ISA 95 – Setting the Stage for Integration of MES & ICD Systems

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Proposed Topics

- Introduction
- Where did S95 come from ?
  - Those who do not study history are doomed to repeat it.
- Why is S95 needed ?
  - Until windows were standardized, every window was custom crafted.
- What does S95 mean to your company ?
  - Things are changing. Make a plan.
- Summary

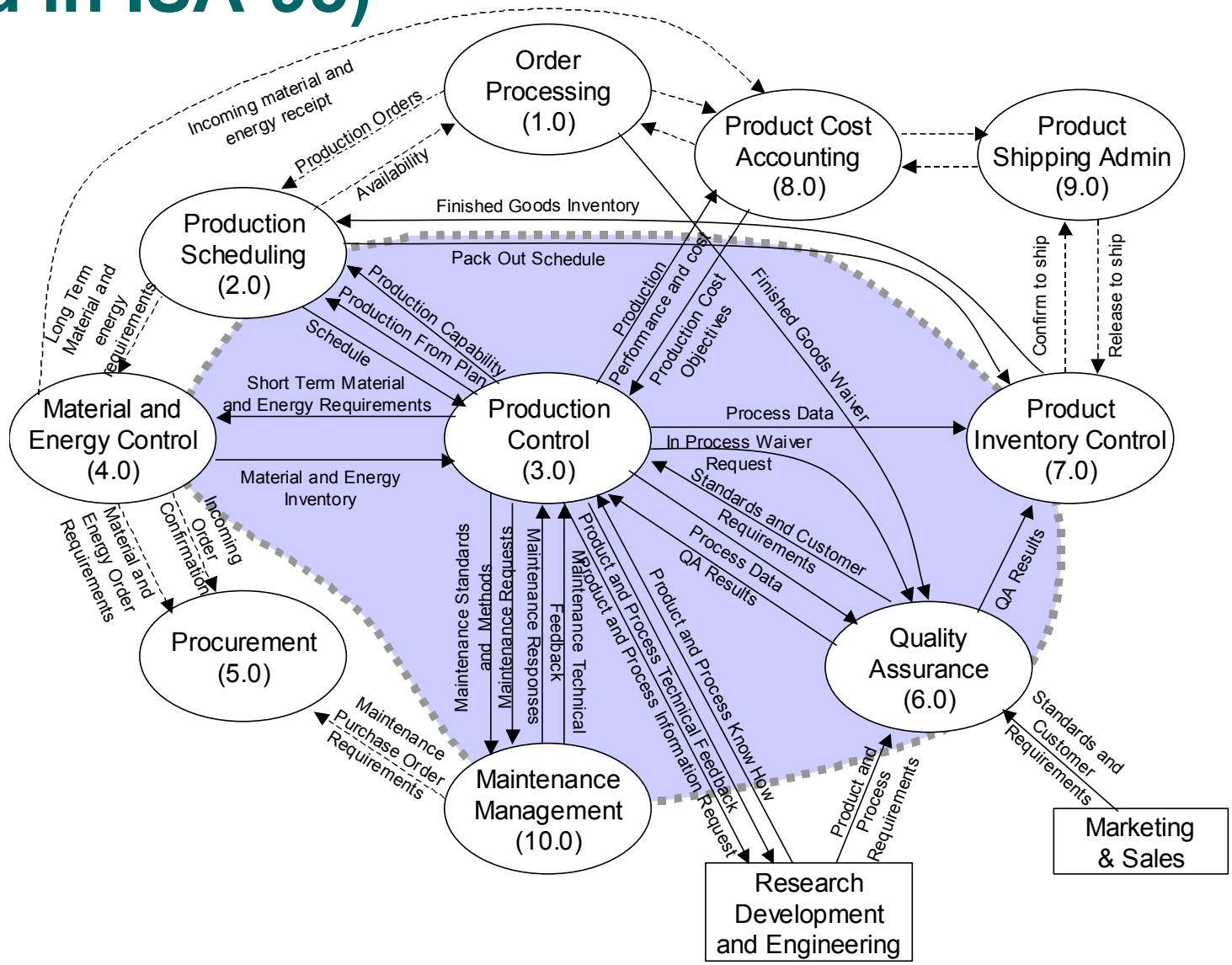
Introduction – Gary Rathwell

- President, Enterprise Consultants, Inc (ECI)
- Long experience in Industrial Controls and Telecom
  - 9 years doing Oil & Gas Projects in Russian & FSU
  - 8 years Fluor's World Leader of Controls & Industrial Automation
  - Lead 12 PERA Master Plans for multi-billion projects, contributed to many more.
  - Manager process control and optimization at ICI and Texaco
- Early PERA proponent (Purdue Enterprise Reference Architecture)
  - 1980s ➔ now.
  - See www.pera.net (all materials open for public use)
- Still participates in S95, S99 and IEC Standards Teams.
- Author of many master planning and engineering tools & standards.

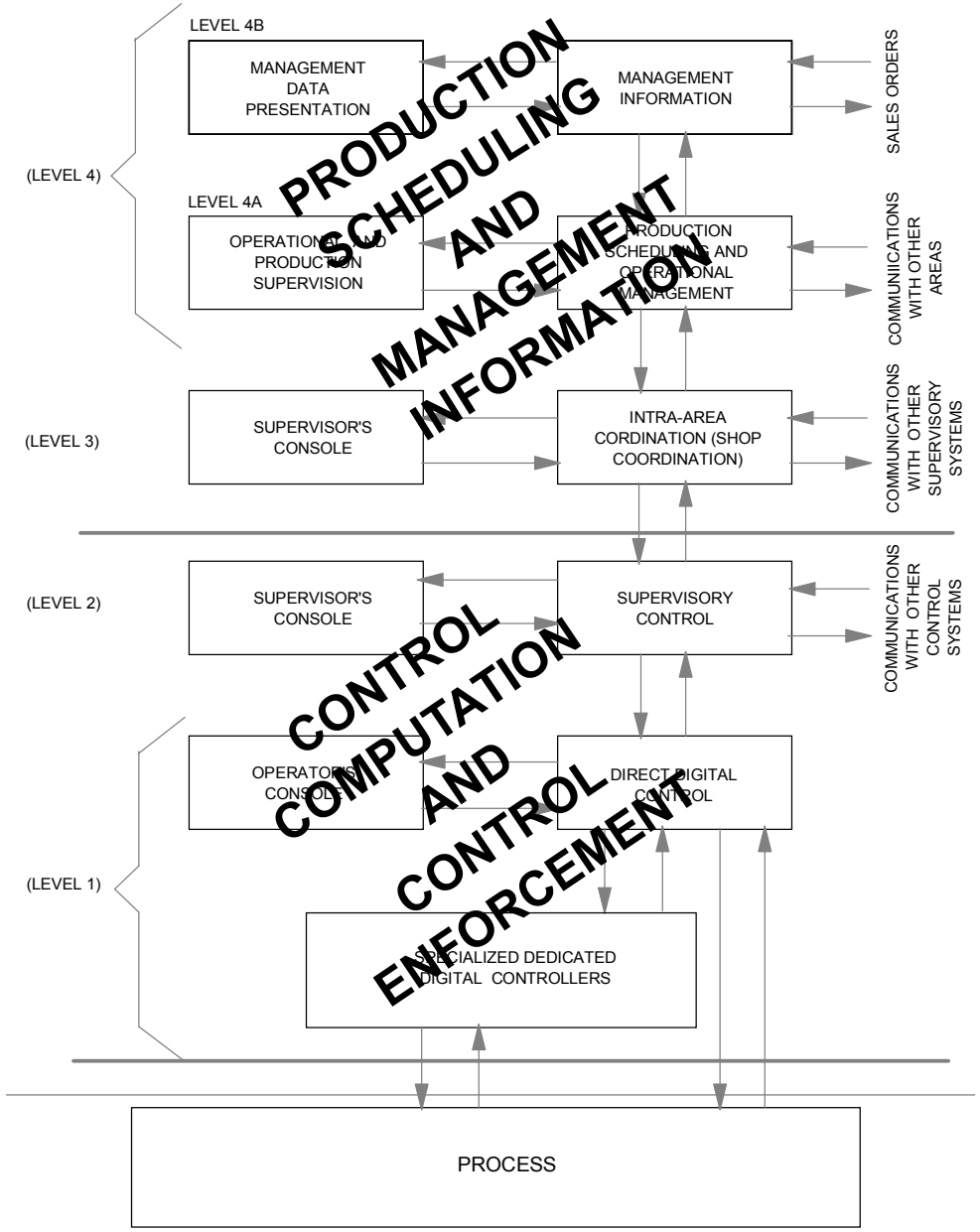
PERA was first published in 1989

- The Purdue Enterprise Reference Architecture (PERA) and the Purdue Reference Model for CIM were first published by a consortium of industrial users, suppliers and academia.

Purdue Reference Model for CIM (used in ISA-95)



Purdue Enterprise Reference Architecture (used in ISA-95)



PERA Handbook published in 1995

- The PERA Handbook of Master Planning was published in 1995 to provide a guide for using PERA in Enterprise Integration projects.
- In the intervening years the PERA Reference Model and the Master Planning Handbook has been used in hundreds of enterprises in Metals and Mining, Oil and Gas, Chemicals & Petrochemicals, Power, Food and Beverage, Pharmaceuticals, Government, and many other industries

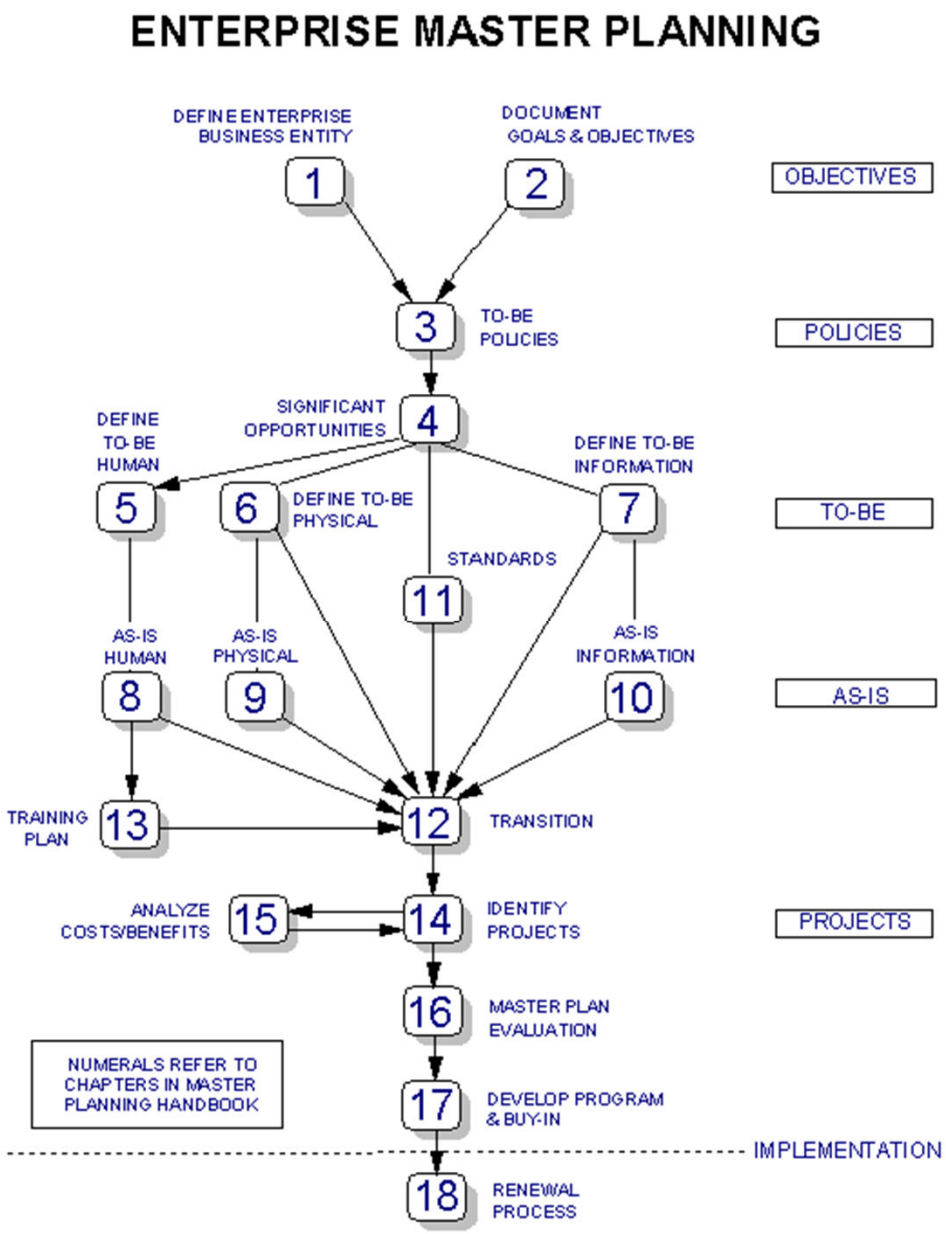
PERA Master Planning Process

- A formalized process for Enterprise Master Planning

- Supports application of standards such as ISA95, ISA99, ISA88, ISA84, IEC 61508 & 61511, ISO 15000, etc.

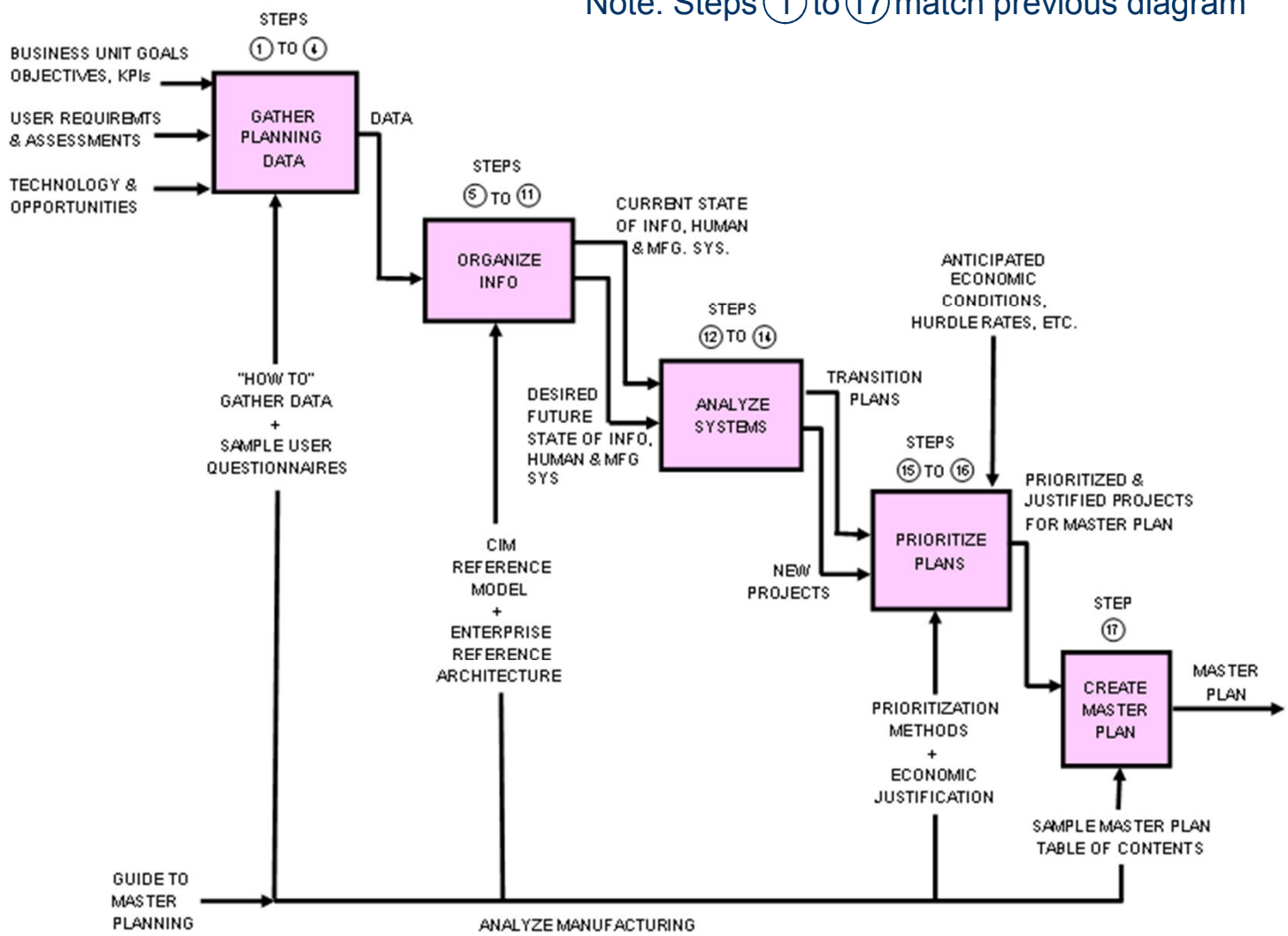
- An Integrated part of PERA (and thus ISA95, 88, etc.)

- Like PERA it is free.



PERA Master Planning Workflow

Note: Steps 1 to 17 match previous diagram



So, What took so long ?

- The Purdue Reference Model for CIM has been adopted as the basis for a number of key standards including ISA-95 and ISA-88. This involved formalizing and extending the original PERA concepts, and makes them more widely adopted and recognized.
- The concept of ERP, MES, and ICD Domains at specific levels in the Enterprise Architecture has been formalized. Each of these has different requirements which become more industry-specific as one moves lower in the Architecture.
- Network security standards including ISA-99 have evolved which influence design of Corporate, Plant MES and ICD networks. These new standards have been integrated with the concept of architectural levels in the Reference Model
- Industrial control standards for SIS/SIL (Safety Instrumented Systems/Safety Integrity Level) have been codified in IEC 61508 and 61511, which also influences design of ICD systems and networks.
- Evolution of Industrial Control Devices and Networks (Smart Instruments, Field buses)
- Quality standards have been introduced including ISO 9000 and SOX (Sarbanes Oxley) which also influence design of ERP and MES systems.
- ISO 15000-5 introduced the concept of “Core Components” which are similar across enterprises (for example within the Physical Facilities Model, pumps or control valves have many common elements). These core components are supported by “Product Classes” within the Engineering Workbench.

Why is S95 needed ?

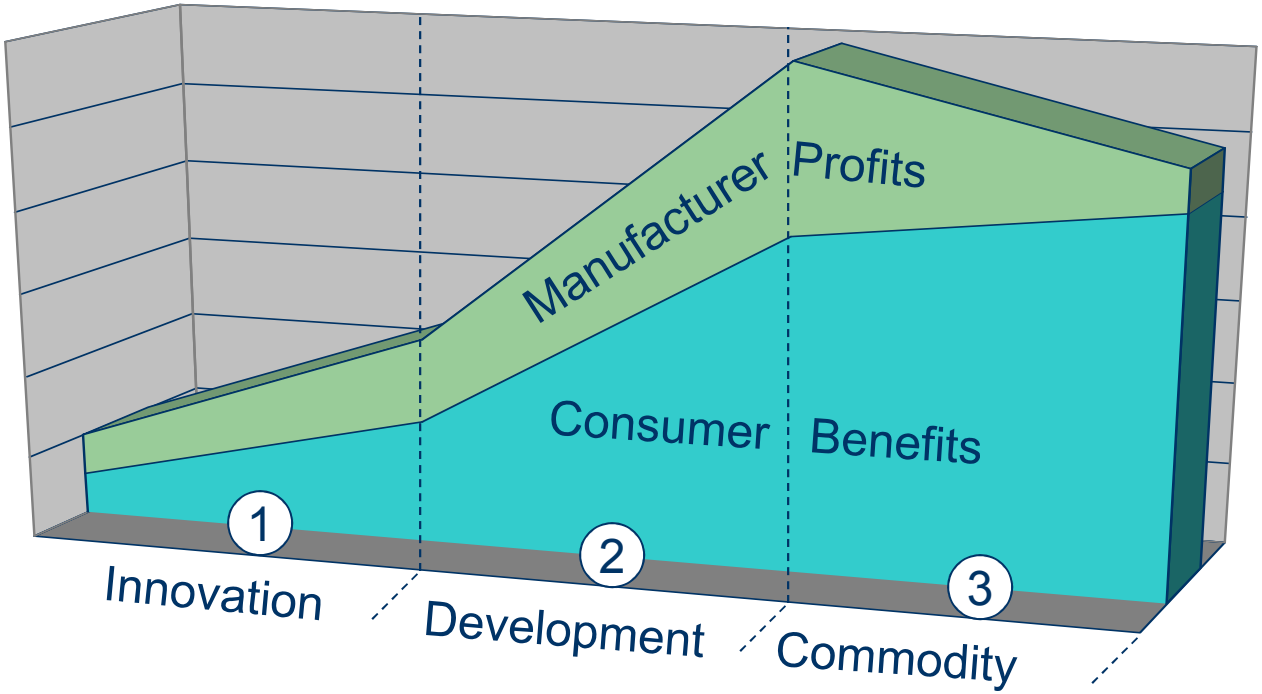
- To Provide:
  - Standardized application Interfaces
  - Standardized application naming and basic features
  - Common Naming and Semantics
  - Common Interfaces to a standard “bus”
  - Life Cycle Management of data
- To standardize interface between ICD and MES applications (through firewall)
- To allow flexible Business Process Management (BPM) in the ICD and MES environment.
- Houses only became cheap when windows, doors, pipes, etc., were standardized.

What should ISA 95 NOT standardize ?

- How applications accomplish results internally
- Industry-specific data or applications (80% rule)
- Languages (other than XML for interfaces)
- Operating Systems (e.g. MS or Unix, Programming Environments (e.g. Java or Biz-Talk)
- Architecture Levels (these are standardized by each enterprise, S95 definition as Level 3 to 4 is an accident of history. Russian pipeline network has 6)
- Any areas subject to rapid technical evolution (see 1 - next slide)
- Any vendor-specific or patented implementation (see 2 - next)
- Example of GOST (Be careful what you wish for !)

Progression of New Technology

1. innovation (no standards)
2. feature competition (proprietary standards)
3. price competition (open standards)



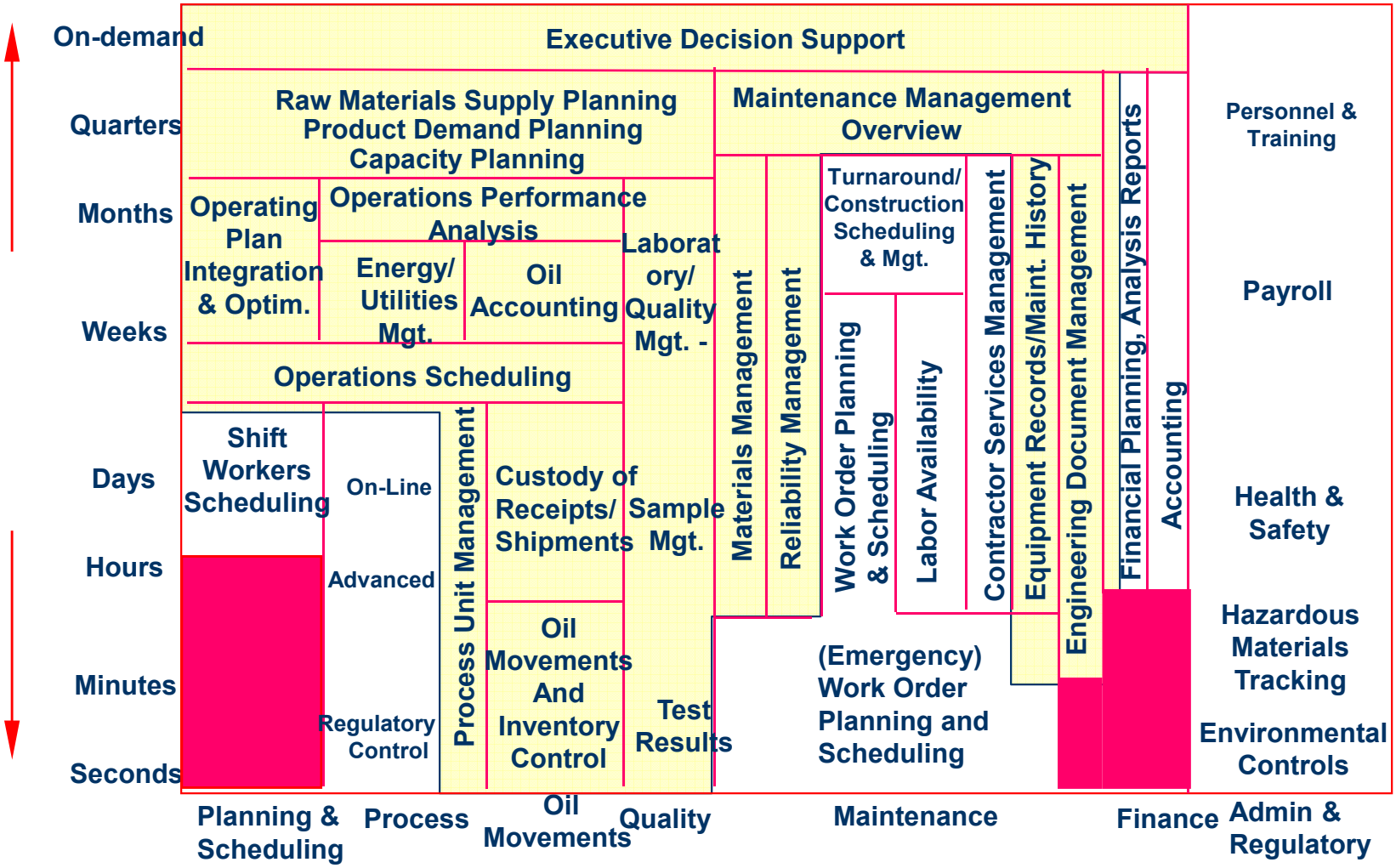
Examples of this Progression

- Custom Device Software Interface
  - 1980 – Setpoint Corp - $50K to $100K (custom)
  - 1995 – OSI - $5K to $10K (proprietary standard)
  - 2010 – SAP - $500 to $1K ? (open S95/ISO standard ?)
  - - more thumbs on keyboards
- PLC highway Hardware Interface
  - 1990 – Modbus - $1500 (proprietary standard)
    proprietary cable $10/meter
  - 2000 – Ethernet - $150 (open standard)
    commodity cable $1/meter
- Don’t forget, suppliers resisted open-standard industrial highways for a decade ! (MAP, Fieldbus)

The Industrial/MES Bus Concept

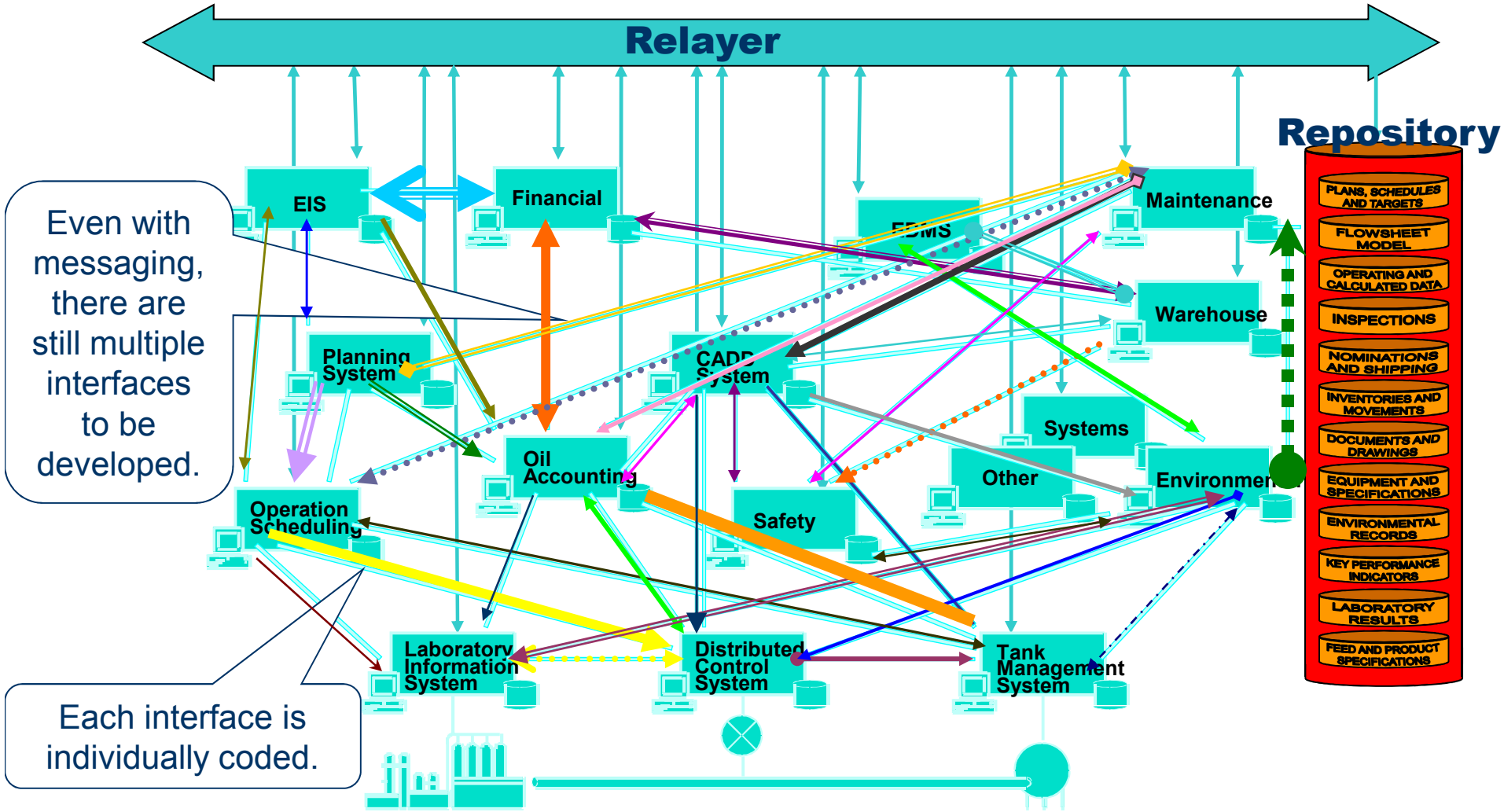
- S95 eliminates the need to create “Point-to-Point” interfaces between ICD and MES.
- Following slides show the difference between “P-to-P” and a “Bus”
- Used with permission from RIS, but SAP, IBM, Oracle and others provide similar bus concepts.

RESOLUTION© - Scope

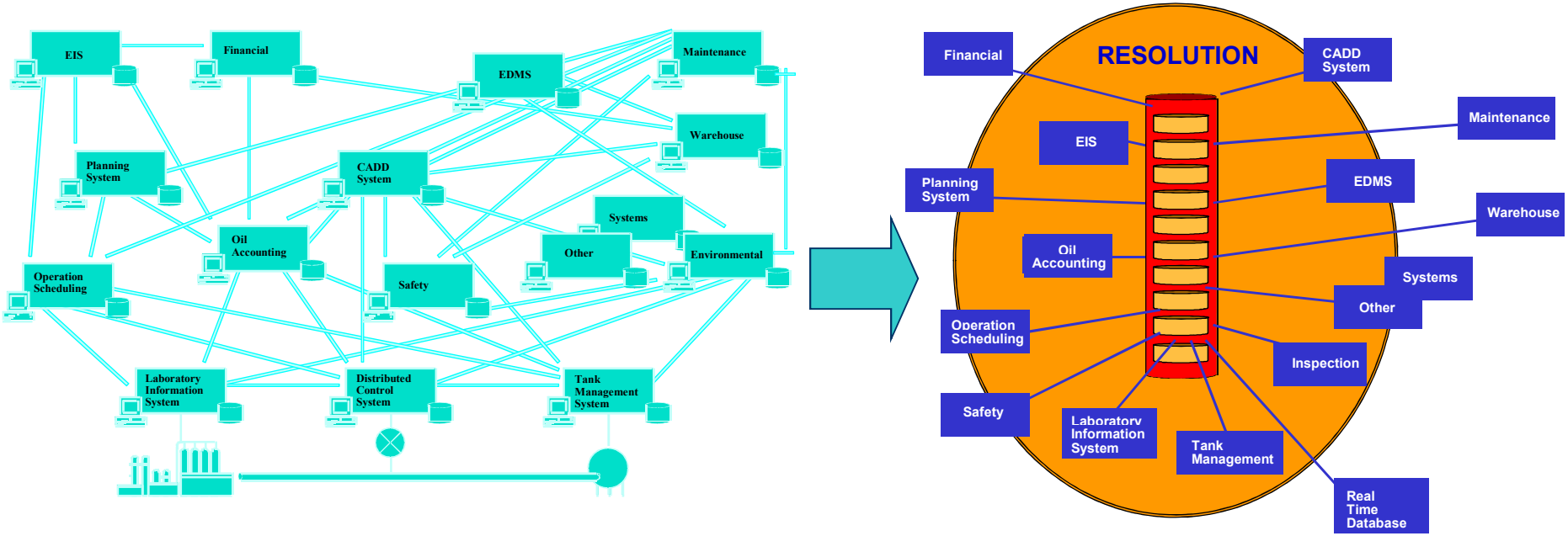


Reference: Solomon Associates Inc.

RESOLUTION © - Strategy



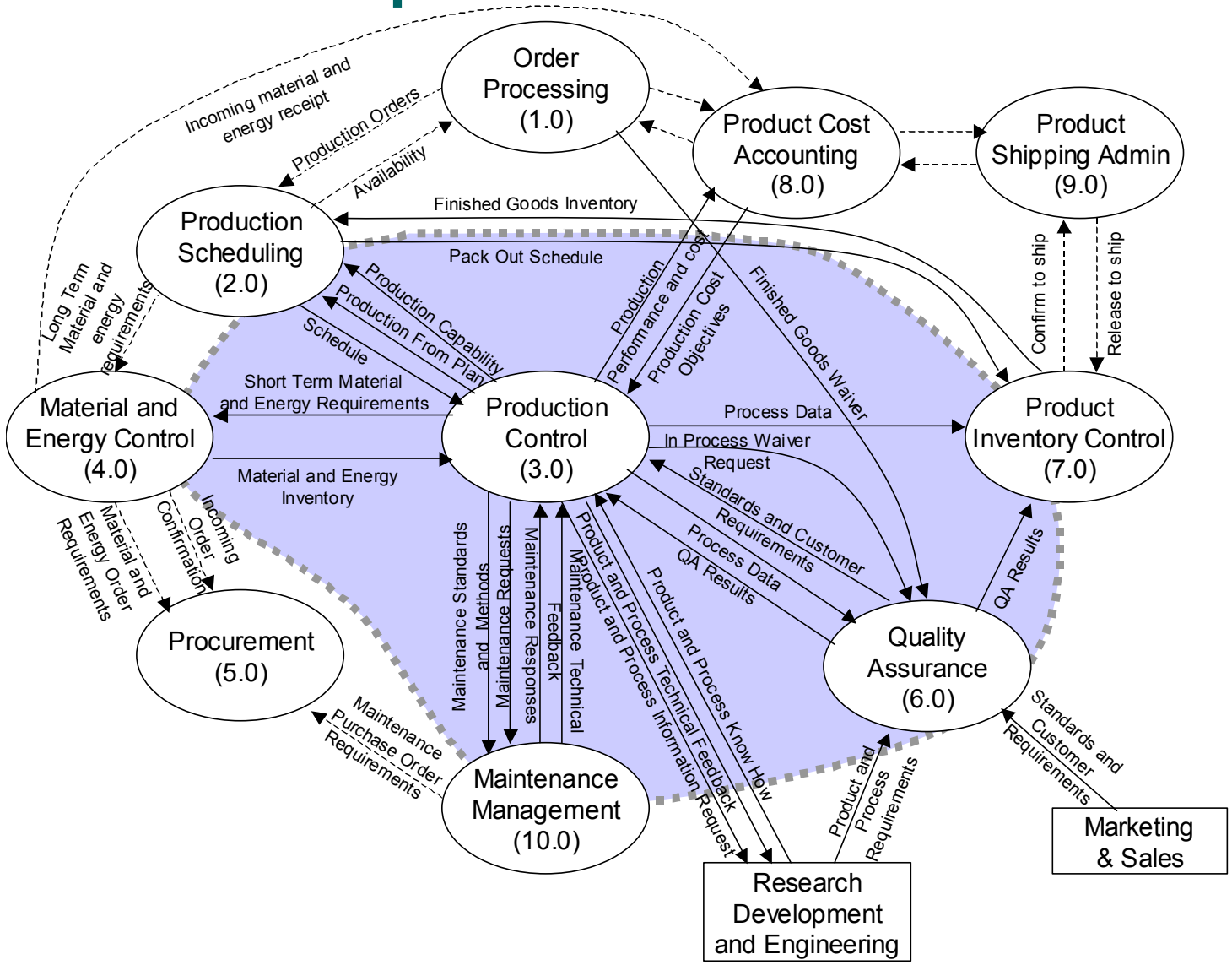
RESOLUTION© - What it offers



Will different S95 buses interoperate ?

- So, now vendors' devices and applications can "mix and match" without developing custom interfaces. (generally works, but no testing service).
- However, even if buses from different vendors are S95 compliant, these busses are proprietary implementations and will not interoperate (too early to standardize)
- In other words you may be forced to "lock in" a single vendor (at least at each site ?).

Each of these Standard Applications may be built of "Core Components"

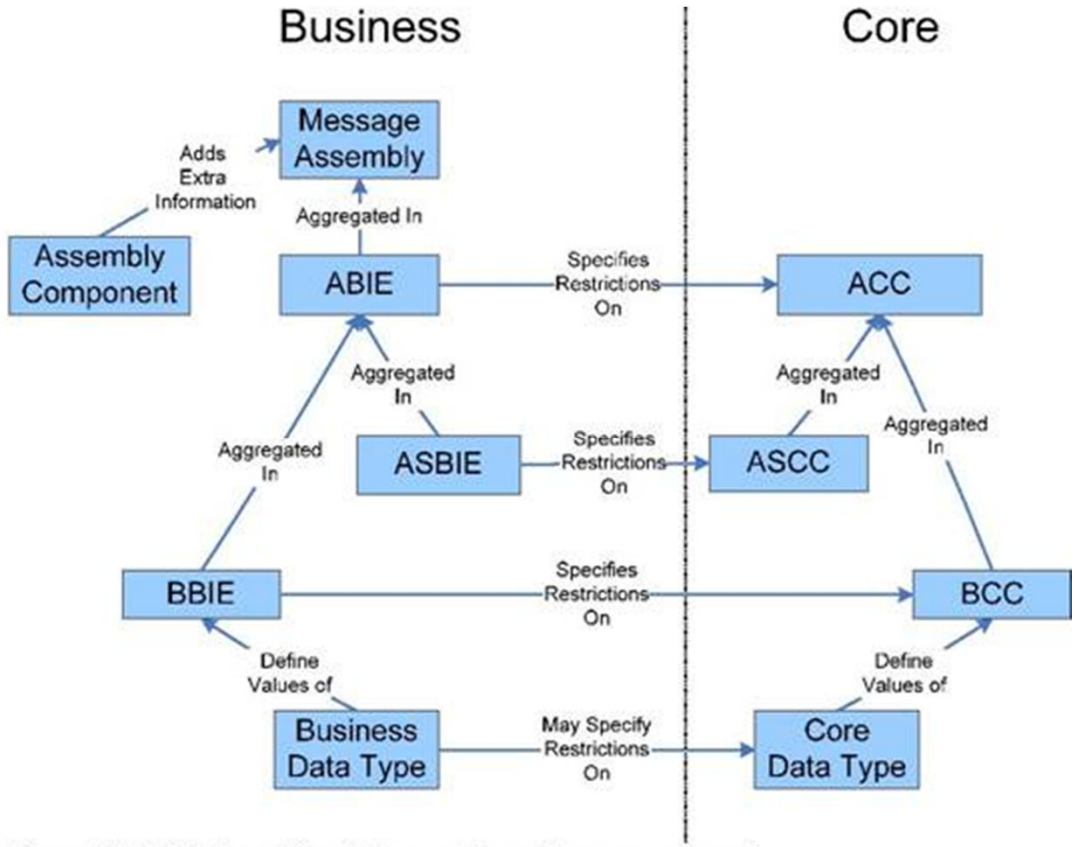


Common Semantics

- To communicate between applications, we must use the same data and semantics at both the Application & Component level.
- ISO and United Nations are addressing this via ISO11179-5 and ISO 15000-5
  - Although currently proprietary, these will soon be available in web-based public registries so that anyone anywhere will produce/describe the same item
  - Have a set of “Core Components” that are used within a “Business Context” (next slide)

Business Context of Core Components

(reference: page 19 of ISO 15000-5 Draft b)



504
505 Figure 5-2. Relationships Between Core Components and

UML of Core Component Model

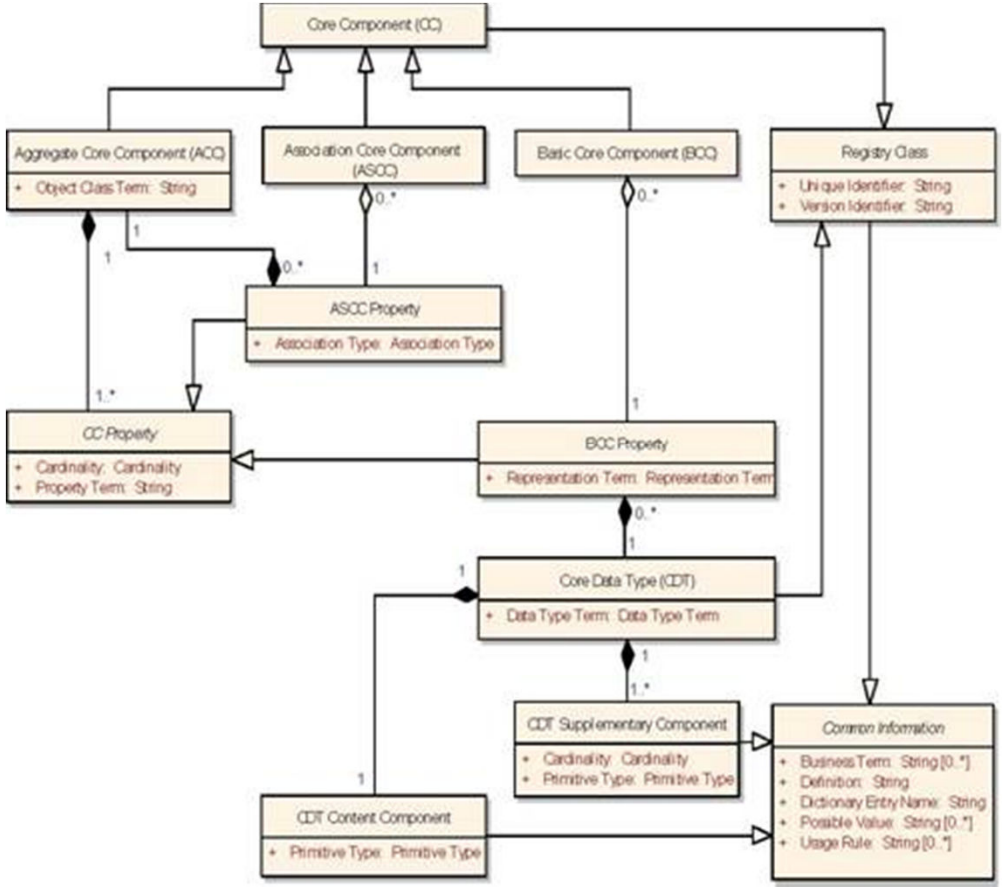


Figure 6-1 UML Diagram of Core Component Basic Definition Model (p 25 from Draft b)

Provides for Life Cycle Management

- Success with the “Best of Breed” Component Model means ensuring that those that have the right to Change the Process can do so in a Timely Manner.
  - Must integrate to relevant “ML” (Markup Language) Standards. Almost Every Business Segment has defined their unique ML (e.g. B2MML)
  - PERA and ISA 95 provide the overall framework for Life Cycle Change and recognize the need for Scenarios of data within a Phase and provide for a consistent Data Structure between phases so that the same item, e.g., Unit Capacity has different values and slightly different meaning within each phase.
  - Even XML Messages have a Life Cycle! Using XML, New data may be added, but old data expiry is more problematic.

Business Process Management (BPM)

- Standards are evolving that provide the Framework for dynamic BPM at all levels of the architecture.
- IBM, Oracle, SAP, MS, et. al. are working on BPM tools do accomplish this.
- Goal is for an End User to have a live “Picture” of their Biz Process and as they change the Picture, the Biz Process adapts without programming:
  - IT supports the Infrastructure and Environment
  - Must be auditable, e.g. SOX (Sarbanes Oxley) etc.
  - Computer Integrated Manufacturing (CIM) from the 80s is finally materializing!
  - Combines MES/ERP structure with LEAN manufacturing dynamism.

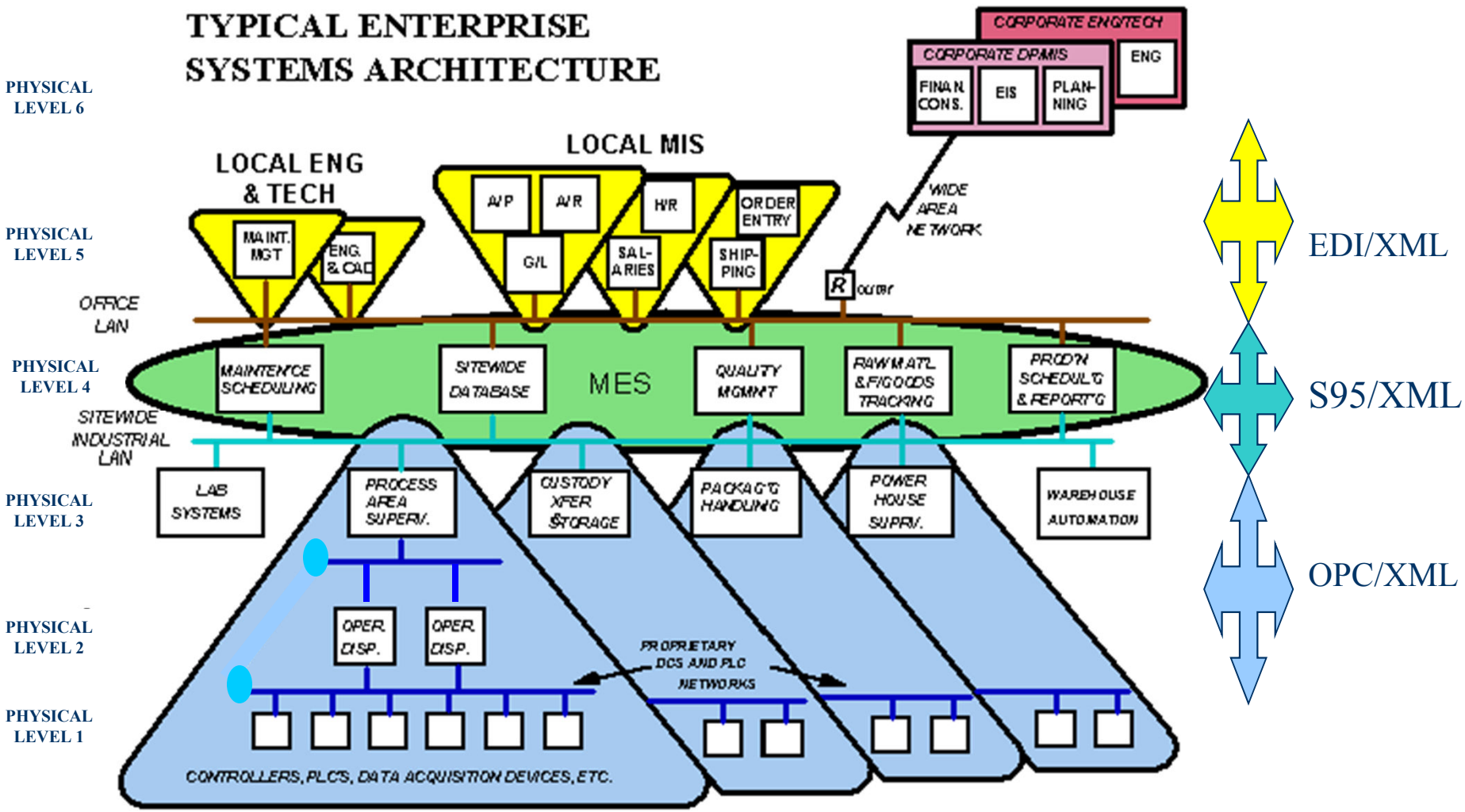
What does this mean to your company?

- The new ICD and MES environment, and the standards associated them, represent financial opportunities, as well as security and competitive threats.
- An effective enterprise solution will not happen by default. It requires a carefully considered plan with wide participation.
- Since PERA provides a well developed methodology for planning these new ICD and MES enterprise systems, it should be evaluated, particularly since it is immediately available, proven, and free.

So, What must be Standardized by your company ?

- A Unified Design Including General and Specific Requirements
  - Enterprise Systems Architecture including CIAD (logical architecture) and CIND (physical architecture) diagrams
  - Philosophy and Standards for Safety & Security
  - Naming and Numbering Systems (S95 base + special)
  - Physical and Logical Network Documentation Formats
  - User and Network Application Interface Standards
  - Functional Requirements for Major Systems (S95 base + Special Requirements. E.g. board of trade interface)
  - Functional Requirements for specialized Sub-systems (E.g. oil custody transfer metering)

TYPICAL ENTERPRISE SYSTEMS ARCHITECTURE

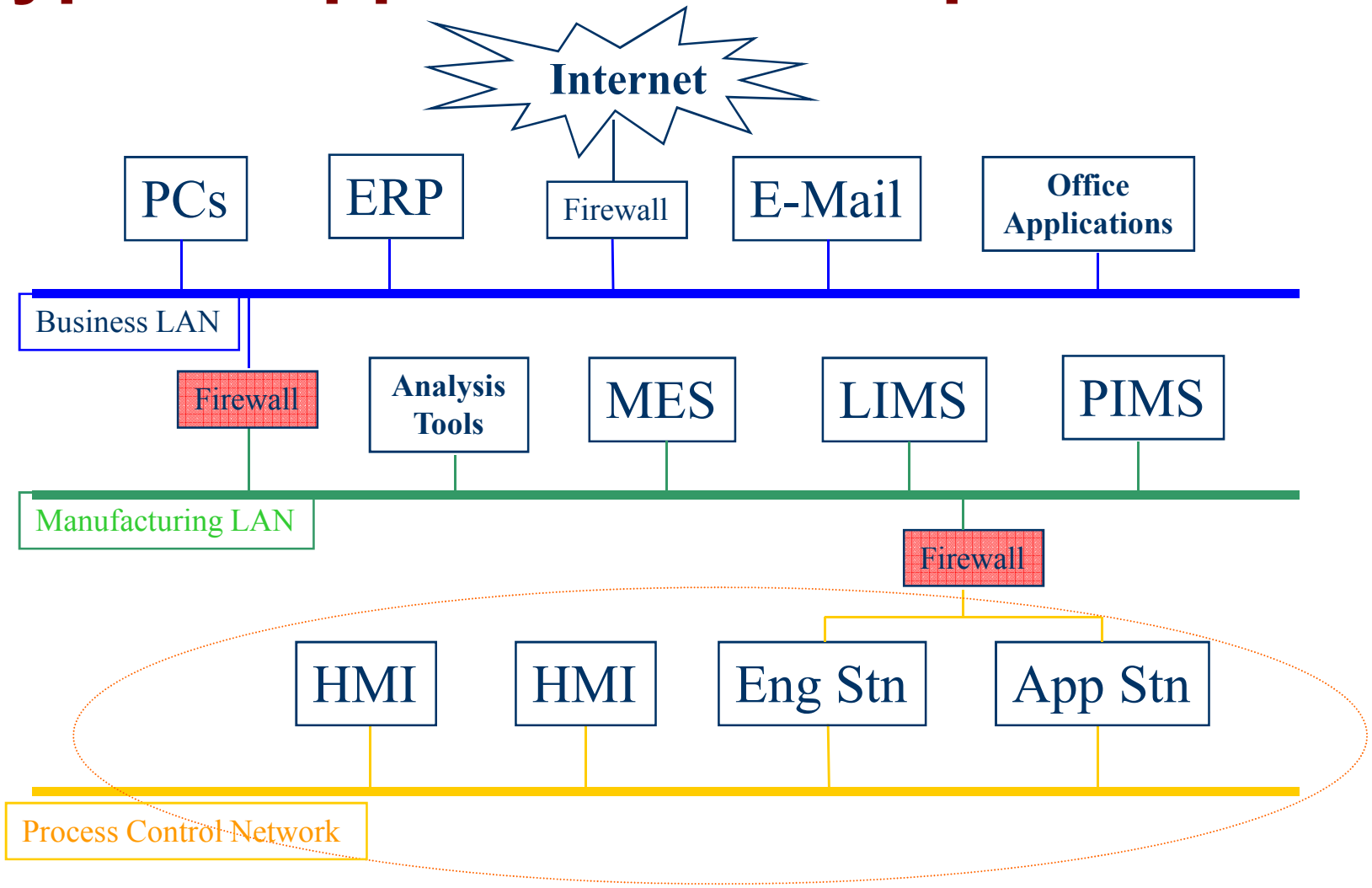


Note: Horizontal and Vertical Communications may be to Peer Systems in other Companies

What must be Standardized?

- Standardized Technical Documentation:
  - Content
  - Format
  - Naming
- Procedures for:
  - Specifying and Procuring Standardized Systems (airport security example).
  - Approval and Design of Custom Systems in a secured ICD and MES environment.
  - Auditing ICD and MES Security (e.g. new laws like SOX).
  - Management of Change of systems in a secured ICD and MES environment.

Typical Application Example



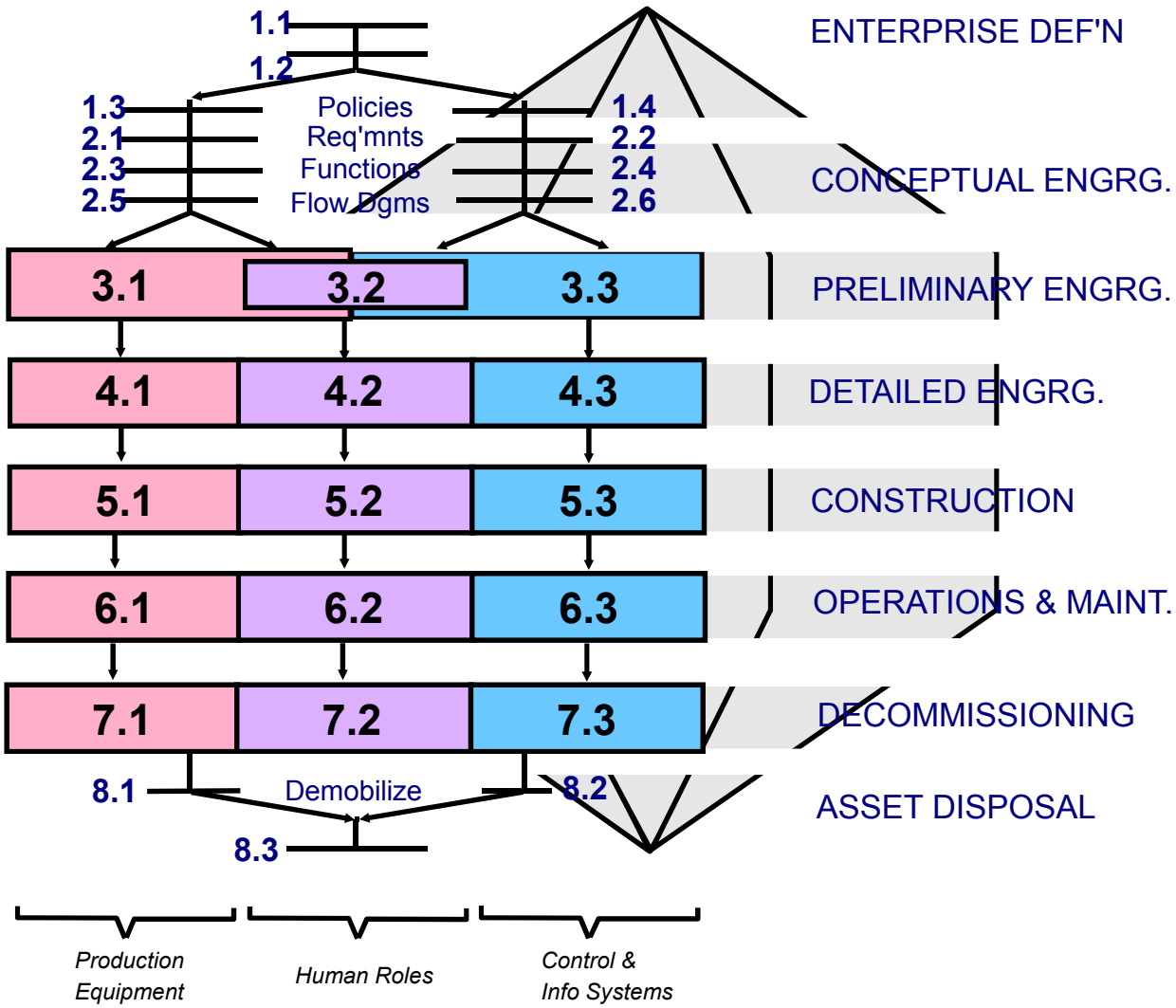
Select New Standards

- Rapid development of new technological standards in:
  - Industrial Devices such as Smart Instruments, controllers and analyzers (OPC UA, Web Components)
  - industrial Data Networks, Fieldbus, Profibus (IEC TC65C)
  - New international standards for Process Safety and Reliability (IEC 61508, ISA 84).
  - Industrial Telecom and Network Security (S99)
  - And of course, ICD to MES data interchange (S95)
- International standards must be used, as the current rate of standards development cannot be funded by any one country.

The Initial Planning Approach:

- Define a set of Major Systems (perhaps 20 counting basic S95 set of 12 ?)
- Define a set of Documents based on International standards (e.g. IEC, IEEE, ISA, PIP, etc.). See examples for Industrial Networks.
- Define a set of Project Phases, Architectural Levels, etc., within which to structure Major systems (company-specific but PERA provides basic set)
- Document System Requirements by Discipline (e.g. Control Systems, Telecom or Industrial Systems (see Engineering Workbench for starter set of Disciplines and Documentation).
- Develop documentation by “Phase” beginning with Conceptual Engineering (Standardized Phasing is also provided by PERA).
- System Documentation must match engineering documentation phase for phase.

PERA Implementation Model (Engineering Phases)



The Detail Planning Approach:

- Define Specifications for Major Systems including:
  - Detailed Functional Requirements
  - All relevant Industry Standards
  - Documentation Requirements (e.g. Drawings, etc.)
  - Testing and Commissioning requirements
  - Training requirements
- Develop other Preliminary Engineering Phase Documents including:
  - Control Diagrams (or P&IDs)
  - Hardware Architecture Diagrams
  - Typical Layout Drawings (e.g Computer & Telecom Rooms, Rack Rooms, Control Rooms, etc.

Summary

- Rapidly changing industrial systems integration market.
- Opportunities are growing, but complexity and risks are also increasing
- S95 represents the ONLY efficient way to implement links between automation, MES and ERP (e.g. SAP etc.)
- S99 and Security architectures are essential at all enterprise levels. Failures have legal implications if best technology was not applied
- Industrial information systems integration and security planning is crucial.