

01

Megatrends shaping the future of infrastructure

1.1 Introduction to the megatrends survey and methodology

Megatrends are large-scale, transformative, well-established trends that proceed exponentially. Such trends have the potential to fundamentally change users' needs, shift where value is created, and reshape the nature of competition. Megatrend analysis takes a structured approach to assessing the implications of these trends by gauging industry leaders' views on these trends and then using these views to construct extreme, but plausible, versions of the future. These scenarios are intended as a planning tool, allowing organisations to test the robustness of their strategies against these possible future realities.

For example, governments can test the strength of current public policies against challenges for which they might be unprepared. Similarly private investors and industry leaders might draw insights into the risks that are most likely to impact financial returns. This is particularly relevant for long-term strategic planning and vital in an industry with long asset life cycles.

This report is based on a global survey gathering perspectives on the 25 megatrends most relevant to the infrastructure industry, which are organised into five megatrends domains:

1. Society and workforce
2. Market and customers
3. Geopolitics and regulation
4. Technology
5. Sustainability and resilience

For each of the megatrends, the survey asked members of the infrastructure industry for their views on three dimensions:

- The certainty of both the direction and impact of each trend
- The potential impact of the trend
- The preparedness of the infrastructure industry to handle the trend

Respondents were also asked to identify megatrends that could offer the biggest opportunities and those that pose the most significant risk over the next 30 years.

For the purpose of generating scenarios, the most interesting megatrends are those that are high in uncertainty (involving many possible futures), high in potential impact for the infrastructure industry (involving potentially very different futures) and low in preparedness (involving potential future actions and policies that can make a significant difference). Our analysis of the survey results focuses on these dimensions.



**Table 1: Categorisation details
Megatrends by domain**

Domain	Megatrend
Society and workforce	Urbanisation and population growth
	Ageing population and workforce
	ESG/corporate social responsibility
	Sharing economy
	Pressure for companies to increase efficiency and productivity
	Rise of health and safety concerns
Market and customers	Demand shift to emerging economies
	Infrastructure financing gap
	Rise of bigger, more complex projects
	Private participation in infrastructure
	Globalisation and international trade
Geopolitics and regulation	Global divide and increased social inequality
	Multipolar world
	Rise of distrust and pressure for increased transparency
Technology	Rise of new materials and substances
	Rise of green energy sources
	Rise of IoT, sensors and smart infrastructure
	Rise of AI and automation
	Autonomous driving and new transport modes
	Digitisation (building information modelling, or BIM, onsite collaboration apps)
Sustainability and resilience	Ageing infrastructure
	Rise of natural disasters and resilient infrastructure
	Rise of climate change
	Resource scarcity and rise of circular economy
	Rise of security risk

Table 1 illustrates the details of each domain, with further details available in the appendix of this report.



1.2 Survey results

The survey received responses from more than 400 respondents in 70 nations, with 35% of respondents from emerging markets, and 65% from mature markets. All G20 nations were represented. Respondents came from the full spectrum of different organisational types—including government, international organisations, multilateral development banks, contractors and operators, private investors, technology firms, academia and think tanks—and represented all organisational levels, including a large number of CEOs and directors.

The top and bottom five results (of 25 megatrends), across each of the three dimensions, are summarised in Figure 1 (a full ranking of the megatrends is included in the appendix).

Figure 1: Overall survey results
Top five megatrends by dimension

	Lowest	Highest	Lowest
	Certainty of direction	Impact to industry	Preparedness to handle
1	Sharing economy	Urbanisation and population growth	Rise of climate change
2	Globalisation and international trade	Ageing infrastructure	Global divide and increased social inequality
3	Rise of bigger, more complex projects	Rise of green energy resources	Rise of natural disasters and resilient infrastructure
4	ESG/corporate social responsibility	Rise of natural disasters and resilient infrastructure	Resource scarcity and rise of circular economy
5	Multipolar world	Rise of climate change	Rise of distrust and pressure for increased transparency

	Society and workforce		Technology		Geopolitics and regulation		Market and customers		Sustainability and resilience
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The megatrends with the lowest certainty, as seen in the first column above, and therefore most generative of potential different futures, are clustered in the domains that also have the lowest average certainty overall: society and the workforce, market and customers, and geopolitics and regulation. In particular, it is worth noting the connection between the megatrends of globalisation, international trade, and the multipolar world, suggesting that respondents saw the international environment as one of the major sources of uncertainty for the infrastructure industry.

The megatrends with the highest impact (and therefore the most different potential futures from today) are from the sustainability and resilience domain, which respondents rated as having the second-highest overall potential impact. While the rise of green energy sources was the only technology trend that ranked in the top five megatrends, technology megatrends were all ranked above average in terms of impact, leading that domain to have the highest overall impact rating.¹ If we link the rise of green energy sources to both a technology and a sustainability component, it appears that respondents view the intersection of sustainability and technology trends as among the biggest influences on the future of the infrastructure industry.

The megatrends with the lowest preparedness (and therefore for which the most significant potential difference could be made by future actions and policies chosen) are clustered in the sustainability and resilience, and geopolitics and regulation domains (the two domains with the lowest preparedness overall), and overlap significantly with the list of highest-impact megatrends. This suggests that sustainability and geopolitics are viewed as the two areas in which further preparation might be required.

Across the three dimensions, there is a relatively high degree of correlation (0.48) between responses on the ‘certainty’ and ‘impact’ dimensions. That is, megatrends that respondents saw as high in certainty were also typically viewed as high in potential impact. Interestingly, there was very low correlation between ‘impact’ and ‘preparedness’. That is, megatrends that respondents saw as very high in potential impact were not more likely to be megatrends that the industry was well prepared for.

Figure 2a: Overall survey results
Top five risks

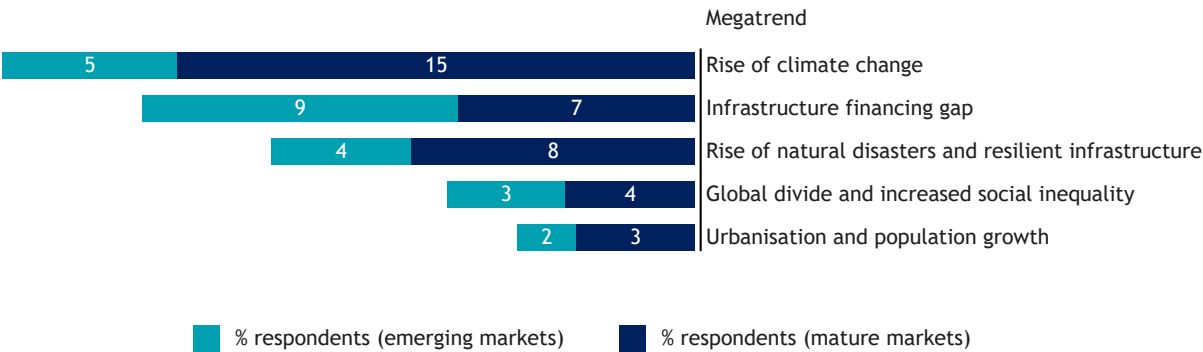
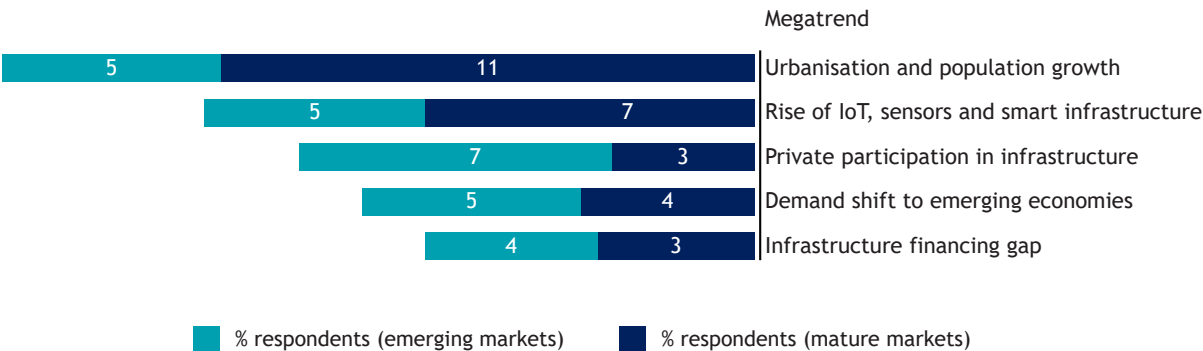


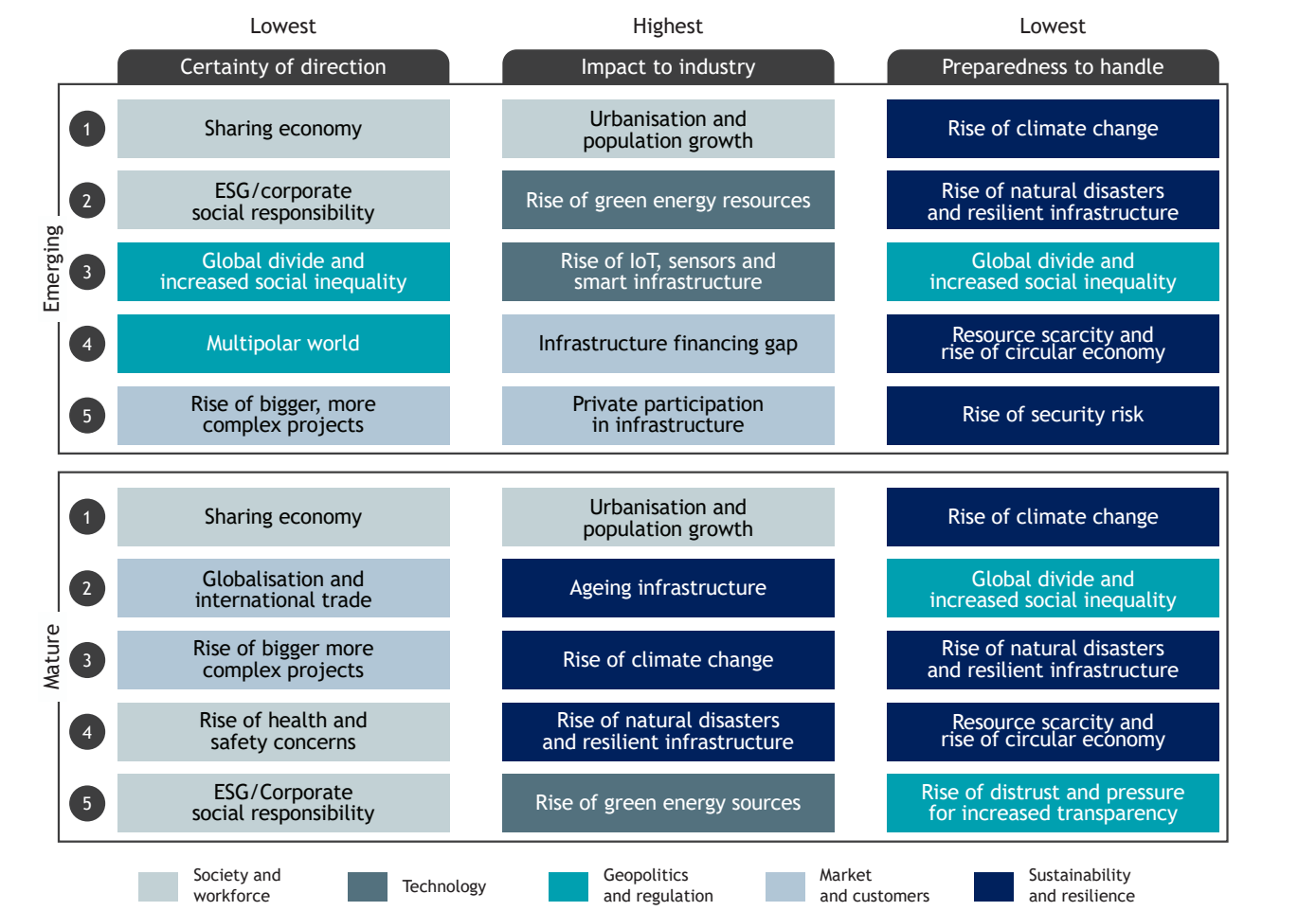
Figure 2b: Overall survey results
Top five opportunities



The trend with the highest perceived risk (Figure 2a) was the rise of climate change, which was also perceived as high impact and the lowest level of preparedness. This trend was highly correlated with the rise of natural disasters and resilient infrastructure. The second most prominent category of risk was the infrastructure financing gap, which is a well-known challenge with much work currently underway to address it.²

We also asked participants about opportunities. The trend with the highest perceptions of opportunity (Figure 2b) was urbanisation and population growth, being identified by 16% of respondents. This trend, and that of ageing infrastructure, were highly correlated with climate and natural disaster–related trends, suggesting that many in the infrastructure industry believe that the pressures of urbanisation and ageing infrastructure are likely to compound the effects of climate change and natural disasters. The next-highest-rated opportunity (12% of respondents) was the rise of IoT, sensors and smart infrastructure, which likely reflects the overall opportunities and impact of technology in infrastructure.

Figure 3: Emerging and mature markets survey results
Top five megatrends by dimension



Across respondents from emerging and mature markets, the greatest difference in views was in the megatrends that would have the highest impact (Figure 3). After urbanisation and population growth (which both types of markets agreed on), emerging market respondents focused on technology and financing trends, while mature market respondents focused on ageing infrastructure, the rise of climate change and the rise of natural disasters and resilient infrastructure.

Based on expert discussions, this difference likely reflects the degree of existing infrastructure in each country, with the relatively greenfield nature of emerging markets leading to an emphasis on new technologies and financing, while mature markets with extensive, albeit ageing, infrastructure are focused on green issues and how to recycle, retrofit and make existing infrastructure more resilient. This is reflected in the tension in international discussions, including at the G20, around what is most important in infrastructure, with emerging markets focusing on access and financing and more mature markets focusing on mitigation and resilience.

Both emerging and mature markets shared similar opinions about the certainty of direction of the megatrends and the industry’s preparedness to handle them. However, respondents from emerging markets appear to be slightly more focused on the uncertainty in geopolitics and regulation, with the global divide and increased social inequality, and multipolar world featuring more prominently.

To better understand where views of preparedness diverge, Figure 4 shows the perception of lack of preparedness rankings by organisation type.



Figure 4: Infrastructure organisation type survey results
Top five megatrends ranked by lack of preparedness

Academic institution and think tank	Consulting and advisory firm	Contractor and operator	Government
Rise of climate change	Rise of climate change	Rise of natural disasters and resilient infrastructure	Rise of climate change
Global divide and increased social inequality	Rise of natural disasters and resilient infrastructure	Rise of climate change	Global divide and increased social inequality
Resource scarcity and rise of circular economy	Resource scarcity and rise of circular economy	Rise of AI and automation	Rise of natural disasters and resilient infrastructure
Rise of distrust and pressure for increased transparency	Global divide and increased social inequality	Ageing infrastructure	Resource scarcity and rise of circular economy
Rise of natural disasters and resilient infrastructure	Rise of distrust and pressure for increased transparency	Global divide and increased social inequality	Rise of distrust and pressure for increased transparency
International organisation	Investor	Multilateral development bank	Technology firm
Ageing population and workforce	Global divide and increased social inequality	Resource scarcity and rise of circular economy	Global divide and increased social inequality
Global divide and increased social inequality	Rise of climate change	Rise of climate change	Multipolar world
Urbanisation and population growth	Sharing economy	Ageing population and workforce	Rise of distrust and pressure for increased transparency
Rise of natural disasters and resilient infrastructure	Rise of natural disasters and resilient infrastructure	Sharing economy	Ageing population and workforce
Ageing infrastructure ¹	Rise of distrust and pressure for increased transparency ²	Rise of natural disasters and resilient infrastructure ³	Rise of security risk ⁴

Society and workforce
Technology
Geopolitics and regulation
Market and customers
Sustainability and resilience

Not included in the list but equal to the marked trends were 1. Rise of AI and automation, infrastructure financing gap
2. Multipolar world 3. Autonomous driving and new transport modes 4. Infrastructure financing gap

In aggregate, investors and government officials felt that the infrastructure industry was less prepared for the 25 megatrends compared to other groups of respondents, such as technology firms, or contractors and operators. On the other hand, contractors and operators and international organisations (e.g. the United Nations [UN] or the Organisation for Economic Co-operation and Development [OECD]) felt that the industry was more prepared than other groups. Variances among stakeholders in perceptions of preparedness might indicate that there should be greater levels of communication and collaboration between different groups of stakeholders in these areas to achieve greater alignment across the market.

There was greater agreement on the biggest areas of industry unpreparedness. Global divide and increased social inequality appeared in seven of the eight groups in Figure 4, rise of natural disasters and resilient infrastructure appeared in seven of the eight groups, and the rise of climate change in six of the eight groups. Interestingly, one area where investors felt more prepared was private participation in infrastructure; however, this level of confidence was not shared by the other stakeholder groups, such as government and academia.

02

Overarching themes from the analysis



It is clear from the survey results that there are four key areas for industry, the public sector and the international community to investigate in more detail:

1. Given the significant shifts occurring, we see a clear need for **better coordination between all players** to create a positive, rather than a dystopian, future. This will require business models to be anchored in partnership.
2. It is clear that **the role of data** will be increasingly important. Industry will need to glean better insights on the way assets function, consumers behave and industry competes. Government and the private sector must adapt to the increasing role of data in the infrastructure sectors.
3. The required **workforce skills mix** within the infrastructure sectors is changing as Industry 4.0 reshapes industrial value chains and processes. Grappling with labour market dislocations and upskilling workforces are increasingly urgent agendas for both government and industry.
4. Ensuring **inclusive infrastructure development** in the future will take the combined efforts of government and the private sectors. Infrastructure is the essential foundation for economic and social activities, yet it is not a given that assets will be built and managed in a way that serves society equitably or safeguards the environment.

Better coordination between all players

In order to respond effectively to the analysed trends, we contend that both governments and private firms need to develop business models anchored in partnerships over the longer term, rather than acting transaction by transaction. Without this cooperation, we see little chance that the industry could achieve the fundamental change required to respond to, for example, climate change, or to accelerate the introduction of technology into the ecosystem.

Governments will need to consider how to design flexibility into regulations and contractual models, emphasising outcomes, not just inputs, in the infrastructure sector.³ Governments will also need to test whether current competition policy, which generally aims to encourage more suppliers in the market and foster price competition at the point of tender, supports or hinders the ability to work together with industry to achieve change over the longer term.

As governments move more toward partnerships, and as technology players become increasingly present in the market, incumbent firms will need to develop business models anchored in strategic partnerships to succeed—for example, between traditional construction firms and technology companies, and between government and business. Rather than trying to build the capability required internally, partnerships will allow firms to be more flexible, and work with different players to access capability and respond to a shifting environment. The players that are best able to enter into and evolve these flexible partnerships are likely to win. Additionally, multinational firms need to consider which partnerships can manage multi-jurisdictional operations, with respect in particular to the issue of intellectual property.



The role of data

The use of large volumes of data to make informed decisions will become a critical source of advantage in the future. The future of asset management, commercial revenue strategies, demand forecasting, public procurement and network planning (to name just a few) will be reshaped through the use of data. Grappling with how to generate, standardise, secure and interpret this data will become critical.

Firms should review what proprietary data they can collate that would give them an advantage. This will require infrastructure firms to think both about data that helps them run their current business better, as well as data platforms that might open new business models which cut across the entire sector.

Governments will need to develop policy frameworks for infrastructure data. These will need to test whether government should take an active role in collecting, managing and providing access to data, or whether to leave this to the private sector. Moreover, regulators need to develop models that protect critical infrastructure assets, such as electricity grids, gas pipelines, ports, and water and telecommunications networks, particularly against the threat of espionage, sabotage, and coercion. Regulators will also have to engage in issues linked with consumer privacy, an agenda far larger than the infrastructure industry alone.

Workforce skills mix

The infrastructure industry is especially exposed to countervailing forces where, on one hand, technology offers significant productivity gains through the replacement of low to semi-skilled labour, while, on the other hand, political incentives continue to position the industry as an important source of employment for low- to semi-skilled workers. Moreover, it is likely that today's infrastructure industry does not have sufficient talent with the necessary skills, or diversity, to meet future needs. Nor does it have the processes to help employees build these capabilities.

Ultimately, the industry must balance greater productivity with acceptable workforce disruption. Government and industry will need to work together to construct a smooth transition path. Industry leaders should develop technology plans and timelines, detailing what technology improvements they plan to introduce, the timeline for them, and what impact this will have on the workforce. Governments should require private companies to develop these plans as part of major tenders, both to encourage productivity improvement and to ensure a managed transition. In addition, government will need to develop systematic plans across the industry for retraining the workforce. Individuals should expect to go in and out of training over the course of their career as the skill requirements evolve.

Inclusive infrastructure development

The infrastructure industry plays a central role in enabling society, from providing access to centres of employment, to opening international markets, through to promoting opportunities for long-term savers to realise their goals. Yet, it is not certain that the benefits of infrastructure will be spread evenly across everyone in society.

Governments should ensure that national infrastructure networks meet inclusivity targets and shift to follow globally accepted environmental, social and governance (ESG) factors.⁴ The private sector should embrace foundational ESG practices outlined in the Equator Principles. Given that growing evidence suggests ESG factors may offer long-term investment performance advantages, this is just good business sense. Moreover, the private sector can be the vanguard by pushing the frontier forward by setting clear, stretch targets along each ESG dimension.

03

Developing scenarios for the future



Having assessed the megatrends, we see a set of potential implications for the industry. It is also feasible to project forward and develop possible future scenarios for the industry based on how these trends might play out. In this report, we lay out three possible future scenarios. These scenarios are relatively extreme extrapolations of current trends, but remain plausible. They are designed to foster debate about the type of industry we want to create in the future.

3.1 Using the survey to generate scenarios

To develop the scenarios, the survey results were combined with expert interviews and discussions, including with the WEF Global Future Council on Infrastructure, to identify three megatrends that respondents see as most determinant of future possibilities.

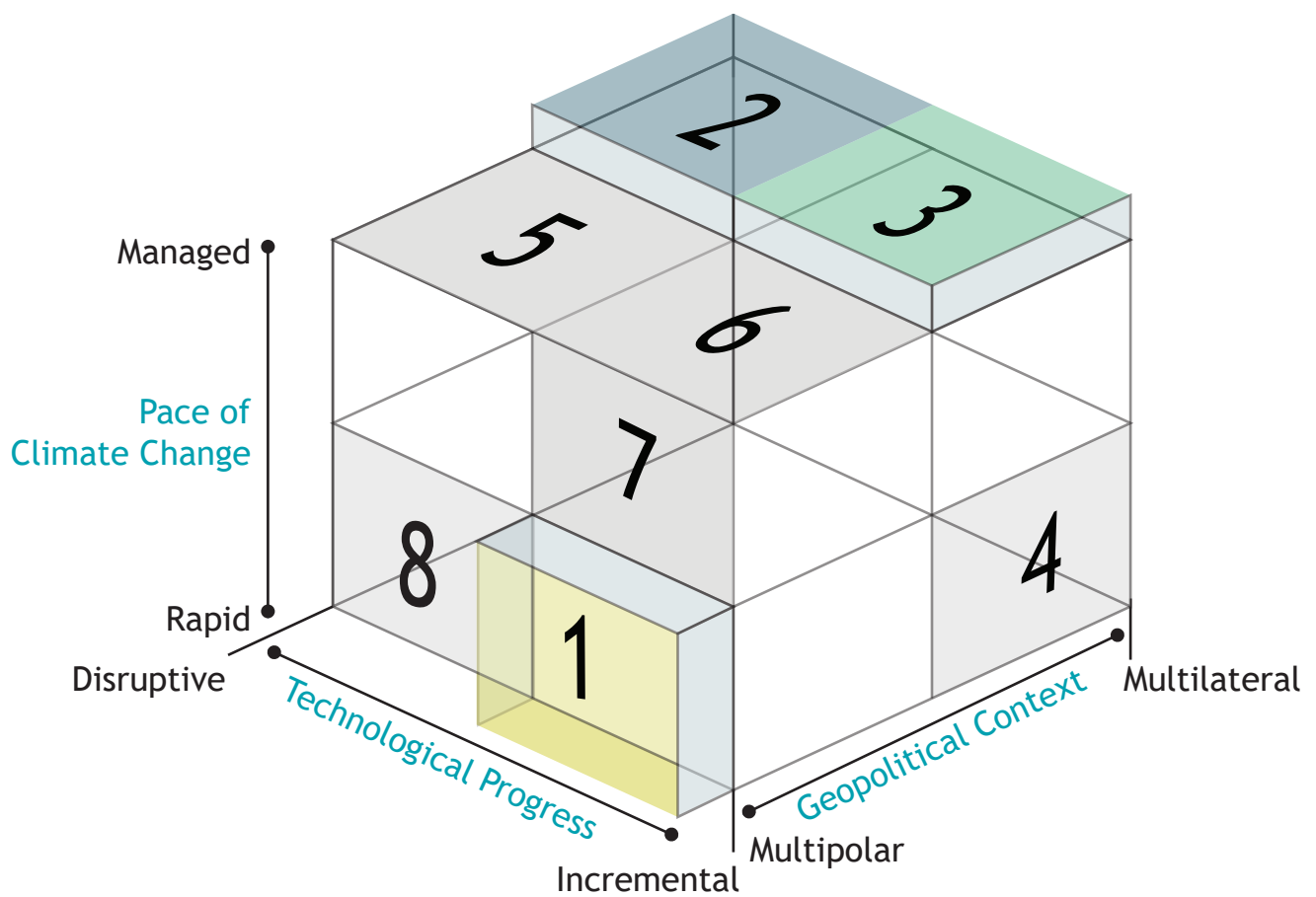
We started with the megatrends that are high in uncertainty (involving many possible futures), high in potential impact for the infrastructure industry (involving potentially very different futures), and low in preparedness (involving potential future actions and policies that can make a significant difference). The three megatrends that we saw as having the highest potential to shape very different futures are used as determinants to construct scenarios. The three determinants are:

- **Geopolitical context**—Multipolar versus multilateral: The possibility of a multipolar world was seen as driving a wide range of divergent potential futures with very different implications for industry structure and priorities.
- **Pace of climate change**—Managed versus rapid: The set of trends with the lowest preparedness in the survey was the rise of climate change and rise of natural disasters, and resilient infrastructure. The latter category also scored high for impact and was viewed as the highest in risk by survey participants. The survey results were also consistent with the findings of the 2019 WEF Global Risks Report⁵.
- **Technological progress**—Incremental versus disruptive: Technology trends, particularly in the emerging world and in the construction and operations sectors, were seen as having the highest potential impact. This is consistent with recent work conducted by the World Economic Forum⁶ and the Global Infrastructure Hub,⁷ which also highlighted the potential impact of technology across the infrastructure industry.

Having selected these critical megatrends, we then investigated the spectrum of possibility for these trends. With three megatrends selected, each of which has two potential and polar opposite outcomes, we can construct eight unique scenarios for the future. However, many of these eight scenarios are similar. So, from the eight, we selected three unique and quite different scenarios to include in this report. Figure 5 details the logic behind the three selected scenarios.



Figure 5: Scenario option space
(with selected scenarios highlighted)



For each of the three selected scenarios, a vision was fleshed out for what the future could resemble, taking some licence on the interpretation of how trends might play out.