AUTOMATION

Development of Technology may be classified in three categories:

- Manual Technology
- Mechanized Technology
- Automated Technology

Though massive changes have already taken place into field of technology but even today manual technology is quite appropriate in today's high-tech environment. Advantages of manual technology are:

- Low cost for low volume production
- Since capital costs are low, risks are low.
- Inherent flexibility (both operational and financial) that goes with it.
- Capacity can usually be expanded or contracted very quickly (unless high skills are not required)
- For some low volume customized products craftsmen can produce quality superior to mechanized technology.

But it has serious drawbacks and limitations associated with it. Some are:

- It is terribly expensive for high volume production.
- Quality problem is quite a problem because of human error and process variation inherent in manual processes.
- Production cycle is quite long affecting the delivery response time.

Mechanized Technologies: Substitution of machines for human labour is as old as even the most primitive factory systems. Until a few years ago, mechanized technology was the technology of choice. General purpose machines were the first to be developed and special machines came to existence much later. The difference between general and special machine is vital for mechanized as well as special machines. Special machines are dedicated to the production of a single part or product and are useful for very high production rates. Thus if low cost is the defining criteria special purpose machine is useful and if flexibility of product or part design is required than flexible process technology is required. Both at the same time are not possible.

Automated Technology: Automation is not as new or as unfamiliar as it appears, although application of its principles is rather a recent occurrence. Thermostatic control of room temperature or electrical equipment is being used for many decades now. Use of common flat valve which automatically fills the tank upto a given level much more older. Automatic control of chemical processes has been possible for quite some time now. But today far more advanced technologies and concepts are being introduced, which include:

1. Robotics
2. NC machine (Numerically controlled machines where machine tools are computer controlled.
3. FMS (flexible manufacturing systems that combine NC machines in flexible system of production)

4. CAD/CAM (Computer aided design and management system that combine product design and manufacturing instructions).
5. CIM (computer integrated manufacturing in which all aspects of manufacturing are integrated through a design and manufacturing database.
6. GT (Group technology that organizes planning and facilities for small-lot manufacturing by grouping various parts and products with similar design.

Robotics: A robot is a programmable multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

What differentiates it from other machines is the similarity of their movements with that of humans and also the fact that like humans they are reprogrammable. They are gaining preference because they do not get tired, do not go for strikes, do not mind hot, dirty and dusty conditions, can work long hours without rest breaks and ***do not sue when injured***!

Some of the advanced capabilities being designed into robots in addition to their basic reprogrammability and manipulative skills are virtually all the human senses - vision, tactile sensing and hand-to-hand coordination.
Robot applications: The robots have some unique applications where human safety requires remote mechanical handling such as - **assembling high explosive shells in government arsenals, picking up hot steel ingots and placing them in presses, handling radioactive rods in nuclear power plants and other nuclear applications.** But they are in great use in ordinary mechanical handling such as spot welding and material handling. Auto industry is the dominant user.
Economics of Robots: An average robot costs $6 to $8 per hour including capital and operating costs where as an average worker is paid more than $ 26 per hour thus robots as such are a bargain. The accuracy and consistency of robots results in far greater saving. For precision jobs where rejection is about 10% when humans operate with robots becomes 0%. They also operate with far greater accuracy.

Numerically Controlled (NC) Machines: When position and paths of cutter tools are under the control of a digital computer, we have **numerical control**. When two dimensions are controlled we have **position control** and when three dimensions are controlled we have **contour control**. Contour controls require very complex programming. Advantages are that machine tools are not tied up for long time and repeat orders require virtually no set-up time. Thus it is quite popular for process technology for both high-volume, standardized types of products and customer design products.
Comparative cost for NC: The comparison of cost for three assembly methods namely - manual, NC and hard automation is shown in following chart. Thus NC becomes cheaper than manual at very low volumes and very much cheaper at higher volumes.
Flexible Manufacturing Systems (FMS): The figure shows a schematic layout of an FMS, where NC machines of different types are positioned around a material handling system.

- The system automatically moves the parts to be processed to computer-directed locations.

- Robots move the part to and from the individual machines.
- The individual NC machines are equipped with tool changers that load the required tool into the machine
- Set up is solely in the programming of machine.
- A wide variety of parts can be produced on the same flexible system.

Advantages of FMS: Greatest feature is its flexibility with no machine time for set up. Thus low cost parts can be produced cheaply in small volumes.. Even single part can be produced. The flexibility of such systems and their economy for smaller batches suggest smaller plants located closer to market. Since customer is the king in today's world such an automation is becoming vital.

Applications and economics of FMS: It was pioneered in US but Japan has taken a considerable lead. GE produces 2000 different types of meters on same FMS with an output of more than a million meters per year. Fanuc Ltd. of Japan which makes robots at a plant costing $32 million. But a conventional plant would have cost them $320 million! They have employed only 100 workers with each worker supervising 10 machines. In another plant utilizing FMS only 215 workers are engaged against 2500 for an equivalent conventional plant. Obviously with such a system cost of production planning and control can be reduced drastically

Some examples of FMS are GROUP TECHNOLOGY and AUTOMATIC FACTORY.

Group Technology: This is a concept for organizing manufacturing resources to increase productivity in process-focused, small lot situations involving parts and products which are similar. The idea is to group similar parts, sizes or types of products into families to gain productivity advantages. It also includes a classification and coding system that is computerized and which can be coupled to CAD/CAM. Thus the system becomes numerically controlled . Modular programmes, stored in a master computer programme reduces programming time and other related costs of production planning, Similarly group tooling takes advantage of similar tooling requirements thus reducing or eliminating the need for individual tooling for each part.

The Automatic Factory: This is still a dream. But portions of factory that are automatic are not uncommon nowadays. e.g. ***Seiko*** has developed a system for the automatic assembly of watches in which no human input to the assembly process is required. we have already discussed some instances of automatic factory earlier.