

## Utilization of Digital Assemblies for Large-sized Press

Kazushi Doutani

*Installation is the last process that lies at the end of a long series of activities for marketing a large-sized press starting with the manufacture. Generally the installation work is carried out by an appointed local contractor under the supervision of Komatsu engineers. It is a very difficult assignment, and particularly so in a foreign country because of the language barrier which is likely to produce a communications gap.*

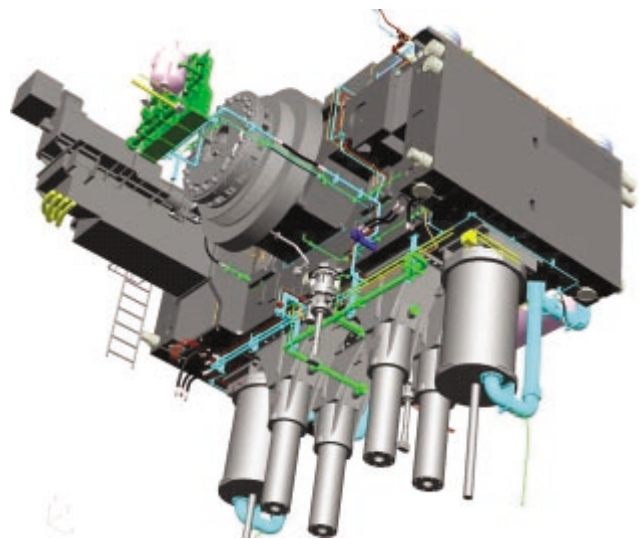
*This paper introduces a digital assembly technology which is a means to precisely and easily acquaint local contractors concerned with a method for installing large-sized presses and an instance of its application to the actual installation work.*

**Key words:** *Large-sized Press, Digital Assembly, 3D, Viewer, Installation, Installation Manual, Pro/ENGINEERING, Product View*

### 1. Introduction

Industrial Machinery Division of Komatsu presently designs what is termed as a large frame, such as a crown, slide, bed, etc. and piping, using a 3D CAD method. (See **Fig. 1**) In particular when we make up a 3D model for piping, it is necessary to build in models for a die cushion, drive unit and covers for the purpose of checking the interference.

In recent years, the manufacturing station can utilize the 3D models, too, in part because the database of 3D models has been completed and in part because a linkage with a 3D viewer software has been established. Until then 3D models had been utilized only in the upstream, i.e. the designing process. And then an idea of using them in the downstream, the onsite installation, popped up.



**Fig. 1** 3D piping model of crown for module transfer press

## 2. What is digital assembly?

The digital assembly is a technology that simulates assembling a specific component on the computer display, utilizing a 3D model which is a kind of digital data. It has a merit of presenting assembling procedures clearly thanks to the visualized assembly processes. Unlike a freehand illustration and photo, it enables a viewer to look at a model at any desired angle, so that users are able to check a specific component at various angles according to different purposes as if in the actual assembly. Furthermore, made up with the 3D CAD method, the individual 3D models can compose a complete real press on the display. Differing from a freehand or Excel-made illustration, the press image provides precise information on details of the actual press and has a characteristic of being easy to understand. The advantage does not end there. As a digitally compiled data, it is easy to color or cut and paste 3D models, transport them easily in the form of CD-ROM and manage them by feeding into the database. (See Fig. 2)

## 3. Onsite installation of large-sized press

Installing a large-sized press onsite is time consuming work. It normally takes approx. 3.5 months in the case of one tandem press and approx. 5.5 months in the case of one module transfer press.

The normal onsite installation work is made up of about 50 to 60 processes. It starts with laying out a base plate and the other major processes include installing the bed, temporarily installing the slide, mounting the crown, connecting the slide, piping and wiring, switching on, making adjustment, delivery inspection, training client's operators and delivery.

A pair of engineers dispatched from Komatsu, who are usually called a Technical Adviser (TA), play a pivotal role in the onsite installation work. The TA's mission is to see that the purchased press is safely installed in the client's factory and delivered to the client before the agreed delivery date and within the planned man-hours. TA is a team commonly consisting of a mechanical engineer and an electrical engineer, and the team carries out its mission of assembling a press onsite, organizing and supervising recruited local subcontractors. In the past, they relied on an installation manual compiled with a word processor when explaining the installation work processes to the subcontractors. However, the manual often proved to be not good enough to have them well understood largely because they were not an expert on the installation work. Indeed there used to be some portions in the work whose explanations were beyond the scope of the

traditional installation manual. On each such occasion, the TA's team tried to supplement shortcomings of the manual either by drawing an illustration or by demonstrating how to do specific work in person. In other words, they had to convey know-how on the installation to a group of amateurs and supervise them at the same time in spite of a high language barrier. You can easily imagine how tough the team's job was then.

## 4. Applying digital assembly to actual installation work

I have mentioned earlier that there used to be an onsite installation manual that was formally titled "Installation Work Standard". It was a simple manual compiled with a word processor that contained an outline of the installation work and supplementary illustrations. Because of its limited contents, the manual could only project a rough image of presses. It was originally intended for TA engineers and as such very difficult for the beginners to understand.

Now we decided to combine Installation Work Standard with a digital assembly using 3D models into one volume and worked out new Installation Manual. Edited process by process, the new manual was so designed as to enable any viewer to readily understand details on the press installation work. The ultimate goal was to improve the quality, cost and delivery period as well as enhancing the safety.

For the clutch assembly and the brake assembly which require more complex assembly work, we prepared a digital assembly using animations, seeking for even better understanding. (See Fig. 3)

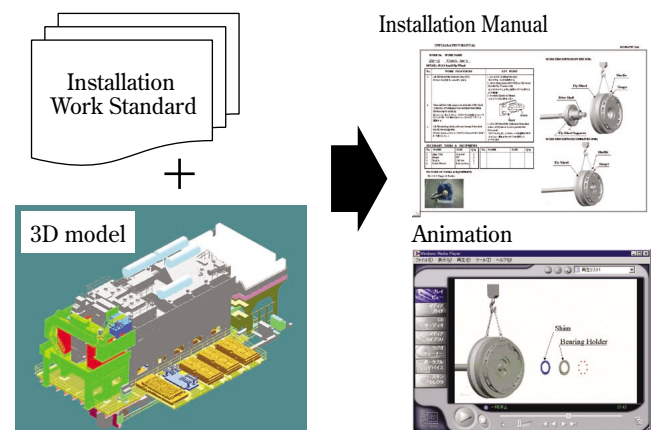


Fig. 3 Combination of Installation Work Standard with digital assembly



Fig. 2 An instance of digital assembly showing clutch installation

5. Characteristics of Installation Manual

The most outstanding characteristic of Installation Manual is that it is a manual that has been made intelligible to installation subcontractors thanks to the introduction of digital assembly technology. It is written in Japanese and English so that it can be used not only at home but abroad as well.

Now let us turn to the manual layout and features here. (See Fig. 4)

(1) WORK PROCEDURE

Working steps for installation are explained in Section A Work Procedure. Basically this section was written modeled after Installation Work Standard, but its style has been changed to detailed explanations by working step, and the descriptions have become far easier to understand than the predecessor for the benefit of local subcontractors.

(2) KEY POINT

In Section B Key Point, portions of installation work which require a special attention and safety precautions are discussed. Like the chapter of Work Procedure, descriptions are made in detail by working step, as a result of which it has been made much clearer where in the course of the work and what to pay attention to.

(3) NECESSARY TOOLS & EQUIPMENTS

In Section C Necessary Tools and Equipments, we have shown what tools and jigs and how many pieces of them are required for carrying out this installation work. By reading this section, local subcontractors can have a clear idea as to what kind of tools and how many of them are required and prepare them in advance.

(4) PICTURES OF TOOLS & EQUIPMENTS

Section D Pictures of Tools and Equipments takes up special tools and jigs. Photos are attached to such items that are easily mistaken to help identify a correct one. Fig. 4 shows an example for Installation Manual that deals with lifting the tie rod. You will see an eyebolt is introduced together with photos as a special tool required for the work.

(5) WORK DESCRIPTION

Section E Work Description visually explains the contents of press installation work, utilizing the digital assembly technology.

In order to promote better understanding of the readers, each page is separated into the upper and lower sections, and the condition before starting the work is shown under the title of WORK DESCRIPTION (ON THE JOB) and the condition after finishing the work is shown under the title of WORK DESCRIPTION (COMPLETED JOB), each using 3D models. Jigs and tools in use are prepared in a 3D CAD method and also visually presented in the digital assembly, ensuring better understanding of their usage.

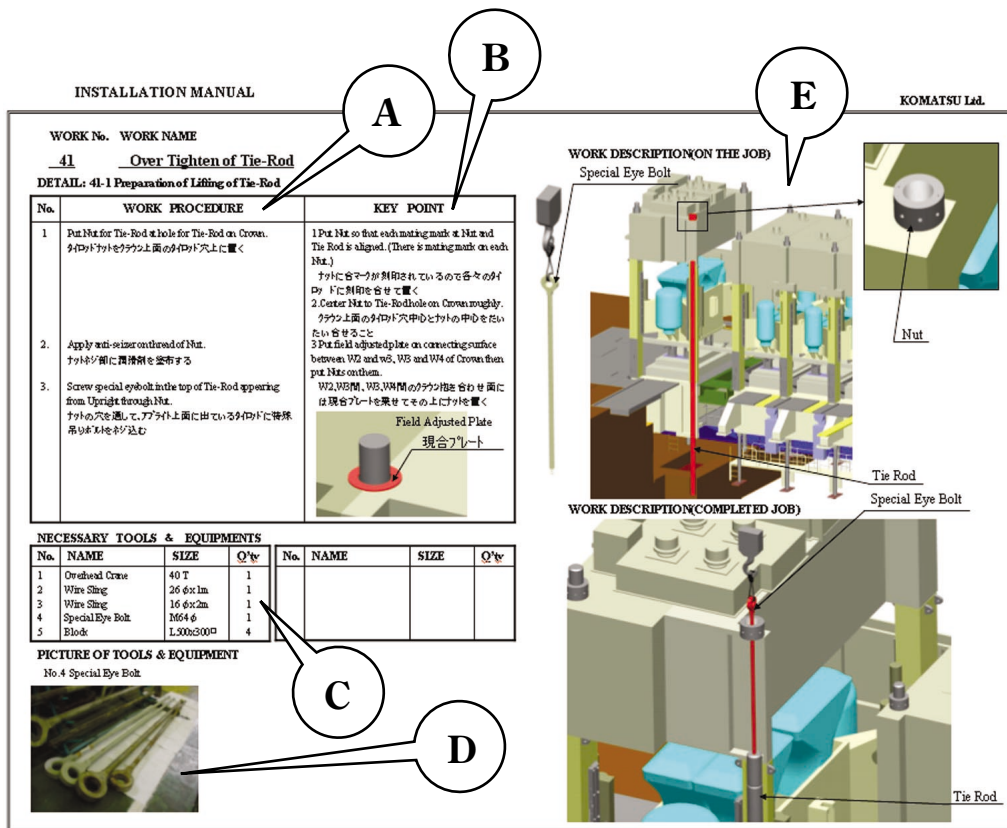


Fig. 4 Installation Manual for lifting tie rod

## 6. Procedures for compiling Installation Manual

Installation Manual is made out according to the compilation flow shown in Fig. 5.

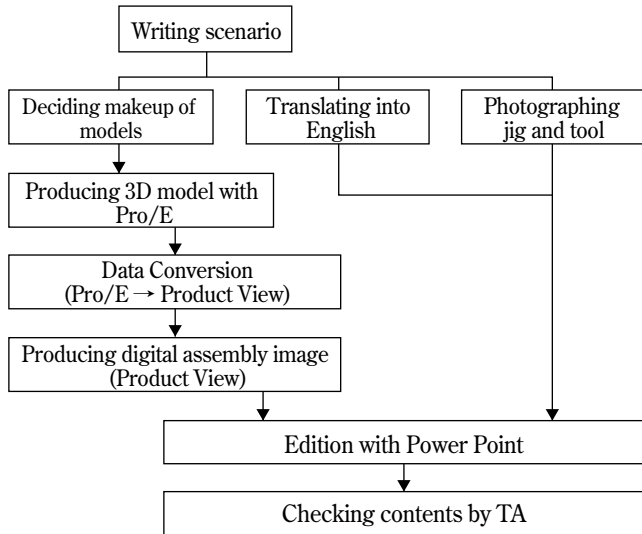


Fig. 5 Flow chart for compiling Installation Manual

### (1) Writing scenario

The whole compilation work starts with writing a scenario. This is the most important part of the compilation work. Drafted in this process are contents and steps of the installation work and key points, and illustrations before and after the work for each stage of the installation work.

### (2) Deciding makeup of models

Next a makeup of 3D models is decided. It is carefully examined what makeup of them is effective for local subcontractors to understand without much difficulty. Then 3D CAD operators are instructed to produce them based on this philosophy. 3D models covering large-sized presses, which constitutes the basis of Installation Manual, have already been produced with Pro/Engineer (by PTC Japan Inc. – hereinafter “Pro/E”). Then Jigs, tools and equipment (gantry crane, slings, etc.) are added to them to make up basic data for the digital assembly.

### (3) Data conversion

Pro/E data are converted into a data format that Product View (of PTC Japan Inc.), viewer software, can read.

For producing the digital assembly, Product View was selected as viewer software. There are six major reasons for having selected this software as listed below. (See Fig. 6 Operation of Product View.)

- ① Seamless conversion from Pro/E data
- ② High degree of perfection as viewer software
- ③ A computer for 3D CAD application must have very high performance. But Product View accepts a computer of lower performance
- ④ Easy to operate (Pro/E needs training for operation by an instructor from outside.)
- ⑤ It has a function of outputting to the Jpg image and is capable of seamless linkage with an image processing software.
- ⑥ An optional animation producing function is provided (called “Realizer”).

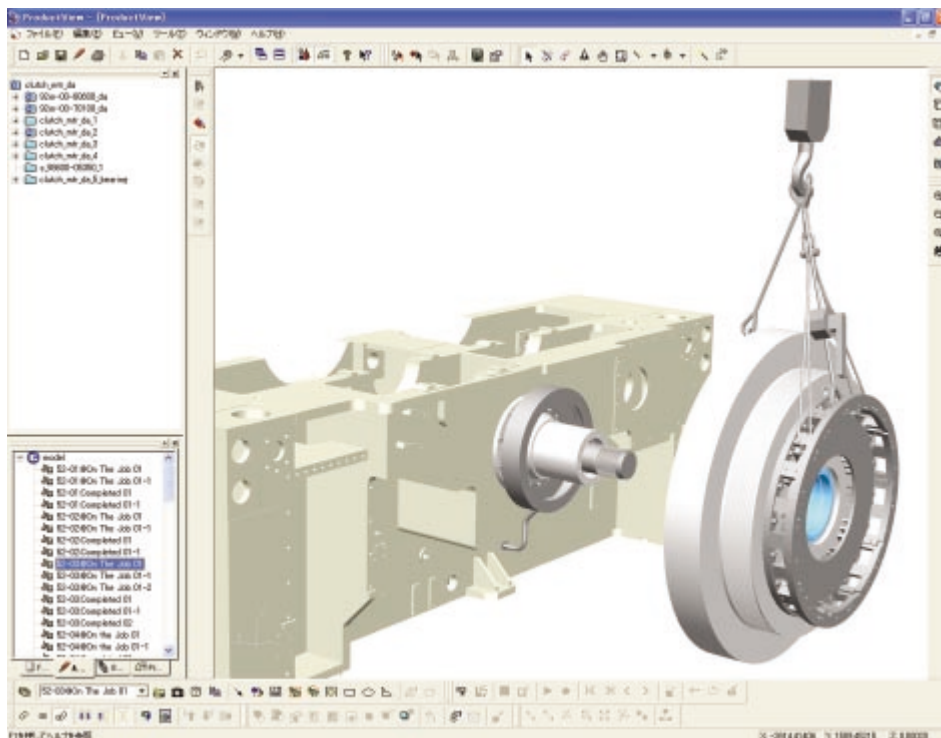


Fig. 6 Operation of Product View on display

(4) Producing digital assembly image

A model part is disassembled and then reassembled, using Product View. A complete model is disassembled instead of the model being assembled and played back in reverse. Thus digital assembly is consummated.

Furthermore the images are colored to have them look like a real press, which is intended to help a viewer better understand visually.

(5) Translation of scenario and photographing necessary jigs, tools and facilities

(6) Edition

All the material data are compiled into Installation Manual using Power Point. The reason for using Power Point is that output to a printer is easy and a presentation is possible with Power Point. Thus we judged it is the best tool to suit our purpose.

(7) Checking contents by TA

TA checks the contents to see if there is any error or shortage. When they are satisfied, a new Installation Manual is born.

**7. Procedures for compiling digital assembly animations**

Animations for the digital assembly are made out according to the compilation flow shown in Fig. 7.

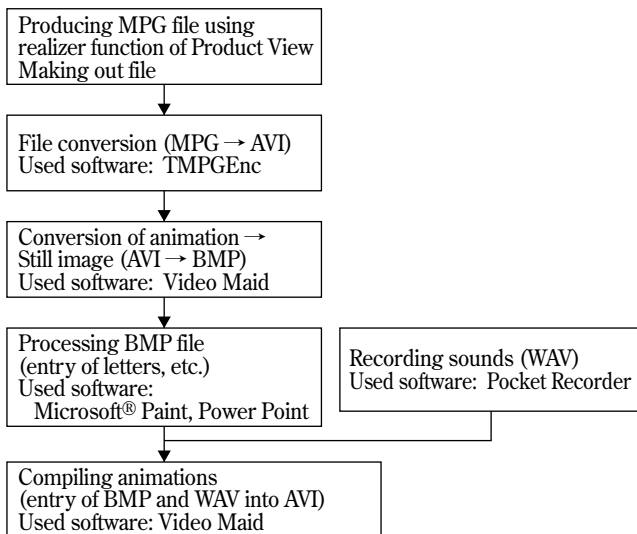


Fig. 7 Flow chart for compiling animation

(1) Producing animation file for digital assembly

An animation MPG file for digital file is made out using the Realizer function of Product View. The Realizer function sets a time base within which a model is shifted or rotated and thereby produces animations. (See Fig. 8)

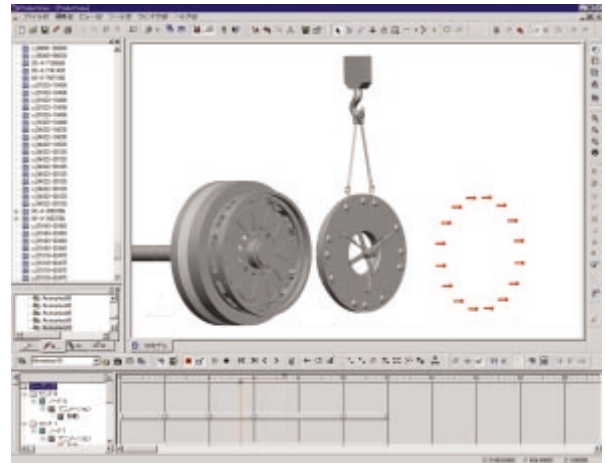


Fig. 8 Image of Realizer in Product View on display

(2) File conversion

An animation MPG file is converted to an animation AVI file. The reason for this conversion is to make easy a linkage with image processing. For the conversion, we used TMPGEnc, which is free software accessible on the Internet (<http://www.forest.impress.co.jp/video.html>). (See Fig. 9)

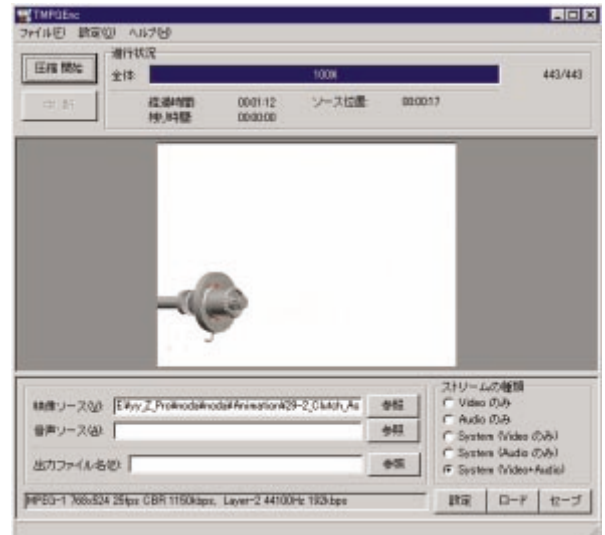


Fig. 9 Operation of TMPGEnc on display

## (3) Conversion from animation to still image

Portions of the animations, which require image processing, are taken out of the animation AVI file and converted to the still image BMP file whereby image processing becomes easier. For this conversion from animation to still image, we used Vide Maid, which is another free software accessible on the Internet (<http://www.anipeg.yks.ne.jp/backno.shtml>). (See Fig. 10)

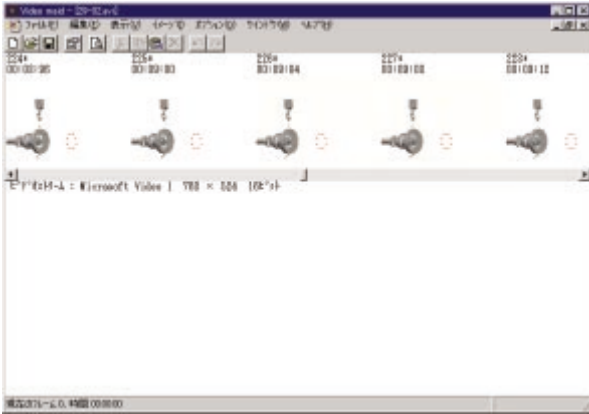


Fig. 10 Operation of Video Maid on display

## (4) Processing still image

This is a process in which letters are added to the still image BMP file or images in the file are processed. (For example, a spray is pasted to express greasing.)

For this processing, we used MS Office (Power Point) and Microsoft® Paint that is installed in Windows as a standard software and entered letters and images in the BMP file.

## (5) Recording sound

Narration of the text was recorded in English. At first we considered use of Microsoft Speech SDK (<http://www.microsoft.com/speech/>), but changed our mind afterwards and decided to adopt "Pocket Recorder" (<http://www.chrono.pos.to/pocket/>) which is free software for voice recording. The recording was made with a microphone and the WAV file was completed. Opting for "Pocket Recorder" then was based on our judgment that human voices are more audible.

## (6) Compiling animation

When the still image BMP file processed in Item (4) and the voice WAV file made out in Item (5) are transferred to the animation AVI file, an animation with narration and sounds becomes complete. For this editing work, we used Video Maid referred to in Item (3) above. This software of Video Maid also has a function of combining the still image BMP file and voice WAV file with the animation AVI file.

## 8. Infrastructure

In utilizing the digital assembly, VRAM (Video RAM) can cause a bottleneck in the computing infrastructure. In October 2001 when we started with developing the digital assembly technology, a VRAM of 8 to 16 mega byte capacity was commonly used as a standard specification in personal computers. In order to realize the digital assembly technology, however, a VRAM of over 32 mega byte capacity was required. (A VRAM of 128 mega byte capacity is commercially available as of October 2002.)

The computing infrastructure we have decided for this time is as follows:

OS: Windows NT4.0

PC: IBM M/Pro CPU: Pentium III 800 MHz

Memory: 768 Mbyte

VRAM: 64 Mbyte (The graphic board was switched to ELSA Goria III.)

HD: 10 Gbyte

## 9. Conclusion

In this short paper, we have discussed Installation Manual utilizing the digital assembly technology. It has been prepared as a support tool for local subcontractors as well as Komatsu engineers in installing large-sized presses onsite. It focuses on enhancing QCDS of the work, namely quality, cost, delivery period and after-sales service. TA's, who have actually used this manual onsite, give a very high mark and express great satisfaction. On the other hand, it is true that we have yet to succeed in creating a truly virtual installation site. For further improvement, we are now planning to adopt the latest IT and widen the scope of contents to the assembly work at the plant. It is our desire to see that the digital assembly will evolve to digital engineering in the future which will eventually realize a zero risk in the installation work by simulating the whole onsite installation work.

## Introduction of the writer



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## [A few words from the writer]

It is often said about the computer industry that "Dog's Year" governs the industry, originated in a saying that dog's one year is equivalent to seven years of human beings. Indeed the speed of change is almost dizzying in this industry as compared with other industries. 3D data usually applies very big load on the computers, so that no quick response is hardly to be had even now. This shortcoming often limits the range of its application. But I am sure that the shortcoming will be removed in the near future as IT makes its progress. I will keep a constant watch on the development of the computer industry and make better use of 3D technology and IT in an effort to bring on a reform in our way of doing the work both in the office and in the works.