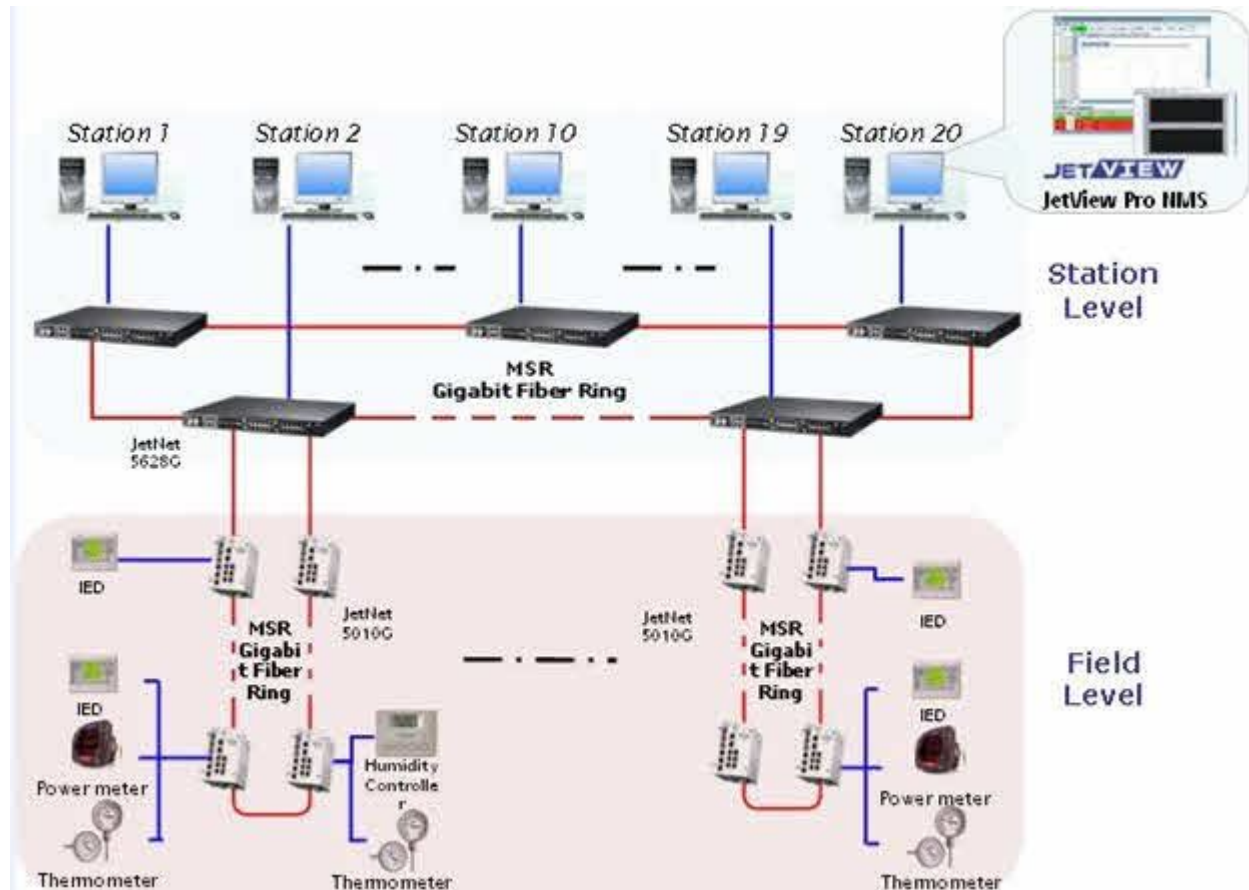


Distributed Control System is most popular which is specially designed with redundancy and diagnostic capabilities to improve control reliability and performance. It gives greater flexibility to control distributed discrete field devices and its operating stations.



Distributed Control System

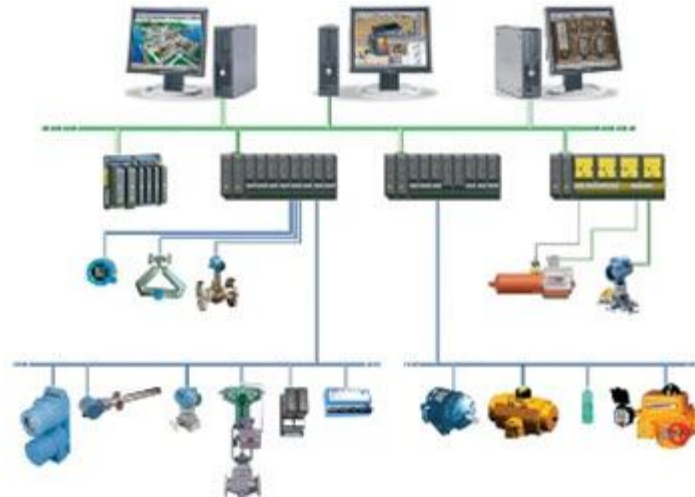
To increase reliability, productivity and quality while minimizing the production cost, process control industries must be driven by integrated controllers with high distributed control capability.

## **What is Distributed Control System**

Distributed Control System is a specially designed control system used to control complex, large and geographically distributed applications in industrial processes. In this, controllers are distributed throughout the entire plant area.

These distributed controllers are connected to both field devices and operating PCs through high speed communication networks as shown in figure.

Discrete Field devices such as sensors and actuators are directly connected to input and output controller modules through communication bus. These field devices or smart instruments are capable of communicating with PLC's or other controllers while interacting with real world parameters like temperature, pressure, etc.



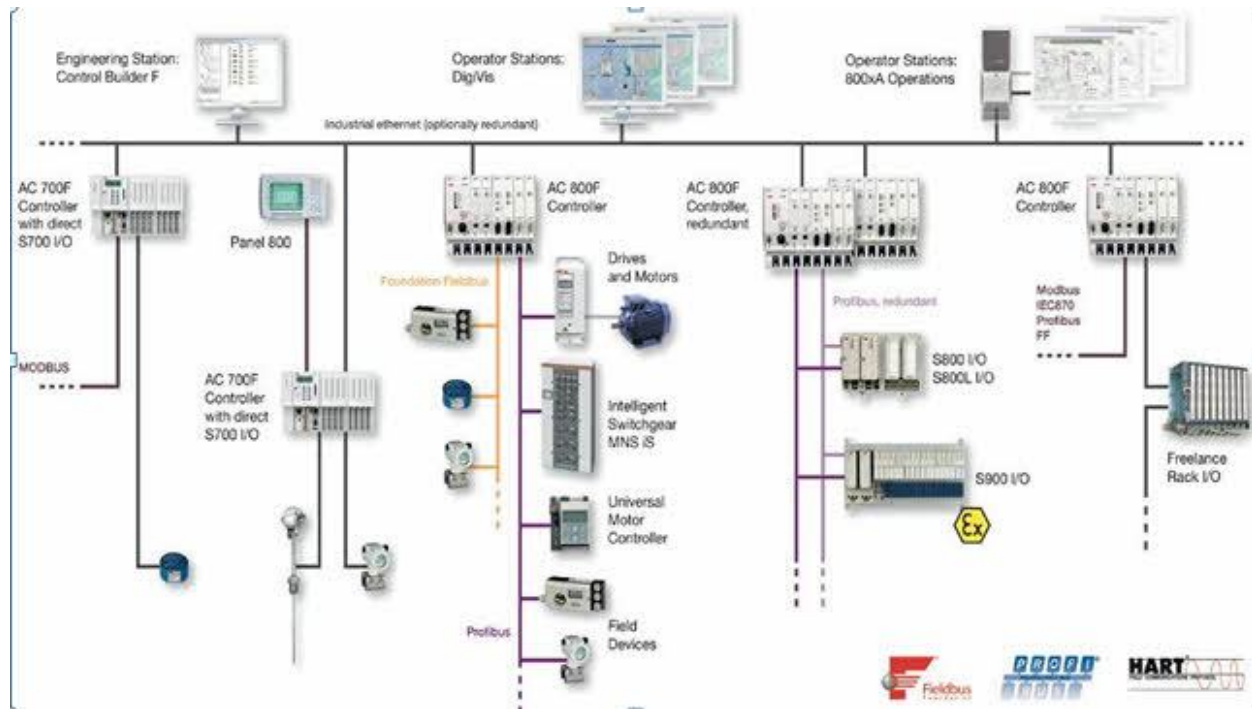
*DCS Architecture*

Controllers are distributed geographically in various section of control area and are connected to operating and engineering stations which are used for data monitoring, data logging, alarming and controlling purpose via another high speed communication bus.

These communication protocols are of different types such as foundation filed bus, HART, Profibus, Modbus, etc. DCS provides information to multiple displays for user interface.

## **4 Basic Elements of Distributed Control System**

Distributed Control System continuously interacts with the processes in process control applications ones it gets instruction from the operator. It also facilitates to variable set points and opening and closing of valves for manual control by the operator. Its human machine interface (HMI), face plates and trend display gives the effective monitoring of industrial processes.



*Elements of DCS*

## Engineering PC or controller

This controller is the supervisory controller over all the distributed processing controllers. Control algorithms and configuration of various devices are executed in this controller. Network communication between processing and engineering PC can be implemented by simplex or redundant configurations.

## Distributed controller or Local control unit

It can be placed near to field devices (sensors and actuators) or certain location where these field devices are connected via communication link. It receives the instructions from the engineering station like set point and other parameters and directly controls field devices.

It can sense and control both analog and digital inputs / outputs by analog and digital I/O modules. These modules are extendable according to the number of inputs and outputs. It collects the information from discrete field devices and sends this information to operating and engineering stations.

In above figure AC 700F and AC 800F controllers act as communication interface between field devices and engineering station. Most of the cases these act as local control for field instruments.

### **Operating station or HMI**

It is used to monitor entire plant parameters graphically and to log the data in plant database systems. Trend display of various process parameters provides the effective display and easy monitoring.

These operating stations are of different types such as some operating stations (PC's) used to monitor only parameters, some for only trend display, some for data logging and alarming requirements. These can also be configured to have control capabilities.

### **Communication media and protocol**

Communication media consists of transmission cables to transmit the data such as coaxial cables, copper wires, fiber optic cables and sometimes it might be wireless. Communication protocols selected depends on the number of devices to be connected to this network.

For example, RS232 supports only for 2 devices and Profibus for 126 devices or nodes. Some of these protocols include Ethernet, DeviceNet, foundation field bus, modbus, CAN, etc.

In DCS, two or more communication protocols are used in between two or more areas such as between field control devices and distributed controllers and other one between distributed controllers and supervisory control stations such as operating and engineering stations.

## **7 Important features of DCS**

### **• To handle complex processes:**

In factory automation structure, PLC-Programming Logic Controller is used to control and monitor the process parameters at high speed requirements. However due to limitation of number of I/O devices, PLC's cannot handle complex structure.



### Handling Complex Processes

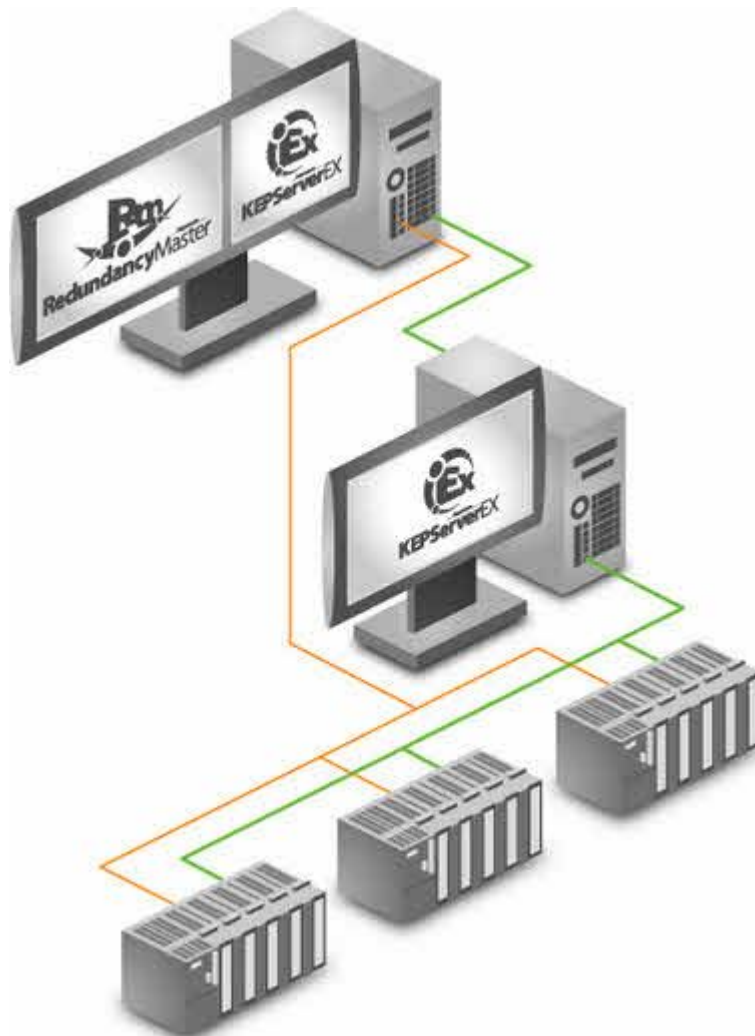
Hence DCS is preferred for complex control applications with more number of I/O's with dedicated controllers. These are used in manufacturing processes where designing of multiple products are in multiple procedures such as batch process control.

### System redundancy:

DCS facilitates system availability when needed by redundant feature at every level.

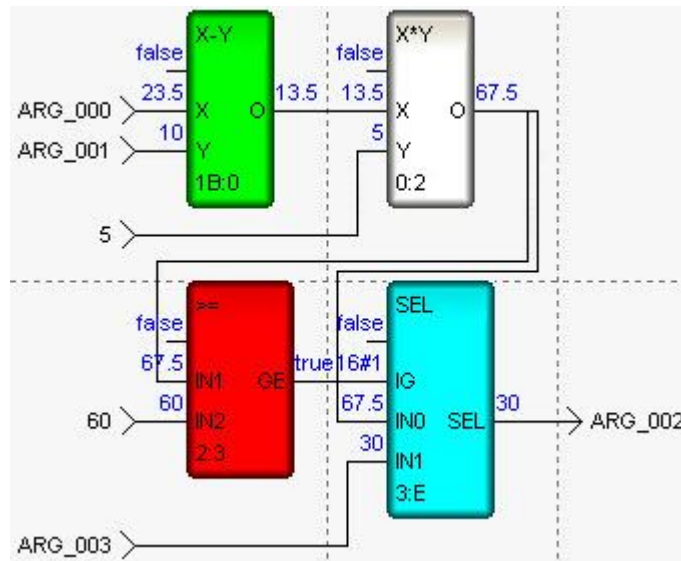
Resuming of the steady state operation after any outages, whether planned or unplanned is somewhat better compared to other automation control devices.

Redundancy raises the system reliability by maintaining system operation continuously even in some abnormalities while system is in operation.



System Redundancy

## Lot of Predefined function blocks:



*Predefined Function block*

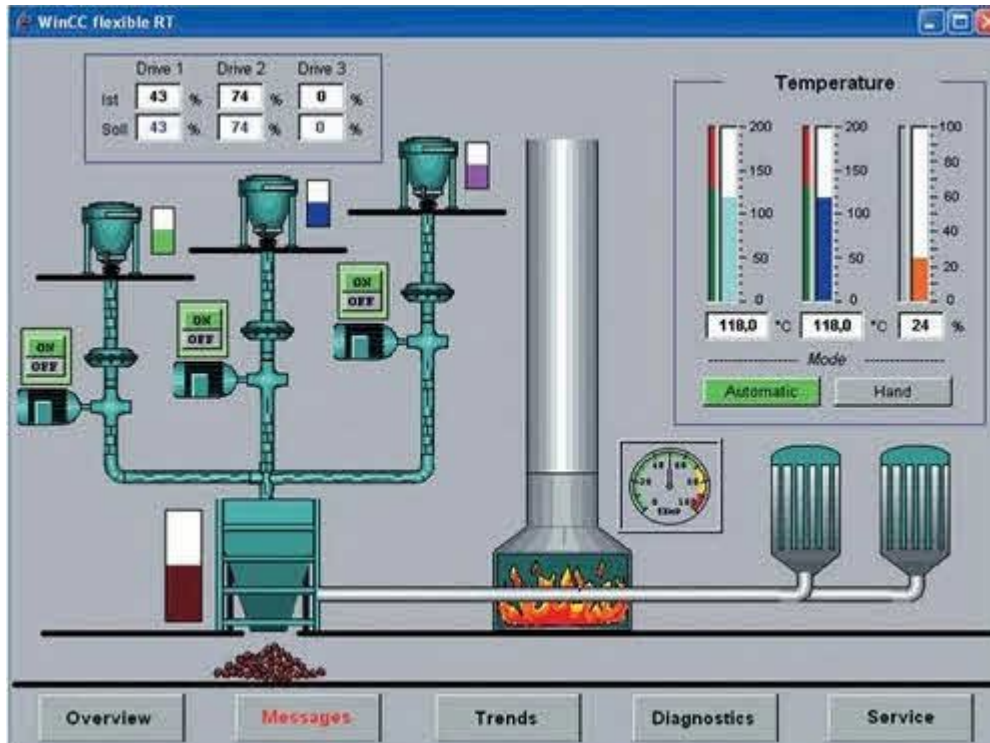
DCS offers many algorithms, more standard application libraries, pre-tested and pre-defined functions to deal with large complex systems. This makes programming to control various applications being easy and consuming less time to program and control.

## Powerful programming languages:

It provides more number of programming languages like ladder, function block, sequential, etc for creating the custom programming based on user interest.

## More sophisticated HMI:

Similar to the SCADA system, DCS can also monitor and control through HMI's (Human Machine Interface) which provides sufficient data to the operator to charge over various processes and it acts as heart of the system. But this type of industrial control system covers large geographical areas whereas DCS covers confined area.



*Sophisticated HMI*

DCS completely takes the entire process plant to control room as a PC window. Trending, logging and graphical representation of the HMI's give effective user interface. Powerful alarming system of DCS helps operators to respond more quickly to the plant conditions

### **Scalable platform:**

Structure of DCS can be scalable based on the number I/O's from small to large server system by adding more number of clients and servers in communication system and also by adding more I/O modules in distributed controllers.

### **System security:**

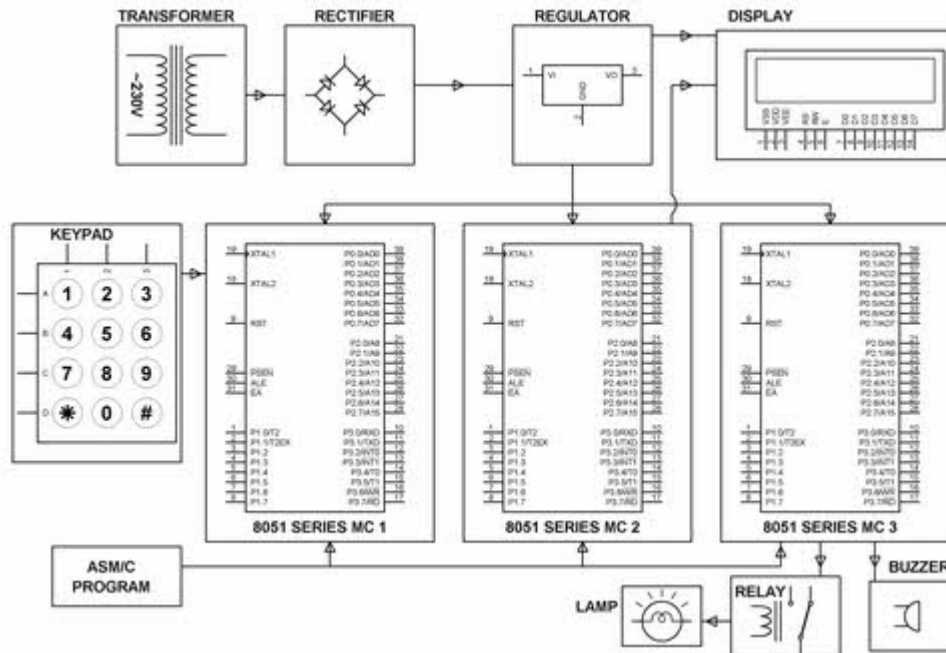
Access to control various processes leads to plant safety. DCS design offers perfect secured system to handle system functions for better factory automation control.



Security is also provided at different levels such as engineer level, entrepreneur level, operator level, etc.

## Application of Distributed Control System

DCS system can be implemented in a simple application like load management using network of microcontrollers.



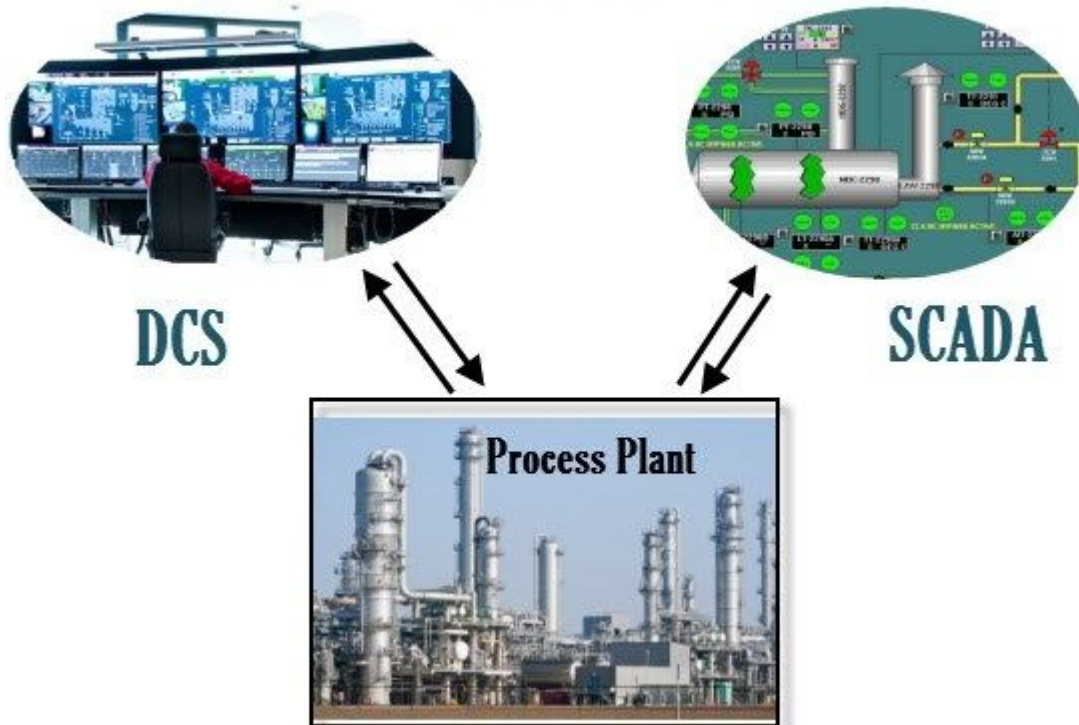
*Application of DCS*

Here the input is given from a keypad to a microcontroller, which communicates with the other two microcontrollers. One of the microcontrollers is used to display the status of the process as well as the loads, while the other microcontroller controls the relay driver. The relay driver in turn drives the relay to operate the load.

### Difference between SCADA and DCS (DCS vs SCADA):

Although both DCS and SCADA are monitoring and control mechanisms in industrial installations, they have different goals. There exist some commonality between DCS and SCADA in terms of hardware and its components, however, there are certain requirements by

the end applications that separates a robust and cost-effective DCS from the viable SCADA system. Some of the differences between DCS and SCADA are listed below.



## Difference Between DCS and SCADA

1. DCS is process oriented, whereas SCADA is data-gathering oriented. DCS emphasizes more on control of the process and it also consists of supervisory control level. And as a part of doing so, it presents the information to the operator. On the other hand, SCADA concentrates more on acquisition process data and presenting it to the operators and control centre.
2. In DCS, data acquisition and control modules or controllers are usually located within a more confined area and the communication between various distributed control units carried via a local area network. SCADA generally covers larger geographical areas that use different communication systems which are generally less reliable than a local area network.
3. DCS employs a closed loop control at process control station and at remote terminal units. But in case of SCADA there is no such closed loop control.
4. DCS is process state driven where it scans the process in regular basis and displays the results to the operator, even on demand. On the other hand, SCADA is event driven where it does not scan the process sequentially, but it waits for an event that cause process parameter to trigger certain actions. Hence, DCS does not keep a database of process parameter values as it always in connection with its data source, whereas SCADA maintains a database to log the parameter values which can be further retrieved for operator display and this makes the SCADA to present the last

recorded values if the base station unable to get the new values from a remote location.

5. In terms of applications, DCS is used for installations within a confined area, like a single plant or factory and for a complex control processes. Some of the application areas of DCS include chemical plants, power generating stations, pharmaceutical manufacturing, oil and gas industries, etc. On the other hand SCADA is used for much larger geographical locations such as water management systems, power transmission and distribution control, transport applications and small manufacturing and process industries.

In spite of these major differences, the modern DCS and SCADA systems come with common standard facilities while dealing process plant automation. However, the choice between DCS and SCADA depends on its client and end application requirement. But if the client choice between these two, by gaining equal requirement from the process, DCS is the economical choice as it help to reduce the cost and offer better control.

### **DCS Systems from Different Vendors:**

Some of the available DCS systems include

- ABB- Freelance 800F and 800 xA
- Yokogawa- Centum CS 3000 and 1000
- Honeywell-TDC 3000
- Emerson- Delta V Digital Automation
- Siemens- Simatic PCS 7
- Allen- Bradley- NetLinx