Grid Dynamics Whitepaper

Supply chain resilience:

a modular framework for sailing through disruption

www.griddynamics.com

Grid Dynamics

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Introduction

We're living in a world where disruption to operations and supply chain management is the new normal. This environment of constant change and shifting policies requires organizations to operationalize an effective strategy to not only withstand, but sail through disruption, and, in turn, hone their edge in digitization and sustainability.

Supply chain resilience is critical to being able to efficiently deal with shortages as well as disruptions to cost containment, and managing excess inventory.

The goal of this white paper is to introduce a comprehensive, modular, "lego brick" approach to supply chain digital transformation for resilience rather than a big bang, "change everything" approach. Based on industry research, expert interviews, and firsthand expertise, this research presents Grid Dynamics' point of view on the state of supply chain for 2023, and focuses on:

1. Establishing why supply chain resilience is a key theme for the manufacturing industry in 2023, and why a modular approach is preferable for developing it.
2. Defining Grid Dynamics' technology framework for adding resilience as a crucial factor in the supply chain optimization process.
3. Expanding on the specific technology framework elements, and the key actions organizations can take, starting today.

Supply chain resilience: a primer

What is it?	Supply chain resilience is an organization's ability to recover from a disruption in its ecosystem.
How to measure it?	It can be measured by three key metrics: • Time to Recover (TTR): Time needed to get back to full functionality after a disruption. • Time to Survive: Maximum disruption that a supply chain can sustain while maintaining demand with supply. • Performance Impact: Impact on key performance indicators such as revenue and profit margins during TTR.
How to approach it?	Key lessons to keep in mind when addressing supply chain resilience, especially due to recent events: 1. Balancing resilience and efficiency of operations 2. Restructuring global and local strategy of supply chains 3. Reshoring does not always guarantee resilience

Table 1. Supply chain resilience definition and key concepts based on research and articles by Dr. David Simchi-Levi, Supply Chain/Operations Researcher, Consultant, Author and MIT Professor

Why is resilience critical for operations and supply chain management?

State of supply chains in 2023 and beyond

The broader industry, and especially the manufacturing sector, is under constant pressure to be able to forecast and anticipate risks that can cause disruptions in the supply chain. Moreover, each year demands more proactive tactics and flexible strategies from organizations.

Major supply chain disruptions can no longer be considered rare, with the risk and likelihood of disruption becoming ever more significant thanks to the rising number of global crises.

> ***In fact, according to a BCI 2022 global risk and threat assessment report, supply chain disruption is ranked as one of the top ten most impactful and frequent disruptions organizations can expect now and in the future.***

While in past years, COVID-19 was the dominating factor, and still has a significant impact, other challenges now weigh more heavily. These include cybersecurity threats, ESG (environmental, governance, social), geopolitical and restriction-related, financial (such as liquidity, solvency, profitability) and operational risks.

> ***According to a 2022 Manufacturing Supply Chain study by Deloitte and Manufacturers Alliance of US-based manufacturing companies, production and profits were impacted the most, leading to a reduction in profits of up to 13%.***

Figure 1 illustrates the biggest areas of impact.

These factors suggest that the industry faces new optimization challenges, which include the need to minimize costs and maximize efficiency to ensure uninterrupted and stable supply. Therefore, as 2023 progresses, resilience will shift in its meaning from managing shortages to cost containment and excess inventory management.

For an organization to be able to continue progressing with supply chain digital transformation, an adjustable framework for balancing investments in immediate and strategic results is needed. Such a framework should lay a strong foundation for a holistic ecosystem that allows manufacturers to pivot quickly to ensure supply assurance while securing profitability.

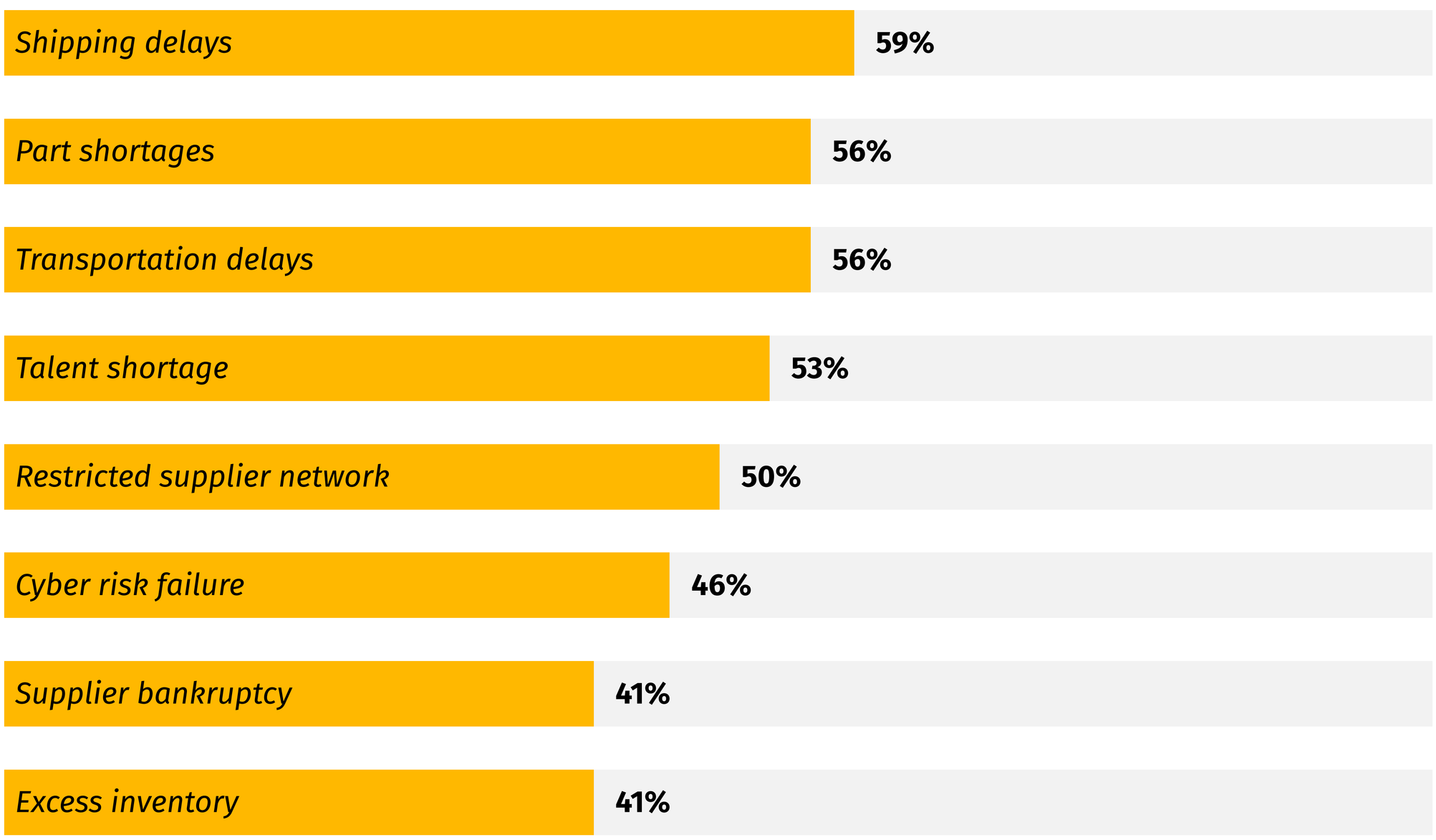


Figure 1: Deloitte analysis of 2022 manufacturing supply chain disruption

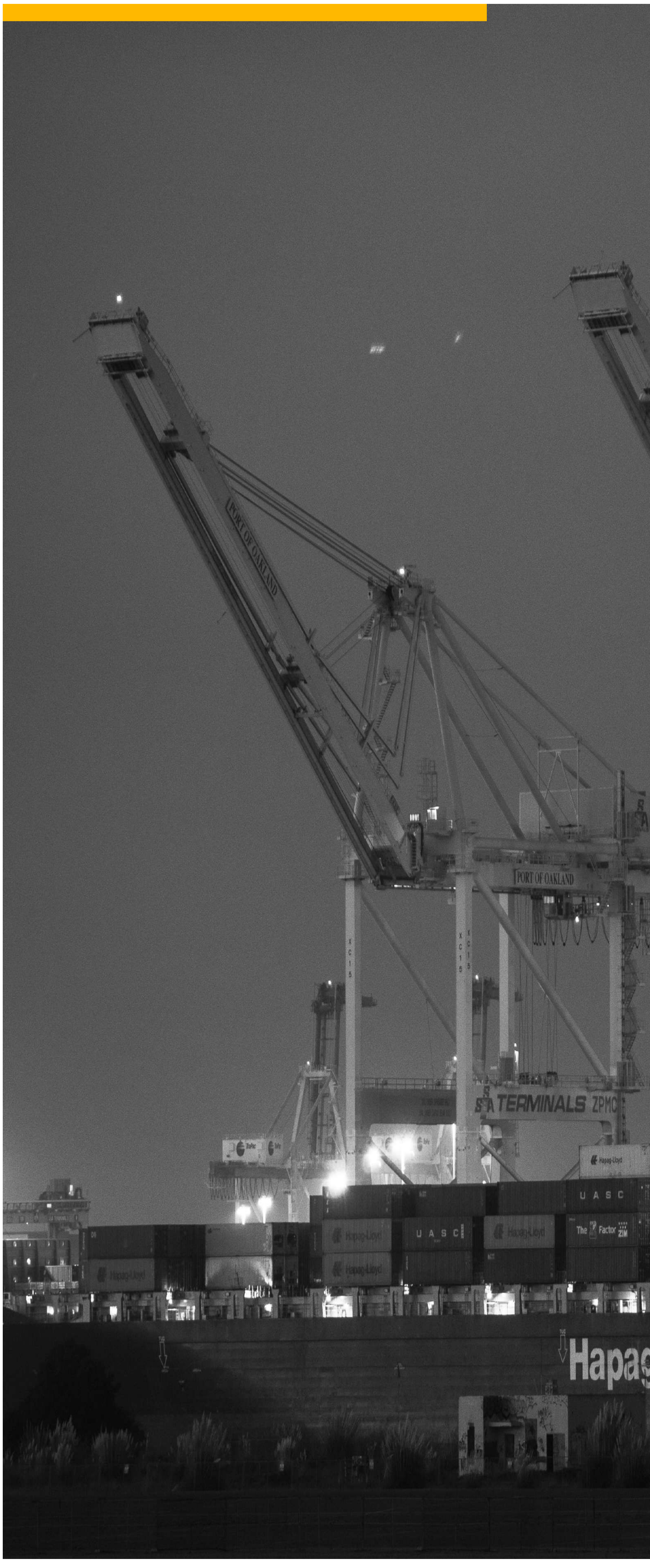
Key risk categories to monitor

To effectively manage risks, organizations must monitor the potential sources of disruption, not only in their supply chains, but also in the extended supply chains of partners and suppliers. As mentioned above, apart from non-occupational diseases (such as COVID-19) that brought about the challenge of remote working, the risk assessment should include the following categories:

1. **Financial:** Impact on revenue, profits, liquidity
2. **Operational:** Impact on infrastructure, capacity
3. **Cyber Security:** Impact on operations, infrastructure via supplier and own network (including IoT)
4. **Geopolitical and Restrictions:** Impacted by political instability, denied persons or companies, embargo
5. **Sustainability:** Impacted by regulations and stakeholder (customers, investors) demands on governance, emissions

   While the risk assessment factors can be split into categories, they must be sufficiently and collectively evaluated as part of the comprehensive risk assessment process.

   Such disruptions can reduce supply availability, extend lead times, and delay order fulfillment. They are costly from a financial perspective, since they might involve extra charges for spot-market purchases, expedited logistics, idle production lines, or even penalties for late or incomplete deliveries.



According to a 2022 Annual Global Supply Chain Report, the average annual cost of supply chain disruptions is estimated at $143M.

Setting up an intelligent analytics platform to gain broad visibility of supply chain risks is necessary, if not crucial, to understand the interdependencies within the organization and in the supplier network. The reported growing importance of digital transformation for improving supply chain visibility, control, and coordination supports this statement.

Industry outlook shows that advanced technology, including robotics and automation, data analytics platforms, especially based on artificial intelligence, machine learning, cognitive computing, and digital twins are among the top plans for investment for increasing operational efficiency. Moreover, digital technologies are also highlighted as one of the tactics to achieve supply chain resilience.

The point to note, however, lies in the precise attunement of advanced technologies to solve a particular optimization challenge.

This is further practically discussed in the Optimization of order and inventory sourcing decisions in supply chains with multiple nodes, carriers, shipment options, and products article.

A comprehensive framework for building supply chain resilience

This brings us to the explicit need to reconfigure and redesign operations and supply chain management.

As stated in the introduction, this white paper proposes a modular and comprehensive framework for building supply chain resilience. This framework is based on Grid Dynamics' practical experience with manufacturing application modernization and applying innovation to solve tangible business problems. In combination with industry research and expert interviews, we propose to view technology through the lens of achieving strategic goals, and approach it as a 'house' built around organizations' distinct needs and objectives.

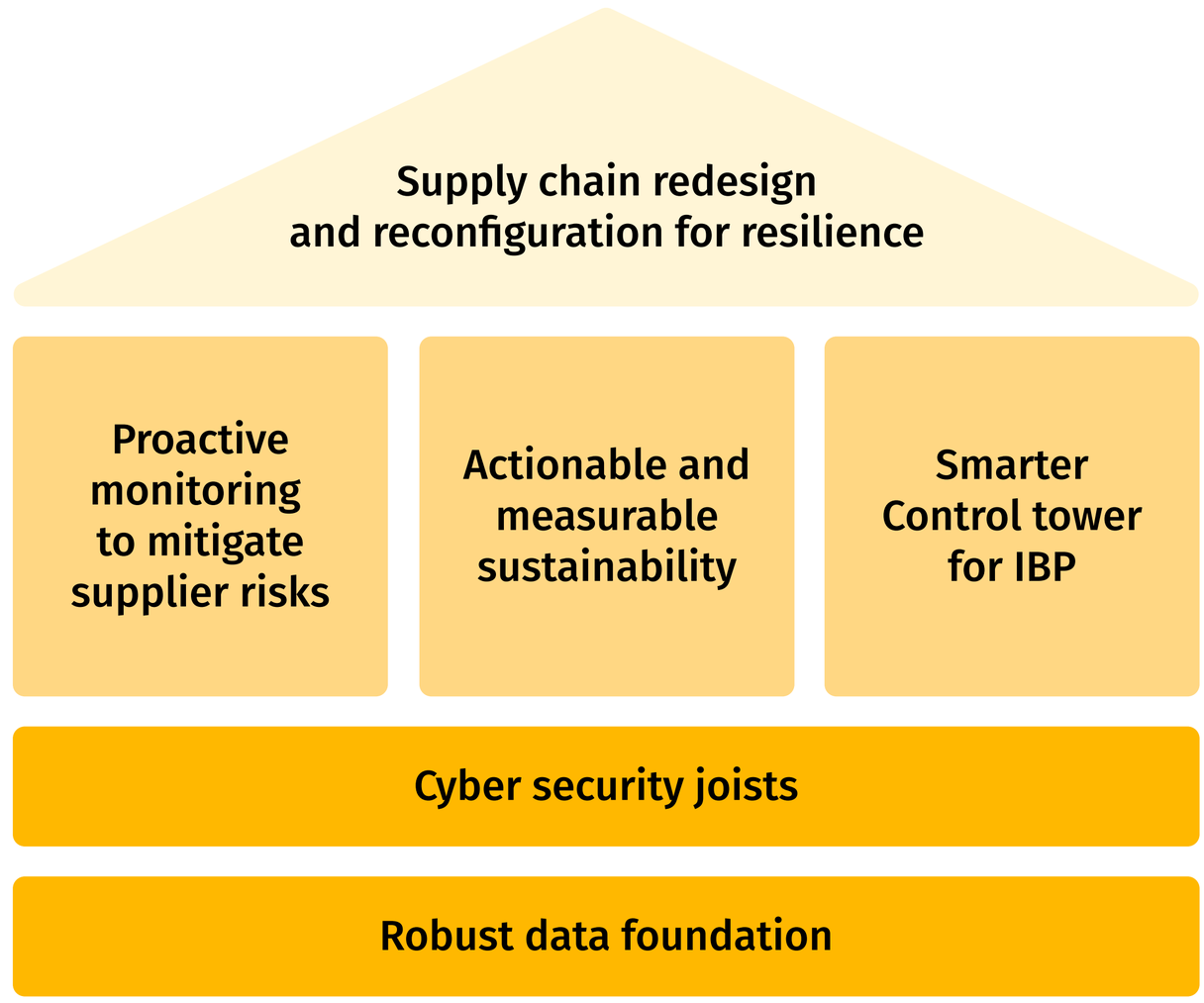


Figure 2. Supply chain resilience framework from Grid Dynamics' point of view

The elements of the framework can be implemented independently, however, starting from data strategy is recommended to lay a strong foundation for other elements.

Lay a robust data foundation first

Gaining visibility of how the organization's supply chain operates holistically, at the right level lays the foundation to evaluating decisions based on tangible inputs.

Areas of focus:

Establishing a comprehensive data strategy

- Bringing together disparate parts of the ecosystem: structured and unstructured data sources and open source, licensed, home-grown technologies.
- Identifying and upgrading the enterprise-wide data strategy on the basis of the comprehensive data.

Laying down the framework for data usage

- Developing a framework that brings together the seamless orchestration, appropriate management and timely delivery of data for both internal and external applications and users across the supply chain.

Capturing the value of data

- Fast-tracking data management policies and capabilities.
- Upskilling teams and shifting to a DataOps model to make the most of the technology investments for insights-led decision making.

Key actions and necessary next steps:

1. **Implement, ideally, a cloud-native analytics platform or data mesh,** purposely built as a distributed data architecture that incorporates data collection and ingestion, data integration and transformation, storage and consumption, analytics, centralized governance, security and standardized interoperability.
2. **Invest in adapters and integrations that allow rapid inclusion of new suppliers and locations** while respecting the required data privacy requirements of these new regions.
3. **Implement data governance policies** and tools that ensure automated data quality checks and anomaly detection, data pipeline orchestration and management.

Key actions and necessary next steps:

1. **Develop clear cyber security policies and strategies that apply to extended supply chain partners.**
2. **Conduct regular cyber risk assessments for all elements within the supply chain** that use IoT devices (storing data, managing inventory, tracking goods), especially those with direct access to sensitive information and/or provide a gateway to wider systems.
3. **Incorporate zero trust architecture** in manufacturing and data collaboration platforms and applications.
4. **Leverage technologies such as Blockchain** to minimize discrepancies.
5. **Automate these technologies for greater product transparency** and to prevent counterfeit products.

Reinforce the base with cyber security joists

Out of 800 senior decision makers participating in the 2023 Global Supply Chain Risk Report survey, 34% of respondents rated cyber risks as having a high impact on supply chains, and 54% as having a medium impact. With more compound risks brought to the ecosystem, full transparency of all links and vulnerabilities is necessary to simplify and secure the systems.

Areas of focus:

Identifying complexities to underpin cyber resilience

- Assessing security risks across all information systems, including IoT devices and connected systems such as plant machinery, equipment, and other hardware assets.
- Utilizing software inventory tools to automate the software trail across all systems, and permitting only authorized software to be run.
- Understanding suppliers' security postures and sharing the expected security requirements.

Assessing the systems and accesses across the chain

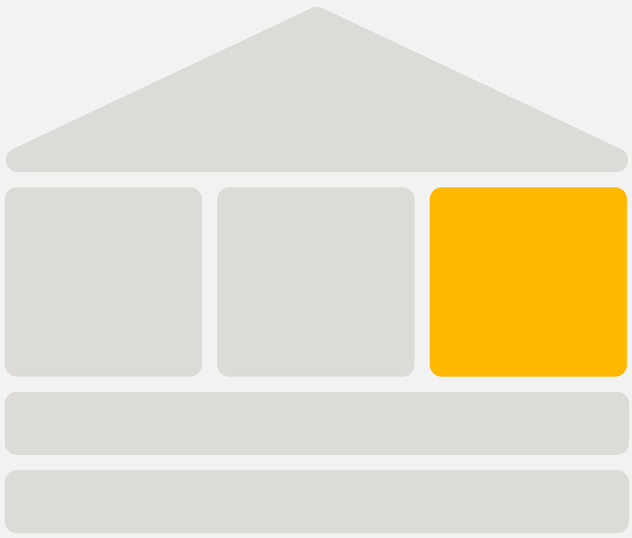
- Analyzing supplier access: level, frequency, risk to the organization’s systems, dependence, and impact of disruption.
- Creating strong security relationships with suppliers to address mutual concerns and improve coordination in case of security events.

Managing increased cyber risks

- Mitigating the compound cyber risks that arise due to rethinking the supplier networks and making changes with nearshoring, onshoring, and ally shoring.
- Guarding against potential threat pathways that expansion and inclusion of smart manufacturing and new devices (IoT) brings.
- Extending security throughout the supply chain to ensure the traceability and ownership of physical materials and finished goods.

Insulate for actionable and measurable sustainability

Embracing sustainability as well as contributing to a circular economy is a must. Sustainability is needed to not only comply with regulations, but to stand and improve an organization's standing in the eyes of customers, partners, and investors.



Areas of focus:

Complying with ESG-related laws and regulations

- Meeting the enforced accountability for greenhouse gas (GHG) emissions and climate-related financial risk standards.
- Increasing ESG-related reporting and tracking for supply chains to comply with regulations such as Germany's Lieferkettengesetz, the United States Uyghur Forced Labour Prevention Act, a proposed Federal Acquisition Regulation, etc.

Extending supply chain visibility for value chain emissions

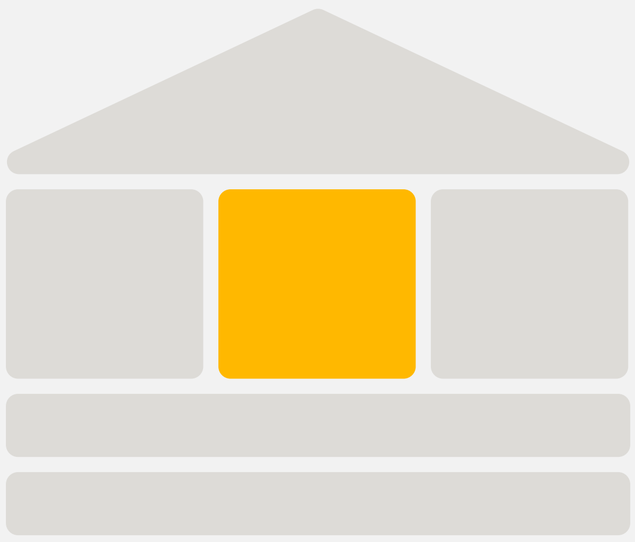
- Including the results of the relevant indirect (not owned or controlled) GHG emissions categories into reporting.
- Monitoring Scope 3 emissions control to meet the demand of important stakeholders such as customers and large investors.

Embracing circular economy

- Putting greater emphasis on handling recycling, returns, and reuse within the supply chain/logistics.
- Differentiating the organization through discreteness and sustainability to grasp market opportunities.

Key actions and necessary next steps:

1. **Capture real-time operational data along the supply chain for measurement and reporting of ESG metrics** to drive process integration between finance, sourcing, legal, and enterprise risk functions using technology.
2. **Develop optimization algorithms that include ESG criteria in planning and fulfillment supply chain engines** utilizing harmonized, validated data sources when evaluating various scenarios.
3. **Focus on more sustainable logistics options** beyond product or packaging sustainability.
4. **Develop or demand last-mile delivery service providers to offer more sustainable delivery options** to capture market share and increase customer loyalty.



Illuminate decisions with smarter control tower for IBP

Increasing complexities across the links of the supply chain, paired with pressure to deliver on time and within budget, and achieving financial goals demand end-to-end visibility. Advanced technologies, such as AI with machine learning, help predict disruptions, resolve external critical issues, and improve resilience.

Key actions and necessary next steps:

1. **Prioritize technology investment in demand planning capabilities, and end-to-end visibility enabled by real-time analytics,** as these can help to maintain operational stability, using AI, especially for inventory allocation optimization, order fulfillment including allocation to promise (ATP) and automation of order management.
2. **Leverage technology partners to customize and build a digital control tower across your industrial, logistics, and financial systems** (data stacks, planning stacks, and reporting stacks) to get end-to-end visibility across the supply chain with an exception-based management capability rather than going for a complete overhaul of underlying software systems.
3. **Optimize order management** with automation across the entire omnichannel fulfillment process.

Areas of focus:

Adjusting supply chain management

- Shifting from Just-In-Time (JIT) to Just-In-Case (JIC).
- Holding extra inventory for critical items.
- Maintaining low-capacity utilization.
- Engaging with multiple suppliers.

Creating a digital twin equivalent for planning and forecasting

- Consolidating Financial, Commercial, and Supply Chain plans and forecasts in a digital twin equivalent for integrated business planning IBP).
- Using this twin to evaluate revenue gap closure proposals, supply chain feasibility and cost scenarios, and price component analysis for inflation.
- Making optimal decisions for profit and loss statements (P&L).

Backing planning decisions with AI

- Shifting from AI-driven process automation to AI-driven decision automation in your business planning.
- Keeping a balance that supports technology foundation and human/process transformation.

Ensure proactive monitoring to mitigate supplier risks

With a need to diversify the supply base and increase regionalization, while meeting relevant laws and regulations, the risks of disruption increase. This demands organizations to pay special attention to extended supplier tiers and standardize the collaboration processes.

Areas of focus:

Monitoring beyond Tier 1

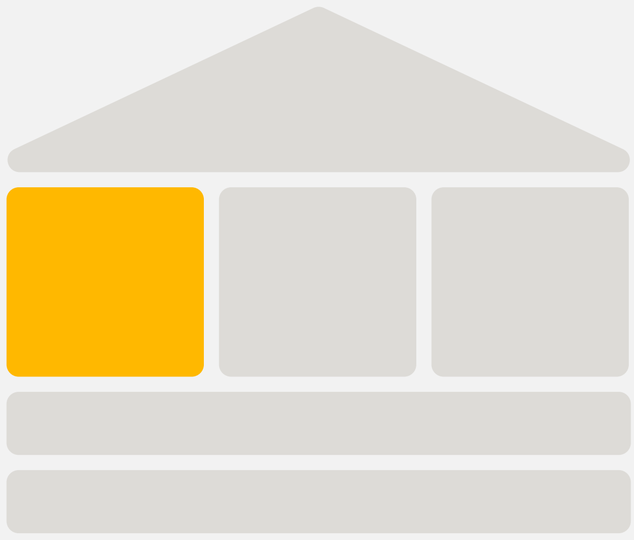
- Increasing visibility into the upstream supply chain, since the majority of supply chain disruptions occur outside the direct supply base.
- Creating a comprehensive dashboard for Tier 1, and 2 suppliers.
- Starting to monitor risk events below Tier 2 (the supplier's suppliers).

Assessing key risks for a broader set of suppliers

- Concluding automated regular assessments for key risk factors.
- Including compliance and operational risks in the assessment.

Designing diversification strategy processes

- Standardizing supplier onboarding and collaboration, and processes for multiple suppliers within a location and multiple supplier locations.



Key actions and necessary next steps:

1. **Adopt real-time data analytics to enhance the accuracy of predictions/ forecasts of demand volatility** and stream these insights from your suppliers to your central systems/control tower.
2. **Use AI/ML techniques to drive automation in standard processes and checks** such as credit checks for supplier onboarding. Leave time for "what-if" scenario analysis and focus on intelligent supplier segmentation beyond just the Tier 1, and Tier 2 suppliers.
3. **Invest in automation to streamline manual activities** such as Global Trade documentation, Free Trade Agreement (FTA) compliance, trade tax calculations, reconciliations and settlements, and reporting as suppliers across new shores join.
4. **Develop standard integration processes and adapters to rapidly onboard suppliers** that oftentimes have different supply chain systems.

Redesign and reconfigure the supply chain for resilience

Resilience is built from the ground up. To successfully sail through the sea of shocks, organizations should remain focused on their values, challenges, consumers, and recenter their operational and technology landscape to withstand storms.

Key actions and necessary next steps:

1. **Move away from monolithic supply chain software solutions** to more flexible, resilient, and composable supply networks, enabled by cloud and modern application architectures (such as microservice architecture) that weave together solutions for your business and supply chain needs rather than the promise of a “one-stop shop for all your needs” solution.
2. **Integrate digital technologies with physical products:** combine grease with code.
3. **Move beyond simple IoT sensors to more complex computer vision use cases** around quality control and incorporation of autonomous mobile robots (AMRs), and automated guided vehicles for picking, assembling, carrying, packing, or inspecting parts and finished products.
4. **Invest in or partner with logistics platforms that offer digitization** (more than just automation) of key services starting with the customer experience, the ability to rate, quote, book and track shipments, and returns management.
5. **Leverage AI/ML for lucrative yet complex aftermarket services and spare parts:** inventory management and planning.

Areas of focus:

Reducing supplier concentration

- Including geopolitical risks and reconfiguration of a global optimized supply chain focus from the most economical shore.
- Considering nearshoring, onshoring, and ally shoring as core features.

Transforming manufacturing footprint

- Including automation, IoT, and a tradeoff between contract and in-house manufacturing.
- Balance between Artificial Intelligence (AI), Process Intelligence (PI), and Human Intelligence (HI).

Enabling elastic logistics

- Including multimode, carrier space, container usage, and route optimization.
- Increasing emphasis on last-mile delivery and reverse logistics with e-commerce as a channel for both B2C and B2B businesses.

Conclusion: start with building bricks, not straws or sticks

Recent global events have led to supply chains suffering larger-than-expected losses, and it is natural to consider what changes or solutions are needed to increase resilience while reducing risks. Moreover, with continued obstacles, simplification of systems or process standardization is a difficult task.

An organization needs to develop the following capabilities to build resilience into the supply chain and remain laser-focused on the outcomes, and the reality that the organization is in.

Digitize the supply chain

Combine available data with advanced analytics and automate key processes

Note: not each element of the supply chain must be transformed/automated or huge investments are needed.

Execute smartly

Use modern tools like machine vision, a foundation of data and automation, and management by exceptions or deviations.

Note: implementing the right mix of digital capabilities can help secure profitability and improve efficiency.

Implement smart supplier segmentation and supplier risk analysis

Increase supplier risk visibility, and segment suppliers beyond just spend but with other parameters such as impact on the final assembly.

Note: focus beyond Tier 1 and Tier 2 suppliers, as recent research shows (4) that Tier 3 and 4 suppliers account for 69% of risk event impact.

Develop integrated and smart Sales & Operations Planning (S&OP)

Determine the optimal prescriptive decisions model for a set of given conditions (environment, target, stage) to readjust for priority or external factor changes.

Note: optimizing the planning for the organization's distinct decision layers should cover both strategic orientation and operational execution.

However, there is never a one-size-fits-all solution, and it is crucial to tailor the strategy to the unique circumstances and needs of the business.

With this white paper, Grid Dynamics starts the Supply Chain Resilience POV series, where the framework elements will be described in greater detail. The series aims to present the strategies and implementations that work for our partners and customers, and can be adapted to be adopted by other manufacturing industry players.

Explore how Grid Dynamics transforms supply chain expertise into practical value for clients:

- **Loss Prevention with AI-powered IoT analytics platform on AWS**
- **Building an IoT Platform in GCP: A Starter Kit**
- **Data observability solution for new products development: Case study**
- **Grid Dynamics Analytics Platform for smart manufacturing: A Jabil case study**

Finding the optimal way and allocation of investment is crucial to start strong. Schedule a workshop with Grid Dynamics supply chain solutions experts to discuss an appropriate business opportunity to make your unique supply chain more resilient.

Resources

1. BCI Horizon Scan Report 2022
2. Meeting the challenge of supply chain disruption, September 2022, Deloitte
3. Annual Global Supply Chain Report, 2022, Vanson Bourne, Market Research
4. 2023 Global Supply Chain Risk Report, WTW, Feb 2023
5. 2023 manufacturing industry outlook, Deloitte, 2022
6. WSJ Article: Infrastructure Companies Say Suppliers Post a Growing Cyber Threat, Jan 27, 2023
7. WSJ Article: Globalization Isn't Dead. But it's Changing, Jan 16, 2023
8. WSJ Article: Impact of Geopolitical Tumult on Business to Continue in 2023, Say Risk Experts, Jan 11, 2023
9. HBR Article: Building Resilient Supply Chains Won't Be Easy, David Simchi-Levi and Edith Simchi-Levi, June 23, 2020
10. HBR: From Superstorms to Factory Fires, David Simchi Levi, 2020
11. Scope 3 Inventory Guidance, US EPA
12. Making Supply Chain Decarbonization Happen, Mckinsey Insights, June 2021
13. CIS Center for Internet Security, the CIS 20

About Grid Dynamics

Grid Dynamics is a global digital engineering company that co-innovates with the most respected brands in the world to solve complex problems, optimize business operations, and better serve customers. Driven by business impact and agility, we create innovative, end-to-end solutions in digital commerce, AI, data, web UI and UX, and cloud to help clients grow.

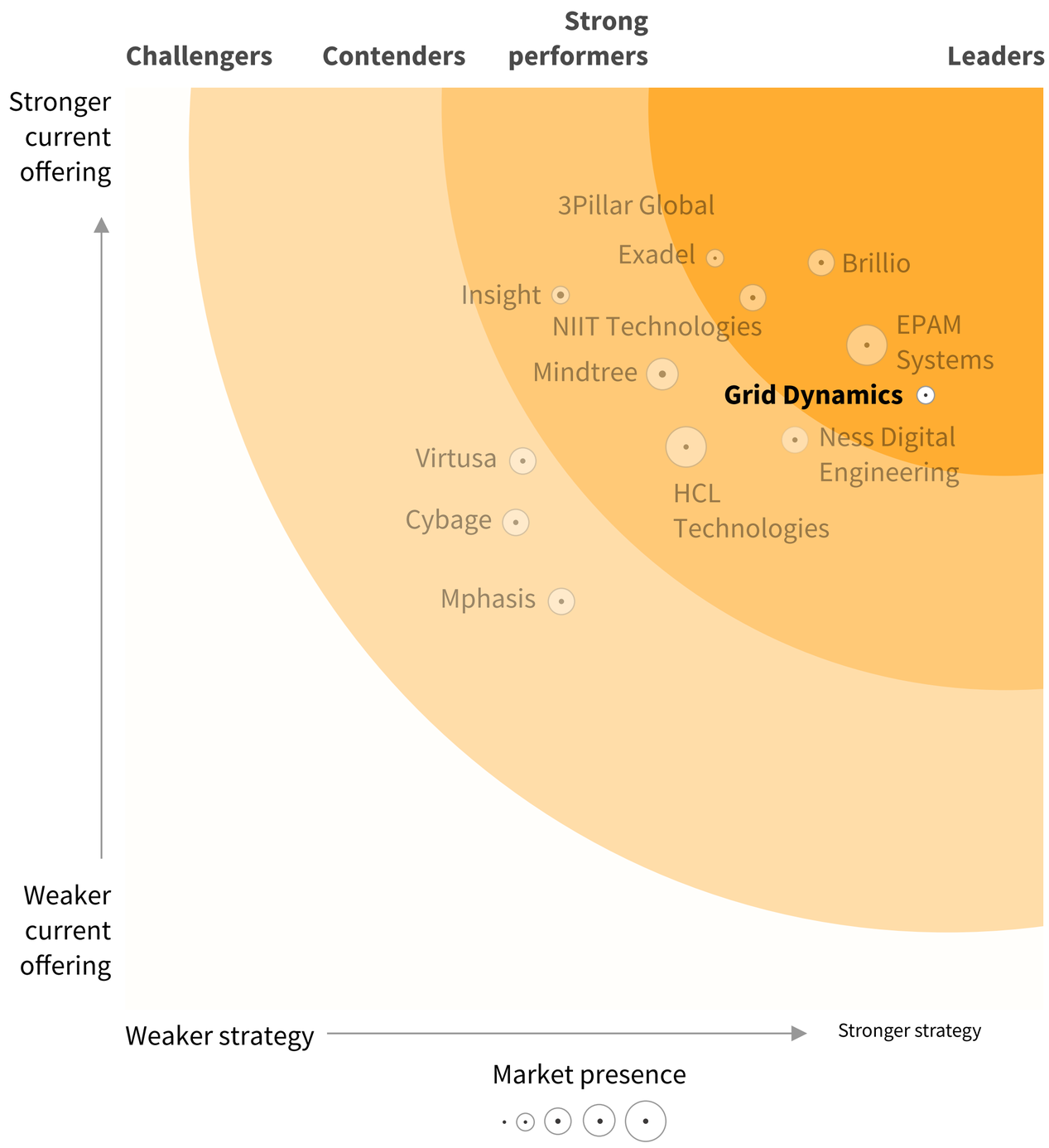
Headquartered in Silicon Valley, with delivery centers located throughout the globe, Grid Dynamics is known for architecting revolutionary digital technology platforms for 7 of the 25 largest retailers in the US and 3 of the 10 largest consumer goods companies in the world, as well as leading brands in the digital commerce, manufacturing, finance, healthcare, and high tech sectors.

Our secret sauce? We hire the top 10% of global engineering talent and employ our extensive expertise in emerging technology, lean software development practices, a high-performance product and agile delivery culture, and strategic partnerships with leading technology service providers like Google, Amazon, and Microsoft.

In 2019, Forrester named Grid Dynamics a leader among midsize agile development service providers. In 2020, Grid Dynamics went public and is trading on the NASDAQ under the GDYN ticker.

The Forrester wave™

Midsize Agile Development Service Providers Q2 2019



About Grid Dynamics

Key facts

- Offices across the US, Mexico, UK, Netherlands, Switzerland, India, and Central and Eastern Europe
- 3,700 employees in Q1 2023
- Forrester Leader Midsize Agile Software Development Service Provider Q2 2019
- Proprietary starter kits developed in collaboration with AWS, Google Cloud, Microsoft Azure, and others.

Areas of expertise

- **Experience engineering**
  Web UI | Mobile | UX | AR/VR
- **Data Science and AI**
  Search | Personalization | Supply chain | IoT
- **Platform engineering**
  Microservices | MACH | Composable
- **Data engineering**
  Big data | Streaming | MLOps
- **Cloud and DevOps**
  CICD | AIOps | SRE | QE

Clients

	Google	
align	LEVI'S	StanleyBlack&Decker
RAYMOND JAMES	svb Silicon Valley Bank	AMERICAN EAGLE
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