# PERA Architecture Levels in Process Industries

**MLM-007-B**

| | |
|---|---|
| **Industry** | **Process Industry** |
| **Principal Role** | **Owner / Operator** |
| **Professional Role** | **Control Engineers + IT Specialists** |
| **Enterprise Phase** | **All** |

Turn on your audio and click start to begin video

START

This MLM provides an introduction to the concept of PERA Architecture Levels in process industry plants. It is intended for Control Engineers and IT Specialists who will define these systems and the associated industrial and IT networks, maintain, and/or develop them in the future.

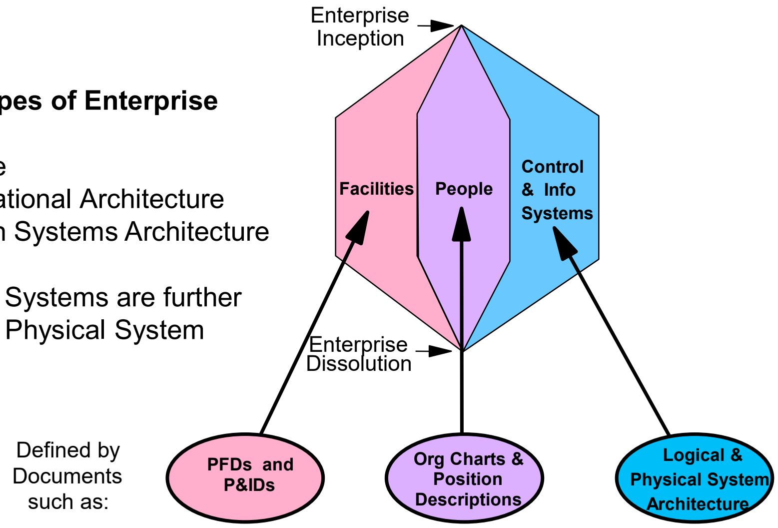
Click the START button when you are ready to advance to the next slide.

## WHAT IS AN ENTERPRISE ARCHITECTURE ?

**PERA defines three types of Enterprise Architecture:**

1. Facilities Architecture
2. Human and Organizational Architecture
3. Control & Information Systems Architecture

Control and Information Systems are further divided into Logical and Physical System Architectures.



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## System Architecture Design

The Control and Information Systems of a process plant, pipeline, oil field or other process facility has an inherent structure, called an “Architecture.

This Control and Information Architecture consists of :

- a Physical Architecture (Computer Hardware and Network Devices and Media), and
- a Logical Architecture (Enterprise Systems, Application Software, and Protocols).

The “PERA Levels” within this architecture may be characterized by a “Time Base” which may be expressed in terms of “4R’s”:

- Response	Time delay between reading and reaction
- Resolution	Time between readings
- Reliability	Time between failures of readings or reaction
- Resilience	Time to restore readings or resistance to failure or cyberattack





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## PROCESS PLANT PHYSICAL ARCHITECTURE

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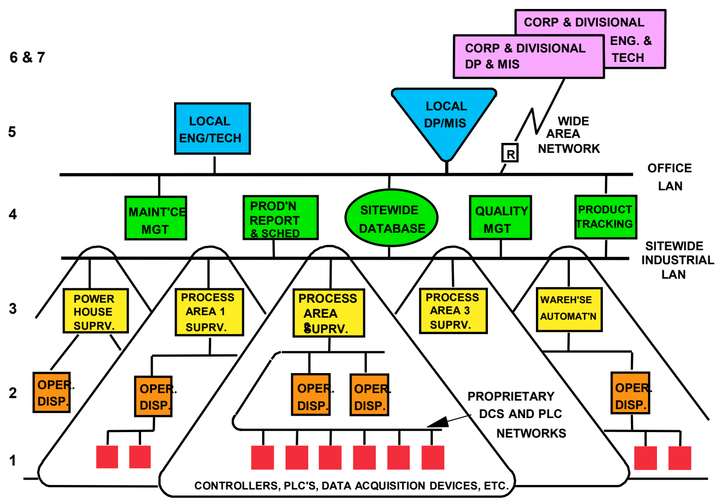




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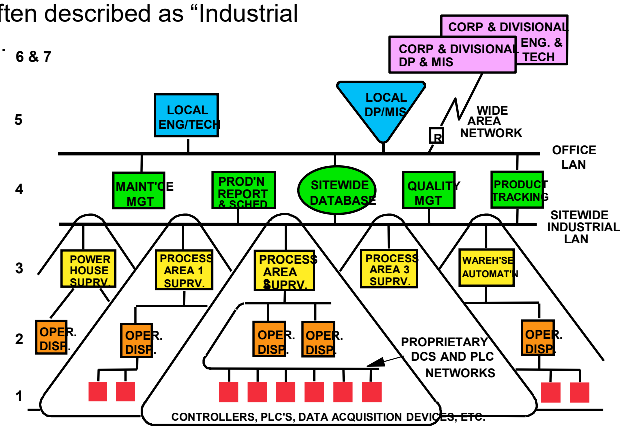
Here is a typical Physical Architecture for a Process Industry Plant.

In this enterprise 7 Architectural Levels have been defined.

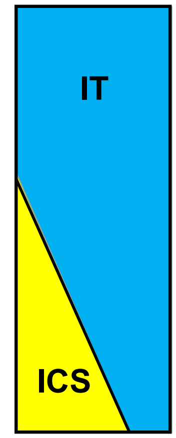
## IT vs. ICS in TRADITIONAL PLANT ARCHITECTURES

Traditionally, IT (data storage, analysis & presentation) predominated at higher levels in the architecture.

Control Systems were often described as “Industrial Control Systems” or ICS.




**Traditional IT vs. ICS split**



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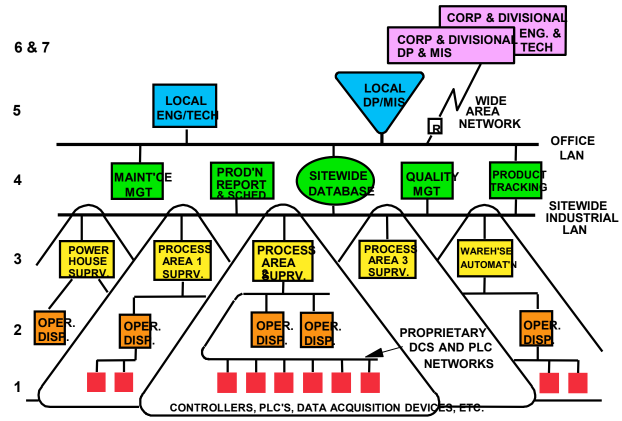
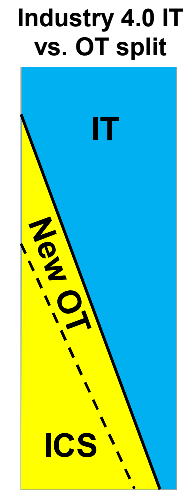
Traditionally, IT (data storage, analysis & presentation) predominated at higher levels in the architecture to the extent that OT was often described as “Industrial Control Systems” or ICS.

## IT vs. OT in "INDUSTRY 4.0" PLANT ARCHITECTURES

With Enterprise Integration, "Digital Twin" Plant Optimization, AI-based Logistics, and MRP systems, "high level" applications increasingly involve real-time data acquisition and regulatory control.

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regulatory control.

OT is often used to describe the combination of new Operational Technology and conventional ICS systems.

Control Engineers often retain the conventional Industrial Control System (ICS) term, and use the OT definition only for applications that include IT infrastructure. This was the original Gartner definition of OT, but this is awkward, as it does not identify what professional skills are required.

PERA prefers to use the OT term for systems where Control Systems and IT professionals work together.  In this case, Control Engineers are responsible for ICS, IT Specialists are responsible for IT systems, and OT systems by definition require them to work together.

## ENGINEERING ROLES in PLANT ARCHITECTURES

- **OT and IT applications exist at all levels of the Enterprise**. The Risks associated with each application determine what Skills are needed to mitigate those Risks to meet company standards.
- **Required Engineering skills might include** Control Engineers, Industrial Network Engineers, Electrical Engineers, etc.
- **Engineering skills may be needed where:**

  - Failures have severe consequences (at any level in the Enterprise Architecture. For example,
    - (OT) Control and optimization of reactors, compressors, or other hazardous equipment
    - (IT) Continuous Environmental Monitoring Systems (CEMS) that may result in fines and/or plant shutdown.

  - Special equipment and network design are required for hazardous areas (e.g., Industrial networks, firewalls, etc.).



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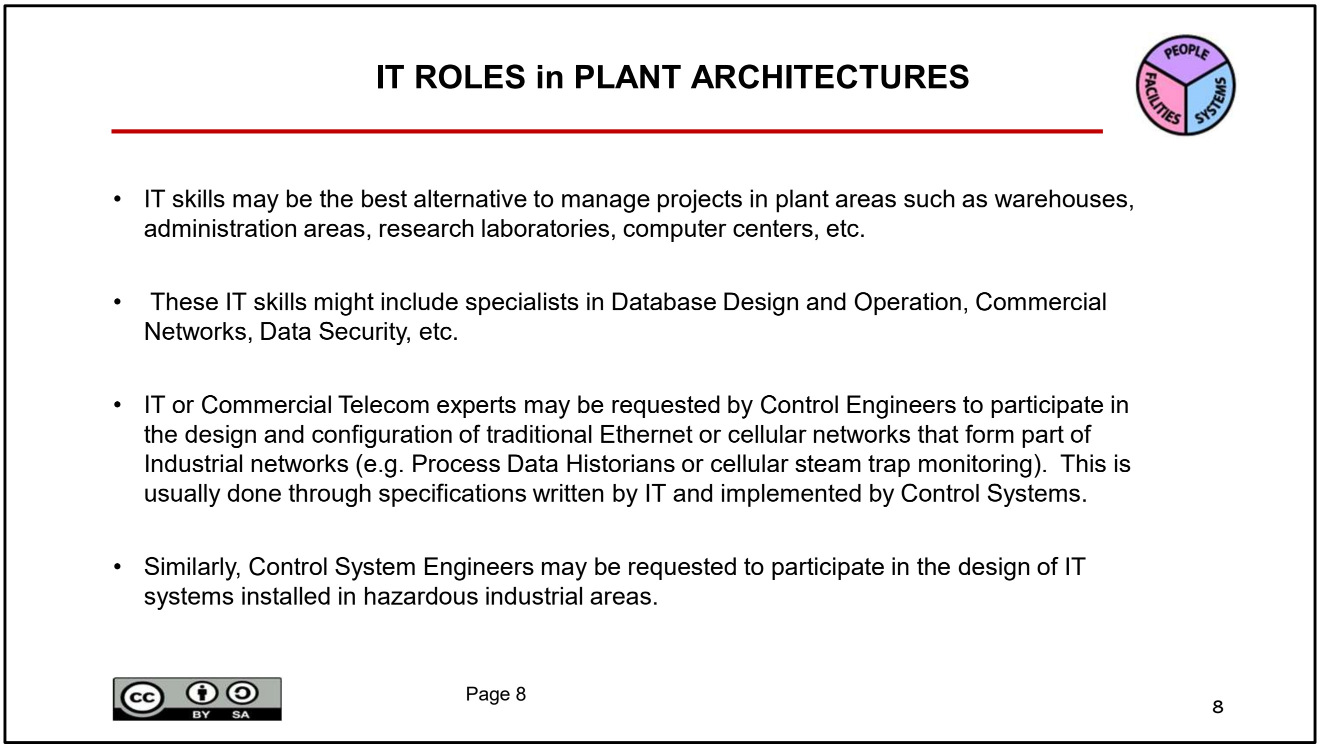


IT skills may be the best alternative to manage projects in plant areas such as warehouses, administration areas, research laboratories, computer centers, etc.

These IT skills might include specialists in Database Design and Operation, Commercial Networks, Data Security, etc.

IT or Commercial Telecom experts may be requested by Control Engineers to participate in the design and configuration of traditional Ethernet or cellular networks that form part of Industrial networks (e.g. Process Data Historians or cellular steam trap monitoring). This is usually done through specifications written by IT and implemented by Control Systems.

Similarly, Control System Engineers may be requested to participate in the design of IT systems installed in hazardous industrial areas.

## COMBINED IT AND CONTROL SYSTEM ROLES in PLANT ARCHITECTURES

- Some large or particularly complex plant systems or applications may require ongoing participation of both Control Systems and IT experts. Even larger facilities may require both IT and Control Systems teams.
- In these cases, Project Management or Plant Management will determine which discipline will lead the work. If two individuals or teams are responsible, then no one is responsible.
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## MAJOR ENTERPRISE SYSTEMS OPERATE AT MULTIPLE LEVELS

Most major Enterprise Systems operate at several levels in the architecture, for example:

- Production Management
- Maintenance Management
- Quality Control
- Engineering, Research and Development and other Major Enterprise Systems.

These systems typically comprise a large number of application programs designed for use by different Professional Roles to accomplish work processes and deliverables, as described below.





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- Quality Control
- Engineering
- Research and Development

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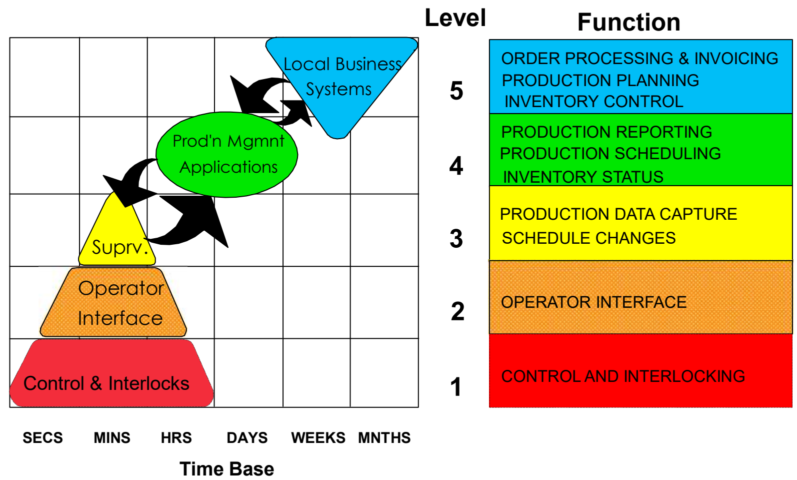
## PRODUCTION MANAGEMENT SYSTEM LEVELS

Production Management Systems span at least 5 levels in the architecture where they are used by different groups.



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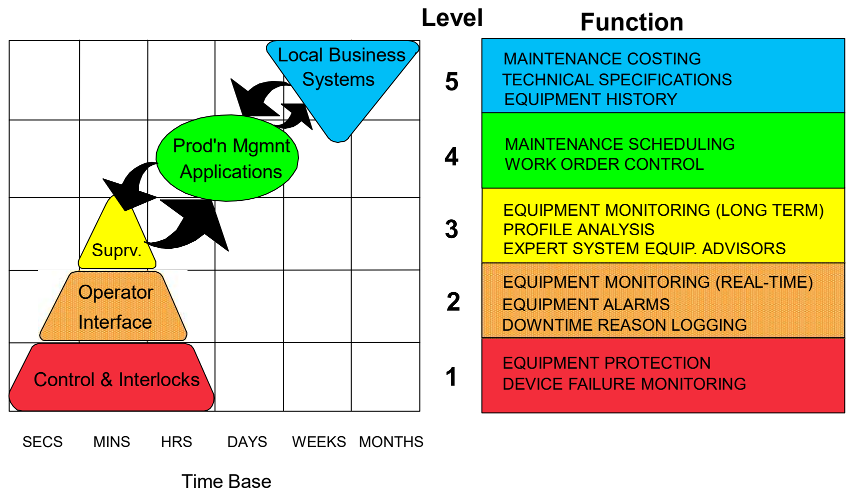
## MAINTENANCE MANAGEMENT SYSTEM LEVELS

Maintenance Applications may span 5 Levels in the Architecture, from Equipment Protection at Level 1, where the 4Rs range from milliseconds to hours, to Maintenance Costing, with 4Rs of days to months.





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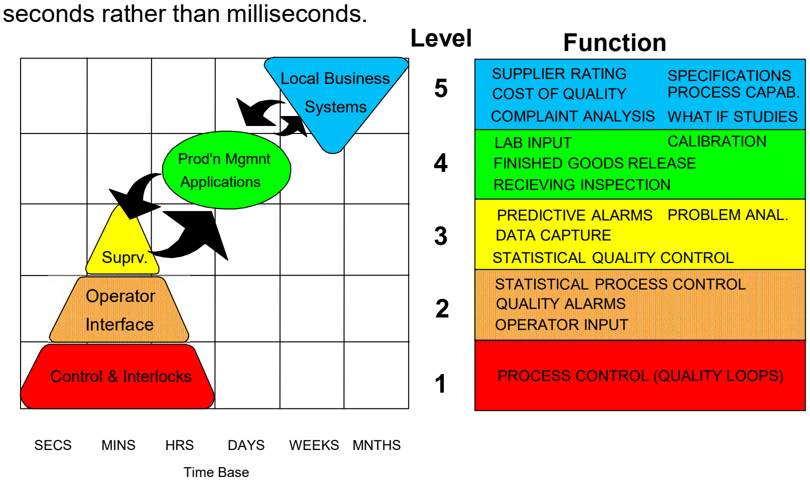
Some designers prefer to separate Maintenance Applications on a separate industrial network (below the plant firewall. However, so many plant readings are shared with Production Management and even Quality Control that this creates more problems than benefits.

# QUALITY APPLICATIONS LEVELS

Quality applications also span several levels, from online analyzers at Level 1 to Complaint Analysis at Level 5 or 6. The nature of quality analyzers and measurements means that 4Rs at the control level may start at seconds rather than milliseconds.



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## KEY MESSAGES

- Logical and Physical Architectures provide a “framework” for the full set of Enterprise Systems.
- Data highways and networks are shown as “horizontal” lines (since they connect devices at the same architectural level).
- Data Flows that move up a level, immediately assume the 4Rs (Response, Resolution, Reliability and Resilience) of the higher level, even if the data flows back down.
- Access between Levels (e.g., between Industrial and Office networks) should be controlled with Firewalls and/or Gateways.
- Multi-level inter-application standards and protocols are required if applications are to communicate (e.g. OPC UA, ISA95, etc.).
- Logical and Physical Architecture Diagrams are developed at increasing detail as a facility is designed and operated, and these provide a tool to communicate to the rest of the Enterprise.



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# AUTHOR

Gary has more than 40 years of experience with enterprise integration and optimization projects, including PERA master planning and project management.

As one of the initial authors of the PERA Handbook of Master Planning, he has used PERA Enterprise Architecture and Master Planning methodologies throughout his career including control and information systems for oil production, pipelines, refining and marine loading, petrochemicals, coal, gas, and oil-fired power plants, polyethylene, ammonia, explosives, paint, pulp and paper, food and beverage, and pharmaceuticals. LNG facilities included world-scale arctic, European, and US Gulf coast complexes.

infrastructure facilities included Fire, Police, and Emergency Response systems for major US cities, as well as emissions reporting and trading systems for more than 100 US Power Plants,