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# Integrated CAD System for Ship and Offshore Projects

**Heung-won Suh*[1] and Sung-Geun Lee**
*Daewoo Shipbuilding & Marine Engineering Co., Ltd., Korea*

**Abstract – Nowadays major shipbuilding companies are trying to expand their business not only to shipbuilding but to offshore projects as well. DSME is one of them. DSME is trying to set up a flexible design and construction environment for shipbuilding and offshore construction in a single shipyard. The shipbuilding and offshore projects, however, have their unique technology but they need to be designed and constructed in one site. To support this new requirement, DSME has developed an integrated CAD system for ship and offshore projects. In this integrated design environment, the designers can design commercial ships and offshore projects in a flexible manner. Concurrent design is very important for ship and offshore design. As compared to the complexity of the product, the design period is quite short. In effect, the design system for the ship and offshore project has to support concurrent design. One essential point of concurrent design environment is a product model based design system. DSME has developed and implemented the 3D product model concurrent design environment based on Tribon M3. Tribon is a widely used CAD system in shipbuilding area that is developed by Tribon Solutions. DSME has both customized the Tribon system and developed in-house application systems to support its own design and production procedures. All the design objects are modeled in one common database to support concurrent design and accurate production. The major in-house development focused on the modeling automation and automatic drawing generation. During the drawing generation process many of the additional production information are also extracted from the 3D product model. In addition, several applications and functionalities have been developed to apply the shipbuilding based Tribon M3 system to offshore projects. The development of shape nesting, tubular connection, isometric drawing, grating nesting systems are the typical.**

**Key Words: CAD, Shipbuilding, Offshore projects, Concurrent design, Product model, Construction, Design Automation**

## 1. Introduction

The role and expectation of CAD system in the design and production process are expanding these days. In the traditional design environment, the most important requirement of the CAD system is to provide drawings for production. Still the main purpose of CAD system is to generate drawings for production of the products. At the modern ship and offshore production environment the CAD system should not only provide drawings but also procurement data, detail production information, and factory automation data [3,7,8]. Many shipbuilding companies are deploying 3D product model based design system [4,9] to support this variety of requirements. DSME is also one of the companies doing design works on the full 3D product model based environment. The designers and production engineers who are involved in a specific project have to share the progress information in real time. The CAD system has to support this requirement.

There are two main business areas in DSME, one concerns commercial ships and the other is offshore area. The similarities between the ship and offshore structures are increasing nowadays. DSME has been using different design system and production lines for those two products. The company is trying to set up a single design and production process and environment for commercial ships and offshore projects. Any commercial CAD system in the market could not support these complicated and unique requirements. Consequently, DSME has developed and implemented its unique design environment based on the well-known shipbuilding CAD solution [1], the Tribon M3 from Tribon Solutions in Sweden.

This paper will explain the integrated design environment for ships and offshore projects and show the implemented results of the system. The CAD system which is used as a modeling kernel for this environment has to provide specific functions. The paper also summarized the basic requirements of the CAD system to support this kind of approach.

## 2. Introduction of the DACOS system

The DACOS, DSME Advanced CAD system for Okpo Shipyard, is a DSME specific CAD system for ship and offshore projects. The system has been developed based on the Tribon M3. DSME has used the Autokon and Tribon system as a hull structure design application since 1980. In the outfitting design area, on the other hand, the CADDS system was used as a design tool since 1983. These separate design environments were not efficient and rendered a number of problems when it comes to sharing the design information in multi-

*Corresponding author:
Tel: +82-0-55-680-7591
Fax: +82-0-55-680-2174
E-mail: hwsuh@dsme.co.kr

discipline. In the offshore projects, the situation is more complicated. Different CAD systems are used depending on the project or owners' request.

DSME has developed a unified CAD system [5] for hull and outfitting of the ship and offshore project in co-operation with the Tribon Solutions starting from year 2000 for three years. During the project TBS developed the core functions and the APIs in the Tribon environment to help the customization of the system by users. The Tribon system has a limitation in design automation and does not support some specific design area. In the DACOS we have developed modeling automation functions and drawing and material information generation utilities from the model. The models and drawings can be generated from the original CAD system but it needs too much resource and is difficult to implement based on our company's production standards. The main customization is focused on the modeling and drawing automation and management of DSME's own production information.

We have developed DACOS applications [6] for each design domain area such as hull, piping, steel outfitting, accommodation, and cabling. These drawing and material information are transferred to ERP system through the design master database. The ERP system manages the procurement and production information. The following Fig. 1 shows the general view of the DACOS system for each application domain. Fig. 2 shows the hardware

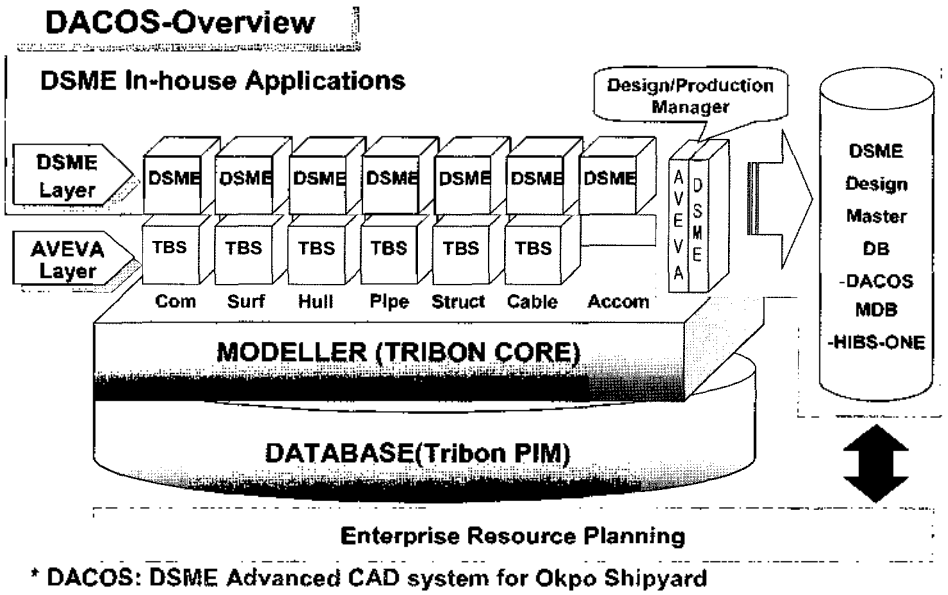


**Fig. 1.** Overview of DACOS applications.

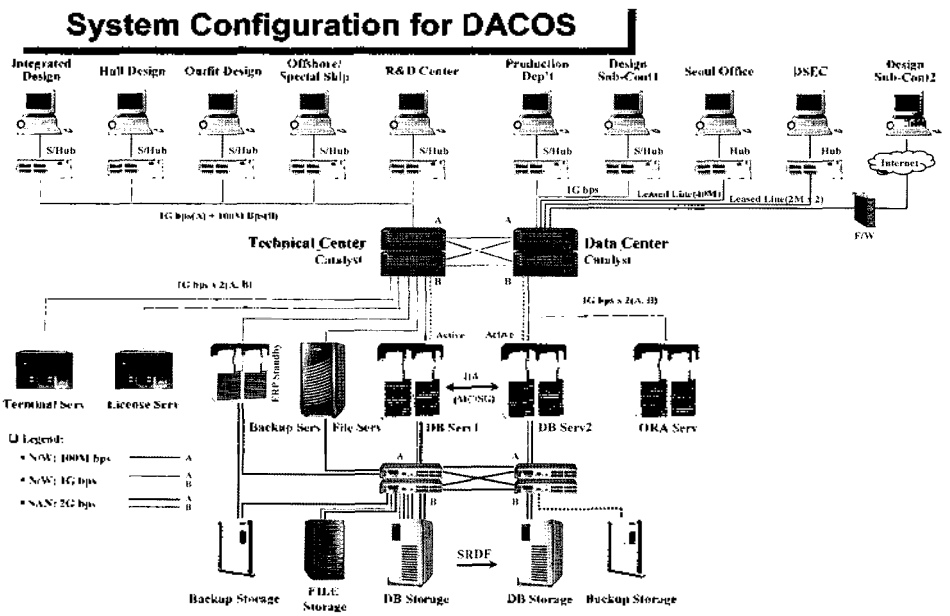


**Fig. 2.** System configuration for DACOS system.

and network configuration for DACOS system.

### 2.1 Initial and early design system

The design activities in the initial and early design stages are much more focused on the engineering analysis than the drawing works. However, some of the initial design results have to be provided in CAD format, 2D drawings and/or 3D models, to the next design stage. The hull surface and compartment information have to be transferred as 3D model data. The classification drawings like mid-ship section, general and machinery arrangement also have to be transferred in drawing format. Those two different types of design results are handled in the DACOS system environment.

We are applying the drafting application for classification drawings such as general arrangement, mid-ship section and typical transverse bulkhead, machinery arrangement and accommodation plan. We also use 3D hull surface modeling system, EzHull system [2], to define hull surfaces. These design results will be stored on the DACOS database for real time data sharing from the detail to production design areas.

### 2.2 Hull structure design system

DACOS-Hull system is for hull structure design system. There are several major parts of the system. As a modeling kernel of the system, it uses the Tribon Hull applications. For more efficient modeling support DSME has developed three major modeling support applications. These are COSMOS, A+Pros, and Hole Interface systems.

COSMOS (Concurrent hull structure modeling system) is a modeling application for detail hull structure members in detail design stage. In the integrated design environment the hull and outfitting design information should be shared in concurrent manner. To support the efficient hull structure modeling in the detail design stage DSME has developed the COSMOS system. The main purpose of detail hull structure model is to support the arrangement of outfitting objects such as pipes, ventilations, cables and equipment.

There is another hull structure modeling system called A+Pros (Advanced production modeling system). This is for production hull structure modeling and drawing support system. Most of the modeling of the production hull structure is available with the original Tribon Hull application functions. DSME has developed the A+Pros system for more efficient and easy modeling and managing of its own production practices. In addition, there is hole information sharing system between hull and outfitting areas. This system concerns all the holes needed for outfitting objects.

There are two more in-house systems to manage the hull production information. The first one is HiBS-ONE and the other is DPN. HiBS-ONE (Hull information data bank system in open network environment) controls all the production information for the hull structure such as BOM and drawings and all the detail manufacturing information. DPN (DSME plate auto-nesting) system is for plate auto-nesting and material management. The following Fig. 3 shows the configuration of the DACOS hull system.

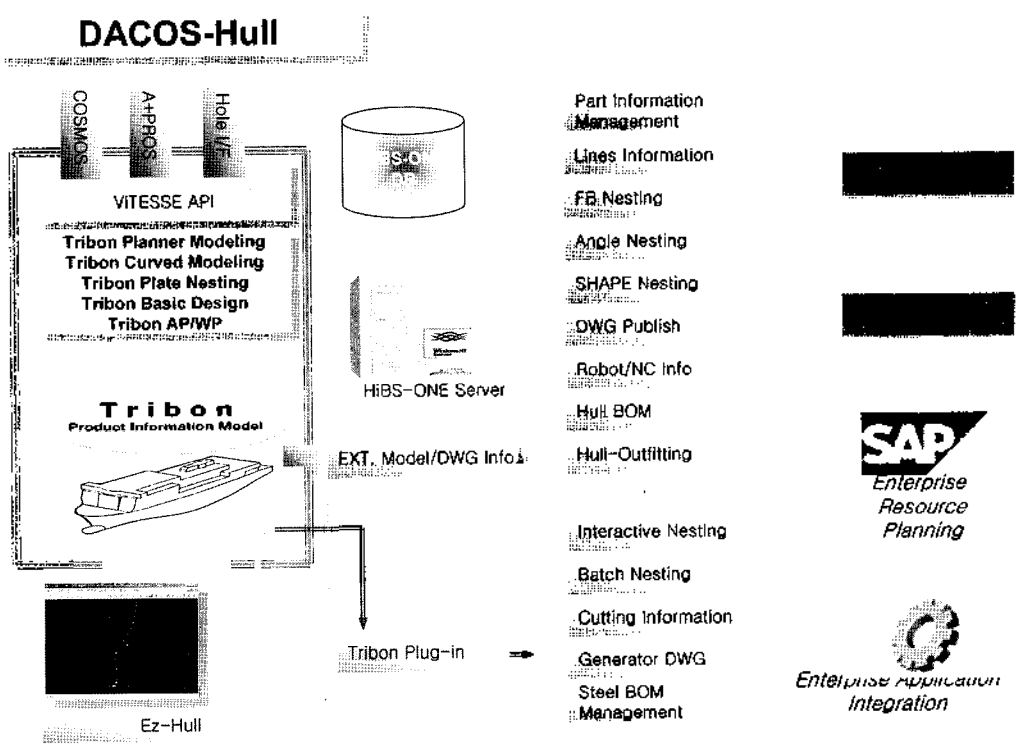


**Fig. 3.** Configuration of the DACOS Hull application.

### 2.3 Piping design system

There are three major areas in DACOS piping design system. The first part is modeling automation functions based on the Tribon M3 Piping application. DSME customized the modeling functions to support our design procedure. The second part is production data handling system such as BOMs and fabrication information. The last part is interface application with ERP system for electronic drawings and production and procurement information.

The following Fig. 4 shows the configuration of DACOS piping system. Fig. 5 shows the DSME specific multiple supports for pipes, ventilations and cable trays as one model and drawing.

### 2.4 Structure outfitting design system

In the outfitting structure area there are various types of objects in both ship and offshore projects. It is quite important to set up a well-organized design procedure for these kinds of objects. In the traditional drafting based

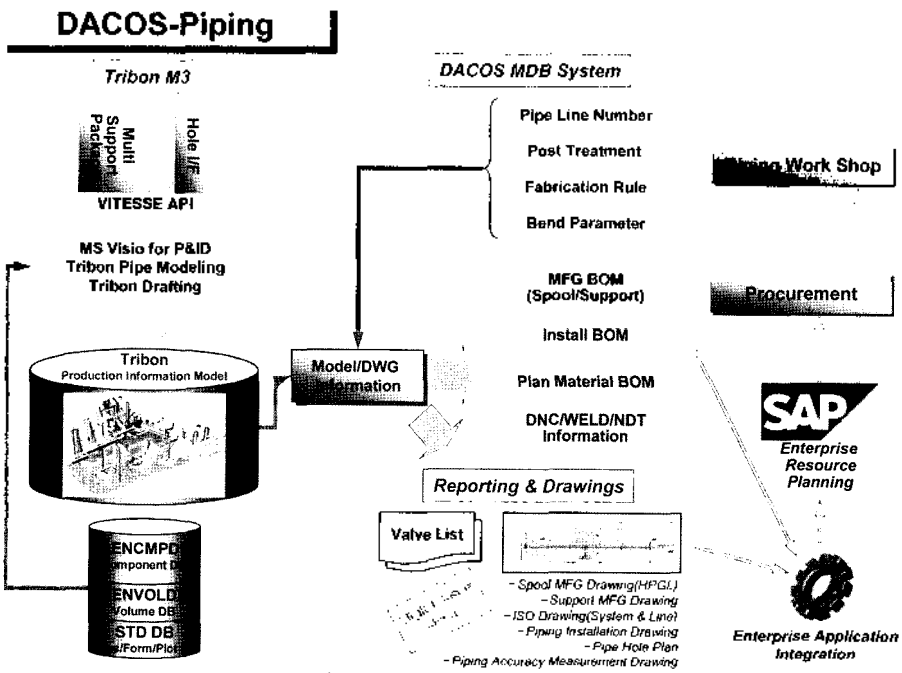


Fig. 4. Configuration of the DACOS piping application.

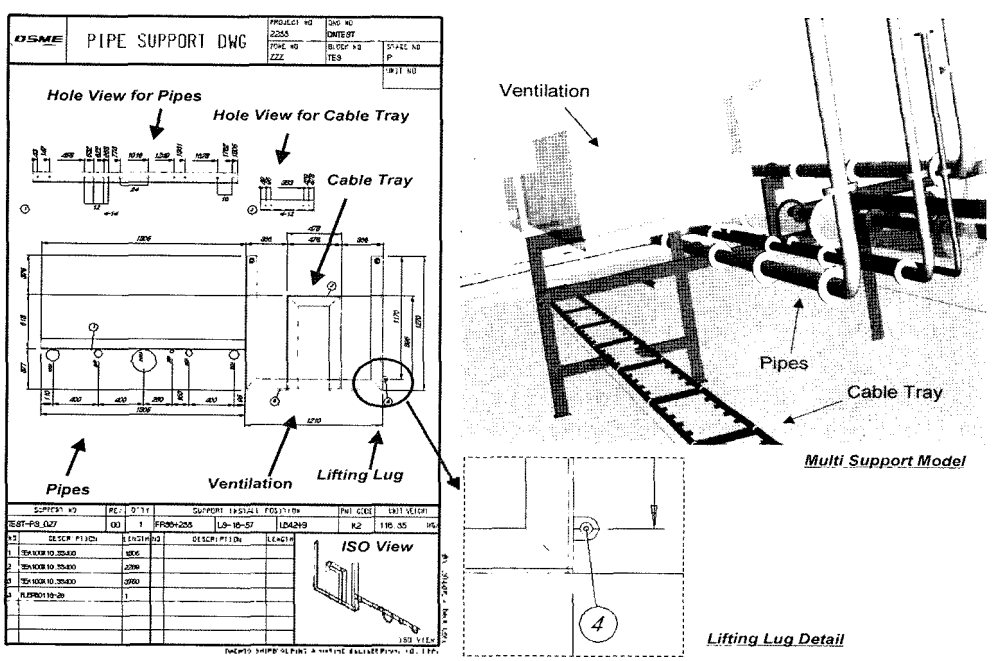


Fig. 5. Example of the drawing and model for multi-suppotr.

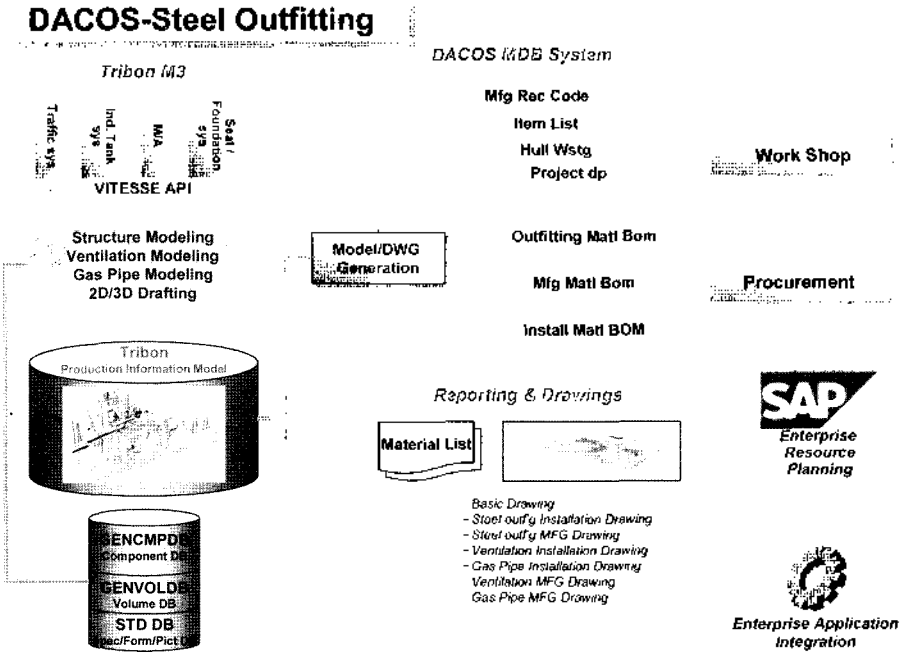


**Fig. 6.** Configuration of the DACOS steel outfitting application.

CAD system many of them are handled by drawings. In the DACOS environment we model most of the structure objects as real shapes and generate drawings and BOMs from the 3D model. To increase the design efficiency in this advanced design environment, the system has to provide a variety of modeling and drawing automation capabilities. The following Fig. 6 shows the configuration of the DACOS steel outfitting system.

### 2.5 Electrical design system

The DACOS electrical design system has four major modules. They are wiring diagram module, modeling module for cable trays, equipment and seats, ERP interface module and cable management module. The cable trays and the seats are designed and constructed differently depending on each shipyard. To support this unique procedure we have developed in-house functions based on the Tribon Cable application. The drawings and the BOMs are generated from the model and the information will be transferred to the ERP system. The cable management module controls the cable way model information and generates the cable plan drawing. The cable management module supports the auto-routing of cables on the cable tray using wiring diagram data. The following Fig. 7 shows the configuration of the DACOS electric design system.

### 2.6 Accommodation design system

The accommodation design system is one of the important parts of the CAD system but there is no application for accommodation design in Tribon system. DSME is building 40 to 50 ships and 2 to 3 offshore projects in a year and so we had to develop the entire accommodation modeling and drawing system internally. The basic procedure of the system is similar to other outfitting design system. We have developed the modeling functions for different types of accommodation objects. The user-defined attributes are used to manage the accommodation specific information. After the modeling is finished, drawings are generated from the model based on the DSME's drawing extraction rules. The drawings and BOMs are transferred to ERP system as procurement and production information. The following Fig. 8 shows the configuration of the DACOS accommodation system.

### 2.7 Production and procurement data support

DSME manages the production and procurement data using SAP as an ERP (Enterprise Resource Planning) system. The DACOS system provides the procurement information and production drawings to the ERP system. For the design data management the DACOS system has DACOS-MDB (Master design database) for outfitting design data and HIBS-ONE for hull structure design data. The MDB and HIBS-ONE manage the manufacturing and install BOMs (Bill Of Material) information. These kinds of BOMs and drawings are transferred to the ERP system through the EAI (Enterprise Application Integration) interface technology.

## 3. Implementation results

DSME has tried to develop a single design and production environment for ship and offshore projects. The DACOS system is implemented for ships and offshore projects design and production data generation.

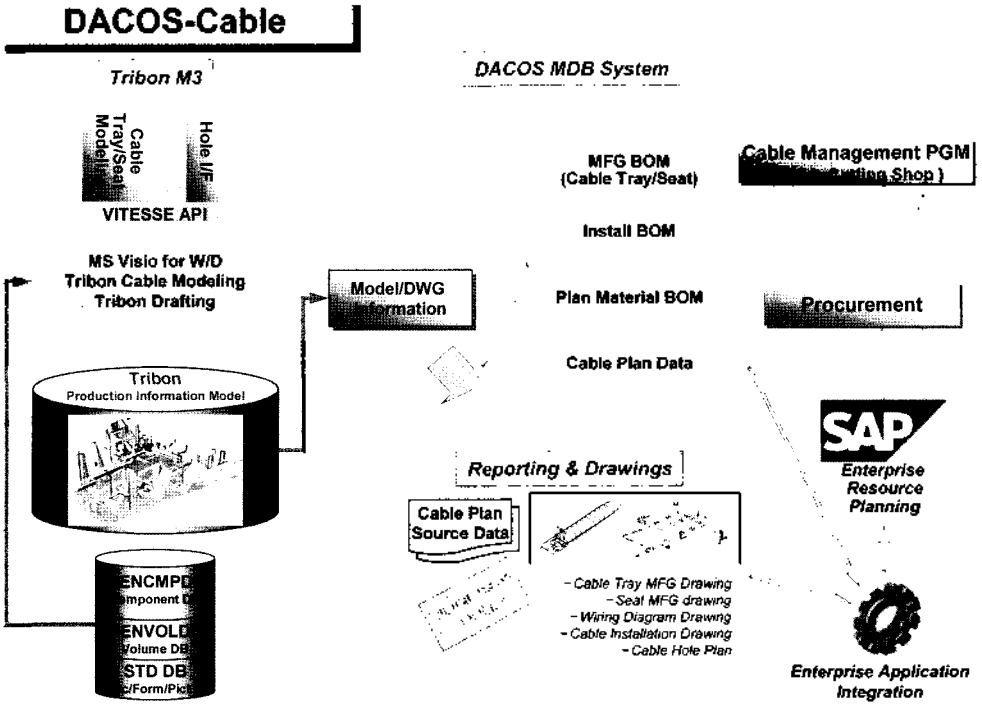


**Fig. 7.** Configuration of DACOS cable application.

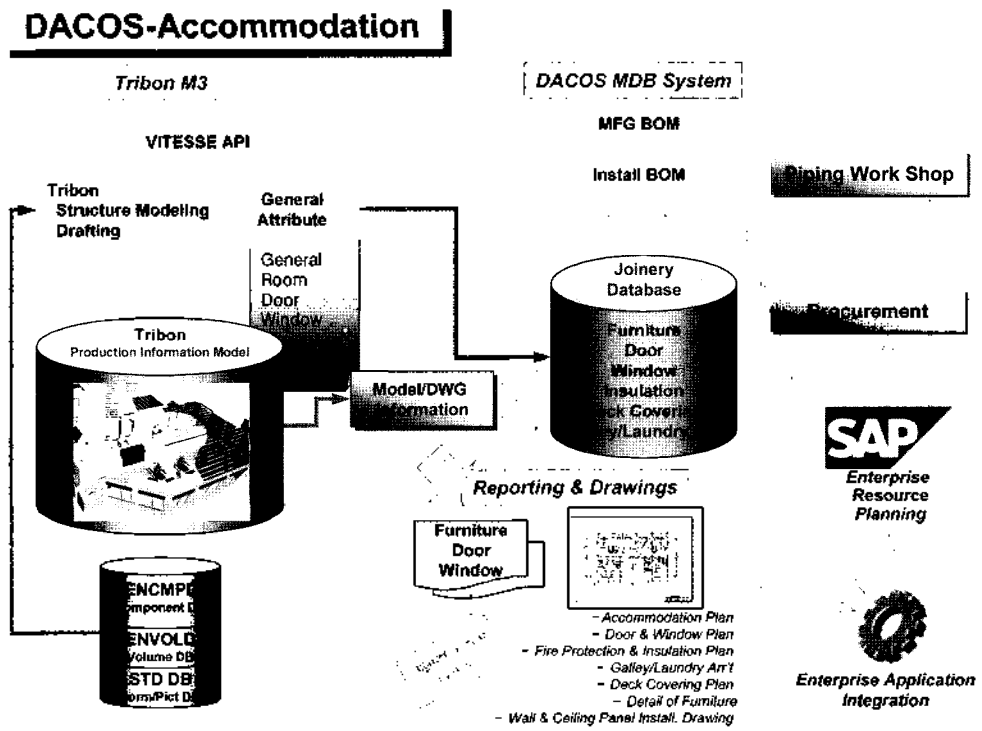


**Fig. 8.** Configuration of the DACOS accommodation application.

DSME is using the system for commercial ships, navy ships, and several kinds of offshore projects. Each product has its unique characteristic for design and production but we believe that a unified system can contain the various requirements. The following Figs. 9 and 10 show the implementation results.

## 4. Conclusions and future plans

### 4.1 Conclusions

DSME is trying to integrate the ship and offshore design and production process. To support this kind of unique process, the company has developed and imple-

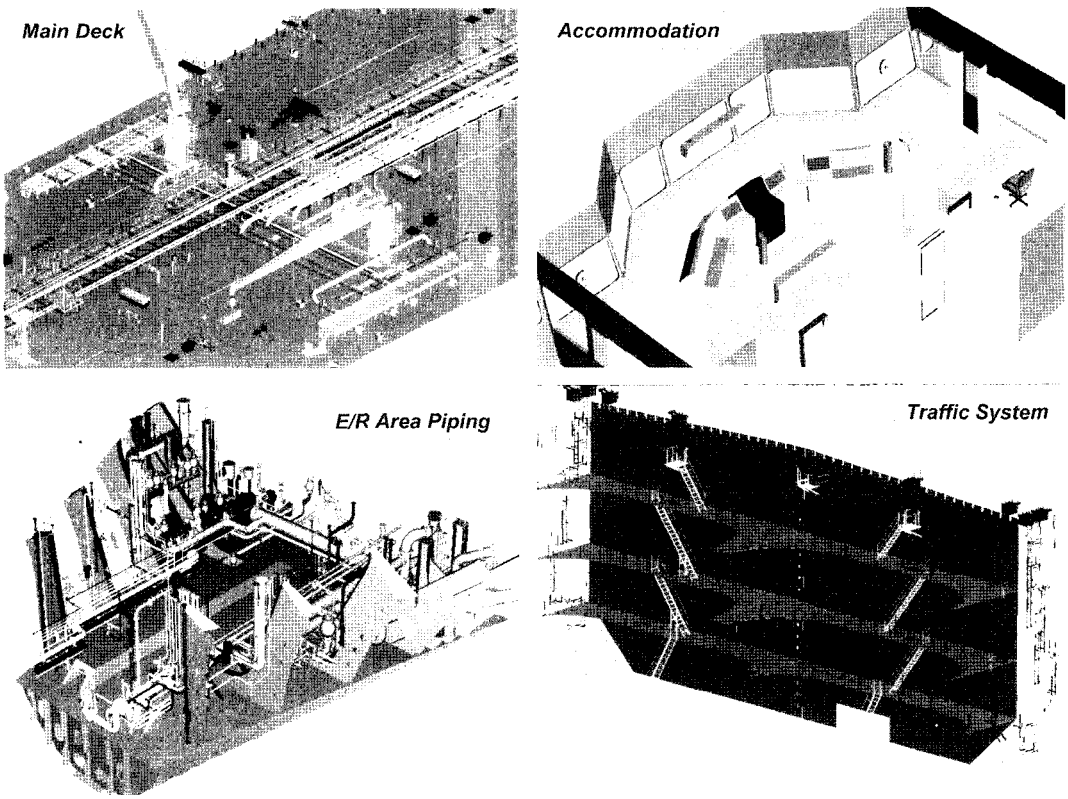


**Fig. 9.** Modeling example for commercial ships from DACOS system.

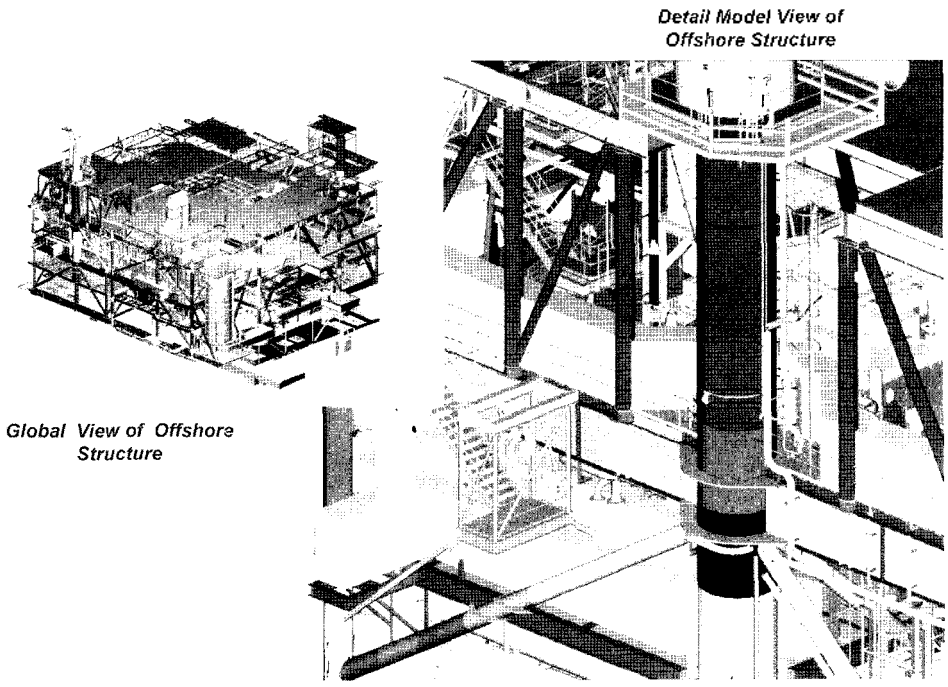


**Fig. 10.** Modeling examples for offshore project from DACOS system.

mented the DACOS (DSME Advanced CAD for Okpo Shipyard) system for ships and offshore projects. The Tribon M3 system is used as a base CAD system. Based on this CAD system, DSME has developed efficient modeling automation, drawing generation and production information management systems to support DSME's own design and production process. The modeling and drawing activities are important parts of design

process. To support this requirement the DACOS system has implemented many modeling automation and drawing generation functions.

There is no CAD solution in the market which can possibly support all the various requirements from different shipyards. Moreover, the design system has to provide additional information required in different design and production process. We believe that these requirements will increase as time passes by and to set up a more flexible and intelligent design and production environment becomes a requisite. Accordingly, the next generation CAD system has to support following requirements for customization and localization;

- Openness of the system for database and application functions
- Integration of project database for concurrent engineering
- Supporting the reuse of experienced project data
- Rule based system to support design and production automation
- Modeling and drawing automation
- Simple architecture in software and hardware

### 4.2 Future plans

DSME has developed quite efficient design environment based on Tribon M3. The company will implement this integrated environment for the time being. The base CAD system, Tribon M3, is going to fade out in a few years as new CAD technology continues to propel. Therefore, the company needs to prepare long-term migration plan for the base CAD environment. DSME has its own modeling, drawing and production information management system. This locally customized environment will help the migration plan. DSME will investigate existing commercial CAD systems as prospects for an advanced modeling kernel that can support our requirements.

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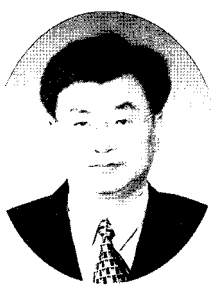
**Heung-won Suh** 1985-Present DSME, General Manager, IT R&D Team Interests : Shipbuilding CAD/CAM and CAE

**Sung-geun Lee** 1979-Present DSME, Vice President, Ship & Ocean R&D Institute 1992 The Ohio State University, Welding Mechanics, Ph.D 1984 Polytechnic Institute of New York, Welding Metallurgy, MS 1980 Seoul National University, Naval Architecture, BS Interests : Ship and Offshore Design Technology, Shipbuilding CAD/CAM and CAE, IT for Shipbuilding Business

Heung-won Suh



Sung-geun Lee