

# Technical Means of Automation

## Components and Structure of Industrial Systems

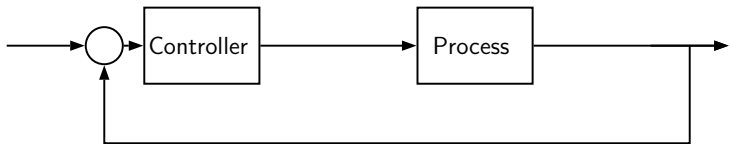
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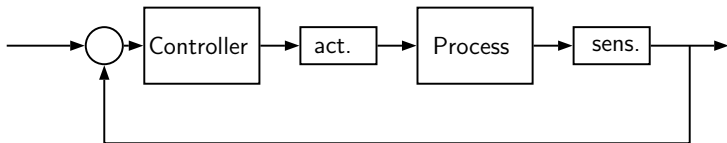
# Closed-loop Control System

Abstraction vs. Reality



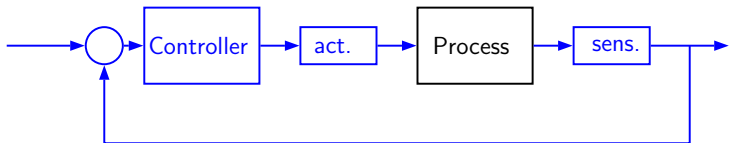
# Closed-loop Control System

Abstraction vs. Reality



# Closed-loop Control System

Abstraction vs. Reality



# Technical Means of Automation

sensors

actuators

control units

# Technical Means of Automation

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# Process Variables

*"If we can't measure something, it is really pointless to try to control it. "*

What we can measure :

- fluid pressure
- fluid flow rate
- liquid volume/level in vessel
- temperature of an object/medium
- electrochemical variables (pH, redox, conc., conduct.)
- mechanical variables (position, motion, acceleration)
- physical dimensions of an object
- optical properties (color, absorbance, refraction)
- electric variables (voltage, current, resistance)
- count of objects

# Technical Means of Automation

sensors



actuators



control units





# Actuators

*“How can we influence the process? ”*

- control the distribution of existing mechanical energy
  - continuous mechanical/electrical valves
  - solenoid valves
  - 3-way valves
- introduction of mechanical energy
  - electric motors and combustion engines (pumps, compressors, stirring, valve control)
- introduction of thermal energy (heat)
  - electric heaters

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sensors

actuators

control units



# Control Units

*“What is the brain of control loop? ”*

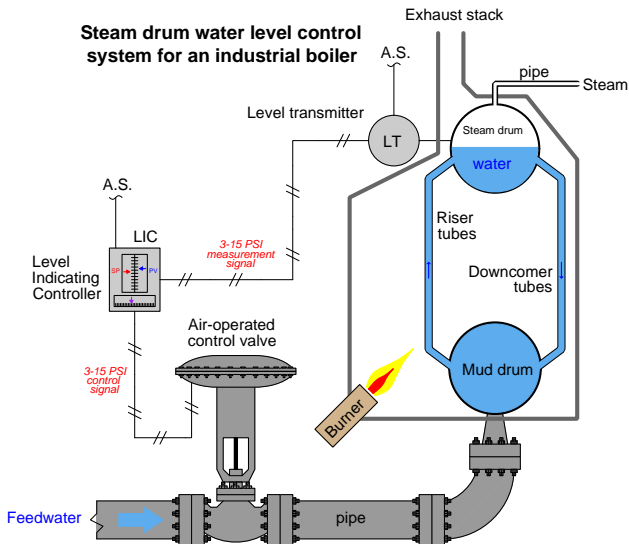
Types of control units:

- analog units
- standard computers
- industrial computers
- commercial embedded controllers
- programmable logic controllers (PLCs)

Features of PLCs :

- CPU and memory
- modularity (IO modules, comm. modules, etc.)
- signal converters (ADC, DAC)
- programmable
- networking (LAN, industrial LAN, Profinet, Profibus, Modbus, etc.)

# Location of Sensors, Actuators and Control Units



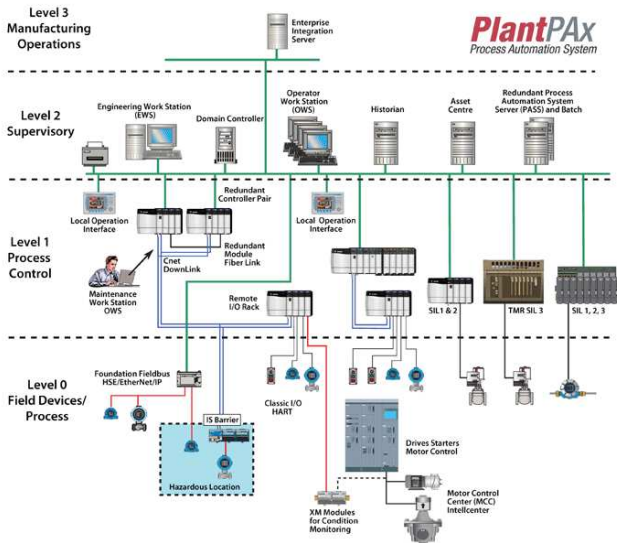
# Historical Design of Plant Automation



# Historical Design of Plant Automation

- analog signals (electric, fluid pressure, mechanical)
- each signal for sensors and actuators led on a separate line
- standalone control units (no centralization)
- manual data acquisition
- only local access
- difficult diagnostics

# Modern Design - Distributed Control System (DCS)



# Modern Design - Distributed Control System (DCS)

- process signals transferred on buses (Fieldbus)
- separately controlled actuators and processes
- centralized upper-level control
- automatic data acquisition
- simple diagnostics
- unified design



# Standard designs of DCS

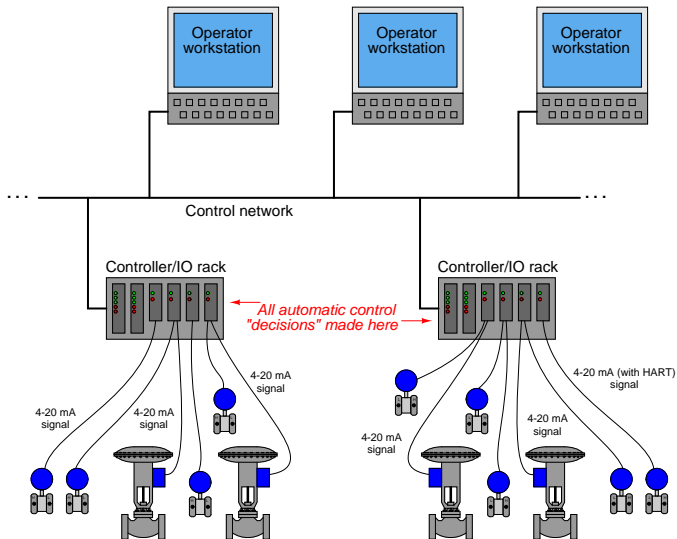
- Analog DCS
- Digital DCS (Profibus)
- DCS with FOUNDATION Fieldbus Field Instruments

# Standard designs of DCS

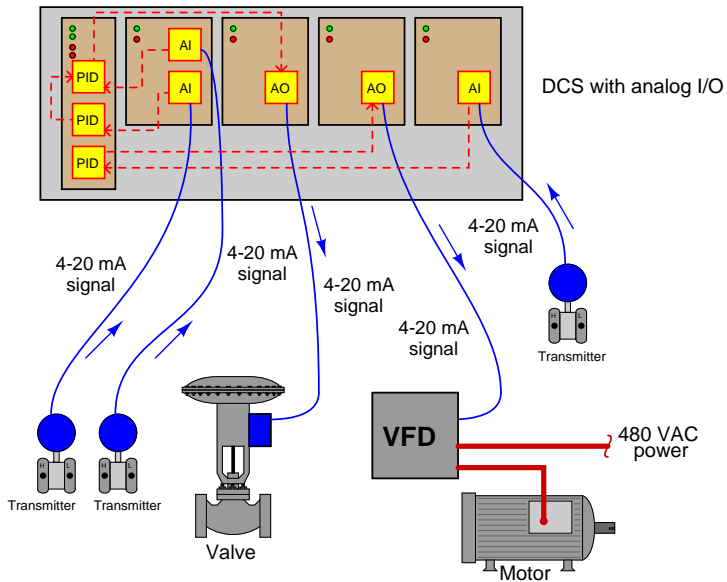
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# Analog DCS

## Traditional, analog-based DCS



# Analog DCS

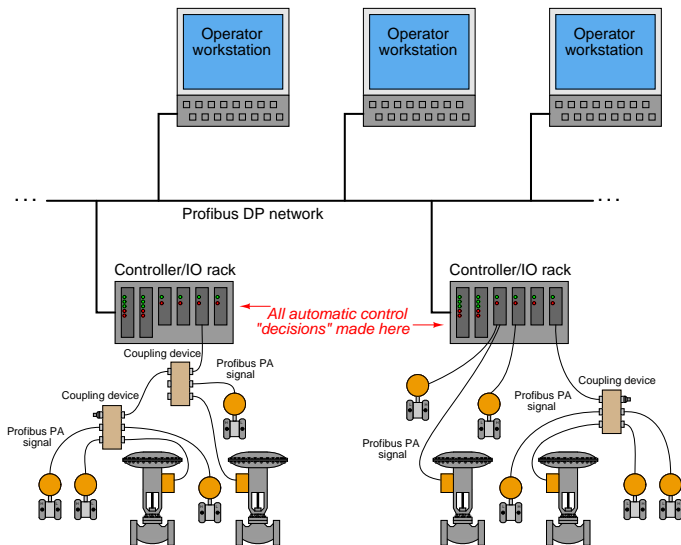


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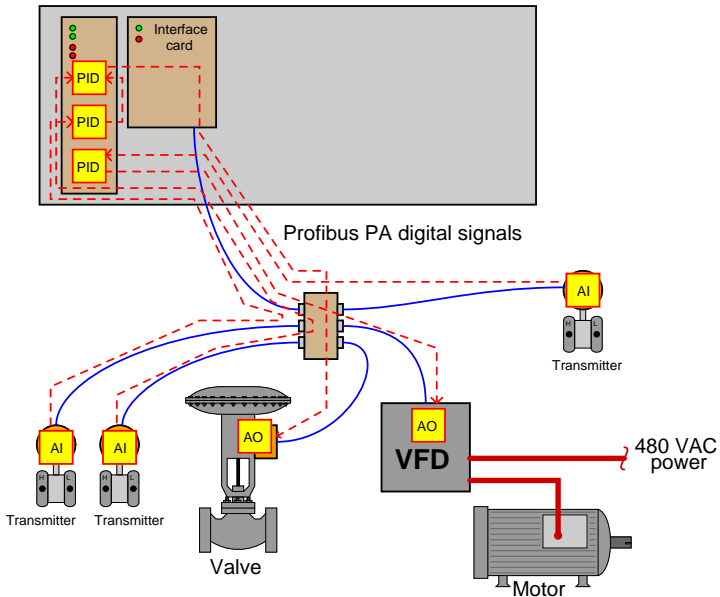
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# Digital DCS (Profibus)

## DCS with digital (Profibus PA) field instruments



# Digital DCS (Profibus)



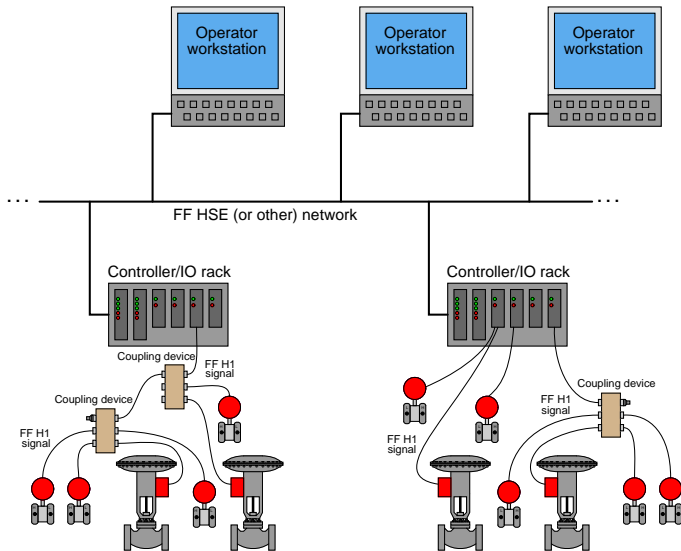
# Standard designs of DCS

- Analog DCS
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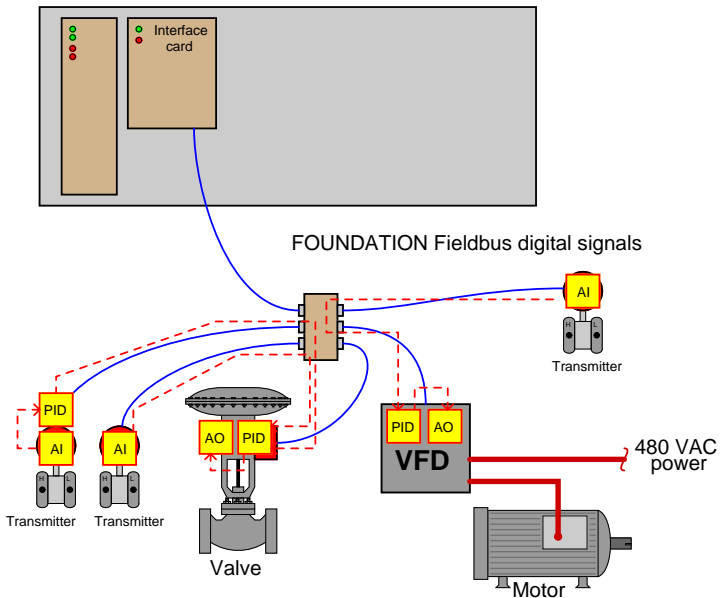
# DCS with FOUNDATION Fieldbus Field Instruments

## DCS with FOUNDATION Fieldbus field instruments



*All automatic control "decisions" made at the field instrument level*

# DCS with FOUNDATION Fieldbus Field Instruments



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