Information Exchange over the Web for the AEC Industry

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With its multitude of stakeholders, information exchange has always been a key element in any AEC practice. Architects and engineers spend by far the majority of their time on communication and exchanging information. The media used for information exchange are however changing over time, going from CAD-based exchanges to exchanges in BIM frameworks and more recently web-based exchanges via cloud-based servers. In this presentation, we focus mainly on the last of these three and review how the well-known file-based BIM exchanges (IFC, MVD) are gradually altering into exchanges of containers (ICDDs) between common data environments (CDEs), and finally cloud-based servers with direct and tailored snippets of data (RDF, JSON, HTTPS, web services).

In a BIM approach, information is available in BIM models, which are typically 3D models enriched with information. The result is a multitude of aspect or discipline models, which together form a coordination model. In addition, plenty other data is available in an AEC project, including images, documents, 2D drawings and regular 3D models. They are collected in a CDE, in which ownership, security and responsibilities can be managed and secured. Exchanges between partners happen in a number of ways, namely (1) setting up collaborative projects (worksets) in proprietary tools, (2) exchange of reference IFC files, always according a particular Model View Definition (MVD), such as the CV and DTV MVDs, (3) use of BIM Collaboration Format (BCF) for issue management and handling. In practice, many CDEs are currently implemented as documented stores. All files contained in those stores (incl. native files and IFC files) can be transferred and handed over to another stakeholder (e.g. the client at as-built handover stage) using a ZIP container with all data. A more complex version of this procedure is standardized into the ISO standard Information Container for Document Drop (ICDD), which ideally also clarifies the links between elements in those documents.

The above way of working is heavily file-focused and handover-oriented, and as such matches well with how IFC has been conceived originally in combination with MVDs. IFC has been built as one large schema, in which it is possible (and required) to select a subset (model view), according to which data can be transferred. The MVD thereby forms the agreement between stakeholders that allows the interoperability of the exchange. Unfortunately, it is difficult to implement these MVDs in software, and only a few widely used MVDs exist in software (CV, DTV, RV). They function much like model views in a relational database, and are hence not purposed to be created on the fly over and over again. As such, they are fundamentally different from a query language (e.g. SQL, SPARQL), in which it *is* possible to query for ad hoc selections to hand over data. This constitutes the difference between implemented MVDs with vendors versus micro-MVDs or rapid partial exchanges that are often asked for by market stakeholder for very rapid and flexible exchanges.

As our world increasingly digitizes, also our AEC industry shifts to the use of more rapid and live exchanges based on filters, queries, web services, and small partial exchanges. The paradigm behind such exchange is fundamentally different from the known file-based and handover-focused exchange in this industry. Newly emerging technologies, including linked data, microservices, IoT, distributed ledgers, and JSON-based web APIs are part of that paradigm. Unlike IFC, they rely on a diversity of smaller schemas that are distributed and can more flexibly mapped and linked to each other. These technologies rely on (1) the use of data stores rather than document stores (data-oriented), and (2) continuous exchange rather than hand-over moments. In support of such semantic data exchange, systems are currently emerging that serve as live and accessible digital counterparts (digital twins), in which data is constantly accessible for queries and small data snippets (often JSON-based). Rather than exporting a BIM model into an IFC file to then import it in a different software, the idea of this latter data exchange paradigm is that data is stored in an accessible web-based data store while it is being modelled and continuously adapted, and information for partners is at any point retrievable by partners in a project according to an access agreement. A modularized ontology structure as proposed in the Linked Building Data (LBD) community, as well as the increasing rate at which web services and microservices are built and made available, clearly support this alternative semantic data exchange mechanism, even if they try to not lose progress made in the past.

In this presentation, this overall evolution is presented and discussed, including primarily examples that show key differences between implementation approaches, as well as how our way of working in the AEC practice is altering now.