SAMI Consulting
robust decisions in uncertain times

info@samiconsulting.co.uk
www.samiconsulting.co.uk

# Futures of Industries

This blog collection looks at a range of industries and their possible futures...

## The future of water – fertile futures

*Image by Nick from Pixabay*

One of the critical challenges that the climate crisis brings is managing scarce resources, most notably water. Droughts, storms and floods are all expected to increase in all global warming scenarios – massively, if carbon emissions do not fall quickly enough.

Around 2 billion people around the world lack access to safe drinking water and 40 per cent of the world's population are affected by water scarcity. Agriculture accounts for some 70% of water usage and more than 90 per cent of disasters are water-related. Demand for water keeps growing, with pressure on freshwater projected to increase by more than 40 per cent by 2050.

The UN Water Conference in March, the first for five decades, developed the Water Action Agenda: more than 700 commitments to address the water and sanitation crisis and ensure equitable access to water and sanitation – Sustainable Development Goal 6. It also announced the appointment of a Special Envoy on Water.

UN member states committed to spending more on critical infrastructure. The US is committing to $49 billion investment to support climate-resilient water and sanitation infrastructure and services; the German government is working with the Niger Basin Authority on a £21 billion project; the EU will provide €20 million funding to accelerate the deployment of wastewater surveillance for COVID-19.

The PR release claims key game-changers: reinforcing water's place as a fundamental human right; reducing the pressures on the hydrological system; developing new, alternative food systems to reduce the unsustainable use of water in food production and agriculture; designing and implementing a new global water information system to guide plans and priorities by 2030.

But is this sufficient?

The World Economic Forum argued that developing a system of accountability, as has been done with climate change, will be critical. The world's 'financial plumbing' needs to be fixed, so that funding flows from global capital markets to small enterprises and communities working to tackle water shortages. At the current rate of progress, by 2030, 1.6 billion people will still lack access to safe drinking water and 2.8 billion will lack safe sanitation. A four-fold increase in progress is required.

As well as an SDG in its own right, water is an issue connecting all 17 SDGs. Collective action bringing together governments, multinationals and their whole supply chains and NGOs is essential. A water "Net-Zero" moment.

Others argued that non-binding commitments, paucity of scientific data and poor representation of global south left a lot to be desired at summit. Several issues were identified:

- **Lack of co-ordination**: the various commitments are disparate and uncoordinated and will further fracture an already fragmented sector and occupy political space on water without unlocking substantive progress
- **Accountability:** the commitments, being non-binding, won't result in cohesive action; transparent reporting from world governments, the business community, and financial institutions is needed, as well as greater levels of targeted aid, financial and policy reform
- **Rigour**: the process lacks coherent analysis; the water crisis warrants its own scientific panel / commission, akin to the Intergovernmental Panel on Climate Change, to review progress, resolve controversies and channel rigorous evidence to decision makers.
- **Inclusiveness**: action should be informed by the realities and voices of those most affected. It must be based on reliable knowledge, evidence of what works, and the lessons of the past four decades of effort.
- **Institutions**: In addition to the new United Nations' water envoy, a UN Convention on Sustainable and Equitable Water Use is needed; this transnational water

governance regime would set ground rules, arbitrate fair water use, and to bolster authority, transparency, accountability and participation at regional, national, and local scales

A particular set of initiatives, on a more local scale, is the Portuguese contribution to the Venice Biennalle International Architecture Exhibition this year – "Fertile Futures". This aims to stimulate thought about a fertile, sustainable and equitable future of water.

Their exhibition consists of seven case studies of man-made impacts on natural and finite water resources, chosen to demonstrate various strategies for the management, preservation, and transformation of fresh water. It explores architecture's contribution to redesigning a decarbonised, decolonised and collaborative future in cooperation across disciplines, generations and species – with the aim of building shared knowledge.

It is clear that the challenges of water management in the future are considerable. And that it underpins so many aspects of life. In a fractured geo-political situation, getting global consensus will be difficult, just as it is for climate change issues in general, but as such a critical issue for every country major efforts need to be made.

*Written by Huw Williams, SAMI Principal*

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# Flooding London, TRLs, and Need.

*Image by Steve Bidmead from Pixabay*

The Environment Agency has decided to improve London's tidal defences by 2050 – 15 years earlier than anticipated. Sea levels are expected to rise by a metre by 2100. And that means the Thames Barrier, which has been closed 207 times since its introduction in 1982, needs to be looked at. And hard.

The Barrier is planned to continue in service until 2070. But if it is to continue to protect the capital until 2100, it will need to be improved. "That decision," says Karen McVeigh in The Guardian, "– whether to build a new barrier or upgrade the existing one – will wait until 2040, with all options remaining open until then."

McVeigh's article quotes Professor Ivan Haigh of the University of Southampton ""With 1 metre of sea level rise, you could go from 10 closures a year to many hundreds of closures a year – perhaps up to 300.""

The Environment Agency, and London, confront one of the great problems of planning for climate impacts. What do we do, and when?

It's not just London that takes time to develop these projects though. The MOSE project – which started in 1984 – protects Venice from the acqua alta. Or at least, it does at the moment. MOSE's aim is to protect Venice from sea level rises of up to 60cm, and has

already been used 49 times since its activation in 2020. A full 1m rise though will overtop the defences entirely.

That uncertainty about what to do and when is one of the reasons we started the Sustainability Innovation Pathway project. Technology has a lead time, and that lead time can be very long indeed. Not only does the technology have to exist, but the factories to manufacture it have to be built, the tools made, the raw materials sourced, the funding secured. And then, when all of that has been done, the technology has to be manufactured at scale, and introduced. And then – and only then – can it start having an effect.

In the SIP, we use technology readiness levels (TRLs) as a basic input to our thinking. Essentially, a technology readiness level of 1 is an idea sketched on the back of an envelope (fag packets are now too expensive to sketch anything on); a TRL of 10 means a technology is fully mature and in widespread use. The development velocity of a technology can be influenced by many things – of which the two key ones are money, and urgent need. Urgent need usually encourages money – think of the development of vaccines for coronavirus, which went from a need to deployment in under a year.

Money without immediate need is more difficult, because in that case it has to fit into someone else's planning and budgeting cycle. Governments need to be persuaded, private capital has to be enticed and rewarded, other priorities have to be downscaled. And all on the presumption that something in the future might happen.

For the Thames Barrier, all the published timings are comfortably far away. 2040 for the decision date, 2070 for the in-service date, 2100 for the sea to rise a metre.

There is, of course, no proof that we have that time. This June was the warmest for the UK on record. The average global air **temperature** recorded 2 metres above **Earth's** surface was over 17°C (62.6°F) on 3 July, the highest that has ever been recorded. An analysis last year of more than 200 papers identified six tipping points which are unnervingly close.

And things change fast. When a film called "The Flood" in was released in 2007, a spokesperson for the Environment Agency confidently said "If we use the barrier in combination with other options – such as flood storage – we know that the barrier will be effective up until 2100.""

It is that "we know" which makes the hair stand up on the back of the necks of futurists. We "know" nothing about the future. Between 2007 and 2023, things have changed so much that one of the largest pieces of civil engineering in the UK now needs to be reconsidered.

It is one of our maxims in developing scenarios that no scenario of itself will come true – but bits of all of them will. Our scenarios for the future include climate impacts – now they must also keep up with their rate of change. Because even our most massive engineering projects, of which the Thames Barrier and MOSE are just two examples, take too long to

plan, too long to build, and the assumptions which underlie their construction are simply no longer true.

Where does this take us? Futures thinking needs to accommodate and communicate the pace of change. Government and industry need to shorten funding and development timelines so we can meet future needs faster. And the development velocity of technologies needs to increase.

This all requires money, and determination. At exactly the time when the world is still not recovered from the 2008 financial crisis, is dealing with a major land war in Europe, and when disinformation makes determined unified action all the more difficult. But without it, neither MOSE nor the Thames Barrier, to take only two examples, will not be ready for the world of 2100.

And that assumes the climate is good enough to stick to our scenarios – which it shows few signs of doing.

*Written by Jonathan Blanchard Smith, SAMI Fellow and Director*

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# What Is Cutting UK Productivity?

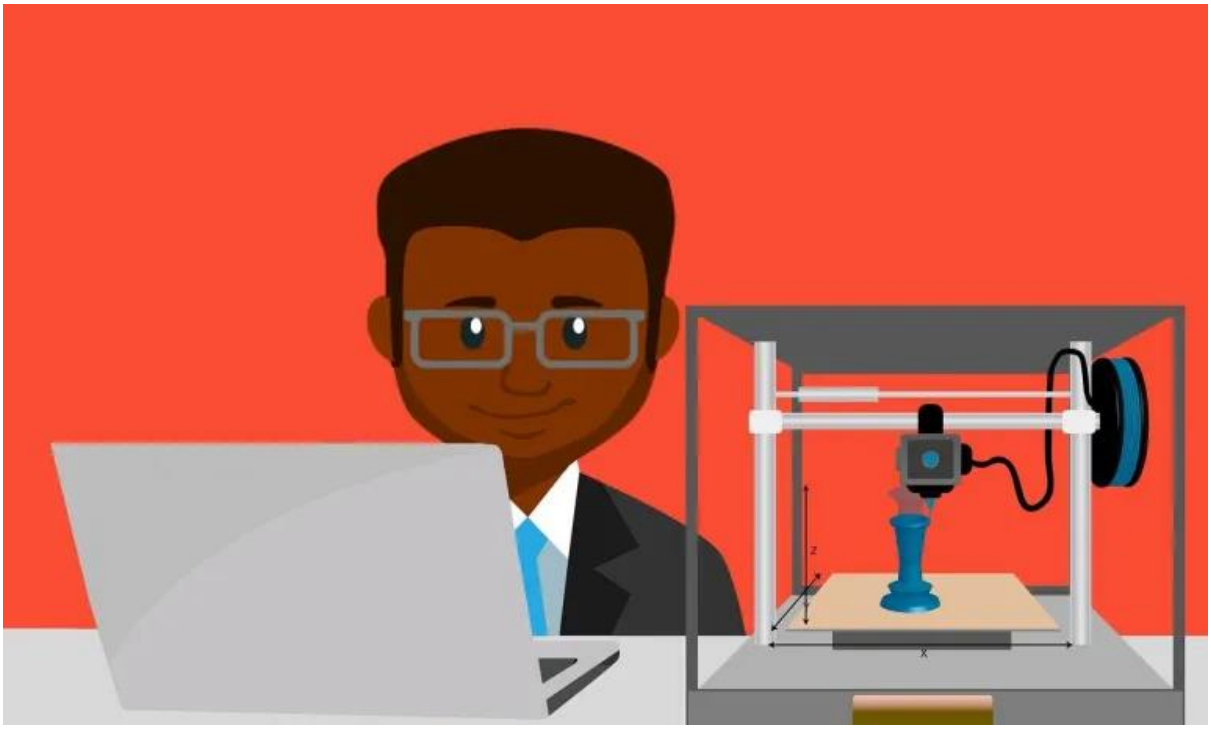

*Image by Mohamed Hassan from Pixabay*

Written by Gill Ringland, Ed Steinmueller & Patricia Lustig, this blog first appeared at the end of June as a Pamphleteer in the Long Finance series, https://www.longfinance.net/news/pamphleteers/what-is-cutting-uk-productivity/

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In "Global Risk – is Software the 'Vlieg in de soep'?" we first flagged a potential new threat to the economy and society. In addition to threats from war, volcanoes, global heating, we could see that our digital society exposed us to a less remarked upon threat. This is the threat from software failures.

We have since developed this thinking further, including through a joint round table with the National Preparedness Commission (NPC). The NPC is tasked to promote better preparedness for a major crisis or incident. The report from the roundtable concluded that "The software element of digital systems failure is a cost to economy and society which will only increase as software has become a utility, is in wider usage, and more vulnerable to failure."

In addition to the threat from catastrophic software failures, we also started to think about their insidious effect.

It is well known that the UK's productivity and productivity growth has lagged the US and – for most of the last two decades – that of the eurozone. While it is only human to look for a silver bullet such as AI, here we suggest measures that would underpin the silver bullet if and when it arrives, and could also increase productivity in the meantime.
The authors have been exploring the risks to UK productivity from software failure for the last two year through a BCS Working Group. Their report "Digitalisation – software risk and resilience – a policy think piece" compared the cost of software failures to the economy with that of road accidents, and found them to be comparable.

Software is now pervasive, and software services are now delivered through complex tightly coupled systems, with unpredictable failure modes. This requires new approaches to the measurement, mitigation and management of software risk and resilience.

The Department for Culture, Media & Sport (DCMS), with the Department for Software, Innovation and Technology (DSIT) issued a "*Call for views on software resilience and security for businesses and organisations*" in February 2023. The BCS response to the call emphasized that digital – software – failures are already impacting the productivity of the UK. Many services in sectors not thought of as digital are dependent for their delivery on software – from ecommerce to entertainment to government services. Productivity, in economics, measures output per unit of input, such as labour, capital, or any other resource. Software failures reduce the number of available hours and/or value of hours worked by users of digitally enabled services.

One of the recommendations of the BCS response was that government could lead on sharing information about breaches in digital services. Metrics for this are defined in the Network and Information Systems (NIS) Directive and Regulation for Regulated Data Service Providers (RDSPs). The four metrics are availability (user hours lost); integrity, authenticity, or confidentiality (user data compromised or services delivering wrong information); risk (to health, safety, or life); material damage to users (financial impact).

This "governance by accident" model is also being proposed for AI systems. Accidents could be defined as breaching service levels using a set of metrics as above. This approach measures the impact (rather than exploring the technical cause) of the failure. The impact approach is being actively considered by the insurance industry, as the legal costs of proceedings to determine the root cause of failure – or whether it was state sponsored or private hacking – mount up over years.

There are complications in the impact approach, but there are precedents. The DCMS's publishes the names of RDSP organisations and fines levied for loss or unauthorised access to customer data. As a regulator, they are empowered to require reporting of breaches over a threshold value of the metrics. It is also suggested that regulators for Other Essential Services (Energy – electricity, oil and gas, transport – air, rail, water and road, health – healthcare settings (including hospitals, private clinics and online settings), water – drinking water supply and distribution and digital infrastructure – TLD (top-level domain) name

registries, DNS (domain name systems) service providers and IXP (Internet exchange point) operators) should impose similar requirements.
Could a "governance by accident" approach to reporting on resilience improve other factors which are affecting UK productivity?

"User hours lost" came to mind when one of us was recently caught up in a blockage of the M1 and was delayed by two hours. The cause was apparently a lorry breaking the safety fence on a cross-bridge and hanging in the air over the motorway. A delay of two hours for all the stranded vehicles translates into a likely loss well in excess of the 750,000 user hours in the NIS Directive definition. However, a quick look at the Department for Transport website does not appear to report on user hours lost, though the impact of loss of productive time is surely an important contributor to the UK's low productivity.

As the UK looks to invest in strategic areas of science and technology, perhaps measuring and tackling digital and physical infrastructure resilience factors which are holding back UK productivity, should be explored in parallel.

The framework above would seem to provide a possible starting point. It provides a language for describing the lack of resilience of infrastructure that we all know is cutting UK productivity off at the knees. Further, becoming known for reliable digital services in our new complex environment would add to the UK's global competitiveness.

*Written by Gill Ringland, SAMI Emeritus Fellow, Ed Steinmueller & Patricia Lustig, SAMI Principal*

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# Future of Offices – real change or just noise in the wind?

*Image by PublicDomainPictures from Pixabay*

The growth of hybrid working following the pandemic led to many suggestions of a fundamental and permanent shift in the demand for offices and their design. Given the long lead times on building new offices – often beyond economic cycles – this clearly is an important area of foresight. A recent "weak signal" – HSBC announcing a planned move from Canary Wharf back to St Paul's – suggests it is time to look again at this issue. After all, HSBC was the iconic lead in the original movement to Canary Wharf.

HSBC is not alone in looking at reconfiguring their office space. BP is re-locating its headquarters from St James Square to Carlton House Terrace, near Trafalgar Square, reducing its floor-space by 30%. It is also moving its main trading operations within Canary Wharf. According to a Knight Frank survey, half of the largest businesses – those with more than 50,000 employees – expect to shrink their global workspaces On the other hand of 640 corporate real estate professionals globally 55% were expecting their floorspace to increase in the next 3 years.

The survey also showed that more than half of those surveyed favoured a hybrid working model, with 30% favouring an "office first" model.

McKinsey's analysis suggests that hybrid working has led to office attendance stabilising at 30% below pre-pandemic norms, and demand for office and retail space in "superstar cities" (including London) falling by 13%. However, there is a push-back against hybrid working from some conservative companies and managers, so quite how this plays out remains uncertain.

Experiments with four-day working have been largely positive. In a recent trial, of the 61 companies that participated, 56 are continuing with the four-day week (92%), with 18 confirming the policy is a permanent change. However, it is notable that there is not a "one-size fits all" solution, with several models being trialled. The knock-on effects on the wider city eco-system as footfall falls in hospitality and retail could be significant as well.

One theme emerging is that of "high quality" office space. The City of London Corporation tenants are seeking a new quality of space: buildings with 'best-in-class' sustainability credentials, provision of meeting spaces, good access to amenities, as well as quality design which communicates the company's brand and values.

Suburbs are likely to benefit from hybrid working as well. Larger homes and green spaces attract middle-class office workers while apartment developments with shared facilities could woo more junior staff.

But most commentators are just looking at the 3 to 5 year horizon, when the lead-time of major building projects is up to 10 years, and the lifetime of the building many decades. So it is important that developers (like other industries) consider the longer term drivers of change.

One approach is ***resilience,*** in the sense of a re-purposable "neutral-use" building whose design, infrastructure, and technology could be easily modified to serve different uses. For example an office block that could easily converted into a medical building, hotel or an apartment building. Modular, modern prefabricated units could be the way forward to achieve this.

That fits with another theme emerging from the long-term trend of building for ***NetZero*** – modify rather than demolish and re-build. The concept of "embedded carbon" will increasingly come into development equations. The Secretary of State has refused Marks and Spencer permission to demolish its flagship Oxford Street store. Michael Gove refused permission partly because it would "fail to support the transition to a low carbon future, and would overall fail to encourage the reuse of existing resources, including the conversion of existing buildings".

Other ***climate change*** factors will include design for hotter summers, with a minimum of air-conditioning, more consideration of flooding risks and storms more generally. New materials such as low-carbon concrete and steel produced in hydrogen furnaces will increasingly change designs. Urban green space will be much in demand.

The ***ageing population*** is another consideration. Older workforces with several generations of workers bring workplace design challenges, and may demand different, again more flexible, facilities.

***Geo-political uncertainty*** may not yet be a major factor in the design of UK buildings, but those in the east of Europe will increasingly be required to have shelters and bunkers as part of their design. Helsinki reputedly has enough shelters for all of its population.

As well as ***technology*** developments in building materials, the technology requirements of office workers will change dramatically, requiring ever more advanced, and upgradeable infrastructure. The Internet of Things with so many more sensors supported by advanced decision software will automate the control of energy, water and other factors within buildings.

And then there is the imponderable about the effect of ***AI*** on the workforce. BT said the introduction of AI across its business could result in the elimination of the equivalent of about 10,000 roles. On the other hand, many analysts believe AI will also create a whole range of new jobs. What is clear, however, is that these will be different, with different requirements than today's massive call-centres.

And finally we come back to how ***changing social attitudes*** – to work, to colleagues, the environment – will shape the design of buildings.

Perhaps more than many other industries, the office construction sector needs to be building plans that can adapt to changing needs, with contingency plans ready to go.

*Written by Huw Williams, SAMI Principal*

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# Megatrends and supply chains

*Image by Gerd Altmann from Pixabay*

We have seen how the Russian invasion of Ukraine caused a spike in oil prices and a rapid re-alignment of European energy supply chains. In what ways will geo-political uncertainty and climate change challenge commodity prices and supply chains and how should you plan for them?

We've also seen how Russia's invasion hit the **wheat** market. In February 2022, its navy blockaded the country's Black Sea ports, trapping 20 million of tonnes of grain meant for export, causing world food prices to soar and threatening to create shortages – even famine – in Middle Eastern and African countries. Ukraine had supplied 725,000 tonnes of grain to the World Food Programme (WFP), which was sent as humanitarian aid to Afghanistan, Djibouti, Ethiopia, Kenya, Somalia, Sudan and Yemen.

After a short-lived deal brokered by Turkey that allowed some wheat to reach its markets through a corridor in the Black Sea, Ukraine is now having to find alternative routes. These include taking wheat by canal into Romania and then sending ships that stay within territorial waters down to the Bosphorus. Other more expensive land routes have opened up. However, these have also caused tensions with neighbours in Poland, Hungary and Slovakia who banned imports of Ukrainian grain because of the impacts on domestic markets.

A less well-known impact has been on the supply of sunflower oil. Since 2012, Ukraine has been the world's leading exporter of sunflower oil with a 47% share of global sunflower oil exports in 2021. Sunflower oil shortages also drove up prices of substitutes such as palm, rapeseed and soya bean oil.

Beyond Ukraine, climate change is hitting other food markets.

In July, India suffered late, heavy monsoon rain which destroyed **rice** crops and threatened inflation. In response the Government ordered a halt to exports of non-Basmati rice (its largest rice export category) halving shipments and triggering fears of further inflation on global food markets. Prices of rice exported from Vietnam and Thailand soared to their highest in more than a decade. Additionally, potential crop losses from the El Nino dry weather conditions I South-East Asia are adding further pressures.

Other **cooking oil** supplies have been hit too. In 2021 farmers in Canada, the biggest producer and exporter of rapeseed, had a disastrous growing season after temperatures soared to almost 50C. Soya bean oil prices soared after Brazil, Argentina, and Paraguay – which account for more than 50% of world supply – were affected by severe drought. Wildfires, drought and soaring summer temperatures in the Mediterranean have cut olive oil production – Spain alone produces half of the world's supply of olive oil.

Climate change also can exacerbate **plant and animal disease**. Bird flu in South Africa is hitting chicken and egg supplies (which came first?) with 20% to 30% of the flocks being culled. In China, African swine fever is spreading rapidly over large distances and other countries in the region are at risk. China consumes far more pork than any other country, accounting for 70 per cent of all meat eaten in the country.

The UK imports 46 percent of its food, primarily from Europe, so is particularly vulnerable to supply chain shocks.

Looking beyond food, there are several key commodities the whole world depends on. In his book Material World(extracts from which were broadcast on Radio 4 recently), Ed Conway describes our reliance on sand, salt, iron and copper, oil and gas, and increasingly lithium.

**Sand** is particularly interesting. As a vital element in glass and silicon chips, it shapes economies -and again China dominates world production and is looking to build self-sufficiency in semi-conductors. Currently, Taiwanese companies produce 68% of the world's semi-conductors, and 90% of those used in AI and quantum computer applications. This is clearly a geo-political risk as China has already demonstrated it can blockade Taiwan, even if a full-on assault may be challenging.

**Salt** is an essential element of the human diet and is a key feedstock in the chemical industry. It has been the subject of state monopolies (notably in China and the British Raj) for centuries. The word 'salary' comes from Latin for salt, hence the term "worth one's salt"

when referring to someone's value. Production is widespread so alternative sources are usually available, but salt produced by evaporating sea-water (solar salt) is vulnerable to bad weather. China is the world's leading producer with around 25% of global production.

**Iron** and steel also underpin economies around the world. Australia has more of the world's mineable iron ore than any other country, more than twice that of Brazil in second position.

**Copper** enabled the revolution of electricity distribution, without which a modern economy cannot survive. Now, as we eliminate fossil fuels from our energy and transport systems, copper becomes ever more important. An electric car requires three or four times the amount of copper as a petrol powered one. More copper mining will challenge environmental limits, and some countries are already looking to impose mining constraint. A third of all copper mined comes from Chile.

**Lithium** has become an important component of battery electrolytes and electrodes, especially for electric vehicles. Debate continues about whether there will be sufficient to meet global demand. Around 70% of lithium production comes from just two countries – Australia (43%) and Chile (27%), currently relatively stable sources, though climate change could hit either badly.

**Rare earth metals** are critical for electric motors of hybrid and electric vehicles, generators in some wind turbines, hard disc drives, portable electronics, microphones, and speakers. Again, China is responsible for 80% of the world's rare-earth supply and has shown it is prepared to use that leverage. Australia with 15% is the second largest producer.

Four out of five SME manufacturers in the US are concerned about the future availability of key raw materials and water, regardless of their industry. Overconsumption of **water** is something manufacturers said they are particularly worried about – with 71% of SME manufacturers concerned about this.

There are also critical points in the physical supply chain – the **Suez and Panama canals**. The Suez canal was blocked by the container ship "Ever Given" for almost a week, delaying around 400 ships, with some choosing go round via the Cape. Given the volatility of the region, it is not hard to imagine a terrorist attack closing the canal for a considerable period.

The Panama canal – which handles an estimated 5% of world trade – however is vulnerable to climate change. Drought in the region has caused the authorities to reduce the flow of ships and their tonnage and El Nino is expected to cause further pressures in 2024.

With so much uncertainty about your supply chains what should you be doing? Attempts to de-risk supply chains by re-shoring or "friend-shoring" with allies are common where possible, but come with extra costs. You can begin by Identifying substitutes (eg replacing sunflower oil with palm oil) in advance, and diversifying your range of suppliers. But the key thing is to have thought about these issues in advance.

Our **Sustainable Investment Pathways** project has a particular interest in supply chains, as governments, investors and companies seek to find efficient, cost-effective and net zero solutions to the movement of goods. By sea, the development of "green corridors", shipping routes between two or more major ports, where zero-carbon emissions ships and other emissions reduction programmes are used. As the need for carbon reduction in transport and freight becomes more compelling, this in itself will have a major impact on supply chains.

A recent report by IGD suggested the main steps were:

- Strategy: examine your resilience to climate change and geo-political risks
- Risk management: establish processes for identifying and assessing risk
- Governance: have Board members oversee these risks.
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We would add identifying your areas of vulnerability, possibly using scenario analysis, and building a set of contingency plans around your base case plan (an "Adaptive Plan").

*Written by Huw Williams, SAMI Principal*

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# Adaptive Planning in National Infrastructure

*Image by Julita from Pixabay*

SAMI have long advocated the development of Adaptive Plans as a means of developing "robust decisions in uncertain times". The concept is explained in a blogpost from January 2023 – Adaptive Plans – a dynamic approach to putting scenarios into action.

Now, the National Infrastructure Commission in its Second National Infrastructure Assessment (NIA2) has also lighted upon the idea:

*"**Adaptive planning:** There is inevitable uncertainty associated with long term infrastructure policy making. Decision makers must not be continually buffeted by this uncertainty, nor ignore it. In this Assessment, the Commission sets out a portfolio of policies that use adaptive pathways to effectively navigate uncertainty."*

The NIC addresses six areas of infrastructure:

| | | |
|---|---|---|
| Digital | Energy | Flood risk |
| Transport | Waste | Water and wastewater |

NIA2 aims to produce a thirty year plan for a low carbon and resilient economy that supports economic growth and protects the natural environment.

In practice, NIA2 approaches adaptive planning through the wider context of "resilience". They are particularly concerned about the resilience of infrastructure under pressures from the energy price shocks and climate change (including loss of biodiversity and invasive species).

Their approach to resilience is structured around 6 concepts: anticipate, adapt, resist, absorb, recover and transform. SAMI itself produced a Working Paper on resilience a little while back which also addressed several different components: –WP21-10-TO-RESILIENCE-AND-BEYOND.pdf.

**Anticipate future risks:** by collecting data on data on how assets will react to acute and chronic risks.

**Adapt:** "Organisations should develop adaptive pathways to adjust systems over time as the trajectory of future climate change becomes clearer." The report gives the example of The Thames Estuary 2100 strategy that considers the strategy in light of data about changing flood risk and how flood risk assets are performing over time.

**Resist:** Networks should adopt a systems approach to resisting shocks, identifying points of vulnerability and consequential effects and changing standards accordingly

**Absorb: "**Operators should understand how far systems can absorb shocks while maintaining services. This includes understanding interdependencies. Sometimes this may be a better strategy than just resisting a climate threat." The example they give is raising electricity circuits and installing tiled flooring where flood risk remains high despite new prevention activity.

**Recover:** this includes insurance (increasingly challenging in repeated flood areas) and community support.

**Transform:** re-design systems with latest capabilities and approaches as resilience is built in.

Whilst the Assessment comprehensively addresses the impacts of climate change on infrastructure and moves to Net Zero which is laudable, it ignores other STEEP issues. Even under climate change it doesn't give much attention to re-structuring the National Grid or changing attitudes to travel.

Infrastructure needs to be resilient to change whatever its origin. For example, nothing is said about changing attitudes to public ownership of infrastructure – power, water, rail in particular.

Looking at the infrastructure challenge of our times – HS2 – it is clear that its problems do not primarily arise from climate change. All infrastructure decisions are vulnerable to

changing ECONOMIC circumstances. The HS2 Business Case will have been put together in an era of low interest rates and low inflation, so will be very different today. That said, with all its sunk costs, the equation might still stand up if we are looking at incremental benefits (virtually all of them) against incremental costs (perhaps half).

Any Business Case revision should also have factored in SOCIAL change – after the pandemic there is lower demand for rail travel; and TECHNOLOGY change– Zoom and working from anywhere reduce value of business time savings. There is also the POLITICAL dimension – levelling up – to factor in.

We should also look at issues of implementation. SOCIAL factors necessitated higher building costs through tunnels; POLITICAL factors drove the need for access to Euston, despite the challenges of working in an already congested underground environment.

There will have been SOCIAL and POLITICAL factors underlying the original Business Case itself. Initial estimates often tend to be over-optimistic in order to support prior political decisions. Trade-offs between different communities are often ignored. Way back in 1976, George Stern coined the term SOSIPing or Sophistical Obfuscation of Self-Interest and Prejudice – a devasting critique of cost-benefit analysis. The infrastructure he was considering was a Third London Airport, where saving a few minutes of multinational businessmen's time (usually men back in 1976) was a given a very high value, whilst inconvenience to the local community and the destruction of natural resources were rated lowly.

NIA2 also doesn't pay much attention to the opportunities of change – over the lifetime of the infrastructure we will have seen/will see huge TECHNOLOGY changes. There is a nod to them under "Transform" but little suggestion that seeking technological opportunities should be an active process.

I would also have liked to have seen more on the practice of foresight itself – horizon scanning and monitoring, scenario analysis, contingency planning (all essential elements of SAMI's Adaptive Plan approach). It is touched on under "Anticipate" but not given the prominence it deserves.

Despite the above critique, NIA2 does a fine job of identifying many of the consequences of climate change for the 6 infrastructure areas and is prepared to make radical and unpopular recommendations, for example of prioritising public transport over cars in cities.

*Written by Huw Williams, SAMI Principal*

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