Interoperability of Heterogeneous Systems – Standardization Roadmap vs. Adaptive Integration
Daniel Schilberg, University of Applied Sciences Bochum

The digital revolution, often also referred to as Third Industrial Revolution, describes the introduction and saturation of digital technology in industrial applications. Since then the use of digital technology has drastically emerged and now touches nearly every area of life as well as led to the so called Fourth Industrial Revolution. The outstanding success of leading corporations specialized in the use of digitalized information such as Google, Facebook, eBay and Amazon shows the potential of mass information and especially, the potential in analyzing such amounts of big data. These concepts form the basis to realize the fourth industrial revolution.

Similar terms like 'Industrial Internet' and 'Industrial IoT' (IIoT), used in other countries and industrial domains also refer to the application of these concepts and base technologies, to describe the next generation of technical systems and the market potential caused by their integration and usage in industrial application scenarios. However, providing technical systems to gather, to store and to analyze raw data is not sufficient and does not lead to the expected breakthrough in information processing. No matter how much data is available, additional context information like time, structure and location are necessary to enable the transformation of raw data into smart data and to provide the necessary information base to extract new insights by applying suitable analysis algorithms. Such transformation from raw into smart data requires context-aware analysis algorithms itself and new ways to make data accessible and interpretable for users and machines.

In a nutshell, this evolution (or revolution) leads to new sorts of human-machine interaction and accordingly to new requirements regarding interoperability aspects. Thereby, interoperability – defined in the IEEE Standards glossary as the "ability of a system or a product to work with other systems or products without special effort on the part of the customer" (1990) – is not restricted to the information exchange between technical systems. Nowadays, it has to address aspects of information exchange between human and machine as well. The human is part of the networked system and therefore the need for a reliable and robust information exchange becomes an inevitable imperative.

As a central issue of the heterogeneous IT landscape can be identified. One approach to overcome the heterogeneity is the homogenization with the help of a definition of unified data standards. In this context a transfer of the data formats into a standardization of data by the use of specific adapters. However, this approach is not practical for a fast changing IT landscape for two reasons. Firstly, the diversity of possible IT tools that are used lead to a complex data standard. This is why its understanding, care and use are time and cost intensive. Secondly, the compatibility issues for individual versions of the standard are to be addressed (see STEP). Therefore the standard must be compatible with older versions and enhanced constantly to reflect current developments of IT tools and to correspond to the progressive development through research.

Another approach includes the use of concepts of the data and application integration, which do not require a unified standard. The interoperability of IT applications must be ensured in a different way so that no standard data format is necessary. This is done by mapping the various aspects of the data formats and structures on a so-called integrated data model or canonical data model. In current approaches to these concepts are extended to the use of semantic technologies.

The semantic technologies enable a context-sensitive behavior of the integration system. The continuation of this approach enables the so-called adaptive application and data integration.

The integration of all data collected in the process in a consolidated data management is only the first step to solving the interoperability problem. The major challenge that must be overcome is the further processing of the integrated data along a process to achieve a combination of IT tools across all levels of the automation pyramid. The question of the analysis of data from heterogeneous sources is addressed in the analysis of corporate data for some time. The applications that enable integration and analysis of data are grouped under the term "Business Intelligence" (BI). BI applications have in common that they provide the identification and collection of data that arise in business processes, as well as their extraction and analysis.

The problem in the application of BI on production is that the implementation of the BI integration challenges of heterogeneous data and information conceptually solves in the first place which causes significant problems in the implementation of functional systems. Thus, in concept, for example, a translation of the data into a common data format and context-sensitive annotation is provided. A translation may not be achieved because it is proprietary information which meaning is not known to the annotation. This is also the reason why so many BI integrations have failed so far.

This talk shows that the previously addressed problems should be solved by the vision of the ´Industrie 4.0´ with an adaptable integration framework instead of standardization.

Bio:

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