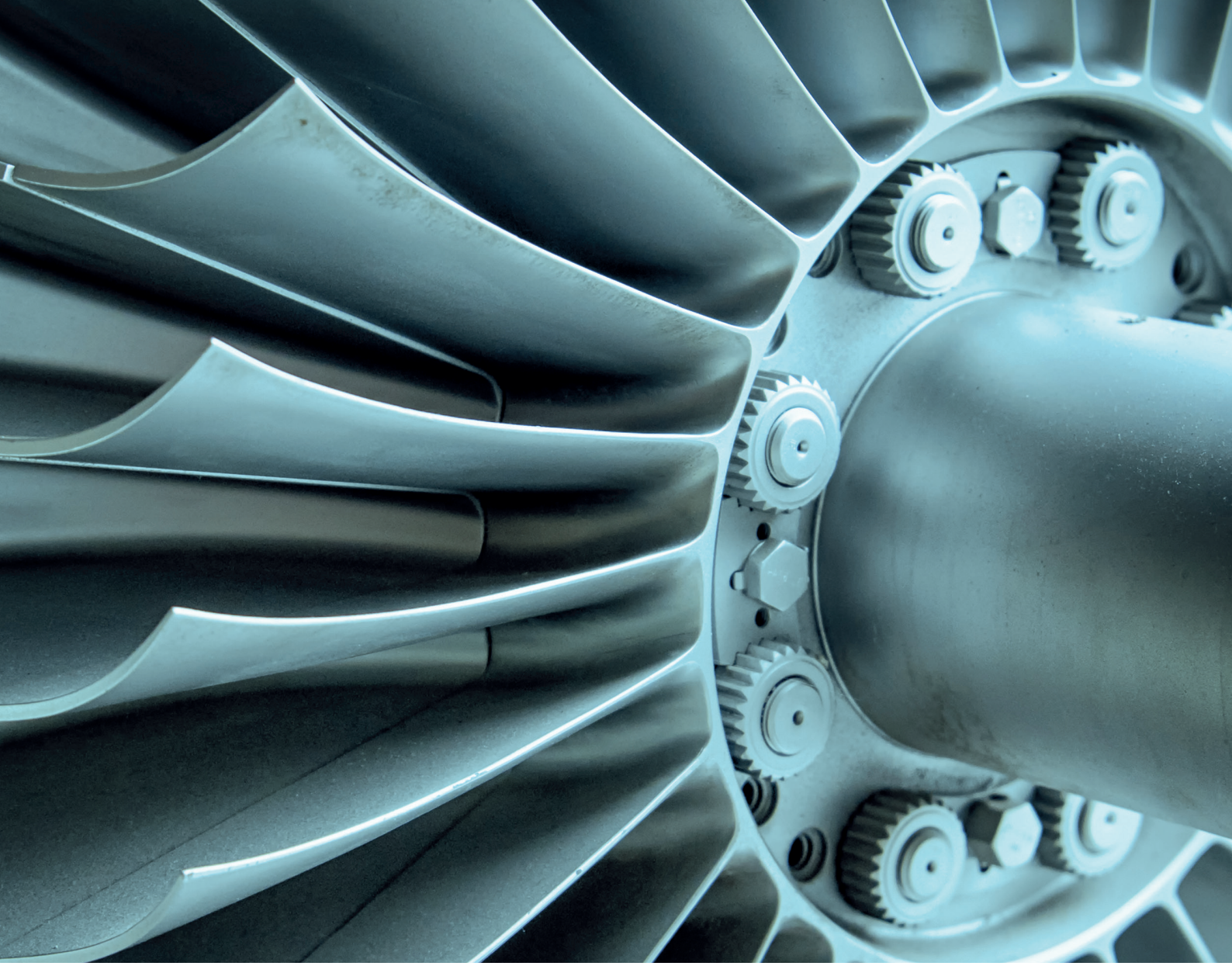

Siemens Energy significantly reduces manual effort for spare parts management of large gas turbines with metaphactory and Amazon Neptune

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EXECUTIVE SUMMARY

Gas turbines of Siemens Energy are used worldwide in different environments and with customer specific configurations. Managing a broad variety of spare parts and configurations for each turbine is a challenge. metaphactory and Amazon Neptune enabled Siemens Energy to build a Turbine Knowledge Graph and visualize the connections between similar parts across the entire fleet of gas turbines. Through rapid application development, metaphactory allowed business users, i.e., turbine service engineers, to provide feedback and help shape the spare parts management application built on top of the Turbine Knowledge Graph. This resulted in shorter time to market for the internal business solution. Supporting business users to efficiently identify and manage spare parts, the solution increases customer satisfaction as well as internal productivity, and yielded savings of up to 1,500 hours (or more than 180 man-days) of manual effort in the first year already. Moreover, the solution helps business users identify and correct inconsistencies in gas turbine documentation and delivers an intuitive user experience.

"THE KEY ADVANTAGE OF METAPHACTORY WAS THAT WE COULD EASILY VISUALIZE OUR DATA DURING DEVELOPMENT FOR EARLY FEEDBACK FROM THE BUSINESS ALLOWING FOR DATA QUALITY IMPROVEMENTS, AND FAST AND TARGET-FOCUSED DEVELOPMENT OF OUR DATA MODEL AND APPLICATION."

Paul Zolnowski
Section Lead - Post Documentation,
Siemens Energy

THE CUSTOMER

With its products, solutions, systems, and services, Siemens Energy addresses the extraction, processing, and transport of oil and gas as well as power and heat generation in central and distributed thermal power plants, and power transmission and technologies for the energy transformation, including storage and sector-coupling solutions. The Generation Service business unit of Siemens Energy is responsible for global services and maintenance around large gas and steam turbines and generators.

EXECUTIVE OVERVIEW

Industry

- Power Generation

Use Case

- Spare Parts Management

Goals

- Smart and targeted maintenance of spare parts of large gas turbines

Challenges

- Heterogeneous digital representations of turbine configurations and a multitude of customer-specific spare parts catalogs and maintenance packages

Solution

- Knowledge Graph driven application for fleetwide analysis of turbine configurations and spare parts

Results

- Shorter time to market of the business solution through rapid application development
- Efficient identification and management of spare parts, resulting in higher productivity an yearly time savings of up to 1,500 hours in the first year already
- Increased business user and customer satisfaction

THE CHALLENGE

Siemens Energy large gas turbines are used in power plants around the world in different environments, be it with the ultimate goal of power generation for households or for industrial complexes.

The turbines generally require customer-specific configurations, fitting the customers' environment and line of business. This results in heterogenous digital representations of turbine configurations. Lacking a standardized way for modeling machine structures, a broad variety of tools was in use for documenting these heterogeneous representations.

When large gas turbines are scheduled for maintenance or repairs, the correct spare parts need to be provisioned in the right amount and at the right time in order to avoid extended turbine downtimes. However, because these turbines are configured to fit the customer environment, each customer needs an individual spare part catalog and packages for maintenance. Since turbine configurations were maintained in heterogenous tools and formats, high manual effort was associated with creating and maintaining customer-specific digital machine structures.

To address these challenges, the Generation Service business unit of Siemens Energy put together a team dedicated to creating and perfecting a smart and targeted solution for maintaining spare parts of large gas turbines.

> "ALREADY FIRST EXPERIMENTS WITH THE RDF GRAPH DATA MODEL AND GRAPH DATABASES WERE VERY SUCCESSFUL AND WE COULD REALLY SEE THIS WORKING NOT ONLY FOR THIS USE CASE, BUT FOR MANY OTHERS IN THE FUTURE."

Lutz Lukas
IT Solution Architect, Siemens Energy

> “THE SIEMENS ENERGY SOLUTION ENGINEERS MANAGED TO TRULY TAP THE POTENTIAL OF KNOWLEDGE GRAPHS AND SHOW WHAT IS POSSIBLE, LAYING THE STEPPING STONE FOR FURTHER PROJECTS THAT LEVERAGE SEMANTIC AND KNOWLEDGE GRAPH TECHNOLOGIES.”
>
> **Dr. Daniel Herzig-Sommer**
> COO, metaphacts

THE SOLUTION

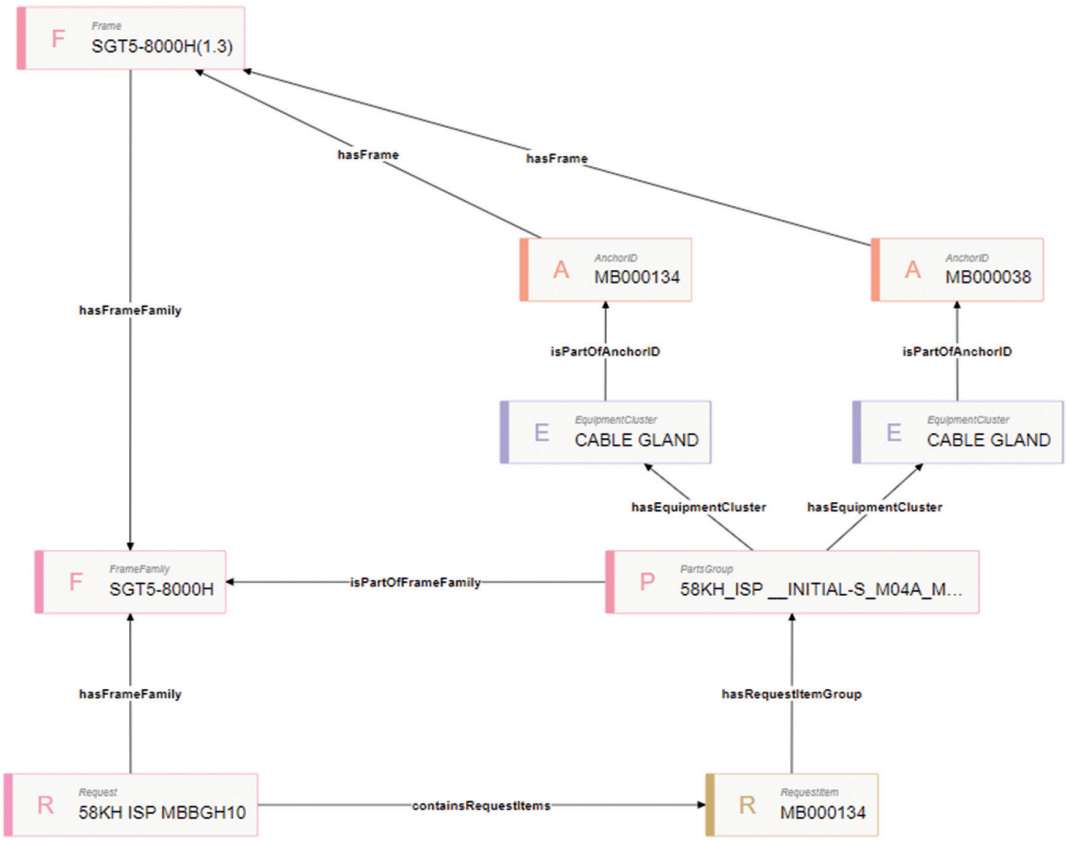
Siemens Energy decided to build a software application that would provide business users, i.e., turbine service engineers, with a unified overview of all large gas turbine configurations and spare parts catalogs previously stored over multiple, diverse data sources. This software application would allow Siemens Energy turbine service engineers to compare existing configurations, identify identical parts, and give recommendations on the quantities for required spare parts, thus reducing warehouse inventory and avoiding extended turbine downtimes. For this, Siemens Energy opted to leverage the power of Knowledge Graphs and develop a solution comprising metaphactory and Amazon Neptune.

Knowledge Graphs – A Unified View over Your Data

When configuring a new turbine for a customer, turbine service engineers generate a machine structure documentation. However, this was previously done in heterogenous formats and custom documentations often
listed spare parts in differing sections. This also resulted in identical spare parts often being recorded multiple times in the internal systems.

The data represented in a turbine documentation is hierarchical, which means that the structure of the documentation can be very well represented as a graph.

Excerpt of the Knowledge Graph showing a request item and connected resources



Visual exploration of spare parts

The flexibility provided by Knowledge Graphs to introduce new links and connections between spare parts and enable insights into similarities between machine structures despite them being documented differently was unprecedented. “Already first experiments with the RDF [Resource Description Framework] graph data model and graph databases were very successful and we could really see this working not only for this use case, but for many others in the future,” said Lutz Lukas, IT Solution Architect at Siemens Energy.

“The Siemens Energy solution engineers managed to truly tap the potential of Knowledge Graphs and show what is possible, laying the stepping stone for further projects that leverage semantic and knowledge graph technologies,” said Dr. Daniel Herzig-Sommer, COO at metaphacts.

Amazon Neptune, a managed graph database service, fits perfectly into the cloud-first strategy driven by Siemens Energy IT, which focuses on reliability, scalability, reduction of maintenance and integration with their existing platform on Amazon Web Services (AWS). metaphactory for Amazon Neptune was purchased via the AWS Marketplace, which allowed Siemens to directly get metaphactory running in their private AWS cloud and connected to their Amazon Neptune service.

Agile Development of End-user Applications

metaphactory enabled the Generation Service business unit of Siemens Energy to build a Knowledge Graph on top of Amazon Neptune. The Knowledge Graph provides a unified view of the data coming from multiple, diverse data sources and allows business users to explore and analyze gas turbine configurations from different perspectives.

The goal was to bring data to business users as fast as possible and ensure that the final product matches business requirements. metaphactory is a low-code platform used to rapidly build data-driven, end-user facing applications matching individual needs. The involved Siemens Energy solution engineers used the metaphactory platform and its out-of-the-box components to rapidly develop a custom application on top of Amazon Neptune. The development of the application was done in-house with metaphacts providing support for metaphactory deployment and configuration questions.

> “METAPHACTORY OFFERS MANY OUT-OF-THE-BOX COMPONENTS AND ALLOWED US A SHORTER TIME TO MARKET. THE FACT THAT WE COULD DEVELOP OUR APPLICATION IN-HOUSE WITHOUT MUCH CODING CONVINCED US.”
>
> **Amit Vaidya**
> IT Project Lead, Siemens Energy

> “A KEY DIFFERENTIATOR OF THE METAPHACTORY PLATFORM WAS THAT IT DELIVERS A GREAT COMBINATION OF GRAPH DATA MANAGEMENT, CUSTOM VISUALIZATIONS, DATA QUALITY ASSURANCE, AND NATURAL LANGUAGE KEYWORD SEARCH IN ONE PLATFORM.”
>
> **Amit Vaidya**
> IT Project Lead, Siemens Energy

metaphactory allowed business users to already use the application for real world tasks during the development process. As such, feedback was collected early on and could be implemented in an agile way, allowing for new features to be added incrementally along the way. “metaphactory offers many out-of-the-box components and allowed us a shorter time to market. The fact that we could prototype and develop our application in-house without much coding convinced us,” said Amit Vaidya, IT Project Lead at Siemens Energy.

Data Curation and Data Quality Assurance

The data quality workbench delivered with metaphactory allowed Siemens Energy to find inconsistencies, curate the data and constantly monitor data quality. Identified data quality issues can now be traced back to the data source and resolved at their origin.

Intuitive end-user search interface across the fleet of large gas turbines

Fleet-wide Search and Visualization

metaphactory's search interpretation engine leverages advanced algorithms to recognize the data structure and schema and return relevant results within seconds. In this case, it uses the data model to support business users in building targeted, natural language queries to quickly find spare parts of large gas turbines and analyze where these spare parts are in use. And all this without the user having to know the data model and the relations between concepts.

From there, users can explore further using metaphactory's rich set of components for interactive visualization and exploration and gain meaningful insights into relations between spare parts, turbines, customer-specific configurations, maintenance schedules, and maintenance history.

THE RESULTS

"A key differentiator of the metaphactory platform was that it delivers a great combination of graph data management, custom visualizations, data quality assurance, and natural language keyword search in one platform," said Amit Vaidya, IT Project Lead at Siemens Energy. metaphactory allowed business users to test and interact with the data and provide feedback while the data experts were building the data model and integrating data from various sources into the Knowledge Graph. The fast development of the spare parts management application resulted in shorter time to market for the internal business solution.

Data quality assurance is another key aspect which was critical to the business solution. metaphactory alongside the in-house developed application helps business users identify and correct inconsistencies in gas turbine documentation, thus reducing the number of error rectification requests and delivering an intuitive user experience.

Access to the right data through the intelligent keyword search framework resulted in higher productivity and an intuitive experience when exploring the Knowledge Graph. The previous approach, which implied asking a different department for a custom SAP report, was replaced by an on-demand report generation engine which not only reveals more insights into the data but also resulted in time savings of up to 1,500 hours in the first year already.

"Through fleet-wide analysis our business users can take data-driven decisions when optimizing outage-specific spare part packages. An optimized package recommendation means happy customers, as it allows us to give them more comprehensive and precise recommendations as to which spare parts to order for which outage," concluded Lutz Lukas, IT Solution Architect at Siemens Energy.

"THROUGH FLEET-WIDE ANALYSIS OUR BUSINESS USERS CAN TAKE DATA-DRIVEN DECISIONS WHEN OPTIMIZING OUTAGE-SPECIFIC SPARE PART PACKAGES. AN OPTIMIZED PACKAGE RECOMMENDATION MEANS HAPPY CUSTOMERS, AS IT ALLOWS US TO GIVE THEM MORE COMPREHENSIVE AND PRECISE RECOMMENDATIONS AS TO WHICH SPARE PARTS TO ORDER FOR WHICH OUTAGE."

Lutz Lukas
IT Solution Architect, Siemens Energy

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Demo

Open Knowledge Graphs
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Get started

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