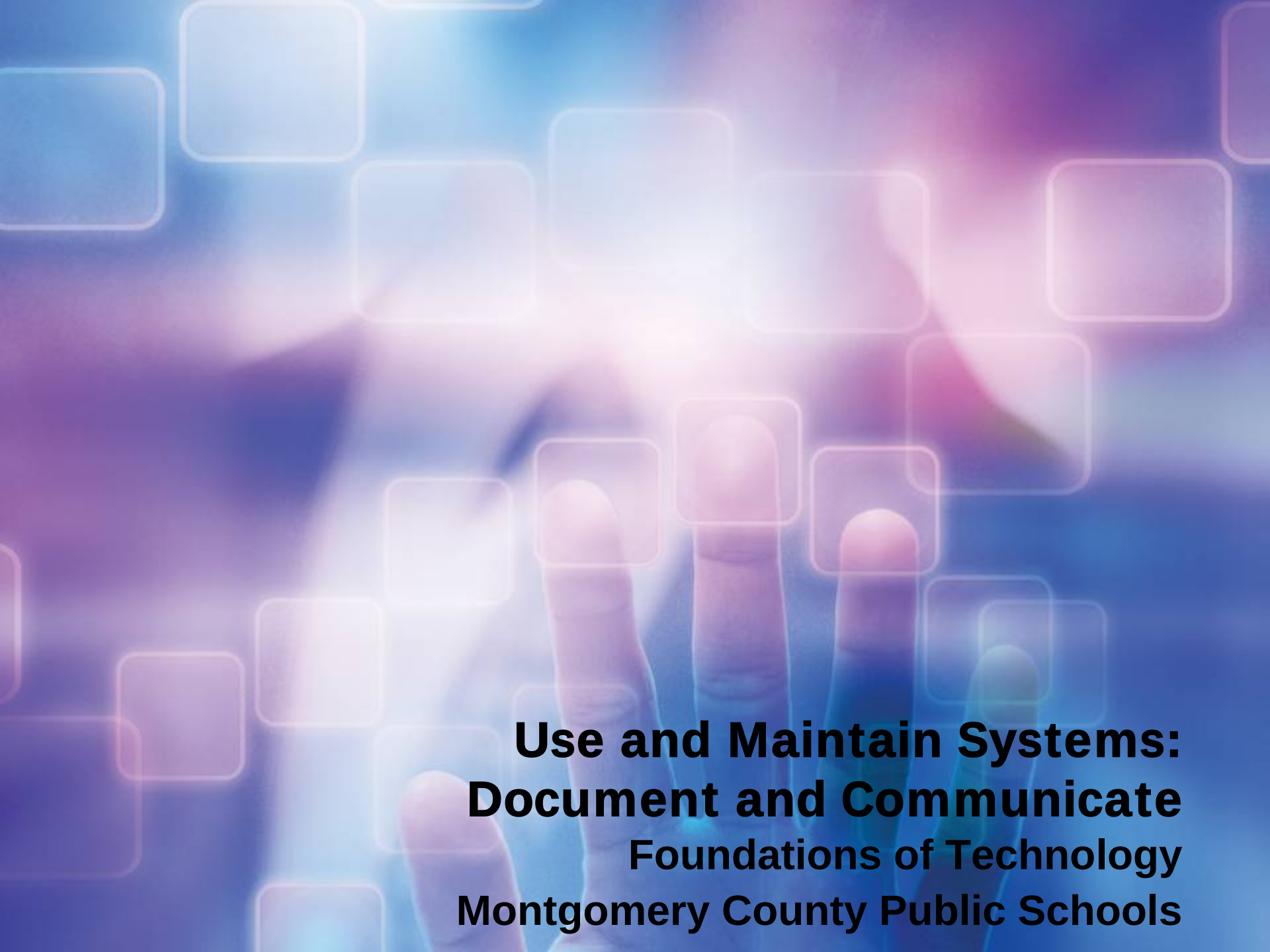


Use and Maintain Systems: Document and Communicate

Foundations of Technology

Montgomery County Public Schools

Outcomes

In this presentation you will learn:

- Document processes and procedures and communicate them to different audiences using appropriate oral and written technologies. (ITEA 12-L)
- Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate (ITEA 12-P)

Documenting and Communicating

This lesson is about how designers communicate product information using various types of documents. Communicating designs solutions is a key element in technology. Those engaged in communicating design solutions are involved with two areas of communication.

First, they create documents and reports that specify all the details of the product. Second, they prepare documents and reports designed to obtain approval for the solution from various decision makers.

Documents and Reports

Documenting and Communicating

The workers who make the parts and assemble them into products must be well informed. They must have knowledge of manufacturing processes. They must be able to set up and operate machines, apply finishing materials, and perform assembly operations. Still, this is only part of the manufacturing knowledge they need.

The workers must “know” the product. This means they must have knowledge about the materials to be used in its manufacture. The workers must also know the size and shape of each part. Finally, they must know how the product is assembled from parts and fasteners (bolts, screws, and rivets, for example).

Factory worker spray painting furniture parts at an assembly line

Three Basic Kinds of Documents

This knowledge of the product is delivered through three basic kinds of documents.

- **Engineering drawings**
- **Bills of materials**
- **Specification sheets**

The following slides will examine how each of these kinds of documents is developed and the information each one communicates.

Engineering Drawings

Engineering drawings communicate basic information needed to construct the product or structure. In manufacturing they are called engineering or working drawings. In construction, however, they are called architectural drawings. In this presentation, to keep things simplified, we will focus on engineering drawings. Keep in mind, however, that although architectural drawings are different from engineering drawings, the basic principles used to prepare both are similar.

Designers commonly use three types of engineering drawings to communicate product information.

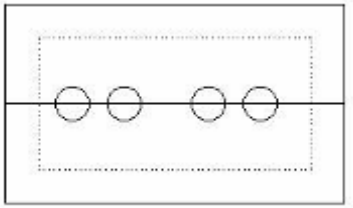
- Detailed drawings**: Drawings that show specific information needed to produce a part**
- Assembly drawings**: Drawings that show how parts go together to make a sub-assembly or product**
- Systems drawings**: Drawings that show the relationship between electrical, hydraulic, or pneumatic components**

Detail Drawings

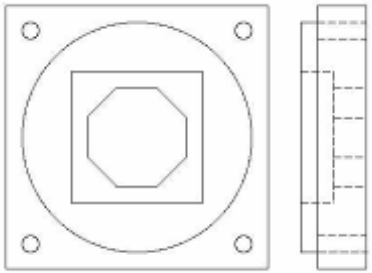
Most products are made up of several parts. Each of the parts must be manufactured to meet the designer's specification. These specifications are often communicated on detail drawings. Detailed drawings commonly contain all the information needed to manufacture one part. Therefore, designers usually generate a number of different drawings for a complete product.

1-2-3-view drawings

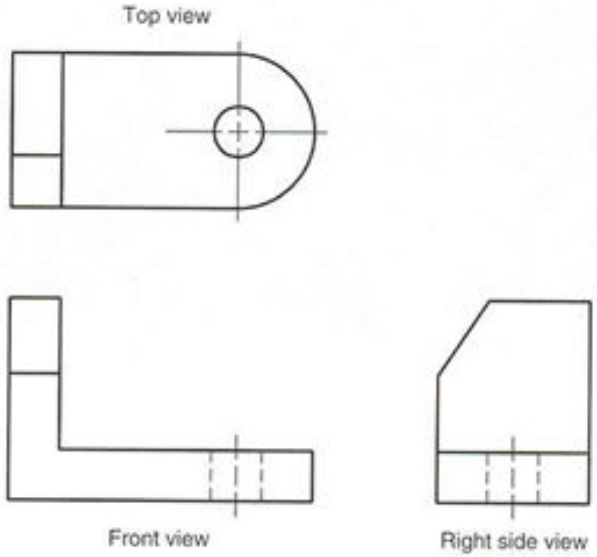
One-view drawings are detailed drawings that are used to show the layout of flat, sheet metal parts.



Two-view drawings are used to show the size and shape of cylindrical parts. The two views shown are the front view, which shows the features along the length of the part, and the end view.

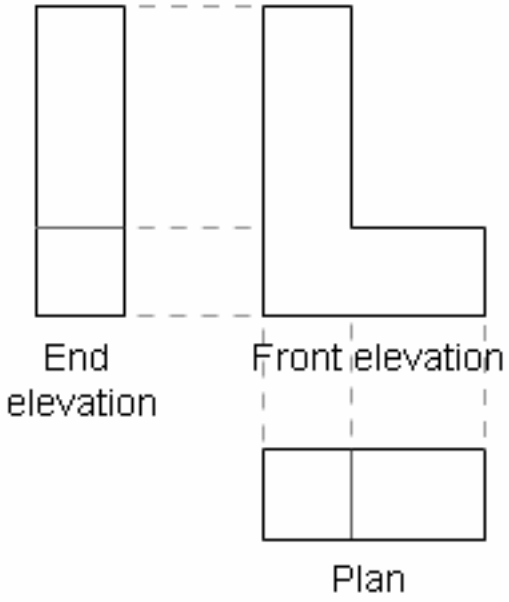


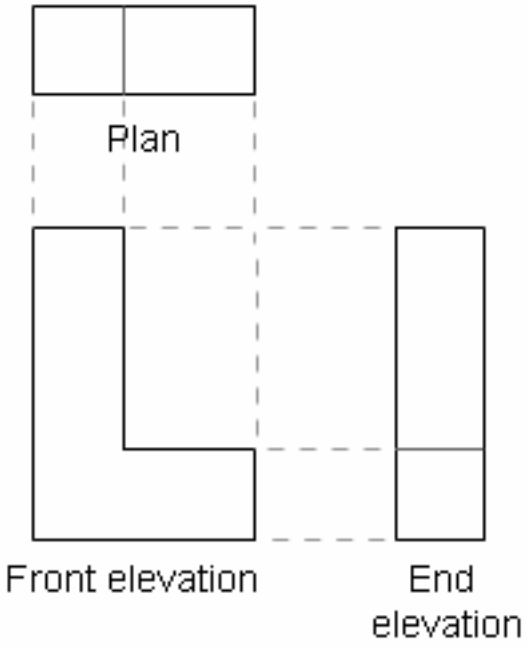
Three-view drawings are used to show the size and shape of rectangular and complex parts. Generally a top, front, and side view are shown.



Orthographic Projection

Orthographic projection is a representation of related views of an object as if they where all in the same plane by using projecting lines drawn at right angles to the plan of projection





Design Sketches and Engineering Drawings

Engineering drawings and design sketches both communicate the appearance of an object. However, drawings are accurate and usually to scale. Drawings should provide clear information about sizes (dimensions) and angles.

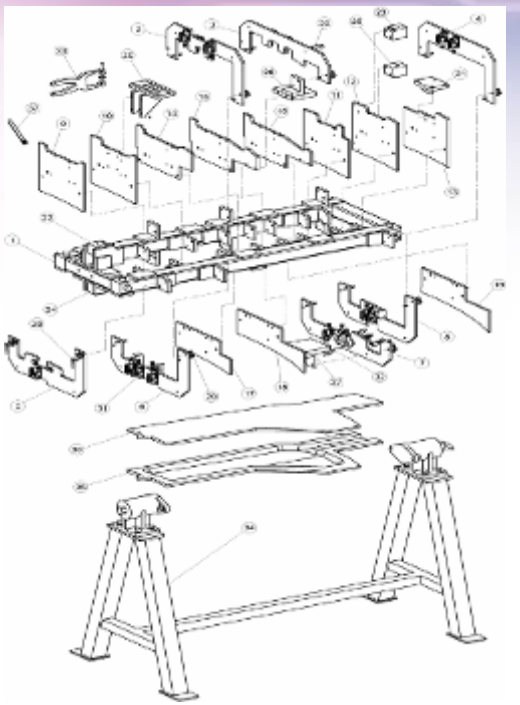
Drawings also frequently provide details about the surface finishes and production instructions. Sketches generally only convey generalized information about the appearance of the object.

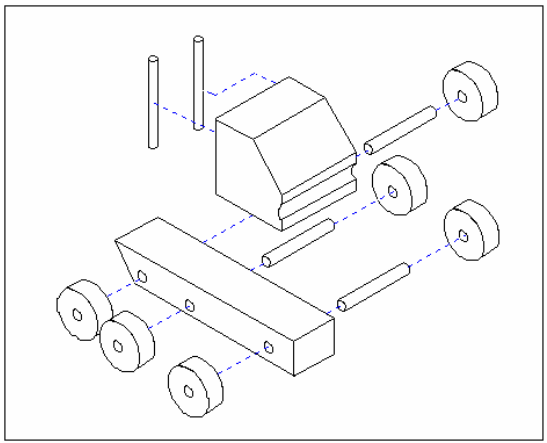
In all cases, the least number of views are used in drawings. Creating unnecessary views costs time and money. The drawing should communicate all of the information needed to make the product or system part. The designer and the drafter will not be on the manufacturing floor to answer questions or supply missing information.

Assembly Drawings

Engineering drawings generally contain a wealth of information. They describe the size and shape of parts and locate important features. They may also describe the surface finish of the part, the type of heat treatment used, and the specific machine settings required to produce the desired result.

A second type of engineering drawing is the assembly drawing. Assembly drawings show how parts fit together to make products.





Systems Drawings

Systems drawings are used to show how parts in a system relate to each other and work together. They are used for electrical, hydraulic (fluid), and pneumatic (gas) systems. They are often called schematic drawings.

This drawing is an example of a systems schematic

Computer-Aided Design (CAD)

Most drawings today are done on the computer. However, there are some drafters that prefer using standard drawing instruments.

A computer is a valuable technological tool. A common industrial application for computer systems is in preparing drawings and models. Computer-Aided Design (CAD) software is the industry standard for engineering drawings.

There is nothing magical about this system. It allows the engineer to complete the steps of laying out and producing drawings following the methods that a drafter uses.

CAD systems, however, do the job more quickly and uniformly. Also, computer drawings are easier to correct, store, and communicate. Computer drafters can send their drawing across the country or around the world in seconds using the Internet.

Architect's Tools of the Trade with Design Blueprints

An Engineer's tools of the trade

Bill of Materials

Not all information needed to produce a product can be obtained on detail, assembly, and systems drawings. Additional documents are needed to provide complete production information. One important document is a ***bill of materials***.

The name of this document causes some confusion. We all pay bills for things we buy and use. A bill of materials does not contain cost information. Instead, it is a list of materials needed to make one complete product.

Most bill of materials contain the following information for each part on the product:

- A part number that can be used on assembly drawings and for ordering repair parts
- A descriptive name for the part
- The number or quantity (abbreviated qty.) of parts needed to manufacture one product
- The size of the part, indicating its thickness, width, and length (for rectangular parts) or its diameter and length (for round parts). Sizes are given as: T x W x L or Diameter x L
- The material out of which the part is to be made

Example: Bill of Materials

Sample Bill of Materials for a Box

Part Number	Part Name	Number Needed	Description or Size	Material	Price
30431	Top	1	6" X 9" sheet metal	Steel	$3
34572	Body	1	12" X 23 sheet metal	Steel	6
90321	Handles	2	C-type	Aluminum	12
36780	Latches	4	French medium	Brass	11
68857	Feet	4	One-inch diameter	Rubber	2
25410	Shelves	5	5" X 11" sheet metal	Steel	6
20983	Dividers	4	3" X 6" sheet metal	Steel	3
65382	Hinges	2	2" X 2"	Brass	2
76379	Padding	5	5" X 11"	Rubber	6
98776	Screws	16	Sheet metal screws	Steel	2
08976	Primer	1 can	Fast drying primer	Renewable	1
98272	Paint	1 can	Spray paint	Renewable	1
Total Cost					**$55**

The items on a bill of materials are listed in a priority order. Manufactured parts are listed first. Parts that are purchased ready to use and fasteners are listed after the manufactured parts.

Specification Sheets

Not all materials can be shown on a drawing — like engine oil, adhesives, or sandpaper. If you could make a drawing of the items, it would be of little value. These and thousands of other items are not chosen for their size and shape.

For example, some important factors in adhesive are the working time — time between application and clamping — the time the work will be held together for the glue to set and shear strength. Window glass must be transparent. Insulating materials must stop heat from passing through them. This kind of information is contained on specification sheets.

Specification Sheets Include:

Specification sheets communicate the important properties that a material must possess for a specific application. A spec sheet as they are called might include the following information:

- Physical properties: moisture content, porosity, surface condition
- Mechanical properties: strength, hardness, and elasticity
- Physical properties: moisture content, porosity, surface condition
- Mechanical properties: strength, hardness, and elasticity
- Chemical properties: corrosion resistance
- Thermal properties: resistance to thermal shock, thermal conductivity, heat resistance
- Electrical properties: resistance, conductivity
- Magnetic properties: permeability
- Acoustical properties: sound absorption, sound conductivity
- Optical properties: color, transparency, optical reflectivity

One Type of Specification Sheet: Material

Specifications sheets or spec sheets are the last document used to communicate about the product or system. They are used to describe items that cannot be shown in drawings. There are two types of specification sheets: material and quality of work. Material specification sheets describe the materials that will be used in the product.

The bill of materials was used to list the types and sizes of the materials. The spec sheets go into greater detail. They list the exact materials, as well as the quality of materials to be used. Quality of work specifications explain how well the product will be produced. They list the type of finish on the materials. This can include how well the materials are sanded, painted, or stained.

Another Type of Spec Sheet: Quality

Quality spec sheets also list who is responsible for different stages of the product. This is important in construction. The spec sheet may state that the owner is responsible for laying the carpet and painting the interior.

The bill of materials, drawings, and specification sheets must be exact. These documents are often used when companies make a bid to produce the solution. A bid is a price a company charges to make a product.

If a document is wrong, it may cost the designer a lot of money to have it changed once a company has made a bid. The documents are used as part of the contract between designers and manufacturing and construction companies.

Computers Evaluate and Communicate

In this presentation we will examine how computers process information, evaluate information, and communicate information. Two major information-processing machines have changed the way we handle information. They are the calculator and the computer. Both of these machines are different from all other machines in one important way: they can store information.

We will focus only on the computer here, however, because of a feature unique to them. Unlike calculators, which have fixed programs that cannot be erased or changed, computers have programs that can be changed. This quality provides great information-processing power.

Although computers were not in use until the 20th century, the idea was conceived in 1830 by Charles Babbage. He had spent most of his life searching for a way to perfect a mechanical calculating machine.

Because computers are used for many activities in everyday life, they come in a variety of sizes including supercomputers, mainframes, minicomputers, and microcomputers. Each of these is used in a specialized capacity for business, industry, and home use.

Computer Data

A **computer** is a machine for manipulating data according to a list of instructions. A computer is an information-processing machine that works by converting all kinds of information into binary numbers (ones and zeros) and then using simple mathematics to make decisions about, or to rearrange, those numbers.

There are two things essential to understanding the basics of how a computer works. One is that a computer treats any type of information (not only numbers but also letters, words, dates, and so on) as if it consisted simply of binary ones and zeros.

For example, a computer can translate the letter “A” typed into its keyboard into a string of ones and zeros, such as 1000001. One reason to do this is that once in binary form, the information can be stored and moved about more easily.

On a hard disc, the “ones” could be stored as magnetized spots on the disc, while the zeroes can be stored as non-magnetized spots. Once information has been converted to ones and zeros, the computer can get to work.

Electronic Circuits

The second key to understanding how a computer works it to remember that all of a computer's functions are based on the movement and transformation of electrical pulses (representing ones and zeroes) in electrical circuits.

Inside the computer are electrical circuits that perform *computations* on the zeros and ones, such as adding and subtracting them. That's why we call the machine a computer even though we use it for word processing, games, or surfing the Web.

These computational circuits are called the *logic* of the computer, because the calculations they make are similar to simple logic decisions. Everything that a computer can do with information is done by using these logic circuits.

Logic Circuits

For example, if you press the A key on the computer keyboard, circuits inside the computer receive pulses of electricity representing the A in binary form—1000001. Those pulses are sent to logic circuits that make yes or no decisions based on the input they receive.

A very simple example would be a circuit that determines whether the input you send it is a one or a zero. The output of the circuit is a new piece of information—a binary one or zero that is the result of the simple yes or no decision.

Other groups of such circuits count the number of yeses and no's to determine whether the data is an A or some other character. Then the result of that determination is sent to other circuits that store, display, or process that data.

Millions and millions of these logic circuits are used together to do much more complex tasks, such as finding, retrieving, and displaying a Web page. Yet everything your computer does is based on digital ones and zeros and the use of logic circuits.

The 5 Parts of a Computer

All computers have five parts:

1. input unit
2. processing unit
3. output unit
4. memory unit
5. program.

The **input unit** is a device used to enter data (letters and numbers) into the system. Input devices include keyboard, tape drives, dick drives, telephone modems, mice, and other computers.

The **central processing unit** (CPU) is the part of the computer that manipulates the data. The output unit is a device to display and record the results of the processing unit's actions, These devices include monitors, printers, plotters, and disk drives.

Memory and Software

The memory unit is the section of the computer that holds information and instructions. The memory unit has two types of memory. Read-only memory (ROM) contains the instructions that allow the computer to receive and manipulate data. This part of the memory cannot be changed.

Random-access memory (RAM) temporarily stores data and feeds it to the central processing unit on command. RAM is constantly changing as the computer processes data. Also, it usually is erased when the computer is turned off.

The program is the instructions the computer uses to process the data and to produce output. Often the program is called software because it cannot be seen or handled once it is loaded in the computer. The other four units that were described are all hardware. Hardware is the physical parts of the computer system.

Programs are typically used to make mathematical calculations, maintain records, prepare drawings and other graphics, and handle text.

Computers Evaluate and Communicate

Computers are at the heart of most modern information-processing systems. They are at every level of business life.

They process financial information, and prepare financial reports, maintain schedules and ticket records for airlines, operate point-of-purchase units at the supermarket check-out-stands, guide spacecraft to distant planets, maintain the fuel-air mixture in automobiles, guide washing machines through their wash-rinse-dry cycles, help prepare layouts for advertising, and control industrial machines.

Summary

- Communicating design solutions is a key element in creating successful technological systems
- Designers must communicate vital information to manufacturing personnel and decision makers
- Manufactures must understand the solution in order to produce it
- Consumers must be able to assemble and use the solution
- Designers use three different documents to communicate the solutions
- Designers and engineer's create bills of materials, drawings, and specification (spec) sheets showing and explaining the solution
- Engineering drawings communicate the detail of each part, the way parts are assembled into products, and the arrangement of system components
- The drawing that are created are called mechanical drawings
- Drawings are created using either traditional or CAD tools
- Drawing can be detailed, assembly, or schematic and each has a specific use
- Specification sheets list the properties a material must posses for a specific application
- Designers also prepare written and oral reports to gain approval for the product or structure
- Detailed drawings are usually created using orthographic projection
- Orthographic drawings have several views to describe the object

Summary

- A computer is a machine that performs a series of mathematical or logical tasks under the control of a set of instructions called a program
- Software are programs loaded in the computer that direct it to perform specific tasks
- An input device is used to enter data into the computer system
- A processing unit is the part of the computer that manipulates the data
- The output device is used to display and record the results of the processing unit’s actions
- Memory is the section of the computer that holds information and instructions
- The program is the instructions the computer uses to process data and to produce output