Graph Architecture and Semantic Layer for Product Personalization, Cross Selling, and Revenue Growth

The Challenge

A global home furnishing retailer partnered with EK to design and implement a knowledge graph that connects customer style preferences with aesthetically compatible products (e.g. based on product types, colors, patterns, materials). This effort serves to enhance product cross-selling and personalize the customer shopping experience by recommending curated product sets across home furnishing areas that help customers "complete the look" based on their style preferences. Much of the retailer's knowledge about styles (e.g. "boho" and "mid-century modern") and compatible product groupings (e.g. sheet sets and bedspreads) that reflect customer styles, has either been buried in unstructured PDFs or exists as tacit knowledge in the heads of interior design experts. As a result, the creation of new product groupings aligned to specific styles required weeks of manual effort and expert involvement, and was limited in its applicability.

In addition to building the knowledge graph, the retailer had a vision for establishing a semantic layer and semantic knowledge management practices across the organization to lay the foundation for more connected, accessible, reusable, and meaningful style and product knowledge at scale. Their objective is to enable the transformation of furnishing design expertise into structured, governed, and machine-readable assets that can evolve over time, be used consistently across internal teams and global retail markets, and support a range of intersecting use cases and applications.

The Solution

The retailer needed to aggregate and connect product and style data, enriched with meaningful design relationships, to establish a bridge between how they categorize products and how customers imagine furnishing their homes. EK engaged with the client to develop a knowledge graph that would enable this shared language and help make customer interactions more relevant and intuitive.

The core components of EK's semantic advisory and solution development included:

- **Product Vision and Use Case Refinement:** EK collaborated with the client to shape a product vision for the knowledge graph as an internal tool that boosts operational efficiency and speed-to-market for promoting their style-based product groupings, as well as an external asset that elevates a customer-centric experience and maximizes product cross-selling opportunities for revenue uplift. EK complemented this with a strategic semantic layer lens for standardizing their home furnishing knowledge and promoting data accessibility and reuse across the organisation. EK's guidance on this vision resulted in a compelling narrative to drive stakeholder engagement and tangibly shape the direction of solution expansion.

- **Taxonomy and Ontology Modeling:** EK's semantic modeling experts partnered with interior design experts, content specialists, and product team members to design and implement 15+ taxonomies and 3 ontologies that accurately reflect and connect market-specific styles and products in the home furnishing domain to create robust sets of compatible product groupings. The reusability and extensibility of these core semantic models streamlined the incorporation of new datasets as EK expanded the solution, maximizing the potential sales uplift across the target areas of the customer-facing product groupings generated in the graph.

- **Knowledge Graph Implementation and Process Automation:** EK built a knowledge graph that connects products based on both stylistic and functional attributes, enabling more personalized and accurate product recommendations. By capturing expert knowledge of aesthetic relationships, the graph helps match products to a customer's specific style preferences, such as "rustic farmhouse." To ensure practical compatibility, EK also incorporated market-specific sizing logic, so that recommended items such as comforters, bedspreads, and sheets actually fit the customer's bed size (e.g. for a US customer with a queen-sized bed). This combination of aesthetic and functional data connectivity creates a consistent framework for delivering style-aligned, size-appropriate product recommendations to customers.

- **Tooling Selection and Production-Readiness Enablement:** To effectively scale from a proof-of-concept to a production-ready solution, EK guided the client on selecting and successfully gaining buy-in for the procurement of a graph database and a taxonomy/ontology management and graph visualization platform. EK also developed a tailored production-readiness checklist that defines *technical* (e.g. platform setup, ETL development, UI enhancements), *organizational* (e.g. tooling ownership, governance roles, security considerations), and *process* (e.g. change management workflows, user training) requirements for maturing the retailer's full semantic ecosystem. EK continues to work hand-in-hand with the client to operationalize these efforts for a fully embedded, scalable, and enterprise-wide solution to power customer-facing experiences.

Data Quality and Architecture Enrichment for Insights Visualization

Example Model Concepts for Product Personalization

The EK Difference

- **Semantic Modeling and Scalable Graph Development:** EK brought extensive expertise in semantic modeling and technologies to ensure the robustness and extensibility of the taxonomies, ontologies, and graph data for long-term application and scale. EK enabled accelerated expansion into more complex style and product grouping use cases as the retailer's priorities shifted to a new market, and successfully reduced significant manual efforts, driving towards more comprehensive and scalable graph data creation and enrichment.

- **Strategic Governance and Operationalization:** EK recognizes that the graph is not a standalone solution to operationalize semantics at the organization, and provided expert guidance in a range of areas to facilitate progress towards the retailer's vision for semantic knowledge management. EK defined a tailored operating model, which expands the technology lens to critical people and processes by outlining key roles and responsibilities and structuring guidance for strategic organizational engagement. This operating model establishes reusable patterns, shared standards, and sustainable ownership and support structures for a truly scalable, connected, and adaptive knowledge ecosystem.

Data Quality and Architecture Enrichment for Insights Visualization

- **Organizational Buy-In:** Additionally, to gain greater visibility and broader buy-in of the ongoing work across the organization, EK worked closely with the retailer's core team to identify and engage with key departments and other product owners to create a shared understanding of the graph capabilities and promote strategic collaboration for wider application of the semantic style and product data. EK facilitated collaborative use case discovery sessions and created reusable knowledge sharing materials covering a range of expertise areas such as semantic search and transforming RDF graph data to serve LPG-powered applications. These sessions and materials were contextualized to the audiences and their priority use cases, resulting in new partnerships critical for maintaining development momentum and maximizing organizational alignment for shared success.

The Results

The core logic established with the knowledge graph automated the generation of specific style-based product groupings across the retailer's range, fully eliminating an error-prone manual process in which interior design experts had to previously search for specific product IDs. Leveraging the graph to automatically select appropriate products based on their aesthetic and functional attributes increased the coverage of product groupings and reduced the speed-to-market of the end-to-end process from **2.5 weeks to 4 days.**

Ultimately, the knowledge graph and parallel strategic efforts for their semantic layer are driving the retailer towards the realization of their overarching objectives for semantic knowledge management. Externally, this work is elevating and personalizing the customer experience and maximizing product cross-selling opportunities for sales and revenue uplift across their departments and target markets. Internally, EK helped the retailer boost operational efficiency, speed-to-market, and scalability for their style-based product grouping curation. At the close of the most recent phase, EK delivered a roadmap that the organization has adopted, where EK will continue to advise on their technical, process, and organizational readiness for a production knowledge graph ecosystem and enterprise-wide semantic knowledge management.

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