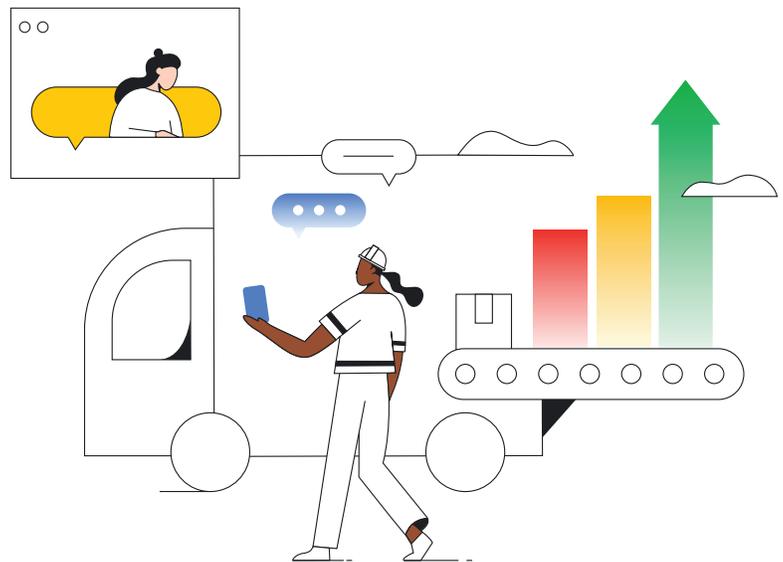




How Data is Driving Resilient and Sustainable Supply Chains



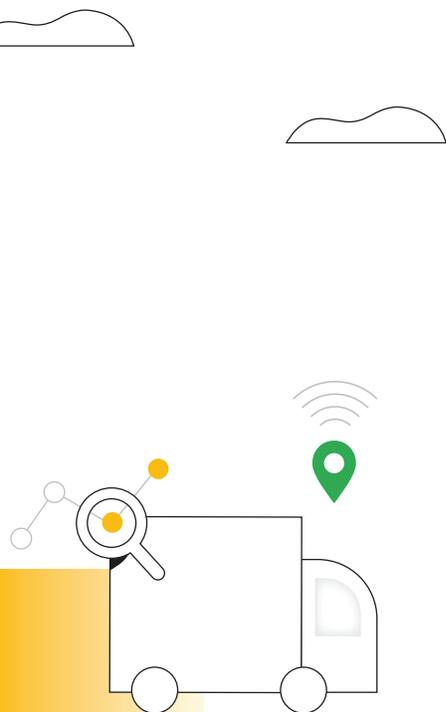
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Overview

Building resilient and sustainable supply chains has become a key priority for companies in every industry, and every region of the world. The COVID-19 pandemic pushed existing supply chains to the brink and the stress exposed the weakness of current designs and execution.



But it's not only pandemics which disrupt and stress supply chains. Extreme weather patterns, and geopolitical events that result in changing tariff, trade and tax policies are occurring with even greater frequency. Supply chain risk and sustainability requirements are closely connected with each other, which leads to the conclusion that a resilient supply chain needs to be sustainable and a sustainable supply chain needs to be resilient.

The circular economy provides a guiding principle to build resilient & sustainable supply chains. It involves gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. This approach requires us to focus on and reimagine three key processes: supply chain design, supply chain monitoring, and supply chain operations.

And this is where data and analytics provide the necessary visibility and intelligence to ensure the supply chain is optimized to reduce environmental impact while being able to adapt and mitigate disruptions in real time.

This requires:



Creating a digital representation of the supply chain that interconnects and brings together data from across the supply chain to provide end to end visibility.



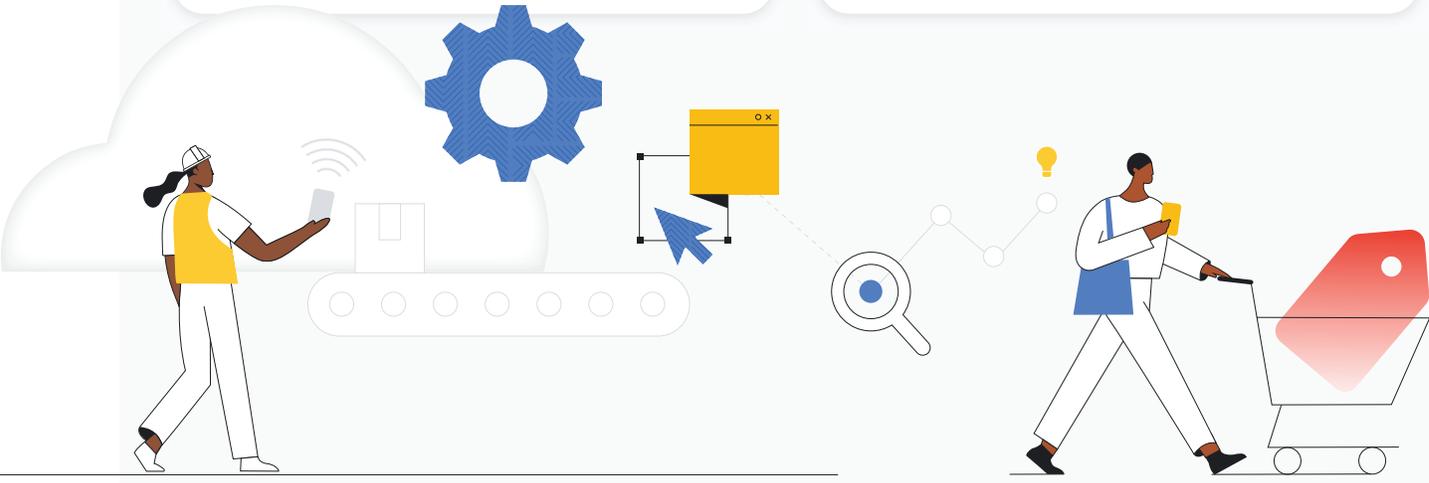
Providing the ability to perform scenario analysis and optimization through simulation to mitigate risks and meet sustainability targets.



Providing supply chain professionals with access to both the collective data, the resulting analysis, and real-time or predictive notifications.

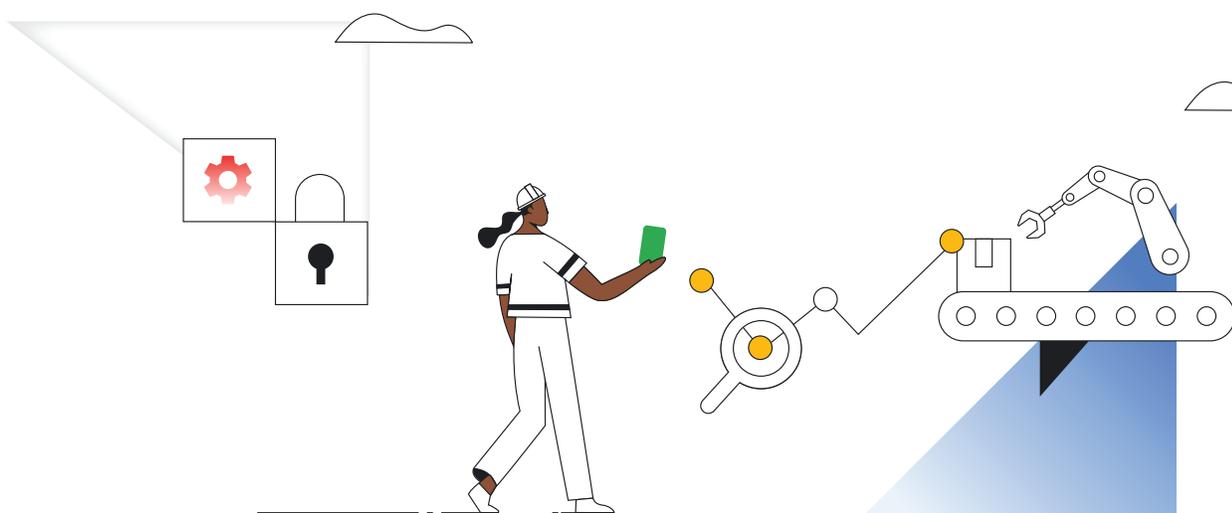


Building a partner ecosystem to support the integration of data, applications and processes with this new digital supply chain platform.



Understanding the resilience and sustainability problem

When the COVID-19 pandemic hit, no one anticipated the level of impact it would have on human life and the economy. Supply chains in particular, were hit—and hit hard. Factories, restaurants and stores shut down or moved to reduced operations. As consumers rushed out to stock up on basic goods, the systemic weaknesses in current supply chains that had been lurking beneath the surface caused many companies to struggle as they attempted to respond to the unprecedented turn of events.



Supply chains need to be more resilient to disruptions such as:



Global and regional health crises

The shutdowns and ramp ups create a bullwhip effect throughout the entire supply chain. In addition, the distribution and logistics networks need to be agile and well planned as the major pharmaceutical companies did in the case of their COVID-19 vaccine rollouts¹.



Weather-related events

The frequency and financial impact of storms, wildfires, floods, earthquakes has been increasing. In fact, climate related disasters have increased by more than 80% over the last four decades².



Geopolitical events

Global trade negotiations and changing tariffs on products very often trigger changes in sourcing and manufacturing locations. Some countries are introducing legislation on human rights and end-to-end supply chain sustainability, which will require companies to have full visibility from raw materials to finished products.

1. Source: Fierce Pharma, March 2021, [What does it take to supply COVID-19 vaccines across the globe?](#)

2. Source: United Nations, October 2020, [Climate-related disasters increase more than 80% over last four decades](#)



Even before the pandemic hit, sustainability was another growing concern for companies. According to the CDP's Global Supply Chain Report for 2020, suppliers expect financial impacts of US\$1.26 trillion from environmental risks in the next 5 years. Many of the environmental risks highlighted by these suppliers will result in cost increases, and if passed on corporate buyers could face a cost hike of US\$120 billion according to the report.

Supply chains are more environmentally responsible and being designed to reduce:

01

Greenhouse gas emissions

In 2020, suppliers actively cut emissions by 619 million metric tons of carbon dioxide, according to the CDP report³. This resulted in over \$33 billion cost savings or a 67% increase in cost savings over the year prior. In many sectors, supply chains are responsible for over 80% of total greenhouse gas emissions.

02

Deforestation

Protecting and restoring forests is already high on the global agenda, due to the Paris Agreement. 27% of global forest loss⁴ can be attributed to deforestation through permanent land use change for commodity production, including beef, soy, palm oil, and wood fiber.

03

Water usage

As companies begin considering their water-related risks, the first step is to understand their withdrawal, consumption, and discharge rates. In 2020, suppliers identified \$248 billion associated with all water related risks, according to the CDP report³.

3. Source: CDP Global Supply Chain Report 2020, [Transparency to transformation: A chain reaction](#)

4. Source: Science, 2018, [Classifying drivers of global forest loss](#)

Supply chain processes that need to be addressed

Looking beyond the current take-make-waste extractive industrial model, a circular economy⁵ aims to redefine growth, focusing on positive society-wide benefits. It involves gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system.

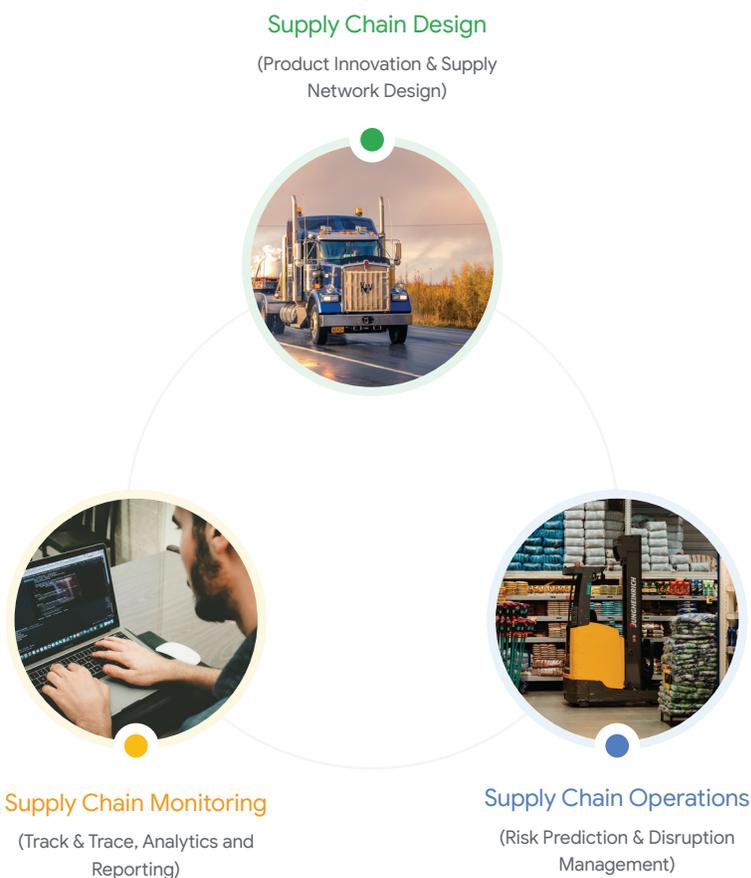


Figure 1

Supply chain processes to address for a resilient and sustainable supply chain

5. Source: Ellen McArthur Foundation, [What is a circular economy?](#)

To build a resilient and sustainable supply chain in a circular economy there are three main processes to address:

01

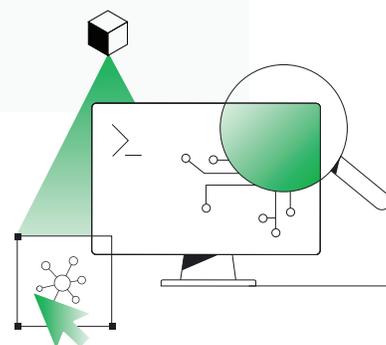
Supply Chain Design

Product innovation: This process has by far the biggest impact on building a resilient and sustainable supply chain. Not only does it predetermine 80% of the supply chain cost, but also 80% of the sustainability cost. It determines

- Which (reusable) materials, ingredients, and components are being used
- Which packaging material is required
- Where to source from
- What is the production process and therefore the energy consumption

Currently companies are not able to consider all these constraints holistically and therefore only make point decisions.

Supply network design: Companies use this process to determine the distribution network, and the recycle & return process. This process is responsible for the remaining 20% of the supply chain and sustainability cost.



Supply Chain Monitoring

Track & trace: This is one of the most critical processes. Most companies only have a connection to their direct suppliers, but don't know the suppliers' to their suppliers and their locations. Building an effective track & trace process requires a network of companies, sharing information. But technology such as satellite information for deforestation, water, agriculture and mining efforts, can enable an ongoing monitoring process. Also, technologies such as Blockchain and 5G are important for this process in addition to the sensors on products, pallets, etc.

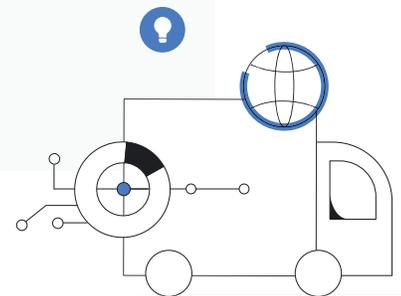
Analytics & reporting: Collecting all this information requires a scalable data lake and the integration of many data sources.



Supply Chain Operations

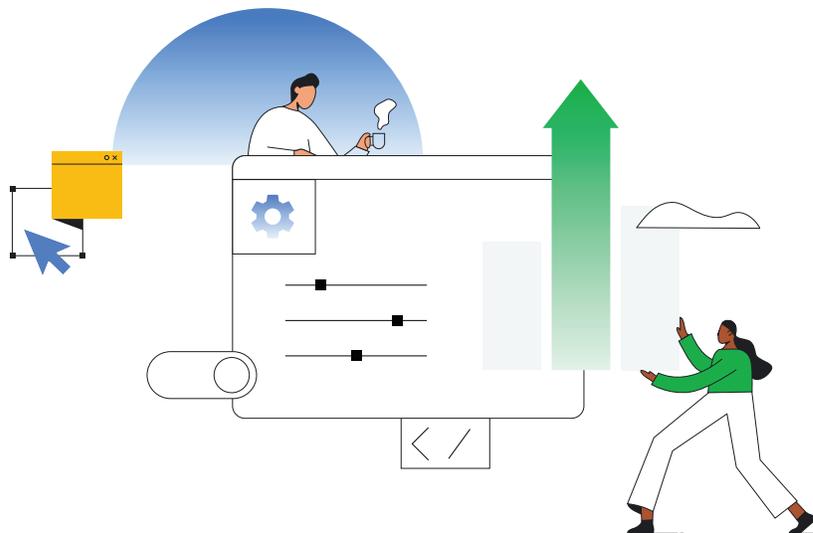
Risk prediction: Having the data available enables the possibility of predicting risks. This information can be used to determine inventory levels and a much faster response to increasing risk levels.

Disruption management: Currently companies make short term decisions based solely on cost impacts. Disruption management needs to take risk management and sustainability information into account to guide supply chain professionals.



The role of data in providing the solution

The solution requirements to address these processes for a resilient and sustainable supply chain involve integrating multiple data sources, enabling collaboration with a network of suppliers, and developing innovative artificial intelligence (AI) and machine learning (ML) algorithms to provide valuable insights, predictions and recommendations.



This collective data will then be used to:

01

Build an end-to-end supply chain model

- The first step is to model the business network, which includes multi-tier suppliers, logistics partners, manufacturing partners, equipment manufacturers, service providers, and of course the customers. It's not only important to understand who the partners are, but all their locations which are relevant for your business.
- The second step is to model all the products, components and inputs which are used in this network.

02

Monitor risk levels

- Companies need to differentiate between the three major risk categories, the natural, operational, and financial risks.
- Natural risks include the extreme weather-related events we discussed earlier.
- Operational risks refer to forecast accuracy, inventory positioning, supply shortages and asset downtime.
- Financial risks include the risk profiles of business partners, typically provided by financial institutions.



03

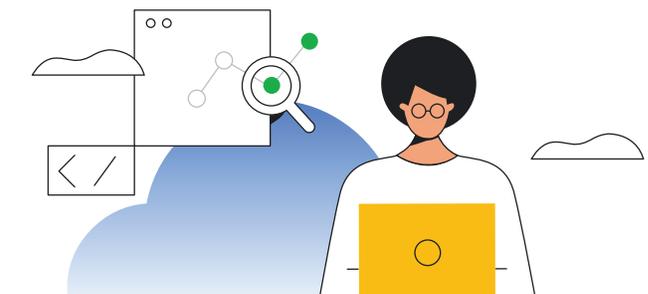
Monitor sustainability

- Most companies have started monitoring greenhouse gas emissions. There is scope 1, scope 2 and scope 3 data. Scope 1 covers the direct emissions caused by the enterprise itself. Scope 2 refers to energy consumption, specifically the share of renewable energy. Scope 3 are indirect emissions caused by business partners in the end-to-end supply chain.
- For the circular economy there are a number of indices available by industry (reuse of components, share of recycled materials, etc).
- Social responsibility requires monitoring environmental information (e.g. geo-spatial information on deforestation, water, agriculture, mining, etc) as well as human rights by using technology.

04

Leverage AI/ML algorithms to predict risks and sustainability impact

- Risk management and sustainability processes are currently focused on analytics and scoring mechanisms.
- The next step is to use AI/ML algorithms for product innovation, supply network design, risk prediction and disruption management.



Architecting the digital supply chain platform

The comprehensive platform consists of four pillars:

01

A digital twin of the supply chain

- This is the digital representation of the physical supply chain. The twin is company-specific and represents the company's data. We have defined three segments for the digital twin – a private segment, a community segment, and a public segment.
- The private segment focuses on enterprise data sets by connecting to one or several ERP systems. The relevant data sets include location and product information, operational risk information (typically related to predictive maintenance of assets), and scope 1 greenhouse gas emission information.
- The community segment enables trusted collaboration between business partners by simply sharing data views in a secure environment and avoiding costly electronic data interchange (EDI) or application programming interface (API) integrations. Collaboration on risk and sustainability information is key and the relevant data sets are scope 3 greenhouse gas emission information (e.g. from logistics service providers), but also risk information can be shared between business partners.
- The public segment includes publicly available information which is relevant to create a comprehensive view of the supply chain. This includes data sets such as business news, weather information, traffic information, satellite information, risk management data, greenhouse gas emission information.

02

User access and supply chain pulse

Access to the digital twin's information should be available to supply chain professionals on all their devices (mobile, laptop, command center) and enable them to receive alerts, analyze data, communicate with colleagues or business partners, and to trigger simulations.

03

Supply chain simulation and optimization

Resilient & sustainable supply chain processes are huge data problems and AI/ML algorithms enable companies to significantly reduce risks and meet sustainability targets. There are two time horizons to consider, the intra-day horizon to solve immediate issues and the tactical/what-if horizon.

04

Supply Chain Partners

Key for the strategy to succeed is to provide data sets for risk and sustainability information. Companies have established partner relationships for some of the data sets, but the goal should be to build a comprehensive ecosystem of partners that address two key areas, data aggregation and applications.

Conclusion

Building a resilient and sustainable supply chain is a key priority for most companies.

At Google we have been carbon neutral since 2007. By 2030, we aim to be the first major company to operate carbon free. We are committed to helping companies on their path to sustainability, both within their IT operations and across their supply chains. With carbon-free energy scores, businesses can choose Google Cloud data center regions that are optimized for lower carbon emissions.

We also enable companies to build digital supply chain platforms that address their end to end visibility, resiliency and sustainability needs. By combining cloud computing, satellite imagery and AI, we helped a multinational consumer product company create a more holistic view of their supply chain's environmental impact and raise their sustainable sourcing standards. By leveraging AI to dynamically optimize fleet routing, a global logistics provider was able to reduce their annual fuel consumption by 10 million gallons (approximately 38 million liters) and save over 400 million US dollars.

To learn more about creating a resilient and sustainable supply [chain](#), [visit our supply chain and logistics solution](#) page or [contact us](#) online.

