EXECUTIVE SUMMARY

The Centre for Strategic Futures (CSF), in consultation with local and international subject matter experts, developed 17 Driving Forces (DFs) in 2021 that we believe will shape the operating context in 2040 (see Annex).

CSF recognises that the lines between individual DFs are often arbitrary, and that there are cross-DF themes that reflect how clusters of DFs may be collectively shaping our future. Five themes distilled across the 17 DFs represent major discontinuities shaping human existence in 2040:

- **The "Digireal" is coalescing.** The increasing significance of the digital domain, and the blurring of boundaries between the physical and digital worlds, has seen the emergence of a new domain at the meeting of the two that we call the Digireal. How will future societies move between the digital and the physical—if that distinction even persists in the future—and with what effects?

- **Physical constraints are inescapable.** Paradoxically, the rise of the digital has highlighted the increasing salience of the hard constraints imposed on societies and economies by the physical world—not just carbon constraints or climate change, but also natural resources and ecosystem services. How will natural resource and climate considerations reshape (geo)politics, economies and societies?

- **Power and influence are mutable.** The nature and distribution of power and influence in the world, including how it is generated and used, is in flux as new actors rise and new relationships evolve. How will the nature and distribution of power between and within states evolve in the future, and what new political and governance ideals, entities or institutions might arise as a result?

- **Interconnectedness is evolving.** The form and extent of interdependence and interconnectedness in terms of goods, services and systems are changing, and the interconnectedness of people across borders has morphed in new and unanticipated ways. What will interdependence and interconnectedness between states look like in the future, and with what implications?

- **Societal values and beliefs are under renegotiation.** Collectively, these developments are undermining existing visions of a shared future, mutual obligations within societies, and shared objectives or goals within existing communities. One major cause is **increasing (relative) inequality** along various dimensions, including income, class, gender and access to opportunity. How will the social compact between the public, private and people sectors evolve?

The 17 DFs, together with the five themes, offer a useful starting point for exploring different pathways to plausible futures. This is useful for challenging mental models and assumptions about how the future will play out, exploring challenges and opportunities over the next 20 years, and thus supporting better decision-making in the long term as the world reaches inflection point.

INTRODUCTION

The Centre for Strategic Futures (CSF) produces a compendium of "driving forces" (DFs)—key forces of change that will shape the operating context in the next 20 years, and the ways in which they might play out—every three to five years. These explorations are not predictions and are not intended to be exhaustive. Rather, they offer alternative ways to think about the future. The objective is to spark conversations around navigating a turbulent world and preparing for an uncertain future.

In 2020, having produced a set of five shifts in the operating context due to COVID-19 in the medium term, CSF turned its attention to articulating a set of 2040 DFs that would illuminate how the world might be changing in the long term. Even amid a global pandemic, CSF was acutely aware that it was important to look beyond the structural effects of COVID-19 in exploring the key forces of change shaping 2040. In a long view of the world, other forces such as changes in global demographics and disruptive technologies are arguably at least as important, if not more so.

The set of 17 2040 DFs that the CSF produced in 2021 collectively point to a world reaching inflection point in the next 20 years. Five themes distilled across the DFs represent major discontinuities shaping human existence in 2040.

THEME #1: THE "DIGIREAL" IS COALESCING

The increasing significance of the digital domain is clear. In many parts of the world, e-payment systems make transacting online increasingly frictionless, spurring the virtualisation of retail experiences. Virtual and augmented reality, enabled by connectivity technologies beyond nascent 5G, make it easier for individuals to explore virtual spaces as if they physically inhabited them, and perhaps even to form social bonds as authentic as if these were in-person interactions. Artificial intelligence (AI) animates bots and avatars online which individuals may interact with—not just on a transactional level, but perhaps increasingly on a personal, relational level, as children engage in existential exchanges with virtual assistants such as Apple's Siri, Amazon's Alexa or Google Assistant.

These developments have blurred the boundaries between the physical and digital worlds, resulting in an emerging domain at the meeting of the two that CSF has termed the "Digireal". While some experiences happen entirely in the physical world and others in the digital world, it is arguable that experiences increasingly happen in a mixed zone, where digital content and experiences overlay or underlie those of the physical world. The concept of the Digireal is not new. In some quarters, it has been called the "Phygital"—although this term has been used more frequently to describe a retail experience or marketing strategy that blends the physical and digital worlds.

This emerging space is potentially one of great opportunity for overcoming physical barriers. It can, for example, expand possibilities for relationship-building and collaboration. In the YouTube video series *World Makers*, which profiles the people behind avatars in the virtual world *Second Life*, Fran Swenson, then in her 80s and suffering from Parkinson's disease, explains not only how *Second Life* was a new lease of life for her, but also how it facilitated her fundraising for Parkinson's research and her weekly virtual support group.[1] Yet, the emerging Digireal space also presents new risks. For instance, new vulnerabilities will arise as physical infrastructure is increasingly linked to digital infrastructure in an Internet of Things, presenting a massive attack surface for malign actors. We are already seeing a range of unanticipated cross-over impacts between the digital and physical worlds, with mixed effects. The meme-induced GameStop stock frenzy, advent of cancel culture and TikTok's acceleration of the campaign to emancipate Britney Spears are just a few examples.[2]

Societies will adjust to this emerging space in different ways depending on their economic, social and cultural makeup, leading to new divides or exacerbating existing ones. For instance, some segments of society, such as the "analogue-by-choice" or the digitally disadvantaged, may be unwilling or unable to adapt to or access the Digireal. Others, whether for religious or other reasons, may grapple with the notion of AI personhood and personality. There could also be greater fragmentation of collective experiences as people inhabit physical, digital and Digireal realities to different degrees, both within and across countries.

At the same time, this emerging space also has the potential to reshape the economic, social and cultural makeup of societies. The growing interplay between the digital and the physical worlds could recode not only human behaviours and social norms, but even our cognitive and physical capacities, in new and unexpected ways. Ranjan Roy, in the biweekly online newsletter *Margins*, observed that:

> "It's long been socially acceptable to caps lock, rage-type profanities as a Facebook reply, but yelling at someone in the street is still not good. How do we manage this collision of our online and offline lives and prevent future explosions?"[3]

This is a stark reminder that we cannot assume the ability nor willingness to code-switch between digital and physical experiences in the mixed zone of the Digireal, where they increasingly blend together.

Researchers believe that the digital world may be affecting the ways in which we learn and interact with others, including attentional capacities, social cognition and our brain's reward circuitry and memory processes. Social media use by teenagers has been linked to body dysmorphic disorder, mental health issues such as depression, anxiety, aggression and anti-social behaviour, and a dramatic decline in dating and romantic relationships. Research has also shown that virtual movement can influence human cognition and bodies. Imagining movement can have positive effects on motor skills, balance and learning—*without* actually moving the body. Virtual reality's therapeutic effects may extend beyond bodily movement, for example to chronic pain and the social skills of people on the autism spectrum.[4]

How will future societies move between the digital and the physical—if that distinction even persists in the future—and with what effects?

THEME #2: PHYSICAL CONSTRAINTS ARE INESCAPABLE

Paradoxically, the rise of the digital has highlighted the increasing salience of the hard constraints imposed on societies and economies by the physical world. Optimism about the potential for digital technologies to help solve some of the most intractable global challenges, including climate change, has in recent years been tempered by growing awareness of their exploding environmental footprint. The physical infrastructure, hardware and software that underpin the digital world all rely on the continued availability of vast resources—not least energy.

The computational resources required to train large AI models have increased 300,000-fold between 2012 and 2018, and in 2018 were found to be doubling every 3.4 months. In 2019, a life cycle assessment for training common large AI models found that the process emits nearly five times the lifetime emissions of the average American car, including the emissions from its manufacture. This has led to calls for AI researchers to publish the financial and computational costs of training their models alongside performance results, and develop more efficient neural networks.[5,6] At the same time, however, adoption of AI solutions is growing rapidly as businesses leverage them to drive value and advantage. Brian Mullins, CEO of the AI start-up Mind Foundry, an Oxford University spinout, has advocated for measuring the success of an AI system in terms of its overall impact and selecting the correct levels of complexity for a particular problem. In this way, he argues, businesses can strike a balance between benefiting from AI and its long-term environmental impact.[7]

Blockchain-based technologies that are entering the mainstream, such as cryptocurrencies and Non-Fungible Tokens (NFTs), are also under growing scrutiny for their outsize carbon footprint. Bitcoin's annual energy consumption exceeds that of entire countries, such as Malaysia and Sweden.[8] Minting and sending one NFT on the Ethereum blockchain can require the same amount of energy used to power the average American household for 1.5 days.[9] However, proponents argue that recent advancements in "proof-of-stake" blockchain networks—which functioning cryptocurrencies such as Cardano, Polygon, Tezos, Polkadot and EOS already employ, and Ethereum 2.0 intends to use—could reduce energy consumption by a whopping 99.99 per cent. Moreover, carbon offsetting and alternative energy, including for data centres, will also lead to greener digital technologies, be it AI or blockchain.

However, the hard limits of the physical world go beyond those imposed by carbon constraints or climate change more broadly. E-waste from discarded electrical or electronic devices—a health and environmental hazard—is the world's fastest-growing domestic waste stream, due to higher consumption rates of electric and electronic equipment, short life cycles, and few options for repair. In

2019, only 17.4 per cent of e-waste was collected and recycled—which also meant that an estimated US$57 billion in gold, silver, copper, platinum and other high-value, recoverable natural resources were dumped or burned.[10] But digital technologies are just one symptom of the problem—humanity has been using natural resources and ecosystem services as though we had 1.7 Earths.[11] It is not difficult to imagine a world that successfully averts the worst effects of climate change through adaptation and mitigation, but continues to deplete natural resources and degrade ecosystems. It remains to be seen how a consumption-based global economy and society might be reinvented under a sustainability paradigm.

Natural resource and climate considerations will reshape much more than consumption and production patterns. For instance, jurisdictions that manage to mitigate or adapt to the effects of climate change, or leverage leadership in energy transitions to become green giants, will enjoy not only lasting economic advantage but also the ability to reshape (geo)political dynamics. Relative positions will also depend on shifting natural endowments—such as arable land, freshwater resources, and land, sea and air connectivity—wrought by climate change. Climate stress will result in new waves of internal displacement and international migration as populations move to avoid natural disasters or in search of opportunity. As global and generational attitudes towards climate change shift, sustainability issues may become a key source of unity or conflict in societies. Green finance may trigger new waves of infrastructure development in emerging economies, galvanising green growth. At the same time, physical risks from climate events and transition risks from moves to a low-carbon economy present challenges to global financial stability.

How will natural resource and climate considerations reshape (geo)politics, economies and societies?

THEME #3: POWER AND INFLUENCE ARE MUTABLE

The nature and distribution of power and influence in the world, including how it is generated and used, is in flux. Power and influence are changing amongst states, as challengers leverage new technologies to narrow asymmetries in hard and soft power vis-à-vis incumbents. Powers that used to be the purview of states, such as a monopoly on the legitimate use of violence, or the provision of some forms of public or merit goods, are growing among private and other non-state actors.

In particular, Big Tech has capitalised on first-mover advantage and network effects to become monopoly facilitators of global data flows, leveraging their vast databases to improve their online platforms and financial muscle power to buy out or suppress potential competitors. This has had wide-ranging effects. Four companies—Amazon, Google, Microsoft and Oracle—control 67 per cent of the world's cloud infrastructure, on which many governments, businesses and people run.[12] Moreover, through their ownership and control of online platforms, Big Tech provides essential infrastructure for public life. As Fordham Law School Associate Professor Zephyr Teachout observed, Facebook and Google "stand in for sidewalks, post offices, telephone lines and public squares, all bundled together".[13] Tech companies are also developing (cyber)weapons, minting (crypto)currencies and verifying (digital) identities.[14]

Private actors have growing influence not only over what citizens have access to, but also what they believe—and greater power to mobilise groups to collective action. These actors include corporate giants such as Big Tech, religious institutions, and even global movements such as the BTS ARMY fandom, Extinction Rebellion activist movement and QAnon conspiracy movement. Alternative networks, including social media platforms like Facebook and Instagram, private messaging apps like WhatsApp and WeChat, and livestreaming platforms like Discord and Twitch, have pervasive influence on what people see and believe today. They reshape the infosphere in ways that may be unknown to users, for example when engagement-hungry algorithms amplify fringe voices, or mis-, dis- and mal-information. Alt-networks have had mixed effects. They have facilitated grassroots organising and the mobilisation of aid or funding for diverse communities and causes, including foreign workers in Singapore and the ALS Association in the United States (US). They have allowed paramilitary operations and hacktivist collectives that target terrorists and other threats to the state, such as GhostSec and Anonymous, to spring up online. However, they have also fomented violence, including against the state as evinced by the 2021 US Capitol riot.

States are starting to push back against the growing power and influence of Big Tech, alarmed by their ability to shape not just economies but also societies and politics. China's ongoing crackdown on the technology sector, including Chinese tech giants Ant, Tencent, Meituan and Didi, focuses on adherence to anti-monopoly laws, protecting users, safeguarding data and obtaining official authorisation to operate.[15] China has liquidated its online tutoring sector, made cryptocurrency transactions illegal, imposed stringent limits on gaming to curb video game addiction and enacted new data privacy protections for Chinese consumers in a series of sweeping regulatory moves this year. The European Union (EU) continues to build on its robust record of antitrust enforcement from the past four years, and South Korea, India, Australia, post-Brexit United Kingdom (UK) and the US have also started to step up antitrust enforcement.[16] With Big Tech ramping up lobbying in response, and given many governments' interest in capturing as large a share of the global digital economy as possible, it is uncertain how this contestation will play out.

Apart from private actors, sub-national governments—acting through state or provincial governors or city mayors—also seem to be wielding power more assertively vis-à-vis national governments. This may undermine or reinforce national policy goals, whether or not it contributes to the public good. For example, 11 US states with Republican governors recently sued the Democratic Biden administration, seeking to block a COVID-19 vaccine mandate for federal contractors on the grounds that it was unconstitutional and violated federal procurement law.[17] There has also been a proliferation of sub-national networks to tackle issues that have been insufficiently dealt with at the international level, including crime, income inequality and climate change. However, it remains uncertain how independent these emerging networks will be from the traditional global stage.

How will the nature and distribution of power between and within states evolve in the future, and what new political and governance ideals, entities or institutions might arise as a result?

THEME #4: INTERCONNECTEDNESS IS EVOLVING

The pervasive impact of interdependence and interconnectedness between states, and reactions to the risks of such interdependence, also have the potential to reshape the future. It is widely acknowledged that the COVID-19 pandemic threw into sharp relief how deeply the world's supply chains are entwined in a globalised international economy, as well as how fragile those interconnections can be in a crisis. This includes the vulnerability of extended value chains to disruption, the risks of hyper-concentrations and complex inter-sector/country interdependencies. For example, the lack of car parts being manufactured in China due to the COVID-19 pandemic resulted in the throttling of assembly lines and closure of numerous car manufacturing plants in Europe.

There are signs that states may increase their emphasis on self-reliance, or prefer regional supply chains to global ones, to increase their resilience in times of crisis. However, in the long term, states' ability to do so will also depend on the extent of the future mismatch between global labour supply and demand—both in terms of geographic location and skills—as well as the size, location and nature of the global middle class whose consumption drives the global economy, in light of the seismic global demographic shifts that will play out in the next 20 years.

Technology has also enabled, with increasing ease, similar levels of interconnectedness in domains beyond physical goods and critical resources. An increase in tradeable services, coupled with potentially freer movement of labour across national borders, even if only virtually, is reshaping national economies. International financial systems and currencies are also deeply intertwined, with emerging fields which lack regulatory firebreaks that can stop or slow a cascading crisis such as the 2008 Global Financial Crisis (GFC).

One new financial stressor deserves particular mention. The growth in non-bank financial institutions, and the overall size of the non-bank sector, has been rapid and unevenly regulated. The Financial Stability Board estimates the global shadow banking sector to be over US$50 trillion, representing 13.6 per cent of total global financial assets.[18] In the wake of the GFC, tighter bank regulation and low interest rates, increasing the availability of funding, have led to a wave of financial innovation, including in how technology is used by the financial sector—broadly referred to as fintech. The non-bank sector is now providing cross-border liquidity in ways that are not fully understood by regulators of markets. However,

the sweet spot of regulation without stifling beneficial innovation will be difficult for regulators to achieve. As interconnectedness increases, variegated regulation across jurisdictions may also introduce new sources of arbitrage and risk into the international financial system.

Yet, interdependence and interconnectedness in terms of goods, services and systems are familiar, even if their form and extent are changing. They remain easier to understand and intervene on than the interconnectedness of people across borders, which has morphed in new and unanticipated ways in recent years.

Alt-networks have helped to transform once-distant and "foreign" concerns into intimate ones. The use of emotive media such as videos, and the formation of trans-boundary online communities, have facilitated the spread of ideologies traditionally bound by geography. For instance, what started out as emotional posts or livestreams in reaction to police brutality in the US in 2020 resulted in demonstrations around the world in support of the Black Lives Matter movement in far-flung countries like Japan, South Korea and Thailand, and have influenced conversations in Asia about racism. Similarly, the internet meme war between Thai netizens and pro-Beijing trolls in 2020 ended up unifying netizens from different parts of the world to form the Milk Tea Alliance—an online democratic solidarity movement that initially spanned Hong Kong, Taiwan and Thailand, but quickly grew to include netizens from Myanmar, the Philippines, India, Malaysia and Indonesia.[19] It is unclear, however, if trans-boundary social identities might eventually trump a citizen's allegiance to the state, or otherwise threaten the continued viability of the nation-state paradigm.

The internet-fuelled interconnectedness of people across borders has been increasingly weaponised by adversaries seeking to advance geopolitical objectives. The most popular Facebook pages for Christian and Black American content in the run-up to the 2020 US Presidential election, which was the most highly contested in US history, were run by Eastern European troll farms.[20] Information operations, or info ops, are often "hyperlocal" in their approach—they are micro-targeted, designed to play to individuals' or groups' fears, anxieties, hopes and desires.[21] Troll factories create campaigns around fake social media accounts customised to capture the hearts and minds on multiple sides of social divides, in order to stoke tensions, create confusion and chaos, and amplify discord. Governments and digital platforms are only just beginning to grasp the magnitude of the threat posed by info ops and the multifaceted challenges in countering them.

What will interdependence and interconnectedness between states look like in the future, and with what implications?

THEME #5: SOCIETAL VALUES AND BELIEFS ARE UNDER RENEGOTIATION

Finally, the values and belief systems of societies are being renegotiated. The preceding four themes capture some of the key challenges to the values and belief systems of societies. As the Digireal coalesces, we are considering how we should relate to digital entities and worlds, and in so doing, grappling with what it means to be human and the nature of reality. The growing salience of the hard constraints that the physical world imposes on economies and societies is forcing us to reconsider the relationship between humanity and nature, and to develop new ways of life more attuned to the planet. The changing nature and distribution of power and influence is seeing not only new actors rise to prominence, but also new priorities, practices and arrangements jostling for space alongside the old. Evolving interdependence and interconnectedness are revealing new affinities as well as vulnerabilities, causing us to reconsider the geography of our political, economic and social realities. Collectively, these developments are undermining existing visions of a shared future, mutual obligations within societies, and shared objectives or goals within existing communities.

One thread that must be highlighted across the preceding four themes, as a major cause of the ongoing renegotiation of societal values and beliefs, is **increasing (relative) inequality** along various dimensions, including income, class, gender and access to opportunity. An important factor is labour disruption. Historically, the adoption of new technologies has equitably improved productivity and living standards, but this relationship appears to have broken down as the bargaining power of labour has eroded relative to capital. Economic imperatives and technological advancements are rapidly disrupting traditional work norms, built around formal employee-employer relationships, fixed workplaces and stable employment. However, in many industrialised countries, the providers of technology, capital and

highly skilled labour have prospered dramatically even as blue-collar employment has become increasingly hollowed out, resulting in widening social inequality and widespread resentment. The phenomenon of labour disruption has only been accelerated by the rise of the gig economy, as contingent workers fall between the cracks of social safety nets developed with assumptions of stable employment.

At the same time, new technologies are opening up novel possibilities for the means of production. In 2017, it was reported that Linden Lab, the privately held company behind *Second Life*, made most of its money from the rental of (virtual) islands to (virtual) residents—and raked in almost US$60 million in aggregate the year prior.[22] Earlier this year, the artist Chris Torres produced a one-of-a-kind NFT rendition of his Nyan Cat GIF, which went viral on YouTube in 2011, to celebrate its 10th anniversary. It sold for US$590,000 at an online auction.[23] Ordinary people have also found lucrative ways to monetise the attention economy as content creators and social media influencers. Hyram Yarbro, the 24-year-old creator of Skincare by Hyram—first a YouTube channel and now a TikTok account that has grown from 100,000 to more than six million subscribers during the pandemic—was expected to become a multi-millionaire in 2020 from online ads, affiliate sales and fees from brand partnerships. Without any formal training, he has become the authority on teenage skincare.[24] The influencer marketing industry is expected to exceed US$15 billion by 2022, almost doubling from US$8 billion in 2019.[25]

Increasingly, daily lived realities are calling into question traditional narratives around meritocracy, hard work and a life of dignity, if not success. They are also raising important questions around what we can and should expect from one another, and what we owe one another. There are growing calls for fundamental changes to the socioeconomic compact, using the power of the state to protect the economic livelihoods and bargaining power of labour. Apart from collective bargaining proposals, some argue for controversial taxes on wealth, data or robots to fund not just retraining, but also a public sector job guarantee or universal basic income.

It appears that businesses are beginning to embrace, or at least concede, the importance of a multi-stakeholder approach balancing the needs of shareholders with other groups such as customers, employees, suppliers and communities in which businesses operate. However, difficult questions remain around defining stakeholders and engaging them, as well as balancing this with the challenges that many businesses face, including high corporate mortality rates. Moreover, the forms and functions of businesses are changing and highly variable—while corporate giants are consolidating power and influence, other businesses are becoming more decentralised and flexible. There are also commercially influential individuals, such as Elon Musk or Jack Ma, who have an outsize ability to move markets by virtue of their business or even personal decisions. It is likely that vastly different narratives of the ideal worker-business-state relationship will develop.

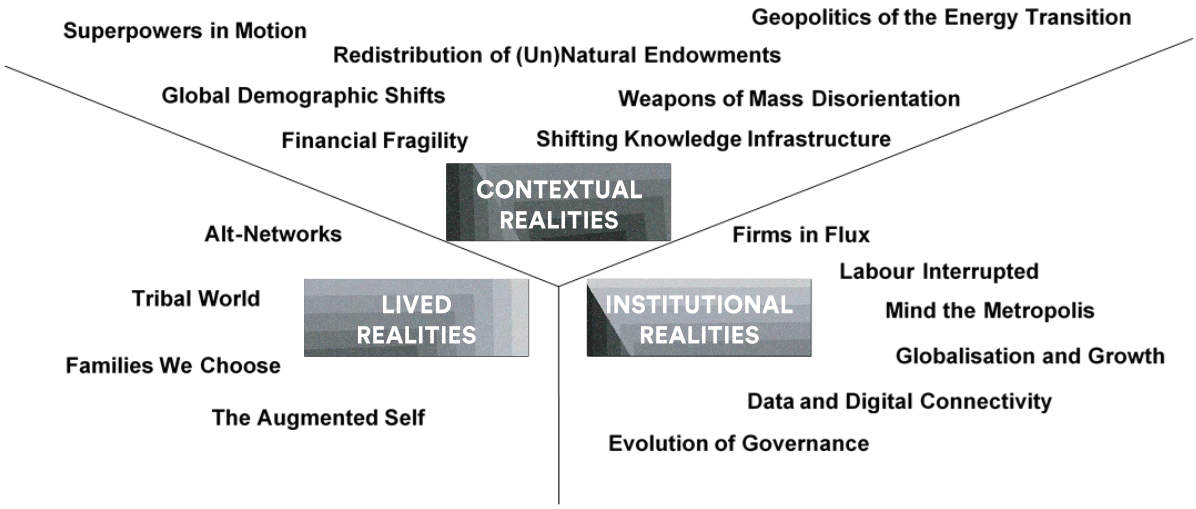
How will the social compact between the public, private and people sectors evolve?

LOOKING AHEAD TO 2040

> "Warp threads are thicker than the weft, and made of coarser wool as well. I think of them as like wives. Their work is not obvious—all you can see are the ridges they make under the colourful weft threads. But if they weren't there, there would be no tapestry."
>
> —*The Lady and the Unicorn* (2003) by Tracy Chevalier

In the language of weaving, the five themes distilled from the set of 2040 DFs are warp threads, while the DFs themselves are weft threads. From these two sets of threads, a multitude of tapestries can be woven, with each being the result of uncertainties playing out in particular ways. They offer a useful starting point for exploring different pathways to plausible futures. This is useful for challenging mental models and assumptions about how the future will play out, exploring challenges and opportunities over the next 20 years, and thus supporting better decision-making in the long term as the world reaches inflection point. ⧈

ANNEX: DRIVING FORCES 2040



The DFs have been categorised into three clusters:

- Some of these forces will transform our ***contextual realities***: Major powers' ability to influence others will wax and wane, while non-state actors (e.g., major cities and provinces, global firms) achieve new prominence on the international stage. Changes in climate and weather patterns will shape where and how communities live, work, and play, while the energy transition will redefine cross-border interdependence and force us to reconsider the distribution of essential resources.

- Other forces will transform our daily ***lived realities***: Alternative sources of information will further fragment our shared reality and influence how and with whom we form kinship bonds. Technology will give us choices about reproduction, mental capacity, and longevity that humanity has not had before. These choices will shape the texture and colour of our society over the next two decades.

- Mediating between the external and internal world, how our ***institutional realities*** evolve will also shape Singapore's future: Singapore's ability to navigate and thrive in a more turbulent environment will continue to hinge on whether we can maximise our potential, in part through catalysing vibrant public, private and people sectors that work well together. There will be challenges posed by changes in international institutions such as the international financial system and the global trading system, and also questions about how domestic institutions should adapt.

These clusters are not the only way in which the DFs can be categorised. Some might choose to categorise the DFs by domain, for instance. There is no right or wrong way to categorise the DFs, and in fact, choosing to categorise them in different ways can bring into focus new relationships between them that are useful for policymaking. We encourage teams and organisations to experiment with categorising the DFs in ways that are most useful to you.

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