# Supply Chain Risk Intelligence for Manufacturing: Achieve N-Tier Visibility with Snowflake

Uncover hidden supplier dependencies and concentration risks before they disrupt your production.

The Problem in Context

Procurement and supply chain teams believe they have diversified sourcing because their ERP shows multiple Tier-1 suppliers across different countries. But that data is incomplete—visibility ends at the first tier.

- **Tier-N blindness costs time and money.** When a disruption occurs at Tier-3, you're blindsided weeks later by sudden shortages, leaving no time to qualify alternatives.

- **Single points of failure hide in plain sight.** Three Tier-1 vendors across three countries may unknowingly source raw materials from the same refinery in a geologically unstable region.

- **Reactive firefighting replaces strategic planning.** Without predictive risk signals, procurement teams spend time managing crises instead of building resilient supply networks.

- **Compliance and audit gaps create exposure.** Regulations like UFLPA require traceability beyond Tier-1, but current systems cannot provide that visibility.

Tier-N Visibility Gap
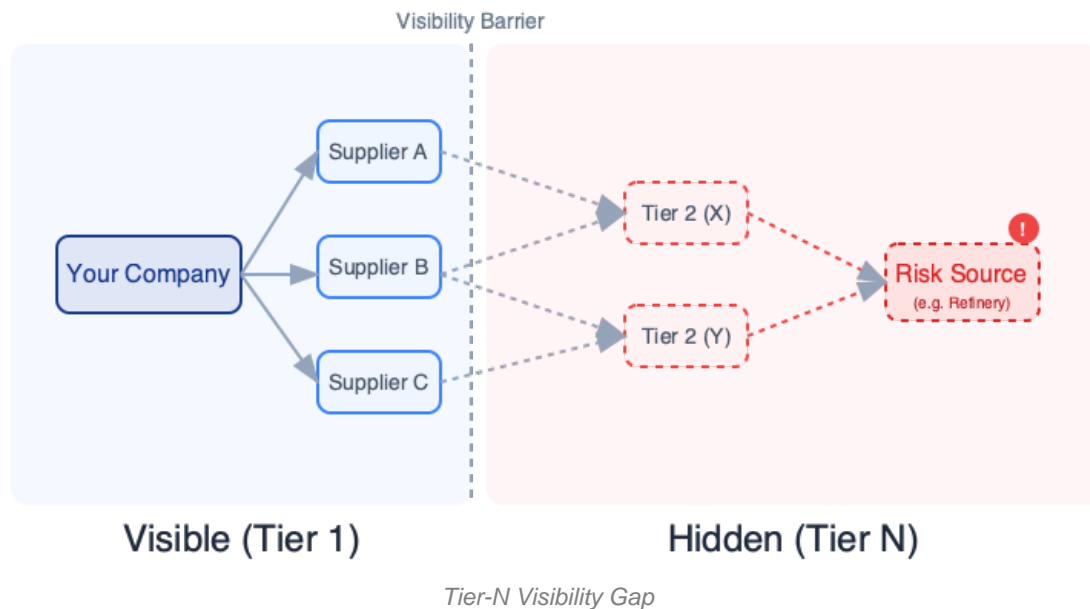
Traditional ERP visibility ends at Tier-1. Risks fester unseen in deeper layers of the supply network.

What We'll Achieve

This solution transforms supply chain management from reactive response to proactive resilience.

- **Predictive risk scoring.** Alerts for latent risks before they manifest—"Part X has a 75% risk score because its estimated Tier-2 source is in a sanction zone."

- **Automatic concentration discovery.** Identify hidden bottlenecks where multiple Tier-1 suppliers converge on the same Tier-2+ source.

- **Proactive supplier qualification.** Find and qualify backup suppliers months before a crisis, not during one.

- **Faster time to insight.** Reduce supply chain due diligence from weeks of manual research to minutes of AI-powered analysis.

Why Snowflake

- **Unified data foundation.** Internal ERP data and external trade intelligence join seamlessly in a governed platform—no data movement, no pipeline complexity.

- **Performance that scales.** GPU-enabled notebooks train graph neural networks on millions of trade records without infrastructure friction.

- **Collaboration without compromise.** Share risk insights with sourcing partners and internal teams while maintaining data governance and access controls.

- **Built-in AI/ML and apps.** From PyTorch Geometric models to interactive Streamlit dashboards, build and deploy intelligence closer to where decisions happen.

The Data (At a Glance)

The solution fuses internal ERP data with external trade intelligence into a knowledge graph that reveals what your ERP cannot see.

Data Architecture
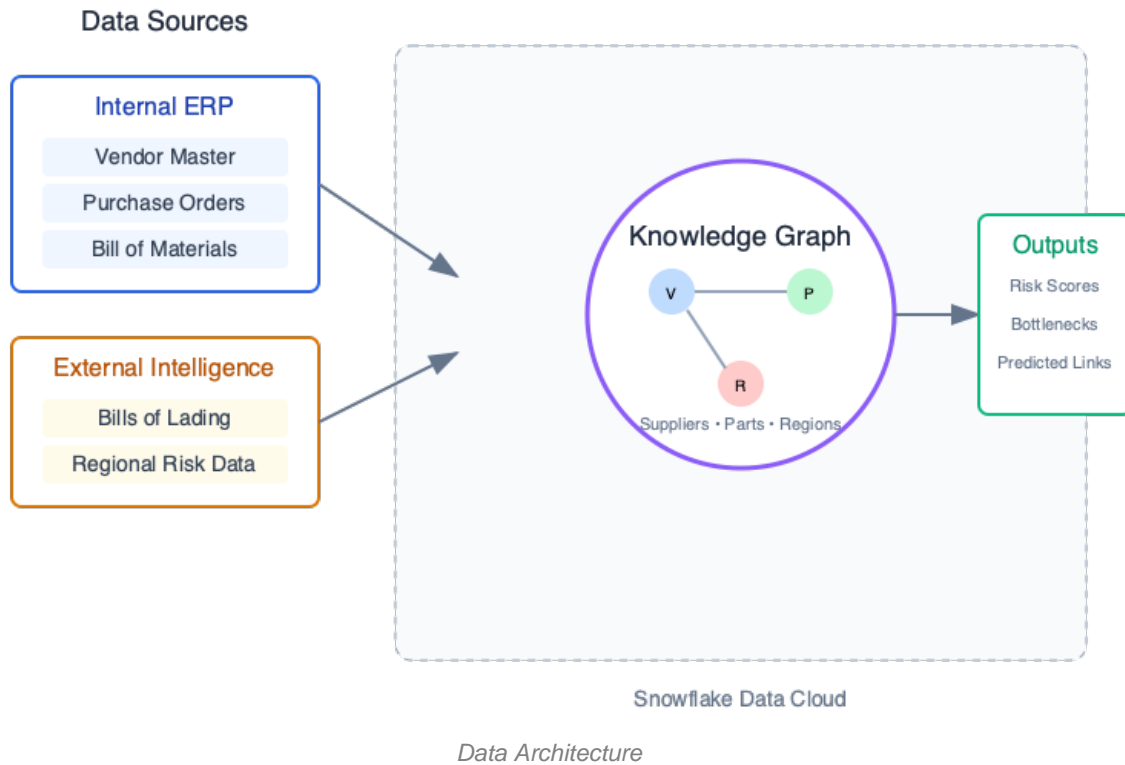
Internal ERP data forms the backbone; external trade intelligence fills in the hidden Tier-2+ relationships.

- **Domains:** Vendors (Tier-1 suppliers), Materials (parts and BOMs), Regions (geographic risk factors), Trade Data (bills of lading linking shippers to consignees).

- **Freshness:** Batch ingestion for ERP data; continuous refresh for trade intelligence via Snowflake Marketplace.

- **Trust:** All data stays within Snowflake's governance boundary with role-based access controls.

Data Source	Type	Purpose
Vendor Master (ERP)	Internal	Known Tier-1 supplier nodes
Purchase Orders (ERP)	Internal	Supplier-to-material transaction edges
Bill of Materials (ERP)	Internal	Product assembly hierarchy

Trade Data (External)	Enrichment	Hidden Tier-2+ relationship inference
Regional Risk (External)	Enrichment	Geopolitical and disaster risk factors

See Snowflake Marketplace: Real-World Data Integration for production data providers.

Snowflake Marketplace: Real-World Data Integration

Moving from demo to production requires high-quality external data. These **Snowflake Marketplace** providers deliver the trade intelligence and entity data needed to operationalize N-tier visibility—no data pipelines to build, no contracts to negotiate outside your Snowflake account.
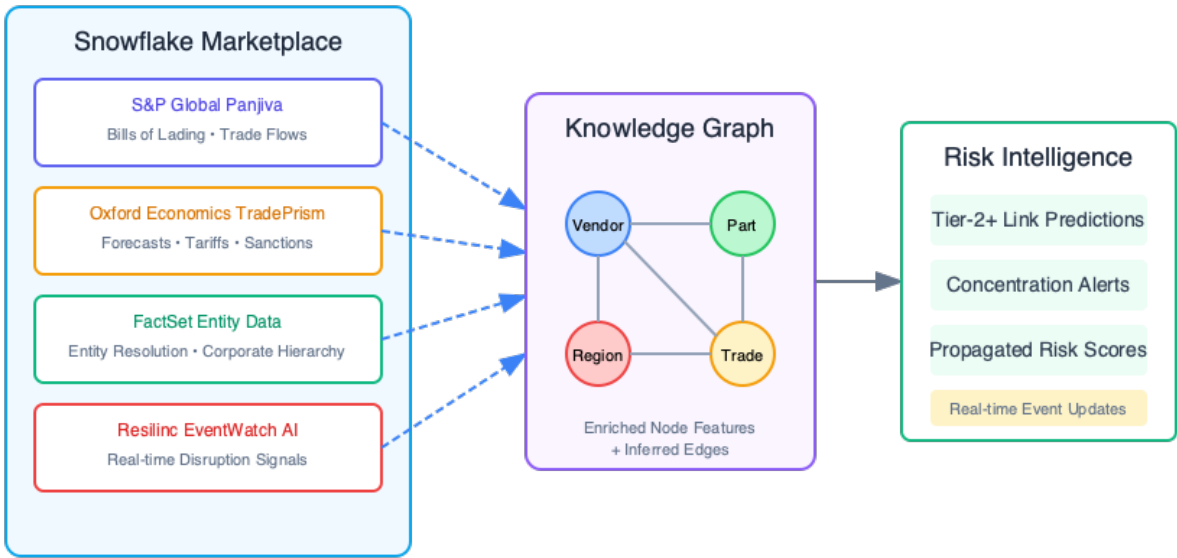
Marketplace Integration

Snowflake Marketplace providers plug directly into the knowledge graph, enriching internal ERP data with global trade flows and entity relationships.

S&P Global Market Intelligence — Panjiva Supply Chain Intelligence

The gold standard for inferring hidden Tier-2+ relationships.

[Panjiva Micro](#) | [Panjiva Macro (UN Comtrade)](#)

- **What it provides:** Customs-based bill-of-lading shipment records with shipper/consignee entities, HS codes, origin/destination ports, volumes, and values.

- **How we use it:** Feed shipper→consignee trade flows as edges into the GNN. When your Tier-1 supplier appears as a consignee, Panjiva reveals who shipped to them—your likely Tier-2 suppliers.

- **Key insight:** If three of your Tier-1 vendors all receive shipments from the same overseas refinery, Panjiva exposes that hidden concentration before a disruption occurs.

Oxford Economics — TradePrism

Forward-looking trade forecasts and scenario modeling.

[TradePrism Full Dataset](#)

- **What it provides:** Global trade forecasts at HS4 level across ~170 economies, including tariff scenarios, sanction impacts, and trade rerouting projections.

- **How we use it:** Overlay predictive risk scores with forward-looking exposure. A supplier in a stable region today may face tariff escalation or sanctions risk tomorrow.

- **Key insight:** Combine historical Panjiva shipment data with TradePrism forecasts to answer: "If sanctions expand to Region X, which of my supply chains are exposed?"

FactSet — Supply Chain Linkages & Entity Data

Entity resolution and corporate relationship mapping.

[FactSet on Snowflake Marketplace](#)

- **What it provides:** Company fundamentals, estimates, and supply chain linkages with standardized symbology for entity matching across datasets.

- **How we use it:** Map shipper/consignee names from trade data to actual vendor entities in your ERP. Build supplier/geo exposure roll-ups at the corporate parent level.

- **Key insight:** Your ERP shows "Acme Electronics (Shenzhen)" as a supplier. FactSet reveals it's a subsidiary of a larger conglomerate with operations across five countries—changing your geographic diversification assumptions.

Resilinc — EventWatch AI

Real-time disruption monitoring and supplier risk signals.

Resilinc EventWatch AI

- **What it provides:** AI-powered monitoring of global events (natural disasters, geopolitical incidents, factory fires, labor actions) mapped to supplier locations and impact zones.

- **How we use it:** Inject real-time risk signals into the propagated risk scores. When EventWatch detects a factory fire at a Tier-2 location, the GNN immediately recalculates downstream impact.

- **Key insight:** Move from periodic risk assessment to continuous monitoring. Know about disruptions hours after they happen, not weeks later when parts don't arrive.

Data Integration Architecture

Marketplace Provider	Graph Node/Edge Type	Integration Point
Panjiva	Trade flow edges (shipper→consignee)	GNN link prediction training
TradePrism	Region risk attributes	Node feature enrichment
FactSet	Entity resolution, corporate hierarchy	Supplier node canonicalization
Resilinc	Real-time event signals	Dynamic risk score updates

Why Marketplace Data Matters

- **Zero ETL.** Data lives in Snowflake—join to your tables with SQL, no data movement required.

- **Always current.** Providers update their datasets; you automatically get fresh intelligence.

● **Governed access.** Marketplace shares respect your Snowflake RBAC; sensitive enrichments stay protected.

● **Rapid time-to-value.** Skip months of data licensing negotiations and pipeline engineering.
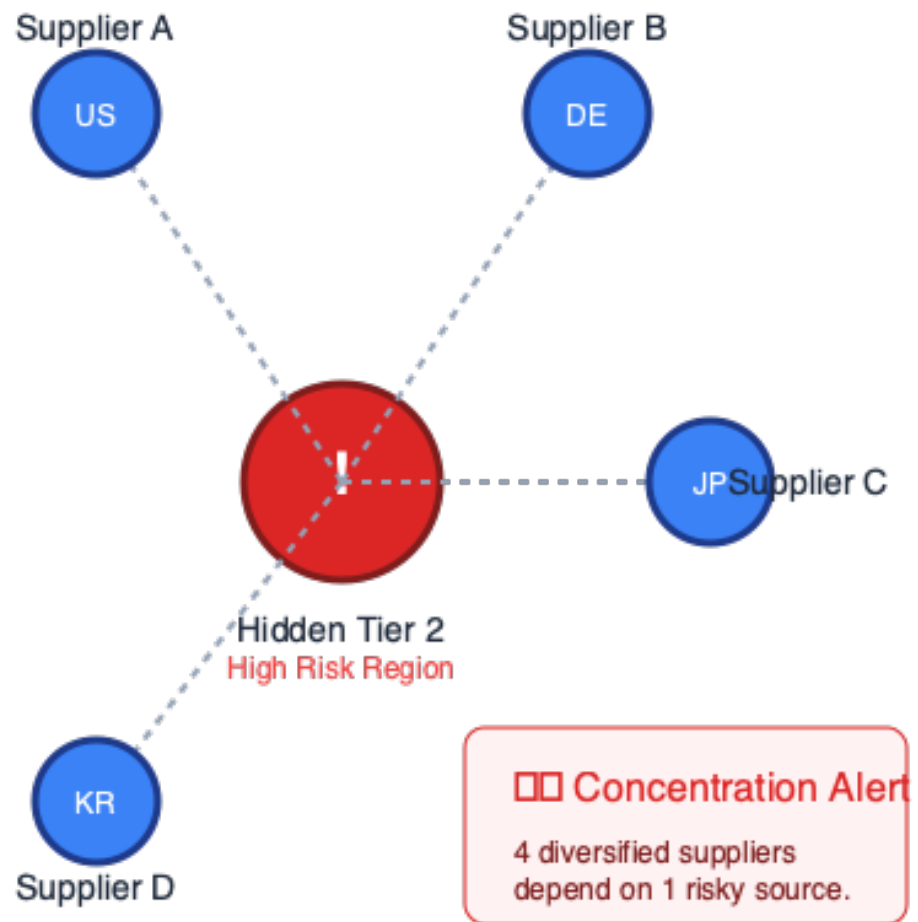
How It Comes Together
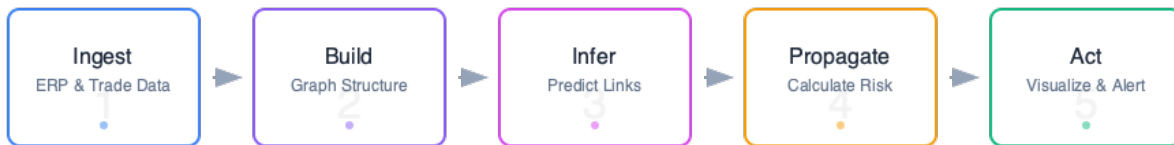
Solution Flow

From raw data to actionable risk intelligence in five steps.

1. **Ingest.** Load ERP exports (vendors, materials, purchase orders, BOMs) and external trade data into Snowflake tables. [→ SQL Setup Scripts]

2. **Build the Graph.** Construct a heterogeneous knowledge graph with suppliers, parts, and regions as nodes; transactions and trade flows as edges. [→ GNN Notebook]

3. **Infer Hidden Links.** Train a GraphSAGE model on trade patterns to predict likely Tier-2+ supplier relationships with probability scores. [→ GNN Notebook]

4. **Propagate Risk.** Calculate risk scores that flow through the network—a shock at Tier-3 propagates to impact Tier-1 and final products. [→ GNN Notebook]

5. **Visualize and Act.** Explore the supply network graph, analyze concentration points, and prioritize mitigation actions in an interactive dashboard. [→ Streamlit App]

The Discovery Moment

Supplier A — US

Supplier B — DE

Supplier C — JP

Supplier D — KR

Hidden Tier 2
High Risk Region

⚠ Concentration Alert
4 diversified suppliers depend on 1 risky source.

Concentration Risk Visualization

The "aha" moment: Three seemingly independent Tier-1 suppliers all depend on the same hidden Tier-2 refinery.

Traditional analytics show a diversified supply base. Graph intelligence reveals the convergence.

Before: "We're safe—we source from three different vendors in three countries."

After: "All three vendors rely on one Tier-2 supplier in a high-risk region. We need to qualify alternatives now."

Dashboard Experience

The Streamlit application guides users from executive summary to prioritized actions.

View	What You See
Home	Key metrics: nodes analyzed, critical risks, bottlenecks discovered
Supply Network	Interactive graph to filter, zoom, and trace dependency paths
Tier-2 Analysis	Predicted links, probability scores, and concentration impacts
Risk Mitigation	Prioritized actions ranked by impact with AI-assisted context

Top Concentration Risk

Highest-impact Tier-2 dependency identified

Concentration Alert

Jiangxi Graphite Ltd — Tier-2 supplier with **50** dependent Tier-1 vendors

Impact Score: 100% · External supplier 'Jiangxi Graphite Ltd' is a single point of failure for 50 vendors

Legend:
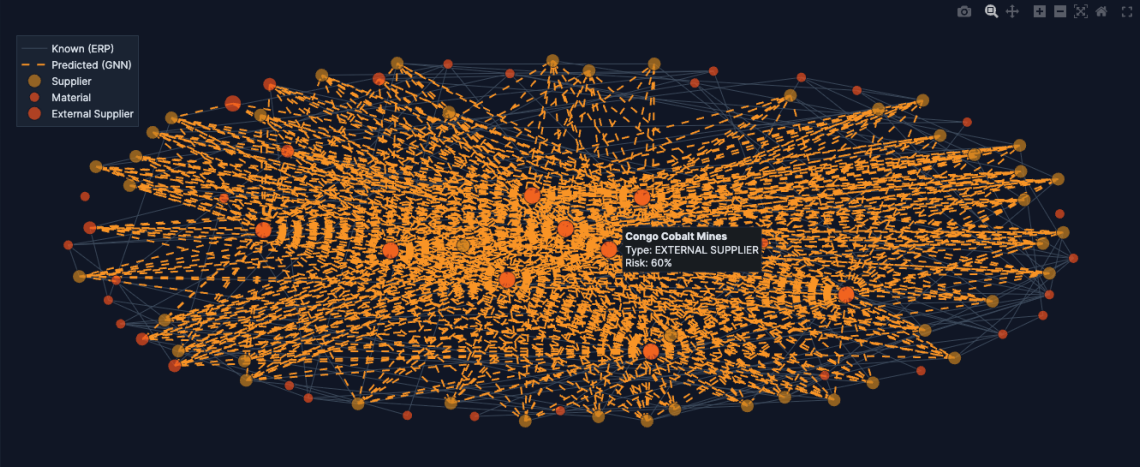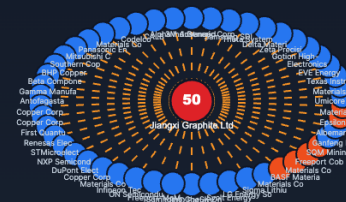- Your Tier-1 Suppliers
- Hidden Tier-2 Supplier

Nodes: Materials Corp, BASF Materials, Materials Corp, Freeport Cobalt, SQM Mining, BYD Battery, SK On, Svolt Energy, LG Energy Solut, Sigma Lithium, **50** Jiangxi Graphite Ltd

Blue nodes: Your Tier-1 suppliers (visible in your ERP) │ **Red node:** Hidden Tier-2 supplier (discovered by GNN) │ **Dashed lines:** Predicted dependencies

Home Dashboard

Network Graph

Drag nodes to explore relationships. Zoom and pan to navigate. **Dashed lines** indicate inferred Tier-2+ relationships.

Legend:
- Known (ERP)
- Predicted (GNN)
- Supplier
- Material
- External Supplier

Congo Cobalt Mines
Type: EXTERNAL SUPPLIER
Risk: 60%

Supply Network Graph

Highest Concentration Risk

Jiangxi Graphite Ltd — Tier-2 supplier with **50** dependent Tier-1 vendors

Impact Score: 100% · External supplier 'Jiangxi Graphite Ltd' is a single point of failure for 50 vendors

AI RISK ANALYSIS

The concentration risk posed by Jiangxi Graphite Ltd, a hidden Tier-2 supplier, is significant as 50 Tier-1 vendors rely solely on this single supplier, creating a single point of failure. If Jiangxi Graphite Ltd experiences a disruption, such as a production halt or bankruptcy, it could lead to a complete loss of supply for all 50 dependent vendors, resulting in potential production stoppages, delayed shipments, and significant revenue losses. This risk necessitates immediate mitigation strategies, such as identifying alternative suppliers, diversifying the supply base, or developing contingency plans to minimize potential disruptions.

Dependency Network

Trade Evidence
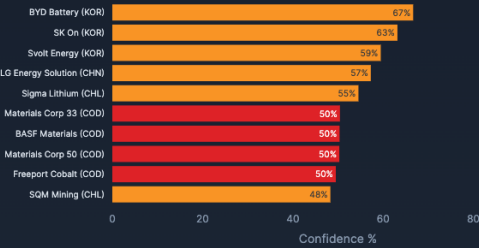
SHIPMENTS FROM JIANGXI GRAPHITE LTD

- **21** total shipments
- **535,168 kg** total weight
- **$27,791,140** total value

Consignees (Your Tier-1 Suppliers): 17 companies

Electronics Corp 42 · Albemarle Corp · SQM Mining · Ganfeng Lithium · Sigma Lithium · Theta Systems · Materials Corp 50 · Renesas Electronics · Umicore Materials · Materials Corp 44 · ON Semiconductor · Panasonic Energy · Generic Corp 49 · BHP Copper · Materials Corp 36 · Alpha Industries · Freeport Cobalt

Primary Commodity: Industrial Materials

Affected Tier-1 Vendors

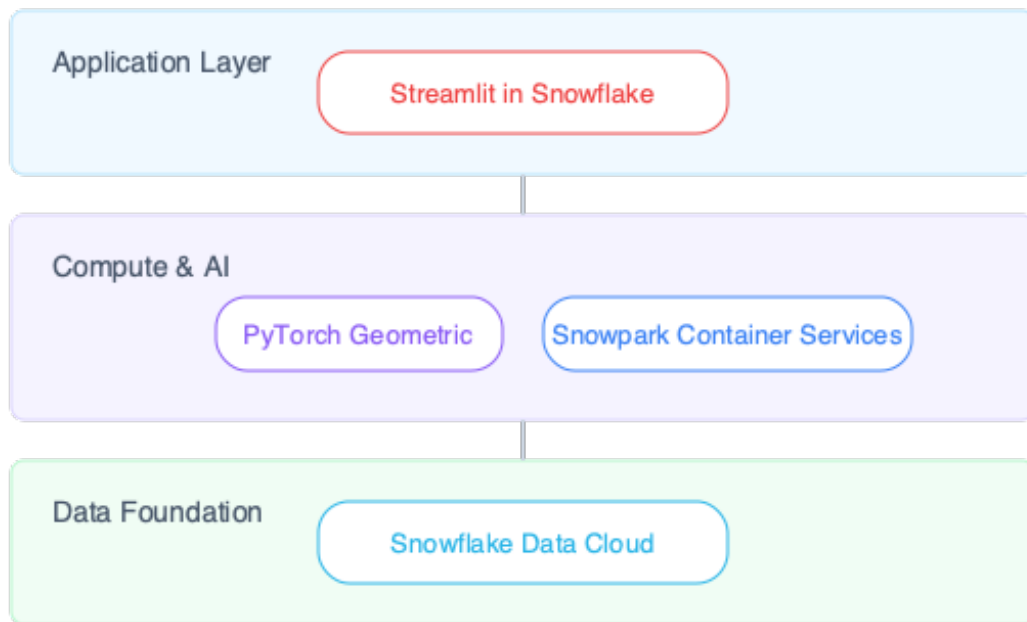| Vendor	Confidence %
BYD Battery (KOR)	67%
SK On (KOR)	63%
Svolt Energy (KOR)	59%
LG Energy Solution (CHN)	57%
Sigma Lithium (CHL)	55%
Materials Corp 33 (COD)	50%
BASF Materials (COD)	50%
Materials Corp 50 (COD)	50%
Freeport Cobalt (COD)	50%
SQM Mining (CHL)	48%

Tier-2 Analysis

Risk Mitigation

Personas and Value

Persona	Key Need	How This Solution Helps
VP of Procurement	Reduce supplier-driven production disruptions	See concentration risks before they cause shortages; make proactive qualification investments

Supply Chain Manager	Faster risk assessment for critical materials	Propagated risk scores highlight which parts need attention—no manual tracing required
Supplier Quality Engineer	Identify high-risk suppliers for audit	Filter by risk category; prioritize reviews based on network position, not just financials
Data Scientist	Build and iterate on risk models	PyTorch Geometric runs in Snowflake Notebooks with GPU; experiment close to governed data

Technology Foundation

Component	Role
Snowflake Tables	Store ERP data, trade intelligence, and model outputs
Snowflake Notebooks (SPCS)	Execute GNN training with GPU acceleration
PyTorch Geometric	GraphSAGE model for link prediction and risk propagation
Streamlit in Snowflake	Interactive dashboard for exploration and action planning
Snowflake CLI	Orchestrate deployment, execution, and cleanup

Technology Stack

Application Layer

Streamlit in Snowflake

Compute & AI

PyTorch Geometric   Snowpark Container Services

Data Foundation

Snowflake Data Cloud

Technology Stack

Call to Action

Primary: Run the Demo in Your Account

1. Clone the repository and deploy to your Snowflake account:

`bash

./deploy.sh -c your_connection

`

2. Execute the GNN notebook to generate risk scores:

`bash

```
./run.sh main
```
`

3. Open the Streamlit dashboard:

`bash

```
./run.sh streamlit
```
`

Secondary: Explore with Your Data

- ● Review the data architecture and map to your ERP schema
- ● Subscribe to Marketplace data sources for Tier-2+ enrichment:
- ● S&P; Global Panjiva — Trade flow intelligence
- ● Oxford Economics TradePrism — Forward-looking trade forecasts
- ● FactSet — Entity resolution and corporate linkages
- ● Resilinc EventWatch — Real-time disruption monitoring
- ● Schedule a working session to design a proof-of-concept with your critical materials

Built with ❄■ Snowflake | ■ PyTorch Geometric | ■ Streamlit