

Supply Chain Prime

A brief on contemporary supply chain management topics



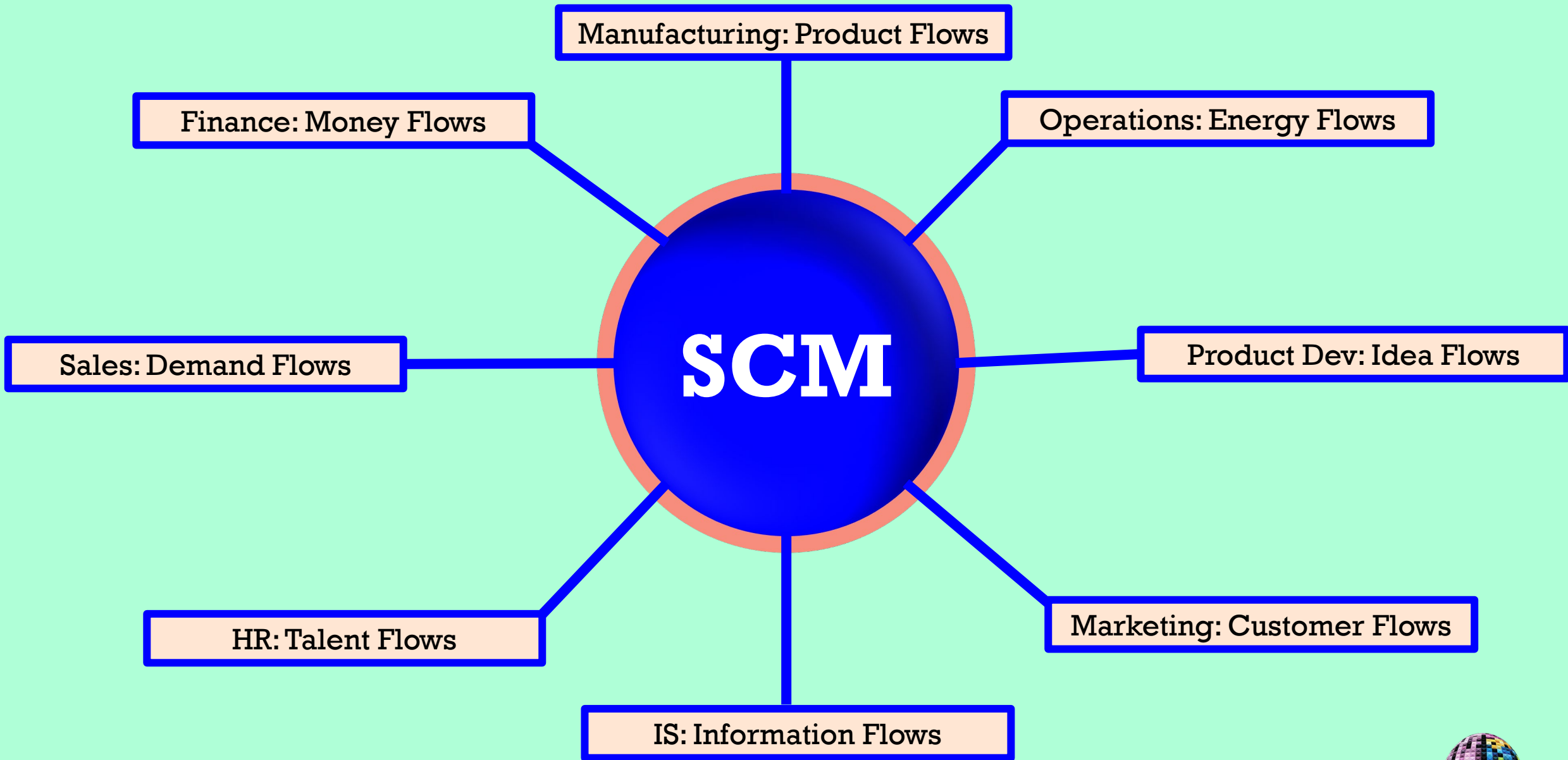
Topics

- 📍 **Uncertainties and the Supply Chain**
 - 📍 Living with uncertainty
 - 📍 Supply chain resilience
- 📍 **Let AI influence the Chain**
 - 📍 The ready (or not so ready) promise of AI
 - 📍 Chat GPT (or other generative AIs) supply chain use cases
- 📍 **Circling the Chain**
 - 📍 The circular economy and sustainability
 - 📍 The challenges with circular supply chains



What is Supply Chain Management?





What is Uncertainty?



It seems, living with high degrees of uncertainty is becoming the new 'business as usual' normality. No longer are we simply seeking to manage the common or known risks of supply chain management; its now important to test chain linkages to help understand the business impact of disruptive events, especially those that may create long-term shocks and threaten survivability

Uncertainties

The certainties of uncertainties is they are certain, Stuff happens

[Adobe Firefly](#) AI: Prompted: "create an image of uncertainty"

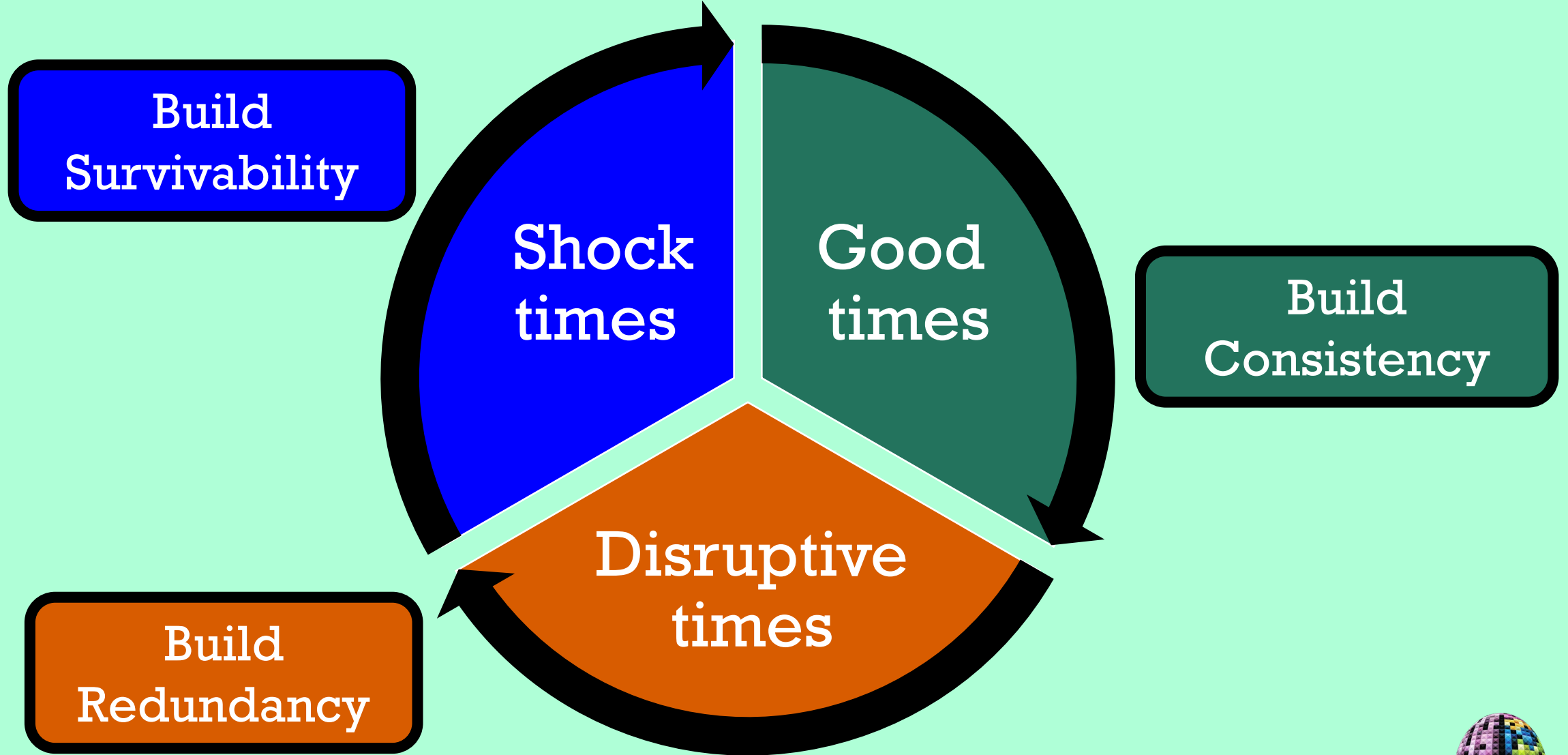


Uncertainties & Supply Chain Resiliency

- 📍 Many small to medium size manufacturers do not have the resources (time, talent, treasure, technologies) to implement supply chain stress testing.
- 📍 However, there are several lowtech and effective methods to assess and think about supply chain resiliency
 - 📍 Uncertainty categorization
 - 📍 Uncertainty indexes
 - 📍 Uncertainty and product supply categorization
 - 📍 Supply chain network mapping
- 📍 *Critical to stress testing*, it isn't so much the method of testing, it's the discipline to set aside time (annually at least) to evaluate supply chain performance and uncover vulnerabilities.



Supply Chain Resilience



Geopolitics: Governments seem to be everywhere all at once

They want to correct the problem of globalization by winning back manufacturing jobs

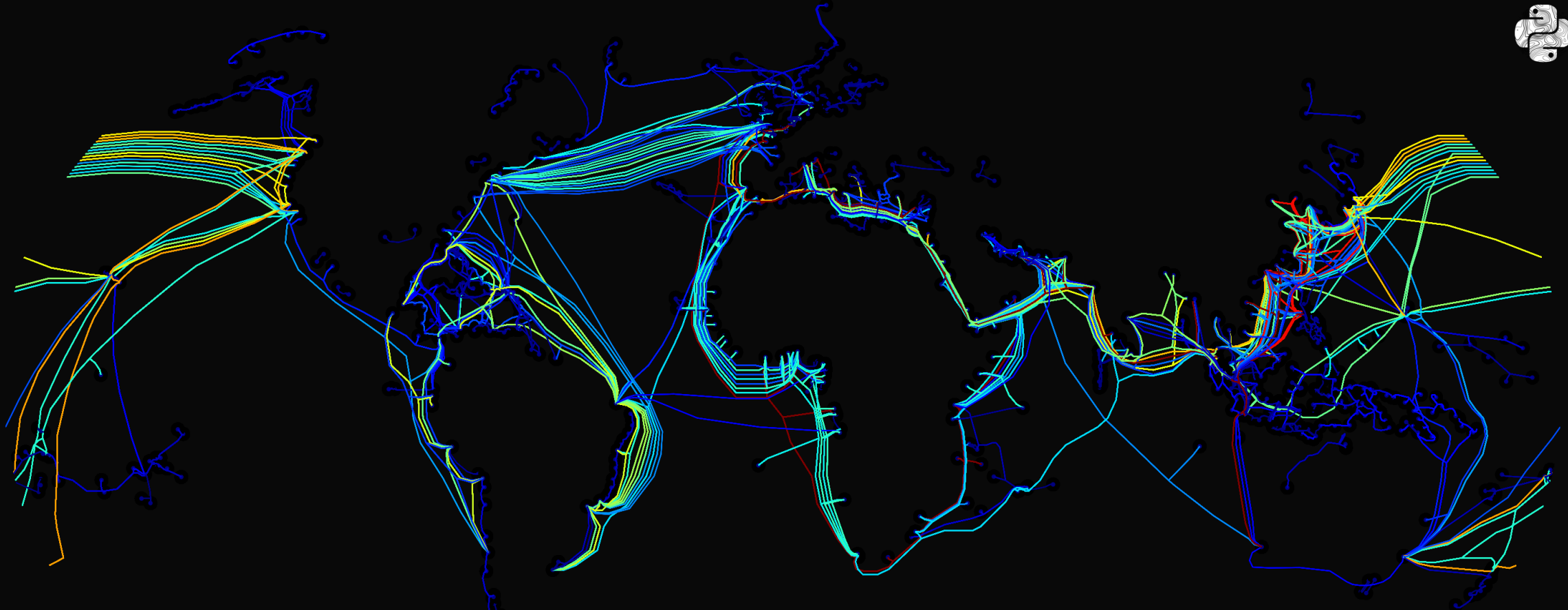
They want to enhance national security by protecting vital technologies

They want to fight climate change by speeding up decarbonization

The Overstretched CEO: Economist July 29th – August 11, p 9



Charting the Depths: The World of Subsea Cables



With data demand surging, at least \$10 billion is expected to be invested in subsea cables worldwide between 2022 and 2024, driven by cloud service providers and content streaming platforms.

Undersea Cables @PythonMaps

The map depicts active and planned submarine cable systems, their landing stations, cable length, ready for service (RFS) date, owners, suppliers, and website. Data accessed - October 2022.

Data Source - <https://www.submarinecablemap.com>.

Charting the Depths: The World of Subsea Cables (visualcapitalist.com)

Length (Km)

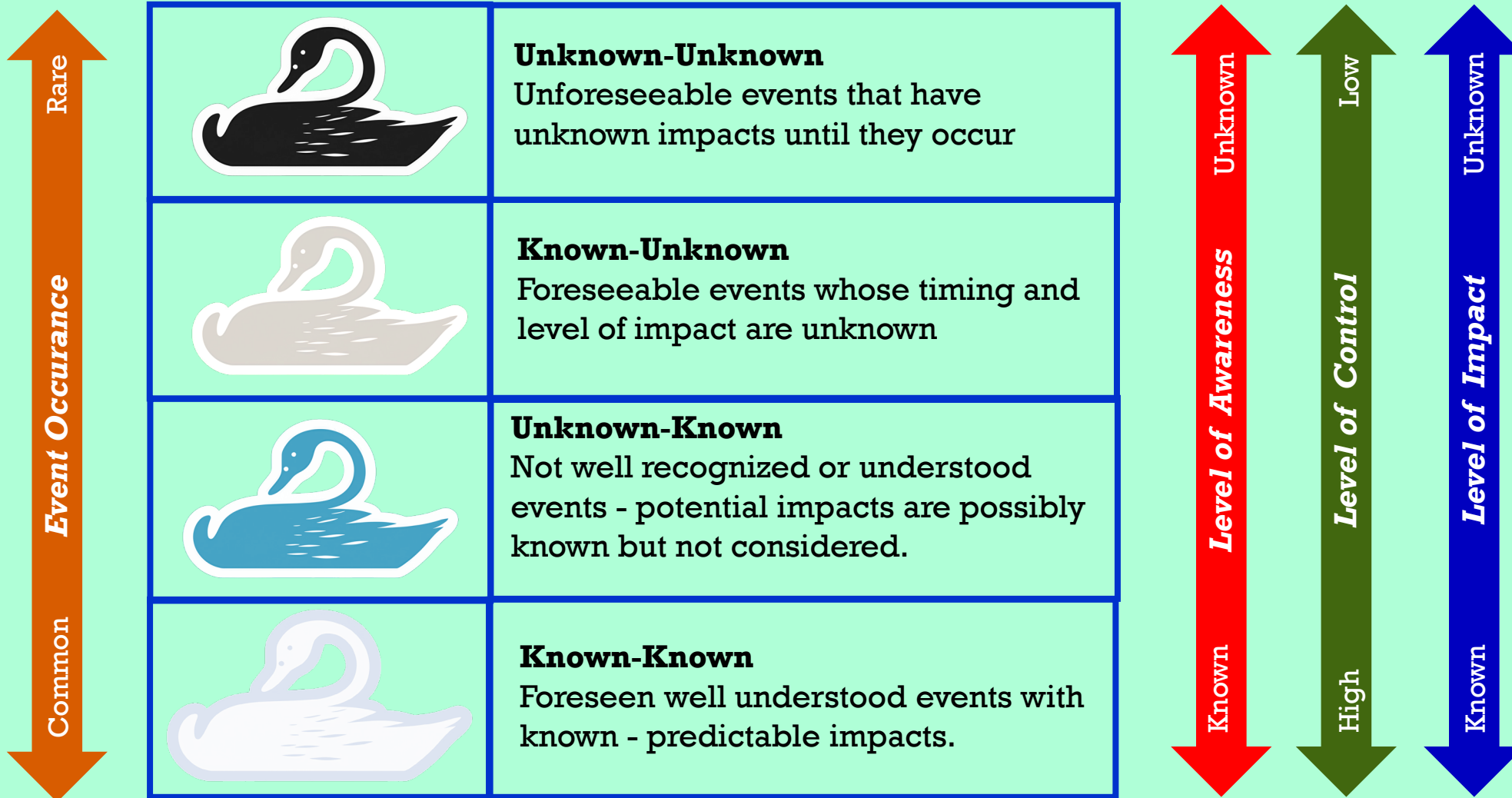


By Adam Symington 9-23-2023

Categorizing Uncertainty



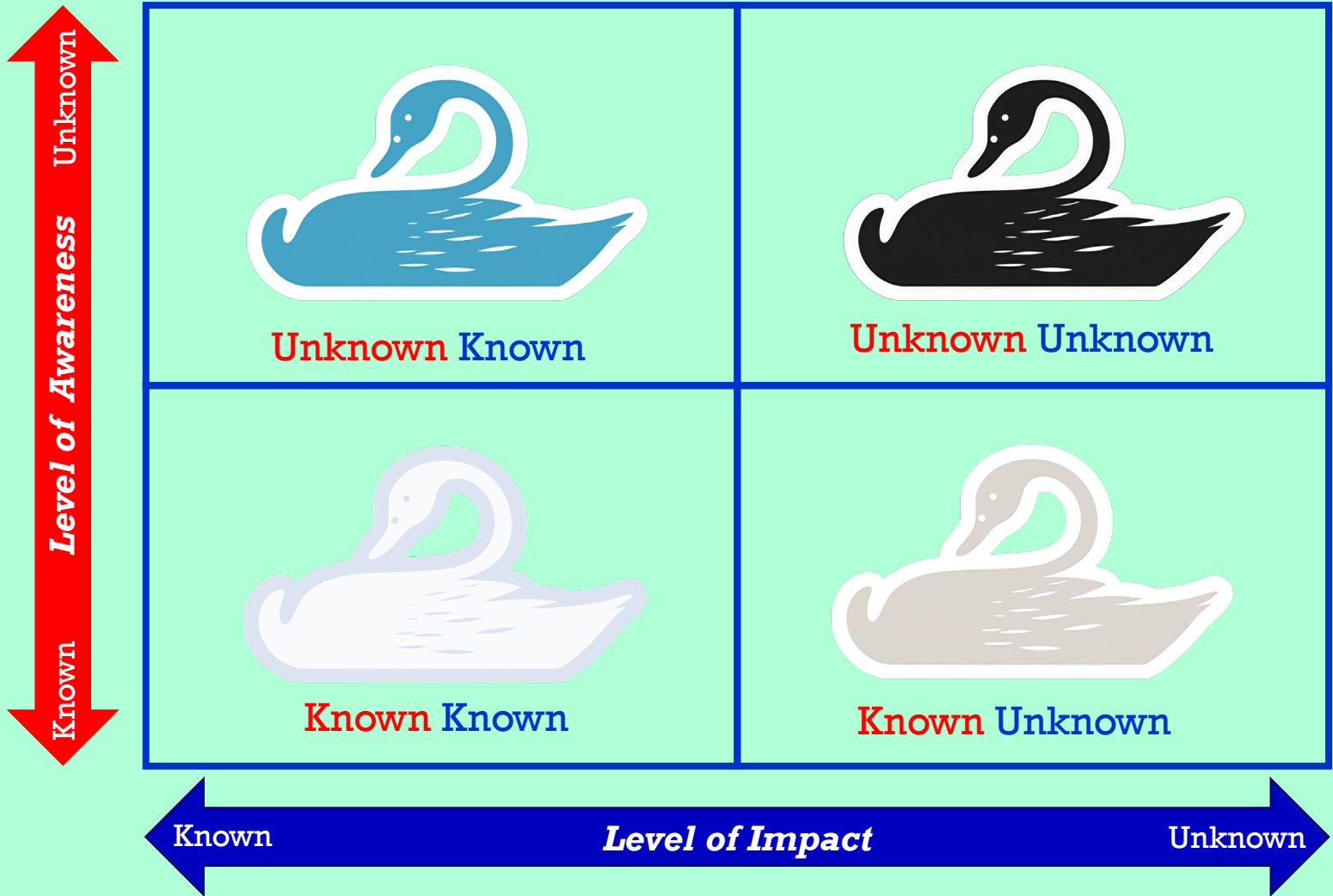
Uncertainty Categorization



- Nassim Nicholas Taleb made the term Black Swan a common description of impacts of highly improbable events
- Known-Unknown classifications adapted from Dimitry Ivanov



Uncertainty Matrix



Known-Known

Foreseen well understood events with known - predictable impacts

Unknown-Known

Not well recognized or understood events - potential impacts are possibly known but not considered.

Known-Unknown

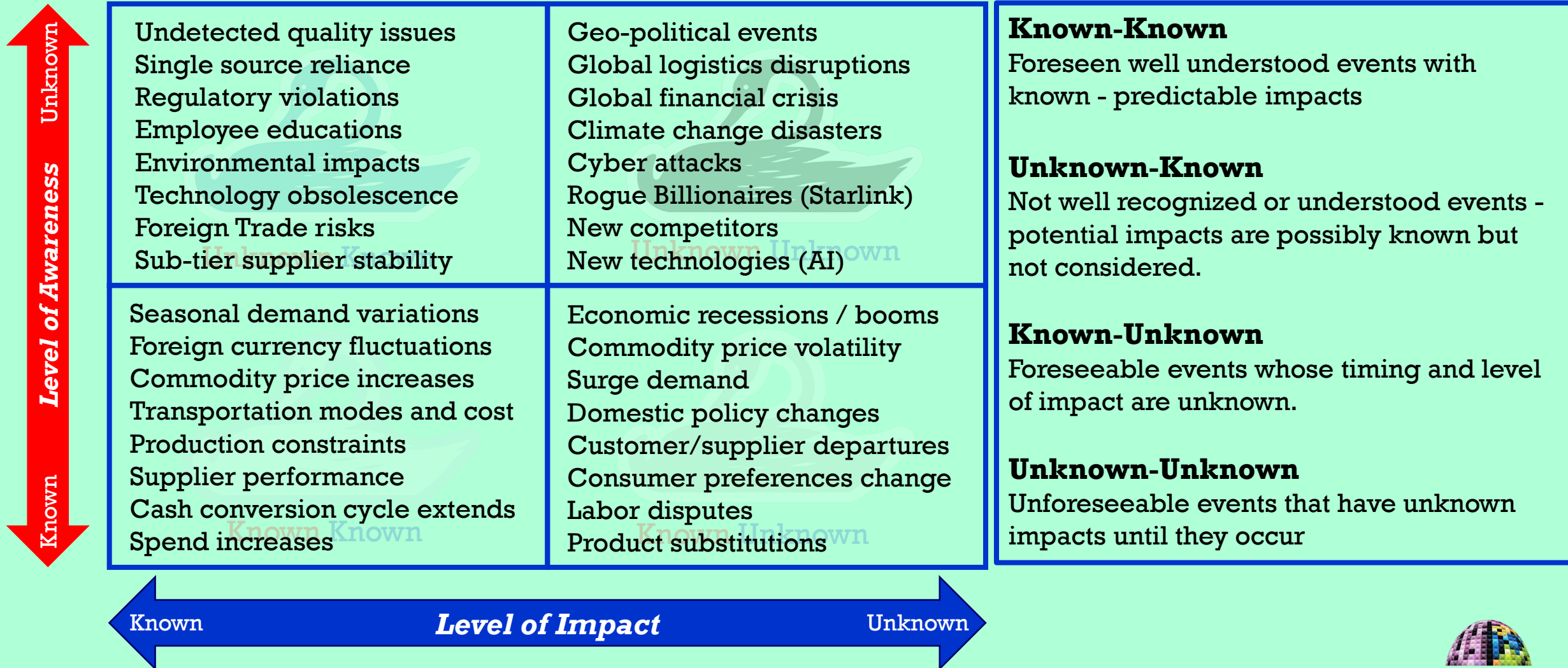
Foreseeable events whose timing and level of impact are unknown.

Unknown-Unknown

Unforeseeable events that have unknown impacts until they occur



Uncertainty Matrix



Known-Known

Foreseen well understood events with known - predictable impacts

Unknown-Known

Not well recognized or understood events - potential impacts are possibly known but not considered.

Known-Unknown

Foreseeable events whose timing and level of impact are unknown.

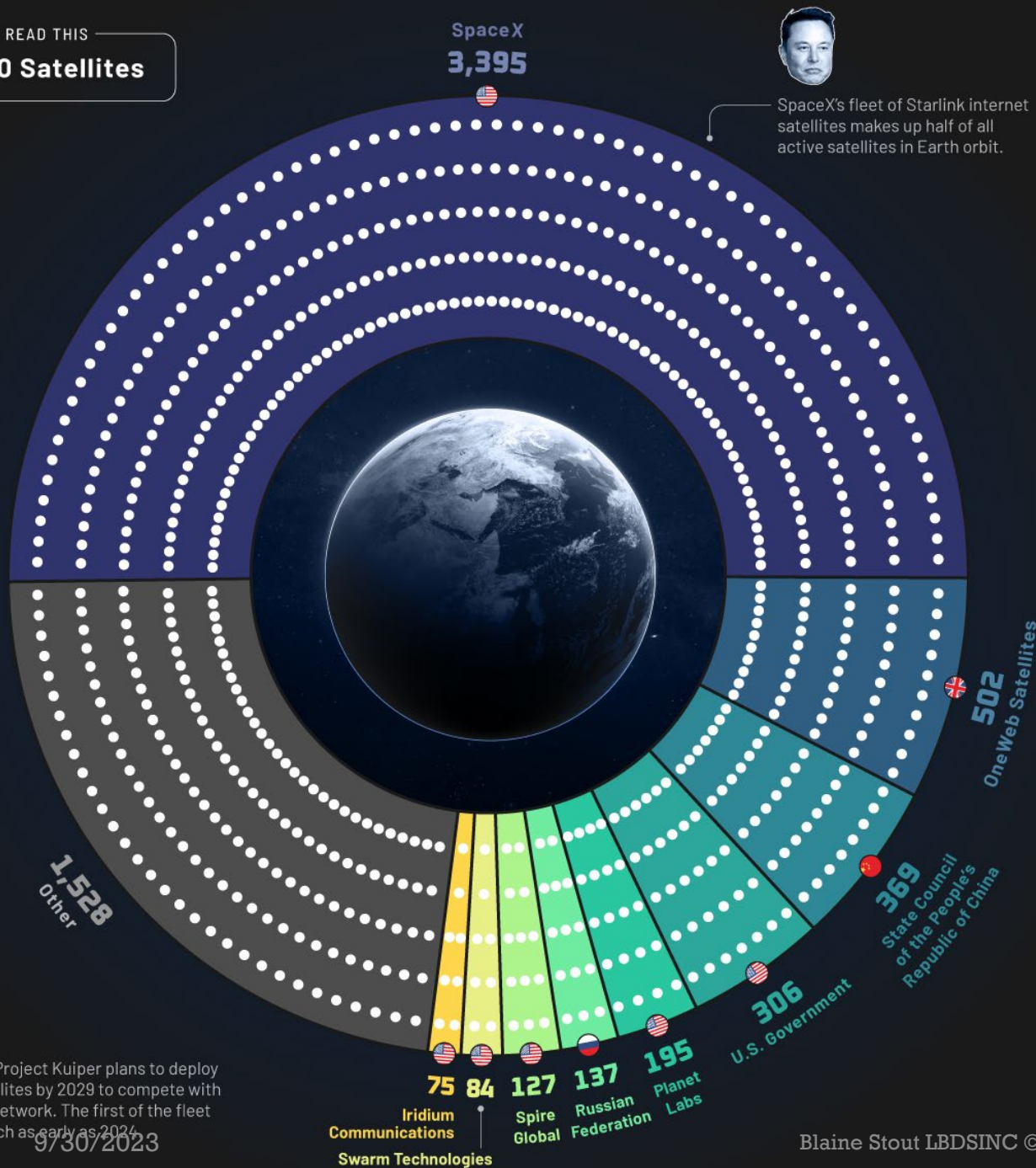
Unknown-Unknown

Unforeseeable events that have unknown impacts until they occur



HOW TO READ THIS

● = 10 Satellites



Amazon's Project Kuiper plans to deploy 3,236 satellites by 2029 to compete with SpaceX's network. The first of the fleet could launch as early as 2024.

Which Companies Own the Most Satellites?

Owner	Total	Share	Country
SpaceX	3395	50.0%	USA
OneWeb Satellites	502	7.0%	UK
Chinese Government	369	5.0%	China
U.S. Government	306	4.0%	USA
Planet Labs, Inc.	195	3.0%	USA
Russian Federation	137	2.0%	Russia
Spire Global Inc.	127	2.0%	USA
Swarm Technologies	84	1.0%	USA
Iridium Communications, Inc.	75	1.0%	USA
Other	1528	23.0%	

SpaceX's Dominance in Space

“SpaceX, led by Elon Musk, is unquestionably the industry leader, currently operating the largest fleet of satellites in orbit—about 50% of the global total.

The company has already completed 62 missions this year, surpassing any other company or nation, and operates thousands of internet-beaming Starlink spacecraft that provide global internet connectivity.

Starlink customers receive a small satellite dish that self-orientates itself to align with Starlink's low-Earth-orbit satellites.”

Which Companies Own the Most Satellites? (visualcapitalist.com)

By Bruno Venditti 9-23-2023

Quantifying Uncertainty



Uncertainty Index (known, knowns)

Uncertainty	Uncertainty Value	Occurance Probability	Effort Index	Complexity Size	Uncertainty Value
Seasonal demand surges	3	10%	0.30	Small	3
Foreign currency fluctuations	3	5%	0.15	Factors related to the uncertainty are very well understood	
Commodity price increases	5	15%	0.75	Moderate	5
Transportation modes and cost	5	20%	1.00	Factors related to the uncertainty are somewhat well understood	
Production constraints	5	25%	1.25	Large	8
Supplier performance	13	5%	0.65	Factors related to the uncertainty are not very well understood	
Cash conversion cycle extends	8	15%	1.20	Extra Large	13
Spend increases	5	5%	0.25	Factors related to the uncertainty are not well understood	
Totals and Average		100%	0.69375	Exceptional	21
				Factors related to the uncertainty require resources not present	

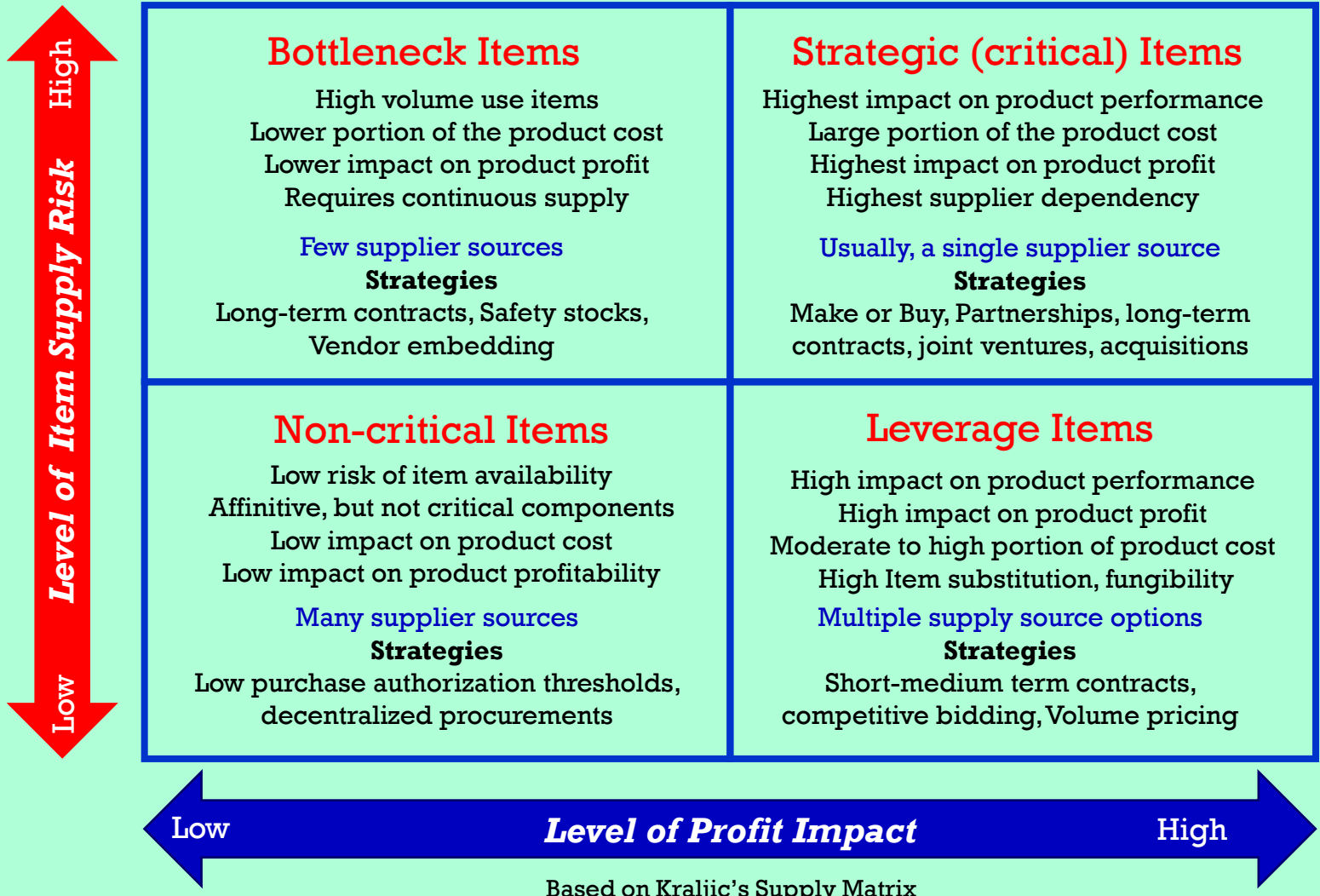
The index is subjective to complexity values and probabilities assigned to the uncertainty. Using a Fibonacci sequence, the scale helps measure levels of complexity and can be relative to level of resources required (time, talents, treasures, and technologies) to manage the uncertainty.



Mapping Uncertainty



Uncertainty and Supply



Based on Kraljic's Supply Matrix

Strategic Items Data

Detailed market data
Long-term Supply and demand forecasting
Competitive intelligence
Industry data

Bottleneck Items Data

Near-term Supply and demand forecasting
Detailed material - supplier data
Inventory levels, locations, and costs
Production variabilities
Maintenance downtimes

Leverage Items Data

Near-term Supply and demand forecasting
Detailed material - supplier data
Transport modalities and rates/costs
Material performance and fungibility options

Non-critical Items Data

Short-term demand forecasting
Item order history
Spend projections
Spend alternatives



Supply Chain Node Mapping

Node Factors

Supplier

Tier Level

Location (Lat and Long)

Material or parts supplied from this location

Criticality

Item

Cost

Annual Volume

Days of supply

Annual dollar purchases

Lead times

Supplier Risk Assessment

Vendor alternatives

Financial stability

Operational stability

Collaboration

Disruption mitigation

Alternate suppliers

Alternative materials

Inventory strategies

Why map the supply chain?

To learn of vulnerabilities

To stress test its resilience

To assess cost impacts

To assess sales and profit impacts

To understand Supplier

Total Cost of Supply (TCS)

Total Revenue Contribution (TRC)

Time to survive [TTS]

Maximum length of time the entire supply chain can continue to function normally before the ripple effects of the disruption affect performance (Simchi-Levi)

Multiple ways to measure resiliency: e. g. Sales lost when the SC is disrupted

Time to recover [TTR]

The time it takes for a node to be restored to full functionality after it has been initially disrupted (Simchi-Levi)

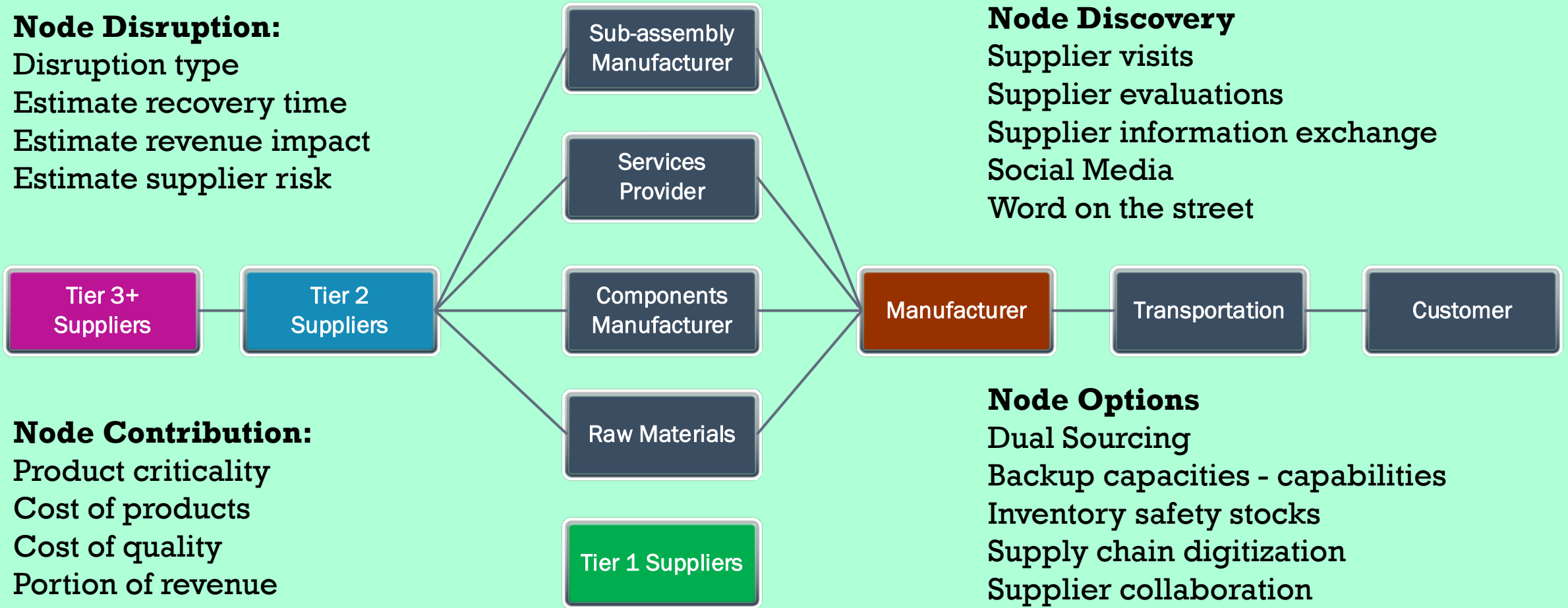
= Time to resolve the disruption + Time to resume normal operations



Supply Chain Node Mapping – Ripple Effects

Node Disruption:

Disruption type
 Estimate recovery time
 Estimate revenue impact
 Estimate supplier risk



Node Discovery

Supplier visits
 Supplier evaluations
 Supplier information exchange
 Social Media
 Word on the street

Node Contribution:

Product criticality
 Cost of products
 Cost of quality
 Portion of revenue
 Total cost of supply

Node Options

Dual Sourcing
 Backup capacities - capabilities
 Inventory safety stocks
 Supply chain digitization
 Supplier collaboration
 Verticalization
 Supplier embedding



Supplier Chain Resilience

📍 Takeaways

- 📍 Plan for uncertainty through frequent supply chain reviews
- 📍 Employ simple exercises to assess types & impacts of uncertainties
- 📍 Employ simple exercises to assess item criticalities
- 📍 Employ simple exercises to map supply chain vulnerabilities
- 📍 Do deeper dives into understanding vulnerabilities
- 📍 Stress test assumptions based on disruption scenarios



As manufacturers embrace the digital productivity promise of Industry 4.0 & 5.0, AI will become a more prevalent technology investment to aid in guiding strategic, operational, and risk management outcomes



Let AI Influence the Chain

The promise of AI and Supply Chain Use Cases

AI's been around since 1955, McCarthy

Chat about ChatGPT & AI?

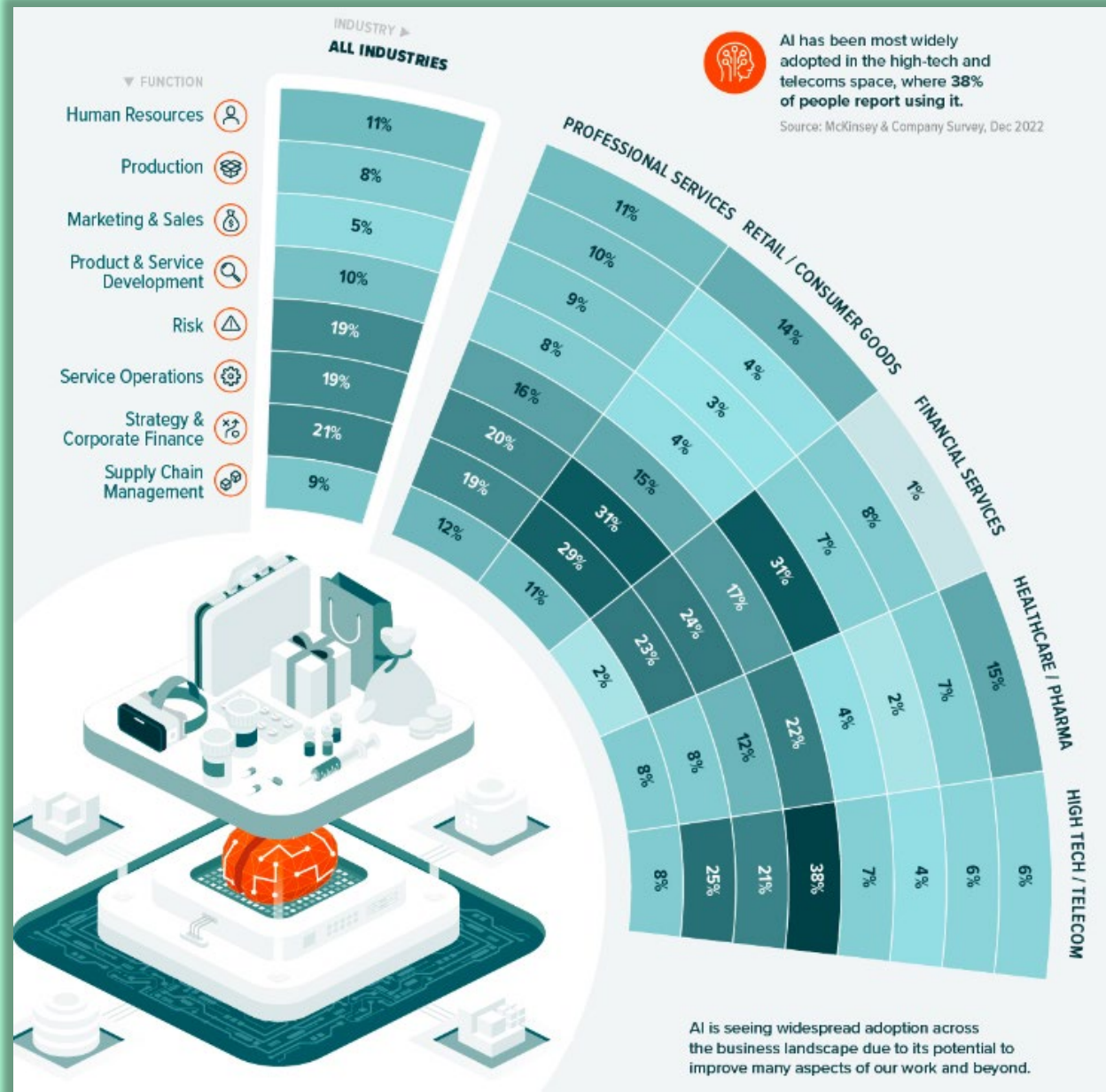
- 📍 *“AI is a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions” (OECD 2019).*
- 📍 *ChatGPT and AI in general are prediction technologies*
 - 📍 Comprised of Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision (CV) applications with the ability to learn and train on vast amounts and types of data.
 - 📍 With capabilities of prediction, detection, and classification.
- 📍 *AI Attributes*
 - 📍 Helps identify and create new business opportunities
 - 📍 A general-purpose technology (GPT) with cross-function capability on problem solving
 - 📍 Requires only human capital (albeit, highly skilled) to interact with AI technologies
 - 📍 Open-source technologies, simultaneously used by competitors, key being data ownership



Generative Pre-Trained Transformer (GPT)

- 📍 *Trained using RLHF (reinforced learning from human feedback)*. Data in the form of words, numbers, images, audio, etc., are transformed into machine language (ML) and through natural language processing (NLP) is trained to respond in a conversational manner,
 - 📍 What GPT and AI in general promises is to help solve problems, through its capability to ingest and analyze vast amounts of data, and by continuously learning spot patterns that may not be visible to human eyes.
 - 📍 AI requires humans to provide everything it needs to be useful.
 - 📍 We also know, data can be inaccurate: inventories, machine, material handling, point of sale, sensors, and other data from both human and automated sources often require validation.
- 📍 *The rise of the Prompt Engineer*
 - 📍 For GPT and AI to learn, requires constant questioning and correction to its responses.
 - 📍 Learning how to ask questions of AI that invite more correct (albeit, cross-checked) responses.
- 📍 *Humans are good at rational thinking* (sometimes), making sense of uncertainty, and processing real world situations.
 - 📍 Our shortcomings lie in comprehending and synthesizing complex problems, this is the capability AI offers
 - 📍 AI's real-world sensing is only as good as the data it's fed and retrained on, even then its predictive ability still requires validation.





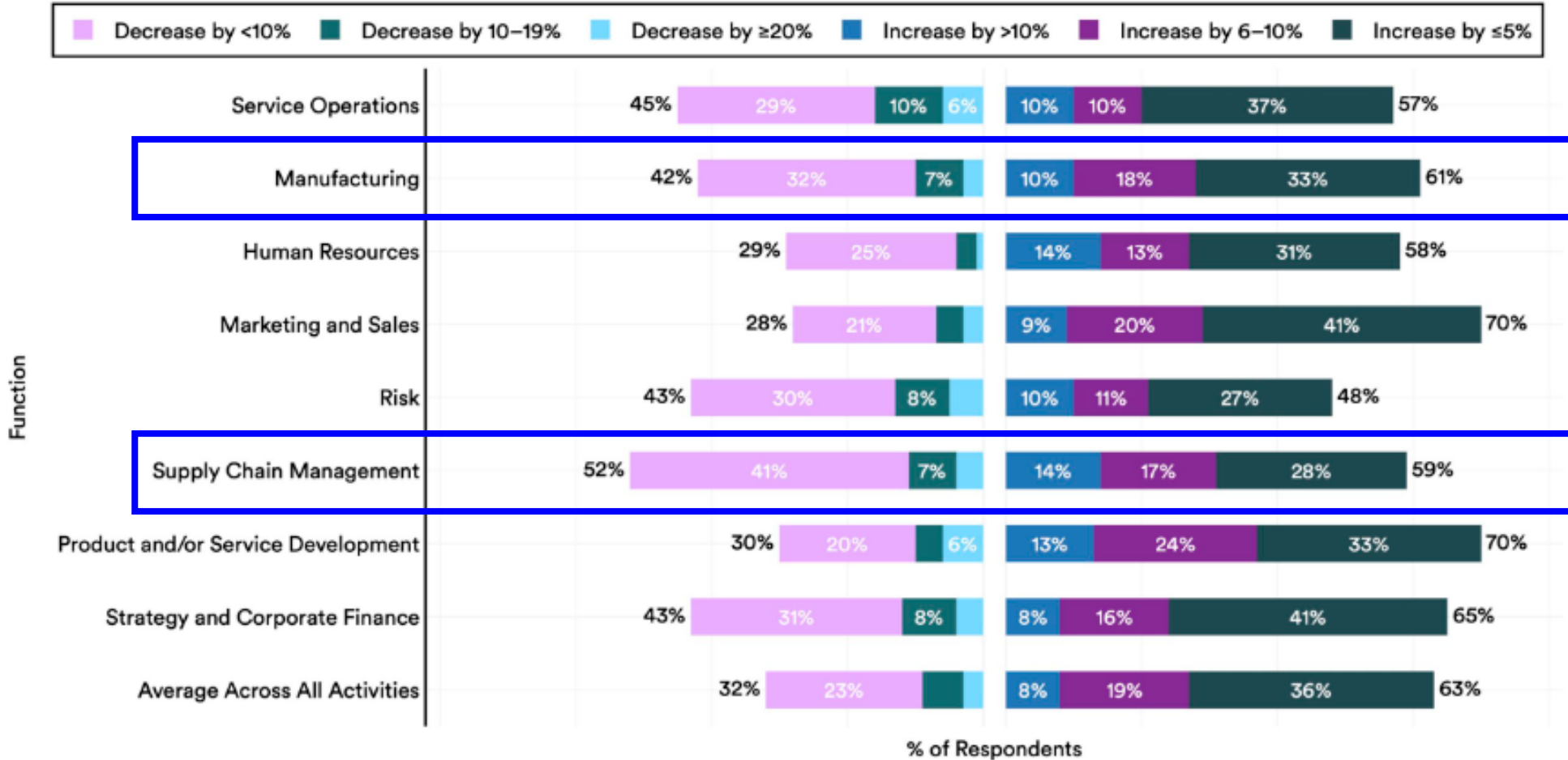
Whose Adopting AI?

[AI Adoption is Growing, but Who Uses It and For What? \(visualcapitalist.com\)](https://www.visualcapitalist.com)



Cost Decrease and Revenue Increase From AI Adoption by Function, 2021

Source: McKinsey & Company Survey, 2022 | Chart: 2023 AI Index Report



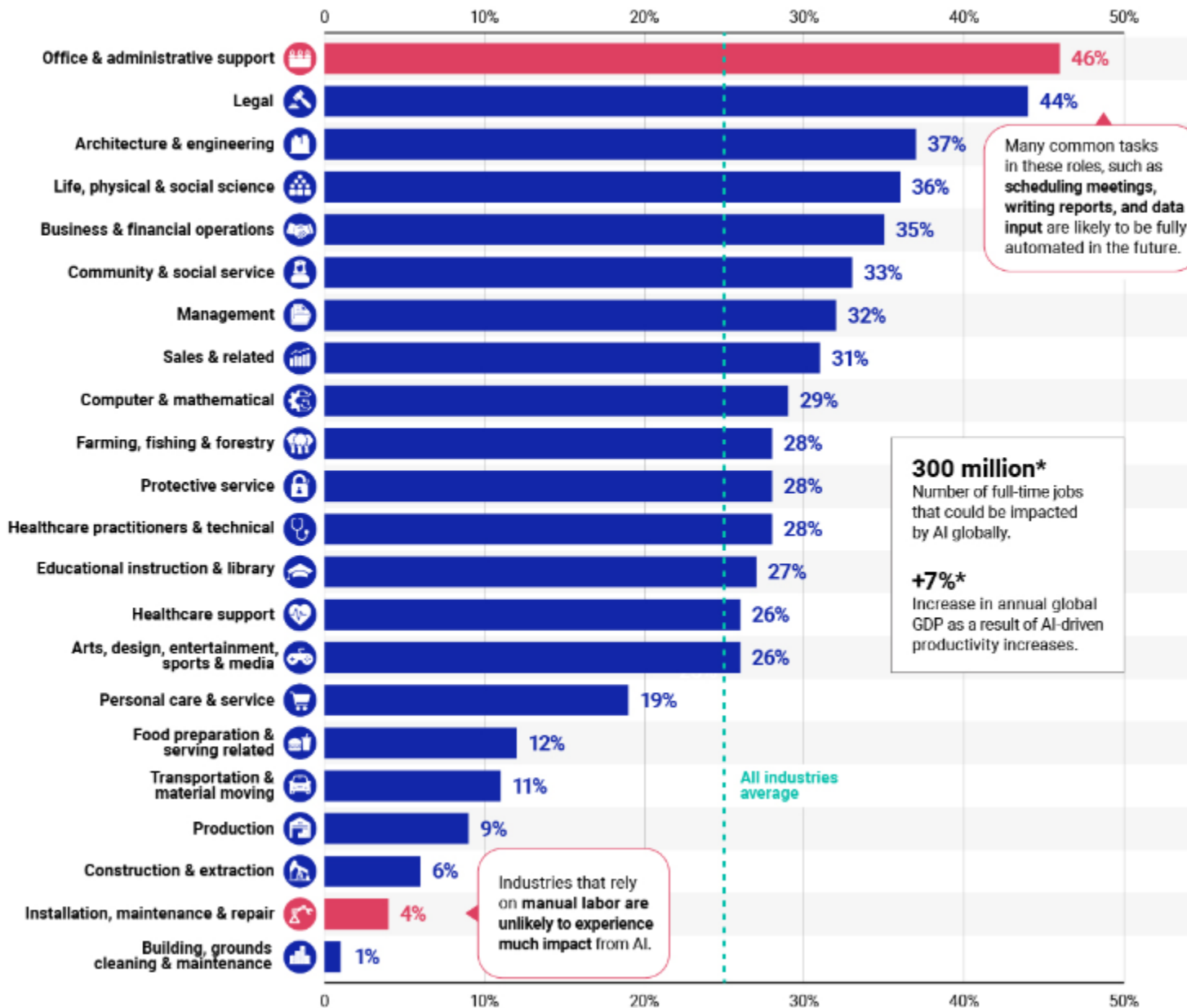
The Benefit?

The proportion of companies adopting AI in 2022 has more than doubled since 2017, though it has plateaued in recent years between 50% and 60%, according to the results of McKinsey’s annual research survey. Organizations that have adopted AI report realizing meaningful cost decreases and revenue increases.

[AI Index Report 2023 – Artificial Intelligence Index \(stanford.edu\)](https://stanford.edu/~srege/pubs/aiindex2023/)



Estimated Share of Employment Exposed to AI Automation



Employment affect?

[The Potentially Large Effects of Artificial Intelligence on Economic Growth \(Briggs/Kodnani\) \(gspublishing.com\)](#)

[Ranking Industries by Their Potential for AI Automation \(visualcapitalist.com\)](#)



Supply Chain Use Cases

📍 Forecasting & Risk Management

- 📍 Real-time data streams collected from a variety of sources can be aggregated and quickly analyzed for demand planning scenarios.
- 📍 Can help anticipate potential supply chain bottlenecks, production capacity issues, inventory flows, and material movements.

📍 Inventory Management

- 📍 Can help optimize inventory levels relative to supply and demand.

📍 Material Movements

- 📍 Can help optimize material movements between distribution centers, stocking yards, and customers

📍 Transportation logistics

- 📍 Can help optimize transportation modalities, route patterns, vehicle downtimes, maintenance efficiencies, and fuel options



Supply Chain Use Cases

📍 Product and process development

- 📍 With the right data, can help with choosing options on materials, product features, and manufacturing processes
- 📍 Could help streamline processes for material procurement, product costing, and waste controls

📍 Communication

- 📍 Automating routine inquiry and response communications with customers and suppliers

📍 Lead-time predictions

- 📍 With historical and real-time data, supplier performance can be anticipated and remedied in advance of potential issues

📍 Virtual simulations

- 📍 SC managers can optimize supply chain linkages with digital twin AI



AI

📍 Takeaways

- 📍 Think about AI usefulness and benefits
- 📍 What functions can benefit from AI
- 📍 What level of talent is required to implement AI
- 📍 What investment in organization education is required
- 📍 How can AI improve on decision making and problem solving



What are circular economies and how are they of importance to supply chain networks

Are CE's right for all industries is of significant debate.

What is of relevance is understanding the ecosystem in which typical manufacturer 'take-make-consume-dispose' models operates.

By examining circularity, innovative, economic and societal benefits may be gained through an expanded awareness of resource-use and resource-re-use

Circling the Chain

Circularity, sustainability and its challenges





Product redesign to minimize waste

Maximize product lifecycle

Conserve natural resources

Rethink energy consumption

Discover recovery/reuse options

[Visualized: The Circular Economy 101 \(visualcapitalist.com\)](https://visualcapitalist.com)



Supply Chain Redesign, challenges & opportunities

- 📍 Economic and financial viability
- 📍 Market competitiveness
- 📍 Product characteristics
- 📍 Regulatory and industry standards
- 📍 Supply chain management
- 📍 Technology investments
- 📍 Servitization business models – revenue on functions, pay per use
- 📍 Closed loop business models – revenue on product

Bressanelli, et al., 2019



Supply Chain Redesign, challenges & opportunities

📍 Economic and financial viability

- 📍 Financial risk – shifts from user to manufacturer (SBMs)
 - 📍 Sales oriented BMs – shifts from manufacturer to user
- 📍 Operational risk – like financial risk
- 📍 Revenue lags between use receipts and time of manufacture

📍 Market competitiveness

- 📍 Product cannibalization, CE designed longer lifecycle products versus traditional
- 📍 Remanufacturing by 3rd parties could lead to IP and Know-how loss
- 📍 Brand reputation – remains by a 3rd party and not the OEM, may not perform as well

📍 Product

- 📍 Fashion sensitive – shelf life
- 📍 Complexity – materials used may pose recovery – reuse challenges
- 📍 Made to desire products – mass customization like complexity may have reuse challenges

📍 Regulatory and standards

- 📍 Taxations
- 📍 Metrics & measures
- 📍 Lack of standards



Supply Chain Redesign, challenges & opportunities

📍 Supply Chain Management

- 📍 Return flows – uncertainties on how end-of-use products are managed
- 📍 Transportation – increased recovery costs
- 📍 A CE product may have less willing supply partners to participate
- 📍 Information sharing among SC tiers
- 📍 Traceability & Tracking

📍 Technology Investments

- 📍 Environmental efficient technology processes – recovery processes
- 📍 Continuous product improvements due to extended lifecycles
- 📍 Data privacy and security



CE

📍 Takeaways

- 📍 Moving to a CE business model can invite creative destruction
- 📍 Traditional products may be cannibalized by longer life products
- 📍 Can longer life products be competitively priced at a premium
- 📍 Can supply chain partners be found to participate in the CE



Thank you

bstout@lbsinc.com



References

- 📍 Bressanelli, G., Perona, M., Saccani, N. 2019. Challenges in supply chain redesign for the Circular Economy: a literature review and multiple case study. *International Journal of Production Research*. 57(23):7395-7422
- 📍 Goldman Sachs. The Potentially Large Effects of Artificial Intelligence on Economic Growth (Briggs/Kodnani) (gspublishing.com)
- 📍 Ivanov, D., 2022. Stress testing supply chains and creating viable ecosystems. *Operations Management Research*. 15:475-486
- 📍 Kennedy, A., 2023. A visual Guide to AI Adoption, by Industry. Visual Capitalist
- 📍 Lu, M., 2023. Ranking Industries by Their Potential for AI Automation. Visual Capitalist
- 📍 Neufeld, D., Jamshed, P. 2022. The Circular Economy 101. Visual Capitalist
- 📍 Simchi-Levi, D., Simchi-Levi, E., Kaminsky, P., Shankar, R. 2022. *Designing and Managing the Supply Chain*. McGraw Hill
- 📍 Stanford. AI Index Report 2023 – Artificial Intelligence Index (stanford.edu)
- 📍 Taleb, N.M. 2010. *The Black Swan*. Random House

[AI Adoption is Growing, but Who Uses It and For What? \(visualcapitalist.com\)](https://visualcapitalist.com)



Uncertainty: Geopolitics

- 📍 Going Global with China created lower cost goods and Supply Chain efficiencies
- 📍 Past decade, concerns over China's global ambitions, led to placing a myriad of tariffs, FDI reviews, and export controls on many sensitive technologies
 - 📍 Recent US pressure to police private sector FDI in China as a stalwart on China aggressiveness
 - 📍 Constrain China's military and geopolitical rise through its access to state-of-the-art technologies.
- 📍 Administration risk-mitigation emphasis on 'friend-shoring'
 - 📍 Companies moving manufacturing out of China to USA friendly countries
 - 📍 Costs to friend-shore may be higher but worth the trade off by the US having safer country relations and in turn mitigating company / country risks.
 - 📍 Problem being, many of the companies within friendly countries still rely on China for material inputs
 - 📍 This reliance may adversely impact on 'friend-shoring' initiatives, with China at the back-door of many SE Asia countries, balancing geo-political relationships with the US and China may be at odds.



Supply Chain Node Mapping

Ripple effect: Disruptions at one node in the supply chain impacts others. Leading to reverberations at all tiers within the supply chain.

Bullwhip effect: Small fluctuations in upstream demand can lead to larger downstream fluctuations.

Time to survive [TTS]

Maximum length of time the entire supply chain can continue to function normally before the ripple effects of the disruption affect performance (Simchi-Levi)

Multiple ways to measure resiliency: e. g. Sales lost when the SC is disrupted

Time to survive [TTS]

Maximum length of time the entire supply chain can continue to function normally before the ripple effects of the disruption affect performance (Simchi-Levi)

= Time to resolve the disruption + Time to resume normal operations

Risk exposure index

Weighted ranking of direct and indirect suppliers identifying supply chain weak links



Chips, Bolts, & Bolts

