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LIGHTEN 3D DATA AND ITS APPLICATION IN MANUFACTURING INDUSTRY

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ABSTRACT

The basic concepts of lighten 3D data is introduced; the problems of the traditional three-dimensional visualization technology and the current development status of three-dimensional visualization as well as the development trend of three-dimensional visualization are analyzed in this paper. A variety of solutions of the three-dimensional visualization are compared, the applications and directions of lighten 3Ddata applications are proposed after combining the actual situation of the development of manufacturing industry.

Keywords: *Three-Dimensional CAD; Visualization; Browser*

1. INTRODUCTION

Three-dimensional visualization technology is a popular field of studying computer and information technology. Three-dimensional model is becoming an important medium of communication in manufacturing industry due to a characteristic of real, intuitive, easy to communicate with each other for the designers, the craft workers, the manufacturing workers and the management within an enterprise, etc. However, it is still difficult for data exchange and sharing information with different CAD systems, especially under the internet environment owing to the characteristic of a large amount of model data generated by the three-dimensional CAD system, a lower processing efficiency, and not compatible between a variety of CAD systems, which hinders the spread of the CAD model data within the enterprise and between the enterprise. Lighten three-dimensional model has a broad application prospects for retaining but restricted to the product structure and geometric topology, not including non-geometric information for reducing the amount of information of the model.

2. 3D LIGHTEN

2.1 3D lighten Overview.

3D lighten is a procedure of lightening a 3D model graphics file by removing the non-geometric information of the model, retaining only the product structure and geometric topology relationships to reduce 3D file storage space greatly, the compression or lighten files after processing can be viewed, be added comments and other convenience interaction information by using browser software or other ways to achieve the three-dimensional shape of the original product graphics.

Lighten 3D data makes other people within the enterprise discharge their comments or suggestions easily on the design document with the visualization tools by the specification of text or graphics, it can be earlier and more directly introduced the company's customers into the definition and design stage of the product, can be introduced the partners of supply chain and other members of the value chain into the development procedure, so that the designers can design rightly at the first time, shorten business processes. Browsing 3D lighten data saves a lot of time, accelerate greatly the design review, shorten the development cycle of product in compared with the traditional paper-based processes, it can also make communication between all sectors of business become more intuitive, and paved a way for sharing of design cross the department.

2.2 The development of lighten 3D visualization.

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2.2.1 The problems of the early three-dimensional visualization solution.

3D lighten data is developed gradually on the basis of direct data exchange of the three-dimensional model, for the three-dimensional visualization of the early time the original document of design would be delivered directly to the data receiver, and read by CAD / CAM software of receiver. It leading to the original design files in different CAD / CAM software can not to be exchanged and shared for the variety of CAD / CAM software is not compatible, in this case ,the model transformation interface technology attract more attention by people gradually, as a result, a variety of data exchange standards have been Developed.

In 1980, the National Bureau of Standard of the U.S. accepted IGES (Initial Graphics Exchange Specification) as a product data exchange standards [1], the French aerospace industry published the data exchange specification SET (Standard Exchange) in 1983 on the basis of IGES [2],the German automobile industry has also developed VDA-FS (surface standard of the association of Automobile Manufacturers), that is DIN66301 [3]. In 1991 the International Organization for Standardization issued the STEP standard (Standard for the Exchange of Product Model Data). These types of data exchange mode apply neutral format as the exchange medium, the process of transformation of the data exchange standard format and Browsing procedure are shown in Figure 1:

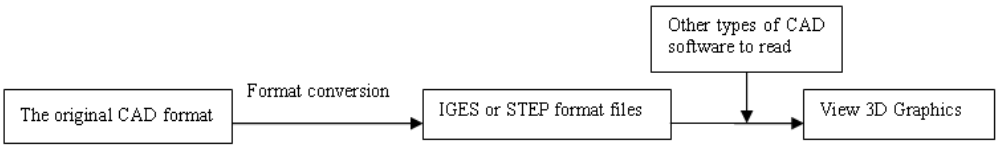

Figure 1 the process of transformation of the data exchange standard format and Browsing

The problems of using a neutral file format as the medium of data exchange are: due to lack of triangular surface information in the document, it usually needs to take a long time to open the file with the three-dimensional system, for a large assembly model, such data exchange mode is not stable enough, the model features and label information will be lost in the conversion course, it is easy to lose the model geometry information, and the neutral file format generated by the different system cannot completely open correctly in other systems, Figure 2 is a comparison test of surface model conversion conducted by the German Pro STEP with IGES, STEP and VDA-FS format, We can be seen from Figure 2 that approximately 99.8% of the surface model can be successfully converted by STEP, 99.5% can be successfully converted by VDA-FS , 99.2% can be successfully converted by IGES [4]. Figure 3 is a joint validation and testing conducted by JAMA (Japan Automobile Manufacturers Association), JAPIA (Japan Auto Parts Industry Association) and IT dealers, the result is: IGES file conversion success rate is about 90%, STEP file conversion success rate is about 95% [5].

In addition, for the assembly model, the problem of data redundancy still exists in the neutral file, sometimes the neutral file is even larger than the source file, the need for large CAD / CAM software system to support reading, and not conducive to the spread and exchange and so on.

With the development of technology , information vendors have introduced a new variety of solution for data exchange for the three-dimensional visualization, which aims to achieve lightweight and not to association with the three-dimensional software , to meet the growing business needs while retain the basic information of the three-dimensional model.

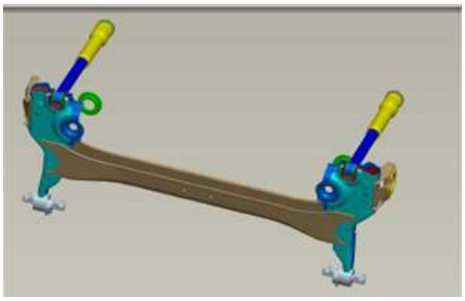

Figure 5 View 3D graphics with Adobe Reader

2.2.2 The development of lighten 3D visualization.
(1) Conversion and browsing of lighten three-dimensional graphics file.

Product model express with lighten data is a trend as viewing three-dimensional model, there are many ways to lighten the file, but mainly rely on compression and simplifying data. It is usually used

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a neutral non-geometric file format as data exchange medium, which is a non-accurate representation mode of product model. There are two approaches to convert CAD files into a lighten format and there are also two approaches to browse these files accordingly, as shown in Figure 4:

(2) The development status of lighten three-dimensional visualization. In 2004, Intel, Boeing, Adobe, Microsoft and more than 30 companies announced in Barcelona, Spain to develop a general standard format for 3D graphics called U3D. In 2005, Adobe released the Acrobat 3D in the industry, which is to made it support for 3D files on the basis of the original Acrobat, to enable it to import CAD files from a variety of tools and convert to Universal 3D (U3D) format. It begins to support 3D content embedded in a document for Adobe's PDF format from Adobe Acrobat 7.0, users can open and use these files with Adobe Reader (PDF browser), he or she can rotate, zoom the 3D model and make other relatively complex operation processing, as showed in Figure 5.

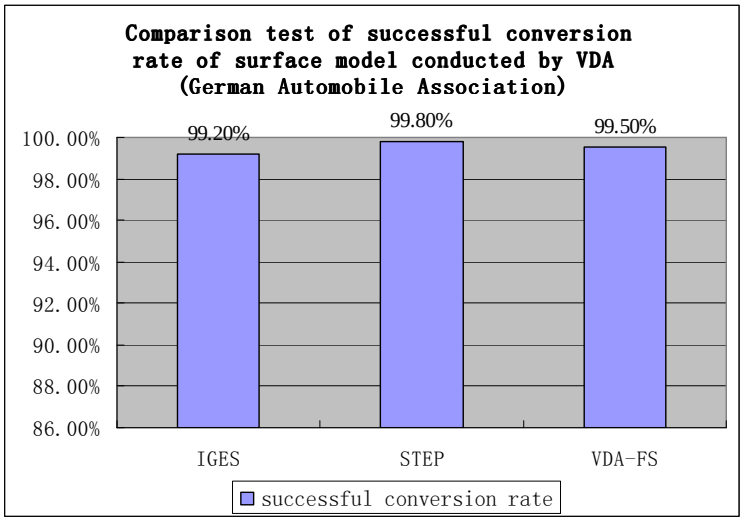

Figure 2 Comparison test conducted by VDA

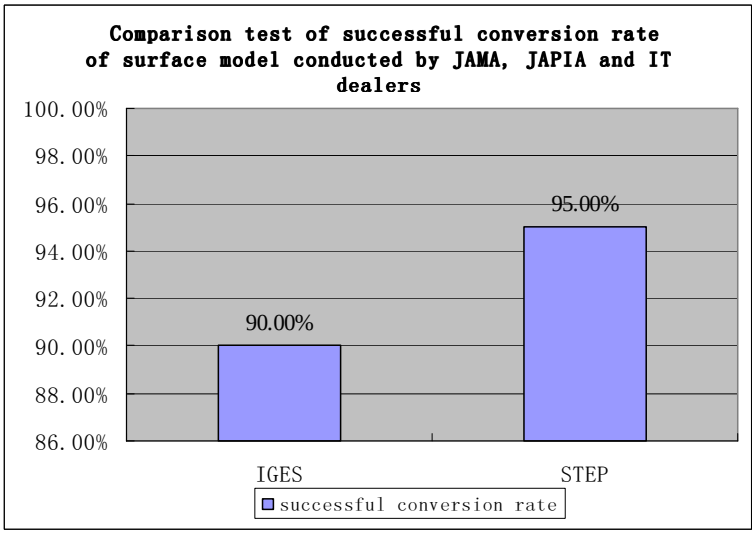

Figure 3 Comparison test conducted by JAMA, JAPIA and IT dealers

In the mean while, company also introduced a variety of 3D lighten data formats, the most typical representative of them are shown in Table 1

(3) The trend of 3D visualization. In recent years, 3D visualization technology is developing rapidly, in 2008, Dassault Group acquired 3DVIA, launched 3DVIA Composer module, with which a variety of CAD data, including CATIA, Pro / ENGINEER and many other standard CAD format can be read, a highly compressed of the file format

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can be created, a number of standard file formats can also be output, including Microsoft Office, PDF, HTML, SVG, CGM, etc., its function can also be integrated into all mainstream PDM products. In 2009 PTC launched Wind-chill Product point visual collaborative solutions, at the same time, many domestic PDM / PLM products have begun commonly to integrate AutoVue browser to achieve its system function for the three-dimensional visualization, thus enable the entire system read a diversity of file formats, as a result, it brought a very convenience for the user. In generally, the trend of 3D visualization technology is from heavy to light, from the status of supporting a small amount of format to supporting a variety of formats to browse, from the closed to continuously open.

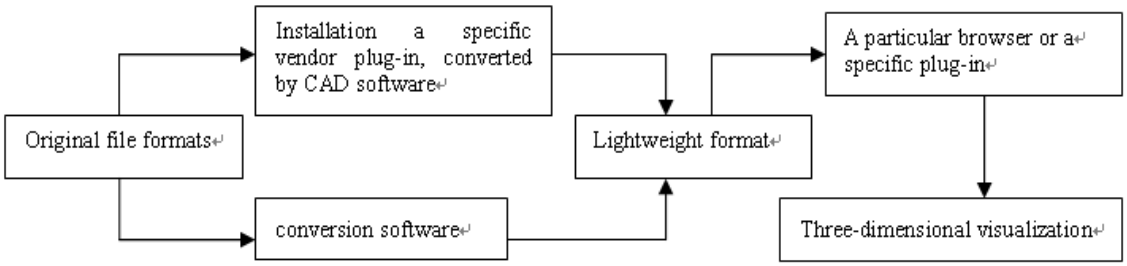

Figure 4 Approach to convert CAD files into a lighten format and approach to browse

Table 1 the three-dimensional visualization solution introduced by major manufacturers

Vendors	Format	Browsing	Software to support	The main advantages
Adobe	U3D	Adobe Reader	NX、Solidwork、CATIA、Pro/E、AutoCAD、3D MAX ,etc.	a wide range of customers
Dassault Group	3DXML	Word, Excel, Web (installation 3D XML Player)	CATIA、Solidworks、Pro/E	PLM integration is good
Siemens PLM Software	JT	JT2GO browser	NX、Solid Edge、CATIA、Pro/E, etc.	PLM integration is good
PTC	PVS	to install Product View Express Web browser plug-in	Pro/E etc.	PLM integration is good
Autodesk	DWF	Web browser (to install Autodesk's Windows High Performance DWF plug-in)	Inventor、AutoCAD、3D MAX ,etc.	a wide range of customers
Solid Works	edrawing	to install eDrawings Professional plug-in	the current mainstream 3D software format	Support a wide format
Oracle		to install AutoVue browser	about 450 file formats	Support a wide format

3. APPLICATIONS OF 3D LIGHTEN IN MANUFACTURING INDUSTRY

The forms of organization of manufacturing enterprise in China are mainly for the functional organization or business type, and the functional form of organization is especially common in small and medium enterprises, which usually has a organizational structure of purchasing, marketing, finance, R & D, production planning, technical quality, security, administrative and other management functions, it assumes the responsibility of a number of functions, including market research, product development, production organization, process control, quality assurance, product marketing, auxiliary management, etc., Companies will receive and produce a large amounts of data (especially 3D data) while realizing

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these functions, and will formed information and knowledge with the data. The formation and the management implementation framework for 3D data, information and knowledge are shown in Figure 6 [6]:

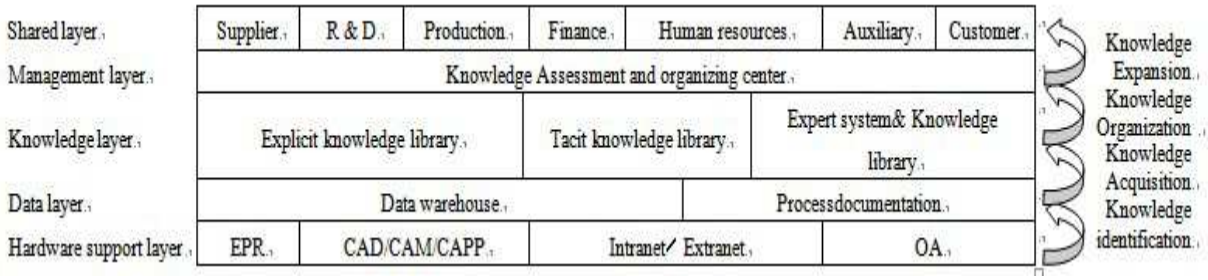

Figure 6 implementation framework for 3D data, information and knowledge in manufacturing industry

The formation and the management implementation framework for 3D data, information and knowledge in manufacturing industry can be divided into five layers, from hardware support layer to the share layer, The Degree of discovery and using for information and knowledge increases layer by layer. Hardware support layer is mainly composed of the enterprise EPR (Enterprise Resource Planning), CAD / CAM / CAPP, Intranet / Extranet, OA (office automation systems) and other components, data layer are composed of the enterprise data warehouse and process document, knowledge layer are composed of explicit knowledge library, tacit knowledge library, expert system and knowledge library, at the management layer, setting the special organization for knowledge assessment to promote knowledge sharing between the various departments, suppliers and customers, it contains all the main functions need to share knowledge at shared layer.

As the most popular form of data in manufacturing industry，3D data exists generally in the formation and the management implementation framework of information and knowledge in the enterprise, from the hardware support layer to the shared layer, 3D data is being everywhere in the enterprise, it occupies the most important position in the enterprise. Manufacturing enterprises are facing with the problem of how to make 3D data can be shared and widespread in the procedure of design, development, manufacturing, production technology, quality control, assembly, shipped out of factories, maintenance, sales, marketing, and etc while using of 3D CAD system to improve the efficiency and quality of design, development and manufacturing. For example: it need to embed 3D graphics into a spreadsheet list of components; to connect to the bill of materials (BOM) of ERP system, to establish an online procurement bidding system of components, to make the user manual or technical documentation for service support. These applications not only need to embed 3D data into the MS OFFICE, PDF, HTML, and sometimes even need to use existing 3D CAD resources to produce a three-dimensional, visual, interactive animation files, to maximize the application value of the 3D data.

The limitations of the traditional 3D data make enterprises faced a series of difficulties for a long time: It is not convenient to transmit for the huge data, non-technical department cannot grasp the complexity of the CAD software, data format from different CAD systems is not compatible with each other, which greatly restricted the range of applications, the appearance of lighten 3D data solved all of these problems. Therefore, lighten 3D visualization technology is not only to improve business processes, reduce business costs, but also to improve business efficiency.

4. SUMMARY

Three-dimensional visualization technology has become more and more widely used in industry for the characteristic of operability and lightweight. With its communication and coordination between engineering staff , business leaders, marketers, customers and the crew of other non-technical department which brings convenience for them. Hence, it contributes a lot to the improvement of product quality, acceleration to the speed of the design review. The trend of 3D visualization technology is from heavy to light, from the status of supporting a small amount of format to supporting a variety of formats to browse, from closing to continuously open, from dispersing to unification, with the continues development of three-dimensional visualization technology, more and more customers can get involved in product customization as well as product design. ours individual needs will be fully met in the future.

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