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Master's Thesis

Agile and Resilient Data Flows for Water Consumption Forecasting

(theoretical / conceptual)

Description

In the context of our MigHANA research cooperation https://uol.de/en/vlba/projects/mighana) and together with our project partner OOWV (https://www.oowv.de/), we are developing innovative approaches for agile and resilient data architectures that support strategic management control or – more specifically – so-called "Management Control Systems" (MCSs; https://en.wikipedia.org/wiki/Management_control_system).

Management Control Systems are used to help organizations with accomplishing their goals. They use IT systems, or structured, unstructured, or even random interactions between people to provide feedback on achievement rates, to make predictions and to develop new forecasting and decision models.

From an IT point of view, Management Control Systems collect and process data from internal and external sources. Internal sources could be transactional (OLTP: https://en.wikipedia.org/wiki/Online_transaction_processing) or analytical (OLAP: https://en.wikipedia.org/wiki/Online_analytical_processing) solutions like SAP S/4HANA, SAP BW/4HANA, SAP DWC, or SAP SAC; external sources may me as diverse as weather data (e.g. https://www.dwd.de/EN/Home/home_node.html), epidemiological data (e.g. https://ourworldindata.org/coronavirus), data about governmental interventions in the interest of public health (e.g. https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker) or financial data (e.g. https://www.bloomberg.com/professional/product/market-data/ or https://www.reuters.com/markets/global-market-data/).

Technically, such data are mostly collected in data lakes or data warehouses; the (data) architecture of these systems is based on architectural patterns or reference architectures (e.g. LSA++ or Data Vault). In our "VUCA" (https://en.wikipedia.org/wiki/Volatility,_uncertainty,_complexity_and_ambiguity) world, however, neither the kind of data needed nor the forecasting and decision models processing them are stable.

In the past, a sufficiently accurate forecasting model for water consumption might have been based upon nothing but historical time series, climate, and weather data. Nowadays, however, we may have to know more about for instance pandemics or the effects of wars on commodity prices to come up with useful predictions.

It stands to reason that measures meant to contain the spread of COVID-19 or the current dramatic jumps in energy and raw material prices will also have an impact on individual and institutional decisions and behaviors and thus constitute new significant factors for forecasting water consumption. Classical forecasting systems, however, usually do not take such factors into account and – contrary to experience - assume a reasonably stable environment.

Problem Statement

The deliverable is a resilient architecture, that is: a pattern for a data architecture that can be adapted to environmental changes with minimal effort.

Primarily, this shall be achieved by separating ontological, epistemological, and semantic (meta-)data. Nevertheless, some intensive research in terms of formative indicators of data model agility/resilience is required right at the beginning.

The architectural model is to be described based on the selected example (data flows for water consumption forecasting, step-by-step including epidemiological and economic data plus data from water monitoring) and to be implemented in the form of a prototype. Only the data flows required for the forecast are in scope for the latter.

The prototype will be implemented in collaboration with the project partner based on SAP HANA, S/4HANA, BW/4HANA, SAP DWC and SAP SAC - supplemented by code in Python and/or R.

The focus lies on developing the data architecture. In contrast, the implementation serves merely as a proof-of-concept.

Requirement(s)

Ideal prerequisites for the project are prior knowledge/interest in data architecture and data warehousing, a basic interest in common ERP solutions such as SAP S/4HANA, as well as basic programming skills in Python and/or R. The focus of the project is not to deliver a turnkey solution, but rather contributing to the development of new (reference) data architectures. Although the work is more conceptual in nature, you will also have to "get your hands dirty" a bit, in other words: work close to the system.

The topic is especially interesting for students who want to pursue a career as an IT or management consultant. The supervisor has worked in similar roles for several decades and can therefore "coach" the researcher in this regard as well. The proposed question is - against the background of pandemic and warlike conflicts - a "red hot" challenge affecting almost every industry.

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