AVEVA MARINE

AVEVA Marine

Concepts

User Guide

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VANTAGE Marine Concept

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Concepts

1 Introduction to AVEVA Marine

The AVEVA Marine system has been specifically designed to provide a structured way to develop and improve the information flow between the different tasks within the shipbuilding process, where many design development tasks are performed in parallel. The requirements of the complete information flow have been considered and so the system is not just a computerisation of a conventional manual process.

The system is based on the use of a Product Information Model (PIM) database, which has been designed to handle in an efficient way all of the structural and outfit objects found in the shipbuilding industry. The information in the Product Information Model contains all the technical data that is needed to define the final product. It addresses all phases in the design and production process. Information from one stage can be used in the next stage. All types of drawings and reports can be derived from the model.

This concept with one common product information model or “ship database” for each project being used by all designers and production planners means that the information stored in the database is immediately available to the entire organisation. This source of consistent information ensures that no errors can develop between design and production functions. It leads to a very efficient flow of information and which results in reduced man-hours and elapsed time for a project.

The purpose of this document is to present and explain the AVEVA Marine concept and to give a general overview. The document covers in the main applications, features and concepts in the Hull and Drafting related areas, and for the purpose of clarity, explanations have been simplified. Detailed documentation can be found in the user documentation pertaining to each application. Consequently, this document can not replace proper training in the use of AVEVA Marine.

1.1 Limitation of Scope

This document concentrats on those parts of AVEVA Marine that originate from the Tribon System, i.e. mainly Hull and Drafting. Corresponding information about PDMS should be found in the PDMS manuals.

2 Applications

A number of different applications are availible, each adressing its specific discipline and phase within shipbuilding.

More detailed descriptions of the various applications are availible on the AVEVA site on Internet.

3 Overview of Some AVEVA Marine Data Structures

3.1 The Product Information Model

The core of the system is the Product Information Model database. This can be regarded as a comprehensive “Ship Database” containing all information about a specific project. The database is object-oriented in the sense that all design and production data stored as "objects". These "objects" are all of the types of physical items found in ship construction, e.g. plates, stiffeners, etc. The description of each type of object is formulated in such a way as to contain all the necessary technical data and/or properties which are required in order to describe a particular instance of the object. The technical data and/or properties are then used to derive the graphical representation of the object for use in symbolic sketches or in 2D or 3D views, depending on the context of the presentation. When design modifications are necessary it is this technical data which is changed rather than the graphical information, as would be the case in most other CAD systems.

The object-oriented approach, which has been adopted for the database, means that different views of the Product Information Model can be easily derived, allowing fast dissemination of the design data to various users.

The Product Information Model is a complete cohesive database describing a whole ship design and its associated production details.

Two important concepts are used in the Product Information Model implementation in order to enable the system to handle the large volume of data that represents a complete ship with good response performance and with realistic database sizes.

Firstly, all data is stored using *Object Technology* in which geometry is not explicitly stored, but is derived as and when needed from the stored technical data.

Secondly, a combination of *Solids* and *Light Solids* are used for model display and model development, again to give a good optimum performance. Light solids are a simplified way of storing and handling solid primitives and in which a canonical representation is used instead of a boundary representation.

Below, some of the major characteristics and benefits from the Product Information Model are listed.

3.1.1 Multi User Concurrent Access to the Product Information Model

This improves the user access to all information associated with a whole project. The data in the Product Information Model can be created and updated by many designers and production engineers working both in parallel within technical disciplines and across disciplines. Hull and outfitting designers, for example, can therefore work together in a concurrent manner. The use of a common database means that design development progress and design changes are instantly accessible to all designers. Information can easily be extracted across a whole project by various alternative selection criteria, e.g. by block, by system, by location, etc.

3.1.2 Database Capable of Handling a Complete Ship

The development and storage of the complete ship design in one large concurrent multi-user access database promotes the smooth and efficient flow of design information between engineering disciplines and leads to a shorter elapsed design time and to a more correct design.

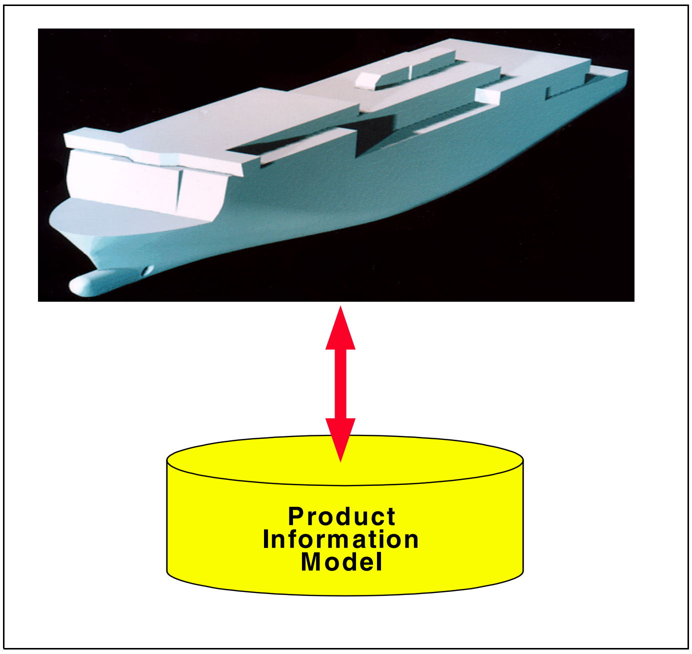


Figure 3:1. Single Database capable of handling large Assemblies such as a complete Ship.

These operational advantages lead to a much reduced volume of documentation, less duplication of work, fewer inconsistencies and errors in the development and transference of design information and which in turn leads to less information being subject to revision and change. The structured way of handling the information flow will help to produce a more technically correct design, at a lower cost and in a shorter time. In addition production can start earlier and both elapsed time and man-hour savings can also be made in production by using specifically created complete and consistent information for each stage of production.

3.1.3 Re-use and Refinement of Information in Later Design Stages

The building of a Product Information Model is a process of refinement. This encourages entry of data early in the design process and then later, progressive extension and refinement.

The system allows for all stages in the design development process in such a way that information from one stage can be utilized in the next.

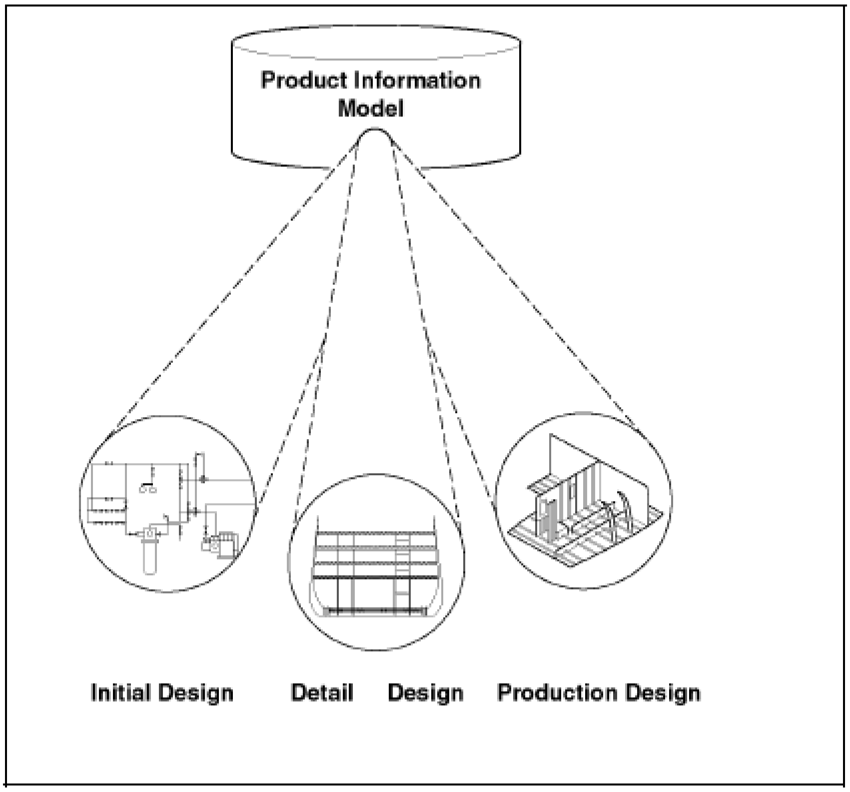


Figure 3:2. Integration of all Design Stages

3.1.4 Integration of Hull and Outfitting

The data from all structural and outfit disciplines (e.g. Hull, Pipe, etc.), required to define a complete ship design and its production, are stored in one and the same Product Information Model database. The close association between the Hull and Outfit data allows the hull structure and outfit designers to work in parallel sharing the most up-to-date information during design development and producing well integrated final arrangements.

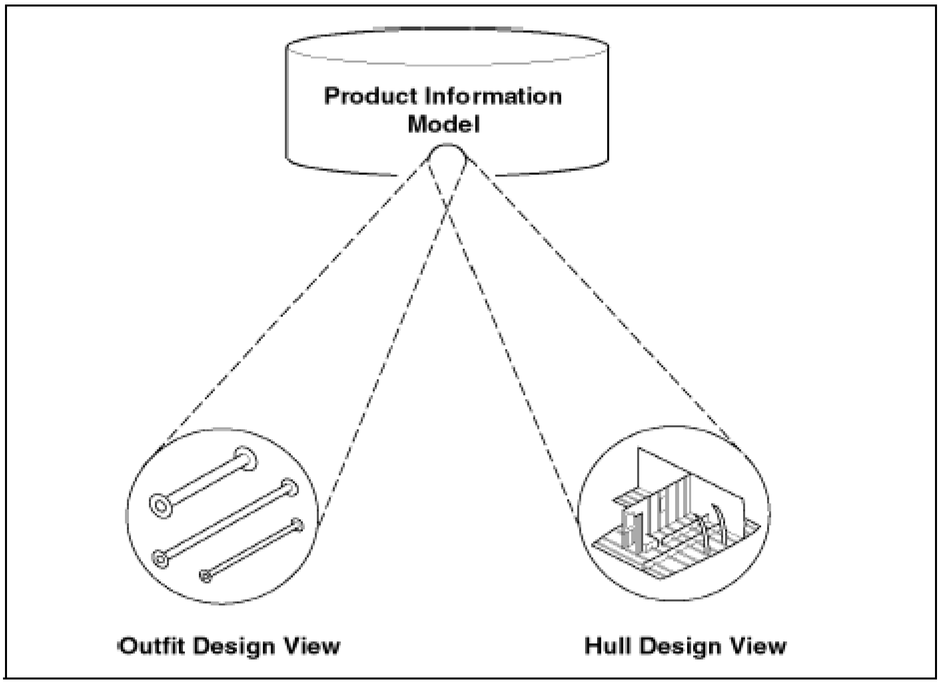


Figure 3:3. Close Association between Hull and Outfit Data.

3.1.5 Close Connection of Modelling and Drafting

The close integration of the Modelling and Drafting functions in the system means that workshop drawings can be built up in parallel as the structural and outfit modelling is carried out. This reduces overall design time and reduces the cost of any subsequent changes that may need to be made to the design information prior to fabrication.

3.1.6 Component Catalogue

The various model objects in a Product Information Model are frequently built using many different types of components and a particular standard component type may exist in many places in the ship model. For this purpose, the system has a standard component catalogue. Each component in the catalogue will typically have several items of technical information associated with it. The designer selects components from the catalogue when building up the Product Information Model. This information structure makes it possible to analyse the ship model and to produce parts lists.

The Component Catalogue is continuously updated by a shipyard, and component data can easily be shared between yards and design agents.

3.1.7 Specific Rules for Each Type of Object

The object-oriented approach enables the user to define within the model what the different parts of the model really represent and to establish the rules and restrictions connected to each type of object. In this way the tools to build and change the Product Information Model include check functions in order to ensure correct design and to produce a design that is easy to manufacture. For example, the pipe modelling functions can check the practical capabilities to bend a particular pipe in the shipyard pipe bending machines. The system is able to distinguish pipes from other items that may physically look like pipes. In order to interpret the model in an intelligent way, the 3D geometry definition is not sufficient; all of the object technical data as found in the Product Information Model is also needed.

3.1.8 Associativity to Support Easy Modifications

The extensive use of associativity in the building of the Product Information Model ensures that any required modifications to a model item can be carried out swiftly. The associativity information is specific information on the relationships between objects. These relations are used to maintain consistency in the overall ship model and to ensure that when one object in the model is changed then, if necessary, the related objects are modified accordingly. The associativity information is used to make the model as independent of fixed geometry as possible. The full technical and “topological” data that describes each design object is stored rather than the simple “numeric” geometry of the design. This means that, if for example, a change of the hullform is made and which does not affect the associativity, then the new structural geometry can be rapidly created from the earlier stored information. The associativity and topological information in the technical data is also used to automatically re-create new geometry in other parts of the design. In the example below a web frame is moved, or “copied”, to a new location. In this case the system re-calculates the geometry to fit the boundary at the new location maintaining the same topological description.

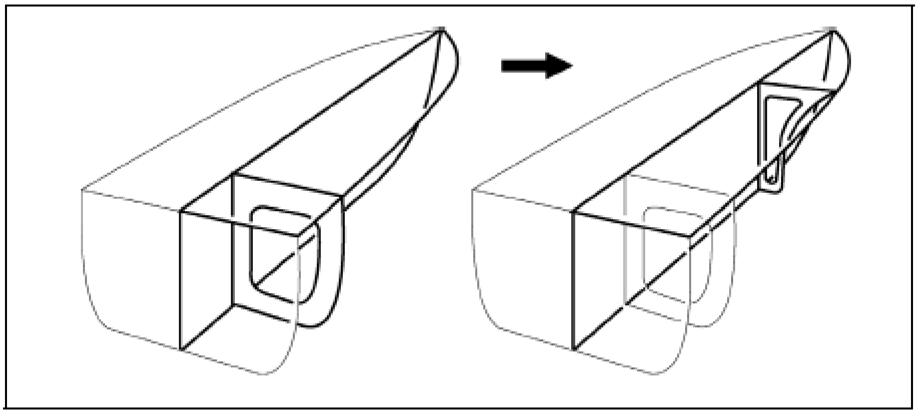


Figure 3:4. Ease of Making Changes and Copying Design Arrangements.

3.1.9 Information Derived from Technical Data in the Product Information Model

Additional information can be readily derived, on request, from the Product Information Model rather than it being explicitly stored. For example, if there is a rule that a stiffener is welded to an adjacent plate, then the amount of weld can be calculated from that rule and the stiffener model.

This concept of deriving information from the Product Information Model is also used in the modelling phase where it is often difficult, at that stage, to define the exact boundary and geometry of a model feature. For example, in the case of brackets the system includes sizing rules and application rules about the context in which a bracket may be used. In such instances the system can automatically calculate the full bracket geometry including all cutouts, stiffeners and flanges which make up the bracket, leaving the designer to specify the scantlings and material.

3.1.10 Multiple Hierarchy Structures

The Product Information Model is used to support both design tasks and the creation of the vessel's build strategy, plus detailed assembly information, using the same model object data. In order to be able to do this the model objects in the Product Information Model can be referenced to both the design hierarchy and to the production hierarchy data structures contained with the Product Information Model database. This means that model objects can be selected, viewed and manipulated from both a designer's point of view and a production engineer's point of view.

3.1.11 Integration of Design and Production Engineering Data Structures

Each region or part of a design can be both part of the overall Hull design hierarchy structure and at the same time part of the production hierarchy structure (i.e. assemblies). This feature means that design information can be easily grouped into production assemblies even if it was originally created from a design point-of-view in different applications and at different times. This feature aids concurrent engineering of both the design and the build strategy so that information for pre-fabrication and pre-outfitting can be easily and efficiently created.

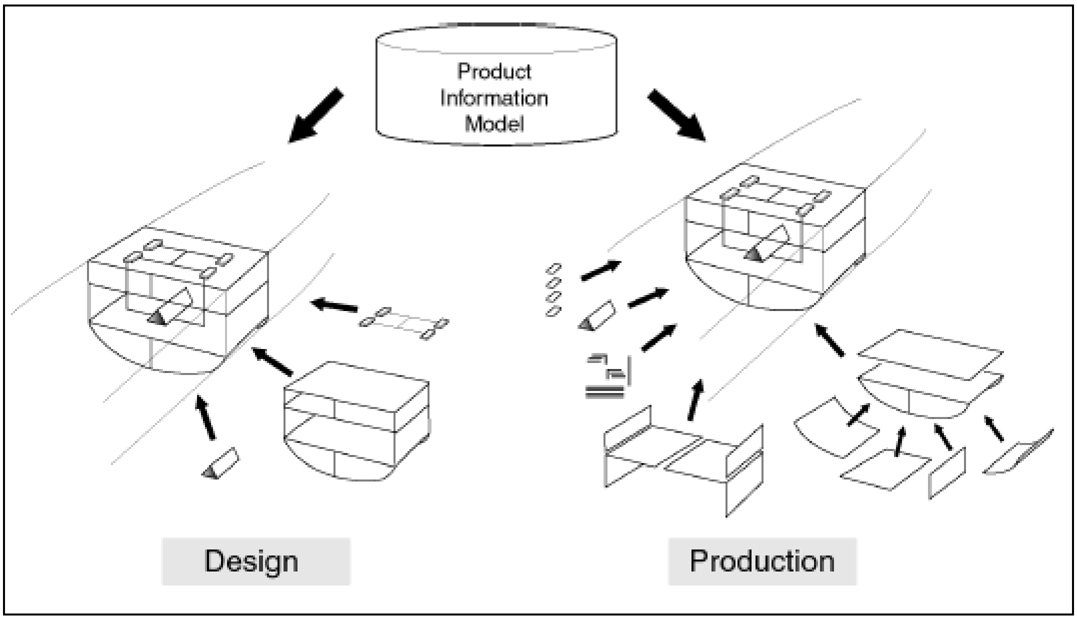


Figure 3:5. Integration of Design and Production Engineering Data Structures.

3.1.12 Automatic Production Information

The many different types of production information that are needed for parts manufacture and assembly can be automatically generated from the Product Information Model. To support pre-outfitting activities, specific production information for the manufacture of combined hull and outfit assemblies can also be created. The consistency of the information in the database promotes improved quality in production and avoids potential problems, e.g. conflicts.

Since the Product Information Model can store both the design view of the ship and the associated production view in one single database, the production engineering personnel can work in parallel with designers in order to first develop the build strategy and then later group designed objects into production assemblies. All design objects that are to be manufactured have automatic routines to create the necessary production information. This means that once the design of the object is complete the associated production information is automatically created.

For example, all elements of hull lofting are automated in the hull application modules, thus saving an appreciable amount of man hours and elapsed time. In addition the automated routines give a consistent output which generates savings in production.

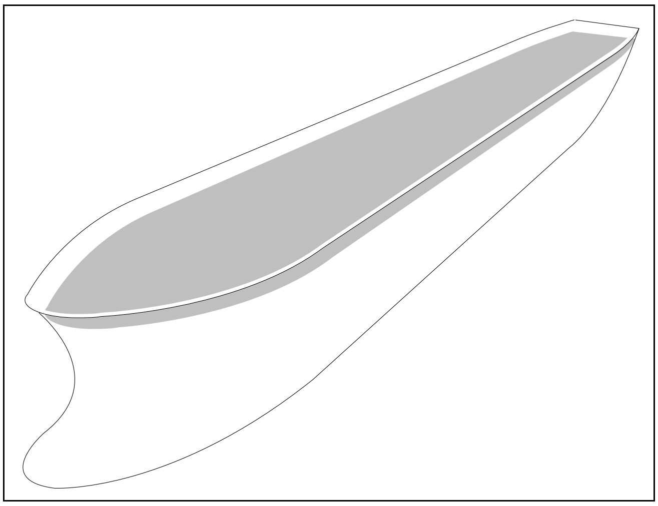
3.2 Data Structures of the Product Information Model

The Product Information Model contains an integrated mixture of different data types, e.g. technical data, administrative data, associativity data, functional data and geometrical data. The geometrical data may be 2D as well as 3D. The 3D data may be surface-based as well as solid-based. Data may be symbolic or true, and it may be implicit or explicit. This mixture of different types of data and the alternative representation of specific items, is efficiently handled in the Product Information Model.

The Product Information Model is arranged in the form of a hierarchy of data. This hierarchy reflects the actual natural hierarchy of objects in design development and production stages. e.g. pipe components such as valves are parts of pipelines which in turn are parts of pipe systems which in turn are parts of the outfit model. The database organisation and management successfully handles these vertical hierarchies.

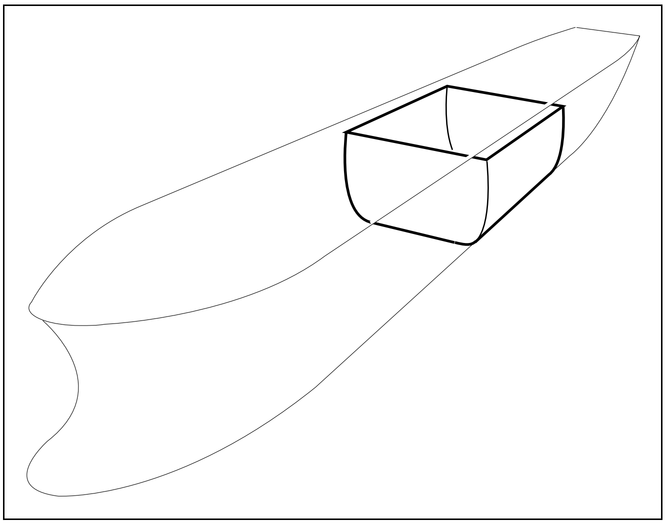
Surface

- The position and shape of the major structure of the ship dividing the complete ship within the hull envelope into functional compartments. e.g. Main Deck, Engine room Bulkhead, Inner Bottom etc.



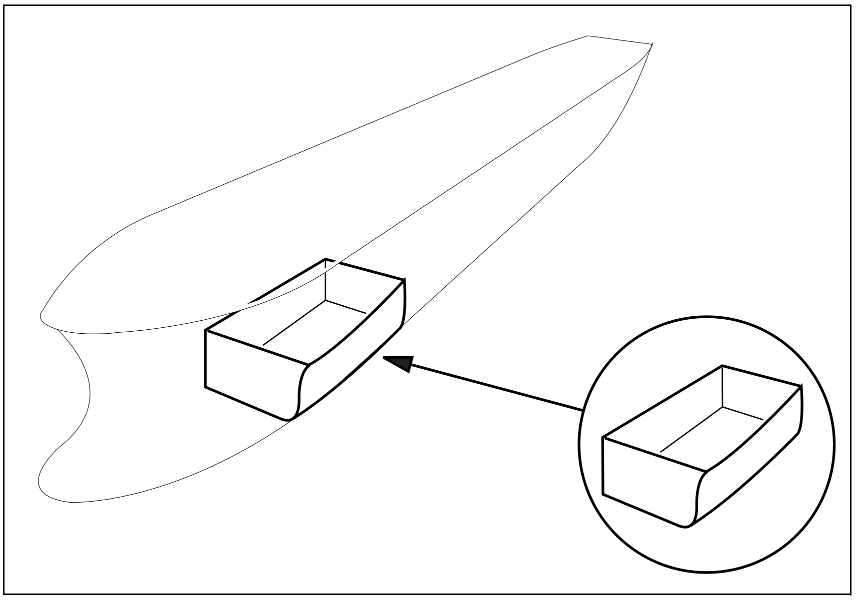
Compartment

- Typically a compartment has a functional purpose such as becoming a Cargo Tank or a Machinery Space. The shape and size of a compartment is defined by a closed set of boundary surfaces.



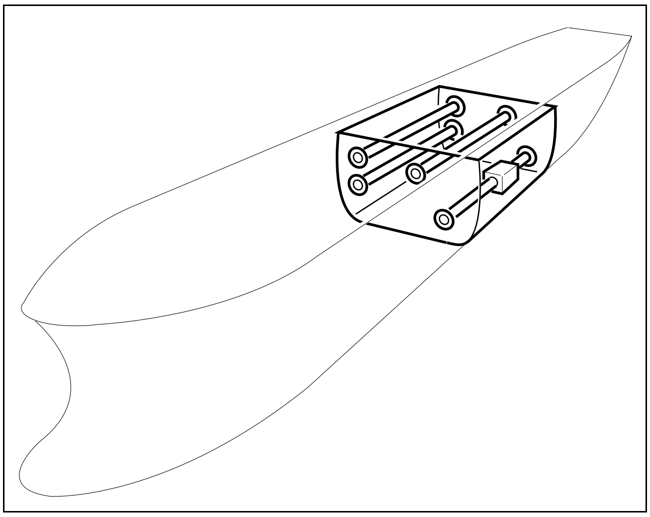
Block

- A general physical zone within the ship. Typically a major assembly of hull steel and outfit support structure and which is typically then lifted into its final hull position in the building dock.



Module

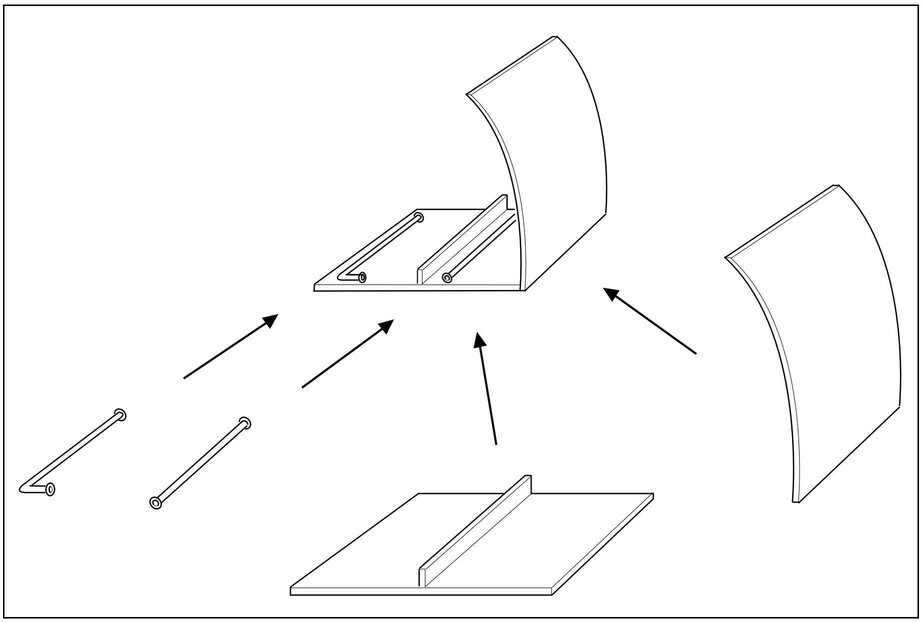
- A grouping of objects in a general physical zone of the ship associated together for assembly purposes.



In addition to the design hierarchy for each type of model object there is a shipyard defined production hierarchy in order to group design objects into sub-assemblies and assemblies according to the actual build strategy chosen for assembly production.

Assembly

- A grouping of parts or sub assemblies which will be joined together in the construction process at a particular stage.



3.3 Initial Design Objects

The part of the Product Information Model for containing Initial Design information is organised to handle the functional definition of the complete ship structure. The ship model is divided into a number of surfaces and the related compartments that are created.

There are four main types of purpose-defined surfaces, that is hullforms, decks, longitudinal bulkheads and transverse bulkheads. Surfaces themselves can be sub-divided into panels with structural features such as plating, stiffeners and holes, as sufficient for initial design purposes. An overview of the Initial Design data structure is shown in the figure below.

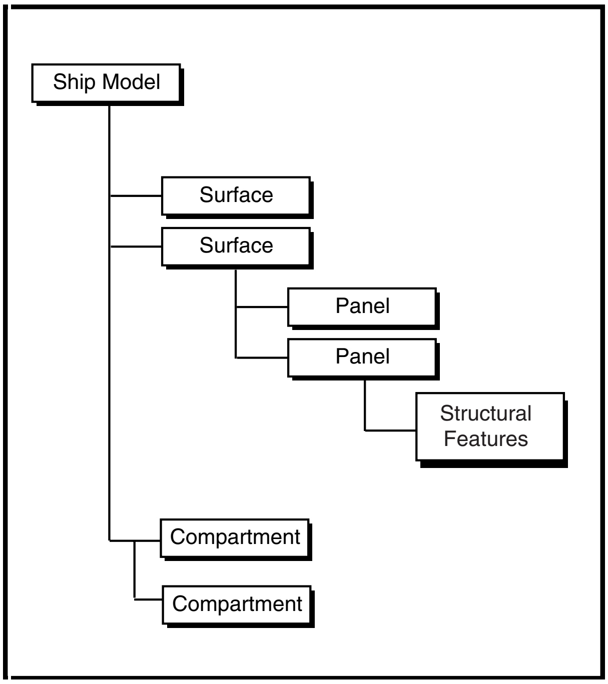


Figure 3:6. Overview of the Initial Design Data Structure.

3.4 Hull Objects

The Product Information Model contains a model hierarchy which allows hull structure objects to be grouped together in terms of their function or their physical location in the ship model. In the Hull Application the basic approach is that the ship model is divided into a number of Blocks, which in turn are sub-divided into Panels. Each Panel is assumed to be composed of Plates, Stiffeners, Seams, Notches, Brackets, Flanges, etc. Corrugated panels can be represented as well.

Blocks are defined as a physical zone of the model. An overview of the Hull data structure is shown in the figure below.

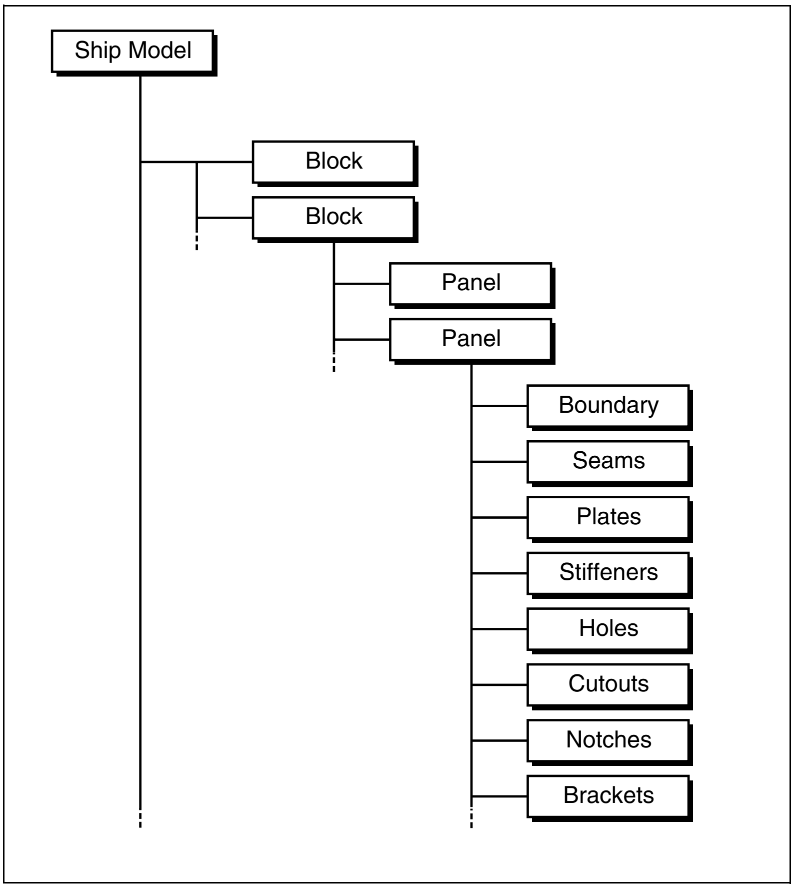


Figure 3:7. Overview of the Hull Data Structure.

The full ship model is thus represented by a contiguous set of unique blocks, having well defined interfaces between adjacent blocks and with no overlaps, gaps or duplication of boundary elements between blocks.

More detailed views of the Hull and other closely related functions can be found below. Functions in bold are such functions, that can normally be found in the start menu. Functions in italic are functions within Planar Hull or Curved Hull.

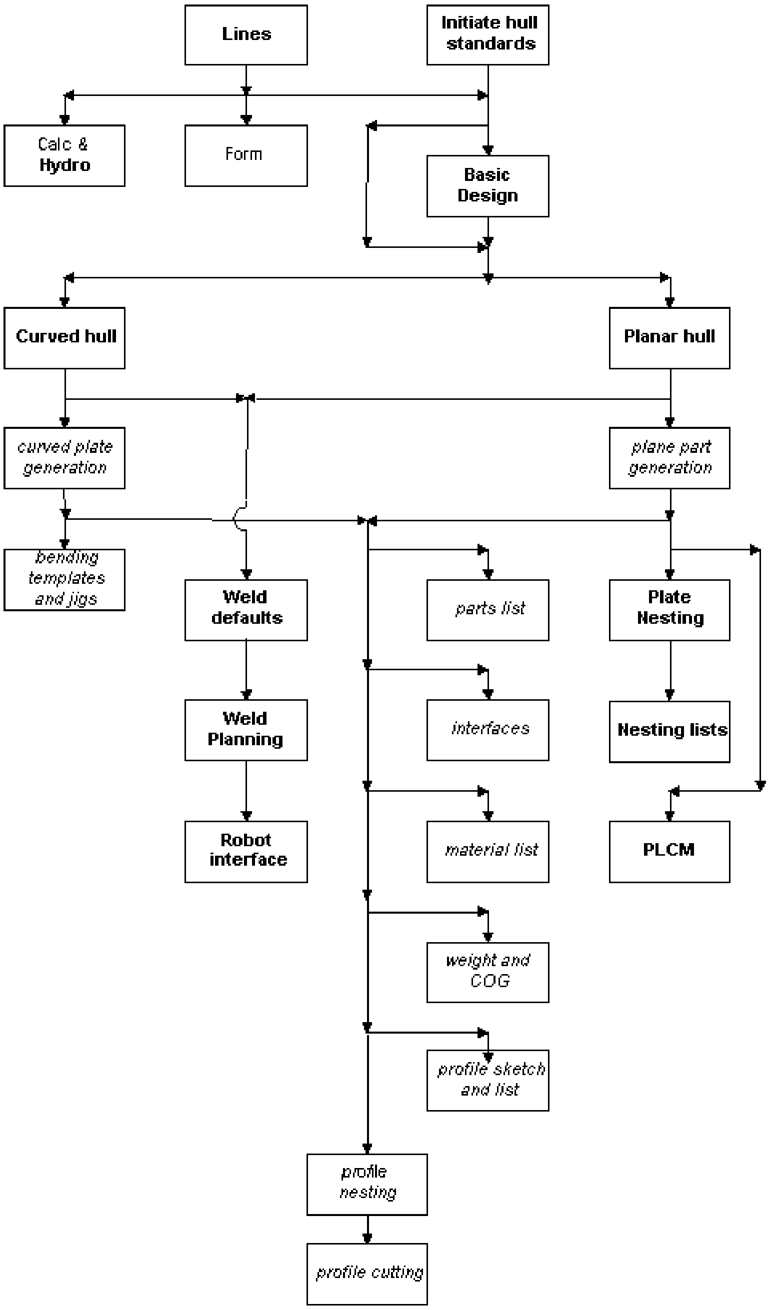


Figure 3:8. Hull main functions.

After having created the hull form and established the hull standards, valid for the project, the actual modelling of the hull structure can start. The modelling is done in two separate modules: one for planar hull structures, and one for curved hull structures. The modelling results in a digital description of the hull model in a databank. Another important result is the drawings of various kinds, e.g. hull steel drawings, that are developed simultaneously with the model. A separate function, Parts Generation, splits the model into its parts, plates and profiles, which in turn are stored in their specific databanks. The later nesting steps nest these parts into raw plates and raw profiles and create the necessary information for plate cutting machines and profile cutting robots. The parts generation function also loads the

Production Data Interface with all necessary information to be able to interface other sorts of software.

Hull also contains an extensive set of list functions for the production. Those functions read information from all involved databanks.

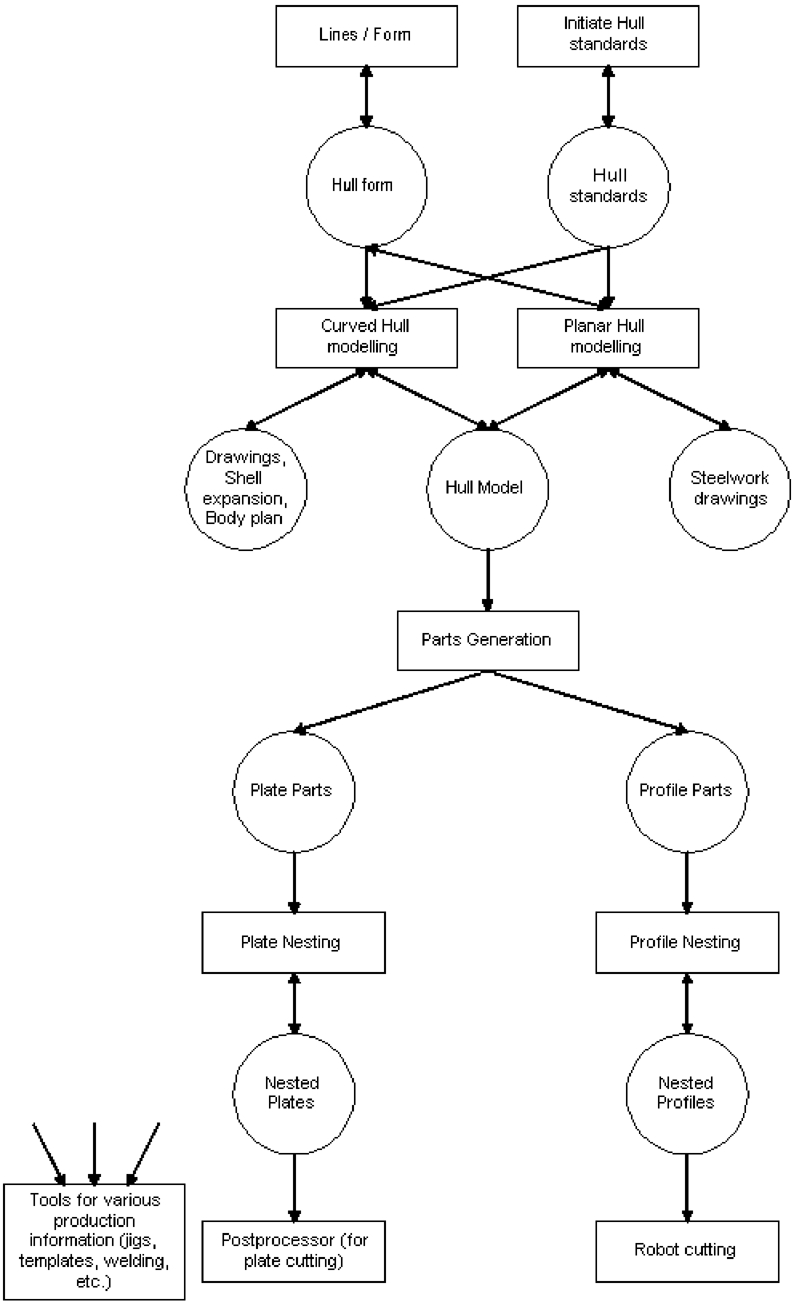


Figure 3:9. Hull modules and functions. Legend: rectangle boxes show functions while circles show data.

3.5 Production Assembly Hierarchy

In parallel to the design hierarchy there is a user shipyard defined production hierarchy describing the overall construction of the complete ship made up of assemblies. Assemblies can contain other sub-assemblies or piece part objects in the design definition. There is no practical limit to the number of levels of assembly that can be created. (No assembly sequence or time-base is inferred).

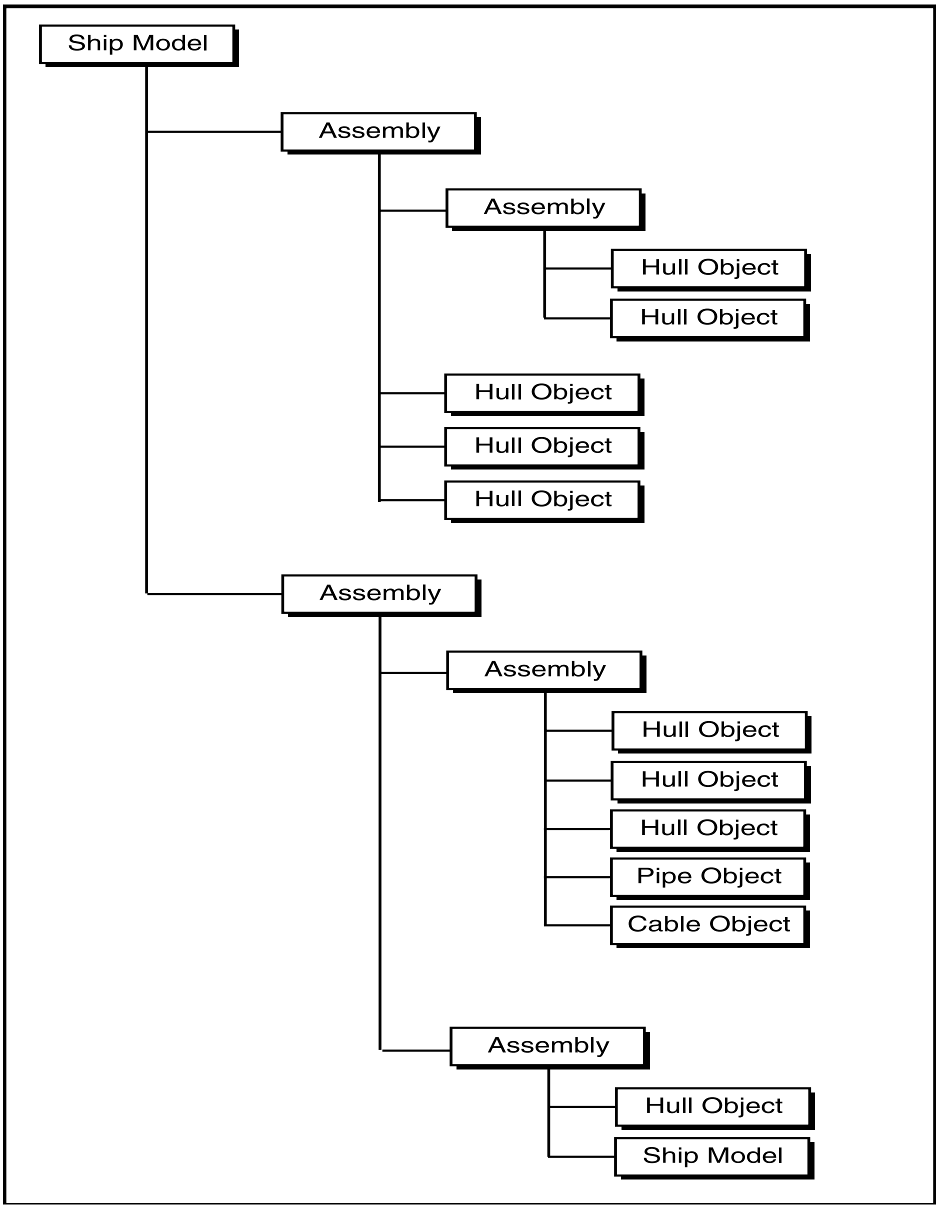


Figure 3:10. Overview of the Production Assembly Data Structure.

3.6 Data Management

The Data Management (TDM) is embedded and adapted data management functionality in the core of the system, based on the Product Information Model. TDM focuses on the organisation of data from Hull as well as other sources, on the control of status for different types of data and on access control. TDM further can handle revisions of drawings and versions of the ship model.

The TDM functionality can be adapted to a yard's specific demands. For each project the yard can choose a desired level for the data management.

The TDM functionality can also be interfaced to other commercial Product Data Management systems.

From the Hull application's point of view, TDM can be seen as a filter to the Product Information Model.

3.7 Technical Implementations of the Product Information Model

The Product Information Model database is logically divided into databanks. A data bank is a permanent storage for model objects. The system is structured so that there are a number of predefined data banks for different purposes. There is for instance one data bank for hull panel objects, one for plate and profile parts and so on.

The proprietary database implementation is object oriented. Normally the databanks belonging to one and the same project are clustered into one directory. The databanks are automatically kept un-fragmented, and the technique is well-proven and very efficient, with short access times.