Position paper of the European Construction Industry for developing model-based IT tools for planning, realising and operating buildings, facilities and infrastructure

Introduction

The construction sector is the largest industrial sector with a portion of approx. 10% of the entire European GDP. Changes brought around by „virtual planning, production and operation" will have the largest economical impact across the whole European construction market. This is especially the case when it is taken into account that the construction industry has under-proportionally participated in developing new technology in this area.

The planning and production methods of other industrial sectors, such as the automobile or the shipbuilding industry, have been subject to fundamental changes in the past years. The core element of this change is virtual product development using computer models. Before a product is produced it has already been designed and constructed in 3D within a virtual environment. This makes it possible to do sustainable analysis and calculations over the entire product life cycle at a very early stage, i.e. from the design idea right up to the final disposal of the product. Especially by simulating the production process and the operation period products can be optimised. These developments will not take halt before the construction industry.

As the largest single group within the construction sector, the construction industry is prepared to face the challenge of implementing these revolutionary approaches to our way of working. Besides massively adapting current work processes, new hard- and software tools must be developed. In order to accelerate and coordinate the development of these IT tools, leading European construction companies suggest launching a common initiative of the European construction industry.

By describing harmonized requirements in a catalogue aimed at the hard- and software industry, this initiative has the goal of coordinating the development of powerful tools which are tailored to the needs of the construction industry, thus enabling their sustainable and accelerated implementation.

A market analysis will show the construction market size and the need for common tools in this field.

Initiative

This initiative "virtual construction" is initiated by the construction companies MAX BÖGL, STRABAG SE / Ed. Züblin AG, CCC, Royal BAM Group and Ballast Nedam with the goal of describing harmonized requirements of the European construction industry for the development of new innovative tools by the hard- and software industry.

Tools

Four central components are needed for this new way of working:

(1) 5D*i* Modeller

- The tool offers an intuitive and easy-to-learn user interface, which enables a detailed, comprehensive and fast generation of any kind of three-dimensional model, including all necessary semantic information.

- The tool supports a construction-element-oriented structure of the three-dimensional model and creates a so-called GUID (Globally Unique Identifier) in order to allow for the explicit and persistent identification of information units through the entire production process (construction element objects).

- The data model upon which the tool is based furthermore allows for any kind of higher-ranking construction element grouping (including dynamic regrouping and splitting of objects and groups) (also using a GUID) and facilitates presentation in different levels of detail.

- The tool offers parameters both for a simple definition and adaptation of construction elements as well as for the description of interdependencies of the construction elements.

- The tool offers the possibility of creating different views on all product data and furthermore allows for geometrical information and data being linked bi-directionally to associated databases.

- Access to the properties and parameters of the construction elements should not only be possible using the construction and modelling tool itself but also through any associated database.

- The tool incorporates a generic catalogue of building and construction components for products of the supplier industries and for company-specific solutions which allows the user a quick start-up and early productivity.

- The tool offers new powerful interfaces for exchanging three-dimensional building models and they fulfil the following minimum requirements:

  o sharing interface (checkout) with a filter for certain model parts (for example construction element objects per floor or per construction stage), different views for different applications (for example information for calculation and billing) or by parameter types (for example all doors of a certain fire protection class) [=partial export].

  o sharing interface (check in) with update, combination, merging, versioning, validation of certain model parts (for example construction element objects per floor or per construction stage), different views for different applications (for example information for calculation and billing) or by parameter types (for example all doors of a certain fire protection class) [=Update import].

- The tool has 2D interfaces for handing over boundary conditions (edges) for the detailed plans (final plan, shop drawings) with construction specific demands such as plans for architecture, formwork, reinforcement, pre-cast elements, steelwork, finishing and services. The reference to the original construction element is preserved through the GUID.

- The tool must completely support open (and/or) certified industry standards. This applies to standards within the construction industry as well as other industrial sectors.

- It should be aspired that the data format used allows for archiving (long-time accessible graphic information covering legal requirements).

(2) 5D*i* Data Management

- Scope of data management is to handle all relevant sets of data (geometry / attributes / descriptions / specs / etc.) on the basis of a persistent global ID. This allows for version management and a traceable reconstruction of the data history.

- Data management for the construction industry is bi-directionally linked with the 3D modelling tools and can administer geometric object information like: properties, parameters, interdependencies and comments.

- The data management has project orientated architecture and can be configured for controlled access of participants via intranet / internet.

- The data management allows for the use of project data for the automatic generation of project documentation, for example project status reports, task lists etc.

- Project database is connected to template databases and dashboard databases to achieve comprehensive reporting and collaboration through all projects of a company.

- The data management supports industrial standards for synchronisation and integration with ERP systems.

- Data management is used for interaction with process specific applications like: calculation, DMS, scheduling programs, simulation, etc.

(3) 5D*i* Viewer

The 5D*i* Viewer is a central graphical user interface, that closely interacts with the 3D-/4D-/5D-modelling and data management components. The viewer must meet the following requirements:

- Integrated visualisation of both graphical and alphanumerical product and project data

- Creation of different views on all product data

- Depicting construction elements of all building trades with the necessary geometric level of detail during planning and execution

- Supporting hard and soft clash detection

- Supporting dynamic queries to visualise both product and project related data sets

- Capabilities to generate comprehensive project documentation and reporting with different levels of detail (for example project status reports, task lists etc.)

- Supporting simulation and analysis scenarios both for prediction of project performance and 'as-is' / 'to-be' comparison

- Support of role-based functionality sets

(4) 5D*i* Process Management

The scope of the process management is to handle interaction and communication between the three aforementioned classes of tools (modelling component, data management component and viewer component).

- The modeller and the data management component have an open and well documented API in order to communicate with existing software solutions (expert systems) used in the construction industry.

- Sound and legally compliant mechanisms for digital signatures and a certified archive format for the three-dimensional building model data, the external data and the process documentation must be provided.

- Workflow systems must be able to be incorporated and open standards must be supported. A graphical user interface allows a workflow to be created, modified and controlled during project execution between actors on the model and database. The workflow can be dynamically adapted to the relevant project organisation or award of contract model (planning partner / consortium) respectively. Bilateral e-mail communication is to be avoided.

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