Mitsubishi Agricultural Machinery

Improving Assembly Processes Using XVL

3D data was introduced into Mitsubishi Agricultural Machinery (MAM) in 1999, and initially used on components of its combine harvester product line. In 2003, 3D data was applied to the whole assembly of a combine harvester using Pro/ENGINEER® with both ProductView and Lattice Technology's XVL applications for 3D viewing. Since then the company has focused on expanding its use of XVL® for downstream 3D data use.

As of 2008, 60% of completed drawings contained 3D data and almost 50% of parts drawings also had 3D.

Mitsubishi Agricultural Machinery uses PTC's Pro/ENGINEER platform to design products, and then manufactures them using XVL applications throughout its operation.

Building Assembly Processes Using XVL

When the company first introduced 3D into its processes, Mitsubishi was prevented from using it downstream because the company was still deeply entrenched in delivering assembly process information using paper reports and drawings.

The design, product planning and production divisions continued to adhere to the traditional methods long after 3D was introduced which caused obvious delays and frustrations: For example, the product planning division waited for delivery of approved hard copy drawings from the design division, the production division then waited for the hard copy assembly process management sheet. Thus, their tasks could not commence until each division received the paper instructions.

In Spring 2009, however, these production processes were changed in order to shorten lead time and minimize inventories. The new process is known within the company as the 'Flexible Manufacturing Method'.

Using this method, the handling of the assembly BOM (commonly called the mBOM) has become a very critical part to the process since it is now required to track the location of parts-level information and the related suppliers. The assembly process tree created and stored within the 3D XVL data now provides the base level of data required to create this assembly BOM – data which is quite different from the eBOM created from the structure tree as designed with Pro/ENGINEER.

The assembly BOM created within XVL is then forwarded to the MIPS (MAM Mix Production System) which manages the parts procurement process automatically.

Benefits

The XVL applications allow MAM to:

- Perform process planning concurrently to other tasks
- Plan processes faster and more accurately
- Create the assembly process design entirely from 3D data
- Gradually eliminate conventional assembly drawings from the process
- Streamline shop floor processes by using 3D data in the factory
- Have teams working on the same assembly without confusion

Features

XVL delivers the following features for the company:

- mBOMs are created as part of 3D XVL data
- Allows a fully automated parts procurement process
- Delivers semi-automated creation of assembly process instructions
- Applicable to many disciplines within the company's operation
- Work hours for each process are managed and calculated within XVL Studio
- Allows company to work towards a paperless operation

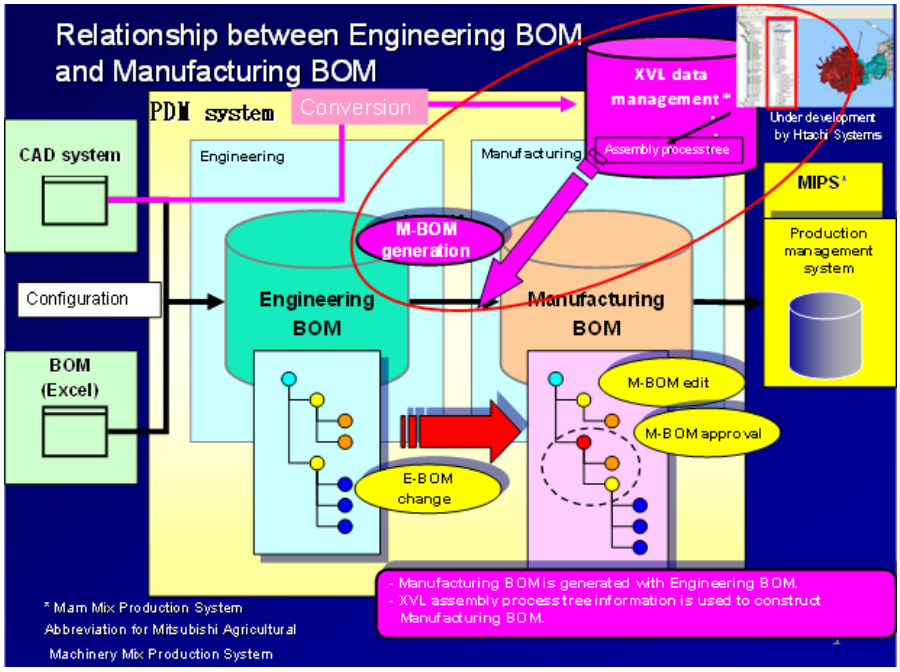

Image 1: Taking the eBOM into the mBOM using XVL

In the product process planning phase, the following problems were identified and XVL was used to find a way to resolve them:

1. Little or no collaboration with the design division
2. Neither the entire assembly structure nor the assembly process planning procedure could be viewed.
3. Creating the 2D illustrations for the assembly process sheet was time consuming and design changes were not included because of the inability to update and share data quickly and easily.

The objective for using XVL in production process planning is to 'front-load' process design using the assembly tree structure in XVL, and also to reduce man-hours by having a semi-automated method for generating assembly process instructions. Mitsubishi picked XVL because of its performance in 3D as well as its ability to assemble process instructions automatically, which was far superior to other products offering this. XVL also offered applicability to many other disciplines in the company from design all the way through to sales.

Prior to implementing XVL, the assembly process planning was only undertaken after receipt of approved drawings. With XVL, the assembly process planning is now completed long before receiving any paper drawings. In addition, Mitsubishi has been improving productivity further by creating work instructions directly from the shop floor that are input and saved inside the XVL file.

Now XVL is being used for assembly process planning and creating work instructions. The assembly process planning now comprises: (1) constructing a correct assembly tree structure, (2) setting up work processes (3) allocating the shop floor resources and (4) export of the assembly process tree.

In stage 1, Mitsubishi designs the basic assembly processes in XVL Studio, grouping parts to be sub-assembled in the basic assembly process.

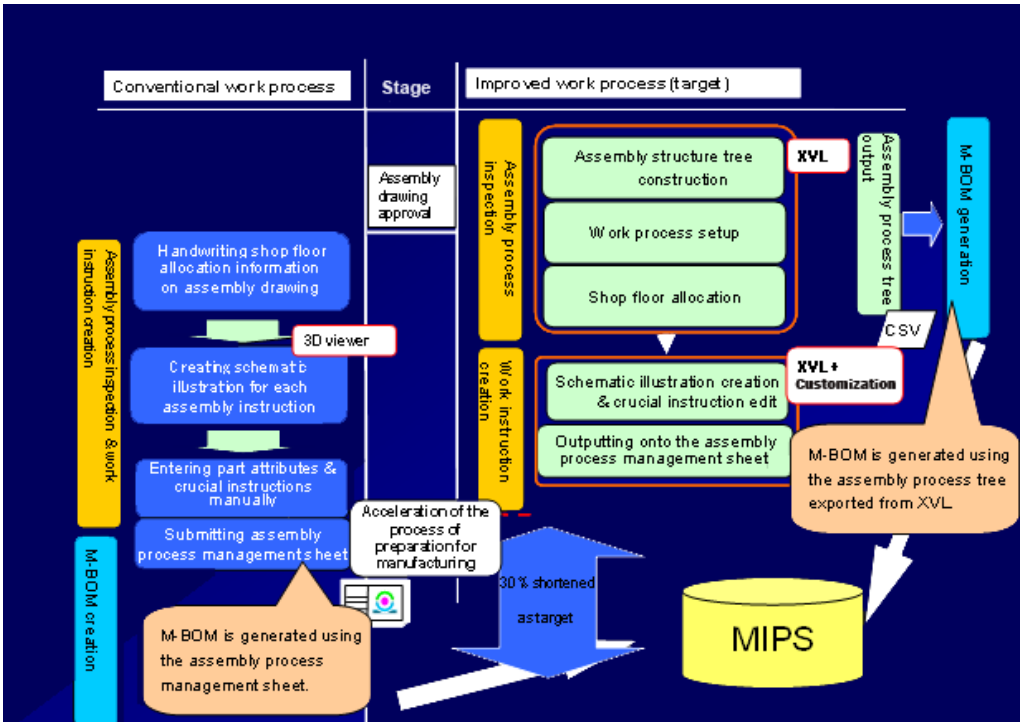

Image 2. Improvements in work processes as a result of XVL

Then the order of the assembly will be changed and edited in the detail manufacturing process and parts will be added or repositioned with XVL Studio.

Since it is quite difficult for one person to cover the entire assembly, this work has to be shared with a team. By merging the CSV files of the process tree with the sub-assembly process defined in XVL Studio, the team can quickly generate the whole assembly process — something easily done thanks to Studio version 8.0.

In stage 2, man-hour calculations and critical assembly instructions, which have previously been handled in Microsoft Excel, are now handled as attributes of XVL.

In stage 3, shop floor resources are allocated to each process, and line shares and shop floor allocations can be done rapidly.

Stage 4 is delivered via some basic customization of XVL Studio which allowed Mitsubishi to easily identify the assembly structure and parts attributes, and to verify the line loads using the man-hour calculations in the software.

The creation of process instructions consists of (stage 5) -- generating schematic illustrations alongside lists of critical instructions and (stage 6) export of the information directly into an assembly process management sheet.

The schematic illustration is generated by using snapshots of a process animation created in XVL Studio. Editing of annotations in the illustration is also easily completed within the application.

The schematic illustration can be retrieved by searching the name of the process part. The Export function used as part of section (6) was achieved through customization of XVL Studio including exporting the saved snapshots and attributes generated in (5).

Benefits and Issues

By changing the assembly process planning and work instruction methods, Mitsubishi achieved gains through faster planning and better process design. However, the methods for making work instructions needed be reviewed, as the creation of the snapshots for the work instructions proved to be very time consuming.

The company has been receiving positive reactions from the engineer responsible for the assembly process planning: Namely that this new system allows him to create the assembly process design by having the whole process viewed in 3D. Expectations for 3D data use on the shop floor have also been rising, since XVL can show assembly structures, assembly processes and work instructions. This has motivated Shop Floor staff to change their attitude towards 3D as a tool instead of sticking to conventional methods.

Future Directions

The image below shows the company's assembly process design improvement achieved, and planned for the future, using XVL. These achievements also allow the company to more easily review whether conventional assembly drawings are still required as a result of the improved information collaboration and data exchange made possible through XVL. The critical assembly instructions which are defined within the CAD file are automatically transferred to XVL as annotations in the 3D, which assist with building productivity in manufacturing engineering. The company is now considering using 3D data without the added support of conventional 2D drawings.

Another plan is to distribute the results of process designs digitally: The current semi-automatic generation of work instructions is seen as a transition phase and simply emulating the conventional methods digitally did not deliver as much benefit as expected. The company is now advocating using 3D as the main medium for a paperless process.

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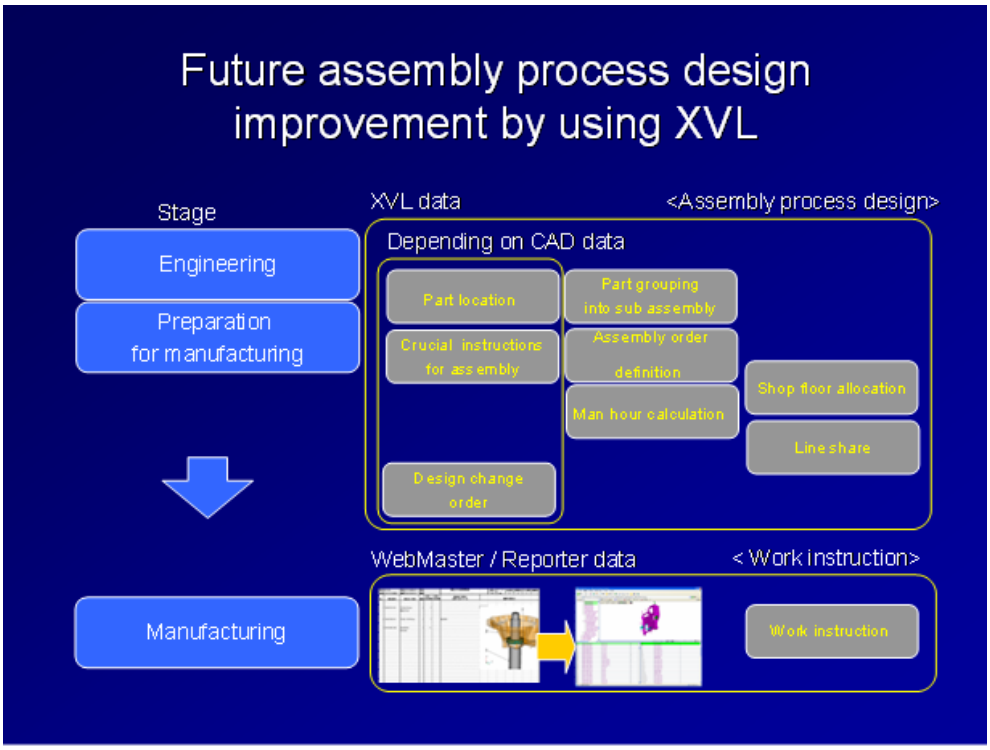

Image 3. Building further into XVL for productivity improvements in process design

End users of the 3D data within the company have begun to see the effectiveness of XVL via the Lattice 3D Reporter and XVL Web Master applications – these tools enable them to quickly and easily provide information and data in real time, in common document formats (Excel and HTML) without using paper reports and drawings

Mitsubishi Agricultural Machinery has already benefitted from the improvement of assembly process design through the introduction of XVL and is looking forward to even greater improvements in the near future.

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Lattice Technology Digital Manufacturing Solutions are focused on making manufacturing productive, efficient and profitable through the use of 3D data. While creating 3D design data is the first step, it is not tuned to the needs of the shop floor, production, procurement or support staff, nor easily applied into these disciplines in its native formats. In addition, as 3D design data has become much more complex and heavyweight, so problems with design errors are more easily missed and adequate simulation and testing of the data is not being performed. XVL and the XVL solutions solve these problems.

Lattice Technology's applications deliver the tools to thoroughly test and accurately check 3D design data before it is released, and to build, simulate and document manufacturing processes in 3D long before manufacturing commences. XVL and its applications deliver the information that has typically been delivered on paper drawings and reports, but embedded within the lightweight 3D file, to allow immediate cross-referencing of listed parts, work instructions and other annotations with the specific, relevant 3D data.

Customers of Lattice Technology have measured significant improvements in design accuracy, process design, as well as eradication of delays, and considerably reduced errors on the shop floor. To find out more about the XVL applications, visit www.lattice3d.com.