

Master's Thesis

Data Warehouse Architectures under Knightian Uncertainty (Water Resource Management)

(conceptual / theoretical)

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).

“Diagnostic Control Systems” in particular - but also to some extent “Interactive Control Systems” - (<https://hbr.org/1995/03/control-in-an-age-of-empowerment>), have a close relationship with IT. Data warehouses (DWHs), for example, collect raw data from a wide variety of applications, process them to generate Key Performance Indicators (KPIs) and supply these KPIs to diagnostic control systems. On this basis, operational, tactical, and strategic management assess the extent to which a department or the company has achieved predefined goals and what corrective measures may be required.

Viewed the other way around, the architecture of a data warehouse in the form of metadata, information models, or ETL processes embodies an “frozen”, instantiated MCS; the architecture of a DWH reflects world view of certain individuals at a certain point in time; it measures and captures only events that occur in that world view and processes those events in a then meaningful way, for example to generate KPIs.

As early as the 1920s, however, economist Frank Hyneman Knight pointed out that such a view - in which uncertainties are at best represented by (known) probability distributions - oversimplifies reality.

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In distinction to "risk" Knight developed the term "uncertainty". Uncertainty means:

1. We do not know whether the world exists at all or whether it follows any rules (ontological uncertainty).
2. If the world exists and follows rules, then we do not know if we can even recognize those rules or have recognized them correctly so far (epistemological uncertainty).

The first issue is of a more philosophical nature, but the second has quite significant practical implications for the architecture of information systems. This is because the "worldview" mentioned above is either explicitly reflected in data structure and processing logic or underlies a data warehouse in the form of (conscious or unconscious) design decisions.

If such a world view has influenced the data model or processing logic far "upstream" (i.e., close to the data source), then a change in this respect entails very high adaptation efforts "downstream". It therefore makes sense to model assumptions and rules that are subject to a particularly high degree of uncertainty as far "downstream" as possible. This idea underlies, for example, the distinction between "soft" and "hard" business rules in Data Vault 2.0 and the idea of "late binding" in programming.

Problem Statement

The focus of the work is the distinction between "hard" and "soft" business rules. The construct – binary so far - is to be extended into an (at least) ordinal measure, possibly also into a multidimensional one, and formative and reflective indicators for a construct such as "softness" or uncertainty are to be elaborated (for example, through literature research or empirical analysis of historical data).

The findings are to be applied to real-world examples with our project partner (using the domains of consumption billing and water resource management), and the benefits of the extended construct are to be demonstrated by setting up exemplary data flows (in SAP BW/4HANA or SAP DWC).

Requirement(s)

This topic is a challenging conceptual-theoretical and interdisciplinary task, on the other hand also promising exciting insights. Although some hands-on work in SAP is required towards the end of the project, the focus lies clearly on theory development.

Since the work is embedded in the context of an ongoing PhD project, there are also publication opportunities, both in management and computer science.

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