



End-to-End Business Intelligence Case Study

Titanium Dioxide Exposure & Regulatory Risk Intelligence

U.S. Cosmetics Industry

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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 Chemical 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

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

Why This Matters

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

Data Model (Star Schema)

Why Star Schema

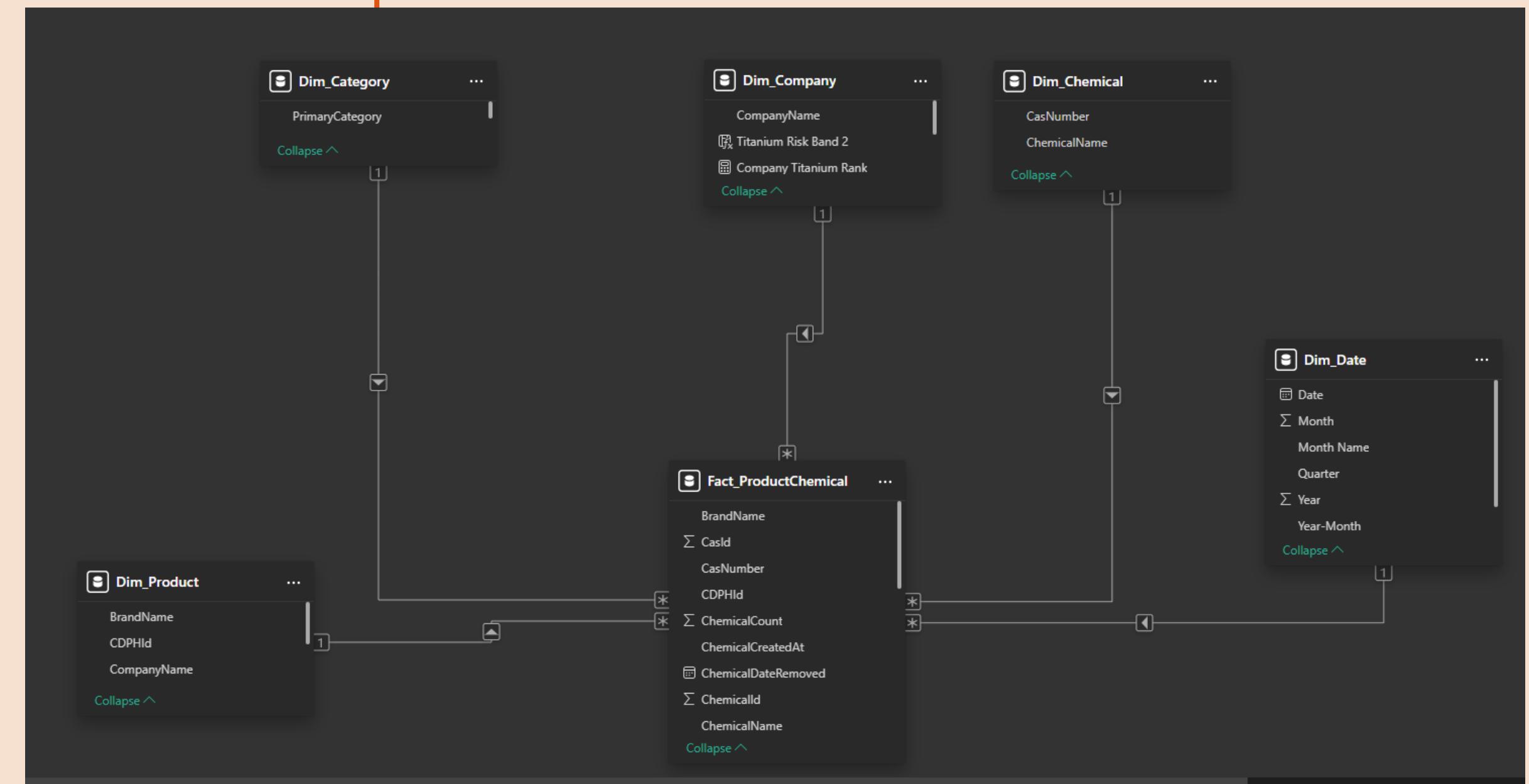
- Accurate aggregations
- Scalable BI design
- Reliable DAX calculations
- Supports time intelligence and drill-downs

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

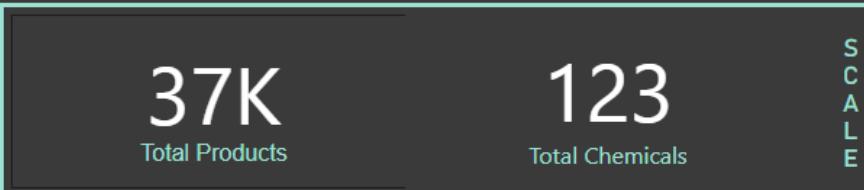
- 86.6% of cosmetic products contain Titanium
- Dependency remains high over 12 years
- No meaningful shift away from Titanium

Business Interpretation

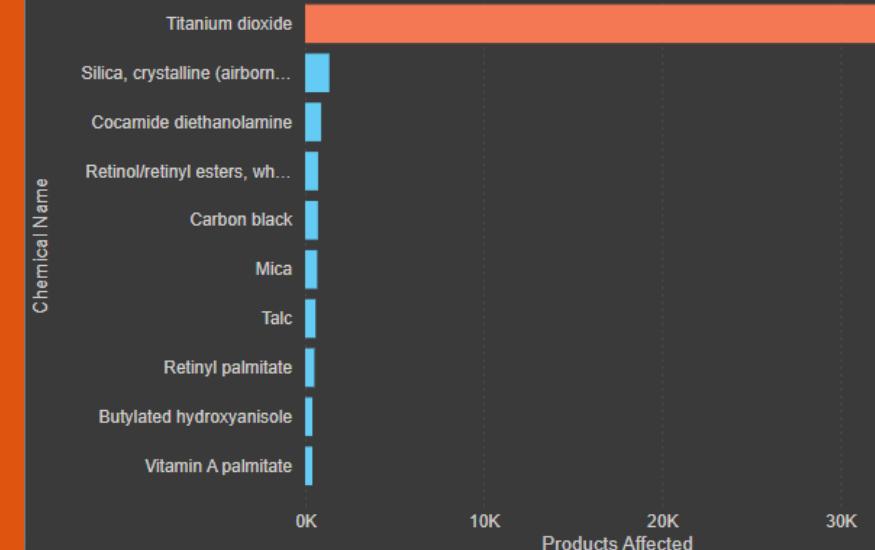
Titanium is a **structural dependency**, making regulatory action highly disruptive.

Market-Level Titanium Exposure Overview

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



Top Chemicals by Product Exposure



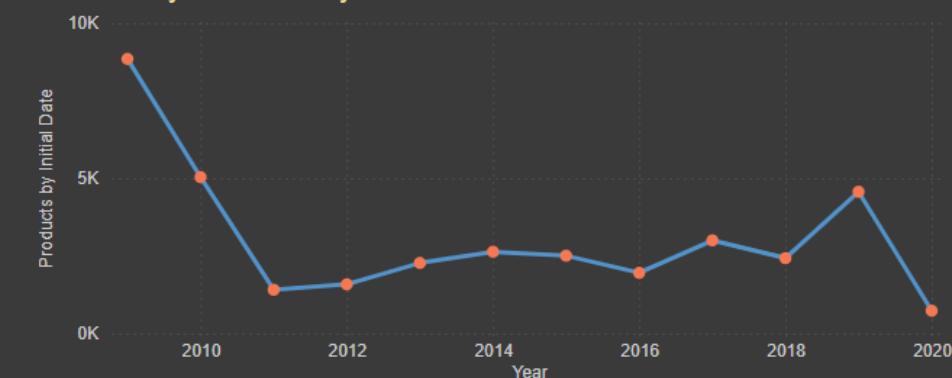
"Filter by Category"

PrimaryCategory

"Filter by Company"

CompanyName

Products by Initial Date by Year



Category-level Risk Insights

Highest Risk Categories

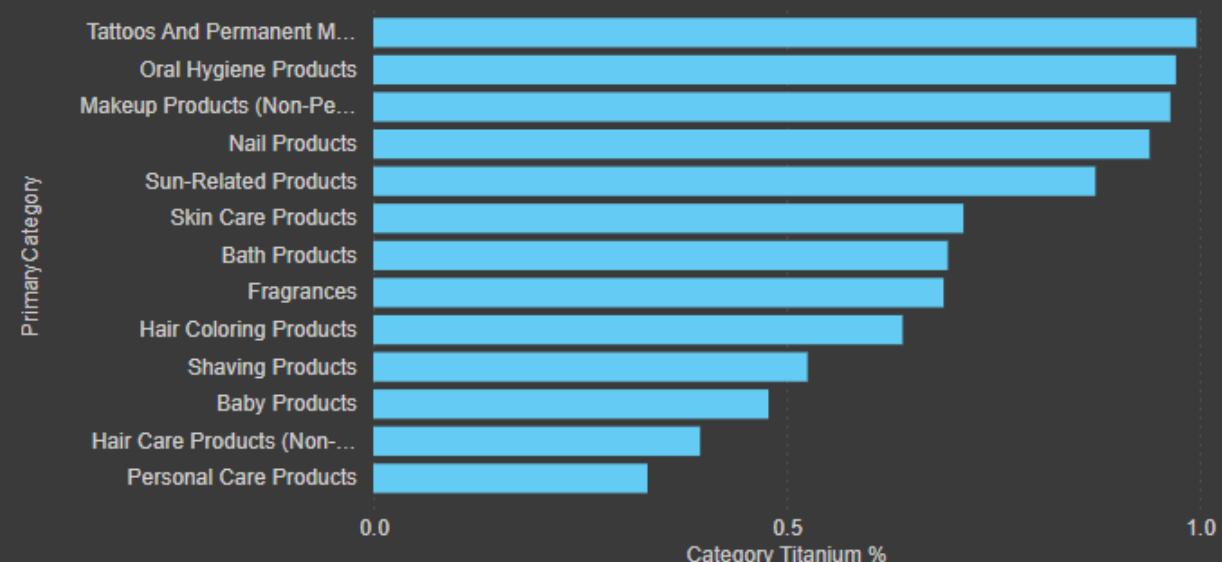
- Makeup (Non-Permanent)
- Nail Products
- Oral Hygiene
- Tattoos & Permanent Makeup

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

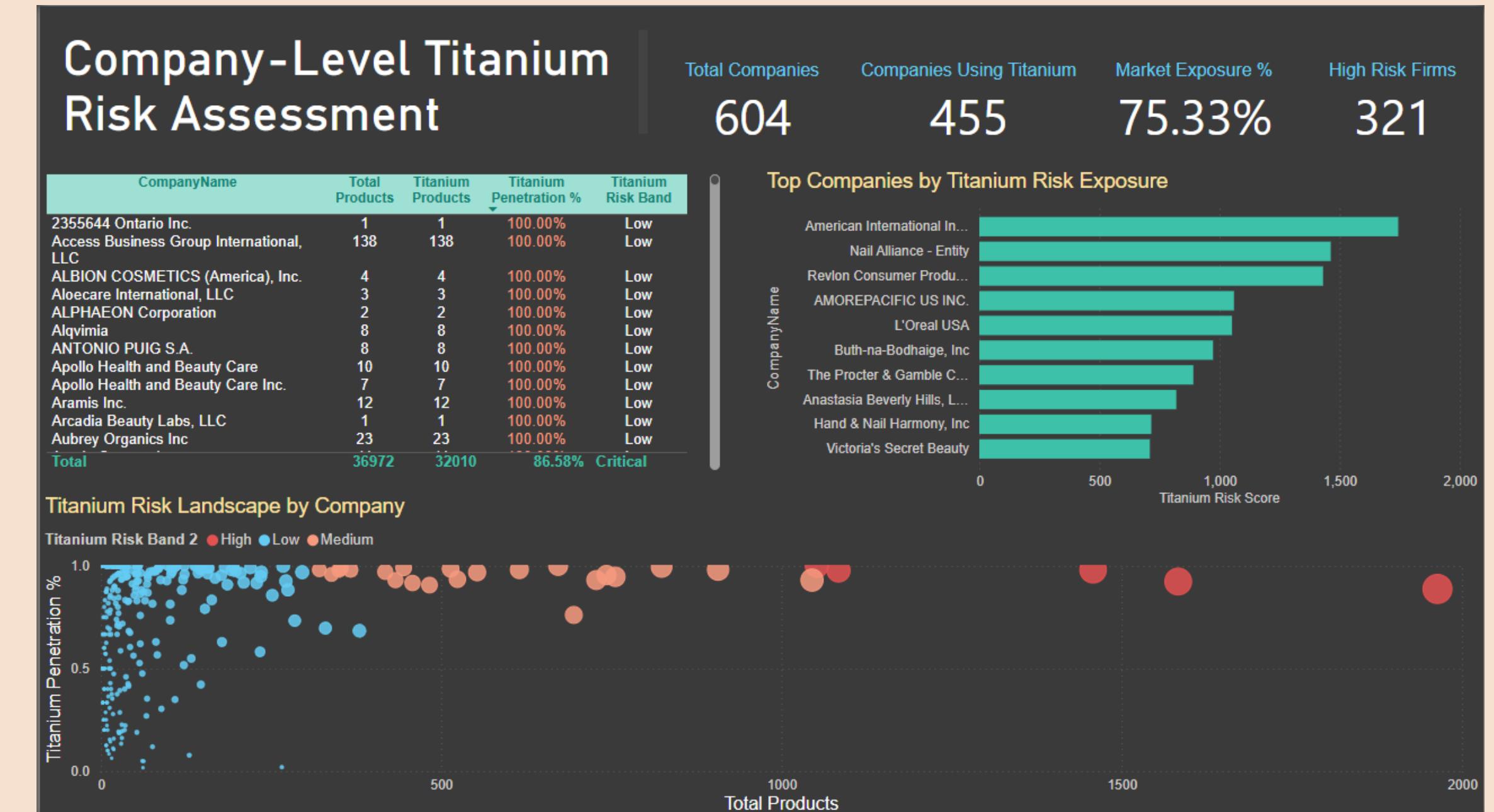
- Large companies dominate Titanium exposure
- High dependency × large portfolios = extreme risk

Top Exposure Companies

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

Insight

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



Titanium Risk Landscape by Company

Titanium Risk Band 2 • High • Low • Medium



Risk Landscape (Scatter Analysis)

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.