techUK

FOR WHAT COMES NEXT

Risks in Tech Supply Chains

November 2022

Contents

Resilience and Sustainability: A Global Challenge

Supply chain sustainability and resilience are tier one global issues in the post-pandemic world. In 2020, the continuous stream of global trade ground to a halt. The resulting commodity prices increases and widespread part and product shortages made clear that if one link in the chain is broken, the knock-on effects are significant. Companies, customers, and governments are now paying much closer attention to the importance of supply chains, hence the subject of this paper.

Supply chain disruption came at a time of renewed geopolitical tensions and increased scrutiny over the environmental and human rights impacts of trade and manufacturing. Businesses are now judged on their environmental, social, and corporate governance (ESG) credentials, while governments are developing legislation aimed at increasing the visibility of exploitation and penalising businesses who aren't doing enough.

Products undergo a long and complex journey to reach end users, a major source of emissions and other associated risks, as well as moral questions for firms and end users. While this paper is primarily examining supply chains it is obvious that the industry will need to extend to a more widely encompassing 'value chain' due diligence framing in the future.

This should be viewed as a discussion paper, setting out the risks and opportunities of this new paradigm, with the clear take away that firms must be more transparent, better integrate tech into their due diligence practices, and have answers and processes in place where issues are identified.

What is a 'typical' supply chain for tech?

There is no 'typical' supply chain for tech products, but there are a few commonalities we can observe. Furthermore, what has been considered typical is quickly changing; we are highly likely to see new sourcing countries and routes emerge as a response to geopolitical tensions, climate change and government efforts to 'reshore' production. While different product categories will have variations in sourcing locations, a typical supply chain of a tech product will have the following stages:

1. Raw material extraction and processing

2. Manufacturing and assembly of devices

3. Shipping and logistics

4. Retail and getting products to the end user

5. After sales care, repair, remanufacturing and recycling

It would be impossible to lay out all the different supply chains as processes differ for products such as semiconductors, mobile phones, printers/copiers, TVs, or precision medical imaging equipment. However, there are some assumptions that can be universally applied. These include:

- **Tech products need a vast array of raw materials and minerals that come from unstable places.** Tech products comprise of a vast range of resources, chemicals, minerals and material, often sourced from parts of the world with frequent conflict, cultures that are very different and governance models that are very different from those in Europe. This represents significant risks (discussed in the next section) and travel to ensure these materials can be delivered 'just in time' to manufacturing centres. These conditions make conducting due diligence extremely difficult, even for the largest brands.

- **Manufacturing is primarily in Asia.** Asia is the source for most components and products. Contrary to common expectations China is not the only place products are made, with factories distributed across the ASEAN member states, South Korea and Japan. Primary and secondary inputs into manufacturing are also often subcontracted, resulting in many suppliers feeding into a finished article. This is primarily driven by cost, labour availability and concentration of raw material stores.

- **Assembly often happens elsewhere.** Even though most manufacturing happens in Asia, it isn't always the case that final assembly happens there. Some products may be assembled nearer to local markets for logistical reasons, proximity to other supply chains (such as defence or automotive plants), strategic national interests, regulatory reasons or the need to access scientific capabilities.

- **Most goods reach 'the west' via the sea.** Maritime trade is the lifeblood of global markets, with container ships becoming larger over time. The tech market is no exception. Proof of just how reliant we are on shipping freight can be seen with the 2021 blockage of the Suez Canal, which Lloyds estimated cost $400m an hour in lost trade.

- **Firms make products for global markets.** Tech manufacturers tend to produce items centrally for global markets, with minor adaptations to meet local regulatory requirements or standards (for example safety rules, chemical use, voltages, and to have the right plugs). Preparing products for local markets can take place centrally or locally, but the rule of thumb is that more variations means higher manufacturing, logistics and compliance costs which are passed on to the consumer.

- **Support and after sales are regional.** While the production of the product will occur primarily in Asia, the legal ownership of an item as it passes through the supply chain to end customers will often sit with local or regional teams, with regional hubs responsible for warranty, repaires and placing items on the market.

- **Tech is becoming more 'circular.'** The trend towards more reuse, designing products to be more durable and/or repairable, refurbishment and leasing represents a disruption to traditional supply chain models, with more demand for local spare parts and repair expertise, and the ability to resell models.

- **Emissions hide in the supply chain, with supply chain emissions 11.4 times higher than operational emissions.** The Carbon Disclosure Project shows most of the carbon emissions for tech companies exist in their supply chain. Telecoms providers estimate around 97% of their emissions in their scope 3 suppliers. Supply chains should be in the sights of governments when attending multi-lateral discussions on climate.

The corporate approach to supply chain transparency

Supply chains cannot be sustainable if they are not transparent. Knowing where parts and components come from, how and by whom products are made, the subcontractors and economic actors involved, is the first step towards improvement.

For firms making high-tech ICT and consumer electronic products there are multiple 'tiers' (the direct supplier of an original equipment manufacturer is considered tier one, the direct supplier's own supplier is tier two and so forth). Having leverage and understanding below tier two is exceedingly difficult due to the fact that so many factories making small components will be involved with many other manufacturers in different sectors. However, firms are improving their transparency and ways to improve it to get beyond tier two in several ways.

- **Changes to corporate governance.** Having a governance process in place that checks, reviews, and makes changes to supply chains is key. This must be driven at board level because more transparency can lead to difficult decisions and discoveries some companies may not like.

- **Corporate disclosures.** The next section will look at the legislative and regulatory drivers for disclosure, but stakeholders expect and require businesses to know and explain their supply chain risks. This requirement has driven investment in transparency tools.

- **More auditing and spot checks.** While traditional auditing has been difficult during Covid, firms have increased the amount they spend on external audits and have reviewed the timings, scope, and frequency of audits to keep them fresh and to ensure auditors get a truer understanding 'on the ground'.

- **Industry associations and partnerships.** Businesses know they cannot do this alone, particularly when operating in China or Southeast Asia. Collaboration used to invoke fears of cartel behaviour, however organisations such as the Responsible Business Alliance (for tech firms) can share the load and distribute best practice as well as offer insights into different sourcing regions. Furthermore, constructive engagement with NGOs in sourcing countries can provide a better picture of what is happening.

The role of digital technology is to support organisations all in the above and below and this paper has multiple case studies and examples of how tech can make supply chains more sustainable.

Supply chain sustainability risks

Ensuring supply chains are sustainable is a priority for the tech sector. In short supply chain sustainability means ensuring that human rights are respected, and environmental impacts are understood and addressed.
Firms are looking at their entire supply chains, from extracting and procuring raw materials, to manufacturing and assembly, to distributing products to customers. Before exploring how tech firms are taking on and addressing these risks, please see some of the respective climate, human rights, resource consumption and energy/water usage impacts below.

Raw material extraction risks

- **Conflict Minerals.** This refers to metals and rare earths linked to civil unrest in the form of localised conflict and violence. Their sale may fund political conflict, while the control of their extraction is a source of conflict. In many cases, the economic value of these materials bypass local communities, doing little to alleviate poverty. In countries such as the Democratic Republic of Congo, conflict over subsoil wealth has resulted in over 3 million deaths in 2 decades.

- **Labour exploitation.** Raw material extraction has seen increased labour exploitation, particularly in Africa and South America where mineral extraction has grown dramatically in the past decades. Both legal and illegal mines can be situated on indigenous lands and mining companies have been known to employ coercive measures to ensure a productive and profitable labour force on extremely low wages.

- **Environmental damage.** Open cast mining has created issues in local environments which people rely on for food, water, and healthcare provision. Leaching from mines can make water undrinkable and harm wildlife. Furthermore, the spread of illegal mining into nature reserves threatens species in global biodiversity. Supporting infrastructure built around mining can lead to habitat fragmentation and associated impacts on nature.

- **More carbon emissions.** Even when materials can be sourced from well-governed safe sources there are emissions associated with mineral and resource production. Plastics are extremely common with the OECD claiming that plastic production accounts for 3.4% of global emissions, 90% of which are in the manufacture. Of course, tech products will only be a small proportion compared to food packaging and other uses, and tech firms are switching to recycled plastics, but this does represent a contribution that should be lowered.

Manufacturing and assembly risks

- **Modern slavery and forced labour.** The ILO has estimated 50 million people are in some form of modern slavery, forced labour or bonded labour and a major source of this is Uighur labour in Xinjiang working elsewhere in China and migrant labour workers seeking a better life ending up on factory floors.

- **Poor labour practices.** For many workers they face working hours, health and safety risks and unstable working conditions that have long been banned in Europe. These can include long hours, poor lighting or cramped conditions, exposure to harmful substances or few labour rights such as the right to organised labour and safeguarding against harassment or bullying.

- **Environmental damage around factories.** Factories in the global South are often in places with poor environmental protections or right of remedy. Air pollution is a serious problem with demonstrable impacts on the medium and long-term climates of these regions, not to mention health impacts on the citizens who are at risk of the direct harm of air pollution. Other issues include water toxicity and chemicals that enter the environment, damaging crop yields, poisoning water supplies, as well as poor waste management.

Shipping and logistics

- **Carbon emissions of transport.** Transport accounts for over 20% of global carbon emissions with freight making up 30% of that. Emissions associated with manufacturing and transport reduced significantly with the Covid pandemic but have bounced back due to a major increase in demand for goods. Climate change and geopolitics will also see trade distances grow 12%, resulting in more emissions unless this sector can decarbonise (routes of which to be discussed below).

- **Biodiversity loss.** Road, rail, aviation, and port infrastructure is often built on forest, jungle, river, and coastal environments which displace wildlife and contributes to habitat loss via deforestation, splitting off predatory species from food sources and disrupting migration patterns. For example, container ship noise is encouraging cetaceans to migrate to new places, road collisions are killing migrating animals, invasive species are being transferred via logistics hubs and criminals are using global trade flows to facilitate the illegal wildlife trade. Ballast water practices have significant impacts on biodiversity, including the introduction of invasive species and coastal pollution.

- **Labour rights.** Particularly prevalent in maritime trade, human rights abuses and poor labour conditions are a real part of international trade. Labour rights can be abused by international shipping and nefarious actors can withhold pay or leave mariners stranded. The ILO rules are not adequately enforced, and this represents a challenge.

Retail and getting products to the end user

- **Last mile logistics.** It may be too early to make post-Covid permanent assumptions about retail, however GFK data suggests a nearly 50/50 split of physical and online sales of electronics. This has been consistent since lockdown and shows a potential shift that means more road deliveries. Last mile delivery is expensive and carbon intensive and decarbonising this form of transport is going to be important for local air quality and emissions.

- **E-Waste and circular economy.** At the end of life, too many tech products are not treated in the way they should be and there needs to be more products treated, reused, refurbished, or recycled. Illegal waste exports are a considerable issue as end-of-life products end up in West Africa.

There are also similar issues with packaging, with the UK creating a new Plastic Packaging Tax (levied at £200 a tonne for packaging with under 30% recycled plastic) and a new extender producer responsibility scheme where packaging producers will be responsible for 100% of the cost of recycling.

- **Labour issues and modern slavery in the global north.** Despite most labour issues occurring in the manufacturing stages, there are occasional issues with labour abuses in the retail and warehouse environments in the country of sale (the UK estimate is 100,000 victims of modern slavey). Exploitative work practices in countries with stricter labour regulations may be rarer, but present greater exposure for firms when they do occur. Outsourced services that involve agency based low skilled workers, especially if they are migrants, indicates a big modern slavery risk factor and companies should conduct stringent due diligence on suppliers. In short low risk does not mean no risk.

Addressing supply chain sustainability risks

The above risks represent significant global challenges, and the tech sector is very aware of these issues. In this section the paper will set out some of the methods and tools companies are using to address these risks. Below this section the paper will set out some promising supply chain transparency and sustainability digital tools and below that the legislative and regulatory context.

- **Adopting net zero and other targets.** Tech firms have adopted net zero targets, with techUK encouraging members to sign up to Race to Zero and 2030 Breakthroughs which set short, medium- and long-term decarbonisation targets covering scopes 1-3. This will filter through the supply chain as firms identify specific actions that can reduce emissions. However, techUK does appreciate the Race to Zero initiative will not work for everyone but encourages as much harmonisation as possible around the net zero terminology and standards.
- **Responsible business conduct as a boardroom function.** To make the biggest impact businesses are now assigning board level responsibility for ensuring firms adhere to the UN Guiding Principles on Business and Human Rights and climate risks. This is a TCFD requirement and has shifted business culture.

- **Form partnerships and join industry associations.** Tech knows it cannot address supply chain sustainability itself and needs support from others; indeed, Sustainable Development Goal 17 is partnerships. One such example is the Responsible Business Alliance which shares intelligence and auditing as well as provides a forum for best practice. The multi-stakeholder European Partnership for Responsible Minerals (EPRM) runs projects to improve the lives of those involved in mining and is working to implement the whitelist of smelters and refiners first proposed in the Conflict Minerals Regulation. On a smaller scale involvement with techUK, Digital Europe, Sustainable Procurement Ambassadors, Coalition for Digital Environmental Sustainability (CODES) plus the new UK Government Digital Sustainability Alliance and facilitates discussion and dissemination of training, webinars, best practice, and support for responsible business. Working with NGOs on the ground to examine health and safety, or to better improve or prevent environmental damage arising from factories is increasingly common.

- **Increasing transparency.** The move towards disclosures has seen firms rapidly improve their capabilities in reporting their energy mix, material use, carbon emissions and material consumption which allows for more scrutiny from investors, stakeholders, and customers. As well as act as an organisational driver for change, this provides baselines to measure progress against and ensures reputation conscious boards on the need to constantly do better.

- **Procurement and operational changes.** Tech firms are always looking to streamline operations and save energy, a pertinent current issue. This means looking at how tools can be rolled out to minimise journey times, use less energy across their logistics chains and use procurement to switch to renewable power and more energy efficient plant and machinery.

- **Contractual clauses and supplier codes of conduct.** On their own, requiring suppliers to abide by a supplier code of conduct on human rights is ineffective, however if combined with requirements to cascade training, enhanced audits and partnership working, these can be powerful tools to drive sustainability performance in supply chains. It also gives a legal basis to exit contracts, although techUK encourages firms to work with suppliers rather than disengage and displace the issue.

- **Customer sustainability clauses.** Mandating a potential supplier to share carbon reduction plans, sustainability disclosures or report on emissions is a blunt, but increasingly common method to drive climate ambition. In the UK public sector this is default and anecdotally members have seen a 50-75% increase in questions, leading some firms to take steps for the first time. Some members require decarbonisation clauses, requiring alignment with 1.5 degrees warming, or that firms do voluntary modern slavery statements even if not legally compelled to.

- **Cascading training through the tiers and leveraging own solutions.** Tech companies are fully aware supply chain visibility and corporate leverage disappears tier 3 downwards, so have adopted an approach to cascade training and capability throughout the supply chain where tier 1 teaches tier 2 and down the train. With products and services in scope 2 for many tech firms, more have been involved with helping factories deploy innovative energy saving technology, carbon emissions reduction strategies and new processes as part of their emission reduction plans. Beyond this firms as part of their corporate responsibility agendas run environmental, other sector or skills plans in many sourcing countries. More detail on how digital tools can deliver sustainability in supply chains is in the next section.

- **Promoting reuse and adopting circular business models.** Tech firms have fully embraced circularity and are rapidly adopting circular business models, preventing e-waste, reducing materials needing to be extracted and reducing emissions associated with travel.

- **Access to remedy and worker voices.** Being able to receive complaints, provide a voice to impacted workers (sometimes anonymously or covertly), enabling human rights defenders and being active in local communities where negative impacts are occurring to develop programmes and projects to prevent harm. Examples can include apps, anonymous message boards or dedicated inboxes or whistleblowing hotlines.

The role of technology

Digital technology has a considerable role to play in supply chain sustainability and the below section is case studies from members on how their tools can be applied for identifying, mitigating, and remedying negative supply chain outcomes. Some specific tools and solutions are explored below, as well as overviews of some of the key methodologies.

Case studies

Microsoft and Tech Against Trafficking: mapping the anti-trafficking landscape and ensuring privacy for victims

Microsoft jointly founded Tech Against Trafficking (TAT) in 2018 to run initiatives including an accelerator program, forming long-term partnerships and projects tackling this most urgent societal problem. The first project was understanding the anti-trafficking landscape, so Microsoft helped establish an interactive encompassing 300 counter-trafficking technology tools and designed to enable tool discovery, gap identification, and technology advocacy. Another issue is understanding the profile of victims and typology of the crime, however collating all the data presents privacy and anonymity challenges for victims. To overcome this TAT and the Counter-Trafficking Data Collaborative (managed by the IOM, the UN Migration agency), pools data from IOM, Polaris, and Liberty Shared to create the world's largest database on identified victims of trafficking. The CTDC data hub makes derivatives of this data openly available via anonymised datasets, interactive dashboards, interactive maps, and topical data narratives. This helps policy makers and researchers understand the profile of victims, but also preserves privacy.

Climate Essentials: Carbon management platform for businesses

The Climate Essentials software developed by Climax Community enables organisations to identify carbon hotpots and access a tailored carbon reduction strategy. For example, a large manufacturing business was able to identify that 86% of their carbon footprint was due to the purchase of metals from their manufacturing process (Scope 3). The rest of their emissions came primarily from energy use, and they could identify a 52% reduction in direct emissions via procuring energy from renewable sources.

Circulor: A blockchain platform that brings transparency to complex global supply chains

Circulor is a global technology business, headquartered in the UK, that enables customers to gain visibility into their supply chains, demonstrate responsible and ethical sourcing, and prove their ESG and GHG goals. With Circulor, businesses can track the physical flow of critical materials from extraction to final production and through remanufacturing and into recycling, as well as associated ESG characteristics and embedded carbon across Scope 1, 2, and 3 emissions. Circulor assigns a digital identity to a commodity at its point of extraction and tracks the supply chain data at each stage of production to provide an immutable record of provenance, activity, compliance, and potential anomalies.
For example, Circulor is working with RockTech Lithium and the world-renowned Fraunhofer Institute to ensure the production of German-made lithium hydroxide with the lowest possible environmental impact. Based on Circulor and Fraunhofer's work, Rock Tech will create a material passport for its product, providing holistic documentation of its value chain to its downstream EV battery customers. The Rock Tech and Circulor partnership also entails traceability and CO_2 tracking for Rock Tech's planned recycling at the facility, aiming to become Europe's first closed-loop supplier of lithium hydroxide.

Oracle: Deploying cloud for biodiversity

The environmental impacts of supply chains need to consider the impact on nature. A key material risk for nature is displaced pollinators as a result of logistics, manufacturing, and agricultural practice, so to mitigate these impacts Oracle and the World Bee Project trialled a project to better understand the delicate balance between farming practices, pollinators, and the local environment, as well as new tools and guidelines to support bee-friendly practices.

The project benefits from research from the University of Reading as well as BeeHero's sensor technology, which is usually used to provide pollination services to commercial farms. Oracle Cloud provides a wide range of analytics and data science capabilities, enabling collaborative research across these teams. The project requires traditional on-site survey data, collected manually across the UK, as well as large volumes of IoT sensor data, which is automatically captured every 15 minutes. The sensor data includes hive temperature, humidity, and in-hive acoustics, as well as data related to more than half a million trips the bees make every day. The project also collects hourly third-party weather data as well as satellite images.

The data is transferred into an autonomous database in the Oracle Cloud, which uses analytics tools including AI and data visualisation to give researchers new insights into the bees and their journeys from their hives to the different crops they pollinate.

Responsible Minerals Imitative: Conflict Free Smelters

The Responsible Minerals Initiative, run by the Responsible Business Alliance set up a list of smelters and refiners that have successfully completed an assessment against relevant standards and have been verified to be conflict free. This helps tech firms and their supply chains source minerals and metals that are conflict free and can be considered responsible. The full lists can be accessed here.

Worker voice apps in Asian factories

Nitin Spinners, one of the largest spinning mills in South Asia has deployed an app by ES3G to be able to get anonymous input in multiple languages by staff working in factories to provide information on freedoms, health, and safety, pay, hours and conditions. Within 48 hours 8,290 data points covering 56 topics were collected, all directly inputted by the workers.

IBM: repurposing emitted CO_2 with AI and blockchain

Mitsubishi Heavy Industries and IBM are partnering to develop CO$_2$NNEXTM, a digital platform that aims to use emitted CO_2 as an industrial input. The platform helps visualize and strengthen the CO_2 supply chain using blockchain and AI. Today, data about how CO_2 is captured, used, and stored is only visible at each individual step in the process. CO$_2$NNEX links and visualises the data, provides traceability, and matches CO_2 emitters with companies that can use it, providing supply for new applications in industries like agriculture and alternative e-fuel.

Circularity First: Creating resilient and stable IT supply chains

We used our expertise in new and circular technology to create authorised networking supply chains that our client relies on.

Working in partnership with a global telecommunications provider, we forecasted demand and enabled accurate pre-staging of the equipment. New and authorised remanufactured technology was seamlessly added to the existing supply chain and results included a reduction in both the cost of networking maintenance and waste generated. Existing equipment solutions were remanufactured to extend their working life, delivering both benefits to the environment and alignment with the client's commitment to circularity and sustainability.

There are commercial benefits too. Our client benefits from annual savings of $1m and 40,000kg of technology has been kept in use by aligning sourcing to the circular economy. Extending the life of technology is more cost-effective, resilient to supply chain shocks and better for the planet.

Supply Chain Sustainability and Transparency Legislation

In the last decade, governments have introduced several pieces of supply chain related legislation, often built off of the relevant UN and OECD frameworks. WIth the ISSB finalising their own sustainability disclosure standard, there has been growing adoption of standards to aid in compliance.

In many jurisdictions it is reasonable to assume there will be blanket bans on products made with forced labour, as well as mandatory due diligence sustainability reporting to allow investors and stakeholders to understand company impacts and pressure them to do more. In the future there will also likely be carbon border taxes to account for so called 'carbon leakage' where manufacturers will face extra costs for carbon intensive imports. The green procurement agenda will also see forced labour due diligence for those seeking to win government contracts.

In the UK, the passage of the Modern Slavery Act (2015), was the first national law, while the US Uyghur Forced Labour Prevention Act (2021) built on previous legislation, showing what was to come. The British Procurement Bill will force firms to ensure goods and services provided to the public sector do not contain forced labour. This will be complemented by a strengthened Modern Slavery Act which will introduce civil penalties for non-disclosures, more prescriptive reporting requirements and a single repository

of statements to allow for better comparability.

In Europe, the EU's proposed Corporate Sustainable Due Diligence Directive proposal (2022) and agreement on the Corporate Sustainability Reporting Directive (2022) are significant and for tech the Conflict Minerals Regulation (which has a global scope) and proposed ban on products made with forced labour have direct implications on the legal need to conduct supply chain due diligence.

Away from due diligence, the TCFD requirements and potentially TNFD will go down the supply chain to deliver more climate and nature disclosures. If supported by increasing customer requirements, there is huge potential here.

The Carbon Border Adjustment Mechanism (CBAM) is a potential EU requirement aimed at avoiding carbon leakage and encouraging countries to collaborate on carbon pricing. CBAM targets imports of carbon intensive products in compliance with international trade rules, to reduce the export of emissions by EU countries to non-EU countries. CBAM governance is decentralised, meaning individual countries can choose how to implement the approach. This poses issues of increased cost to tech part imports (over €150 in value), as well as fragmentation between states involved in the movement of tech products for sale.

Supply chain resilience

Supply chain 'resilience' speaks to the ability of an organisation to respond to crises and to keep business moving by adapting to unexpected circumstances. The last couple of years have thrown up a particularly high number of unforeseen scenarios that technology businesses have needed to respond to, which has led to greater C-level focus on building greater resilience into tech supply chain practices. This section the paper will set out some of the key challenges, how businesses can make their supply chains more resilient and some of the best tech use cases to prevent shortages and improve resilience.

The technology sector has historically relied upon a 'just in time' model which seeks to finetune the supply chain and manufacturing processes in a way that minimises inventory and storage costs. Within this model there is an inherent trade-off between efficiency and resilience - the model relies upon detailed analysis of historical data patterns to forecast supply and demand and to respond accordingly. When the model works well this can improve both economic and operational efficiency and therefore increase profit margins, but to the same extent this attempt to optimise supply chain processes can limit companies' room for manoeuvre where unanticipated events cause real-world data points to diverge from forecasts.

The current supply chain challenges have arisen due to a perfect storm of unique challenges that have fundamentally altered the supply and consumption forecasts that companies had been building their supply chain plans around. These include:

Covid impacts on supply chains

- **Disruption to manufacturing and transport during lockdowns.** Enforced social distancing measures during the Covid-19 pandemic with factories around the world either ceasing activity entirely or operating at reduced capacity to limit social contact. Freight activity was similarly impacted as companies struggled to transport goods to key transport hubs, and ports and airports operated at reduced capacity. The impact was particularly heavy in China due to the government's 'Zero Covid' policies which caused significant disruption throughout the global supply chain as key hubs such as Shanghai were shut down for extended periods of time. The semiconductor / microchip sector was particularly impacted, and the complex nature of these operations also means that it takes time to ramp up supply and production once lockdown measures are eased, which has led to sustained bottlenecks into 2022 and expected into 2023.

- **Persistent changes in consumer demand driven by the pandemic.** The early days of the pandemic saw a particular spike in consumer demand for technology goods as people adapted both their work and leisure activities within successive periods of lockdown. As the worst days of the pandemic subside this demand has rebounded but remains higher than would have been expected before the pandemic as much of the digital transformation and consumer tech adoption induced by the pandemic has come to take on a more permanent role in people's lives. Tech businesses have struggled to respond to this demand as the supply-side challenges and bottlenecks described above take time to be resolved.

- **Switching production.** During the pandemic, factories and logistics switched production to goods to support pandemic response and have not yet got back to speed on basic materials required by tech manufacturing.

- **Customer prioritisation.** The practice of prioritisation for resources has increased post-covid due to constraints on suppliers. This can undermine a company's own supply chain, through the process of buying out their suppliers of essential resources and commodities. Supply chain tech can improve visibility and reduce the risk of this happening.

- **Increasing costs impacting resilience.** As a result of the above Covid saw input costs rise for all manufacturing as well as downstream price increases for consumer tech. For example, shipping container costs rose from $2000 to $15-20000 per container.

- **Government supply chains** Changes to the pressures on the public sector have increased pressures on suppliers. There now needs to be a trade-off between meeting the needs of public services and regulatory compliance. It is unclear at present the direction that this balance is going to move in, but it is clear that there is increasing economic pressure on public sectors to be more ethical and efficient in their sourcing.

Energy costs and geopolitical risks

- **Russia invasion of Ukraine.** Russia's invasion of Ukraine has further exacerbated supply-side challenges by dramatically increasing global fuel and energy prices. The technology sector has been impacted by the reduced availability for neon gas, a key input into the semiconductor manufacturing process for which 50% of the world's supply comes from Ukraine.

- **More onshoring and government scrutiny.** Governments across the world have looked at supply chain disruption and decided to make efforts to move production closer to home. Examples of this are the US CHIPS Act, the European Chips Act and UK Critical Mineral Strategy. All of these contain proposals to build in resilience for manufacturing production and have specific measures impacting tech firms. Governments may also act to

regulate or restrict the supply of certain materials to protect domestic manufacturing capability.

- **Geopolitical tensions and export controls.** Globalised technology supply chains are increasingly being impacted by export controls introduced amidst rivalries between global superpowers to develop next-generation technologies. In October 2022, the United States announced an expansion of export controls against China to prevent American companies from selling chipmaking equipment and advanced chips to the Chinese market. These types of interventions in the global supply chain create additional challenges that tech companies must navigate and respond to.

- **Sanctions and reputational risks.** Sourcing materials and products from countries that represent a geopolitical risk could create reputational issues for firms involved or see them impacted by sanctions on countries or entities. In the UK, the sanctions regime is independent, and the government has been highly active in sanctioning for human rights as well as security concerns.

- **Cyberattacks and ransomware.** The last few years have seen an increase in the prevalence of cyberattacks on corporate supply chain management systems, which can create devastating disruptions to business activity. Technology companies work alongside many second tier and third-tier suppliers, which creates additional points of vulnerability to cyberattacks and ransomware as it is difficult to ensure that all suppliers are actively enforcing sufficient cybersecurity measures.

- **Cost of cloud (input costs related to energy price).** Increasing energy prices in Europe resulting from supply chain disruptions affects those services which are directly reliant on the energy system. Cloud computing and cloud services are an example of an industry that is facing higher costs under the present climate, which are often passed on to service users. In this way, the energy supply chain influences the delivery of tech services. Blackouts would pose a more immediate material risk to tech supply chains and logistics. Small Modular Reactor technology may mitigate this risk in the future, but more research and investment are required.

- **Inflation.** Inflation is rising in most of Europe as the continent heads into a recession. This suggests lower purchasing power and a need to cut supply chain costs for companies operating out of this region. This could mean trade-offs are made with sustainable and ethical resourcing to keep companies afloat. Tech can be used to forecast price changes and availability to mitigate the downsides of inflation.

- **Lack of sustainability readiness in certain geographies.** Not everywhere has got access to the same technology & innovation to meet sustainability targets set by western countries, particularly suppliers in remote Asian/African settings who do not have access to renewable infrastructure or capital to reduce emissions. This will inevitably slow down supply chain emission reductions and is why cascading innovation is key. A good example of best practice in tech is the Tech Against Trafficking initiative which partners tech firms with NGOs and community organisations to run projects in the global south.[1]

Climate impacts

- **Need new supply chain routes.** Rising sea levels and more volatile conditions change the safety and economics of key transport routes, as well as opening new routes (for example the well-publicised shipping lanes in the Arctic).

- **Damaged or unviable transport infrastructure.** Moving goods will become more difficult even if the world meets the 1.5 degrees warming target. Yale University estimates that with 90% of trade moving by ship, most of the 2,738 recognised coastal ports will be partially underwater or not be able to have the same capacity. This applies to road and rail too, as extreme weather makes highways impassable.

- **Heatwaves & Droughts UK data infrastructure.** The resilience of the infrastructure which enables supply chains to work efficiently is under threat from extreme weather. Data centres, telecoms and other forms of communication may be heavily impacted by flood and heatwaves in certain future climate scenarios. This also poses barriers to the labour supply chain in the event that repairs, or maintenance are needed in extreme weather events.

- **Depleted resource availability.** As temperatures rise, resources needed for tech may become harder to reach, and labour availability could diminish. Desertification could change the geography of mining or forestry regions or make water (necessary for production and resource extraction) scarcer.

1. Tech Against Trafficking

17

- **Climate refugees and labour impacts.** With the global South facing disproportionately high climate impacts, output will be reduced in the primary and manufacturing from that region, as people seek new employment or leave the region.

How companies can mitigate risk and improve their resilience

The tech sector is managing and mitigating these risks in a number of ways as issues become more apparent. There are strategic ways to do this by changing management and governance processes, as well as specific steps for specific risks.

At a top level, the US government has developed basic principles for resilient supply chain management that tech companies should consider:

- **Identify** not only the risks to the supply chain, but people from across the organisation to be responsible for resilience and ensure they are well trained and have clear reporting lines.
- **Manage** compliance with clear policies and procedures, following industry best practice (the UK Institute of Risk Management guidance is appropriate).
- **Assess** transport routes, ICT and cyber resilience, outsourcing partners, manufacturing risks to the range of identified risks
- **Know** suppliers' resilience to risk and their sources, and verify any assurance they give, with regular reviews.
- **Evaluate** supply chain risk management by determining the frequency of reviews, how feedback and concerns are managed, assessing suppliers against best practice and industry recognised third party schemes

There are other frameworks (such as Monitor, Analyse, Mitigate, Learn) that can be adopted too.

Specific action that companies can take to prepare for and mitigate supply chain risks are set out below.

- **Map supply chains.** Tech firms have invested heavily in supply chain mapping, so they can understand the supply chain and make risk assessments for each area. As well as sustainability benefits, mapping allows firms to look at where potential bottlenecks can arise, estimate the quantities of materials that will be available and examine the costs of relocating some aspects in the event of geopolitical, commodity or transport shocks.

- **Invest in capacity building with 2nd and 3rd tier suppliers.** Within any complex manufacturing process, it is insufficient to focus only on your own company's resilience practices - larger companies also need to consider the vulnerabilities they may have from key suppliers (see 'map supply chains' above). Companies can respond to these challenges by partnering with their suppliers to improve supply chain resilience throughout the supply chain, as well as increasing capacity in other business critical operations such as investing in training to support suppliers in detecting cyber and ransomware threats. Vertical integration may be an option for some companies.

- **Giving climate risk more consideration at board level.** Climate change is going to disrupt business operations, even if the world meets the 1.5 degree warming target. Firms are now looking (and will be forced to under TCFD and emerging ISSB standards) at how climate risk will cost them, as well as setting out their own impacts. This means having alternatives in place, making sure facilities and transport are resilient and building in climate risk into all decision making.

- **Integrate AI into Enterprise Resource Planning (ERP).** Larger technology companies manage supply chains using real-time data that is made accessible across the business via software, enabling those in the business to make better decisions and improve inventory planning. A big opportunity to improve supply chain resilience is by integrating artificial intelligence (AI) to analyse trends across the entire supply chain and detect patterns human analysts may not be able to identify, and enabling better predictions around demand, supply, and transportation. While AI cannot shift the realities of all physical supply chain challenges, it can help businesses make more informed and strategic decisions to respond to these challenges and free up staff time.

- **Collaborate to access additional data sources.** The AI solutions described above rely upon having access to a multitude of data sets relating to the supply chain. Tech companies can increase the quality and quantity of supply chain data sets that they have access to by strategically collaborating on data-sharing initiatives with trusted suppliers and partners, and/or investing in partnerships with data marketplaces and aggregators.

- **Moving away from just in time production.** The just in time approach has been stretched and while it is viable for some production lines and processes, some businesses must stockpile materials or components to ensure uptime and stock availability (this happened prior to the UK's exit from the EU as a response to slowed down road transport and regulatory checks). This comes at a significant cost as it requires additional storage/warehousing but has advantages such as being able to get economies of scale and hedging against future risks. The unprecedented supply-side shocks of the last few years have led some companies to find a new balance between the efficiency of 'just in time' and the continuity of 'just in case'.

- **Diversifying sourcing regions.** In response to risks, firms can diversify where they manufacture, source material from, distribute or store products. This is happening in Asia with manufacturing taking place in new areas and taking advantage of government incentive schemes to develop new facilities (such as seen with semiconductor manufacturing in Israel, the US and Europe or electric vehicle batteries in Germany). The UK Critical Mineral Strategy has a stated aim to source more critical minerals from the UK and using international agreements to create resilient and sustainable supply chains. In some instances, governments have developed added support schemes to incentivise on shoring (see the CHIPS Act) which firms can take advantage of.

Opportunities for digital tech to improve resilience

Dun and Bradstreet: Verification of supplier credentials

There are many issues affecting Supply Chains, however risks need to be kept to a minimum, and an efficient yet comprehensive supplier onboarding verification process is needed. This case study from a a government customer demonstrates how Dun & Bradstreet supported a supplier onboarding:

- At supplier onboarding – an API was used to access the Dun & Bradstreet Data Cloud in real-time to provide the department with data for critical verification and compliance checks, including:
  - Supply Chain Transparency - Visibility of the level of risk a supplier/sector may present, including financial, fraud, restricted party screening, political, supply chain disruption, violations, modern slavery, country risk and ESG rankings to assess and track suppliers environmental, social and performance.
  - Consistent monitoring and validation of information. Key firmographic and beneficial ownership data aided by real-time alerts and predictive indicators of financial health allowed for further decision automation as well as manual intervention.
  - Uncovering significant relationships between companies and people

For this department, their aim was also to:

- Create more insightful dashboards and reports via a small number of integration points in their environment to:

  - Access contract details for the opportunity and to allow for the award of contract and its publication, including whether the vendor was a SME (Small or Medium Sized entity)
  - Cleansed spend data for reporting purposes

SAP: Automating warehouses

SAP and Linfox (the largest logistics platform in APAC) created a digital warehouse solution (DWS) using the SAP Extended Warehouse Management (EWM) application. DWS enables Linfox to streamline important warehouse processes including inventory management, put away, picking, cold chain storage, dangerous goods management, cross-docking, dock appointment scheduling and interleaving, while Linfox customers gain access to a full reporting suite including operational and managerial dashboards.

DWS allowed Linfox to become more competitive and resilient with the ability to onboard a customer in only four to six weeks instead of up to four months, and not having to implement SAP at every site has freed Linfox team members to focus on other tasks. Implementing this solution has also increased Linfox's flexibility as a logistics partner. This served them well when managing the distribution of vaccines during the pandemic and will enable them to continue to function in the case of any future global supply chain disruptions. Additionally, this solution will play a vital part in standardising business processes across the organisation, enabling strategic reporting, the provision of real-time data and further investment in automation.

Accenture: A 'supply chain digital twin' to map semi-conductor supply chain risks

Accenture supported a leading tech firm to create a 'heat map' of high-risk suppliers, components, and ways to mitigate these risks. They created a 'supply chain digital twin' to replicate the global supply chain. Accenture performed a stress test, which subjects the digital twin to pre-defined, disruptive scenarios and provides an overall resiliency score, to understand the revenue and business impacts.

In just six months, Accenture and the company created a foundation for a more resilient, relevant, and sustainable supply chain. The company's ability to mitigate ongoing disruptions has contributed to reducing its revenue at risk by several hundred million dollars. These advanced capabilities also position the company for increased commercial success—proving to its customers that it is well prepared to navigate future upheavals.

RiskLedger: Defending NHS Test and Trace against cyber attacks

From the outset of the pandemic NHS Test and Trace was rapidly established and created an end-to-end service that combines testing, contact tracing and outbreak management to stop the spread of COVID-19.

NHS Test and Trace were able to quickly collect and analyse risk data from their supply chain – much faster than they ever thought possible and used RiskLedger to gain oversight of their supplier connections, beyond just the first tier or third parties but into the fourth, fifth and sixth. They are embedding Risk Ledger into their procurement processes, so all new suppliers are required to create a profile on the Risk Ledger platform.

Through the detailed control-based information on their Risk Ledger profile, NHS Test and Trace discovered that an essential supplier was vulnerable to a widescale, non-targeted malware attack. NHS Test and Trace's cyber security experts decided to work directly with the supplier, helping them to improve their defences and mitigate the risk. The supplier now has significantly improved security defences, reducing the risk of a serious incident for NHS Test and Trace, the supplier, and other clients.

Marsh: Supply chain risk management

Marsh worked with a fashion retailer to deploy supply chain risk management services, from upstream suppliers to internal organisational processes creating the product and delivering it to customers through downstream logistics' providers. They used data analysis to analyse the end-to-end supply process, including production locations, ports of entry/egress, logistics, warehousing, distribution, and associated risk. This delivers operational resilience and enhanced visibility.

Next steps and getting involved

techUK is active across a range of supply chain issues, from helping firms embed responsible business practices and understanding regulatory requirements through to resilience planning and entering new markets. If you would like to learn more please visit www.techUK.org or email Craig Melson, E craig.melson@techUK.org.

About techUK

techUK is a membership organisation that brings together people, companies and organisations to realise the positive outcomes of what digital technology can achieve. We collaborate across business, Government and stakeholders to fulfil the potential of technology to deliver a stronger society and more sustainable future. By providing expertise and insight, we support our members, partners and stakeholders as they prepare the UK for what comes next in a constantly changing world.

linkedin.com/company/techuk

@techUK

youtube.com/user/techUKViews

info@techuk.org