CHAPTER 10

CNC Machines and Automation

CHAPTER OBJECTIVES

At the end of this unit/chapter you should be able to:

- Understand the importance of automation of production and manufacturing operations.
- List the potential areas or manufacturing situations which call for automation.
- Give at least 5 examples of automation with specific reference to manufacturing of discrete components.
- Understand how CNC machines are designed and equipped incorporating automation.
- Give advantages and disadvantages of highly automated systems.
- Explain what is meant by low cost automation (LCA) and what are the principles involved in LCA.
- List the machine tool accessories/devices that facilitate increased automation.
- Enumerate the steps involved in installing LCA.
- Compare LCA and conventional automated system.
- Understand the complexities and challenges involved in LCA.
- Distinguish between hard-wired automation and soft automation.
NEED FOR AUTOMATION

1. Economic advantage through increased productivity.
2. Reduced labour costs.
3. Reduction in operating cost.
4. Savings in supervision.
5. Improved accuracies with consistency of quality parameters.
6. Suitable for mass production with better material handling and reduced WIP (Work-In-Process).
7. Automatic data acquisition for computer aided quality control and inspection.
8. Flexible with zero set-up change over time.

POTENTIAL AREAS OF AUTOMATION

1. Loading and unloading of components.
2. In-process gauging (to enhance quality assurance).
3. Deburring of components machined.
5. Assembly operations.
6. Where human intervention is undesirable.
7. Manufacturing situation where a reduction in cycle time in desirable.
8. Replace the human labour in hazardous conditions.
9. Manufacturing situations where reduction in down time is required.

EXAMPLES OF AUTOMATION IN PRODUCTION AND MANUFACTURING

1. Automatic machine tools to process parts (Single Spindle, multi-spindle automatic lathes, CNC machines etc.).
2. Industrial robots.
3. Automatic material handling.
5. Automated Storage (AS) and Retrieval System (RS).
6. Automatic inspection systems.
7. Feedback control systems.
8. Computer systems for designing products (CAD, design automation) and for analyzing them (FEA, etc.).
9. Computer systems for automatically transforming designs into parts (Rapid prototyping).
10. Computer system for planning and decision making to support manufacturing (CAPP).

AUTOMATION IN RESPECT OF CNC MACHINES

Some examples of automation which the machine tool manufacturers have already considered and incorporated in the design of the machine tools (as in the case of CNC machines).

1. Gantry loaders.
2. Bar Pullers.
3. Pneumatic chucks and collets.
4. Bar feeders.
5. Auto chuck jaw changers.
6. ATC (Automatic Tool Changers).
7. Auto tool off-set measurement.
8. In-process gauging/Post-process gauging.
10. Auto tool length measurement.
11. Auto tool breakage detector.
12. Touch trigger probes.
13. Adaptive feed rate control.

DISADVANTAGES OF HIGHLY AUTOMATED SYSTEMS

A recent study of the Fraunhofer Institute for Systems and Innovation Research, Germany, reveals that more than three hundred of 1000 enterprises have already reduced their degree of automation or planning to do so.

1. The most important disadvantage is the insufficient flexibility of highly automated systems. The combination of losses resulting from conversion, idle time and high technical maintenance costs becoming higher than the expected economic benefits. Today at many locations highly automated production facilities are making way for systems with significantly lower degree of automation. High ended automation can be installed in small enterprises as well as in larger companies. Highly automated material flow systems in assembly lines and highly automated processing machines are considered as poor investments since the economic benefits are really low.
Many companies indicated that today’s shrinking lot sizes can no longer be handled economically with these highly automated systems, since a fairly large lot size is required to justify such an high investment.

2. Inadequate flexibility in capacities is the second most popular reason for dissatisfaction. Companies with innovative product ranges face special difficulties. They have considerable problems in assembly stations and material flows in production. Economical or low cost automation is required to introduce innovations.

**LOW COST AUTOMATION**

Low Cost Automation means any compact, easily available, simple but very effective manufacturing piece of equipment which is designed and assembled internally by a group of employees, in house.

**BASIC PRINCIPLES OF LOW COST AUTOMATION**

Any low cost automation system should be
(a) Affordable.
(b) Simple and robust.
(c) Internally designed (i.e. in house development) using the company’s own engineers and technicians.
(d) Easy to assemble and disassemble (thus easy to repair and maintain).
(e) Provide reasonable flexibility.
(f) Of really low cost. (Low cost automation is defined as an automation system in which the cost incurred in automation is less than the benefits obtained in 1 year as a result of such an automation).

**SOME DEVICES WHICH MAY BE CONSIDERED AS AN INTEGRAL PART OF LOW COST AUTOMATION**

(a) Gravity chutes
(b) Gantry loaders
(c) Part loading trolley
(d) Conveyor unit
(e) Vibratory bowl feeders
(f) Auto feeding devices
(g) Pneumatic inching control