

FACTFILE: GCE TECHNOLOGY & DESIGN

1.9 DESIGN & MANUFACTURE



Design and manufacture

Learning outcomes

Students should be able to:

- demonstrate knowledge and understanding of the following:
 - computer-aided design (CAD) to include drawing, solid modelling, virtual imaging and rapid prototyping;
 - computer-aided manufacture (CAM) computers used to assist in a manufacturing process;
 - computer-integrated manufacture (CIM) computers used for stock control, quality control, manufacturing, and assembly;
 - advantages of using CAD, CAM and CIM;

Course content

What is CAD?

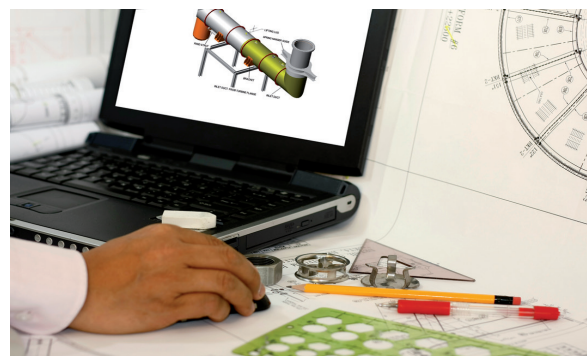
Computer Aided Design (CAD) is the use of computer software to design and create 2D and 3D design ideas, models and prototyping.

There are a range of CAD programs on the market for specific tasks suitable for particular industries. Examples of these programs are: Solidworks and Prodesktop.

What are the Characteristics of Solid Modelling?

Solid Modelling allows you to construct a 3D solid model using different design features like extrusion, cutting, filleting, chamfering and other such features.

Solid Modelling gives the user a clear insight in to what the model will look like when manufactured via computer based pictorial views. It will also contain information about the volume and mass of the object and is suitable for creating section views.



What are the characteristics of Virtual Imaging?

Virtual imaging is a way of showing a product or facilities in 3D in a realistic way. Architects and engineers would use virtual imaging as it benefits them in various ways:

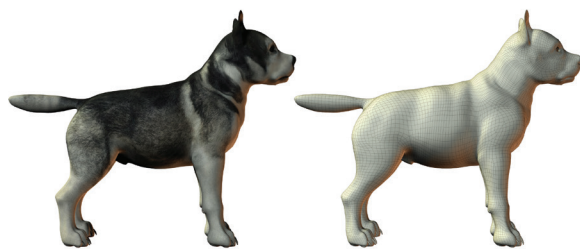
- Three dimensional views of products on screen;
- Images can be manipulated on-screen to give a sense of realism; and
- Quick, interaction with client.



What are the characteristics of Rapid Prototyping?

Creating a rapid prototype involves a number of steps that must be accomplished before the three-dimensional model can be formed. Each portion of the model is built one layer at a time with stereo lithography. It is used in the Aerospace, Medical, Consumer and Architectural industry.

- Like a 3D printer instead of ink it uses a liquid material and 'grows' a three dimensional product.
- Produces detailed products at relatively low cost.
- Relatively quick process compared to other three dimensional processes.



Advantages of CAD

- Dimensioning can be done easily in a clear and precise way.
- All of the required features needed are set within the program i.e. extrusion, filleting etc...
- Both 2D and 3D models can be made easily.
- Scaling is not required as drawings are created in full size.
- Greater accuracy and precision.
- Time saving as parts drawn can be saved separately and reused.
- Details of production methods can be taken from the program.

Disadvantages of CAD

- Implementing the CAD system takes time and money.
- Need to train the users to operate the program.

What is CAM?

Computer Aided Manufacturing (CAM) is a system of using computer technology to aid the manufacturing process. CAM is used in various places including Aerospace, Medical, Architectural, Engineering companies and schools in order to create a 3D model or product.

A CAM system usually controls the complete production process through a variety of methods of automation. All of the manufacturing processes in a CAM system are computer controlled so that accuracy can be achieved.

Computer Aided Manufacturing is often associated with Computer Aided Design (CAD) systems. The computer can take the converted CAD drawing (stereo lithography), and feed it directly into the manufacturing system. At this stage the CAM system will be able to process the drawing either through drilling or cutting to make the 3D model or product.



Advantages of CAM

- Final products are consistent in mass production.
- High accuracy levels in large-scale production.
- Usually speeds up production of low-volume products.

Disadvantages of CAM

- The software is expensive.
- One-off production can be slower.
- Staff need to be trained to use the software and machinery.

What is CIM?

Computer Integrated Manufacturing (CIM) is a system that uses computer techniques to integrate each stage of the production process.

CIM is used in factories (automotive and aerospace industries) where everything can be controlled from one computer to make the factory become more efficient.

Technologies used in CIM:

- Automated Storage and Retrieval System (ASRS);
- Flexible Manufacturing System (FMS);
- Robotics;
- Automated Guided Vehicle (AGV); and
- Automated Convergence Systems.



Computer aided technologies in CIM

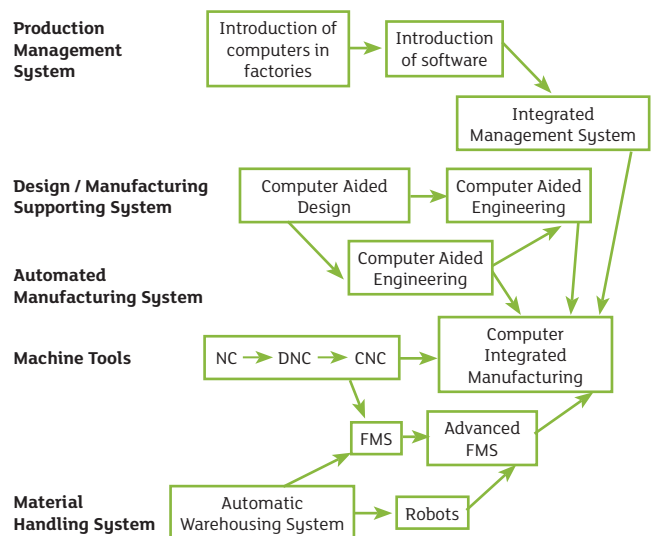
The automotive industry will use various CIM technologies in order to create a car. For example CAD is used to design the car parts, CAM to manufacture parts of the car, CAQ is used to inspect the parts and PPC is used for cost control, estimations and scheduling. Others CIM technologies include:

- Computer Aided Design (CAD);
- Computer Aided Manufacturing (CAM);
- Computer Aided Engineering (CAE);
- Computer Aided Quality Assurance (CAQ);
- Computer Aided Process Planning (CAPP);
- Enterprise Resource Planning (ERP); and
- Production Planning and Control (PPC).

CIM associated with Stock control, Quality control, Manufacturing and Assembly

Full CIM throughout a corporation is achieved when different operations are integrated so that every bit of information is shared and the production line is efficient.

Computers are used to integrate the process of production and business information with manufacturing to construct an efficiently running production line.



Computers will control all of the functions on an automated production line.

Examples include:

- Methods for transferring materials to the required points;
- CNC machines used for making or assembling products; and
- Quality control systems through Control Charts.

All of the processes will provide feedback to the main computer that will inform the operator if everything is running efficiently.

Advantages of CIM

- Manufacturing lead time is less;
- Good quality products are less expensive;
- Increased efficiency;
- Time for production planning is decreased; and
- Transportation time is reduced.

? Revision Questions

- 1** For each of the following points below, and with reference to a product of your choice, briefly outline **two** specific uses for:
- Modelling
 - CAD/CAM
 - Costing

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- 2** Solid modelling, virtual imaging and rapid prototyping are used in the design and manufacture of products.

i) Outline **two** specific characteristics associated with solid modelling.

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ii) Outline **two** specific characteristics associated with virtual imaging.

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iii) Outline **two** specific characteristics associated with rapid prototyping.

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? Revision Questions

3 Computers are widely used in the design and manufacture of products.

i) Briefly outline **two** main advantages associated with Computer Aided Design (CAD).

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ii) Briefly outline **two** main advantages associated with Computer Aided Manufacture (CAM).

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iii) Briefly explain what is meant by Computer Integrated Manufacture (CIM).

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