Data Ontology and Knowledge Graphs Have Incredible Potential for the Mining Industry. Here's Why

WRITTEN BY ARI JOURY, PH.D.

MINERS ARE SITTING ON TERABYTES OF DATA WITHOUT REAPING ITS FULL BENEFITS. ONTOLOGY CAN CHANGE THAT

Data ontology and knowledge graphs are tools to make sense of raw data. In your company, you might be storing data about mines, customers, and business processes in various formats based on various concepts. Up until recently, sifting through all that information required data integration software solutions alongside many skilled humans and many working hours.

Why is data processing in the mining industry so complex?

There are a few reasons for this. First, there is a lot of data. For a single mine, many terabytes of data might be used. Second, the data comes in many different formats. Without software solutions like Eclipse Mining Technologies' SourceOne®, which simplifies the process by using a common data format, many miners find themselves floundering. Third, the data is complex. Each datapoint might refer to several different concepts that are specific to the mining industry, the company, or a particular mine. Understanding one datapoint requires mastering many different concepts.

That's where data ontology and knowledge graphs come in.

THE ORIGINS OF ONTOLOGY

Ontology, the art of organizing knowledge, predates even the most ancient mines owned by companies today. Its roots can be traced back to the great philosopher Aristotle, who hailed it as the "first philosophy" in his seminal work, Metaphysics, dating back to the fourth century B.C.E.

Remarkably, ontology experienced a period of obscurity before regaining prominence. It was the German rationalist philosopher Christian Wolff who reignited the flame of ontology, thrusting it back into mainstream philosophical discourse during the 18th century.

But why has this ancient concept resurfaced and gained traction once again in recent times? The answer lies in the overwhelming surge of data that demands efficient management.

In our modern era, where data reigns supreme, the notion of data ontology and knowledge graphs has gained particular relevance. Industries grappling with massive data volumes, such as mining, find themselves compelled to make sense of the information at hand to achieve success. Enter ontology—the key to unlocking the potential hidden within mountains of data.

Imagine capturing every mining concept as a unique element within an ontology, like pieces of a grand puzzle. Suddenly, data points are no longer isolated entities but interconnected within a rich context. This powerful approach saves invaluable time and effort while unearthing hidden insights that might have otherwise eluded us.

The mining industry, with its colossal data reserves, stands to benefit immensely from embracing data ontology and knowledge graphs. By leveraging these tools, mining companies can transform their operations, enabling a deeper understanding of their data landscape and paving the way for innovative discoveries.

WHAT IS ONTOLOGY?

Before we get into the details of how ontology works in the world of data, let's have a look at what a philosopher would say about it.

At its core, ontology is the study of what is. To make this a little more concrete, one could also say ontology is the study of what exists or of what is real. "Does God exist?," "Are my feelings real?", "What is 'nothing,' and does it exist?" are all examples of ontological questions.

Those are questions you might be asking when it's particularly late at night or when you've had an exceptionally tough day. But for philosophers and, increasingly, computer scientists, these are everyday questions thanks to ontology.

Philosophers like to make assumptions in order to explore such questions further. For example, they might assume that God exists. Then they might ask something like, "What is the relationship of God to humans, animals, plants, the ocean and the sky?" The answers to these questions provide information not only about what exists (e.g., God and humans), but also about the relationship between these things (e.g., God gives kindness to humans).

ONTOLOGY AND DATA

At its core, ontology seeks to capture the essence of everything that exists—entities, ideas, events—and the intricate relationships that bind them. It is this fundamental objective that propelled ontology out of the philosophical realm and into the spotlight of computer scientists during the early 2000s.

Visionaries like Tim Berners-Lee, renowned for his pioneering contributions to the World Wide Web, spearheaded the movement towards what they termed "linked data." The underlying notion was a departure from data existing solely in the form of hypertext documents and hyperlinks. Instead, data should be perceived as representations of real-world entities—people, places, events, ideas—and interconnected in a manner that is easily comprehensible to humans.

Embracing this ontological perspective represented a leap forward in our understanding of data. However, it comes as no surprise that, at the time, the necessary tools to translate these ideas into practice were not yet available.

Today, however, we find ourselves in an era where the Internet has matured, and the tools we require have come to fruition. Consequently, ontology is experiencing a renaissance within the realm of computer science.

Consider, for instance, the evolution of search engines. In the not-so-distant past, entering a query like "gold mine" would yield a list of links deemed relevant based on the frequency of the term's mention, backlinks, and other criteria best explained by search engine experts.

Fast-forward to the present, and the transformation becomes evident. Enter "gold mine" into a modern search engine, and it instantly recognizes the concept of a mine and comprehends the nature of gold. The search results now offer data points directly related to these concepts—details about the largest

gold mines, insights into gold mining techniques, and more. Moreover, the search engine may also provide general knowledge articles encompassing gold mines, mining processes, and extraction methods, tailored to the user's specific interests.

This is ontology in action—an empowering force that bridges the gap between data and human understanding, reshaping how we interact with information.

WHAT IS A KNOWLEDGE GRAPH?

Knowledge graphs and data ontologies are often used interchangeably, but there are some subtle differences in their usage. The term data ontology emphasizes the importance of predefined concepts, like that of "gold" and that of "mine." The term knowledge graph emphasizes the relationship between concepts, e.g., gold is extracted from a mine.

Both terms cover both concepts and their relationships. Which term you use depends on what aspect you want to emphasize.

DATA ONTOLOGIES IN PRACTICE

Let's consider a data set of contracts. Without any knowledge of ontology, you might opt to store all the contract-related data points in a conventional table. This table would feature columns such as "Contract owner," "Coverage," and "Confidentiality."

However, this approach poses challenges when modifications or additions to columns become necessary. To ensure data integrity, you would need to recreate the entire table, ensuring that all entries conform to the new format. Furthermore, some contracts may require specific columns, while others do not, resulting in wasted time and effort by populating unnecessary fields for every contract.

In contrast, with an ontology-based approach to contracts, you would conceptualize different contract classes, such as "fixed-price procurement contract" or "royalties contract," each possessing its unique properties.

Visualize it as a tree diagram, rather than a rigid table structure. Adding a new property becomes as simple as appending a branch in the relevant position. For instance, you could effortlessly incorporate an "equipment purchase agreement" as a branch under the "fixed-price procurement contract." It would be impractical, however, to add this as an entire column to all contract types, as unrelated entities like a non-disclosure agreement pertaining to metal streaming royalties have no relevance to an equipment purchase agreement.

The application of ontologies extends beyond efficient data organization—it holds immense value for machine learning as well. Even for a sophisticated language model, comprehending intricate relationships can be challenging. For instance, understanding that a "gold mine" is a type of mine with specific associated properties, that your company does not currently own one but might be interested in doing so, and consequently, recommending compelling purchase options—all these details can be directly fed to the machine learning model by leveraging an ontology. By doing so, the model can focus its capabilities on delivering optimal purchase recommendations and business models tailored to gold mines.

ONTOLOGY IN OTHER INDUSTRIES

The impact of ontology reaches far beyond web search. In the pharmaceutical industry, AstraZeneca utilizes ontological principles to build extensive datasets, enabling researchers to make sure their hypotheses were right before testing its drugs.

Health records organized ontologically can help people make better food choices, while financial data analysis coupled with ontology has helped uncover financial crime.

These custom-tailored applications reflect the evolving Internet landscape, where each unique problem gets its own unique solution. Ontology is starting to prove invaluable in addressing real-world challenges, connecting data, and offering customized solutions for every business case.

THE AGE OF ONTOLOGY

Ontology might not be as old as mining. However, it is old enough that it's grown out of the phase where it was just a buzzword.

Leveraging ontology for data is disrupting several industries already, and mining might just be next.

The question no longer lingers as “What is ontology and why should I consider it?” but rather demands introspection: “Why hasn’t my company embraced ontology yet?”

Resolving this query doesn’t necessitate delving into philosophical treatises. Instead, it requires a critical evaluation of your company’s current practices and an exploration of how ontology can enhance existing business processes.

It is crucial to differentiate between fleeting tech buzzwords and enduring principles that revolutionize our operational landscape. While not every trend deserves attention, age-old principles, when applied intelligently, can reshape the way we operate in the mining industry by streamlining processes, gaining deeper insights into data, and navigating the vast landscape of information with precision...

Ontology for mining means leveraging age-old principles to drive innovation and propelling your mining company into the next digital era.

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