

# Video Creator Using Digital Manufacturing Technology

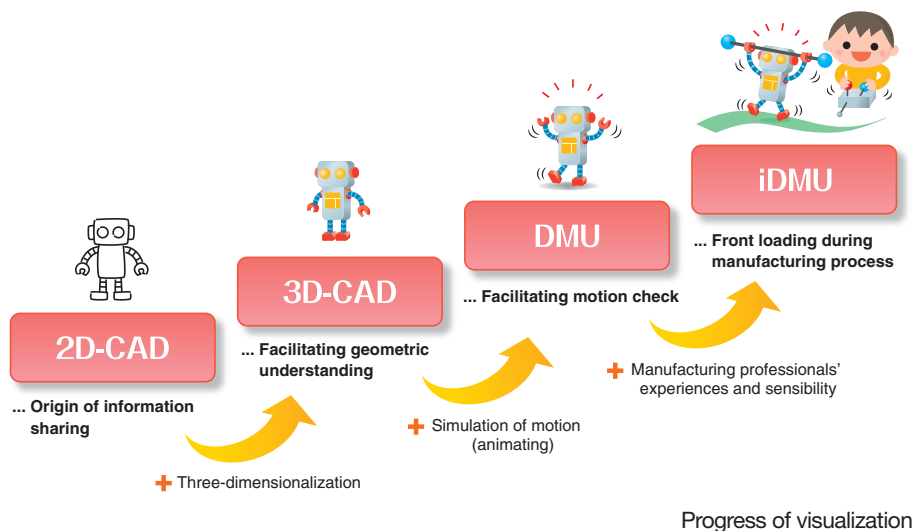
## iDMU technology for awareness sharing by visualization of design, manufacturing, construction, and safety

A “working site” is important for manufacturing. If it is possible to see detailed manufacturing steps in advance, how useful it would be in terms of enhancing imagination to improve production quality. “Manufacturing professionals” who thought as stated above built 3D-Technology for visualizing various manufacturing steps. Watch a realistic visualization video on the homepage.

([https://www.ihi.co.jp/ihi/technology/review\\_library/review/2016/56\\_03.html](https://www.ihi.co.jp/ihi/technology/review_library/review/2016/56_03.html))

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### 3D-Visualization Progress for manufacturing

At the time of thinking for design, manufacturing, construction, sharing of various information such as product shapes, manufacturing procedures, necessary jigs/tools/equipment, and human resources is the most basic of basics. As for conventional manufacturing, being able to image the three-dimensional shape of a product or a component from two-

dimensional information, in particular, on “2D-drawings” was the basic ability required for engineers. When computers have become familiar and correspondingly 3D-CAD has become popular, a stereoscopic image of a product or a component displayed on a display has been rotatable, movable, enlargeable, and reducible. This 3D-CAD technology has facilitated sharing of the structural shape information. Nowadays, Digital-Mock-Up (DMU) technology including a motion simulating is becoming popular. In addition, CAD

further taking into account of the schedule management of a manufacturing and construction process called 4D-CAD, is also becoming popular.

IHI's DMU (iDMU) introduced here is a DMU system based on IHI's manufacturing knowhow, and a technology (system) useful in a much wider situation than other DMUs, i.e., not only a situation of product presentation but also a situation of front loading (front-loading examination and measures) of production management and safety management in a manufacturing factory or at a construction site. The general DMUs mostly remain at a level like a "stereoscopic catalog" stereoscopically showing only products, whereas iDMU can show changes in the motion and positional relationship of "3D-CAD objects" including not only products and components but also workers, scaffolds, jigs/tools, equipment, and so on as a high quality motion video. In other words, iDMU refers to a 3D-CAD technology enabling not only customers but also many people involved in manufacturing to see and check the whole aspect of relevant work. Therefore, iDMU does not only contribute to working hours shortening, cost reduction, and safety improvement but is also expected to tradition of manufacturing know-how.

### Awareness sharing in design stage

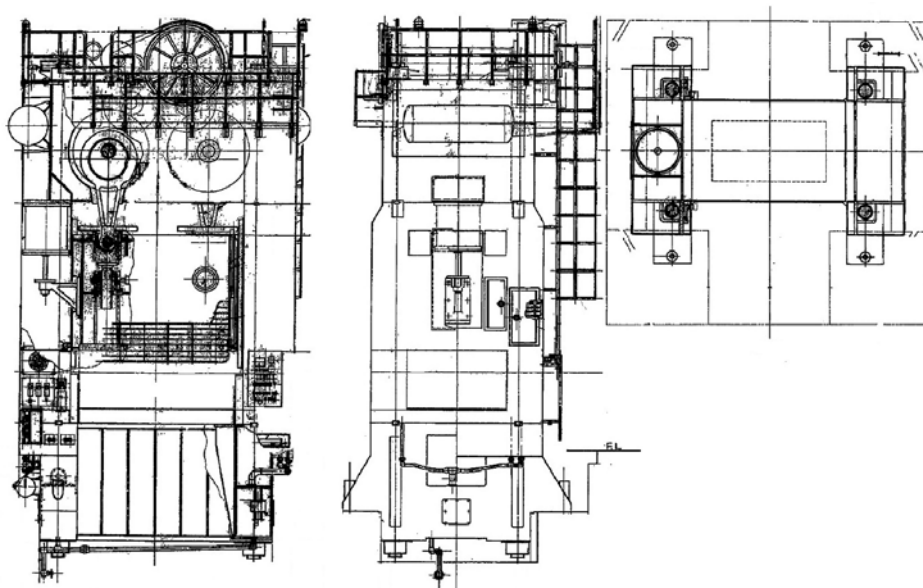
In the design stage, in particular, in the planning stage, specifications are frequently adjusted with customers, and the success of the adjustment depends on the explicitness of explanation. Now, let us cite a tank construction process as one of examples of using iDMU. The outer wall of a tank is made by joining a large number of elongated steel plates together like stacking bricks. For example, a base plate is laid to install a scaffold, and a process of welding a layer of steel plates by one round and stacking the next layer of steel plates with a crane... is repeated. The validity of this procedure is

not easily understandable by customers only orally using two-dimensional still drawings. Therefore, by showing customers a construction process using iDMU in the form of a fast-forward video while appropriately turning on/off the display of an internal structure from an arbitrary angle, we were able to smoothly share what the construction process is.

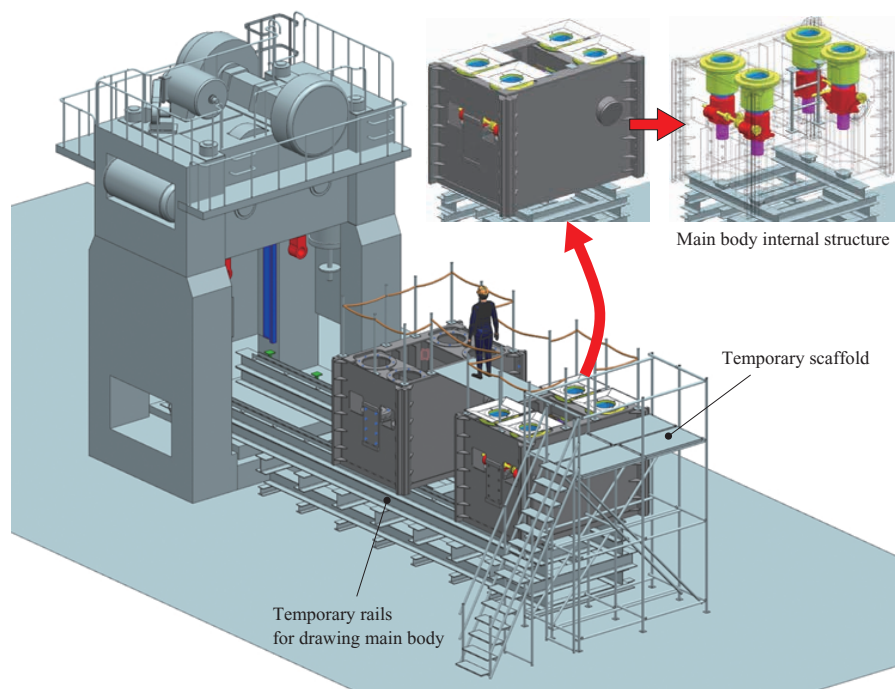
There are an enormous number of check items in the design stage, and among them, there are quite a lot of visually checkable items. A list of such checkable items include equipment, jigs, tools, installation places, arrangement, workers, processes, working procedures, flows of products and components, interference, accessibility (of workers), operability, visibility, safety, and so on.

### Awareness sharing in manufacturing factory

iDMU originally derives from developing the manufacturing process of a Pressurized Water Reactor Steam Generator (PWR-SG). We traced many processes such as deep hole machining for opening 20 thousands holes having a diameter of 17 mm in a tube plate having a thickness of approximately 800 mm, welding of a heat transfer tube to the tube plate and inspection of the resulting welded component, and containing an object penetrating through and integrated with multiple tube support plates in a cylindrical container. We further visualized and developed the processes for making up the literal "Supreme Heat Exchangers" (IHI Engineering Review Vol. 49, No. 1, pp. 14-17), using iDMU on a process basis. Introduction of an unprecedented information sharing method significantly contributed to the achievement of quick delivery which was initially believed to be difficult. Let us here emphasize that to produce 3D procedures and 3D simulations not only 3D-CAD engineers but design and manufacturing professional engineers themselves joined. Such successful achievement allowed the team to have confidence and pride,



Two-dimensional handwriting drawings of industrial machine



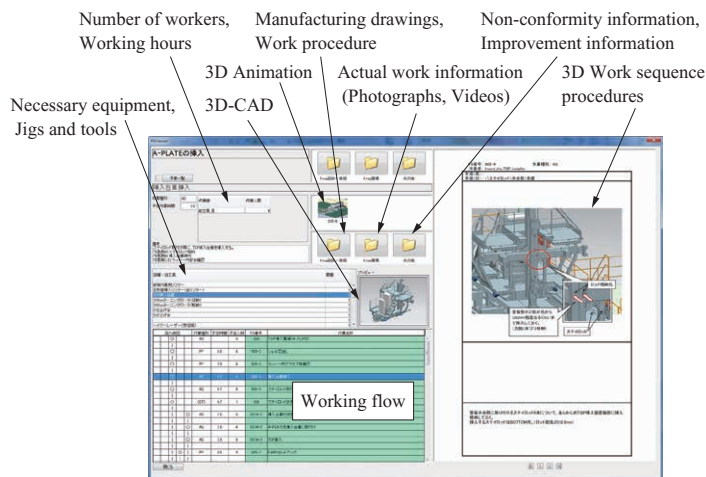
3D procedures for the overhaul work of industrial machine

thus expanding a system initially developed as a PWR development tool into more versatile one, i.e., iDMU.

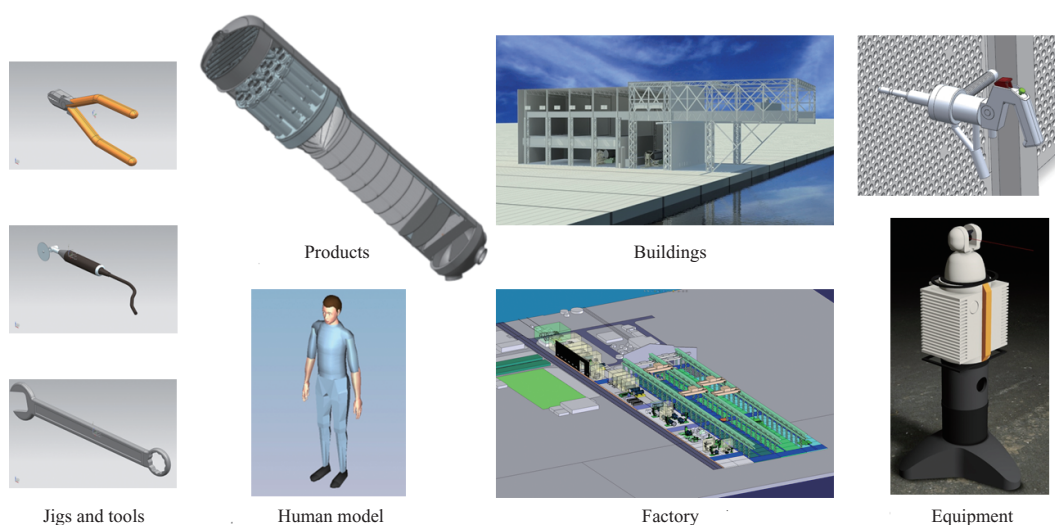
When performing overhaul work on a certain industrial machine, we did 3D-CAD simulation reproducing disassembly and assembly procedures with a model taking account of not only 3D-CAD data on the machine but also jigs, tools, scaffolds and workers required for disassembly and assembly. We also understood and judged the parts configuration from two-dimensional drawings and devised a series of detailed procedures. Although the above work seemed to require an inordinate amount of time, our team finished stereoscopic images in only three days after data acquisition. Such quick achievements were obtained on the basis of team members' rich experiences and sophisticated expertise. This allowed us

to share the awareness of problems with customers through the actual works at a high quality level, which helped us take an action of front-loading measures.

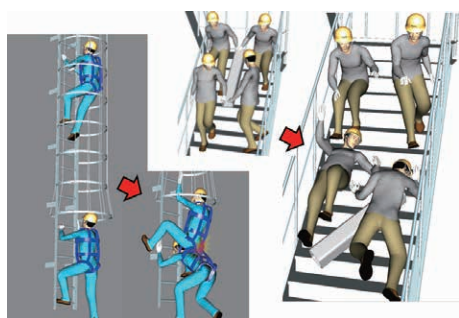
In addition, we developed in-house a "digital work instruction system" supposed to be easy to use in a manufacturing factory. We incorporated all information necessary for manufacturing in this system, such as conventional manufacturing drawings, manuals, necessary jigs/tools, operating procedures, and improvement information as well as motion video contents as described above, thus allowing us to share the information among workers using a large touch panel device owing to confirmation and discussion.



Digital work instruction system



Scope of utilizing 3D-CAD model



Safety video

### Awareness sharing of safety

Manufacturing inevitably involves safety assessment. Sensitivity to risk greatly depends on worker's experience, and therefore to transfer experts' sensibility to young members to share it, the use of iDMU-based videos is the most suitable. In addition, to thoroughly impress precautions on foreign workers as well, the use of iDMU utilizing visual information is extremely effective. "Seeing is better than hearing" just allowed the overcoming of language barriers.

The following are some examples of risk assessment using iDMU. We created many videos such as ones about ① a jack placed upright and stretched between top and bottom portions of a pipe having a diameter of approximately 1 m and placed laid down on the ground slips, comes off, rebounds, and hits a worker, ② a crane vehicle loses balance and overturns to hit a worker, ③ a worker going up a ladder first falls down and hits a worker below, and ④ when lifting a load with a crane with wire passed around it, a hand is caught between the lifted load and the wire. In doing so, we shared risk factors, took countermeasures against them, and provided education on them. Incidentally, a time required to create the video ③ was as extremely short as one day, and the video ② was successfully provided in a very short time because 3D-model data of the crane had been already registered in 3D-model library. When reproducing such risk

factors, the risk predictive ability of the members well-versed in on-site manufacturing was fully utilized. We have so far created 3D-simulation videos about work accident and safety measures based on the assumption of many cases such as falling, a burn, electric shock, and lack of oxygen and so on.

### More realistic and widespread dissemination

The use of iDMU is making many achievements such as work period shortening and cost reduction. In the future, we will apply iDMU to ① improving the accuracy of estimates, ② optimizing processes and procedures, ③ tradition of manufacturing know-how, and so on. In order to further enhance the visualization effect, we will aim for comprehensive manufacturing technology by introducing various leading-edge 3D technologies in addition to iDMU. Virtual reality (VR), mixed reality (MR), and 3D projection will further enhance a stereoscopic effect, 3D printing will reproduce a three-dimensional object as it is, and 3D laser measurement will increase the speed and definition of the process of acquiring three-dimensional model data from a solid body. In addition, we have so far applied iDMU to machinery products and plant equipment mainly including IHI products. In the future, we will expand the field to industries such as electrical, transportation, medical, and communication/media industries, and work on content production services and the development of customized iDMU. Also, we will further brush up and widely spread the iDMU technology as "for taking a look and measures before manufacturing."

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