Story excerpted from the book,
"Improving Lean Manufacturing Through 3D Data"
by Dr Hiroshi Toriya

Alpine Precision

Streamlining Documentation in a Globally Dispersed Manufacturing Operation

In an effort to reduce its mold making lead times, Alpine Precision built an environment that would allow information to be obtained accurately and instantaneously. In so doing, it also eliminated paper-based information from its processes by using the Lattice Technology Solutions.

Alpine manufactures on-vehicle multi-media equipment such as car audio and navigation systems, operating development, production, and sales divisions across the world, including Japan, U.S.A., Europe, and China. Alpine Precision operates as the central hub of the group's production activities - a 'mother ship' to the group's overseas production bases with increasing importance in leading the launch and technical support for local production efforts. In an increasingly competitive and fast-moving world, it remains critical for Alpine to reduce the lead-times for the company's worldwide on-vehicle multi-media product lines.

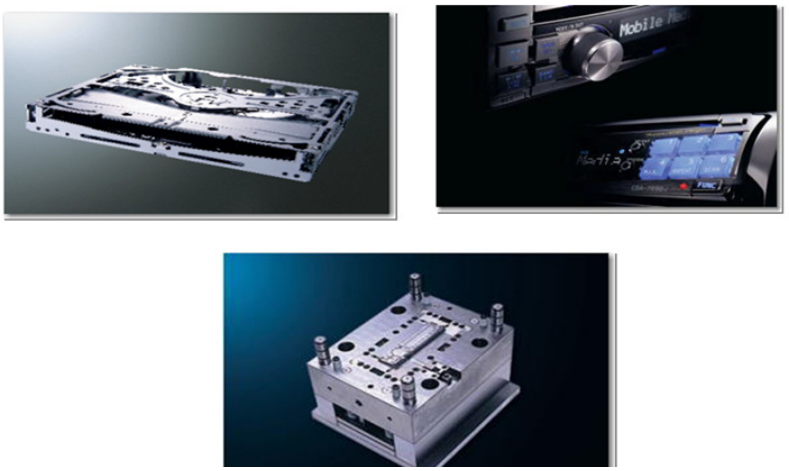

Figure 1: Examples of products manufactured by Alpine

Alpine Precision, which is responsible for manufacturing the molds of these multi-media systems, is a key part to this change. When given this challenge to reduce lead times, the company developed a digital mold-making system code-named DM-T (Digital Manufacturing and Tooling), which halved its mold-making time.

Using DM-T since May 2005, the company has successfully reduced lead-time from design to measurement of test parts by building a process which fabricates molds using only digital data, without relying on paper-based information. In the five years since this practice was established on the company's shop floor, the system continues to evolve. Mitsuhisa Nakamura, the company's Head of Production said; "The advantages of digital manufacturing lies in being able to visualize the progress of the manufacturing process at every stage. All our staff are now able to observe this, and, as a result, they now understand their responsibilities for completing their own tasks by a given deadline. This is a key factor for reducing lead time." Nobuyoshi Mizuno and Shigeki Yoshihara of the company's mold production department have been critical players to building the system for the shop floor. They succeeded in completing a paperless system that was accepted by clarifying system requirements from the perspective of the downstream users.

Benefits

XVL Studio, XVL Web Master and the XVL format enabled Alpine Precision to:

- Halve product lead times for mold manufacturing
- Reduce shop floor training times from 6 months down to just 1 month
- Reduce staffing by 25%
- Start the next process immediately or concurrently to others since the required information is available when design has completed
- Consolidate all required manufacturing information into XVL as a single source.
- Reduce the amount of paper copies created by 93%

"As a result of this change, Alpine Precision reduced staffing by 25%, and shortened mold-making time by half, delivering optimal performance with minimal staff."

Alpine Precision

Why Aim for a Paperless Workflow?

Figure 2 demonstrates the problems addressed by the DM-T Project. The time spent on mold production at Alpine Precision is mainly concentrated in mold manufacturing and mold design; halving the time taken for these two processes would mean the overall lead time would also halve.
The company's success in achieving a paperless process contributed significantly to the reduction of lead times. When paper is used, information inevitably stops wherever the paper stops, making it very hard for the next process to start. However, with digital data, since information flows instantaneously, work does not pause nor stagnate, allowing mold production lead times to shorten dramatically. As a result, Alpine Precision successfully reduced, by 93%, the number of copies made for drawings and reports, which until then had exceeded 5,000 pieces of paper annually. Paper needs to be distributed, managed, and stored, and can also be easily lost, causing a multitude of other problems. Digital data eliminates these hassles. Simply by taking into account the manpower required for managing this amount of paper, the cost-effectiveness of this process is huge.

Alpine Precision's product lineup includes the mechanical units for car electronics, external car audio parts, and their associated molds. The company started out using 3D in its design processes early — in 1994 — and by 2002 had completely digitalized its mold design. In 2003, it embarked on the challenge to realize a paperless process. Alpine's enthusiasm in this process is said to have been driven by its then president, Mr. Mochizuki (who remains as an advisor to the company) who encountered an inspiring, if futuristic, cutting-edge example of digital design and manufacturing. The system used in that case was, however, tremendously costly, and it was unrealistic for Alpine Precision to adopt the same system at that time. So Mochizuki asked his employees to construct a similar system as a joint company effort, based on the knowledge and experience of the shop floor staff, and this started the development of the DM-T system. This concept, spirit, and climate lives on today at Alpine Precision, encouraged by current president, Mr. Yokota.

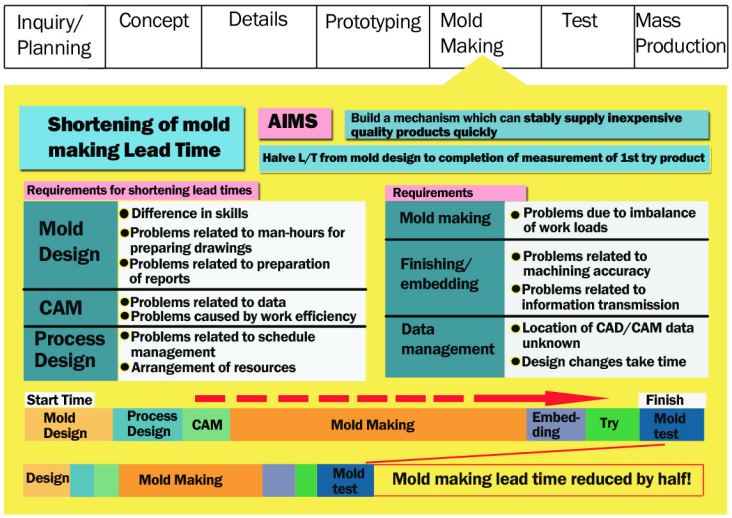

Figure 2: Construction of the DM-T system with a focus on the time spent for mold making during the entire process.

How Alpine Precision Achieved A Paperless Workflow

When developing the DM-T system, the company held meetings with the mold management, mold design, CAM construction, mold manufacturing, and mold measurement departments across three months, thoroughly investigating where needless work and delays were occurring and which processes needed to be tackled. Mizuno and Yoshiwara discussed one interesting experience found during this process: In one test, they deliberately prepared complicated paper drawings to see how three employees would interpret them. All three interpreted the drawings differently, which means each one could build the molds differently, depending on how they understood the drawings. When the staff were asked to do the same thing with 3D XVL models, they all interpreted the 3D model in the same way - and correctly. This showed the team that XVL quickly and accurately conveys mold-making information, and demonstrated that communicating information using 3D data radically enhances mold quality. These kinds of results encouraged Mizuno and Yoshiwara to increase their efforts. Initially, their plans were to build a system based on 3D data and simple paper drawings. However they then discovered that most of the shop floor staff do not really look at drawings carefully, so they decided to completely eradicate paper drawings and reports, replacing them with XVL data instead. They introduced the DM-T system which allowed all the required attributes for mold manufacturing such as materials, and so on, to be input by mold designers using a CAD system and adding machining accuracy to models in 3D XVL on the DM-T system. This allowed the designers to avoid time-consuming paper drawing preparation.

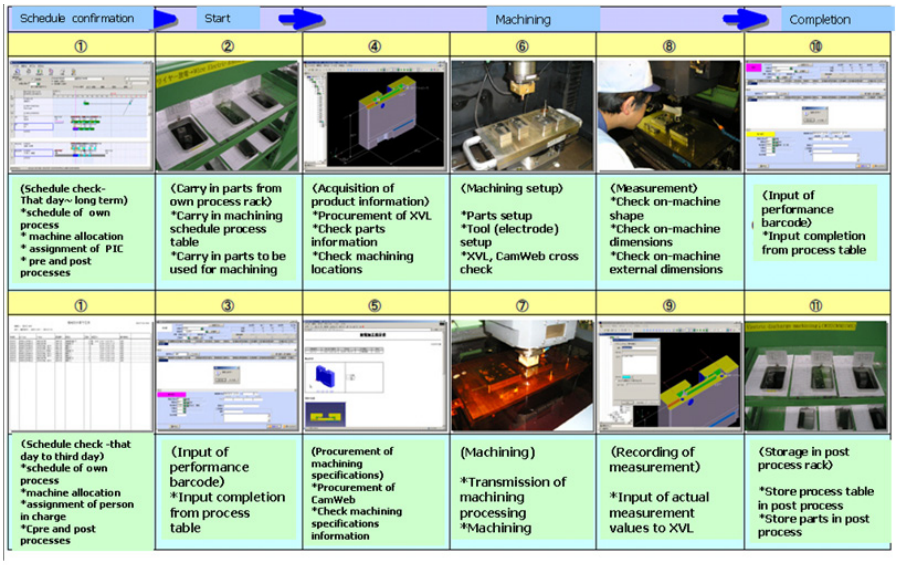

Figure 3. The manufacturing process using DM-T to reduce lead times and increase productivity

Introducing the DM-T System to the Factory Floor

Alpine Precision says that its use of 3D data allows them to complete training, which used to be six months in duration, in just one month.

While introducing DM-T to the manufacturing floor at Alpine Precision, the most difficult task turned out to be teaching the staff to use their PCs effectively. They first had to work out the best possible layout of PCs to minimize burdens on staff, and tried mixing both laptops and desktops at the shop floor. They repeated trials to find out how the staff could work most efficiently using 3D data on PCs in place of paper drawings. Today, each member of staff at the company's plants has access to shared PCs on the shop floor, and everyone is able to easily search the overall mold production schedules and work processes via 3D. The only paper sheets circulating around the plants are work charts listing barcodes for each part.

The company says that the introduction of XVL at its plants was surprisingly smooth, attributing this success to the fact that the system was developed from the perspective of the shop floor. As it was implemented, everyone using it found that the information they needed was now very clear and visible: some even suggested enhancements such as adding manufacturing details to the XVL data and feeding it back to the design process, or using XVL more for communication. In the DM-T system, the 3D XVL data is used as the final mold manufacturing data and by increasingly adding manufacturing information to it means that

XVL, not CAD, is the final data used in the manufacturing process. Alpine's future plan is to convert attribute information added to XVL back into the CAD data.

Mold-making Based on Digital Information

The DM-T system has changed Alpine Precision's mold manufacturing process. Before the system was in place, there were eight steps comprising the mold manufacturing process of the company that involved constant reference to paper drawings and reports that were often delayed or out of date.

The company also worked to eliminate inconsistencies in designers' skills in the mold design process, by using 3D data consistently in the CAD system. This worked by providing automatic cross section functions for cavities and cores, and automatic division of undercuts on 3D CAD data. CAD designers were also able to reduce mistakes and delays, for example losing reports or omission of required details in reports, by entering parts attributes such as material, quality, and deadline into the CAD data and outputting them automatically. In addition, by converting CAD parts shape and attribute information to XVL, their staff got into the habit of checking shapes on their PCs, allowing them to completely do away with drawings. The improvements achieved with the CAM system include efficiency improvements with the 3D CAD data, better work time management, and the elimination of preparing manufacturing instructions on paper. Now, the 3D CAD data can be directly read into the CAM system, and with the CAM system linked to the process management system, the company is more easily able to manage its machining processes.

So that the staff can easily share information on the web, all manufacturing instructions are output in html. There are two types of manufacturing instructions used at Alpine; web-based documents describing setup and machining orders, and 3D instructions specifying EDM positions, made available on the XVL models. Using these two sets of manufacturing instructions, Alpine Precision has enhanced efficiency at the manufacturing floor.

As previously discussed, the mold manufacturing process makes up more than half of the mold production work. At Alpine Precision, efforts to deliver a paperless process contributed tremendously to shorter mold production processes. This is very clearly demonstrated in Mizuno's reply when asked what changed as the DM-T system became increasingly used at the factory floor: "You don't see staff folding their arms in deep thought at the shop floor anymore". Until the introduction of the system, you would often see staff staring at drawings with a blank look on their face. With 3D data, they now "get the picture" at a glance and are able to start on their tasks immediately.

In addition, as part of the new process in place, shapes of parts to be machined next, and details of machining methods, etc., are easily checked on a PC, helping eliminate down-time on the shop floor. With the abundant 3D information available, more and more staff are now able to start preparing for work earlier in the process and consider what needs to be done next. Mold quality has also increased as machining instructions become clearer.

Benefits

The Lattice Technology Solutions deliver both print-ready and digital documents for manufacturers that are automatically created as soon as design data is ready:

- Print-ready and digital PDFs for use across the enterprise
- Print-ready work instruction spreadsheets that are created automatically from XVL data
- HTML-format data that is automatically created from XVL data for use across an intra- or internet
- Digital spreadsheets for work instructions and mBOMs/sBOMs that can include assembly animations
- Automated update of created documents when design data changes upstream
- The ultra-lightweight XVL format means these documents have a small enough footprint to be rapidly shared across a global organization.

"With digital data, since information flows instantaneously, work does not pause nor stagnate, allowing mold production lead times to shorten dramatically."

Alpine Precision

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To achieve these kinds of successes at Alpine Precision, there is an absolute need for work processes based on digital data to be established at the manufacturing floor. Mold parts must be processed while referring to digital information created in earlier stages, as well as work instructions, and the XVL data containing manufacturing information.

Now the teams also “write actual data measured by the machine into XVL” during this process. By looking at this XVL data, the staff can verify that both dimensions and allowances specified by the mold designer are in compliance, as well as have actual values on hand. On verifying the accuracy, final adjustments might be made before the molds are fully produced. By accumulating this data, any problems in the machining methods quickly become evident, enabling further improvement and increased accuracy.

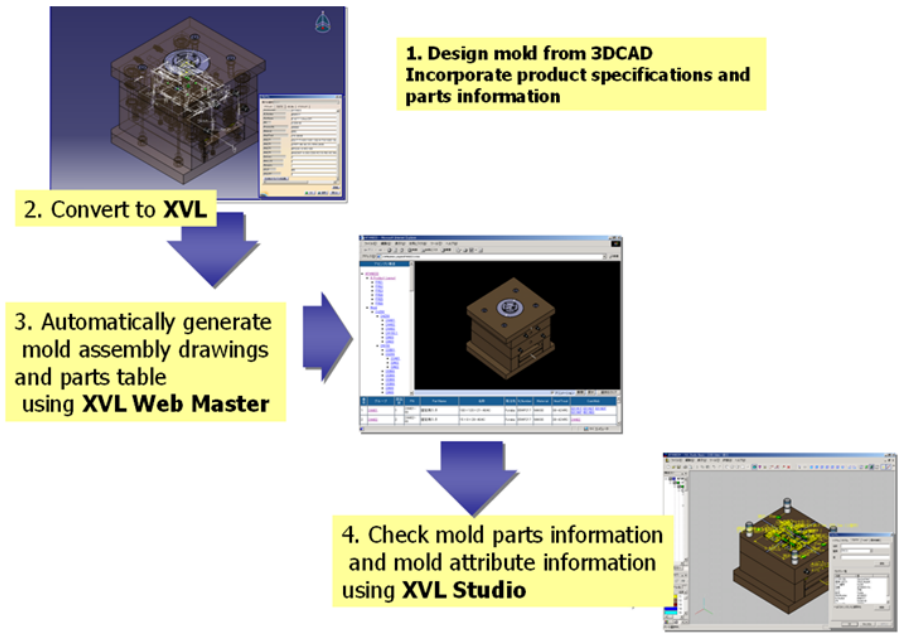

Figure 4. 3D XVL data throughout the entire manufacturing process

Mold-Making in Practise

The authors visited Alpine’s mold-making plant to see the actual mold-making processes in place, and this is outlined below. No paper is used inside the plant except for work tables with barcodes for identifying molds. Laptops are placed next to work tables, and staff carry out their work while looking at 3D models with manufacturing instructions. (Figure 4).

- The staff in charge registers the work for the day using the barcodes listed. The work process is fixed in place for the following three days. Workload is calculated by the DM-T system.
- Staff check the manufacturing process beforehand using XVL Player and the XVL data.
- Staff check machining information on the webpage and start parts machining. They will place the information created on the web.
- In the process of finishing mold parts, staff acquire any machining information which has been added to the XVL data.
- In the mold assembly process, all assembly methods are added to the XVL data beforehand, and staff carry out assembly processes while referring to this information, using XVL Studio.

In the past, drawings were used to learn the assembly process, but this proved challenging, due to the differences in the data provided on paper drawings by the mold designer and the additional information required by the assembly staff at the shop floor. XVL provides a far better process because it allows the configuration tree to be highlighted on-screen. This tree contains the attribute information of the assembled parts, and the required information can be immediately located.

As a result of this change, Alpine Precision reduced staffing by 25%, and shortened mold-making time by half, delivering optimal performance with minimal staff.

Tools For Achieving A Paperless Process

The flow of information generated at the mold design department has accelerated enormously: Now, mold shapes are designed on the 3D CAD systems, and product specifications and parts information required for mold manufacturing are input as attribute information to the CAD models at this stage. This information is automatically converted to XVL. Because XVL data is so lightweight, geometric and attribute information can be easily accessed via the web, in HTML, created using the XVL Web Master application. This software is able to automatically create mold assembly drawings and parts tables directly from

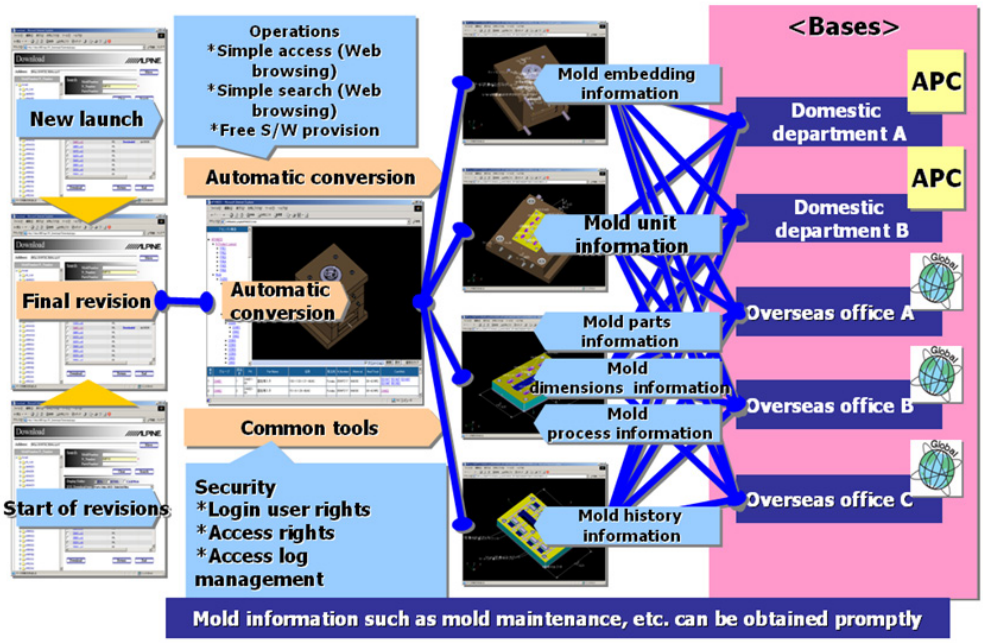

Figure 5. Using DM-T to expand the use of the paperless processes across the global operations of Alpine

XVL, and share the results on the web. By also using the XVL Studio applications, the teams can also check parts information and mold attribute information added inside the XVL file. Using the measurement and cross-section functions, accurate mold dimensions can be quickly calculated. As a result, all information required for the mold manufacturing processes can be immediately shared between the manufacturing and design departments as soon as the mold design is finished

In every process in manufacturing, XVL data is accessed across the web. No paper drawings are required since accurate information is now immediately available digitally. Since product specifications and parts attributes can be obtained for any process, there is no need for paper reports. In the manufacturing department, the shop floor staff often add required dimensions to the XVL data. In the mold assembly process, assembly information can also be added to the data. In this way, all the required information is ready, when it is needed, on the shop floor, and the completed XVL data is shared across the whole company. The benefits of circulating 3D information, not drawings, at the workplace are huge: At the manufacturing department, XVL data is useful for quickly and intuitively understanding the correlation of parts, allowing work to be carried out accurately and efficiently. Even staff who are not familiar with drawings say they are now able to decide what they need to do when they have 3D data at hand. When the authors visited the company's plant, we saw young employees with only several months of work experience working busily while easily referring to the XVL data.

Alpine Precision says that its use of 3D data allows them to complete training, which used to be six months in duration, in just one month.

Spreading the Benefits of a Paperless Process Across the Global Enterprise

Alpine Precision is currently working on activities that will allow it to share its success with all other Alpine Group companies, by disseminating the information made at its mold production department outside the company (Figure 5). Mold assembly information, parts information, and dimensional information is being sent to the overseas subsidiaries as well as partner companies. This data can be easily searched and read on the web. To maintain security, users have access only through passwords and other security measures. With this system, the 3D models of approved molds are processed using XVL Web Master and securely distributed around the worldwide bases. Already the company's Dalian subsidiary in China has introduced the same paperless system as Japan did in 2007. Requests for 3D information from local staff in China are said to be more common. This is because abundant information is being communicated, overcoming language barriers.

Since 2006, the company has been distributing information using digital data instead of drawings even at its external work bases. Drawings and reports that used to be circulated on paper are now converted to PDF so that they can be searched and referenced easily from anywhere in the world. Since 2008, they have also been able to create cross sections and measure data using the free XVL Player, which has led to more and more partner companies asking for 3D data. When the company was distributing paper drawings, their partner companies showed no response nor made any enquiries, but now, with the XVL data, their partners enthusiastically calculate distances or obtain cross-section using 3D XVL models. We asked the team at Alpine if they had met with any resistance in their attempts to promote paperless processes outside the company. They say that they conducted hearings and what they discovered was that drawings were not used outside the company as much as they thought. Still their efforts in supplying the required information in 3D to their counterparts has helped gradually deepen understanding of the usefulness of 3D data outside the walls of the company.

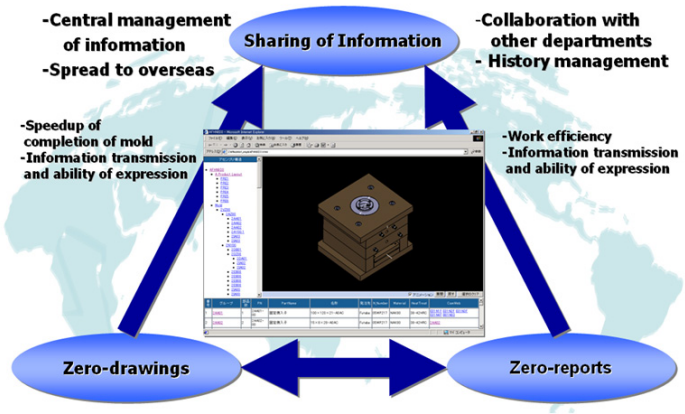

Figure 6: The effects of the paperless process on Alpine's organization.

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If you would like to read the entire story, please contact the Lattice Technology sales team at:

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About 'Improving Lean Manufacturing Through 3D Data' by Dr. Hiroshi Toriya.

This book, one of several published by author, Dr. Hiroshi Toriya, discusses how Japanese manufacturers are addressing the critical need to continually improve manufacturing processes across the entire enterprise. In the cases highlighted in this book, manufacturers are turning to 3D data practices and processes to enable greater leanness of manufacturing. This book discusses why this is a necessity in the current economic conditions and discusses real world examples through in-depth interviews with manufacturers of all kinds.

Published in Japan in 2008, this book is available as an e-book from Lattice Technology, and is available at www.lattice3d.com.

Lattice Technology, Inc. sets the standard in Digital Mock Up and Technical Documentation software applications. These industry-leading applications 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 design errors are more easily missed and adequate simulation and testing of the data is not being performed.

The Lattice Technology Solutions deliver the tools to thoroughly and accurately check 3D design data before it is released, and to design, simulate manufacturability and document manufacturing processes in 3D long before manufacturing commences. These applications deliver the information that has traditionally been delivered on paper drawings and reports, but as print-ready and digital documents that 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 Lattice Technology Solutions, please visit www.lattice3d.com.