31/01/2014, Manufacturing Collaboration with Suppliers throughout the extended Enterprise

On the way to the factory of the future (FoFdation) one of the first and obvious tasks is to integrate the shopfloor with the Product Lifecycle Management (PLM) backbone, which in the end should aim to unify the physical and the virtual worlds in manufacturing. Furthermore another level of diversity needs to be overcome along the value chain. For many years manufacturing companies have been adopting various strategies to optimize their value chain and specific lean production methodologies were introduced to reduce internal complexity and to help outsourcing specific manufacturing tasks to selected suppliers and their factories. These are specialized on certain areas and can fulfill the requirements on quality, speed, price and flexibility.

Original Equipment Manufacturer (OEM)/Supplier collaboration in both engineering and manufacturing disciplines is well established and highly optimized within e.g. the automotive industry, where around 75% of the components come from 3rd party suppliers. The status in the aerospace industry is quite similar while facing even higher product complexity combined with intensive documentation and verification management requirements due to certification needs. In contrast to Enterprise Resource Planning (ERP) which focusses on the internal material and value flow, PLM is meant to support the entire product value chain regardless if this spans over multiple companies. For an OEM there can be thousands of suppliers and many ways of collaborating depending on the supplier's role, which can be classified into distinct categories such as "Build to Specification", "Subsystem Design/Manufacturing", "Systems Design/Manufacturing", "Systems Integrator" and "Contract Staff". As a result one size does not fit all and modern PLM technologies do support multiple modes of supplier interaction.

Immersed		**Single PLM** ▪ Supplier works inside the OEM's PLM ▪ IP and Processes controlled by OEM
Synchronized		**Synchronized PLM's** ▪ Supplier works in own PLM environment, with own teams and local business processes ▪ Automatic synchronization & mapping with OEM
Asynchronous	Self-Service (24/7)	**Package-based Exchange: Self-Serviced** ▪ Supplier works in own environment, but has "eyes in the OEM system" to retrieve context data and updates ▪ Coordinated processes (tracking per transaction)
	Sponsored	**Package-based Exchange: OEM Sponsored** ▪ Supplier works in own environment, and does not have access to the OEM's PLM ▪ OEM sponsor is responsible to provide data and manage the interaction ▪ Coordinated processes (tracking per transaction)

Figure 1: Modes of Supplier Interaction

A major challenge is the supplier interaction without having any sophisticated interfacing in place which is the case for SMB (small or midsized business) companies, which either work in their own PLM environment or even native without any PLM. This requires an asynchronous interaction either by leveraging a self-service mechanism on supplier side or by a dedicated resource on OEM side, e.g. a so called sponsor user. In order to make PLM data available outside an OEM's environment the relevant objects have to be determined and collected for being exported into a transfer package called briefcase, which can be sent to the supplier. This briefcase should not only contain files on product data such as native CAD/CAM file formats or JT Visualization files that potentially can include PMI (Product Manufacturing information) or other documents (PDF, Office, etc.). In order to enable an efficient collaboration and sharing of engineering and manufacturing data structures (such as e.g. routing information, fixtures, tooling, measurements, bill of materials, …) between manufacturing companies during optimization iterations, an extra layer of PLM intelligence is required to support automatic import, ownership and modification rights management, rapid onboarding, round-trip and delta updates.

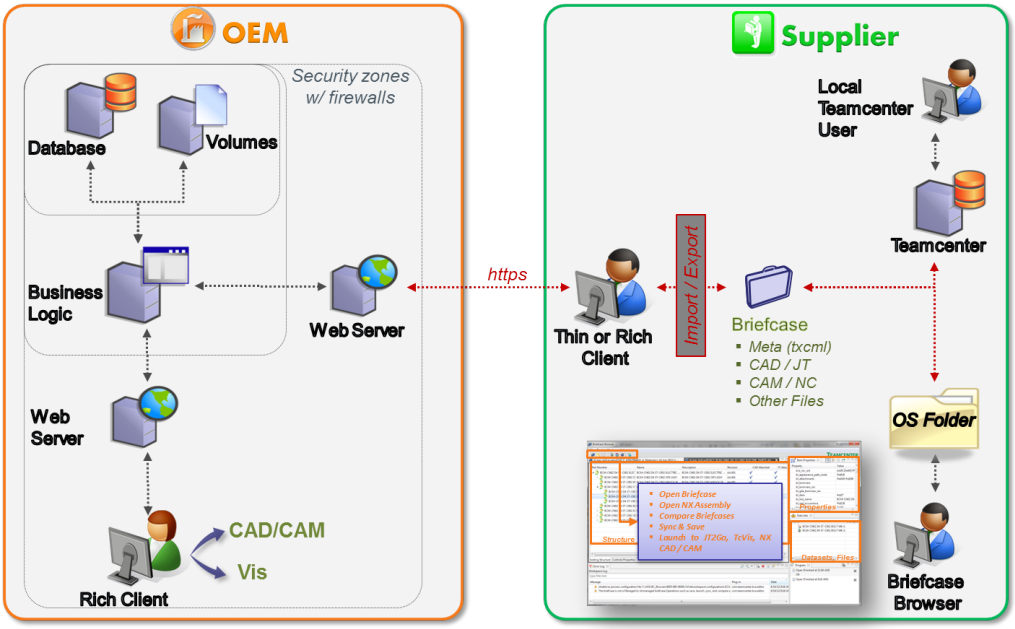

Figure 2: Asynchronous Interaction based on Briefcase

For pure engineering purposes the round trip scenarios provide the most challenging requirements on the collaboration functionality. For manufacturing purposes, already an one way transfer of a complete manufacturing structure provides many challenges just on the core CAM layer in a homogenous CAD/CAM environment (OEM and Supplier are using same CAD/CAM solution, e.g. Siemens NX). Of course the OEM will define the CAM machining operations according to his production facilities, process knowledge and resources, i.e. the CAM setup will use the OEM machines, fixtures and tools in a way, which has been proven on the OEM side in cases for in-house production.

At first all these various manufacturing aspects need to be determined, collected from the OEMs object structure in his PLM environment (e.g. Siemens Teamcenter) and exported into the briefcase, which therefore can be called a "Manufacturing Briefcase" (or MIP in FoFdation). On the supplier side the received manufacturing data structure needs to be mapped with the local resources, so that available tools can be determined although they locally might have different Item IDs or names. Secondly there might be elements defined by the OEM side, which cannot be found on supplier side and related 1:1 to supplier resources, e.g. a specific mill-turn machine available at the OEM side might not be present at the supplier side. Situations like this need to be visualized to the user on the supplier side so that he can understand the requirements to be investigated and rearranged while adopting the CAM setup by using only the resources available locally at the supplier side. Thirdly not only the CAM setup or generated NC programs might be transferred to the supplier but as well the entire part operation plan, which can contain multiple work packages, relating to different machines or even technologies (eg CAM versus CMM, Coordinate Measuring Machine). The manufacturing process engineer at the supplier side needs to work through all these levels and in the end optimize the entire manufacturing process for the locally available production capabilities. Finally all documentation and verification requirements from the OEM side need to be fulfilled, which especially in aerospace (e.g. at Airbus) can be quite challenging and in the end the outcome including monitored KPI's needs to be sent back to the OEM as feedback, which basically also completes a round trip scenario.

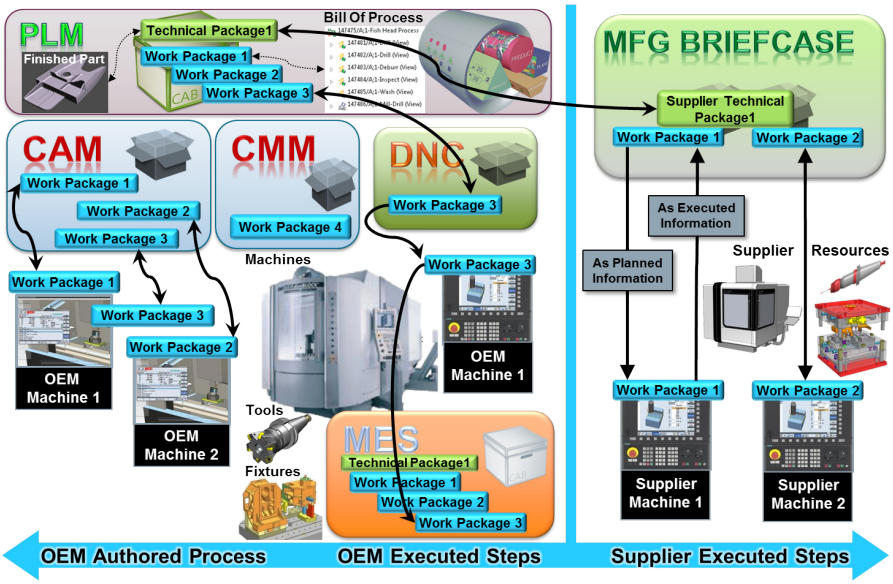

Figure 3: manufacturing Data Flow in an OEM & Supplier scenario

Unfortunately the real world never stays static but is changing permanently. This characteristic needs to be reflected in a modern PLM environment, focusing not only on product aspects, but also on process, plant and resource information. In combination this results in a so called P3R (Product, Process, Plant and Resource) data model approach and object structure.

In PLM every change is recorded and the value of the solution increases when more aspects and information is captured into PLM resulting into an intelligently integrated information model. With regard to the supplier collaboration on one hand it is important, to be aware of all ongoing and upcoming changes. On the other hand it is also important, which of the changes have become approved and made its way into the briefcase, which is sent to the supplier. Hereby it is essential to record, which state was valid and transferred to the supplier and therefore have made their way into the Briefcase.

Global enterprises in Automotive or Aerospace (such as e.g. FIAT and Airbus) which heavily utilize external suppliers would like to collaborate more efficiently since they suffer today from the complexity of the related data structures especially in the manufacturing domain. Siemens PLM has realized that manufacturing collaboration is adding another level of complexity to the engineering collaboration capabilities, which are available today. More sophisticated solutions will be required for the dispersed manufacturing world of tomorrow, where efficiency, speed, flexibility and traceability will become even more important for the digital factory of the future as envisioned by the FoFdation initiative.

For more information about the FoFdation project visit **http://www.fofdation-project.eu** and the project's social media pages, including Facebook (**#fofdationproject**) and Twitter (**@FoFdation**).

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For further information please visit:
http://ec.europa.eu/research/industrial_technologies/factories-of-the-future_en.html