# Business Context & Use Cases: Adventure Works Semantic Knowledge Graph

This document outlines the strategic value of the Graph & Mining Project and details specific business use cases for the implemented graph algorithms.

## 🏢 Business Situation: Strategic Overhaul

**Context:** Adventure Works is a global bicycle manufacturer and distributor that sells products through a vast network of resellers (retail shops) and employs a distributed team of sales representatives.

**The Problem:** The company sits on a mountain of transactional data (SQL tables) but lacks *structural* insight. They know *how much* they sold, but they struggle to answer relational questions:

- "Why does a reseller in Seattle buy specific combinations of frames and helmets?"
- "Which products drive the sales of other products?"
- "Are our sales territories actually aligned with how our teams collaborate?"

**The Solution:** This project ingests flat transactional data into a **Neo4j Semantic Knowledge Graph**. By modeling relationships (e.g., `COMMONLY_SOLD_BY_SAME_RESELLER`, `WORKS_WITH`), the company can move beyond simple aggregation and start performing **Graph Data Science (GDS)** to uncover hidden patterns in their supply chain and sales network.

## 💡 Graph-Driven Use Cases

The following use cases leverage the specific algorithms and projections implemented in the project.

### 1. Inventory & Bundle Optimization

- **Algorithm: Weighted Louvain Community Detection** on the **Product Graph**.
  - *Relationship:* `COMMONLY_SOLD_BY_SAME_RESELLER`
  - *Weight:* Number of resellers stocking both items.
- **Business Application:**
  - **Bundle Creation:** The algorithm identifies natural clusters of products (e.g., grouping specific frames with matching bottle cages and tires). Marketing can package these as "Road Ready Starter Kits."
  - **Inventory Placement:** If a warehouse stocks a primary product, it should also stock the associated accessories identified in its community to minimize shipping splits and logistical overhead.

### 2. Supply Chain Criticality Analysis

- **Algorithm: Weighted PageRank** on the **Product Graph**.
- **Business Application:**

- **Risk Mitigation:** Identifies "Anchor Products" (nodes with high centrality like the "HL Road Frame"). These items are the structural hubs of the sales network.
- **Priority Management:** Operations must prioritize the supply chain for these items. A stockout of an Anchor Product risks breaking the sales chain for all peripheral accessories connected to it.

## 3. Sales Territory Re-Alignment

- **Algorithm: Louvain Community Detection** & **PageRank** on the **Salesperson Network**.
  - *Relationship:* `WORKS_WITH` (based on shared regions).
- **Business Application:**
  - **Team Structuring:** Reveals organic collaboration clusters. If a salesperson is isolated from their assigned cluster, it may indicate a territory misalignment or a need for mentorship.
  - **Identifying Leaders:** PageRank identifies key influencers within the sales force who can lead training initiatives or pilot new sales strategies.

## 4. Intelligent Product Substitution & Recommendation

- **Algorithm: Dijkstra Shortest Path** on the **Knowledge Graph**.
  - *Path:* `(Product A) -> (Subcategory) -> (Category) -> (Subcategory) -> (Product B)`
- **Business Application:**
  - **Stockout Handling:** If a specific model is out of stock, the graph finds the shortest path to a functionally identical substitute (e.g., same model, different color) via shared metadata nodes.
  - **Cross-Selling:** Discovers non-obvious connections between disparate products (e.g., connecting a "Mountain Bike" to a specific "Road Helmet" via shared category hierarchies or regional trends).

## 5. SKU Rationalization

- **Algorithm: Node Similarity (Jaccard)** on the **Product Graph**.
- **Business Application:**
  - **Catalog Cleanup:** Identifies products with a similarity score of 1.0 (indicating they are sold to the exact same set of resellers).
  - **Consolidation:** The company can consolidate these SKUs or simplify tracking for variants that the market treats as functionally identical, reducing administrative and storage costs.