

Chapter 2

Trend Toward Use of Lightweight 3D Data

The development of the network society has promoted the sharing of information in diverse areas of the manufacturing industry, changing the business processes of many companies. However, 3D CAD data, which forms the core of digital manufacturing, has not benefited much from network technologies. 3D CAD is characterized by massive data volume and complicated structures, and is also difficult to integrate with other associated data on the network. Though requiring huge costs to generate, until now CAD data has only been used in the CAD/CAM area, which comprises less than 10% of the whole IT industry.

The emergence of lightweight 3D data such as XVL is changing this situation. Industry is increasingly trying to change the overall business mechanism by converting CAD data to lightweight 3D data. This includes not only companies but also their partners and suppliers. So what is the significance of the existence of this lightweight 3D data and how should it ideally be used?

2.1 Designs Based on 3D CAD to Full Use of 3D Data

3D data is unique in that its simple shapes are easy for everyone to understand. In the case of design drawings, one has to be a design specialist to be able to conceive the actual shape. 3D display allows everyone to understand shape intuitively. This means that 3D data can serve as an excellent medium for communication. The Internet uses text, images, 2D animation, video, and audio to convey information clearly. 3D data will be next.

However, 3D data comes with a big problem, namely, the high costs needed to generate it. 3D CAD is very expensive. Compared to 2D data, 3D CAD data is difficult to handle because of the extra dimension of depth. 3D CAD also requires time and money to learn.

Still, 3D design has become the standard in many companies. In the manufacturing industry, 3D CAD is growing more and more popular and design departments are aggressively accumulating 3D data. It is only natural for companies to want to utilize this 3D data inside the company, with related companies, and for

communication with consumers. Generally, a design department would have ten times its number of production and product-related partners, and these partners would have 100 times more consumers at their end.

If we can use 3D data for communication with product-related partners and consumers, *etc.*, we should be able to reform the business process of the manufacturing industry to a considerable extent. If we can effectively reuse the 3D data created in the design department, the downstream costs to generate 3D data will be zero. There are, however, two obstacles to enable everyone to use 3D data:

- 1. 3D CAD data is very large, and cannot easily be shared on the network.
- 2. 3D CAD systems to read the data are very expensive and complicated, and thus cannot be made available to everyone.

In order to overcome such problems, lightweight 3D data formats and software (viewers) to view them were developed. Generally, lightweight 3D viewers include free viewers for checking 3D shapes and products sold on the market for measurement and interference calculation.

HTML (Hyper Text Markup Language), the language for defining pages on the Internet is gradually being replaced by XML (eXtensible Markup Language), a more general language for representing information. XML can also define complicated 3D data structures and related design and manufacturing information.

By integrating the evolved 3D lightweight technology with XML, it should be possible to solve the above two problems. As shown in Figure 2.1, by converting 3D CAD data to lightweight 3D formats, general users who do not have CAD can use a viewer to access 3D data easily.

Lattice XVL uses XML to create a lightweight, accurate, web-friendly representation of 3D CAD data. This allows lightweight 3D data to be used across the “walls” of organization. XVL can compress 50 MB of CAD data down to 500 KB-small

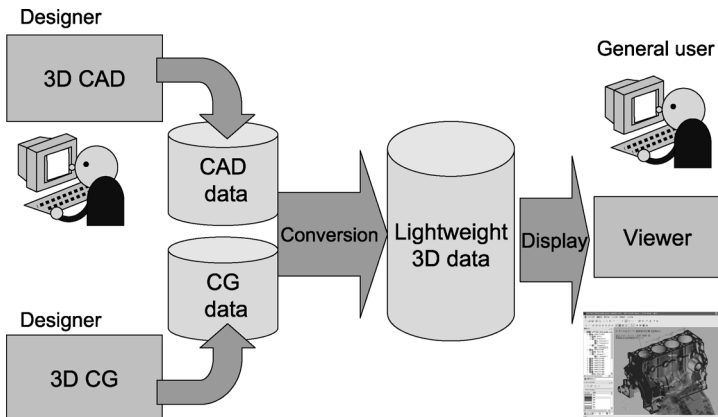


Figure 2.1 Use of CAD/CG data in downstream processes after conversion to lightweight 3D data

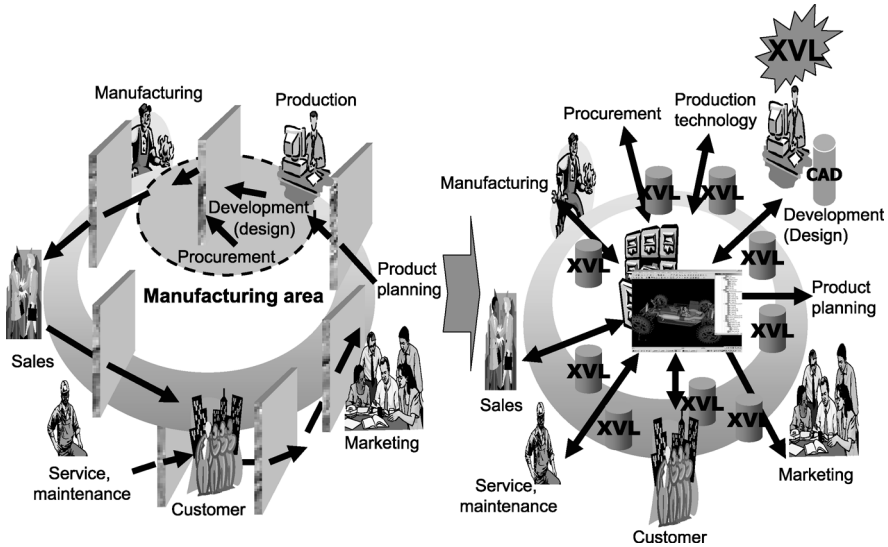


Figure 2.2 Transforming business processes using lightweight 3D data

enough share on the Internet. With a simple XVL viewer, anyone can easily use 3D data anywhere to carry out work. At Lattice, we call such environments allowing use of 3D easily “3D Everywhere.”

3D data that has been released from the bonds of CAD can now be used beyond the design department as a clear communications tool (Figure 2.2). Manufacturing processes that involve diverse employees with different skills, employees of different companies, employees in different countries, and general consumers requires clear visual communication. 3D data released by the design department can provide clear visual communication and can improve business processes at the plant, in the maintenance department, in the marketing and sales department, and in other downstream departments.

2.2 Why Lightweight 3D Data, not CAD?

So why should we use lightweight 3D data instead of CAD data? In order to create lightweight 3D data, we need to convert it from 3D CAD data. Is it really necessary to go to the length of converting 3D data to generate lightweight 3D data? According to a pioneering XVL user, the advantages of lightweight 3D data are to display very large data, use 3D in documents, and use 3D in drawings (Figure 2.3).

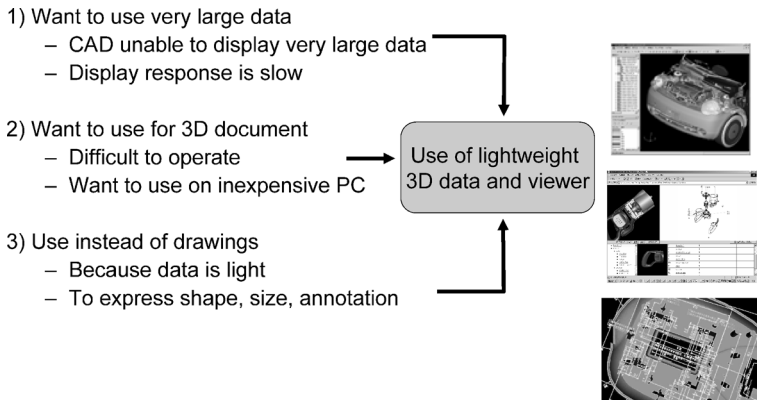


Figure 2.3 Why use lightweight 3D data?

2.2.1 Display of Very Large Data

In CAD, parts are designed by multiple designers, and the shape of the completed product is expressed by combining multiple parts. Depending on the design, data volume can be massive. In the automobile and airplane industries, which use high-end CAD, data volume is said to be 20 Gbytes for cars, and 5 Tbytes for airplanes. Unfortunately, CAD is unable to display such enormous data. When data reaches the level of several hundred megabytes, the display response of CAD drops markedly.

What about in terms of the number of parts making up a product? Generally, an industrial machine is made up of 3,000–5,000 parts, and a printer or photocopier about 5,000–8,000 parts. However, once the number of parts exceeds 5,000, the display response of CAD drops drastically. Of course, at such an enormous data size, real-time data sharing on the network becomes impossible. Lightweight 3D can solve this problem. For instance, XVL allows CAD data exceeding 10 Gbytes to be displayed.

2.2.2 3D Use in Documents

3D data is useful for documentation. By using illustrations generated from 3D data, technical documents can be created easily. Applications for creating illustrations easily from lightweight 3D data are improving rapidly. Also available now are software for creating and distributing 3D animations. However, keep in mind that the downstream users who display 3D animations are not CAD users. So inexpensive, easy-to-use viewers must be available for downstream users. The PCs of most of such users will probably be inexpensive, which are slower and have less memory than PCs for CAD. Lightweight 3D viewers must run with good performance on such PCs with low specifications.

2.2.3 3D Use in Drawings

There are also increasing efforts to use 3D data instead of drawings when conveying information from the design stage to post-processes. Most lightweight 3D data accurately expresses not only shape, but also the annotations, symbols, and dimensions used in design and manufacturing processes. Of course, since the 3D data is referenced by many users, it is necessary to convey the data via networks. This means that the data must be lightweight. In addition, an inexpensive viewer is all that is needed to check 3D shapes. Additional viewers are able to measure size and edit annotations.

Figure 2.4 compares 3D CAD and a viewer using lightweight 3D data. Departments which may need to create, edit, or change 3D data, such as the design department, have to perform 3D design on CAD. However, departments that only need to display 3D data other than design will benefit overwhelmingly from the use of lightweight data for the following three reasons:

- 1. No expensive PCs required
- 2. No sophisticated training required
- 3. Data can be exchanged via network

Downstream departments such as production technology departments, factories, quality assurance departments, service maintenance departments, and marketing departments just need to display lightweight 3D data. So, creating an environ-

	3D CAD	Lightweight 3D data+viewer
Shape generation	** 3D shape design	X No 3D shape design function ** Addition of mobile, configuration Information editing, and comments
Shape display	X Very large data cannot be handled * Difficult to import other CAD data	*** Very large data can be handled * Viewer data conversion and management required
Environment used in	X High performance PC required X Difficult to distribute through network	** Can use on inexpensive PC ** Easy to distribute through network
Implementation costs	X Expensive	** Inexpensive ** Free viewer
Education and training	* Special education and training are required	** Can use even with simple basic operation training

*** very good
** good
* good with condition
X not good

Can be used in production technology, plant, quality assurance, maintenance, marketing, sales

Figure 2.4 Departments suitable for using “lightweight 3D data + viewer”

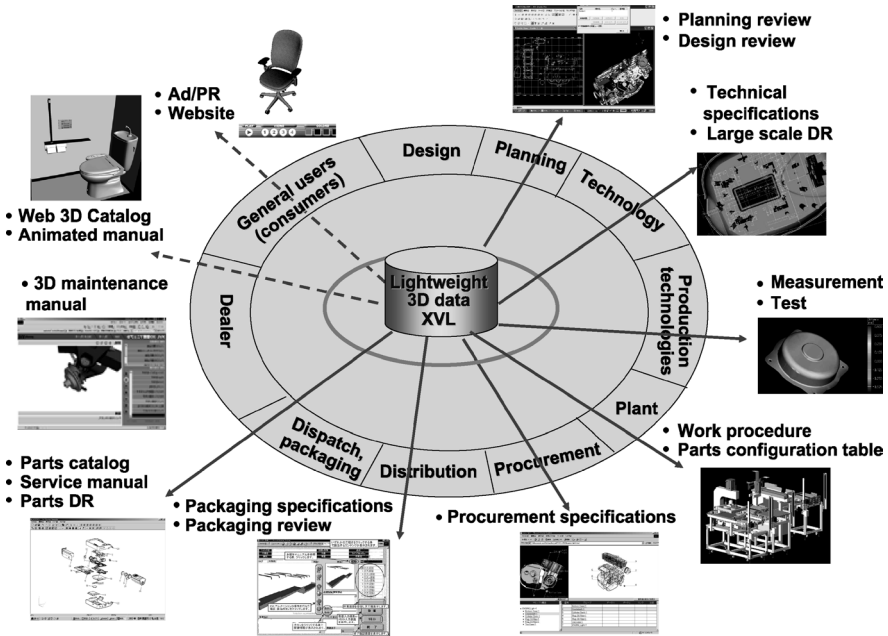


Figure 2.5 Areas of applying lightweight 3D data

ment that allows these departments to access and view 3D data is all that is needed to start using 3D data throughout the enterprise.

Figure 2.5 shows several potential applications for lightweight 3D data. Many companies carry out work restructuring based on 3D data. Planning departments use 3D for planning products, while design departments carry out design review of digital models that have been designed in 3D. Production technology departments use XVL data in measurement verification systems that analyze differences between CAD design data and actual work pieces. On factory shop floors, XVL is pasted into electronic reports, such as parts list and work specifications, thus sharply reducing work hours for creating the reports. Those in charge of viewing the reports also find that they understand the reports considerably more with the communication ability of 3D. 3D data can also be useful for creating parts catalogs in the service maintenance department and for web catalogs in the sales department.

2.3 Use of Lightweight 3D Data Throughout the Company

Once XVL starts to be used in various departments as illustrated above, many companies will face a data access problem. This refers to the fact that a general user may not know where a particular 3D data is stored. This will become a com-

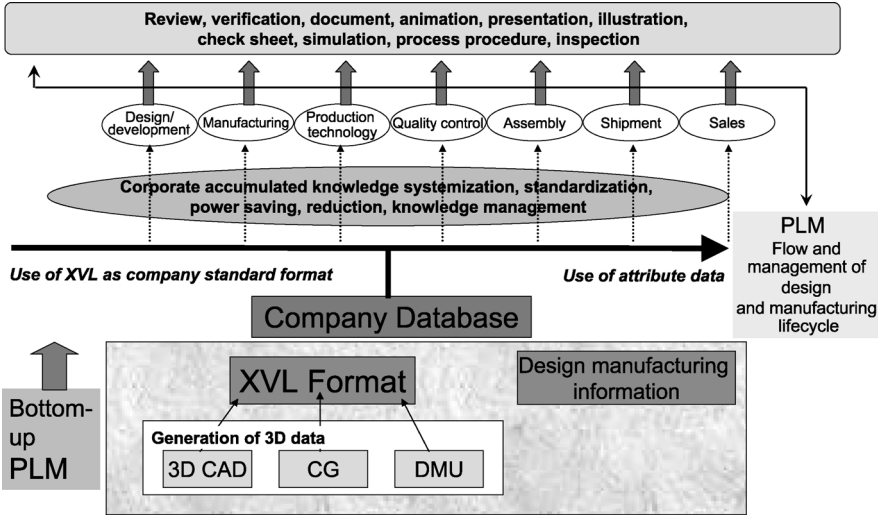


Figure 2.6 Overall optimization effects of XVL as corporate standard data

plicated problem to those outside the design department. If 3D data is to be used at the company level, the company must establish rules to indicate where to find the latest 3D data. One effective solution is to manage XVL within the company's standard database and enable it to be used by all departments (Figure 2.6).

Many companies have multiple 3D CAD systems. They convert all 3D data to XVL to allow people from various departments to refer to it. This in turn enhances the efficiency of a range of operations such as design review, documentation, illustration, sharing of design and manufacturing information, and so on by people from departments such as planning, manufacturing, production technology, quality control, and others. Data sharing throughout the company may raise security concerns, but security control mechanisms are already available for lightweight 3D data and will be discussed in a separate chapter.

Interestingly, lightweight 3D data has established a certain importance even within manufacturing departments, which are traditionally close to design departments. As shown in Figure 2.7, design departments use CAD for defining product shapes, and the shape data is saved as CAD models. CAD data replaces conventional drawings and is treated as official data (master data). This means that designs are saved as CAD data, and CAD models are revised when revisions are needed in the design. On the other hand, XVL serves as the master data for departments using 3D in the manufacturing process. There is a growing trend to write information such as manufacturing instructions and dimensions that are required in the manufacturing process in the XVL model, and this is maintained as master data. Through such trends, manufacturing processes are benefiting from 3D data.

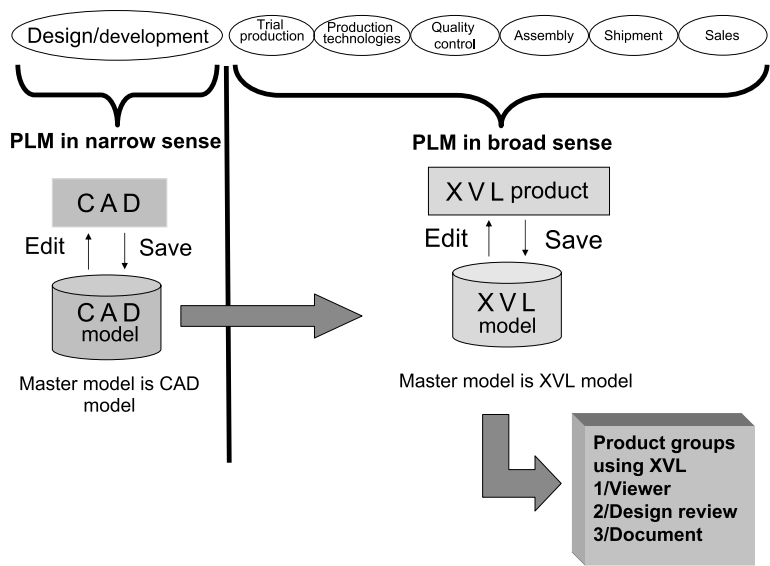


Figure 2.7 Applications of XVL

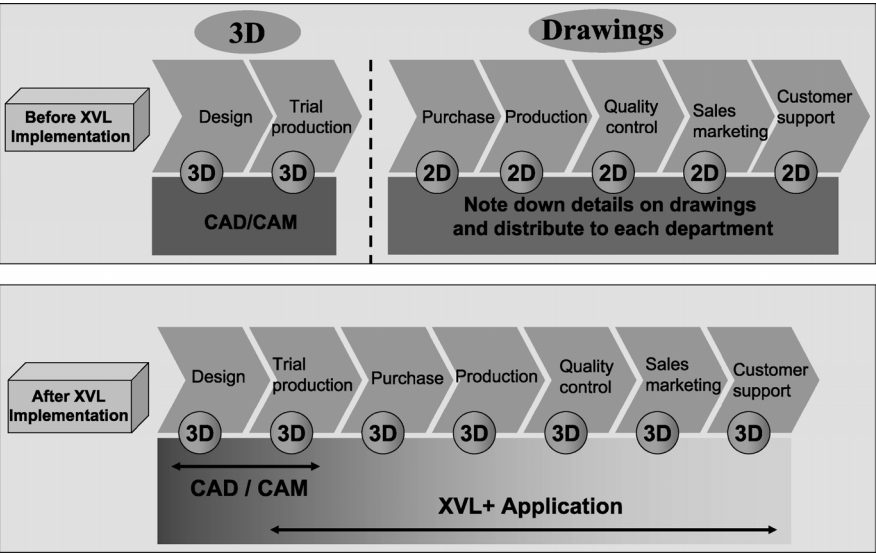


Figure 2.8 Changes in work before and after implementation of XVL

In the past, this was done using drawings. Information such as manufacturing instructions and attribute information required for manufacturing were individually written by different departments on the paper drawings from design. This means that manufacturing-accumulated knowledge was scattered over countless paper drawings. Replacing this with lightweight 3D data enables manufacturing data to be digitally integrated with the 3D data. This provides benefits such as accumulation of manufacturing knowledge in XVL, feedback of manufacturing information to the design department, and central management of information scattered over different drawings (Figure 2.8).

Furthermore, it provides a mechanism to allow access to this data by all who require it. As a result, the data can be used for design review, for design verifications, and for documentation. This means that efficiency can be enhanced by IT and the benefits of 3D design enjoyed even in departments downstream from manufacturing.

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Digital Data

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