Supply chain resilience has decreased further in the final quarter of 2021 and leaves the ASCR Index only marginally above the 40-point tipping point where risk becomes ‘very high’.
We are living through an unprecedented period of pressure on global supply chains. Russia’s invasion of Ukraine, the COVID hangover, disrupted shipping routes, port congestion, and seemingly ever-rising prices are causing substantial concerns for supply chain leaders across the globe. Increased concerns about the health and resilience of supply chains and the global economy dominate the majority of supply chain conversations today. Achilles’ Supply Chain Resilience Index (ASCRI) provides a measure over time of global supply chains’ ability to cope with the increasing strain.

This index* covers the period from October to December 2021, but this is far from being just a historical report. Our objective is to use the past as a guide to the future. We want to bring insight to every tier of the supply chain, from the boardroom of the multi-national using the ports of the USA’s West Coast to the SME who orders online from Asia.

In this report we detail the impact of the continued rise of commodity prices, outline key supply chain disruptors, and offer regional breakdowns of the impacts of these. Crucially, we also signpost some of the key issues supply chains are likely to face in the coming months and years.

Thank you for reading.

Katie Tamblin, Chief Product Officer, Achilles Information

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* The Achilles Supply Chain Resilience Index (ASCRI) is a time series index measuring changes in supply chain resilience. The index measures underlying supply chain resilience by country across six categories: Economic, Environmental, Labour Practices, Legal and Governance, Resilience, and Safety and Security. Each country’s score is derived by combining the Achilles’ Scores of suppliers based in the country with that country’s overall performance in those six categories. This framework is then supplemented by a range of global measures, including shipping and sentiment data.
Key Findings

RISK REMAINS HIGH
Further reduction in supply chain resilience score to 44.9 in Q4 2021. ASCR Index only marginally above the 40% high-risk threshold in Q4. We expect it will breach that threshold in the Q1 reading.

SHORTAGES & BOTTLENECKS
Shortages for key input items will continue to impact downstream supply chains. Supply chain shortages that have hampered global trade throughout 2021 will continue into 2022.

PRICE PRESSURE
Further 12% increase in commodity prices in Q4 2021. Commodity price volatility expected to continue off the back of political instability related to Russia-Ukraine conflict.
Our headline statistic for the ASCR Index for spring is that supply chain resilience has decreased further in the final quarter of 2021.

The decrease of 0.5 to 44.9 from 45.4 in Q3 continues the downward trend since our first report in Q1 2021.

This leaves the ASCR Index only marginally above the 40-point tipping point where risk becomes ‘very high’.

Further deterioration is the result of increased COVID concerns over the Omicron variant in the 4th quarter, continued shifts in purchasing behaviours and on-going logistical challenges.

In addition, on-going commodity price increases are placing further stress on supply chains that are likely to continue into 2022 and potentially beyond. The Russia-Ukraine conflict is raising fears of continued commodity price increases and supply disruptions for oil, gas, key metals, and agricultural items.

Ukraine is the 4th largest provider of cereals and vegetable oil in the EU whose major exports include corn, wheat (20 million tonnes per year or 10% of global wheat exports), and sunflower oil. A looming supply disruption could fuel additional food price inflation – on the day of the Russian invasion, wheat prices in the UK rose by £16 per tonne.

A final note of caution. It must be remembered that whilst the rate of supply chain resilience decline has lessened compared to the dramatic drop of 1.6 points in Q1, the index continues to fall and escalating conflict surrounding Ukraine will put additional downward pressure on resilience in Q1.
Commodities
Commodity prices increased by a further 12% in the final quarter of 2021 registering a 77% year-on-year increase in the fourth quarter of 2021, according to the IMF’s all commodity price index. Commodity prices continued to rise in January and February, signalling that while price pressures might be easing, price increases have yet to fully run their course. In late February, at the time of writing, Russian military action in Ukraine is driving price volatility particularly for oil, gas, nickel and aluminium prices. We are also seeing upstream spikes from throughout 2021 flow through supply chains into consumer inflation, which hit 30 year highs in the UK and the US in December. Consumer price inflation in the US hit 7% annual growth. The same figure was 5.4% in the UK, and is expected to register 5% across Europe, based on the Eurostat flash estimate. Recent price volatility will continue to impact downstream consumer price inflation throughout 2022.

The ASCR Index’s fall over the course of 2021 was largely driven by energy prices, supplemented towards the second half of the year by the relentless rise in the price of metals, particularly tin and molybdenum. Price pressures are strongest for those with high demand end markets that stayed strong throughout the pandemic, like consumer electronics and diy home improvement inputs, and those that rebounded sharply as demand returned.

Tin prices peaked at $39,159 per tonne in November 2021, soaring by 79% from the beginning of that year. The spike was driven by a shortage resulting from sharply heightened demand from the electronics sector, where tin is used for circuit board manufacturing, exacerbated by the fact that the total volume of metal output was insufficient.

Tin prices were very bullish in 2021, rising from $21,920 per tonne in January and storming to record highs by November, marking tin as one of the best-performing commodities in 2021.

Molybdenum has also had a remarkable recent price run, rising from under US$20 (A$26.62) per kg in July 2020 to around US$45 (A$60) per kg in October 2021. Mined mostly as a by-product of other metals and used mostly as an alloy, it’s molybdenum’s close links to steel that have helped drive this price increase. Specifically, China has been buying up huge amounts of molybdenum over the past 12 months as it turns to infrastructure to support its COVID-19 recovery. In steel, for example, moly can increase strength, hardness, resistance to corrosion, and electrical conductivity. Further, demand for molybdenum is being supported by the metal’s applications in energy creation, defence products, and new applications powering electric vehicles. Similarly, Lithium prices have benefitted wildly from the commodity supercycle sparked by the energy transition and the boon of electric vehicle production. While Lithium prices may have followed a boom-bust cycle in 2017-8, they are booming with no sign of a bust in the medium term, as demand outstrips capacity.
**Commodities Outlook**

Russian action in Ukraine is causing additional commodity price spikes that could persist throughout 2022. While commodity prices have exhibited continued strength, underlying fundamentals prior to Russian action in Ukraine would have put the majority at or near a peak. The scale, longevity and impact of conflict will dictate which commodities and on what timeline we could see a relaxation in price pressures for key energy and metal inputs.

Notable exceptions include Lithium and European ferro-molybdenum prices – as they are likely to continue increasing throughout the year, with no end in sight to the global shipping delays and supply tightness that lifted prices to a 13-year high in 2021. Low-priced Chinese ferro-molybdenum material bought during a price dip in November 2021 could add some downward pressure in the near term.

In the medium-term, oil and gas prices are likely to continue to impact a range of sectors and may fluctuate wildly depending on geopolitical developments.

Our view is that if the Russia-Ukraine military conflict is short-lived or contained, commodity prices could ease slightly throughout the year, but spikes in individual prices will continue to ripple through semi-finished and finished goods keeping pressure on overall inflation and consumer inflation. Typically, it takes 6-12 months for full price effects to flow through, which means there is more room for consumer prices to rise.

For example, lumber, widely regarded as an industrial bellwether commodity, saw dramatic price rises in Q4 2021. It appears the shortages are easing in Europe and prices therefore relaxing a bit. However, mudslides in British Columbia and US tariffs are providing additional price pressure in the US and could cause another spike in prices. We expect lumber prices to continue causing downstream impact on housebuilding and infrastructure, as timber prices remain elevated, despite European stocks returning closer to balance.

The price of nickel has risen dramatically in January and February, and these gains are likely to persist off the back of supply disruptions caused primarily by Russian military action in Ukraine and fears over future shortages. The increases in turn will impact a number of industries, not least the automotive sector where it is a vital component in the production of battery packs for electric vehicles. Stainless steel remains Nickel’s biggest end-market, and cross currents in Nickel demand caused by easing construction in China could offset higher demand from the electrical vehicle sector.

Similarly, zinc, copper, oil and gas prices increased in price in Q4 with the expectation that this will continue – an expectation playing out daily on various market exchanges. Inevitably these rises will increase the cost of semi-finished goods, such as fabricated metals, sawn timber, extruded plastics in the first quarter of 2022 with more muted price increases to finished industrial goods, such as machinery by the middle of the year. Throughout Q3 & Q4 of 2022 we anticipate these increases will continue to impact consumer goods, such as clothing and services.
We noted in the last report that semiconductor shortages continue to wreak havoc on supply chains, and we can now add energy storage to the list of items creating headaches for manufacturers in the automotive and technology sectors.

Supply Chain Disruption
In quarter four, we observed a notable decline in sentiment on social media relating to supply chain risk and disruptions. In fact, our sentiment index fell by 111% in Q4, as compared to Q3 of 2021. This means that social media posts referencing supply chain risk and disruption were twice as negative in the last quarter of the year than they were in Q3. This reflects some holiday related disruptions, but also, and more importantly, a resurgence in COVID related disruptions and a number of continuing supply shortages.

We noted in the last report that semiconductor shortages continue to wreak havoc on supply chains, and we can now add energy storage to the list of items creating headaches for manufacturers in the automotive and technology sectors. The Germany based Centre for Automotive Research (CAR) has estimated that the market for automotive batteries will not reach equilibrium until 2030, and battery shortages could take 4.4 million cars out of production in 2026. General consensus is that the chip shortage could reduce production of cars by up to 10 million from 2021-2023, and emerging reports suggest that the number of electric vehicles taken out of production between 2022 and 2029 could be double that. By 2030, excess demand for lithium is expected to reach somewhere between half a million and 1.5 million metric tonnes a year, meaning that demand for the metal, a critical input to battery production, will far outstrip supply – creating the perfect conditions for supply chain disruptions and price spikes. This will also have an impact on the transition to green energy, as energy storage batteries are a critical component of the transition to a sustainable energy system. These two industries – electric vehicle production and renewable energy storage – will, somewhat ironically, compete for the supply of lithium, suggesting that we may get cleaner cars or cleaner electricity production, but getting both concurrently will be difficult given the current lithium mining capacity.
Shipping Reliability
Shipping reliability is a key measure of supply chain resilience. The ASCR Index looks at three measures of shipping reliability (see graph opposite).

The increase in the OSRI (overall schedule reliability index) indicates that the number of on-schedule ships has risen during Q4. Since the start of the year multiple factors have impacted shipping reliability, specifically the increased demand for consumer products, Covid-induced disruption to container ship schedules and a shortage of port workers and truck drivers. All have combined to extend waiting times at ports. Adding to the problem is that when ships arrive at their destinations later than expected, cargo operations and turnaround schedules are knocked out of sequence, causing a ripple effect of disruption on freight, truck and warehouse services.

Whilst shipping reliability is a global issue, it is clear that the problem is particularly severe in North America, specifically Los Angeles and for Asia in the Shanghai, Ningbo and Shenzhen areas.

Shipping Reliability Outlook
Our view is that the supply chain bottlenecks that have hampered global trade will continue into 2022.

There are multiple variables that will determine the severity of shipping woes from geopolitical tensions through to labour capacity. However, there are positives. Disruptions could begin to ease in the second half of 2022, if Russia-Ukraine conflict remains somewhat contained. However, the steadily worsening situation in Europe may take longer to resolve, and freight rates will remain high.

This is likely to particularly affect dry bulk goods and items shipped by container. European ports remain problematic due to a lack of investment in shipping infrastructure capacity. These will continue to create port bottlenecks as demand outstrips capacity and geopolitical tensions remain a disrupting factor.

![Shipping Reliability Index Quarterly Average](image-url)
Regional Performance

An overview of the key drivers and activity in Europe, Asia and the Americas.
The steadily worsening situation in Europe may take longer to resolve and freight rates will remain high.

Conflict
Europe’s biggest risk is, of course, protracted and escalating conflict between Russia and Ukraine. Prices have already responded, and fears of rising prices and shortages that result from the conflict, both directly and indirectly, will drive supply chain decisions across the continent until the conflict is resolved or contained.

More structurally, we continue to observe that European suppliers score highest, on average, in the category of governance, reflecting strong insurance markets and reflecting a robust regulatory framework that rewards companies that can demonstrate processes and management systems compliant with ISO standards.

While European suppliers perform better than their Asia-Pacific counterparts in human right scores, of growing concern are trends observed in Achilles’ Ethical Employment Audits. For example, the rising percentage of workers that reported suffering physical and verbal abuses or discrimination at work in 2021. We also observed that 13% of companies were using financial deductions as a form of employee discipline. In addition, 11% of Ethical Employment Audits identified that workers had not been issued with terms and conditions of employment and 17% of workers reported paying fees to their employer/agency equalling up to 25% of their weekly wage.
APAC
The overall supply chain risk for APAC countries continues to decline due to price volatility, supply disruptions and continuing COVID related disruptions to production and logistics.

Singapore’s supply chain resilience dropped by 0.73 points from 47.05 down to 46.92. Similarly, Korea dropped from 46.97 down to 45.08. The South East Asian economies are being affected by export constraints as a result of high shipping costs resulting from the mismatch between demand levels, supply capacity, labour shortages at ports and COVID.

The cost of a 40-foot container to ship from China to other South East Asian markets, such as Vietnam, Thailand, Indonesia and Malaysia is currently circa 10 times the cost pre-pandemic. Anecdotally, ports in South East Asia 30 percent more congested than usual with knock-on effect on shipping schedules and, in turn, supply chain resilience.

Across the regions covered by the index, APAC suppliers have the lowest average human rights score. This is most likely a result of the dominance of emerging economies in the dominance of the data, and a reflection of lower workforce protections in large emerging economies such as India and China.
United States
The United States has also struggled with port congestion and labour shortages – notably in long-haul trucking and causing similar headaches to those observed in Europe. High inflation and disruptions in tech and automotive manufacturing are also hitting the US hard. The Biden Administration announced mid-year that billions had been approved to fund a Supply Chain Disruptions task force, including a later announcement of $1.5bn specifically enabling schools to respond to supply chain disruptions regarding food supplies. As of the end of the year, it remains to be seen whether or not task force actions will achieve notable outcomes, and, admittedly, it will be hard to quantify how well task force actions will prevent future disruptions.

Americas
The Americas region as a whole has the highest average supplier scores for human rights, reflecting the dominance of US and Canadian economies with robust frameworks in place for protecting workers. This also reflects strong labour protections in Latin America, where heavy labour market regulation in critical economies, like Brazil and Mexico, ensure a minimum of protections for workers across multiple industries.
Supply Chain Resilience Index
Q4 2021

www.achilles.com
The ASCRI is solved leveraging global, regional, and company specific factors to determine directional changes in supply chain risk.

The index is presented on a scale of 1-100, with 100 reflecting high levels of supply chain resilience (low supply chain risk), and a reading of 1 reflecting very low levels of resilience (high supply chain risk). To be clear, supply chain risk is ever present. Even a reading of 100 in the index would not mean zero risk.

Some “resting” risks are simply a part of doing business. Resting risks include the likelihood of a supplier having an accident in the workplace, or the probability that a supplier remains compliant with legislation. These factors will never be eliminated but can be improved over time by raising supplier standards and monitoring the strengths and weaknesses of your supply base.

Achilles scores look at the underlying risk in a country’s supply base centered around legislative compliance, such as health and safety or carbon reporting, and reputational factors, such as modern slavery. Paired with global and regional risk factors, the index casts a wide net of risk elements, providing a comprehensive look at how the base of risk is shifting, globally, over time.

Other risk factors are unpredictable by nature, and can cause large, unexpected disruptions quickly. These “reactive” risks can vary dramatically in the source of the disruption, the lead time organisations have to prepare, or in the cost of the impact. Cyberattacks are the most common disruptive events, but most are usually contained to a single organisation, preventing widespread impacts. Financial crises, on the other hand, can have dramatic global impacts, but often have a lead time of weeks or even months, giving organisations time to prepare for disruption.

Supplier failure was the most common cause of disruption from 2014-2019 (at 28%), followed closely by natural disasters, cyber-attack and trade wars. This mix of resting and reactive risks demonstrates how widespread the source of disruption can be. Naturally, in 2020-2021, COVID and BREXIT have been responsible for the majority of supply chain disruptions.

Businesses are increasingly focused on gaining insight into the varied risk landscape to ensure they respond to disruptions effectively. According to a recent McKinsey study, businesses can now expect a supply chain disruption that lasts for a month or more to occur every 3.7 years. The ASCRI accounts for this dynamic variance by measuring multiple elements that can lead to disruption, giving you the best possible chance of preparation.
The Achilles Supply Chain Resilience Index (ASCRI) is a time series index measuring changes in supply chain risk. The index measures underlying supply chain risk by country across six categories: Economic, Environmental, Labour Practices, Legal and Governance, Resilience, and Safety and Security. Each country’s score is derived by combining the Achilles’ Scores of suppliers based in the country with that country’s overall performance in those six categories. This framework is then supplemented by a range of global measures, including shipping and sentiment data.

The result is a time series index with a range of 1-100, in which a measure of 1 is the highest possible risk of supply chain disruption, and 100 is the lowest possible risk of supply chain disruption. Below is a guide of how to interpret those ranges.

<table>
<thead>
<tr>
<th>ACHILLES SUPPLY CHAIN RESILIENCE INDEX (ASCRI)</th>
<th>INDEX VALUE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resilience is very high, and risk is significantly lower than average</td>
<td>81-100</td>
</tr>
<tr>
<td>Resilience is high and risk is relatively low</td>
<td>61-80</td>
</tr>
<tr>
<td>Resilience is average and risk is moderate</td>
<td>51-60</td>
</tr>
<tr>
<td>Resilience is lower than average and risk is high</td>
<td>41-50</td>
</tr>
<tr>
<td>Resilience is quite low, and risk is very high</td>
<td>1-40</td>
</tr>
</tbody>
</table>
Risk Factors

Economic Factors:

- Achilles financial score: eligible suppliers in the Achilles network of communities are assessed based on their performance in financial metrics including turnover growth, return on assets, liquidity ratio and profit margins. Anonymised scores are then rolled up into a country score, weighted by turnover.

- Commodity prices are both a leading and lagging indicator of supply chain disruptions – with large increases often preceding a disruption as supplies become scarce or following a disruption that caused a supply shock. Similarly, major declines in prices reflect weakening demand or oversupply that often points to a relaxation in supply chain pressures. The ASCRI includes measures of top commodity price indicators for key raw material inputs to the supply chain, providing a global view of supply chain pressures.

- Country-specific economic indicators: a range of factors provide insight on the underlying risk of supply chain dependency on a specific country or region. Debt dynamics, inflation, financial systems, and infrastructure carry implications for supply chain performance by country and are therefore included in our assessment of country-specific economic risk.

Environmental Factors:

- Achilles sustainability score: eligible suppliers in the Achilles network of communities are assessed based on their performance in sustainability metrics including the existence of environmental policies, processes, convictions, management systems, sanctions and notices relating to environmental issues and community engagement. Anonymised scores are then rolled up into a country score, weighted by size.

- Achilles financial score: eligible suppliers in the Achilles network of communities are assessed based on their performance in financial metrics including turnover growth, return on assets, liquidity ratio and profit margins. Anonymised scores are then rolled up into a country score, weighted by turnover.

- Global weather impacts: the ASCRI includes global measures of weather phenomenon impact.
Labour Conditions:
- Achilles human rights score: eligible suppliers in the Achilles network of communities are assessed based on their performance in working condition metrics including convictions and policies relating to topics such as modern slavery, equal rights, labour standards and collective bargaining. Anonymised scores are then rolled up into a country score, weighted by turnover.
- Country-specific working conditions scores: the ASCRI supplements these scores with data from international organisations, including flagship indicators such as the number of labour inspectors per employee by country, injury and fatality data, and scores regarding collaborative working.

Legal and Governance:
- Achilles governance score: eligible suppliers in the Achilles network of communities are assessed based on their performance in governance metrics including documentation, insurance, bribery and corruption convictions, quality control and corporate management. Anonymised scores are then rolled up into a country score, weighted by turnover.
- Country-specific scores: each country is measured on the burden of government regulation, corporate governance, openness to trade, and the maturity of the country’s property rights framework to determine a country score for legal maturity.

Safety and Security:
- Achilles health and safety score: eligible suppliers in the Achilles network of communities are assessed based on their performance in health and safety metrics including accidents, fatalities, near misses, health and safety convictions and improvement notices, policies, documentation, management systems and other processes. Anonymised scores are then rolled up into a country score, weighted by turnover.
- Country-specific security scores: each country is scored based on incidences of corruption and the relative geopolitical risk of the country.

Supply Chain Resilience:
- Supply chain disruption is measured in the ASCRI through a combination of factors that reflect the reliability of delivery, including:
  - Worldwide shipping data
  - Social media sentiment indices
  - Disruption indicators