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Visual PLM - Integrating 3D data in PLM

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Abstract

Factory floor employees need various kinds of PLM data like CAD drawings, status information, BOMs. If they have direct and easy access to the PDM/PLM software the production process can be improved in terms of efficiency and quality while the support effort for other departments decreases. To navigate and access the desired information can become a hard task for inexperienced users because the software is often quite complex to handle and the relevant information objects reside in different parts of the system. These user groups ask for an easier and visual access to the product information. The visual artifacts are created in the CAD departments and visualizing the products in the past has mainly been realized by a loose integration of 3rd party viewers or basic previews of the documents. The viewers can interpret native CAD formats and are capable of many specialized CAD features. While this improved the user experience in some scenarios there is still a gap of a complete visual access to product information. Our paper shows a different and new approach with a tighter and user-friendly integration of the 3D Viewer where the 3D model is displayed in a CAD neutral format. This allows the support of new ways of interaction and navigation within the PLM system adding value to PLM users without CAD know-how and installed CAD software.

1 Introduction

In the digital factory CAD data from the engineering process need to be integrated in the production process (Kühn 2006). While PDM (Product Data Management) or PLM (Product Lifecycle Management) has to fulfill these requirements in theory the practical implementations in the according software systems do not cover all use cases because the integration of CAD data is not deep enough and in many cases still based on downstream generated simple visualization data. Additionally, PDM/PLM software is often quite complex and inexperienced users have problems to find the desired information or artifacts. These user groups can gain higher efficiency with a visual product navigation and integrated

PLM data access. A general concept is to leverage the 3D models that are created in the construction departments in the company. In the past, 3D geometries became a commodity in engineering and they are a natural result of CAx methodology. 3D has value to almost every PLM user and one of the key features of PLM software is to make these 3D models easily available for other business units because CAD systems are normally installed on a limited number of work stations (Sendler 2009, p.112). The classical approach to leverage 3D data is by external 3rd party viewers that support the native file format of the CAD system. While this has been sufficient for many years there is an increasing demand of more integrated solutions that provide a natural interaction with the product based on the 3D models and improve the collaboration capabilities within the PLM system (Müller et al. 2013).

The basics of PLM/PDM and CAD design are considered given as a prerequisite for readers of this paper. The concepts are well established and described in various publications or practical solutions.

2 State of the art

3D is a standard in construction methodology and the resulting CAD models are an important artifact for many downstream activities in the company.

2.1 3D visualization in engineering

Besides specialized features like simulation and FEM modeling virtual 3D models of a product have various benefits for engineers in terms of communicating their work to other stakeholders in the company and reducing the development effort. Especially for complex and expensive products these models are an effective tool to demonstrate new designs to other stakeholders in the company who might decide about the budget and actual realization of a product. Impressive renderings are a trigger for emotion and strengthen the identification and pride of engineers with their designs.

2.2 3D visualization in PLM

In PLM 3D plays an important role for the interdisciplinary collaboration and communication between different divisions in the company. There are various potentials of leveraging 3D data to stakeholders outside the engineering and construction departments and often they have not been bailed out in the field (Sendler 2009, p.97).

In manufacturing, concepts like the digital factory demand a seamless integration of 3D models into the complete production process. For example, machine operators need to know about the lifecycle state of an item they are producing or assembling. They need reliable information if the item is a purchased part that might be soon out of stock. If there are quality issues related with the item, they want to communicate these to the relevant persons. The 3D representation of the product can act as the central access point and allows an easier navigation to the PLM data.

The source of 3D is CAD software and CAD documents are common objects managed with PLM systems. User groups without CAD knowledge or installed software need to view these documents and access the PLM related information.

The most basic viewing approach is to display a preview file generated from the CAD system without any functionality like rotating or zooming. For these features the PLM system needs to provide an actual 3D viewing possibility. This has been realized for many years by configuring the PLM system to support external 3rd party viewers. These viewers support different native CAD and neutral file formats such as 3D-PDF. The viewers often have special CAD-oriented features but lack of a deeper integration with the PLM system. The use cases are focused on the viewing aspect.

With increasing customer demands to PLM and technological progress the classic approach comes to its limits and new solutions which support additional use cases need to be explored and implemented. These use cases are mainly the following:

- Show item and BOM information
- Geometric navigation to PLM data and processes
- Virtual design review and issue reporting
- State change and release workflows
- Viewing of product variants
- Analysis of digital mockups
- Advanced collaboration features
- Using 3D models for technical documentation and marketing material

3 Spatial Connect – integrate 3D deeper into PLM

Spatial Connect is a new component of the PLM system CIM DATABASE that supports the above mentioned use cases extending the single viewing features. To the user it blends in the PLM system and allows new forms of data visualization and process integration. The following sections provide insight into the core features and concepts. Examples show the new possibilities in PLM practice.

3.3 Basic features

The viewing component is based on a neutral file format that is generated from the CAD files in the PLM system by a server side conversion tool. This file format allows to link PLM data to the designs independently from CAD specifics while the original connection to the CAD document is preserved.

The viewer is embedded seamlessly into CIM DATABASE PLM. There is no additional configuration effort and no 3rd party software needs to be installed and configured. Figure 1 shows a screenshot with the basic viewing capabilities as they are part of the existing external viewer solutions.

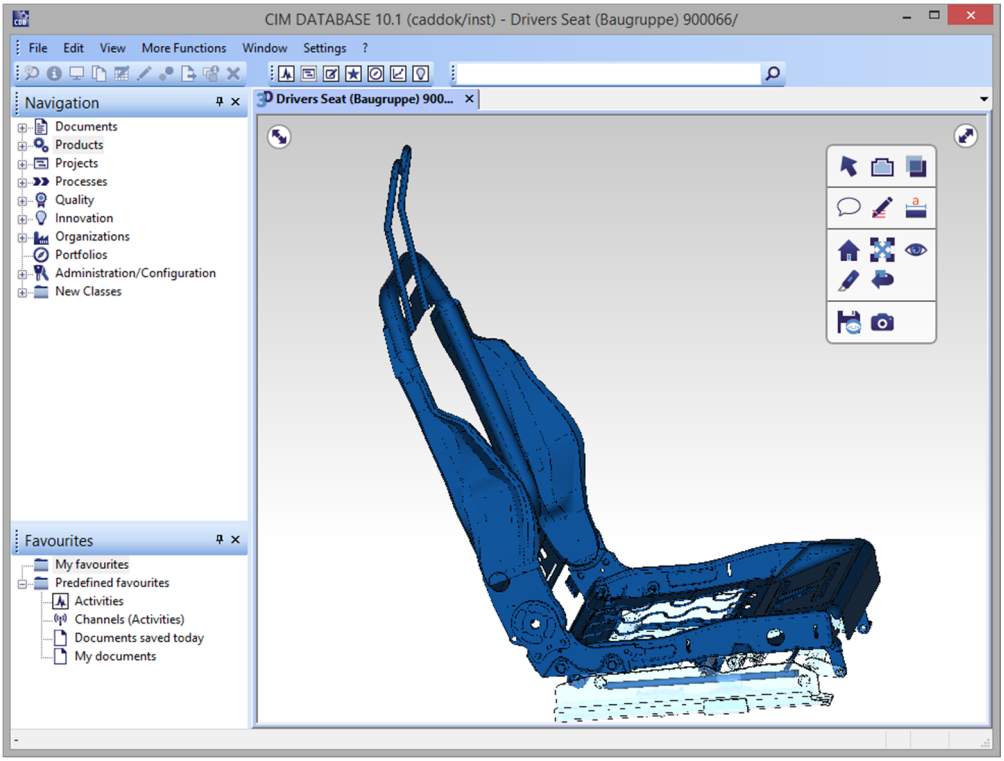

Figure 1: The embedded viewer with the basic features

3.4 PLM related features

The actual benefit for the users is based on the support of PLM related use cases that exceed the standard ones provided with usual external solutions. This is realized by semitransparent overlays that contain the desired information and features. Figure 2 shows a screenshot with the overlays and the following sections explain the additional features. The screenshot is optimized for the printed paper to demonstrate the features. On standard monitors the elements are not so densely arranged and the user interface looks cleaner.

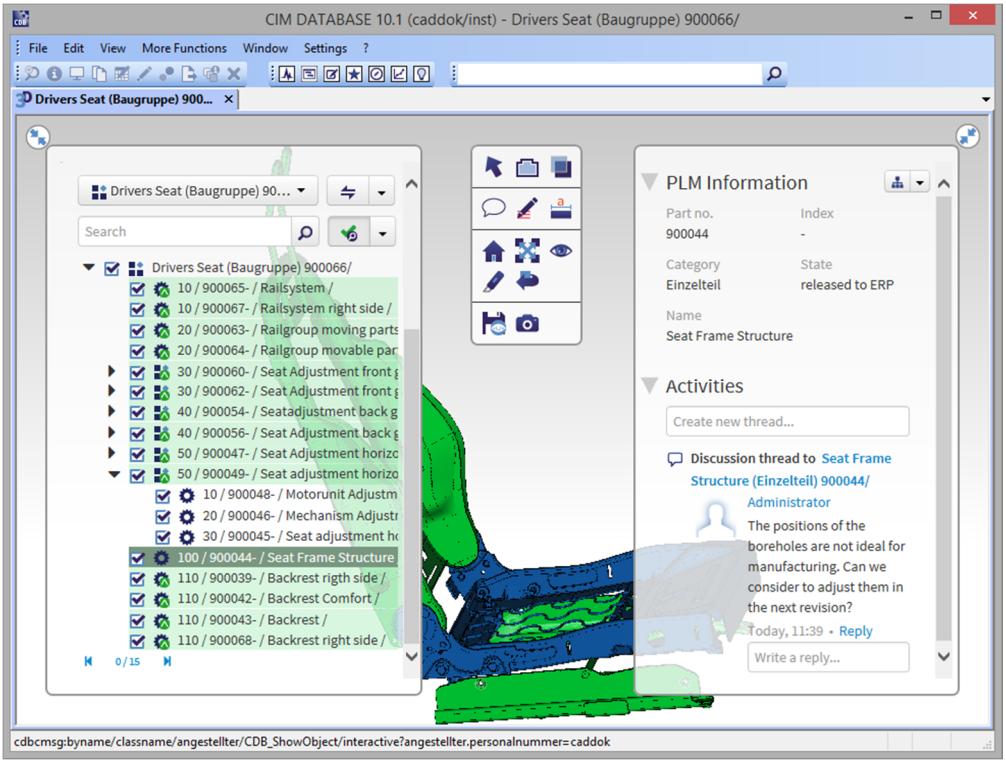

Figure 2: The embedded viewer with semitransparent overlays containing specific PLM features

3.4.1 Geometric item-based navigation

The viewer allows new ways of navigating in complex product structures. The users can open a semi-transparent overlay and in addition to the CAD-model they can choose the item-related product structure. Here they select the desired part in the 3D model or the product tree and it is highlighted in both controls. External viewers allow this feature usually in the CAD generated structure without any connection to PLM related objects.

3.4.2 Access master data of items and products

The tree view of the product structure contains the most important attributes of the master data like item number and title. Further attributes are displayed in the overlay at the right side in the collapsible “PLM information”.

3.4.3 Visual identification of the status

The status of an engineering document or an item is a very important subject of the product lifecycle. For example, machine operators on the factory floor need to know which items are released or still in progress. The users can set filters that highlight the objects in the product

structure and in the 3D model depending on their lifecycle state. Figure 2 shows the released items highlighted in green.

3.4.4 Execute PLM tasks

Tasks like state changes can be executed directly in the context of the 3D model. This brings more transparency to the process and increases efficiency because the user does not need to navigate anymore between the external viewer and the PLM object.

3.4.5 Collaboration features

Common collaboration and review features in the engineering process like redlining and annotations are managed by the PLM system and transparent through the complete lifecycle. An additional feature is the integration of the activity stream, a social media influenced component, which has been described in the 2014 Smart factories workshop (Schlenker & Müller 2014).

3.4.6 Export common graphic formats

Product visualizations usually have to be generated by the engineering departments or at least by people who have the CAD software installed and access to the CAD data. This creates additional and unnecessary work load in the engineering departments and increases the communication effort. With our solution basically all PLM users can export graphic files on their own, addressing different kinds of documents in the company, e.g. technical documentation or marketing materials. They can create individual views of the 3D model by rotating and zooming then exporting them into a common graphic file format like PNG.

4 Findings and outlook

The software component was developed in a short amount of time and the features are considered to lower the barrier of accessing PLM information and enabling new ways of interaction within the PLM system.

4.5 Methodology

The first version of the software component was developed in an agile environment and implemented within a short time frame of about three months. This could be achieved because the technological foundation was established in a prior research project and user centered design methods were applied within the agile project frame. The starting point for the development was the user interface (UI) which was designed with rapid prototyping methods in the inception phase of the project. The UI concept was commonly accepted based on the initial mockup designs and the team could start with the actual implementation in an early stage of the project. This allowed the improvement of the software in the following project iterations incorporating feedback from various stakeholders. The foundations were a

clear product vision and mockups that transported the idea of the software component to the complete team in the early stage of the project.

4.6 Product features

The bias of the project was to create new ways of interaction in the PLM system that improve the navigation and integrate different types of information in one software component especially for persons that use the PLM system infrequently by a deeper integration of the 3D model. In the past 3D viewing was a secondary feature which was available after the users had navigated to the desired PLM objects. With Spatial Connect they can start their PLM tasks based on the 3D model which is a more natural way of navigation than in abstract product structures. For many user groups this can be the central starting point in the PLM system which might result in an easier learning curve and higher efficiency. This has to be evaluated in the future when the component will be part of the official software release. Additionally, new use cases that have not been possible so far might emerge when the component will be used by a wider audience.

5 References

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