# Practical No.1

## Objective:

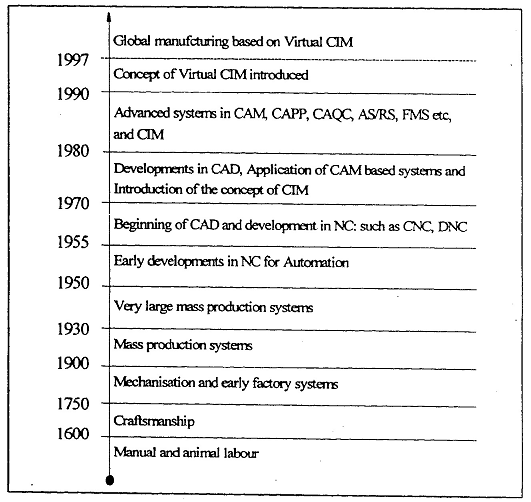
Part a. Description of Background of CIM.  
Part b. Model of CIM in an Industry from Real Life.

## Tools & Equipment:

Computer with MS Office,

## Theory:

1. Background of CIM



Computer Integrated Manufacturing (CIM) is considered a natural evolution of the technology of CAD/CAM which by itself evolved by the integration of CAD and CAM. Massachusetts Institute of Technology (MIT, USA) is credited with pioneering the development in both CAD and CAM. The need to meet the design and manufacturing requirements of aerospace industries after the Second World War necessitated the development these technologies. The manufacturing technology available during late 40’s and early 50’s could not meet the design and manufacturing challenges arising out of the need to develop sophisticated aircraft and satellite launch vehicles. This prompted the US Air Force to approach MIT to develop suitable control systems, drives and programming techniques for machine tools using electronic control.   
 The first major innovation in machine control is the Numerical Control (NC), demonstrated at MIT in 1952. Early Numerical Control Systems were all basically hardwired systems, since these were built with discrete systems or with later first generation integrated chips. Early NC machines used paper tape as an input medium. Every NC machine was fitted with a tape reader to read paper tape and transfer the program to the memory of the machine tool block by block. Mainframe computers were used to control a group of NC machines by mid 60’s. This arrangement was then called Direct Numerical Control (DNC) as the computer bypassed the tape reader to transfer the program data to the machine controller. By late 60’s mini computers were being commonly used to control NC machines. At this stage NC became truly soft wired with the facilities of mass program storage, off- line editing and software logic control and processing. This development is called Computer Numerical Control (CNC).  
 Since 70’s, numerical controllers are being designed around microprocessors, resulting in compact CNC systems. A further development to this technology is the distributed numerical control (also called DNC) in which processing of NC program is carried out in different computers operating at different hierarchical levels - typically from mainframe host computers to plant computers to the machine controller. Today the CNC systems are built around powerful 32 bit and 64 bit microprocessors. PC based systems are also becoming increasingly popular.  
 Manufacturing engineers also started using computers for such tasks like inventory control, demand forecasting, production planning and control etc. CNC technology was adapted in the development of co-ordinate measuring machine’s (CMMs) which automated inspection. Robots were introduced to automate several tasks like machine loading, materials handling, welding, painting and assembly. All these developments led to the evolution of flexible manufacturing cells and flexible manufacturing systems in late 70’s. Evolution of Computer Aided Design (CAD), on the other hand was to cater to the geometric modeling needs of automobile and aeronautical industries. The developments in computers, design workstations, graphic cards, display devices and graphic input and output devices during the last ten years have been phenomenal. This coupled with the development of operating system with graphic user interfaces and powerful interactive (user friendly) software packages for modeling, drafting, analysis and optimization provides the necessary tools to automate the design process.  
 CAD in fact owes its development to the APT language project at MIT in early 50’s. Several clones of APT were introduced in 80’s to automatically develop NC codes from the geometric model of the component. Now, one can model, draft, analyze, simulate, modify, optimize and create the NC code to manufacture a component and simulate the machining operation sitting at a computer workstation.  
 If we review the manufacturing scenario during 80’s we will find that the manufacturing is characterized by a few islands of automation. In the case of design, the task is well automated. In the case of manufacture, CNC machines, DNC systems, FMC, FMS etc provide tightly controlled automation systems. Similarly computer control has been implemented in several areas like manufacturing resource planning, accounting, sales, marketing and purchase. Yet the full potential of computerization could not be obtained unless all the segments of manufacturing are integrated, permitting the transfer of data across various functional modules. This realization led to the concept of computer integrated manufacturing. Thus the implementation of CIM required the development of whole lot of computer technologies related to hardware and software.

**Model of CIM**

We will discuss an application example of CIMS in a giant reﬁnery enterprise. The technological process of the reﬁnery is continuous, the material stream cannot be interrupted, and strict real-time demands for production manipulation are made. The enterprise aims at the following objectives: material equilibrium, energy equilibrium, safety and high efﬁciency, low cost and good quality, and optimized operation of the technological process. The realization of CIMS in this type of enterprise requires the consideration not only of problems such as production management, production scheduling, operation optimization, and process control, but also of business, marketing, material supply, oil product transport and storage, development of new products, capital investment, and so on (Fujiiet al. 1992). The computer integrated production system of the enterprise is constructed according to changes in crude oil supply, market requirements for products, ﬂexibility of the production process, and different management modes. The integration of business decision making, production schedul- ing, workshop management, and process optimization is realized in the giant reﬁnery.  
  
**1. Reﬁnery Planning Process**  
The reﬁnery enterprise consists of many production activities (Kemper 1997). If the blend operation day is called the original day, then the production activities on the day 90 days before that day include crude oil evaluation, making of production strategy, and crude oil purchasing. In the same way, the production activities on the day 10–30 days after the original day include stock transportation and performance adjustment of oil products. Every activity in the production process is relevant to each other activity. For example, in crude oil evaluation, the factors in the activities following the making of production strategy must be analyzed. In another example, people in the activity of crude oil evaluation need to analyze those production activities following the reﬁnery balance in detail.  
  
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Deep analysis of those activities in the reﬁnery enterprise is the basis of design of CIMS in that enterprise. Figure 34 depicts the reﬁnery planning process.

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| [Reﬁnery Planning Process.](http://2.bp.blogspot.com/-sSc7hR2_jeU/UWcMaOeMuGI/AAAAAAAACvw/8D8CHBow7cg/s1600/1.gif) |
| Figure 34 Reﬁnery Planning Process. |

**2. Integrated Information Architecture**  
By analyzing of the reﬁnery planning process, we can construct the integration frame depicted in Figure 35.  
Using the model-driven approach to the modeling of all subsystems, the information integration model in this reﬁnery enterprise could be built as shown in Figure 36 (Mo and Xiao 1999). The model includes the business decision-making level, the planning and scheduling level and the process supervisory control level. Their integration is supported by two database systems.

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| [Integration Frame.](http://2.bp.blogspot.com/-xJGaEG-FTBo/UWcMsscgN1I/AAAAAAAACv4/0ezaEZMgmOg/s1600/2.gif) |
| Figure 35 Integration Frame. |

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| [Information Integration Model.](http://2.bp.blogspot.com/-lJWuTqVnwg8/UWcM0DGNE8I/AAAAAAAACwA/kHpGsjpSKvs/s1600/3.gif) |
| Figure 36 Information Integration Model. |

The relevant information, such as market, costing, ﬁnancial affairs, and production situation, is synthesized to facilitate business decisions of the enterprise, and crude oil supply and oil product sale planning are both determined at the business decision-making level.  
  
The planning and scheduling level synthesizes management information, decomposes production planning to short-term planning and executes the daily scheduling, and gives instructions directly to process supervisory control level. In the meantime, it accomplishes the management and control of oil product storage and transport, including the management and optimized scheduling control of the harbor area and oil tank area.  
  
The process supervisory control accomplishes process optimization, advanced control, fault di- agnosis, and oil product optimized blending.  
  
**3. Advanced Computing Environment**The information integration model of the giant reﬁnery depicted in Figure 36 is built using the model- driven method. The model is the design guidance of the realization of CIMS in the enterprise. Figure 37 depicts the computing environment for the realization of the information integration model, using the client–server computing mode (Kemper 1997).

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| [Advanced Computing Environment.](http://2.bp.blogspot.com/-_cmKaNMQMQw/UWcND14PS5I/AAAAAAAACwI/31rCfmQAJFQ/s1600/4.gif) |
| Figure 37 Advanced Computing Environment. |

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| [Reﬁnery Planning Process.](http://2.bp.blogspot.com/-sSc7hR2_jeU/UWcMaOeMuGI/AAAAAAAACvw/8D8CHBow7cg/s1600/1.gif) |
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| **Figure 35** Integration Frame. |

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| [Information Integration Model.](http://2.bp.blogspot.com/-lJWuTqVnwg8/UWcM0DGNE8I/AAAAAAAACwA/kHpGsjpSKvs/s1600/3.gif) |
| **Figure 36** Information Integration Model. |

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| **Figure 37**Advanced Computing Environment. |

Result:

The model was illustrated successfully.

# Practical No.2

## Objective:

Introduction & comparison of 3 most widely used CAD software around the world.

## Tools & Equipment:

Computer with MS Office.

## Theory:

**CAD Software: What to Look For**

When it comes to finding the right application for your needs, it’s important to assess the features and design tools included to ensure the application offers the functionality you are looking for. Here are the criteria we used for our CAD software reviews to determine the best consumer applications on the market.

**Features**– This category encompasses features that enhance the usability of computer-assisted design software and make it a bit easier and more convenient to use. Look for simple and easy drag-and-drop functionality, a command history to show previous actions, and the ability to create custom tool palettes to show only the tools you want to use for a specific project.

**Design Tools & Methods** – CAD software should offer a wide range of versatile design tools and methods that allow you to create any type of design. Many design applications offer both 2D drawing tools and 3D modeling tools, though some only have 2D capabilities. 2D tools allow you to draw flat designs that show length and width, such as floor plans. 3D tools allow you to build multi-dimensional designs that show depth in addition to length and width.

You should also look for design tools and methods that allow you to add visual interest to a design, yield a more realistic view of an object, or make it easier to read or understand. For instance, transparency options allow you to adjust the transparency of different layers in a design, and a color editor allows you to color the design. Other tools and methods to look for include snap tools, lighting effects and the ability to add textures to your designs.

**File Compatibility** – DWG (drawing) is a binary file format for both 2D and 3D designs and the native format for most CAD software. Most applications also support DXF files, a file format developed by Autodesk to enable data compatibility between its AutoCAD software and other design applications.

While DWG and DXF files are the most commonly supported file types, we also looked for other file types such as PDF, WMF and WPG as well as image files including JPEG and PNG. Greater file compatibility means you’re more likely to be able to import existing designs into an application and export in a file type that can be read by other applications.

**Ease of Use** – Given its implicit functionality, CAD software is inherently more complex than most design or multimedia computer software. However, light (personal) applications should still be intuitive, polished and well organized for easy navigation.

**Help & Support**– Questions and technical issues are likely to arise even with the most intuitive CAD software. Subsequently, it’s important to seek an application that’s supplemented with comprehensive help and support options designed to help you learn how to properly and fully use the software. To that end, we sought applications with a built-in help section accessible directly from the interface. This way, if you are using a feature you don’t know how to use, you can click on the help section to receive information relevant to that feature. We also looked for direct technical support via email or telephone and supplementary FAQs, user guides or training videos from the software’s manufacturer.

Whether you want to design your dream house or a piece of furniture you want to build by hand, our side-by-side comparison and consumer CAD software reviews can help you find the application that’s right for your project.

**Popular CAD Programs**

**AutoCAD:** Produced by AutoDesk, this is the commercial standard for high-end**2D drafting** software.  A wide variety of commands are available for creating complex drawings with lines, polylines, circles, splines, fillets, cross-hatching, text, dimensions, etc.  The program can be customized with LISP and VBA routines.  AutoCAD includes 3D wireframe, surfacing and solid modeling capabilities, but the 3D models are difficult to edit and 3D commands are limited.  Mostly used as a 2D drawing tool.  Sold by “Value Added Retailers”.  The price is around **$3,995** but discounts of a few hundred dollars are often available.

**SolidWorks:** SolidWorks (SW) was one of the first 3D parametric solid modeling programs.  Written for the PC and created specifically for mechanical engineers, it remains the **industry standard** for mid-range 3D CAD.  SW includes Finite Element Analysis and plug-ins for CFD and CAM are available.  Lofting and surfacing tools have greatly improved over the years.  Many small aircraft have been designed with SW, including several at **Scaled Composites.**  Relatively easy to learn, the program is popular with engineering students and professionals.  The standard edition is **$3,995** and prices go up from there.  Non-commercial student versions are around **$100** but expire after one year.

**CATIA, Pro-Engineer, Unigraphics NX:** These are the “big three” high-end CAD systems used by the aerospace and automotive industries.  They are not popular with amateur designers due to their high cost and steep learning curve.  Here’s what you should know:**CATIA v5** is the de-facto standard for 3D CAD in the aerospace industry.  The software is sold in modules (aka workbenches) and by the time you purchase all the modules you need or want, you’ve spent **$15K** or more.  Restricted student editions are available. **Pro-Engineer** (now called Creo Elements) was the first 3D parametric solid modeler and became very successful.  But the developer started focusing on PLM software and many buyers decided the cost of Pro-E was too high.  The company lost market share to SolidWorks, Solid Edge and others.  They offer a FREE personal edition that is restricted to 60 parts.**Unigraphics NX** is the 3rd big competitor and is used by a wide range of companies.  The developer offers a popular analysis program called FEMAP that can be bundled with NX, but these products are marketed to corporate users and prices are high enough that individual users don’t usually purchase them.

## Conclusion & Suggestions:

# Practical No.3

(Research Based)

## Objective:

Introduction & comparison of 3 most useful software in CAM around the world  
1. Catia 2. Pro-E 3.Unigraphics( NX) 4.Solid Works

## Tools & Equipment:

Computer with Office and browsing support

## Theory:

Guidelines: Recommend soft wares are catia, Pro E and NX to be included in top 3.  
 Write down, comparison , characteristics and target market and main users etc.

Rest Write Yourself

# Catia

**Introduction:** Initially, CATIA name is an abbreviation for

**C**omputer **A**ided **T**hree-dimensional **I**nteractive **A**pplication

We had already said in the [introduction of historical](http://catia-v5-cad.blogspot.com/2013/03/catia-cad-cam-history.html), that the French Dassault Systems is the parent company and IBM participates in the software and marketing, and catia is invades broad industrial sectors, and has been explained in the previous post [position of CATIA between 3d modeling  software programs](http://catia-v5-cad.blogspot.com/2013/03/catia-achievements.html).

. - See more at: http://catia-v5-cad.blogspot.com/2013/03/catia-v5-cad-cam-introduction.html#sthash.gBFp80f7.dpuf

**Characteristics:**

Now we will speak about another point which is whether there is a drawing program better than the other?... we must know, that drawing programs provides us drawing tools while not any of them can provide you the ability to design, You should,thinking and looking and imagine then building a design in your mind, either drawing program will help you to transform these designs graphics on papers, for that, we prefer CATIA because it provides us with all the tools that we need.

CATIA classified under the following software packages:

**CAD (Computer Aided Deign)**

**CAM (Computer Aided Manufacturing)**

CATIA is considered  as a  CAM program, in addition to it is  CAD program, in the meaning that you can export files to CNN machines and then manufactured, CATIA Also supports graphics from other programs such as AutoCAD, for example, it is possible to copy a drawing from AutoCAD and enter it to CATIA and then make on it CATIA operations, CATIA  files can be kept with dwg extension which is supported by AutoCAD or the default extension has

**Target Market/Application:**

## Industries

CATIA can be applied to a wide variety of industries, from aerospace and defense, automotive, and industrial equipment, to high tech, shipbuilding, consumer goods, plant design, consumer packaged goods, life sciences, architecture and construction, process power and petroleum, and services. CATIA V4, CATIA V5, [Pro/ENGINEER](http://en.wikipedia.org/wiki/Pro/ENGINEER), [NX](http://en.wikipedia.org/wiki/NX_(software)) (formerly Unigraphics), and [SolidWorks](http://en.wikipedia.org/wiki/SolidWorks) are the dominant systems.

### Aerospace

[The Boeing Company](http://en.wikipedia.org/wiki/Boeing) used CATIA V3 to develop its [777](http://en.wikipedia.org/wiki/Boeing_777) airliner and used CATIA V5 for the [787](http://en.wikipedia.org/wiki/Boeing_787_Dreamliner) series aircraft. They have employed the full range of Dassault Systemes' 3D PLM products — CATIA, [DELMIA](http://en.wikipedia.org/wiki/DELMIA), and [ENOVIA LCA](http://en.wikipedia.org/w/index.php?title=ENOVIA_MatrixOne&action=edit&redlink=1) — supplemented by Boeing-developed applications.

The development of the Indian Light Combat Aircraft has used CATIA V5.

Chinese [Xian JH-7](http://en.wikipedia.org/wiki/Xian_JH-7)A was the first aircraft developed by CATIA V5 when the design was completed on September 26, 2000.

European aerospace [Airbus](http://en.wikipedia.org/wiki/Airbus) has used CATIA since 2001.

[Canadian](http://en.wikipedia.org/wiki/Canadian) aircraft maker [Bombardier Aerospace](http://en.wikipedia.org/wiki/Bombardier_Aerospace) has done all of its aircraft design on CATIA.

The Brazilian aircraft company EMBRAER uses CATIA V4 and V5 to build all airplanes.

[Vought Aircraft Industries](http://en.wikipedia.org/wiki/Vought) uses CATIA V4 and V5 to produce its parts.

The Anglo/Italian Helicopter company [AgustaWestland](http://en.wikipedia.org/wiki/AgustaWestland" \o "AgustaWestland) uses CATIA V4 and V5 to design their full range of aircraft.

All daughter companies of the French company [Safran](http://en.wikipedia.org/wiki/Safran" \o "Safran) use CATIA for a full range of aerospace, defence and security products.

The [Eurofighter](http://en.wikipedia.org/wiki/Eurofighter) Typhoon has been designed using both CATIA V4 and V5.

The main supplier of helicopters to the U.S Military forces, Sikorsky Aircraft Corp., uses CATIA as well.

[Bell Helicopter](http://en.wikipedia.org/wiki/Bell_Helicopter), the creator of the [Bell Boeing V-22 Osprey](http://en.wikipedia.org/wiki/V-22_Osprey), has used CATIA V4, V5 and V6.

### Automotive

Many automotive companies use CATIA to varying degrees, including [BMW](http://en.wikipedia.org/wiki/BMW), [Porsche](http://en.wikipedia.org/wiki/Porsche), [Daimler AG](http://en.wikipedia.org/wiki/Daimler_AG), [Chrysler](http://en.wikipedia.org/wiki/Chrysler), [Honda](http://en.wikipedia.org/wiki/Honda), [Audi](http://en.wikipedia.org/wiki/Audi), [Jaguar Land Rover](http://en.wikipedia.org/wiki/Land_Rover), [Volkswagen](http://en.wikipedia.org/wiki/Volkswagen), SEAT, [Škoda](http://en.wikipedia.org/wiki/%C5%A0koda_Auto), [Bentley Motors Limited](http://en.wikipedia.org/wiki/Bentley_Motors_Limited),  [Volvo](http://en.wikipedia.org/wiki/Volvo), [Fiat](http://en.wikipedia.org/wiki/Fiat), [Benteler International](http://en.wikipedia.org/wiki/Benteler_International" \o "Benteler International), [PSA Peugeot, Citroën](http://en.wikipedia.org/wiki/PSA_Peugeot_Citro%C3%ABn),[Renault](http://en.wikipedia.org/wiki/Renault), [Toyota](http://en.wikipedia.org/wiki/Toyota_Motor_Corporation), [Ford](http://en.wikipedia.org/wiki/Ford_Motor_Company), [Scania](http://en.wikipedia.org/wiki/Scania_AB), Hyundai, [Škoda Auto](http://en.wikipedia.org/wiki/%C5%A0koda_Auto" \o "Škoda Auto), [Tesla Motors](http://en.wikipedia.org/wiki/Tesla_Motors), [Valmet Automotive](http://en.wikipedia.org/wiki/Valmet_Automotive" \o "Valmet Automotive), [Proton](http://en.wikipedia.org/wiki/Proton_(carmaker)), [Elba](http://en.wikipedia.org/wiki/Elba), [Tata motors](http://en.wikipedia.org/wiki/Tata_motors), and [Mahindra & Mahindra Limited](http://en.wikipedia.org/wiki/Mahindra_%26_Mahindra_Limited), [Goodyear](http://en.wikipedia.org/wiki/Goodyear_Tire_and_Rubber_Company) uses it in making tires for automotive and aerospace and also uses a customized CATIA for its design and development. Many automotive companies use CATIA for car structures — door beams, IP supports, bumper beams, roof rails, side rails, body components — because CATIA is very good in surface creation and [Computer representation of surfaces](http://en.wikipedia.org/wiki/Computer_representation_of_surfaces). [Bombardier Transportation](http://en.wikipedia.org/wiki/Bombardier_Transportation) of Canada is using this software to design its entire fleet of Train engines and coaches.

### Shipbuilding

Dassault Systemes has begun serving shipbuilders with CATIA V5 release 8, which includes special features useful to shipbuilders. [GD Electric Boat](http://en.wikipedia.org/wiki/Electric_Boat) used CATIA to design the latest fast attack submarine class for the [United States Navy](http://en.wikipedia.org/wiki/United_States_Navy), the [*Virginia* class](http://en.wikipedia.org/wiki/Virginia_class_submarine).[Newport News Shipbuilding](http://en.wikipedia.org/wiki/Newport_News_Shipbuilding) also used CATIA to design the [*Gerald R. Ford* class](http://en.wikipedia.org/wiki/Gerald_R._Ford_class_aircraft_carrier) of [supercarriers](http://en.wikipedia.org/wiki/Supercarrier" \o "Supercarrier) for the US Navy. In 2004, it has been adopted by the [Beneteau Group](http://en.wikipedia.org/wiki/Beneteau" \o "Beneteau) for development of new sailing and leisure motor boats.

### Industrial equipment

CATIA has a strong presence in the Industrial Equipment industry. [Industrial Manufacturing machinery](http://en.wikipedia.org/wiki/Manufacturing) companies like Schuler and [Metso](http://en.wikipedia.org/wiki/Metso" \o "Metso) use CATIA, as do heavy mobile machinery and equipment companies like [Claas](http://en.wikipedia.org/wiki/Claas" \o "Claas), and also various industrial equipment product companies like [Alstom Power](http://en.wikipedia.org/wiki/Alstom_Power) and [ABB Group](http://en.wikipedia.org/wiki/ABB_Group).

### Other

Architect [Frank Gehry](http://en.wikipedia.org/wiki/Frank_Gehry) has used the software through the C-Cubed Virtual Architecture company, now Virtual Build Team, to design his award-winning [curvilinear](http://en.wikipedia.org/wiki/Curvilinear) buildings. His technology arm,[Gehry Technologies](http://en.wikipedia.org/w/index.php?title=Gehry_Technologies&action=edit&redlink=1), has been developing software based on CATIA V5 named [Digital Project](http://en.wikipedia.org/wiki/Digital_Project).Digital Project competes for market share with [Revit](http://en.wikipedia.org/wiki/Revit), [Microstation](http://en.wikipedia.org/wiki/Microstation" \o "Microstation) and other [Building Information Modelling](http://en.wikipedia.org/wiki/Building_Information_Modelling) applications.

**2. Pro-E (Creo Elements)**

**Introduction:**

**PTC Creo**, formerly known as **Pro/ENGINEER** is a parametric, integrated 3D [CAD](http://en.wikipedia.org/wiki/CAD)/[CAM](http://en.wikipedia.org/wiki/Computer-aided_manufacturing)/[CAE](http://en.wikipedia.org/wiki/Computer-aided_engineering) solution created by [Parametric Technology Corporation](http://en.wikipedia.org/wiki/Parametric_Technology_Corporation) (PTC). It was the first to market with parametric, feature-based, associative [solid modeling](http://en.wikipedia.org/wiki/Solid_modeling) software. The application runs on[Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) platform, and provides [solid modeling](http://en.wikipedia.org/wiki/Solid_modeling), [assembly modelling](http://en.wikipedia.org/wiki/Assembly_modelling) and [drafting](http://en.wikipedia.org/wiki/Technical_drawing), [finite element analysis](http://en.wikipedia.org/wiki/Finite_element_analysis), [Direct and Parametric modelling](http://en.wikipedia.org/w/index.php?title=Direct_and_Parametric_modelling&action=edit&redlink=1), [Sub-divisional and nurbs surfacing](http://en.wikipedia.org/w/index.php?title=Sub-divisional_and_nurbs_surfacing&action=edit&redlink=1) and NC and tooling functionality for mechanical engineers. It features a suite of 10 Apps which are work within the same program. Versions for [UNIX](http://en.wikipedia.org/wiki/UNIX) systems were discontinued with the release of version 4.0, except Solaris on x86-64.

The Pro/ENGINEER name was changed to Creo Elements/Pro, also known as Wildfire 5.0 on October 28, 2010, coinciding with PTC’s announcement of [Creo](http://en.wikipedia.org/wiki/Creo_(design_software)" \o "Creo (design software)), a new design software application suite. Creo Elements/Pro will be discontinued after version 2 in favour of the Creo design suite

**Characteristics:**

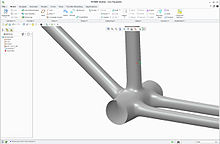
Like any software it is continually being developed to include new functionality. The details below aim to outline the scope of capabilities to give an overview rather than giving specific details on the individual functionality of the product.

Creo Elements/Pro is a software application within the CAID/CAD/CAM/CAE category, along with other similar products currently on the market.

Creo Elements/Pro is a parametric, feature-based modeling architecture incorporated into a single database philosophy with advanced rule-based design capabilities. It provides in-depth control of complex geometry, as exemplified by the [trajpar](http://en.wikipedia.org/wiki/Trajpar" \o "Trajpar) parameter. The capabilities of the product can be split into the three main headings of Engineering Design, Analysis and Manufacturing. This data is then documented in a standard 2D production drawing or the 3D drawing standard .

### Engineering Design**[[edit](http://en.wikipedia.org/w/index.php?title=Creo_Elements/Pro&action=edit&section=3" \o "Edit section: Engineering Design)]**

Creo Elements/Pro offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard [pipe work](http://en.wikipedia.org/wiki/Piping) and complete wiring definitions. Tools are also available to support collaborative development.

[](http://en.wikipedia.org/wiki/File:Bottombracket-Creo-Freeform-image.jpg)

[http://bits.wikimedia.org/static-1.23wmf7/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Bottombracket-Creo-Freeform-image.jpg)

Screenshot captured from Creo 1.0 as an example of the FreeForm surfaces. Sub'D surfaces new in Creo 1.0 This geometry started as a square cube

A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface tools.

### Analysis**[[edit](http://en.wikipedia.org/w/index.php?title=Creo_Elements/Pro&action=edit&section=4" \o "Edit section: Analysis)]**

Creo Elements/Pro has numerous analysis tools available and covers thermal, static, dynamic and fatigue finite element analysis along with other tools all designed to help with the development of the product. These tools include human factors, manufacturing tolerance, mould flow and design optimization. The design optimization can be used at a geometry level to obtain the optimum design dimensions and in conjunction with the finite element analysis.

**Manufacturing**

By using the fundamental abilities of the software with regards to the single data source principle, it provides a rich set of tools in the manufacturing environment in the form of tooling design and simulated CNC machining and output.

Tooling options cover specialty tools for molding, die-casting and progressive tooling design.

**Target Market:**

People who love Pro/ENGINEER don’t love change. Wildfire was the last major innovation to come from the PTC development staff. It was meant to update the GUI into a more “Windowsy” look and feel in order to compete with the likes of SolidWorks. That massive innovation looked like a minor update to my outsider’s eyes… but the existing user base went ballistic. PTC was no doubt inundated with frantic tech support calls asking for a “Pro/E classic view” option.

Most Pro/ENGINEER customers have learned to stay well behind the current release, often 3 or 4 releases behind. If that is the case, will something as radically different as Creo inspire customers to wait longer than usual? I think so.

**3.Unigraphics NX**

**Introduction:**

**NX**, formerly known as **NX Unigraphics** or usually just **U-G**, is an advanced high-end [CAD](http://en.wikipedia.org/wiki/Computer-aided_design)/[CAM](http://en.wikipedia.org/wiki/Computer-aided_manufacturing)/[CAE](http://en.wikipedia.org/wiki/Computer-aided_engineering) software package developed by[Siemens PLM Software](http://en.wikipedia.org/wiki/Siemens_PLM_Software).[[1]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-1)

It is used, among other tasks, for:

* [Design](http://en.wikipedia.org/wiki/Design) (parametric and direct solid/surface modelling)
* [Engineering analysis](http://en.wikipedia.org/wiki/Engineering_analysis) (static, dynamic, electro-magnetic, thermal, using the [Finite Element Method](http://en.wikipedia.org/wiki/Finite_Element_Method), and fluid using the [finite volume method](http://en.wikipedia.org/wiki/Finite_volume_method)).
* [Manufacturing](http://en.wikipedia.org/wiki/Manufacturing) finished design by using included machining modules.

NX is a direct competitor to [Creo Elements/Pro](http://en.wikipedia.org/wiki/Creo_Elements/Pro) and [CATIA](http://en.wikipedia.org/wiki/CATIA).

**Characteristics:**

**Key Functions Include:**

* [Design](http://en.wikipedia.org/wiki/Design) ([Computer aided design](http://en.wikipedia.org/wiki/Computer_aided_design))[[6]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-6)
  + Parametric [Solid modeling](http://en.wikipedia.org/wiki/Solid_modeling) (feature based and direct modeling[[7]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-7))
  + [Freeform surface modelling](http://en.wikipedia.org/wiki/Freeform_surface_modelling), [Class A surfaces](http://en.wikipedia.org/wiki/Class_A_surfaces).
  + [Reverse engineering](http://en.wikipedia.org/wiki/Reverse_engineering)[[8]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-8)
  + [Styling](http://en.wikipedia.org/wiki/Design) and [Computer-aided industrial design](http://en.wikipedia.org/wiki/Computer-aided_industrial_design)
  + [Engineering drawing](http://en.wikipedia.org/wiki/Engineering_drawing) (Drafting)
  + [Product and manufacturing information](http://en.wikipedia.org/wiki/Product_and_manufacturing_information) (PMI)
  + Reporting and Analytics,[[9]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-9) [Verification and validation](http://en.wikipedia.org/wiki/Verification_and_validation)[[10]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-10)
  + Knowledge Reuse including [Knowledge-based engineering](http://en.wikipedia.org/wiki/Knowledge-based_engineering)
  + [Sheet metal](http://en.wikipedia.org/wiki/Sheet_metal) design
  + [Assembly modelling](http://en.wikipedia.org/wiki/Assembly_modelling)[[11]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-11) and [Digital mockup](http://en.wikipedia.org/wiki/Digital_mockup)
  + [Routing](http://en.wikipedia.org/wiki/Routing) for [Electrical wiring](http://en.wikipedia.org/wiki/Electrical_wiring) and Mechanical [Piping](http://en.wikipedia.org/wiki/Piping)
* [Simulation](http://en.wikipedia.org/wiki/Computer_simulation) ([Computer-aided engineering](http://en.wikipedia.org/wiki/Computer-aided_engineering))
  + [Stress analysis](http://en.wikipedia.org/wiki/Stress_analysis) / [Finite element method](http://en.wikipedia.org/wiki/Finite_element_method) (FEA)
  + [Kinematics](http://en.wikipedia.org/wiki/Kinematics)
  + [Computational fluid dynamics](http://en.wikipedia.org/wiki/Computational_fluid_dynamics) (CFD) and [Thermal analysis](http://en.wikipedia.org/wiki/Thermal_analysis)
* [Manufacturing](http://en.wikipedia.org/wiki/Manufacturing) ([Computer-aided manufacturing](http://en.wikipedia.org/wiki/Computer-aided_manufacturing))[[12]](http://en.wikipedia.org/wiki/NX_(Unigraphics)#cite_note-12)
  + [Numerical control](http://en.wikipedia.org/wiki/Numerical_control) (NC) programming

**Target Market:**

**Many famous companies are users of NX**

**Company Name Using**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Acadt | NX (Unigraphics) |  |
|  | Acciona Windpower | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Aerojet - Redmond, WA Location | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Air International | NX (Unigraphics) |  |
|  | Apple | NX (Unigraphics) |  |
|  | Arnprior Rapid Manufacturing Solutions | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Asco Industries | NX (Unigraphics) |  |
|  | Asd | NX (Unigraphics) |  |
|  | Ashok Layland | NX (Unigraphics) |  |
|  | Aston Martin | NX (Unigraphics) |  |
|  | Audi | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Autocar Llc & Navistar | NX (Unigraphics), Teamcenter (iMan) |  |
|  | B2b | NX (Unigraphics) |  |
|  | Be Aerospace | NX (Unigraphics) |  |
|  | Bell Helicopter | NX (Unigraphics) |  |
|  | Bendix | NX (Unigraphics) |  |
|  | Bmw | NX (Unigraphics) |  |
|  | Bradken | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Brigham Young University | NX (Unigraphics) |  |
|  | Cadd Centre | NX (Unigraphics) |  |
|  | Caterpillar Inc | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Cri Pumps | NX (Unigraphics) |  |
|  | Daimler | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Depuy | NX (Unigraphics) |  |
|  | Dextrous Cad Cam Pvt. Ltd. | NX (Unigraphics) |  |
|  | Die&Moulds | NX (Unigraphics) |  |
|  | Disney | NX (Unigraphics) |  |
|  | Donaldson | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Doncasters | NX (Unigraphics) |  |
|  | Dresser-Rand Pvt Ltd | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Egyptian Danish | NX (Unigraphics) |  |
|  | Escort | NX (Unigraphics) |  |
|  | Fiat | NX (Unigraphics) |  |
|  | Ficosa North America | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Ford | NX (Unigraphics) |  |
|  | Ford | NX (Unigraphics) |  |
|  | Ge | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Ge Transpotation | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Gea Farm Technologies Bu M&C | NX (Unigraphics), Teamcenter (iMan) |  |
|  | General Dynamics | NX (Unigraphics) |  |
|  | General Electricals | NX (Unigraphics), Teamcenter (iMan) |  |
|  | General Motors | NX (Unigraphics) |  |
|  | Gmtci | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Gna-Imt | NX (Unigraphics) |  |
|  | Goodrich | NX (Unigraphics) |  |
|  | Goodrich Aerospace | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Goss International | NX (Unigraphics) |  |
|  | Grady White | NX (Unigraphics) |  |
|  | Gtt | Teamcenter (iMan) |  |
|  | Hal | NX (Unigraphics) |  |
|  | Hal | NX (Unigraphics) |  |
|  | Halliburton | NX (Unigraphics) |  |
|  | Hendrickson | NX (Unigraphics) |  |
|  | Hero Honda | NX (Unigraphics) |  |
|  | Honda | NX (Unigraphics) |  |
|  | Honeywell | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Honeywell | NX (Unigraphics) |  |
|  | Hozelock Ltd | NX (Unigraphics) |  |
|  | Infoysis | NX (Unigraphics) |  |
|  | Janus | NX (Unigraphics), Teamcenter (iMan) |  |
|  | John Deere | NX (Unigraphics) |  |
|  | Kennametal Inc. | NX (Unigraphics) |  |
|  | Kulicke & Soffa | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Ladish | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Landt | NX (Unigraphics) |  |
|  | Lg | NX (Unigraphics) |  |
|  | Mahindra | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Mahindra | NX (Unigraphics) |  |
|  | Manufacturing | NX (Unigraphics) |  |
|  | Maruti | NX (Unigraphics) |  |
|  | Maruti Suzuki | NX (Unigraphics) |  |
|  | Mercedes Benz | NX (Unigraphics) |  |
|  | Michigan State University | NX (Unigraphics) |  |
|  | Mind Power | NX (Unigraphics) |  |
|  | Mindtree | NX (Unigraphics) |  |
|  | Montaplast Of North America | NX (Unigraphics) |  |
|  | Muroc | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Nissan USA | NX (Unigraphics) |  |
|  | Optic | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Perfect Engineers | NX (Unigraphics) |  |
|  | Philips | NX (Unigraphics) |  |
|  | Pratt & Whitney | NX (Unigraphics) |  |
|  | Quest | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Rane Trw Stering Ltd | NX (Unigraphics) |  |
|  | Rolls Royce | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Siemens | NX (Unigraphics) |  |
|  | Southco Inc | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Spacex | NX (Unigraphics) |  |
|  | Stellar Enginerring | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Tan | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Tata | NX (Unigraphics) |  |
|  | Tata Motor | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Tcs | NX (Unigraphics) |  |
|  | Topland | NX (Unigraphics) |  |
|  | Trek | NX (Unigraphics) |  |
|  | Ttl | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Tvs | NX (Unigraphics) |  |
|  | Vaso | NX (Unigraphics) |  |
|  | Xcg | NX (Unigraphics) |  |
|  | Zimmer | NX (Unigraphics) |  |
|  | Spacex | NX (Unigraphics) |  |
|  | Amw | NX (Unigraphics), Teamcenter (iMan) |  |
|  | Maruti | NX (Unigraphics) |  |
|  | Triumph | NX (Unigraphics) |  |
|  | Eskay Engineering | NX (Unigraphics) |  |

## Conclusion:

**Major Trends in CAD & CAM**

Globalization is exerting an influence on the development of CAD (computer-aided design) and CAM (computer-aided manufacturing). Companies’ operations, competition and markets have gone global, and in response, CAD and CAM are taking on more functionality and allowing for increased collaboration between departments. Here are the major trends shaping the development of these tools today:

**1) Offshoring**

Sending jobs to foreign locations continues to be a prevalent—and highly controversial—trend. It’s driven by such factors as increasing globalization, the ubiquity of high-speed Internet connections and the rising pressure to increase corporate profits. In fact, in the CAD world, most developers have already placed software teams in India and/or Russia to handle research and development and support. And along with manufacturing, data processing and call center jobs, companies are also taking high-tech engineering design and development work overseas. For example, multidiscipline engineering design and drafting, software development and CAM processing are among the new jobs being outsourced overseas. By 2015, business analysis firm Forrester Research expects some 3.3 million high-tech and service jobs to be transplanted from the U.S. to other countries.

**2) Increasing collaboration**

Because more companies are choosing to shift operations offshore, sharing data is becoming a greater priority. This has contributed to the trend toward collaboration as a management approach, and as a result, CAD and CAM vendors have been charged with the task of incorporating tools that can help different departments work together. “It’s a very big challenge to build in ways to tie in other people,” Robert Kross, vice president of Autodesk’s Manufacturing Solutions Division, tells Design News. “Traditionally, our tools are for technical people who are full time users. Collaboration means we have to tie in other people, financial people and others who aren’t doing design every day. That adds to the challenge, but it’s a necessary component for today’s business.”

**3) Mass customization**

Companies are now placing more emphasis on reducing inventory costs and applying just-in-time manufacturing, a strategy that is paving the way for the mass customization of products, says Kross. Many firms are no longer producing huge quantities of the same product—something that many warehouse manufacturers did just five years ago. Instead they’re tailoring products to meet customers’ specific needs in order to become more competitive.

**4) Growing popularity of 3D Modeling**

More and more engineers are making the switch from 2D software to 3D modeling. In particular, solid modeling—which depicts product designs via electronic 3D solid models—is taking off. Not only do solids give engineers more design flexibility, they also offer realistic images of products and allow downstream tasks, such as analysis, to be more easily integrated. What’s more, solid modeling supports a decades-long push by the CAD/CAM industry to give manufacturing customers “art-to-part” capabilities—bringing a design from the concept to the tooling stage in a completely digital world. By implementing a purely digital process, manufacturers can foster more effective communication between departments, make better products and enjoy greater profits due to a speedier time to market.

**5) Widespread use of neutral formats**

An increasing number of companies are exchanging information with one another using non-CAD formats, including Adobe’s PDF (portable document format), Autodesk’s DWF (design web format) and SolidWorks’ EDRW (eDrawings). While translating a CAD file into a non-CAD format may seem like an unnecessary step, two developments are driving this trend. For starters, increasing globalization of manufacturing is leaving many companies susceptible to the theft of intellectual property. In response, many are refraining from releasing native CAD files and taking the precaution of employing a data format that will prevent information theft. Second, while digital signatures are now legally binding, many companies still doubt their effectiveness and are thus using representations that can’t be edited.

**6) CAM software’s increasing functionality**

CAM software is continuing to get better at its job of interpreting digital descriptions and producing the instructions for machine tools. Its growing functionality is making the jobs of programmers easier. In particular, CAM is becoming more automated, better integrated with design software and increasingly user-friendly. According to CIMdata’s NC Software Market Assessment Report, some recent enhancements include intelligent user interfaces, programming guidance, commands integrating multiple steps, automatic re-machining, and automatic selection of cutting parameters, tools and toolpaths. In short, it’s taking on more, while letting users do less.