End-to-End Business Intelligence Case Study

Titanium Dioxide Exposure & Regulatory Risk Intelligence

U.S. Cosmetics Industry

Abhinav Noel Norbert

Business Intelligence | Data Analytics | Management Consulting

Power BI • SQL • Python • Data Modeling • DAX

Executive Summary

Problem

"Chemical exposure risk in the cosmetics industry is poorly quantified, despite increasing regulatory scrutiny."

What I Built

A full end-to-end BI solution to quantify Titanium exposure across products, categories, and companies.

Why It Matters

Any regulatory restriction would cause industry-wide disruption, not isolated impact.

Key Result

- **86.6%** of cosmetic products contain Titanium
- **75%** of companies are exposed
- Largest brands carry the highest absolute risk
- Titanium Dioxide emerged as the dominant risk driver through analysis

Business Context & Objective

Industry Context

- Cosmetics rely heavily on chemical additives
- Titanium Dioxide used for pigmentation, opacity, and UV protection
- Increasing global regulatory and ESG pressure

Objective

Answer four business questions:

1. How widespread is Titanium usage?
2. Which product categories are most dependent?
3. Which companies face the highest risk?
4. Where is regulatory exposure concentrated?

Data Source
  California Safe Cosmetics Program (CSCP)

Data Scale

• 36,972 cosmetic products

• 604 companies

• 123 regulated chemicals

• Reporting period: 2009–2020

Data Grain
  Each record represents **one chemical used in one product**

Dataset

Data Preparation & Validation

Guarantees **trustworthy metrics** for business decision-making.

Steps Performed

- Raw CSV ingestion

- Python-based data audit and cleaning

- Standardized dates, chemical identifiers, and categories

- SQL-based KPI validation

- Cross-validated product counts and penetration metrics between Python, SQL, and Power BI to eliminate aggregation drift.

- Ensured consistency across Python, SQL, and Power BI

Data Model (Star Schema)

Why Star Schema

- Accurate aggregations
- Scalable BI design
- Reliable DAX calculations
- Supports time intelligence and drill-downs

Fact Table

- Product ✖ Chemical relationships

Dimension Tables

- Product
- Company
- Chemical
- Category
- Date
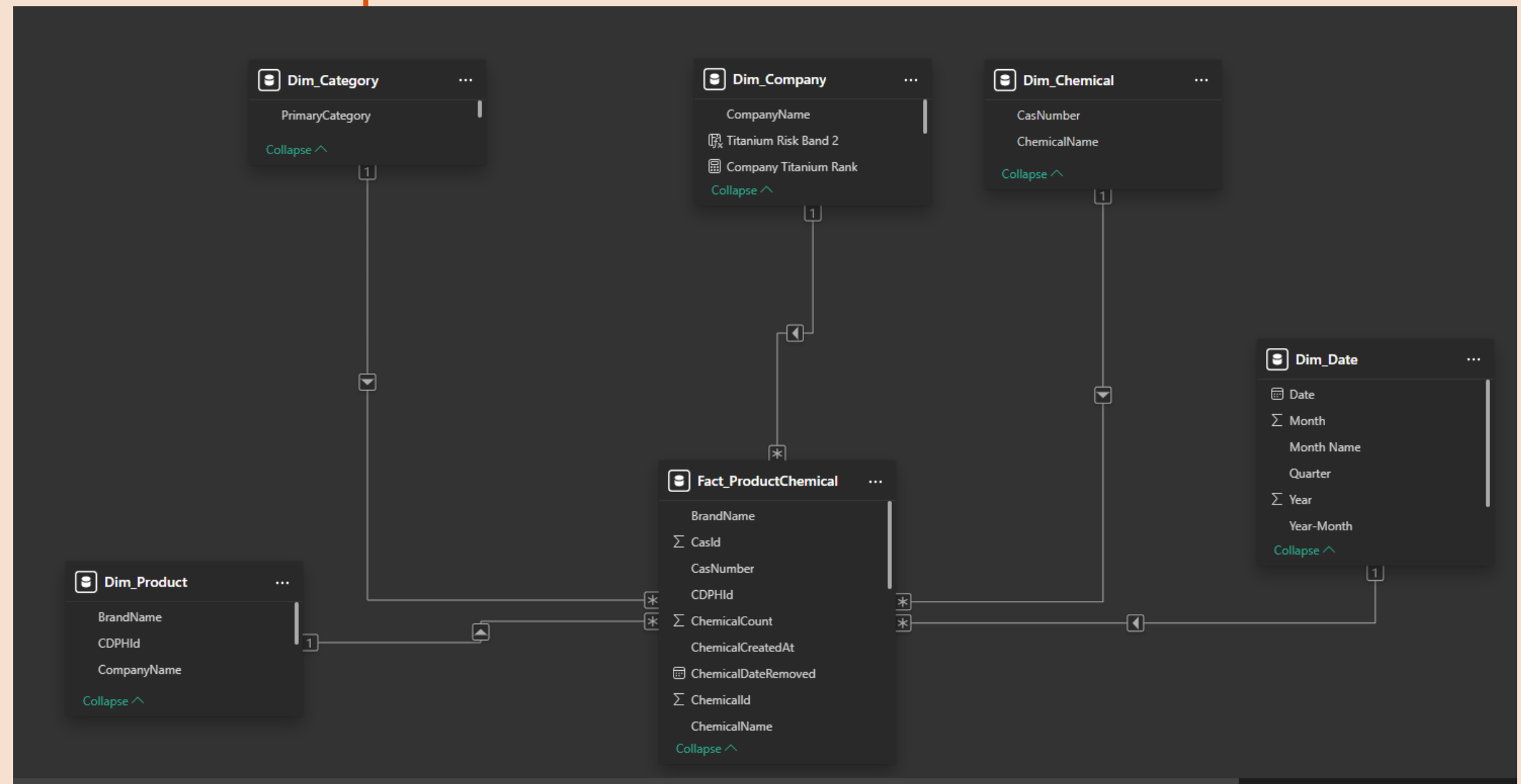
Core KPIs

- Total Products

- Titanium Products

- Titanium Penetration %

- Companies Using Titanium

Risk Innovation

"Percentage-based rankings masked true exposure; absolute Titanium product volume revealed systemic risk."

Key Metrics & Logic

Market-level Insights

Findings

- 86.6% of cosmetic products contain Titanium

- Dependency remains high over 12 years

- No meaningful shift away from Titanium
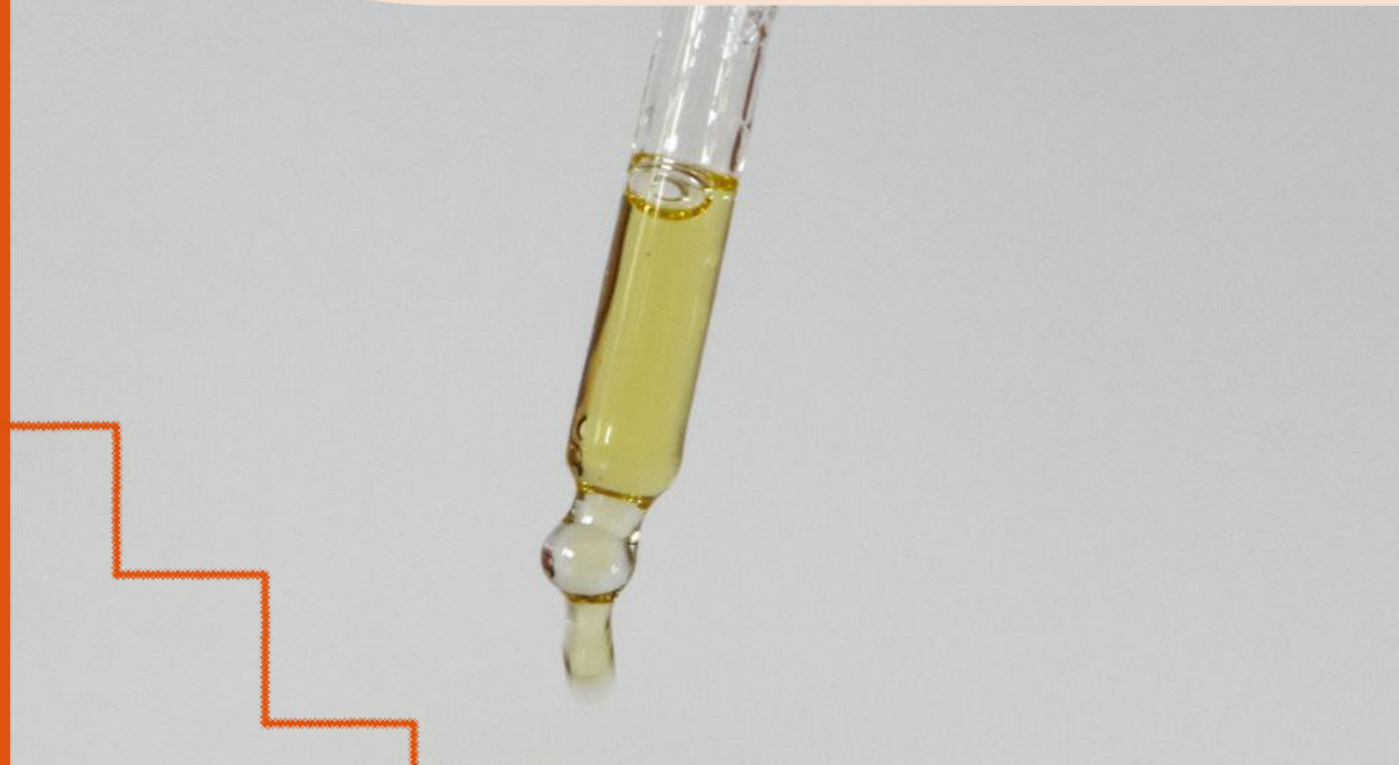
Business Interpretation

Titanium is a **structural dependency**, making regulatory action highly disruptive.

Market-Level Titanium Exposure Overview

"Analysis of product disclosures across U.S. cosmetics (2009–2020)"

37K Total Products	123 Total Chemicals	SCALE

RISK	32K Titanium Products	86.58% Titanium Penetration %

Top Chemicals by Product Exposure

Chemical Name:
- Titanium dioxide
- Silica, crystalline (airborn...
- Cocamide diethanolamine
- Retinol/retinyl esters, wh...
- Carbon black
- Mica
- Talc
- Retinyl palmitate
- Butylated hydroxyanisole
- Vitamin A palmitate

Products Affected: 0K, 10K, 20K, 30K
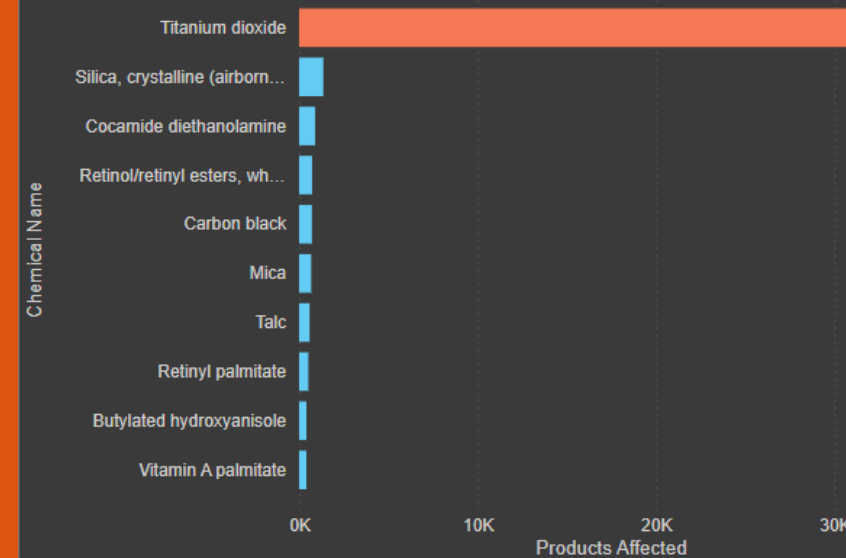
"Filter by Category"
PrimaryCategory
All

"Filter by Company"
CompanyName
All

Products by Initial Date by Year

Products by Initial Date: 0K, 5K, 10K

Year: 2010, 2012, 2014, 2016, 2018, 2020
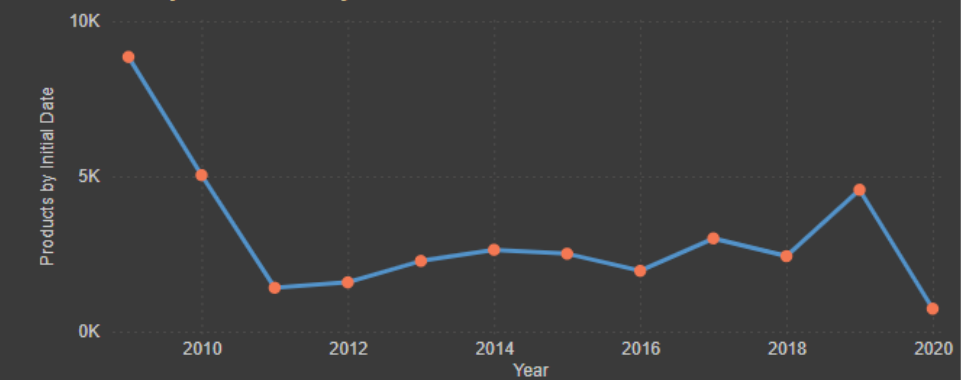
Category-level Risk Insights

Highest Risk Categories

- Makeup (Non-Permanent)
- Nail Products
- Oral Hygiene
- Tattoos & Permanent Makeup

Key Insight

These categories are **chemically locked-in**, making reformulation costly and complex.

Category-Level Titanium Exposure

Titanium Dioxide Penetration by Product Category

Category Risk Table

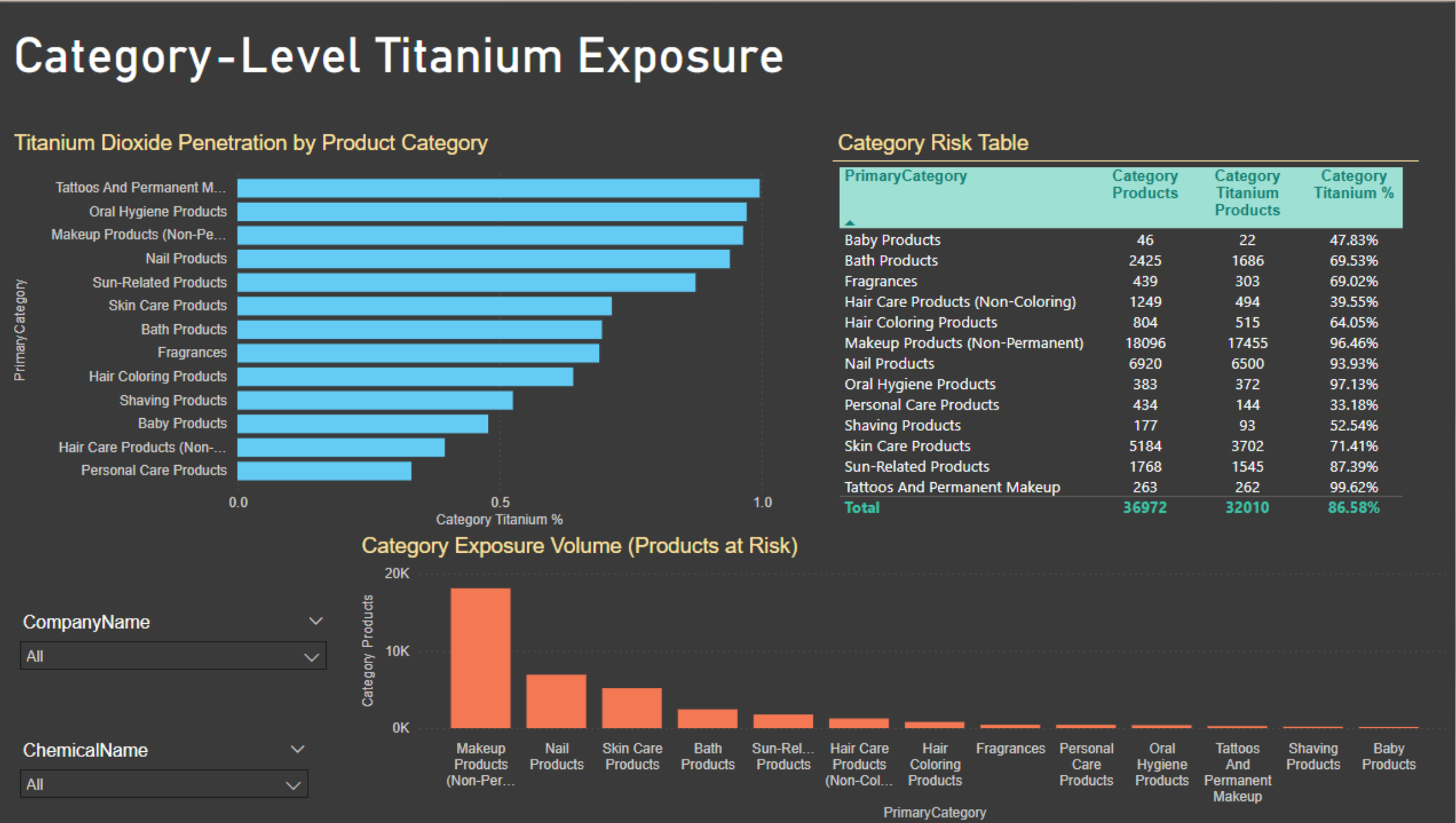| PrimaryCategory	Category Products	Category Titanium Products	Category Titanium %
Baby Products	46	22	47.83%
Bath Products	2425	1686	69.53%
Fragrances	439	303	69.02%
Hair Care Products (Non-Coloring)	1249	494	39.55%
Hair Coloring Products	804	515	64.05%
Makeup Products (Non-Permanent)	18096	17455	96.46%
Nail Products	6920	6500	93.93%
Oral Hygiene Products	383	372	97.13%
Personal Care Products	434	144	33.18%
Shaving Products	177	93	52.54%
Skin Care Products	5184	3702	71.41%
Sun-Related Products	1768	1545	87.39%
Tattoos And Permanent Makeup	263	262	99.62%
Total	**36972**	**32010**	**86.58%**

Category Exposure Volume (Products at Risk)

Company-level Risk Insights
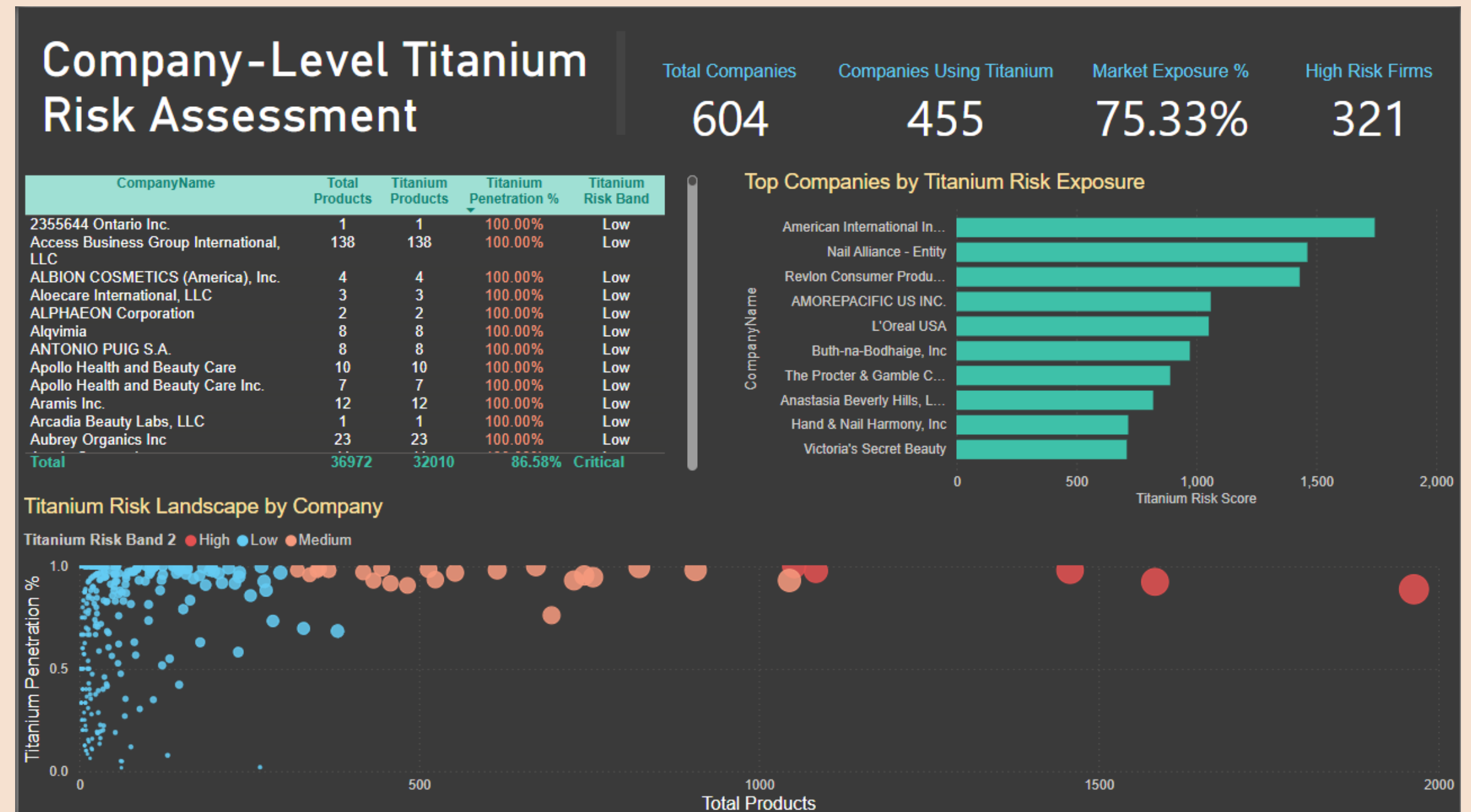
Risk Concentration

- Large companies dominate Titanium exposure
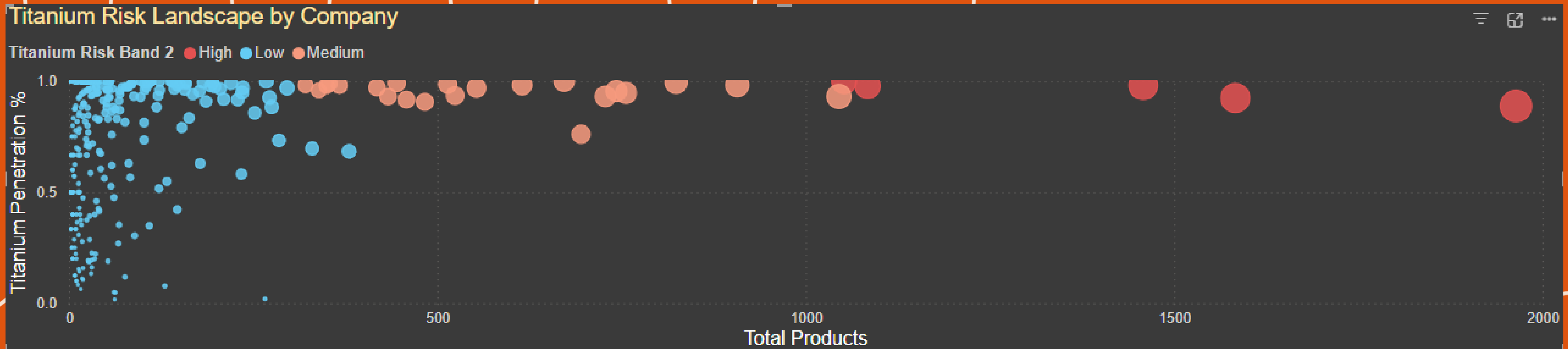- High dependency ✖ large portfolios = extreme risk

Top Exposure Companies

- American International Industries
- Nail Alliance
- Revlon
- AMOREPACIFIC
- L'Oréal USA

Insight

Regulatory action would impact **market leaders first**, not fringe brands.

Company-Level Titanium Risk Assessment

	Total Companies	Companies Using Titanium	Market Exposure %	High Risk Firms
	604	455	75.33%	321

CompanyName	Total Products	Titanium Products	Titanium Penetration %	Titanium Risk Band
2355644 Ontario Inc.	1	1	100.00%	Low
Access Business Group International, LLC	138	138	100.00%	Low
ALBION COSMETICS (America), Inc.	4	4	100.00%	Low
Aloecare International, LLC	3	3	100.00%	Low
ALPHAEON Corporation	2	2	100.00%	Low
Alqvimia	8	8	100.00%	Low
ANTONIO PUIG S.A.	8	8	100.00%	Low
Apollo Health and Beauty Care	10	10	100.00%	Low
Apollo Health and Beauty Care Inc.	7	7	100.00%	Low
Aramis Inc.	12	12	100.00%	Low
Arcadia Beauty Labs, LLC	1	1	100.00%	Low
Aubrey Organics Inc	23	23	100.00%	Low
Total	36972	32010	86.58%	Critical

Top Companies by Titanium Risk Exposure

Titanium Risk Landscape by Company

Risk Landscape (Scatter Analysis)

Titanium Risk Landscape by Company

Titanium Risk Band 2 ● High ● Low ● Medium

Titanium Penetration %

Total Products

What the Chart Shows

- X-axis: Company size (Total Products)

- Y-axis: Titanium dependency (%)

- Bubble size: Titanium exposure volume

- Color: Risk band (Low → Critical)

Why This Matters
Visually identifies **systemic risk clusters** in the industry.

Business & Regulatory Implications

For Regulators

Focus on high-impact companies and categories first

For Companies

- Prioritize reformulation in high-risk segments

- Diversify ingredient sourcing

For Investors

"Titanium exposure represents an unpriced ESG and regulatory risk that could materially impact large-cap cosmetics portfolios."

Skills Demonstrated

What This Project Proves

- End-to-end BI ownership

- Strong data modeling fundamentals

- Advanced DAX for ranking, context control, and risk banding.

- Business-driven insight generation

- Dashboard design for decision-makers

FINAL TAKEAWAY

"Regulatory risk is structurally concentrated – **driven by product design**, not isolated compliance failures."

Thank you

This project demonstrates how bi can be used to **anticipate risk**, not just report numbers.