amongst comparable developed nations[12].
The reasons for this are myriad but include relatively high rates of preventable lifestyle conditions. For example, obesity rates are high in the US and stand at approximately twice the OECD average[13]. Additionally, the US has a relatively high burden of chronic disease. Approx. 28% of US adults report that they have been diagnosed with two or more chronic conditions such as asthma, diabetes, heart disease or hypertension during their lifetime. This rate is twice as high as in the UK and the Netherlands and compares to rates of 22% or less in other comparable countries[14].

10. https://www.who.int/news/item/12-08-2021-post-covid-19-condition-who-supports-standardization-of-clinical-data-collection-and-reporting
11. UNICEF-ESA-Population-Dynamics-Demographic-Dividend-Potential-Nov-2019.pdf
12. Tikkanen & Abrams, 2020.
13. OECD Health Statistics, 2019.
14. Commonwealth Fund International Health Policy Survey, 2016.

Socioeconomic factors are a key consideration. There is a wide disparity in terms of health outcomes within the US. Life expectancy can vary as much as 30 years between the richest and poorest US counties. However, studies have also cited other factors that drive health trends across all income groups. For example, an urban environment that encourages car use over walking and higher levels of stress in the general population which contributes to mental health issues and substance abuse[15].

SHIFTING SOCIAL & GEOPOLITICAL LANDSCAPE

Update on ongoing opioid litigation

— Local and state governments in the US are fighting a potentially decade long legal battle against players along the opioid value chain to recover the substantial funds they have spent on responding to and managing the opioid crisis in their municipalities. The Purdue Pharma bankruptcy settlement with the Sackler family being absolved of all opioid liabilities, is an example of one legal case that has been widely reported. For insurers, general liability lines and medical malpractice lines could potentially be impacted; Directors & Officers (D&O) and Error & Omissions policies (E&O) could also be impacted for example if it is proven that large consultancy firms helped distributors develop aggressive marketing strategies that potentially fuelled the crisis. Several policy defences are in place and recent insurance dispute rulings acknowledged that at least some of the medical and expense costs can be «because of bodily injury», a common exclusion from coverage under general liability policies.

Social inflation elements which may become noticeable in future verdicts reflect an observed shift in societal attitudes - these elements include millennial jurors contributing to oversized verdicts that reflect e.g. their distrust for large corporations following the 2007/8 financial crisis. Third party litigation funding is also increasingly common and largely unregulated.

"#Me Too" – addressing past cases of sexual misconduct

— "#Me Too" became a worldwide movement in 2017, following the revelations of several actresses concerning their experiences of sexual harassment and abuse in the film industry. Through social media, the movement became a global catalyst for the open discussion of sexual abuse that has occurred in many different contexts – including in the church, universities, the scouts movement, sports clubs, the music and film industries, and politics. This new culture of "breaking the silence" about such acts, has encouraged increasing numbers of people to file claims for damages caused by sexual abuse, that in many cases have involved the abuse of children who are now adults.

In some states in the USA, recent "reviver" legislation has been passed that allows the victims of childhood sexual abuse to bring civil claims, well after the applicable statutes of limitations for filing claims have passed. These types of developments have created more uncertainty around how litigation relating to past acts of sexual abuse could develop in the future.

Covid-19 shines a spotlight on inequalities

— Both the 2021 and 2022 WEF global risks reports highlight widening inequalities and the erosion of social cohesion, exacerbated in the wake of the pandemic. Job losses during the Covid-19 lockdowns have had an immediate impact on increasing wealth inequality, as the jobs most at risk have tended to either be of a more precarious nature (e.g. the self-employed) or those at the lower end of the pay spectrum. The Covid-19 pandemic has highlighted both the digital and wealth divide, with some families not having sufficient access to digital equipment - or even a quiet space at home - to enable their children to follow online schooling. Following the easing of lockdowns, an uneven Covid-19 recovery could further widen the gap between the "haves" and "have-nots" if access to technology and ability remain disparate. A "doubly disrupted"[17] generation of youth is emerging, facing serious challenges in relation to the quality of their education, future economic prospects and mental health.

Another aspect of inequality during the Covid-19 pandemic, was that people from ethnic minority groups both in the UK and beyond were found to be disproportionately impacted by Covid-19, as compared to white groups. An observational study published in the Lancet, found that ethnic minority groups studied had a higher risk of testing positive for Covid-19 and of Covid-19 related hospitalisations, intensive care admissions and death, compared to white groups[18]. Possible reasons cited for the differences seen were that ethnic minority groups are more likely to find themselves in positions associated with adverse Covid-19 outcomes, such as living in deprived areas, working in front-line jobs and having poor access to healthcare, although these only partly explained the findings.

15. National Research Council (US), 2013.
16. World Economic Forum Global Risks Report 2021
17. For young adults the Covid-19 pandemic is the second major global crisis they have experienced in a decade, following the financial crisis of 2007/8 and the resulting economic instability and cuts to public spending.
18. Rohini Mathur et al. Ethnic differences in SARS-CoV-2 infection and COVID-19 related hospitalization, intensive care unit admission and death in 17 million adults in England; an observational cohort study using the OpenSAFELY platform. The Lancet, volume 397, p1711-1724, May 8th 2021.

Another major source of Covid-19 inequality being witnessed is the unequal access to vaccines around the globe. As of January 2022, of the approximately 59% of the world population that has received at least one dose of a Covid-19 vaccine, only 8.9% reside in low-income countries[19]. Not only is providing equal access to vaccines a moral imperative, it is also essential if we are to protect the global community against the propagation of new variants that could undermine vaccine efficacy and slow the Covid-19 recovery.

Rising social unrest - role of the "3Cs" - climate change, (enduring traces of) colonialism and Covid-19

— Instances of social unrest since the end of 2018 have been fuelled by a 'perfect storm' of three major issues; climate change, persisting inequalities linked to the aftermath of colonialism and most recently, the Covid-19 pandemic.

The 2018 'Gilet Jaune' movement in France started because of a rapid rise in the rate of a fuel tax, initially implemented in 2014 to reduce carbon emissions and encourage lower-carbon forms of transport. Although the movement could be said to be a by-product of the necessary steps to combat climate change, the reasons for the movement were more related to the perceived unfairness of the tax. Those more affected were people living in rural areas of France, who were both more dependent on car usage for their daily lives and also less affluent than those living in large cities, with more transport options. Although the Gilet Jaune protests aimed to highlight the inequalities in French society, rather than to oppose action on climate change, it illustrates that government and global action to curb climate change will have to be implemented in a way that does not overburden both the individuals and countries that can least afford it, if further episodes of social unrest are to be avoided.

The "Black Lives Matter" campaign mobilised one of the largest protest movements in the history of the US in 2020, following a number of racially motivated incidents, and culminating in the murder of the African American George Floyd at the hands of a Minneapolis police officer. The Black Lives Matter movement was created in the US in 2013 to highlight all forms of systemic racial injustice in the US – but particularly the brutality of the police towards African Americans, with one of the central demands of the movement being criminal justice reform. The murder of George Floyd mobilised approximately 15 - 26 million people in the US, and the protests subsequently spread around the world – initially to display solidarity with African Americans, but these developed increasingly into protests aimed at highlighting the racial injustice existing in different countries around the world[21].

As already mentioned, the Covid-19 pandemic is illustrating and aggravating the fault lines existing in our societies and this is, in itself, a reason why social unrest is likely to increase as the pandemic starts to fade – and as economies reopen. This is not unique to Covid-19; history has several examples of severe epidemics being followed by periods of social instability and recent research has shown that countries with more frequent and severe epidemics also experience more social unrest on average[20]. Another point is that social scarring from epidemic events may take time to appear – as mitigating factors during and immediately following such an event may either prevent unrest (e.g. due to restrictions on large gatherings) or cover up the true extent of financial hardship (e.g. government support packages).

According to the 2021 Global Peace Index, while the long-term impacts of the Covid-19 pandemic on global peace are still unfolding, the changing economic conditions in many nations are increasing the likelihood of political instability and violent protests. The report states that over 5,000 pandemic-related violent events were recorded between January 2020 and April 2021, with India, Chile, Italy, France, Germany and South Africa being particularly affected by demonstrations[22].

"End" of the war on terror amidst declining international cooperation

— The sudden collapse of the Afghan government that occurred in August 2021 and the reinstatement of Taliban control of the country, took place against the backdrop of a disorganised withdrawal of US and international troops after 20 years of the "war on terror". Apart from questions over the utility of past interventions from the West post 9/11 and the loss of life that this has caused, there are currently major concerns for the welfare of Afghan citizens that remain in the country under a return to Taliban rule and the sanctions the country faces as a result. In addition, there is now more uncertainty regarding the future stability of the country and how this will impact the wider global terrorist threat.

From the perspective of international cooperation, the nature of the US withdrawal from Afghanistan put international relations under strain. At the present time, there is more solidarity among Western allies following Russia's invasion of Ukraine; however, the war and its aftermath threaten to divide East and West, at a time when multilateralism will be crucial if global threats such as climate change and the environmental crisis are to be addressed.

19. Coronavirus (COVID-19) Vaccinations - Statistics and Research - Our World in Data
20. The Economics of Social Unrest. Finance and Development, August 2021.
21. What Racism Costs Us All». Finance and Development, September 2020.
22. Institute for Economics & Peace. Global Peace Index 2021: Measuring Peace in a Complex World, Sydney, June 2021.

EMERGING TECHNOLOGIES

mRNA technology

— The Covid-19 pandemic brought many epidemiological and medical concepts into the public spotlight, among them a molecule called messenger ribonucleic acid (mRNA) used by the body to assemble proteins. This molecule acts as a messenger between the central blueprint stored in the DNA and the machinery within the cell that makes proteins. mRNA became a household name following the success of the coronavirus vaccines based upon it, but the technology had been investigated for some time already for treating cancer as well as auto-immune, metabolic and respiratory inflammatory diseases. Now malaria, tuberculosis, Hepatitis B, and cystic fibrosis are some of the diseases that researchers say could be the next focus of mRNA vaccines and treatments, aside from those already in human trials (HIV, rabies, and influenza).

Remaining risks are around the required funding and collaboration as well as managing both public acceptance and expectations, while in addition each new pathogen to be tackled will come with its own unique scientific challenges.

Climate change responses

— The urgent need to act against global climate change is clear, leading to various possible technology-related responses. One example is the removal of CO_2 from the atmosphere, using a technology called Direct Air Capture. Swiss Re has recently entered a 10-year contract with a company that captures CO_2 from the atmosphere, mixes it with water and pumps it underground where it reacts with basaltic rock formations and mineralizes. Although the technology is not currently available at scales large enough to have a significant impact, this could change over the next decade with more investments flowing into the sector.

Another approach, referred to as "geoengineering", works by influencing the natural balance of radiation or of CO_2 cycles. This can be attempted by deflecting incoming solar radiation back into space, or by seeding oceans with iron that causes phytoplankton or algae to grow. These absorb CO_2 from the atmosphere and then sink to the bottom of the ocean where it is locked away for an extended period of time. However, this process can also stimulate the growth of some toxin-producing algae species and can disturb marine ecosystems.

Both solutions are criticised, however, for carrying a certain amount of moral hazard, as they could be used as a reason for not committing to a significant reduction of GHG emissions.

HYPERCONNECTIVITY

Covid-19 and micro-chip shortages

— Factory closures as a result of Covid-19 combined with the digital transformation that has been accelerated by the pandemic, have caused supply chain ripple effects that have resulted in a major global shortage of micro-chips. Although the impacts of chip shortages have been felt throughout the supply chain, they were particularly reported during 2021 for the car manufacturing industry and industries manufacturing mining vehicles and heavy machinery, where chips are used in control instruments.

Chip shortages are set to continue throughout 2022, although delays in supply are likely to vary by industry and application. High demand for complex chips used in hyperscale datacentres, for AI and cryptomining, suggest that these chip types are likely to be in short supply well into 2022[23].

Covid-19 and the increased cyber threat

— Societal hyperconnectivity was further reinforced during the Covid-19 pandemic lockdowns – where owning digital devices suddenly became essential to continue a semblance of normal life. This not only applied to using digital devices to maintain family and other social interactions and activities, but also for the continued functioning of workplaces with employees working remotely and for the provision of essential services such as healthcare. While this transition has given people more choice in many areas of their lives – for example in where and how people are able to work and where they are able to live, it has also resulted in heightened vulnerabilities to cyber threats.

Cyber-attacks on both individuals and businesses increased sharply during the lockdowns; many businesses experienced an increase in cyber-attacks during 2020 due to the need to swiftly transition their enterprise IT architecture to allow remote working - often without having had the time to integrate core cyber-security principles. During the early phase of the pandemic in 2020, the FBI reported receiving up to 4,000 complaints per day due to cyber-attacks, an increase of 400% pre-Covid-19. INTERPOL also reported an increase in cyber criminality targeting major corporations, governments and critical infrastructure, including medical organizations.

The types of cyber-attacks commonly seen during the course of 2020, included cyber criminals accessing IT systems

23. My kingdom for a chip: the semiconductor shortage extends into 2022» Deloitte Insights, 1st December 2021.

using phishing and social engineering techniques. The numbers of ransomware attacks also rose rapidly, with several of these targeting large corporations.

In 2021, ransomware attacks were a major cause for concern, with attacks on the Colonial Pipeline, which paralyzed fuel distribution in much of the southeastern US and obtained a ransom payment of USD 4.4 million (partially recovered by the FBI), and on the US insurer CNA Financial Corp. which resulted in a payment of USD 40 million being made to regain control of its IT network. Other cyber-security concerns in 2021 were the continued exploitation of systems for remote working, including remote access solutions such as VPN, attacks that targetted company mobile devices and making sure that cloud-based IT systems security was effective.

NEW BUSINESS & FINANCE MODELS

Decentralised finance; cryptocurrencies, ETFs and insurer/technology partnerships

— Decentralised Finance (DeFi) is a shift from centralised to decentralised services, creating business models that exist only on blockchains. DeFi is set to break into the mainstream; monthly decentralised exchange volumes already amount to billions and increasing numbers of institutional investors are becoming involved in DeFi and cryptocurrencies. Even governments are beginning bold experiments, with El Salvador recently adopting Bitcoin as legal tender. Saving on transaction fees on funds sent from abroad and also potential protection from counterfeit notes circulating, are advantages of cryptocurrencies. Key risks around this asset class are its intangible and illiquid nature and even human error such as password amnesia which could mean the total loss of an investment. These risks affect broader market adoption and stability and hamper its convertibility and insurability.

The growth of passive funds/exchange traded funds (ETFs) has been propelled by lower management costs that apply to passive strategies compared to traditional active funds. The structural market shift towards ownership of assets by passive funds could pose risks to financial stability and around concentration in ownership. ETFs may also affect the level and vigour of competition in the economy and indirectly impact the discipline of shareholder accountability.

Operational efficiency (automating administration, digitizing decisioning) through digitization along the insurance value chain, is still an industry priority. Recently announced insurance/technology partnerships attempt to transform operations (Sun Life/Amazon Web Services, Munich Re/ HCL Technologies partnerships), but also more strategically to overcome industry-specific issues, such as improving claims handling. An example is the recent Lloyd's/McKenzie partnership that uses geospatial technology to assess damages when physical access is not possible. Partnerships between life insurers and research institutes to study the potential of new technologies are also of interest. An example is investigating the use of implantable AI systems to monitor cardiac arrhythmias or complications after surgery and report them to both doctors and patients via smartphone, allowing for swift medical intervention.

CHAPTER 04

DESCRIPTIONS OF RISKS SHOWN ON THE RADAR

— Air pollution is today considered as one of the world's most serious environmental risks by the World Health Organisation (WHO) leading to 4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution. Numerous studies have consistently shown the deleterious effect of air pollution on human health. For example, ambient particulate matter, nitrogen dioxides and other pollutants have been associated with the increased prevalence of several respiratory and cardiovascular diseases. Ambient air pollutants have also been associated with certain cancers and appear to be correlated with neurodevelopmental disorders in children and neurodegenerative diseases in adults.

For the (re)insurance industry, air pollution impacts could create the risk of negative mortality and morbidity trends, impacting Life and Health portfolios.

— Antimicrobial resistance (AMR) is an increasingly serious threat to global public health. AMR develops when a microorganism (bacterium, fungus, virus or parasite) no longer responds to a drug to which it was originally susceptible. This means that standard treatments no longer work and infections are harder or impossible to control. Consequently, the risk of the spread of infection to others is increased, illnesses and hospital stays are prolonged, with added economic and social costs, and the risk of death is greater. The problem is compounded by a lack of new drugs resulting from the R&D pipeline and by a widespread overuse and misuse of antibiotics, favouring the development of resistance.

— Artificial Intelligence (AI) refers to machines, computers or software that simulate the intelligence of human beings to make decisions and to achieve goals. The use of AI has made much progress over the last 20 years, driven by the exponential growth in computing power and memory capacity, Big Data and leaps in theoretical understanding. However, ethical problems could arise from use of the technology, e.g., in autonomous driving, human resources and medical care. Documentation of the algorithms used in decision-making processes will be necessary to monitor the potential for biased outcomes resulting from AI processes.

Potential risks and challenges identified for the (re)insurance industry include:

- systemic malfunction of any AI that controls critical infrastructure and that could generate large claims
- widespread use of AI increasing cyber-criminality
- increasing complexity of the chain of responsibility with significant liability, legal and regulatory implications
- generation of new types of accumulations arising from potential exposure to risks beyond a company's risk appetite.

However, the technology also offers many opportunities for the industry, including operational efficiencies, targeted/ improved product development and the use of predictive algorithms to improve risk understanding and to anticipate adverse portfolio developments.

— The transition towards more autonomous cars and intelligent machines is an emerging risk for insurers and reinsurers and will create many uncertainties including a shift of business, cyber risks and legal uncertainty.

Examples of threats to the (re)insurance industry could be a cyber event triggered from a replicated single-point-of-failure, creating new forms of accumulation.

Similarly, an identical dysfunction, such as a programming mistake or an inadequate software update could cause simultaneous traffic accidents.

The development of autonomous cars using the 5G network will create some opportunities, but will also probably result in a reduction of traditional motor premium volumes.

—The most visible use of blockchain is the Bitcoin cryptocurrency. Numerous other areas such as financial services, banking, insurance (B3i), legal, compliance, administration and real estate could, however, face disruption from Blockchain, since the need for a trusted third-party could be mitigated by the reliability of this technology.

The benefit of using a distributive (peer-to-peer) public ledger (an electronic transaction record) is that it is maintained by a distributed network of computers, with no central authority or third-party intermediaries required.

For the (re)insurance industry, while blockchain can enable efficiencies and serve customers, managing the change and industry mindset is a hurdle.

Blockchain is a strategic opportunity and would ultimately mean a paradigm shift rather than a quick-fix for any industry.

— Earth's biological diversity is declining in every region of the planet, due to human-exerted pressures, threatening to significantly reduce the ability of ecosystems to deliver essential services such as climate regulation, nutrient cycling, provision of fresh water and clean air, and essential raw materials.

The World Wildlife Fund's 2020 Living Planet Report cited a 68% decline in the diversity of monitored vertebrates between 1970 and 2016. Plants and soil organisms are much less well studied, but it is thought that at least a fifth of plant species are threatened with extinction. Insects, that include pollinators, have also been shown to be declining rapidly - both in numbers and distribution - in recent years.

Potential consequences of biodiversity losses include a) Life impacts due to potential declines in human health and well-being over time, b) impacts on catastrophe exposure via reduction in flood-protecting habitats and through a feedback loop causing the acceleration of climate change.

— Land degradation caused by human activities is undermining the well-being of humanity, contributing to biodiversity loss and intensifying climate change.

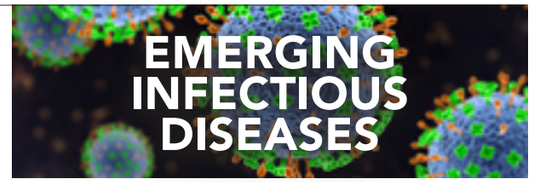
Consequences include the loss of arable land, desertification, increased vulnerability to flooding, water pollution, degradation of infrastructure, increasing risk of conflict and mass migrations.

The impact on the insurance industry is difficult to assess at this stage. However, declining soil quality is likely to create risks from an agriculture insurance standpoint, in addition to being a contributing factor for increased pollution and property damage risks, due to e.g. more flood-prone areas.

Opportunities may be created through an increased need for agro-insurance and natural catastrophe coverage.

— The insurance industry should be aware of the future risk of liability claims linked to climate change. Reasons for the increased risk of organisations being taken to court in relation to climate change include a) raised awareness of the parties responsible for making significant contributions to GHG emissions, both due to increasing disclosure requirements placed on companies and due to pressure from NGOs; b) insufficient or misleading disclosure of the true risks that climate change could create for a company's business model or failure to take timely actions to mitigate risks and c) increasing scientific knowledge linking the changing occurrence of certain natural catastrophes to anthropogenic GHG emissions.

A sharp increase in the number of litigation cases has been witnessed since 2015, with the majority in the US. Of recently witnessed cases, an increasing number are being brought against major GHG emitters and against directors, trustees and fiduciaries for failure to reduce GHG emissions to meet climate targets.



— An Emerging Infectious Disease (EID) is a new or already known infectious disease in which the incidence rate changes in a given population or region. The emergence of new infectious agents is most often the result of a complex combination of different factors, sometimes insufficiently understood. Most risk factors for EID are expected to intensify: social factors (e.g. health care, increased international travel, human interaction with wildlife), demographic factors (e.g. population ageing in developed countries, urbanization, population growth), environmental factors (e.g. global climate change, lack of adequate sanitation, land use practices), as well as general microbial evolution.

Until recently it had seemed that the impact of infectious diseases in the developed world was becoming insignificant in view of sanitation, effective vaccines and antimicrobial drugs. This view changed with new diseases including the global spread of HIV/AIDS, with SARS (2003) and the rapid spread of Covid-19. It is also important to take into account the impact on individuals with pre-existing health conditions and with upwards trending risk factors such as obesity.

For the (re)insurance industry, the risk from an EID lies in the potential of a new disease to significantly influence claims patterns in an unexpected way, especially if the disease is poorly understood, highly contagious and difficult to treat. A quickly spreading disease could cause a pandemic, while a gradual impact on the mortality and morbidity trend would require early detection to allow for inclusion in the medical underwriting process and new business pricing.

— An endocrine disruptor (ED) is a substance that alters functions of the endocrine system (the body's hormone messenger system) and consequently causes adverse health effects in an organism, its progeny or (sub)populations. According to the WHO, there might be as many as 800 different substances concerned.

Exposure is mainly via water and food, but also via air and skin contact, often at continual low dosage over a long period of time. The health effects on humans and wildlife include developmental abnormalities and cancer as well as neurological and reproductive problems. While some legal actions against certain substances have already been taken, the high complexity of the subject makes it difficult to determine a safe threshold for the use of EDs.

For the (re)insurance industry, endocrine disruptors could cause liability risks and also have a long-term impact on morbidity and mortality claims. The wider impacts on society, e.g. via the potential link to lower fertility rates, are difficult to predict.

— The threat from terrorism is evolving, posing new challenges for the (re)insurance market. New threats are originating from the emergence of new terrorist groups and strategies, the use of new technologies including cyber, drones or Chemical Biological, Nuclear and Radiological (CBNR) weapons.

Changes in attack methods have raised awareness of potential third-party liability.

The threat from a cyber-attack is evident and businesses have become increasingly concerned about the extensive repercussions these types of attacks could have on them. In case of attacks on critical infrastructure, the impact may reach far beyond the target itself.

For the (re)insurance industry, a terror attack, depending on its nature, could have impacts across all underwriting activities, including Life (Mortality) and P&C covers (Cyber, Property damage, BI/CBI). A large event could impact invested assets portfolios and have operational repurcussions.

— Following the finalization of BREXIT at the end of 2020, the risk of other EU member states breaking away has diminished.

For the (re)insurance industry, a breakup of the EU could generate investment risks (e.g. currency risk impacting the value of investment portfolios), operational risks (e.g. the updating / rewriting of bilateral contracts and internal changes (tools and HR)) and regulatory risks (e.g. new regulatory compliance).

— Extreme social unrest is of an increasingly global nature with centuries-old injustices being addressed and social media allowing gatherings to be arranged within a matter of hours. Depending on the jurisdiction, traditional contract wordings for war and terrorism definitions are being stretched, leading to coverage uncertainties. Climate change demonstrations could potentially lead to industrial sites becoming targets which would result in higher property damage amounts. The post-pandemic impact of widening inequalities and societal fragmentation could leave a global legacy of debt, unrest and volatility. Examples of recent protests are the global Black Lives Matter demonstrations across several cities and countries, the U.S. Capitol Hill attack, Chili riots, Yellow vests and "Occupy" movement.

An extreme social unrest event taking place across multiple cities, could have a significant impact on P&C business lines, depending on the coverage triggered (terrorism/ orchestrated uprising or riot/ civil commotion). The impacts for Life business lines are likely to be less material. Operational impacts are also possible (e.g. damage to office premises).

— Genetic testing is "the analysis of chromosomes (DNA), proteins, and certain metabolites in order to detect heritable disease-related genotypes, mutations, phenotypes, or karyotypes for clinical purposes". The results of a genetic test can confirm or rule out a suspected genetic condition ("diagnostic test") or help to determine a person's chance of developing a genetic disorder ("predictive test").

The precision and accessibility of genetic testing is evolving rapidly. In the future, this might lead to an information imbalance between insurers and insureds, and thus to the risk of anti-selective purchase (or lapse) of insurance policies, higher premium rates and a lower business volume.

There could also be opportunities, for example, by promoting the use of genetic testing to increase health awareness and encourage a healthier lifestyle.

— Legal and regulatory uncertainty arises from the multiplicity of different regulatory regimes, capital standards and reporting requirements plus the increase of legislative or regulatory initiatives and enforcement actions in the areas of financial crime compliance, anti-money laundering, international trade sanctions and anti-bribery laws, and consumer protection. Implementation of these and any future regulations may increase operational costs, limit or restrict the (re)insurers' ability to do business or increase the number of lawsuits, all of which carry significant financial and reputational risks.

The Covid-19 pandemic has increased legal uncertainty for the industry in 2020/21 due to the pressure on (primary) insurance to pay for BI claims that were not originally priced for. On the regulatory side, the European Commission has published the first part of the SII review's legislative package, but as the discussions are starting at the political level, uncertainties remain on the review's final outcomes.

— The development of cyber risk has mainly arisen from the spread of information technologies, the rapid growth in the number of connected entities, the multiplication and interdependence of access means, and the increased use of the cloud for data storage.

The risk is evolving rapidly given the "commercialization" of cyber-crime, which is driving a greater frequency and severity of cyber incidents, including encryption and data breaches.

According to the World Economic Forum's Global Cybersecurity Outlook 2022, 50% of cyber security leaders surveyed said that the increasing frequency and sophistication of ransomware attacks was their main concern in relation to cyber threats. In addition, Gartner predicts that from now until 2025, 30% of critical infrastructure organisations will experience a security breach resulting in a halting of operations, or of a critical cyber-physical system.

For the (re)insurance industry, Cyber risks present both strategic business opportunities and pose a critical operational risk.

— The overuse of medication and illicit drugs, particularly opioids, is a global phenomenon. The United Nations reported approximately 53.4 million people worldwide used opioids in 2016. Opioids are drugs used for the relief of mild to severe pain. Fentanyl is the main driver of the opioid crisis in North America. Tramadol is driving the opioid crisis in Africa. The highest ever reported opioid-related deaths in a 12-month period occurred between June 2019 – May 2020. The spike suggests the Covid-19 pandemic played a role, as access to critical support services was more difficult and personal stress for many increased.

For the (re)insurance industry, exposure to opioid-related litigation - particularly in the US - could occur via Professional Liability portfolios (e.g. Medical Malpractice, D&O). Life business lines are also impacted by the opioid crisis, but this is difficult to quantify.

— Human beings can only thrive when both physical and mental health are stable and safe. Mental health issues can be both transient and permanent, exogeneous and endogenous. There is a well-established interaction between mental and physical health: mental problems can cause physical problems that can, in some instances, become very severe and in its extremes can result in disability or, in the case of suicide, even death. Untreated mental health problems can also lead to long-term negative impacts on work performance, on communities and societies.

For the (re)insurance industry, Liability covers (Employer's Liability, D&O) may experience an increase in claims if employers are found not to have exercised sufficient duty of care over employees' mental health. For Life business, mortality and morbidity covers could be impacted, due to a downward trend in mental wellbeing, impacting chronic conditions and increasing suicide rates in severe cases. Operational impacts are also possible due to lost productivity and/or staff absences.

— Equipment to handle potentially dangerous agents has become so cheap and so easy to obtain that experiments can be carried out in non-controlled laboratories or in people's homes, causing concerns regarding accidental or intentional release of pathogens.

This is aggravated by the ease of access to information required to manipulate organisms via the internet. As an example, in January 2018 an article in the medical journal *Public Library of Science* documented how a smallpox-like virus was created in six months in a laboratory with artificial genetic material ordered online for a cost of $100,000.

Initiatives such as «BioBrick» aim to develop ready-made elements to assemble at ease which could allow even inexperienced users to experiment with bacteria and to construct new biological systems. These could – intentionally or not - cause the spread of harmful organisms, although the field is currently very much still in development stage.

This risk could impact the (re)insurance industry via mortality and morbidity covers to an unknown degree, depending on the virulence of the released agent. Under an extreme scenario, a global pandemic could be caused.

— Nanotechnology is the engineering of matter on a molecular or even atomic scale.

Widely used in food, cosmetics, construction, sports equipment, automotive, cleaning etc., considerable uncertainty remains today on the consequences of the use of nanomaterials, which can be neither recycled nor removed from the environment.

Three types of nanomaterials have already received specific attention with respect to the possible impact on human health and on the environment (especially water pollution).

For the (re)insurance industry, P&C business lines could be exposed under Product Liability and Worker's Compensation.

For Life business, as nanoparticles can enter human tissues and accumulate, they could cause higher incidences of certain cancers or diseases linked to lower immunity. Nanotechnology-related advances in medicine can also create opportunities, since nanoparticles could be used as therapeutic agents against cancer and diseases.

— Permafrost - a permanently frozen layer below the Earth's surface - covers approximately 24% of the land area in the northern hemisphere, with approximately 65% in Eurasia and the other 35% in North America and Greenland. According to the IPCC, Arctic surface temperatures have increased by more than double the global average over the last two decades, with feedbacks from loss of sea ice and snow cover contributing to amplified warming. This is projected to result in the widespread disappearance of Arctic near-surface permafrost this century. Loss of permafrost has important consequences for global climate, due to the projected release of tens to hundreds of billions of tons of permafrost carbon into the atmosphere, with the potential to further accelerate climate change.

Direct impacts for the (re)insurance industry due to loss of permafrost could include a) pathogen release including unknown viruses and release of pollutants including mercury affecting Life portfolios; b) instability of foundations due to land subsidence causing damage to property and infrastructure affecting P&C portfolios.

— Both plastics and microplastics (plastic particles ≤5mm) are a growing concern for the environment and for health. Every year, approximately 300 million tons of plastic are produced and over 8 million tons of plastic flow into the ocean. The vast majority of all plastic ever produced still exists in the environment today in some form, due to its resistance to biodegradation.

While large pieces of plastic pollution have visible impacts on the environment and wildlife, plastic can also be degraded into microplastic and even smaller nanoplastic particles over time, entering all compartments of the environment and accumulating in the food chain. This persistence of micro and nanoplastics in the environment is the main driver for concerns around the lasting ecological impact and potential downstream health effects due to accumulated exposure. Although human health impacts of microplastic exposure are not yet fully understood, it is known that microplastics can absorb and emit chemicals that have been shown to cause endocrine disruption and cancer.

For the (re)insurance industry, microplastic pollution could negatively impact human mortality and morbidity. However, studies so far have not been able to quantify this risk. For P&C lines, liability exposure to plastic pollution is currently considered remote, due to the difficulty in providing a link between ubiquitous plastic pollution and a single manufacturer. Environmental Impairment Liability claims could only arise against manufacturers if pollution occurs as part of the manufacturing process.

— The multitude of radiofrequency field sources, coupled with increased public awareness (with the introduction of 5G) has created much speculation around the potential of these sources to cause human harm.

While there is no conclusive scientific evidence linking radiofrequency fields to the development of, e.g. cardiovascular diseases, cancer or cognitive disorders, there have been a few court decisions awarding monthly compensatory damages related to bodily injury resulting from excessive mobile phone usage. Although the awarded compensation is small, this may indicate a progression towards positive verdicts for plaintiffs.

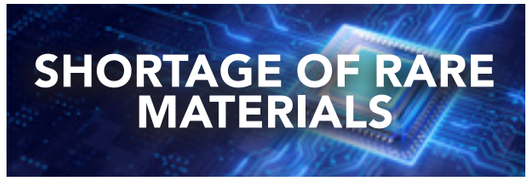
5G uses largely untapped bandwidth of the millimeter wave (MMW), as well as some lower and mid-range frequencies that require small cell stations only 300 metres apart. While it is believed that mobile 5G will jump-start the next wave of unforeseen innovation, it has rekindled the contentious debate over the impacts of cellular radiation on human health. However, the Centre for Disease Control continues to insist that the scientific evidence supporting a link between cellular radiation and cancer remains unproven.

A proven link between exposure to radiofrequency fields and certain diseases could impact Life and Health portfolios, in addition to leading to potentially large numbers of claims from liability coverages.

— Power blackouts can be caused by various triggers such as solar storms, a natural catastrophe event, a large cyber attack, a terrorist act or an act of war, an electromagnetic pulse attack or poor infrastructure management. Such triggers could cause power blackouts in various parts of the world, with impacts that could last from minutes to months.

In Europe, severe electricity infrastructure problems could result from the German strategy to rapidly exit from nuclear power by 2022 and to phase out coal use by 2038.

P&C business could be impacted via Service Interruption and Contingent Business Interruption coverages. In addition, the possibility of a power blackout affecting a company's global data centres represents a major operational risk.



— A world in need of faster computers, smarter phones and more energy-efficient lightbulbs or batteries, threatens to strain the supply of materials used by the global electronics industry. A shortage of these materials could be a serious problem for businesses around the world and could lead to higher prices for many consumer goods. For example, a shortage of rare metals such as Nickel or Cobalt could impact innovation in clean energy technologies such as solar panels or batteries for electric vehicles.

The supply of sand and gravel also raises some concerns; these are now the most extracted materials in the world by weight and since these materials take thousands of years to form by erosion, demand is beginning to outstrip supply. These are key ingredients to the production of glass, electronics and a number of essential construction materials.

Pure demand outweighing manufacturing capabilities is evident from the Covid-19 related semiconductor chip shortage.

— Skills shortages are growing across various industry sectors, most notably in the fields of engineering and medicine. The insurance industry is reliant on highly skilled workers in all industries to safeguard people and premises and contain claim costs. As workers retire and technology advances, skills shortages could increase and Covid-19 impacts are also evident. Inflated or more frequent claims may only be noticed with some latency and limit the possibility to directly attribute costs to a particular skills gap.

Impacts on P&C risks include longer business interruption periods and inadequate disaster response (e.g. through shortages of first-responders such as fire-fighters). For Life business, a shortfall of skilled doctors, nurses and caregivers could have negative impacts on morbidity and mortality and lead to liability claims.

— Stranded assets are «assets that may suffer from unanticipated or premature write-downs, devaluations or conversion to liabilities». Stranded assets can be caused by a variety of factors; they pose risks to individuals and firms, and may have systemic implications. From an accounting perspective, a stranded asset is also defined as one that has become obsolete or non-performing, hence must be recorded on the balance sheet as a loss.

Many environment-related risk factors could result in stranded assets. Within the context of climate change, the risk of stranded assets is likely to increase as the world transitions to a net-zero carbon economy. Sectors at particular risk are highly carbon-intensive sectors such as fossil fuel extraction and energy supply. Stranded assets can also apply to other environmental risks, e.g. more stringent regulation and reputation risks related to investments in sectors that cause deforestation.

— The pollution of natural water can be divided into several categories; pollution from industrial production, from agriculture, and from private households/residential areas. Over 80% of sewage in developing countries is discharged untreated. Rivers, lakes and groundwater are polluted due to inadequate water quality, sanitation and hygiene.

The main exposure for P&C business lines is likely to come from Environmental Impairment Liability insurance covers, particularly in the US. On the Life side, water pollution could lead to increased morbidity and mortality related to infectious diseases spread via water, primarily in emerging countries. Long-term health impacts from harmful substances in drinking water are difficult to predict and quantify.

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