

# CATIA Solutions Version 4 -

## The overview of the CAD/CAM/CAE System

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### Introduction

CATIA Solutions Version 4 is the fourth generation of the internationally recognised CAD/CAM/CAE software CATIA which is being developed by Dassault Systemes (a subsidiary of the French aircraft manufacturer Dassault Aviation). CATIA was put on the market in 1981 and within 13 years has become a leader in its market. Today it is a worldwide used CAD/CAM/CAE system with over than 4.000 customers. IBM markets CATIA worldwide and is a minority shareholder in Dassault Systemes.

CATIA runs on IBM RISC System/6000 workstations or on IBM Enterprise System/9000 computers. The system architecture enables CATIA to run on multiplatform configurations. Dassault Systemes and IBM announced that CATIA will run also on non-IBM platforms in early 1995.

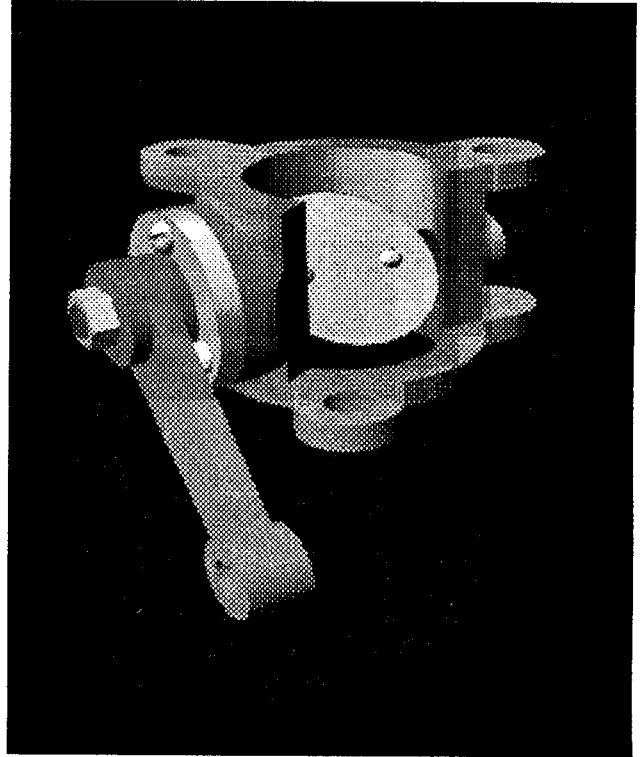
### Design Process

CATIA Solutions Version 4 packaging model is based upon industry requirements for solutions that optimise the design, build and support processes. This in return leads to higher quality products at a reduced cost while shortening the time to bring these products to the market.

By iterating between concept, design, analysis and manufacturing activities, a concurrent engineering environment can be established. This greatly assists in achieving the goals of improved quality and reduced time to the market. In other words, there is a shift from "part design" to "product design" environment. This is reflected in the focus on the "design/build team" approach rather than the traditional, more individualistic approach to the design process.

Typical design flow by activity may be:

Sketching an assembly, defining its spatial envelope and component interaction (kinematics) rather than



the precise shape of each component. After the assembly concept has been determined, individual parts can be defined precisely. In fact, many companies begin their design process at this stage, especially when they are only concerned with part design.

For large, multi-disciplinary projects it is crucial to test how components fit together in a mock-up. The use of a "digital" mock-up, where a complete assembly can be tested by computer, can mean real savings. A typical digital mock-up may contain mechanical, structural and piping components as well as electrical wire bundles. The savings can sometimes overweight the investment in CAD/CAM/CAE system many times over (because of no need to create a physical mock-up).

At this stage it is also possible to produce photo realistic images of components or projects, possibly for the use of the marketing and sales department. The rendering could also impact surface texture

information to the viewer.

Concurrently with the detailed design activities, analysis can be used to find design faults, or to optimise the detailed design. After final part and product design are validated, manufacture needs to commence. This output can be in the form of drawings for subcontractors or shopfloor or directly for NC machining. Throughout this entire design process, a data management system would assist with data access control and data integrity to maintain consistency between all CAD/CAM/CAE data.

### CATIA Packaging

CATIA Solutions Version 4 packaging model answers industry needs by identifying the disciplines involved in the engineering design process, defining the needs of those engineering disciplines and developing solutions that answer these needs.

In designing model, work activities such as Conceptual Design, Detailed Part Design, Analysis, and NC tool path generation were considered.

The 6 CATIA Solutions sets correspond to particular engineering disciplines. These engineering disciplines within CATIA Solutions Version 4 are focused on Mechanical CAD/CAM/CAE applications and Architectural, Engineering, Construction (AEC) Plant Design.

CATIA Solutions Version 4 solutions set includes:

- Mechanical Design Solutions

- Shape Design and Styling Solutions
- Manufacturing Solutions
- Analysis and Simulation Solutions
- Equipment and Systems Engineering Solutions
- CATIA Application Architecture Solutions

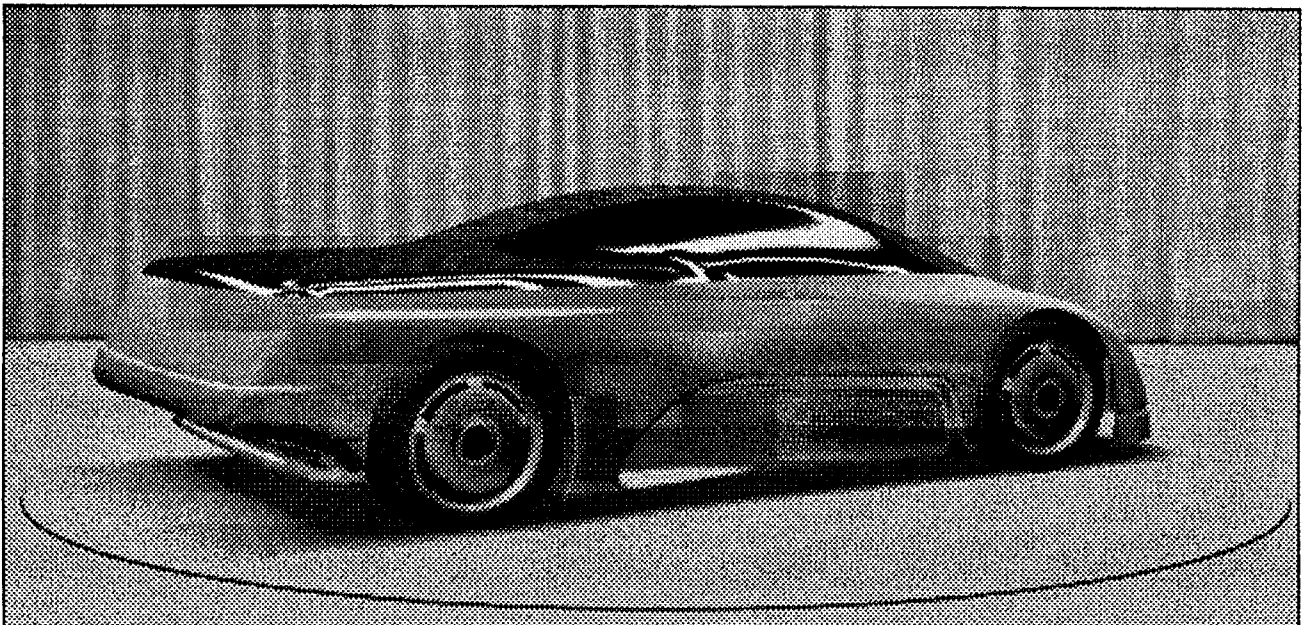
Within the 6 broad engineering disciplines previously mentioned (solutions), work activities can be refined according to the industry requirements. With this in mind CATIA V4 solution sets are composed of specific Configurations that represents a work activity. In addition, CATIA V4 solutions also include "a la carte" products, which can be utilised separately, combined with other Products or added to Configurations to meet specific user needs and optimise the design environment.

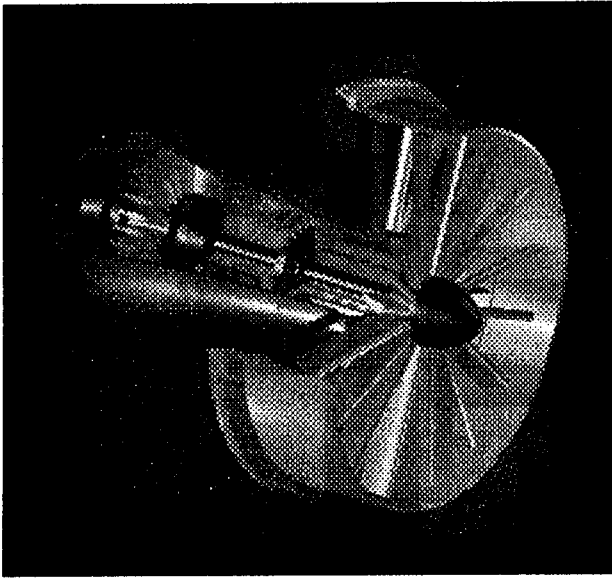
The latest revision of CATIA 4.1.3 comprises now 6 Solutions, 22 Configurations and 65 separate Products.

### CATIA Mechanical Design Solutions

CATIA Mechanical Design Solutions provide the tools for each stage of the product design process in such areas as:

- Digital Mock-up, packaging and space management studies.
- Conceptual design at the assembly level and subsequent kinematic simulation of the assembly.
- Detailed part design, including parametric part modification and design for manufacture.
- Down-stream detailing and drawing production.





The CATIA Mechanical Design Solutions provide the following essential functions:

- \* A natural assembly design methodology - design the assembly's spatial envelope, testing for interference and kinematic envelope, then design a detailed definition of each part.
- \* When a user wants to integrate already existing parts in assembly, he creates contacts between the components of the assembly, then the part is automatically positioned.
- \* Kinematic simulation can automatically be generated from the assembly model sketch, which means mechanism interferences can be eliminated early in the design cycle.
- \* Ability to design complex parts using surface/solids associativity - reinforced integration of solid and surface history management.
- \* Creation and deformation of NURBS curves and surfaces, allowing local or global shape management.
- \* Creation of complex surfaces/fillets.
- \* Automatic fillet creation.
- \* Creation and deformation of NET surfaces, defined by parametric network of nodes (points, tangents, curvature constraints).
- \* Parametrised easy modification of surfaces by changing the nature of the generating elements - curves, LAWS, surfaces.
- \* Real time surface analysis allows the designer to obtain results such as reflection curves and tangency discontinuity curves, which are updated as the curve or surface deforms.
- \* Exact representation of solids enables the solid

based model to become the reference model for all downstream applications such as manufacturing, analysis and drafting.

\* Parametric and feature based modeling capabilities allow capturing of design intent and technology knowledge, so that model shared by applications is not only geometric, but includes also topology and technology information.

\* Local and global parametrisation - Parameters can be defined and managed locally in one or many zones of the part, when parametrization is needed. Global parameterisation can be done if required.

\* Simplified representation of the product design in order to build a rapid digital prototype.

\* In some cases, mock-up solids is sufficient for part design. When required, a mock-up solids can be switched to a precise solid definition without any model re-creation requirement.

\* Drawing management of multiple drawing sheets is provided.

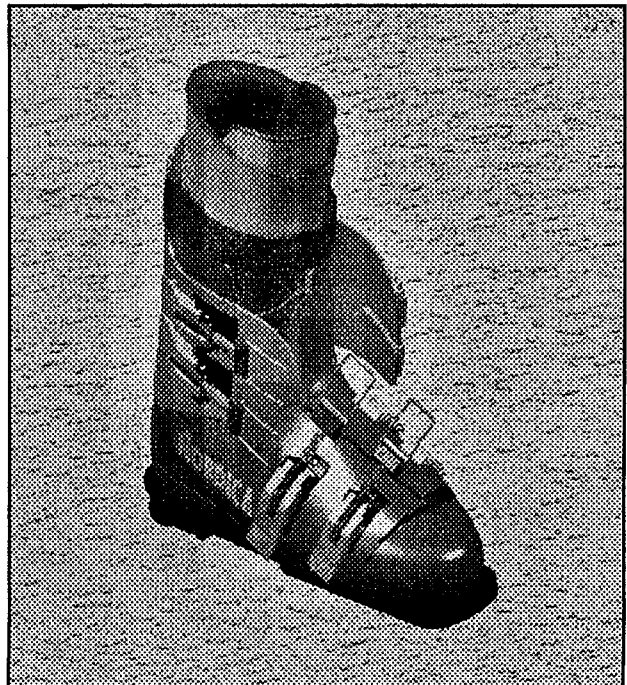
\* Generation of projections or cuts from 3D geometry.

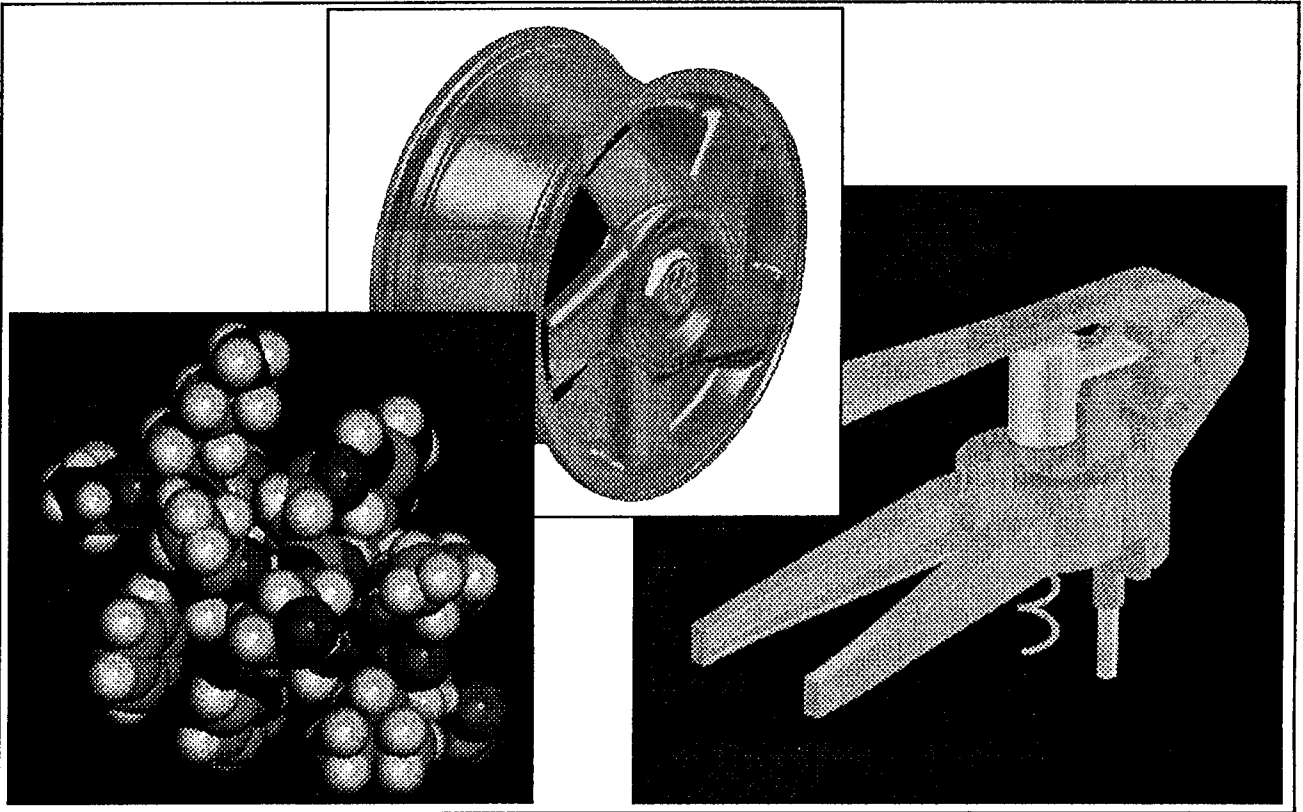
\* Creation of ANSI, ISO, DIN and JIS standard dimensions and annotations

\* Ability to define views of the 3D model in 'transparency mode', add associative dimensioning and dress-up with complementary draw geometry when needed.

\* Space Analysis allows clearance and interference analysis between 3D objects.

\* Space Navigation allows user to 'walk through'





models and also to define 3D boxes in order to restrict the viewing space.

\* Image Design allows users to produce photo-realistic images of 3D models.

### CATIA Shape Design & Styling Solutions

Shape Design and Styling Solutions address two broad areas of engineering design:

1) The product design engineer, working mainly on mechanical or structural components, who needs automated tools for complex shape definition. The aesthetic or aerodynamic quality of the part is not of primary importance. The designer is more concerned with quick creation of shapes and downstream applications such as NC manufacture or finite elements analysis.

2) The conceptual design engineer or stylist who needs to define products/components where the primary design constraints are aesthetic or aerodynamic surface quality. This type of activity can extend from rough conceptual sketches to precise detailed design. These tools must be able to optimise a very iterative design process.

The industries that have these requirements are

automotive, aerospace, fabricated products, consumer goods, mold and die. These industries manufacture for markets that demand complex surface definition to give their products a competitive advantage in the marketplace.

*The CATIA Shape Design and Styling Solutions provide the following essential functions:*

\* *General creation capabilities for curves and surfaces, Bezier and NURBS curve and surface creation and deformation abilities, allowing high quality design of any industrial shape/component.*

\* *Curve and surface definition via constraints of points, tangents and curvatures, allowing very precise control of surface shape.*

\* *Powerfull parametrised swept surface creation defined by LAWS.*

\* *Automated capabilities for filleting and component topology creation - skins, volumes.*

\* *Strong surface/solid integration.*

\* *Specific features adapted to handle the manufacturing process - automatic filleting, draft surfaces, 5 axis side machinable fillets.*

\* *Real time surface analysis capabilities allowing quick validation during the iterative design process. The designer can obtain results such as reflection*

curves and tangency discontinuity curves, which are updated as the curve or surface deforms.

\* Projection and cut operations allowing designers to produce drawings from 3D geometry.

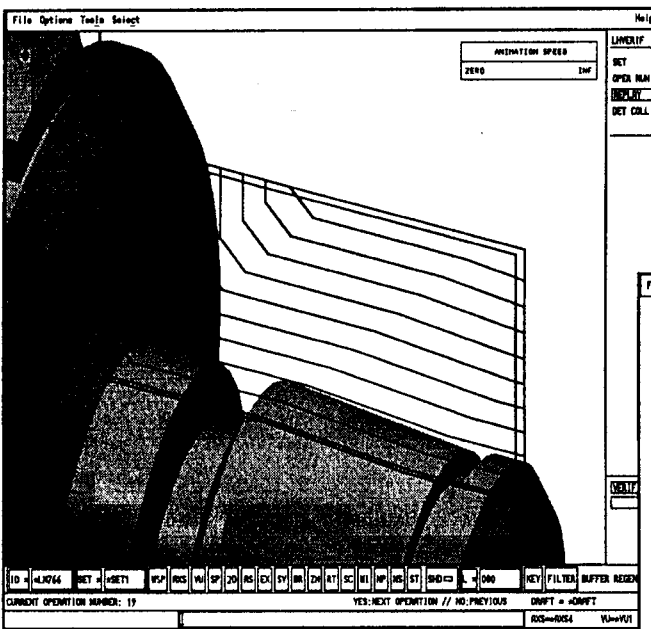
\* Parametrised easy modification of surfaces by changing the nature of the generating elements - curves, LAWS, surfaces.

\* Creation and deformation of NET surfaces, defined by a parametric network of nodes (points, tangents, curvature constraints).

## CATIA Manufacturing Solutions

Manufacturing Solutions are targeted to customers who need to prepare and manufacture simple or complex parts and who have the following requirements:

1) Manufactured products, heavy machinery: Industries that are dedicated to the design and manufacture of mechanical assemblies or parts. In



addition, complex shapes may have to be taken into account when assemblies are to be integrated in a finished product. The machining process involve many machine tools for drilling, milling and lathe.

2) Automotive / consumer goods / fabricated products: Industry that are dedicated to manufacture and/or design tooling for molds and dies. The machining processes involve milling machining tools used, most of the time, in three continuous axis mode.

3) Robotics / manufactured products: Industries

where the manufacturing process involves robotics technology, accurate simulation of the behavior of the robots and their controllers as well as tools for the design of complex work-cells are critical factors for achieving the objective of programming robot tasks.

The CATIA Manufacturing Solutions bring the customer the following important features:

\* Full flexibility to meet any customers manufacturing requirements (lathing, milling, drilling, programming of robots, sheet metal design and composites covering)

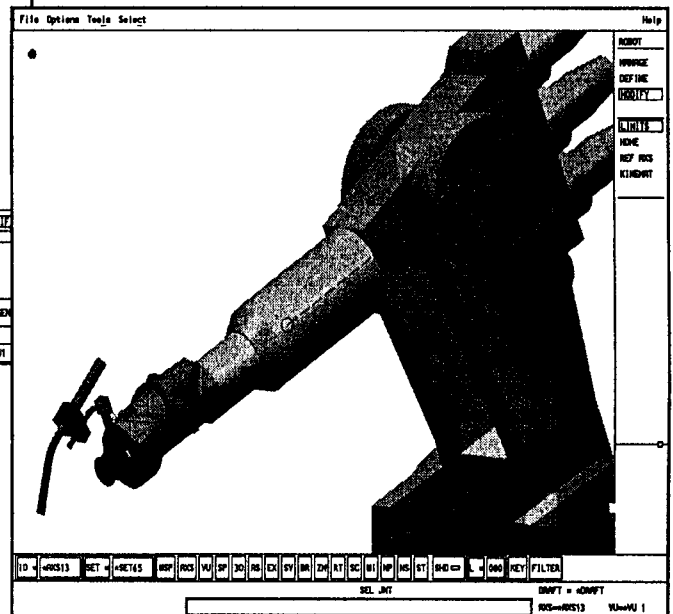
\* Preparation and consideration of the manufacturing constraints (eg. fixtures, die flanges, robot characteristics)

\* Efficient and reliable NC programming dedicated to the machine capabilities, along with realistic simulation and verification in a 'part as machined' fashion.

\* Efficient and reliable cell programming that can represent the complete tasks including simulation of the 'robot as working' with all required verifications (eg. region accessed, collisions).

### milling

\* Ability to define 3D wireframe and complex surface



geometry for 3D model generation.

\* NC tool and macro management via dedicated NC utilities and library function

\* Ability to program milling in 3 or 5 axes, rough

cutting and finishing cutting tool paths.

- \* Ability to study machinable/nonmachinable area definition before and after tool path computation

### lathing

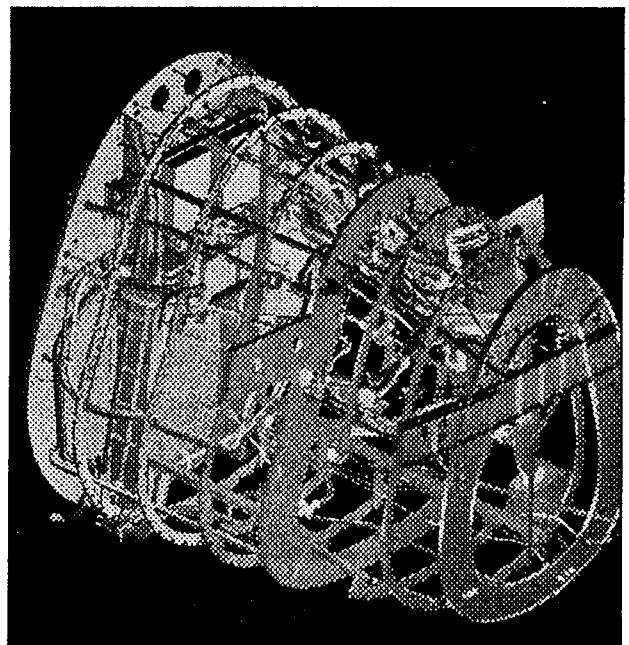
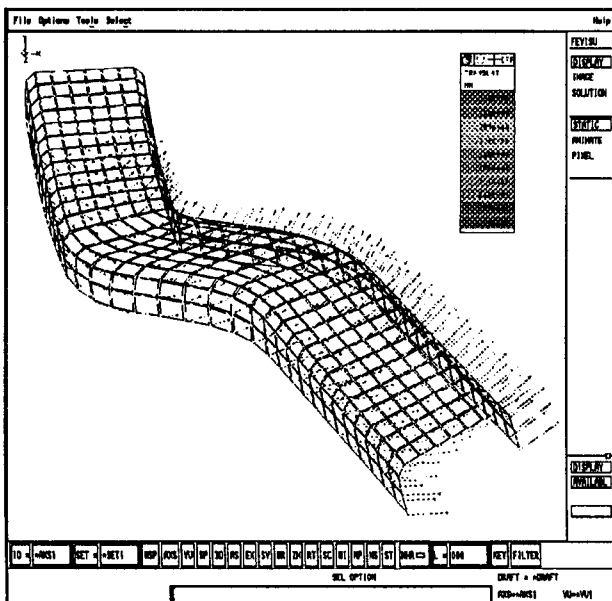
- \* Ability to define 2D and 3D wireframe geometry for model generation.
- \* NC tool management via dedicated NC utilities and library function
- \* Ability to program all machine tools handling 2 axes for lathe as well as drilling capabilities

### Robot programming

- \* For work cell definition, optimization of the configuration as well as for programming tasks with realistic simulation.
- \* Ability to program tasks, including standard or dedicated external commands, with access to an interactive graphic editor which allows the user to easily define, modify and duplicate robot tasks.
- \* Simulate the robot displacements, accessibility and analysis of moments and/or forces exerted on robots.
- \* Simulate controller behaviour, including automatic collision detection when working with 3D solids geometry.
- \* Simulate the robot tasks, including synchronization, and optimise the global cycle time.

## CATIA Analysis and Simulation Solutions

One of the main principles of simultaneous or concurrent engineering is to incorporate as much analysis as possible up front in the design cycle to



provide the best product possible the first time. This has the benefits of influencing design changes early on, when they are the least expensive to implement, and of reducing cycle time later on, by eliminating many changes during production design and manufacture.

There will still be a big requirement for the traditional, highly specialized, intensive advanced analyses as is done by the analyst. But there will also be a large and growing requirement for quick, low-complexity analyses at the component design or subsystem design levels. These analyses would be the classical linear static, vibration analyses (frequencies and mode shapes), and thermal analyses.

The CATIA Analysis and Simulation Solutions provide the following essential advantages:

- \* General purpose pre- and post-processors enabling integration with any solver.
- \* A powerful integrated solver (ELFINI) enables to perform linear static and dynamic vibration analyses.
- \* Interactive, bi-directional interfaces to NASTRAN and ANSYS.
- \* Full integration in terms of user interface, database and other CATIA application
- \* Fully integrated kinematics simulator.

## CATIA Equipment and Systems Engineering Solutions

The CATIA Equipment and Systems Engineering Solutions respond to strong emerging requirements

from the aerospace, automotive, equipment vendors (boilers, heat exchangers), and shipbuilding industries to integrate the design of "engineering systems" (eg. fuel-supply systems, hydraulic networks, electrical systems, ...) within a multi-disciplinary environment.

By introducing this multi-discipline integration around 3D-oriented digital space management work methods, the Equipment & Systems Engineering Solutions illustrates strongly and practically the benefits of concurrent engineering. It provides all necessary capabilities for modeling and managing fluid or electrical networks in the mechanical or structural environment, while managing within an environment which is highly constrained with respect to space.

The requirements for these industries are to meet the needs of the following groups:

- Engineers and designers of electrical systems, especially those in charge of modeling the physical interconnections between multiple electrical devices.
- Engineers and designers of fluid systems such as water/steam supply, fuel supply or hydraulic systems.
- Engineers and designers of building structures (civil

engineers and architects)

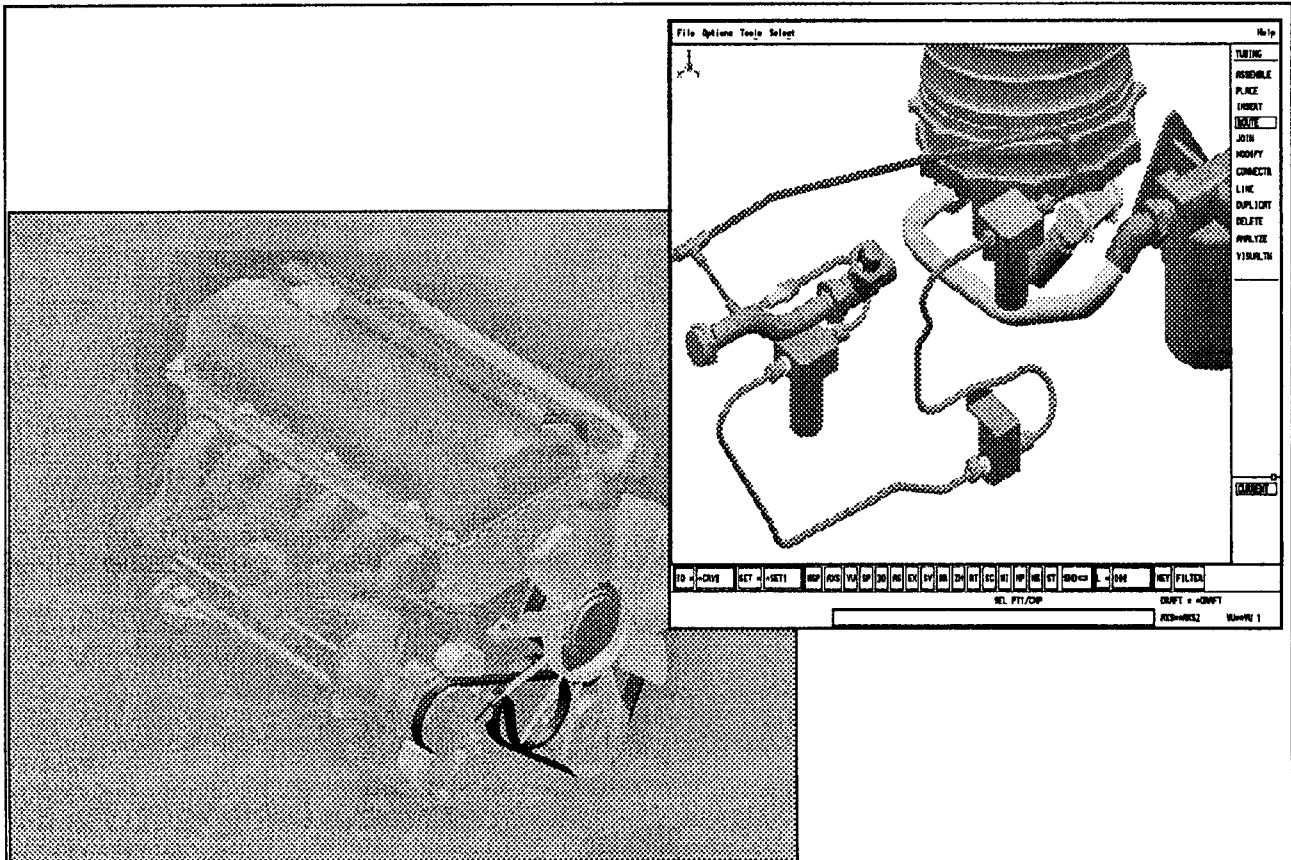
*The CATIA Equipment & Systems Engineering Solutions provide the customer the following essential capabilities:*

- \* *Realistic modeling of complex 3D fluid and electrical networks such as electrical wire bundles and straight/bended pipes.*
- \* *Powerful associative deformations of such networks.*
- \* *Powerfull parametric solid modeling capabilities to design geometry or electrical and tubing devices and supports.*
- \* *Detection and reporting of 100% of relevant interferences (both physical overlaps and clearances).*
- \* *Open architecture to allow integration of company expertise into the system.*
- \* *Digital space management tools to restrict visualization to areas of work and to 'walk' through a mock-up.*

### GATIA Application Architecture Solutions

The CATIA Application Architecture Solutions can be divided into 4 specific, yet related areas:

- Application development



- General infrastructure products
- Logistics products
- CAD infrastructure products.

The CATIA general infrastructure, logistic and CAD infrastructure products are used by all industry applications. Many of these products have already been covered on previous pages. This section will therefore discuss only these products: Application Development, Viewing Services, Data Manager, Distributed Services.

The requirements for this industry are for a robust and consistent work environment for software development, with full API documentation, analysis and debugging tools. The users of CATIA Application Architecture Solutions can be divided into two groups:

- In-house development teams, wishing to integrate programs that have been developed over many years or develop new, company specific programs.
- Software houses who wish to invest in the development of products for the commercial market.

*The CATIA Application Architecture Solutions provide the following essential advantages:*

- \* Total integration of all CATIA applications - support of the full user interface and ability to access all system data.
- \* Investment protection - easy migration of developments to new versions and platforms, and the ability to take advantage of new core function as it is developed.
- \* A full CASE environment - high level user interface development tools with robust and consistent APIs for access to all model data, together with comprehensive program debugging and analysis tools.

CATIA.CAA Application Development provides the necessary development tools to satisfy the needs of in-house and commercial software developers who are writing highly integrated, niche applications that integrate with CATIA CAD/CAM/CAE environment.

CATIA.CAA Viewing Services is dedicated to viewing and plotting CATIA data, annotating and reporting Bills of Materials and generating, transferring and plotting publishing standard formats. CATIA Viewing services is a lower cost alternative to the CATIA Object Manager when view only capabilities are required.

CATIA.CAA Data Management provides support of relational database management systems - Oracle, DB2 and SQL/DS. It enables the building of the required extensions of these database products to help customers store, organise, manage, protect and access definition data.

CATIA.CAA Distributed Services enables interoperability in an environment made up of both RS/6000 and mainframe computer. Capabilities include access from CATIA workstation to CATIA data repository on mainframe.

### Conclusion

CATIA Solutions Version 4 builds on more than a decade of proven marketplace success for CATIA, which currently has more than 4,000 customers of all sizes worldwide in industries ranging from general manufacturing to aerospace, automotive and consumer goods. CATIA is internationally recognised as an industry leader because it has benefited so many users and because of its comprehensive, integrated approach to the entire product design, manufacture and support process.

