Work: **ISA8895 Implementation**

Section: **Structure**

Chapter: **Physical Asset**

Language: **English**

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CCM Research community   www.controlchainmanagement.org
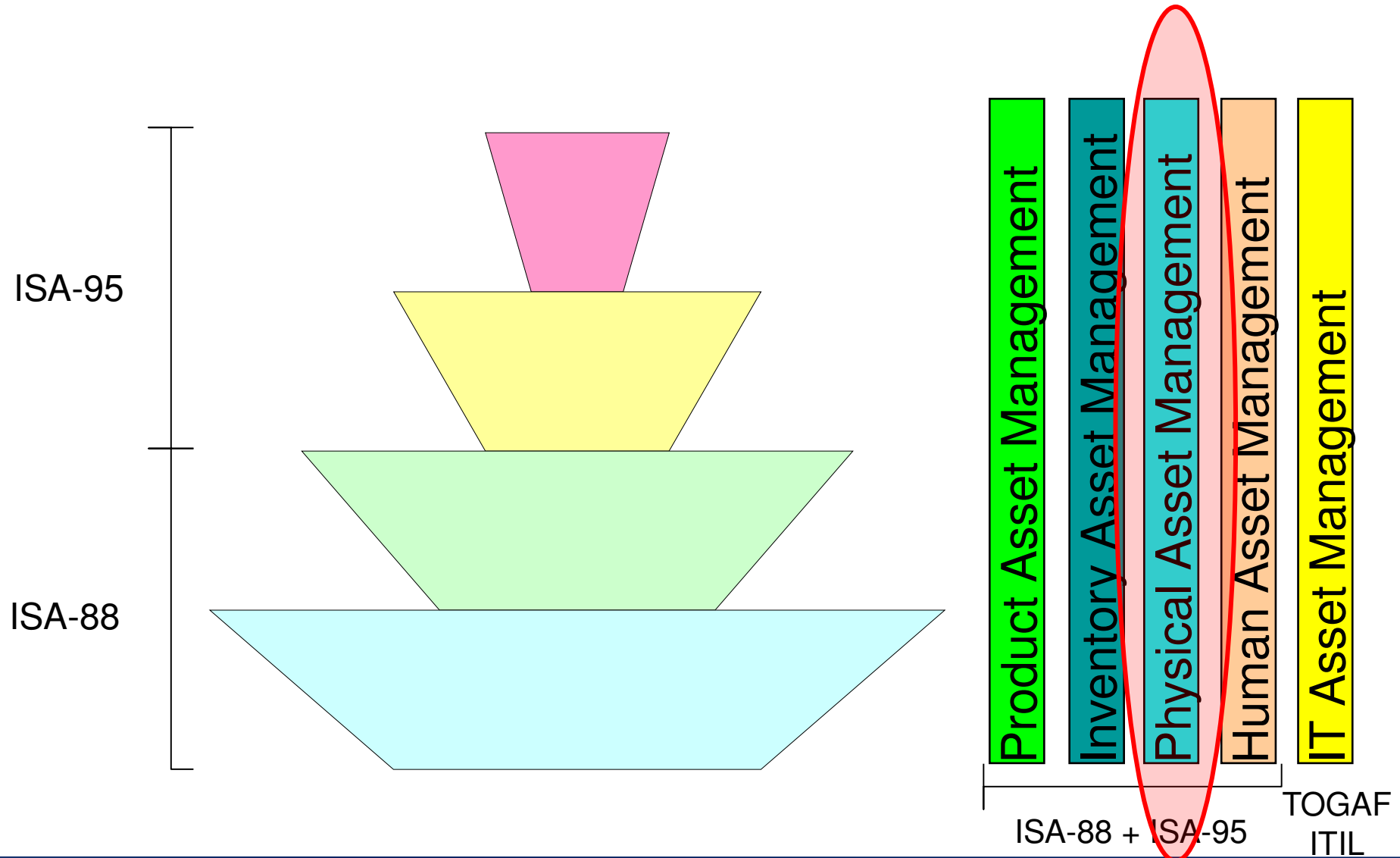CCG Consulting group   www.controlchaingroup.com

Agenda

- **Introduction**
- **ISA88/95 Physical hierarchy model**
- **ISA88 Equipment entity model**
  - ➤ Process Cell / Work Center
  - ➤ Unit / Work Unit
  - ➤ Equipment Module
  - ➤ Control Module
  - ➤ Device Module
  - ➤ Exploit the model
- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

CC functional domains

ISA-95

ISA-88

Product Asset Management

Inventory Asset Management

Physical Asset Management

Human Asset Management

IT Asset Management

ISA-88 + ISA-95

TOGAF
ITIL

Information Elements

Domain	Model	Std	Information elements
Product Asset	Product Product	ISA88 ISA95	Product Hierarchy Product Definition
Inventory Asset	Material	ISA95	Material Resources
Physical Asset	Physical Equipment	ISA88 ISA95	Equipment Hierarchy Equipment Resources
Human Asset	Personnel	- ISA95	Personnel Hierarchy Personnel Resources
Equipment Control	Procedural	ISA88	Functional Hierarchy Equipment Procedural Elements
Physical Process Control	Procedural	ISA88	Physical Processes / Procedural Elements Physical Process Transform Components
Physical Process Mngt	Segment	ISA95	Segments
Operation Process Mngt	Operation Activity	ISA95	Operation Processes Activities / Tasks

Objectives of the physical asset modeling

- **Provide to the system a depiction of the actual composition of the facility**
  - ➢ We build a consistent image of the world from our social and cultural environment, our senses, our experiences
  - ➢ The quite limited perception and computing capabilities of an information system imposes to provide it a structured, preformatted view of its physical environment.
- **This view may be**
  - ➢ Rigid = corresponding to a typical assembly of its constituting equipment
  - ➢ Dynamic = linked to the functional objective of the considered instant
    - ▪ "meccano" view of an entirely dismantled facility, assembled at need to execute a particular "process oriented" functionality

Who's / What's concerned?

PRM	Usr/Rsp	Usage	Typ.IT app
Customer order processing			
Production planning & scheduling	X		
Production control	X		
Material and energy control			
Procurement			
Quality assurance	X		
Product inventory control			
Product cost accounting	X		
Product shipping administration			
Maintenance management	R		
Research & development	X		
Engineering	X		

Cliquez sur l'icône pour ajouter un tableau

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Models overview

- **The Physical asset models identify the enterprise physical aspects**
- **Enterprise physical nature is described in a hierarchical manner**
- **2 models address physical asset modelling**
  - ISA88/95 Physical hierarchy model
  - ISA95 Equipment Model
- **By physical, ISA- and ISA-95 refer to 2 different concepts**
  - Topology as geographical location such as a workshop, a plant (as logical concepts for designating a place or an organizational entity)
  - "Equipment entities" that can be a machine, a facility (as a collection of equipment)

Still quite fuzzy in ISA-95

ISA-88 made some progress by distinguising a physical model for the topology and an Equipment entity model (that associate "control" to make these entity "processing enabled"

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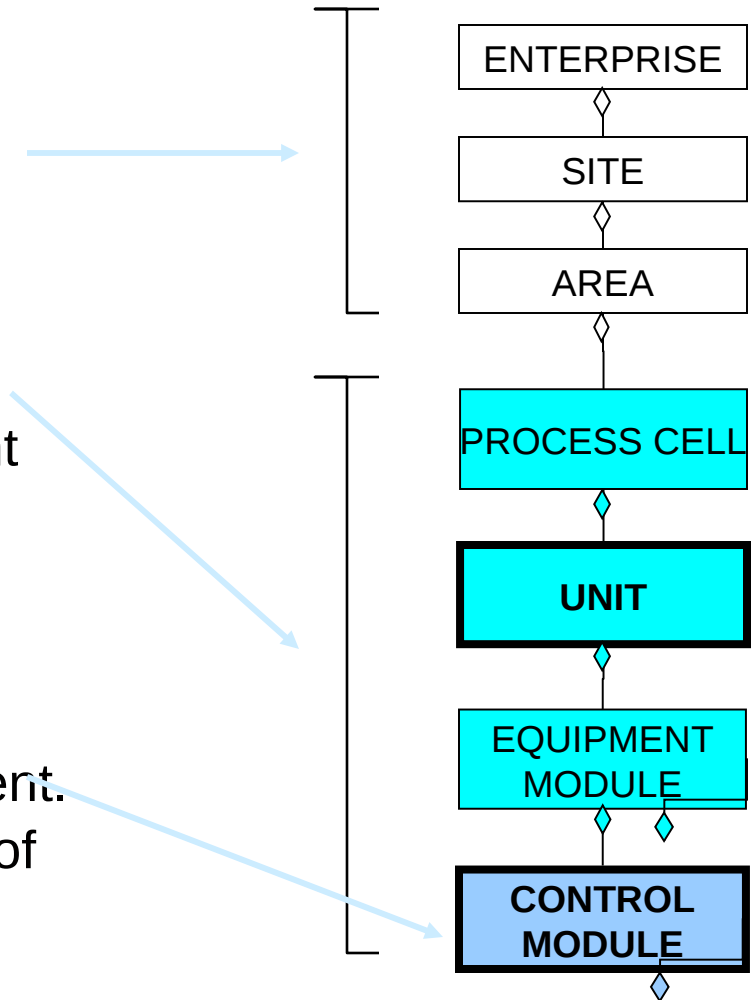- **ISA95 Equipment Model**
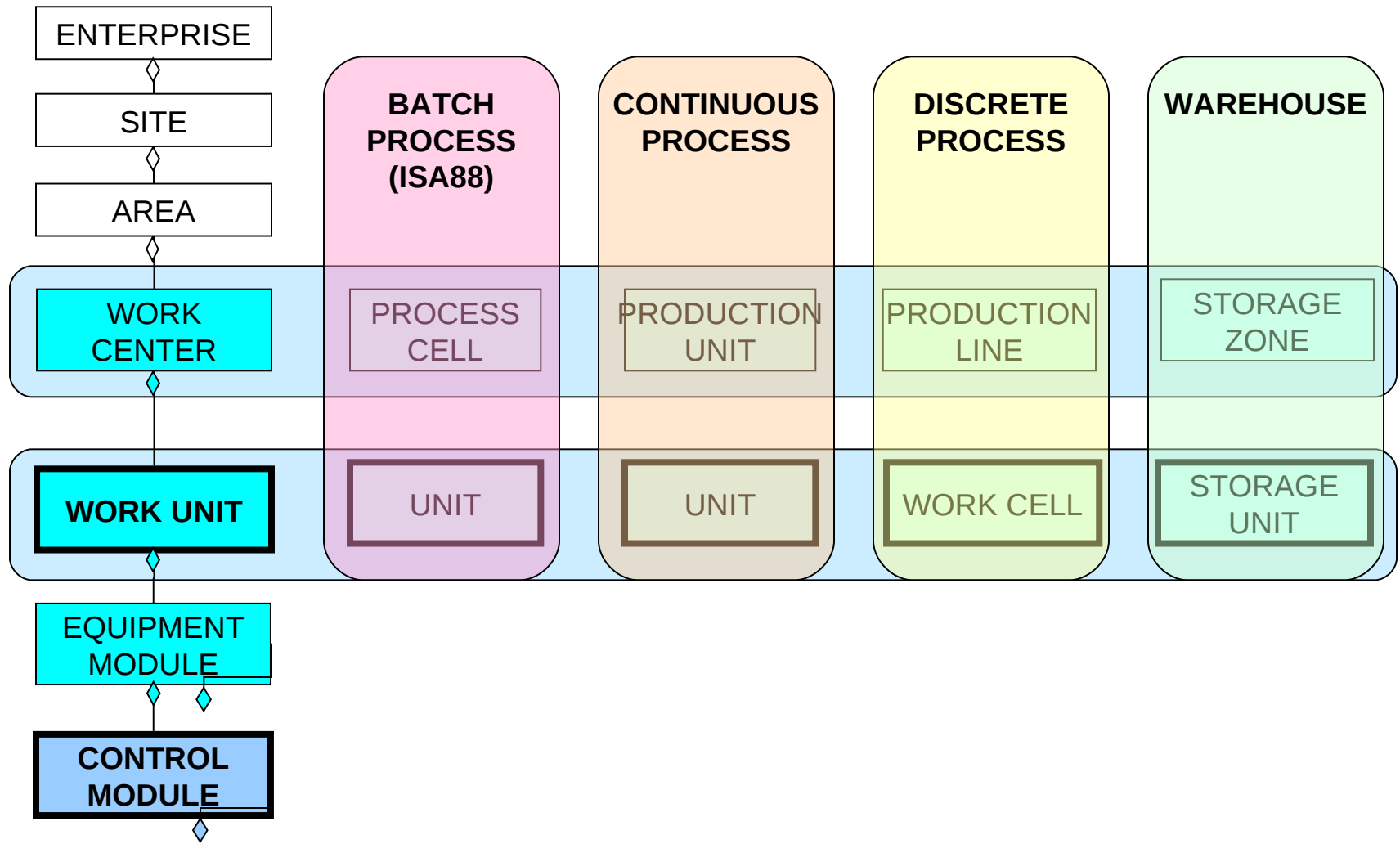- **Practice**

ISA88/95 Physical Hierarchy Model

- **This model is global, covering the industrial part of the enterprise**
  - ➢ Describes the general organization of physical assets hierarchically
  - ➢ Matches one aspect of the enterprise decisional structure
  - ➢ The ISA88 model was initially "Batch Oriented"
  - ➢ ISA95 extends it to cover the whole production system
  - ➢ CCM extends it to cover the financial aspects
- **This model is not very constraining,**
  - ➢ The upper levels describe the logical organization of the enterprise, to match any organisational structures – not to guide organization
  - ➢ Lower levels are more prescriptive and must be respected, but they can be (mostly) omitted or extended
- **Both ISA88 and ISA95 are critically bound to this model**
  - ➢ The information system is primarily structured around this model
  - ➢ The lower levels starting at the Work Center (Process Cell) level are specifically relevant for the ISA88 standard

ISA88 Physical Model

- **7 levels are defined :**
  - ➢ Organizational Upper levels
    - ▪ Entreprise, Site, Area

  - ➢ Technical Lower levels
    - ▪ Process Cell, **Unit**, Equipment Module, **Control Module**
    - ▪ Address flexibility

  - ➢ Control Modules (Lowest level) correspond to the actual equipment.
   - ▪ Other level are compositions of lower levels

```
ENTERPRISE
    ◇
   SITE
    ◇
   AREA
    ◇
PROCESS CELL
    ◆
   UNIT
    ◆
EQUIPMENT
 MODULE
  ◆   ◆
 CONTROL
 MODULE
    ◆
```

ISA95 extended physical model (Actual Facility layout)

	BATCH PROCESS (ISA88)	CONTINUOUS PROCESS	DISCRETE PROCESS	WAREHOUSE
ENTERPRISE				
SITE				
AREA				
WORK CENTER	PROCESS CELL	PRODUCTION UNIT	PRODUCTION LINE	STORAGE ZONE
WORK UNIT	UNIT	UNIT	WORK CELL	STORAGE UNIT
EQUIPMENT MODULE				
CONTROL MODULE				

Upper physical level modeling

- **Enterprise, Site, Area, Process cell**
    - ➢ No technical constraints
    - ➢ Based on organizational considerations
    - ➢ A Process cell corresponds at least to the scope of the Recipes or Process Orders / Production Requests
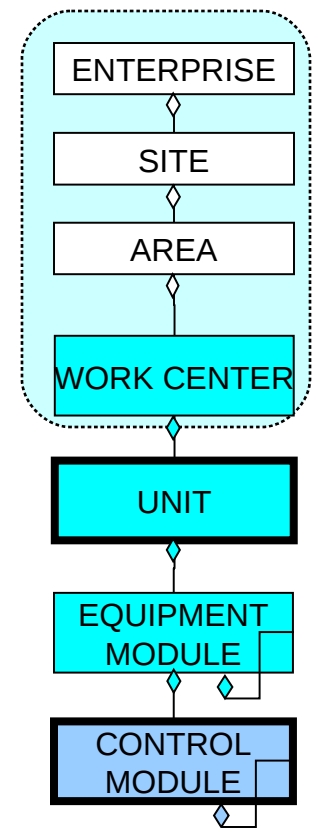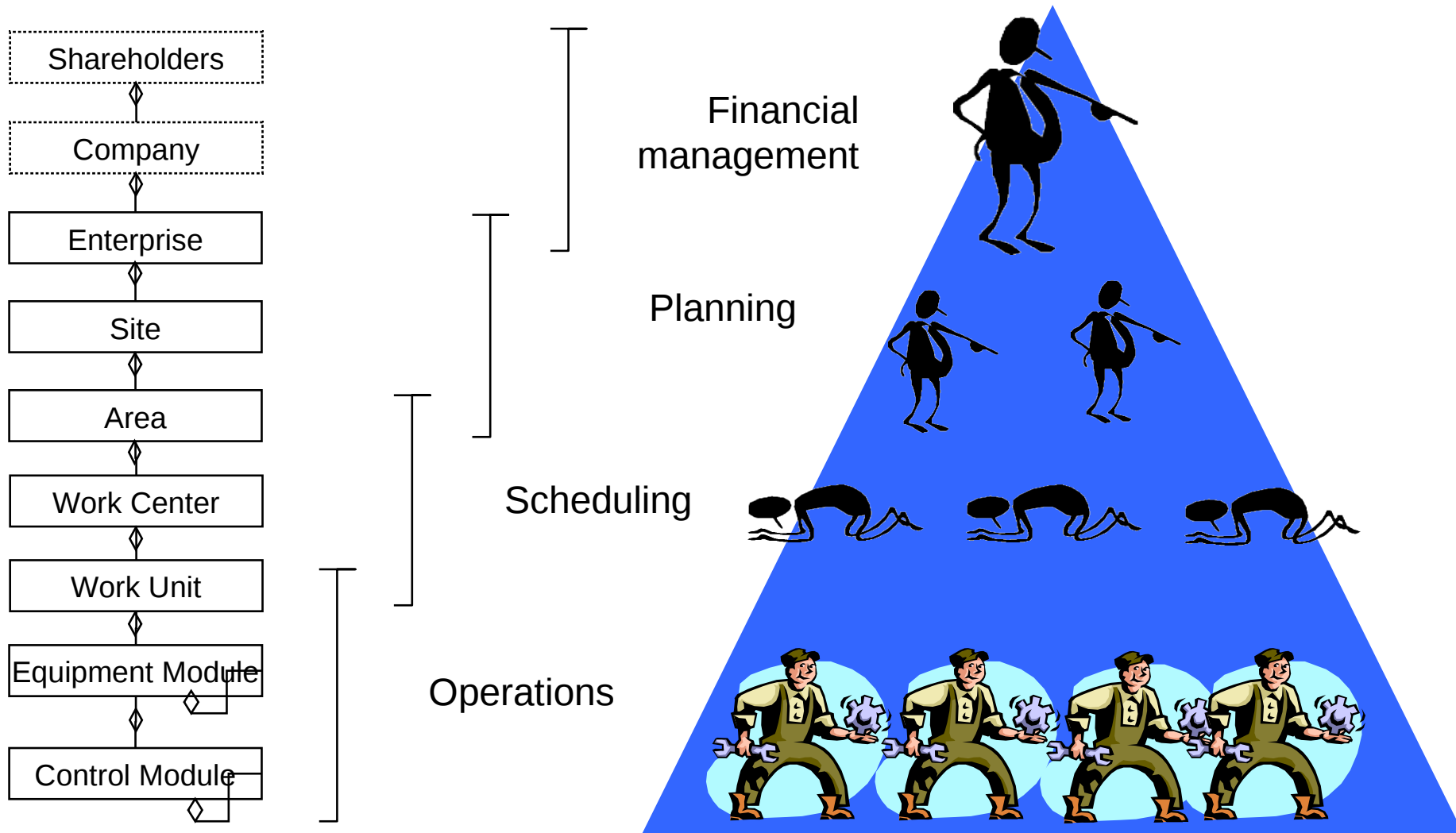
Example of upper level modeling

Enterprise

```
                    ┌─────────────────┐
                    │   LFA & Co      │
                    └─────────────────┘
```

Sites

```
    ┌──────────┐    ┌ ─ ─ ─ ─ ─ ┐    ┌ ─ ─ ─ ─ ─ ┐
    │  Lyon    │    │ Frankfurt │    │  Atlanta  │
    └──────────┘    └ ─ ─ ─ ─ ─ ┘    └ ─ ─ ─ ─ ─ ┘
```

Area

```
  ┌────────────┐   ┌──────────────────────┐   ┌──────────┐
  │ Production │   │  Storage / Shipment  │   │ Utilities│
  └────────────┘   └──────────────────────┘   └──────────┘
```

Work Center

| Building A | Building B | Finihed products | Raw material | Control & Packaging | Steam generation |

Example of upper level modeling

Work Centers

Storage zone
Raw material

Storage zone
Finish products

Areas

Process Cell
Preparation

Process Cell
Production 1

Production Line
Packaging

Process Cell
Production 2

N2
Steam
Water
Power

Process Cell
Utilities

Gazeous effluents
Condensats
Waste water
Heat

Extended Physical & Decisional hierarchy

Shareholders

Company

Enterprise

Site

Area

Work Center

Work Unit

Equipment Module

Control Module

Financial management

Planning

Scheduling

Operations

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  - ➢ Exploit the model
- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

Combining Production / Industrial Information Systems

- **Production System as a physical entity is the Framework (ISA88)**
  - Physical hierarchy corresponds to Decision hierarchy
  - Any Information service or process is embedded within a specific Equipment entity, at any level
    - IIS doesn't exist by itself in the vacuum…
  - Information system is a supporting system, not a leading entity
- **Any part of the production system might need IIS support**
  - Or can live without it
- **Equipment elements are equipment entities when associated with information processing features**

Equipment Entity embeds Equipment & Information

Equipment Element
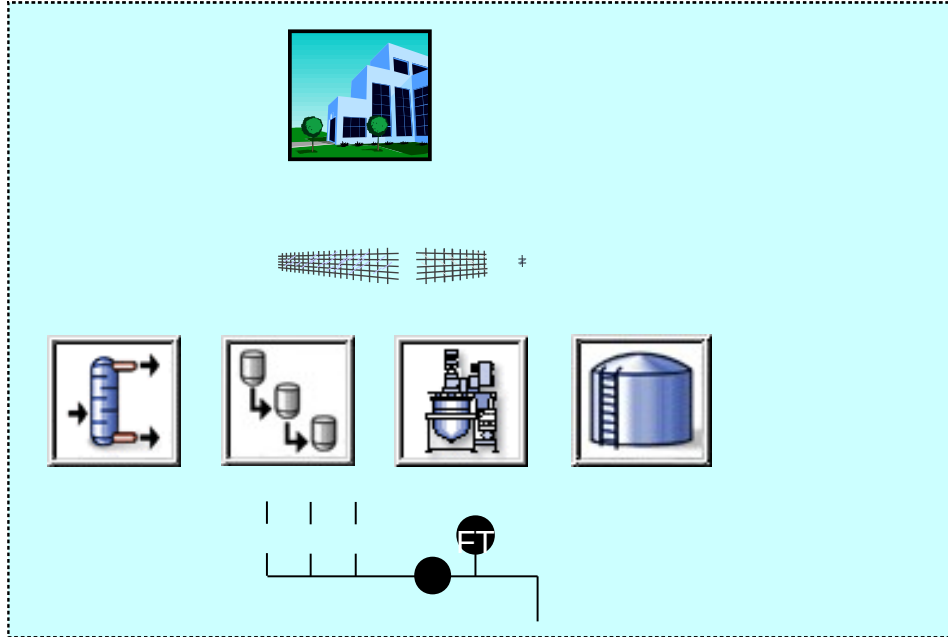
Information Processing

Business Process Management
Physical Process Management
Physical Process Control
Equipment Control

Equipment Entity

Equipment Entity – Example 1

Command
*Run pump
at rate X*

Status
*Pump running
At rate X*

Equipment Entity

Physical Equipment

FT

Information Processing

Σ

Basic
Procedural
Coordination
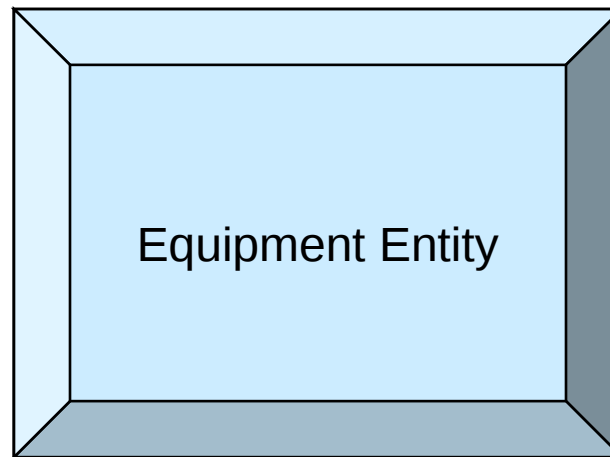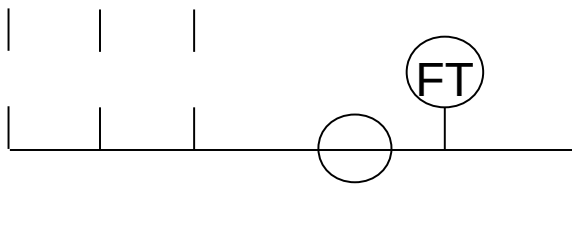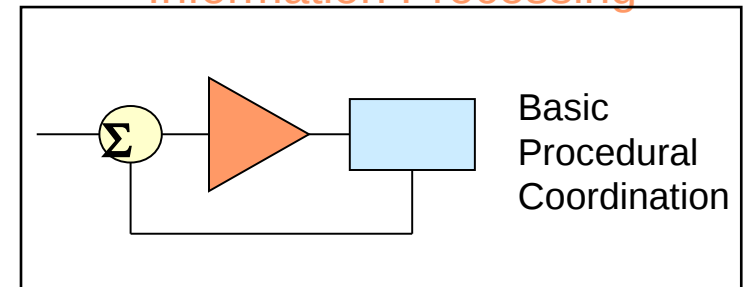
Equipment Entity – Example 2

Command
*Request Process
capabilities*

Status / Response
*Processing Capabilities
Catalog*
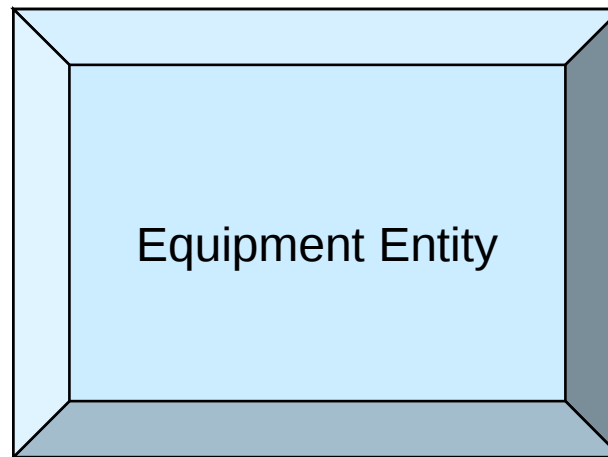
Equipment Entity

Physical Equipment
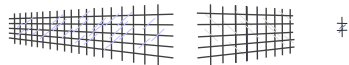
Information Processing

Process segment
Definition lookup

Equipment Entity – Example 3

Command
Optimize Orders'
Scheduling

Status / Response
Optimized
Orders' schedule

Equipment Entity
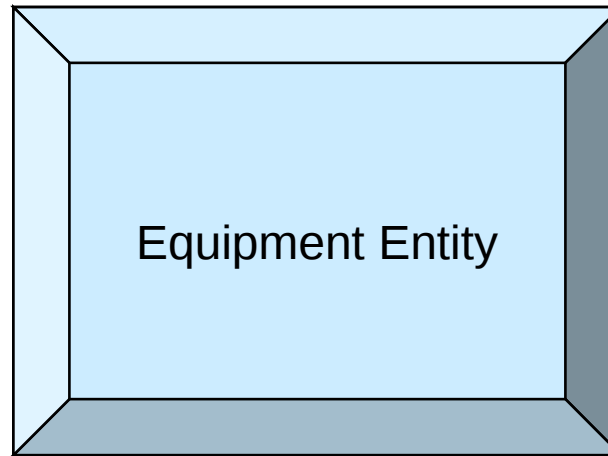
Physical Equipment

Information Processing
Schedule Orders
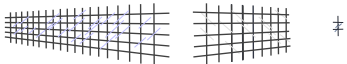
Information & Equipement

- **The physical model is the primary framework of information system**
  - ➢ All functional elements, resources, documents rest on this model
  - ➢ No information can be defined outside the context of an equipment entity – its physical scope

	Ent.	Site	Area	Pcell	Unit	EM	CM
Basic control							X
Coordination control			X	X	X	X	X
Procedural control (Equipment)				X	X	X	
Procedural control (Recipes)				X	X		
Product definition	X	X					
Objects classes	X						

ISA88 definition for lower physical hierarchy model

- **Process cell**
  - A logical grouping of equipment required for production of one or more batches

- **Units**
  - A collection of related control modules and equipment modules that can carry out one or more processing activities

- **Equipment modules**
  - A functional group of equipment and/or control modules that can carry out a finite number of specific processing activities

- **Control modules**
  - A regulating device, a state oriented device, or a combination of both that is operated as a single device
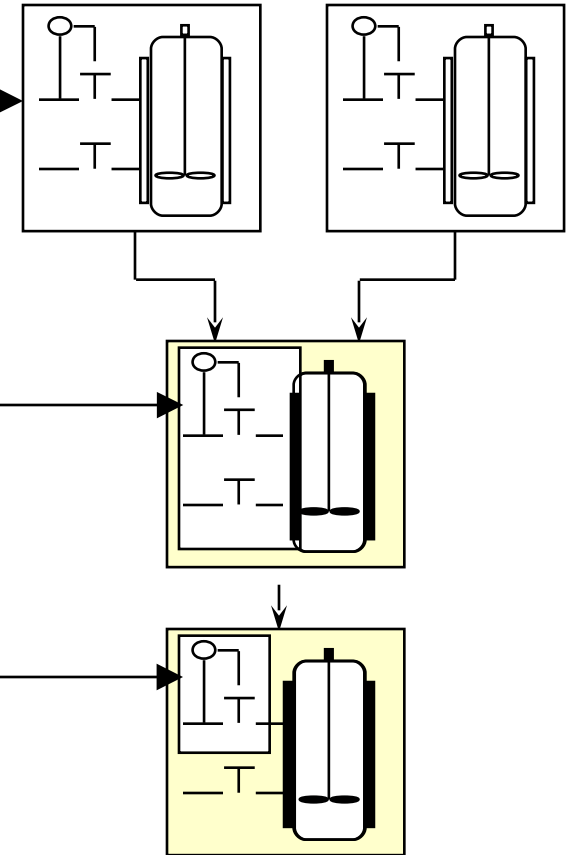
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Role of the Work Center

- **A work centre needs to encompass all the needed Work Units to make a defined product**
  - ➤ The scope of a Production Request
- **Essentially an organizational level**
  - ➤ Activity, topology
  - ➤ No hard constraints
  - ➤ Might help for facilities classification
    - ▪ Ability to replicate a Work Center template
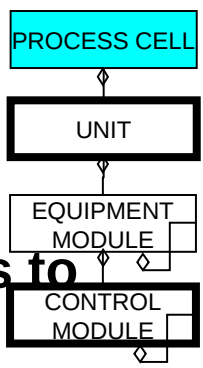
Work Center for Batch: Process Cell
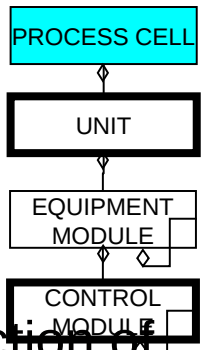
- **Definition**
  - A logical grouping of equipment (Units) required for the production of one or more batches

- **Properties**
  - May contain more than one grouping of equipment needed to make a batch
    - "Train"
  - The equipment actually used for the batch is referred to as the path
  - May contain more than one batch at a time (possibly several independent production order being processed simultaneously)
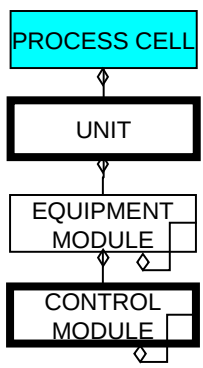
PROCESS CELL

UNIT

EQUIPMENT MODULE

CONTROL MODULE

Work Center for Batch: Process Cell

- **Rules**
  - Static geographical structure, defined at the engineering time
  - The batch maintains its integrity
  - The scope of a recipe or production request
  - The action scope of an operator
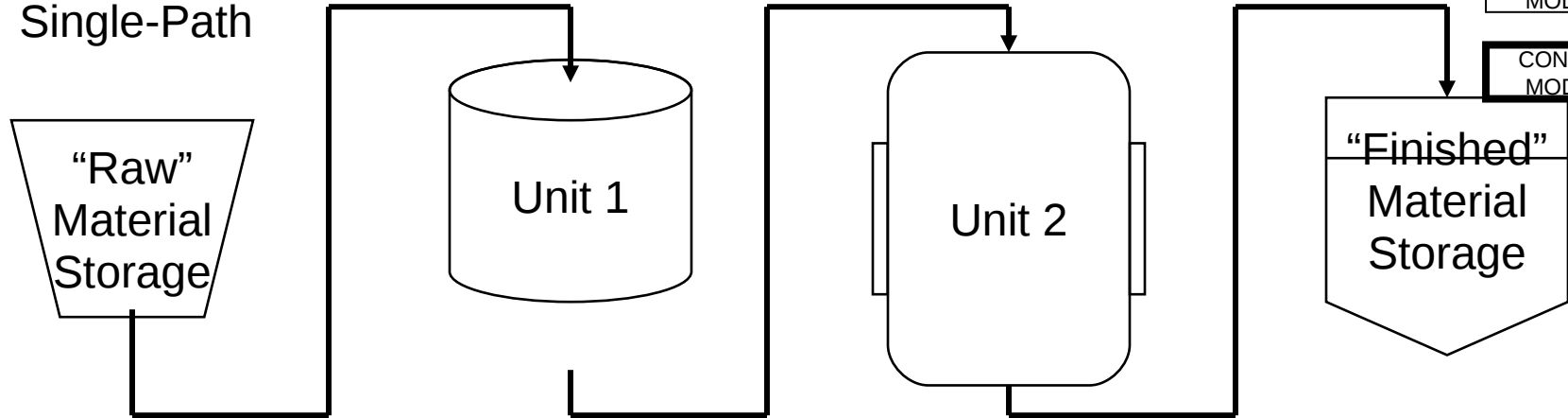 - Bounded by input / output material storage (raw matierial / semi-finished products / finished products
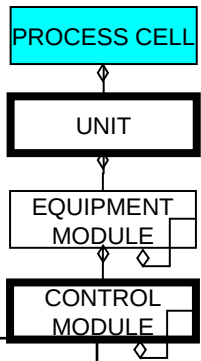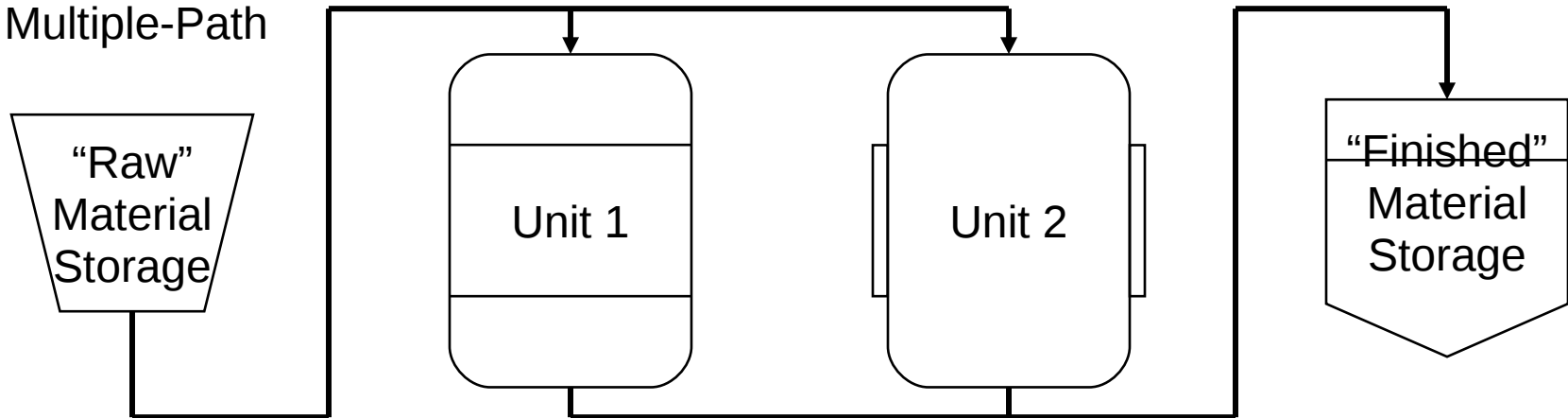- **Examples**
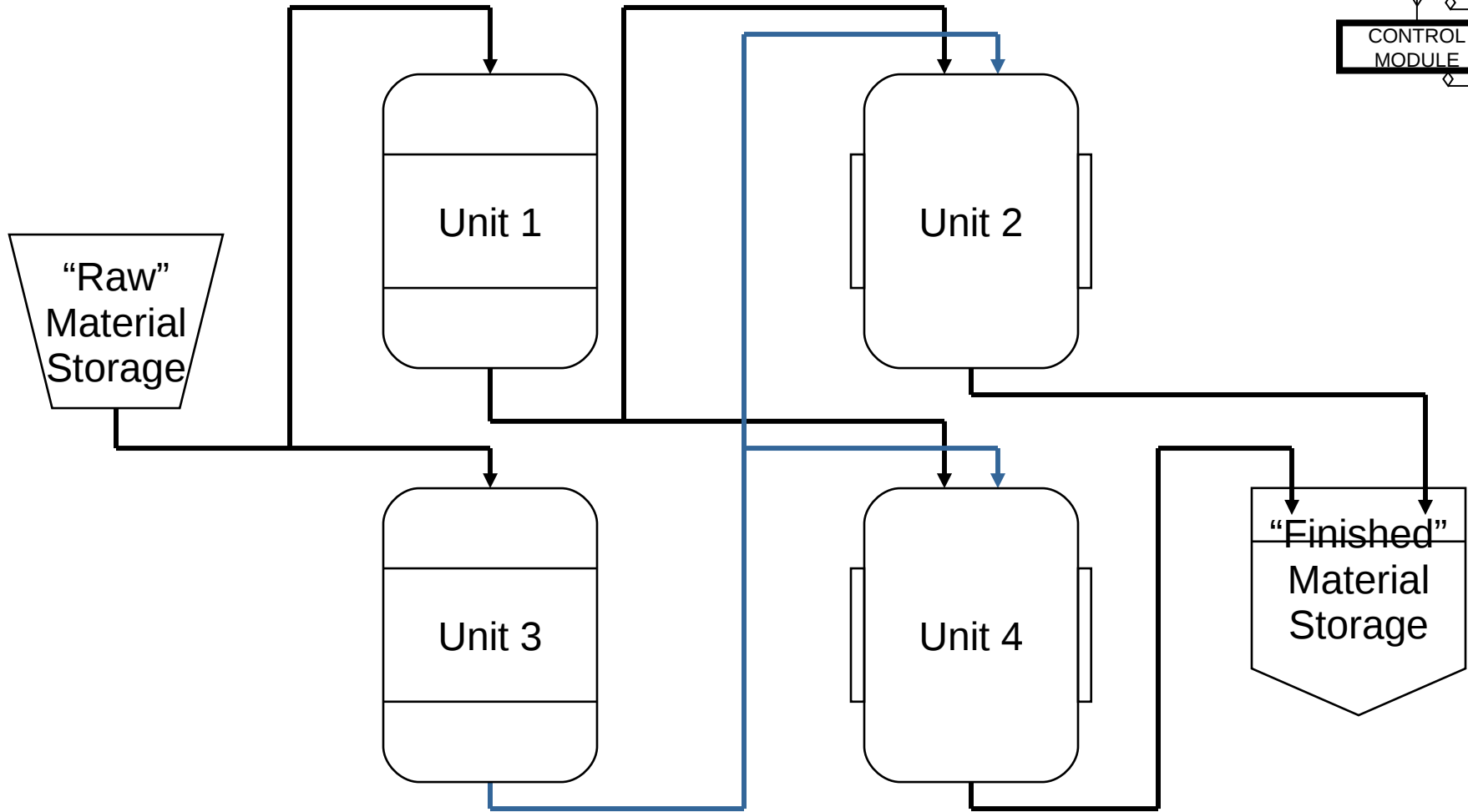 - Building B6
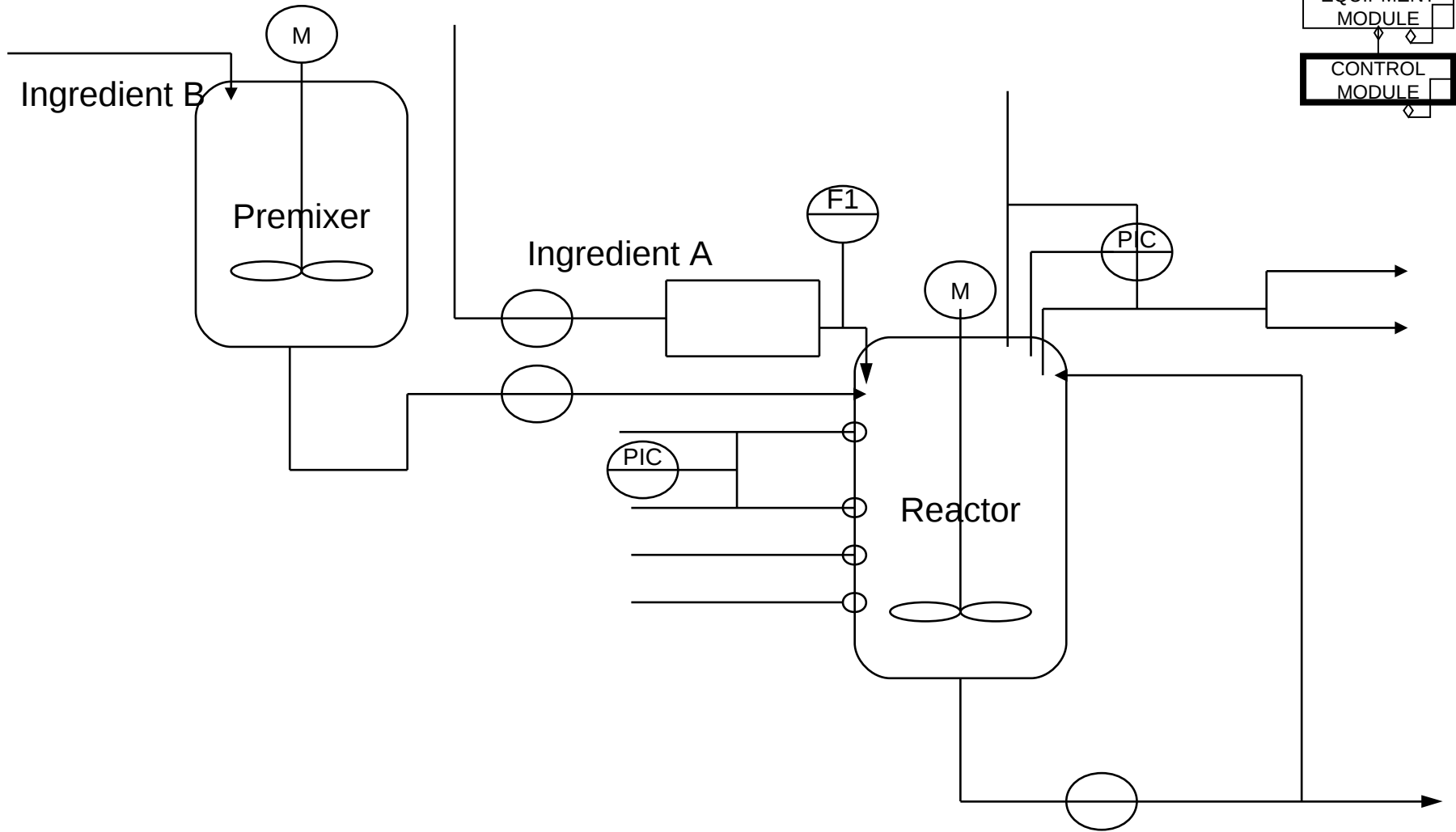 - Finishing workshop

Process Cell Structures

Single-Path

"Raw" Material Storage → Unit 1 → Unit 2 → "Finished" Material Storage

Multiple-Path

"Raw" Material Storage → Unit 1 → Unit 2 → "Finished" Material Storage

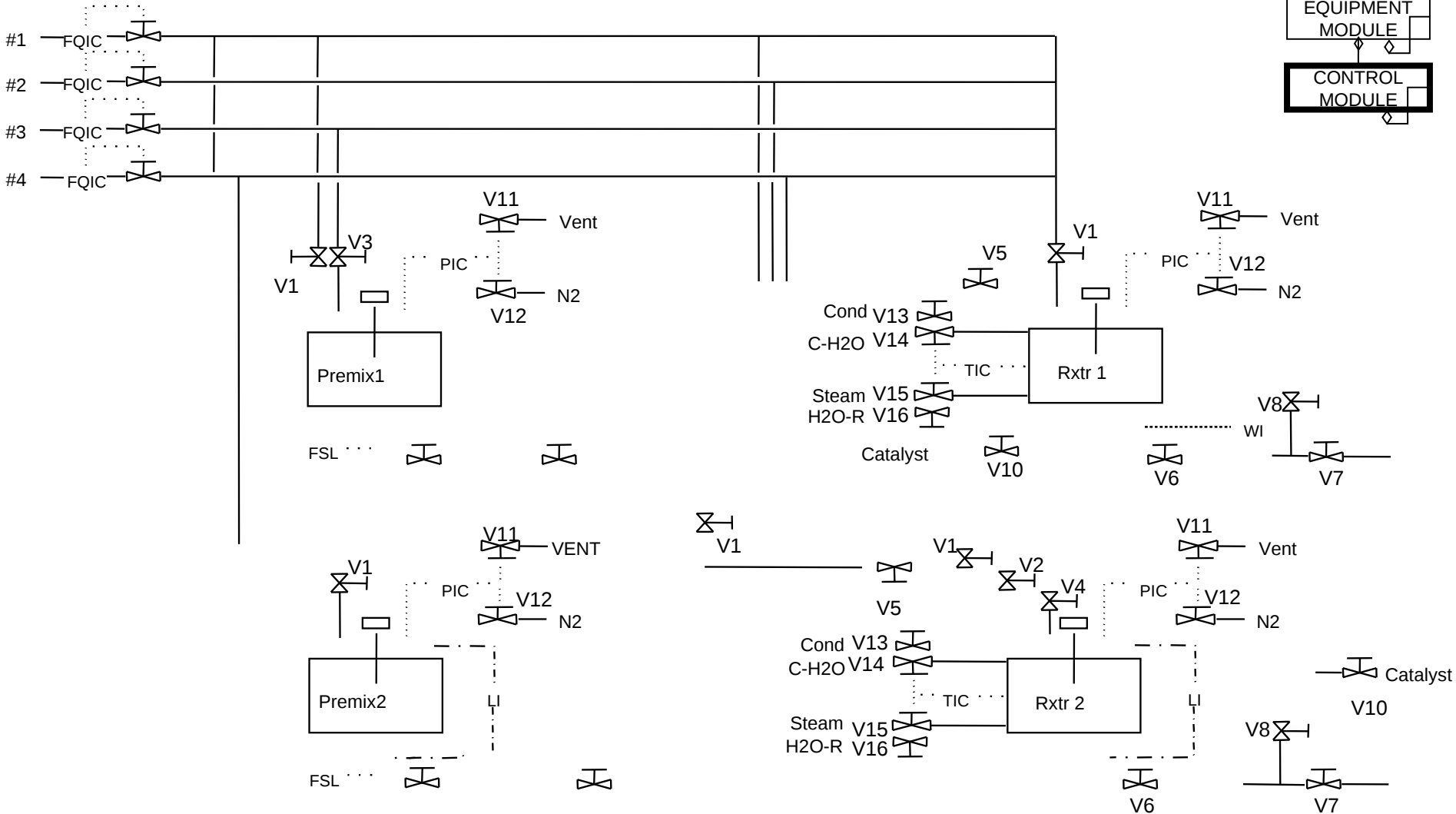PROCESS CELL
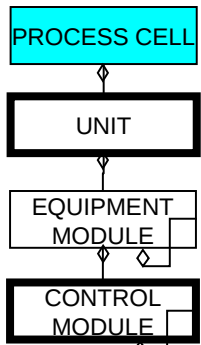UNIT
EQUIPMENT MODULE
CONTROL MODULE

Networked-Path Process Cell Structure

Example of a 2-Unit Process Cell

Example of a 4-Unit Process Cell

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Role of Work Unit

PROCESS CELL

UNIT

EQUIPMENT
MODULE

CONTROL
MODULE

- **The « Central » allocation level**
  - A relatively autonomous entity for planning/scheduling purpose
  - Batch Processes,
    - A strict batch breakdown : Unit contains one single batch
  - Discrete Processes,
    - Work Cell is similar to Unit
  - Warehouses and storage :
    - Allocation is not confined to a specific level
    - Storage Units should be recursive – not in the standard
  - Continuous processes
    - A main equipment, Sub-part of a Production Unit
    - Can segregate "virtual batches" in a continuous flow
- **Provides and execute product independent process services**
  - Implemented by Equipment Procedural Element (EPE)
    (possibly inherited from embedded Equipment Modules)
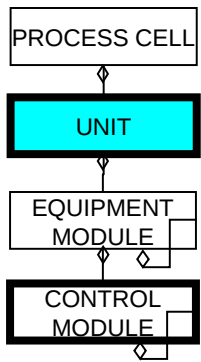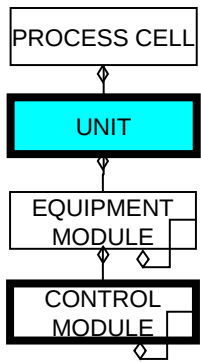
Work Units for Batch: Unit

- **Definition**
  - Is a collection of Control Modules and Equiment Modules
  - Performs one or more significant processing activities, as product independent Equipment procedural Elements
    - *Combining material, Performing a reaction*
- **Role**
  - Basis of procedural control
- **Properties**
  - Cannot contain another unit
  - A unit cannot operate on more than one batch of material at any given time
    - Although a unit is allowed to operate on a portion of a single batch
  - Making a batch often requires multiple units
    - Although a batch is allowed to be completed in a single unit
  - May contain a flexible amount of control modules and/or equipment modules
    - Permanently attached parts to a unit
    - Temporarily attached parts to a unit
   - Totally separate from any unit

Work Units for Batch: Unit

PROCESS CELL

UNIT
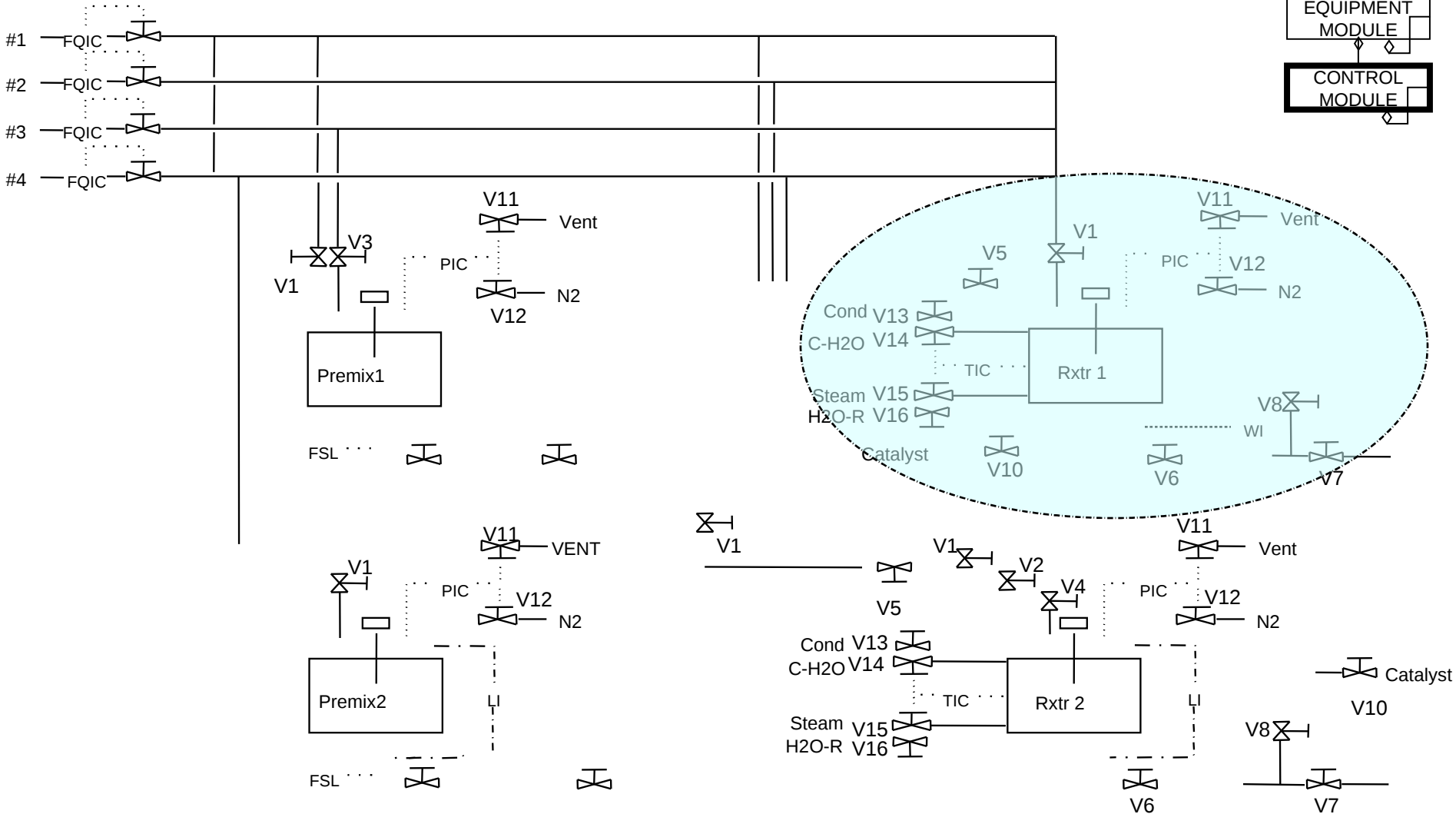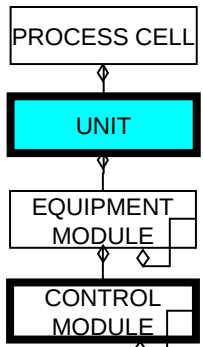
EQUIPMENT MODULE

CONTROL MODULE

- **Rules**
  - Essentially dynamic structure, : identified at the engineering time, but physical scope depends on the context
  - Centered around a major piece of equipment
  - Autonomy: May operate independently of other units

- **Examples**
  - Reactor, Mixer
  - Washing machine
  - Oven
  - Press
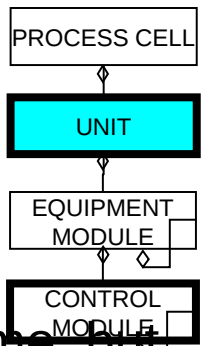
Example of a Unit in a Process Cell

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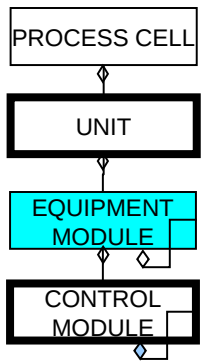- **Practice**

Roles of Equipment modules

- **2 roles**
  - ➢ Breakdown of a Work unit
    - ▪ May be used to limit the scope of an EPE
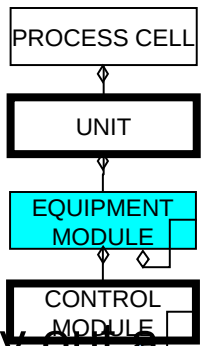   - ▪ Units building blocks
  - ➢ Shared equipment having autonomous process capabilities that can be used with several units
    - ▪ Non-exclusive: distribution of utilities (air, steam, N2, water)
    - ▪ Exclusive: Charging device, transfer lines
- **Not a mandatory element**

Equipment Modules

- **Definition**
  - ➤ A collection of equipment and/or control modules that can carry out a finite number of specific processing activities
    - ▪ Implements Equipment Procedural Elements by commanding control modules or lower level equipment modules
      - ■ *An Equipment module without EPEs is a Control Module*
      - ■ *An equipment module is technically similar to a unit*
- **Properties**
  - ➤ May contain other EMs
  - ➤ Dependent: May be part of a single Work Unit or another Equipment Module for its exclusive usage
  - ➤ Autonomous: May be part of a Work Center
    - ▪ can be temporarily "attached" to a Work Unit as a common resource
    - ▪ Can be used in conjunction with several Work Units or other Equipment Modules, or even running independently

Equipment Modules
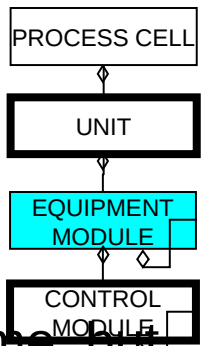
- **Rules**
  - Essentially dynamic structure, : identified at the engineering time, but physical scope depends on the context
  - Inherited from the Work Unit (part of it)
 - Usually centered around a piece of process equipment such as a process heater or weight tank

- **Examples**
  - Weight tank used by a single unit
  - A filter that is only used by a single unit
  - Weight tank shared by multiple units, but only usable by a single unit at a time
    (an exclusive use resource)
  - An ingredient supply system that shared by multiple units and can be used by many simultaneously (a shared-use resource)

Equipment Module Implementations

- **Option 1: No equipment modules**
  - ➢ Any EPE of a Unit can allocate (dynamically) any control module within the Work Center / Process Cell
  - ➢ A single EPE can execute a transfer between 2 units
- **Option 2: Units without EPEs inheriting EPEs from EMs**
  - ➢ Typically for embedded equipment modules
- **Option 3: Units with EPEs commanding EPEs from EMs**
  - ➢ Typically for shared equipment modules

PROCESS CELL

UNIT

EQUIPMENT MODULE
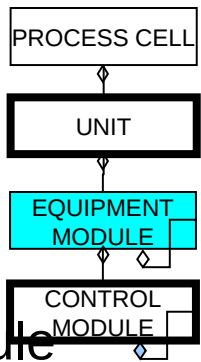
CONTROL MODULE

Example of an EM in a Process Cell
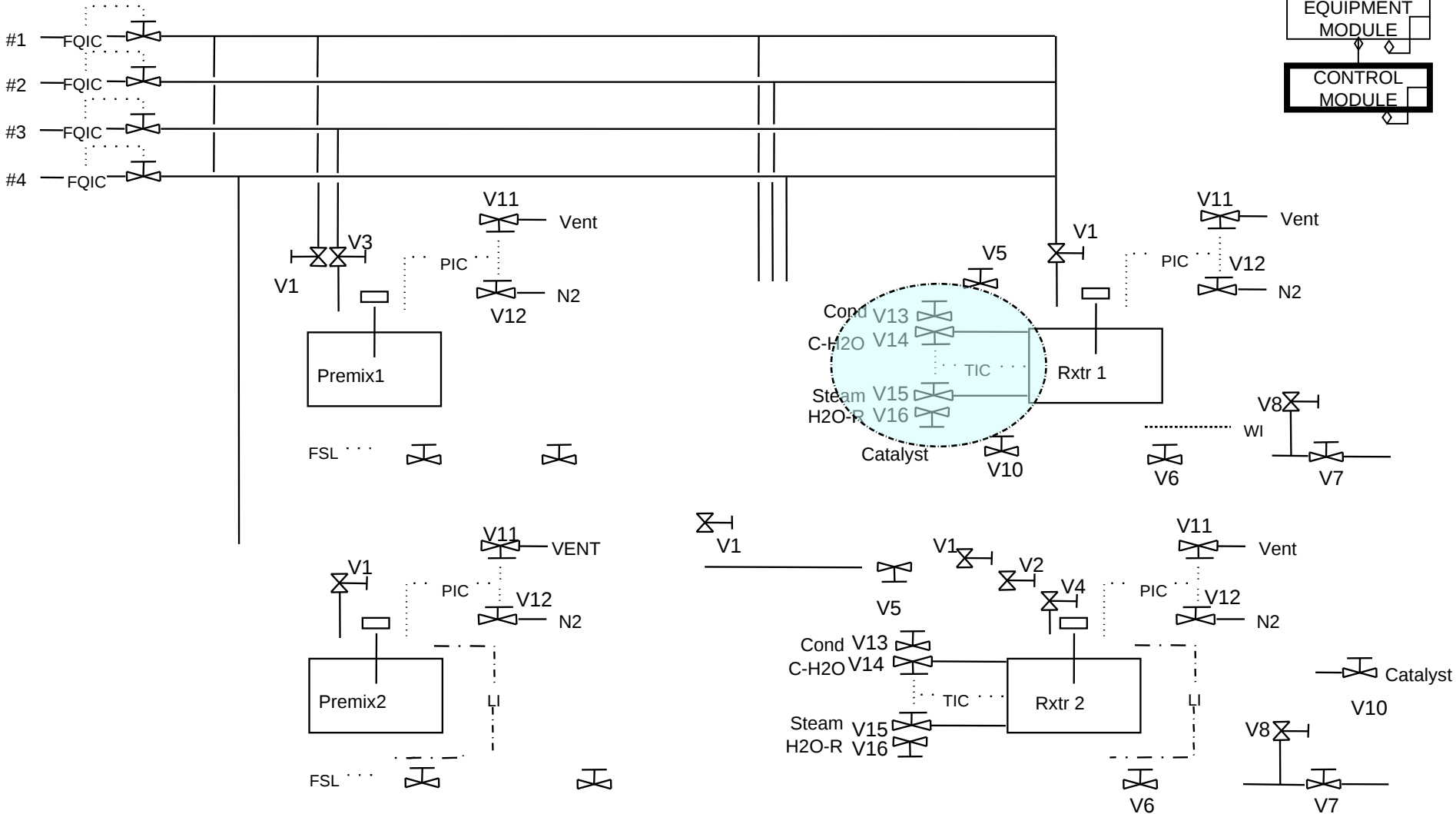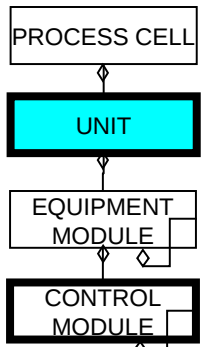
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Role of Control modules

- **The lowest, mandatory level in the Physical Hierarchy**
  - ➢ The only actual equipment entity: all upper level are organizational views with larger or smaller focus
  - ➢ The only acting entity (move actuators, run motors)
- **Mechanical engineering consistency**
  - ➢ CM breakdown corresponds to generic equipment entities
- **Simplification of control:**
  - ➢ Execute elementary equipment services invoked by EPEs
- **Functional leveling of technological variants**
  - ➢ Same interface and capabilities, specific control
- **Prevent conflicting equipment usage**
  - ➢ EPEs can explicitly allocate control modules providing an inherent interlock between conflicting functionalities

Control Modules

PROCESS CELL

UNIT
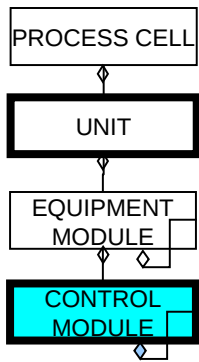
EQUIPMENT MODULE
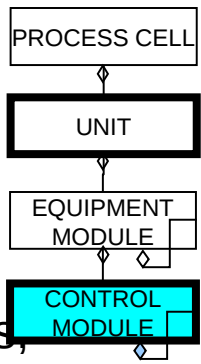
CONTROL MODULE

- **Definition**
  - ➤ A piece of processing equipment with associated collection of sensors, actuators, and other control modules

- **Properties**
  - ➤ Every piece of equipment is controlled by one (and only one) control module
  - ➤ The lowest, mandatory physical level
    - ▪ Any part of the actual equipmeNT is part of one, and only one control module
  - ➤ Provides the only connection to the process
    - ▪ Control modules can content instrumentation
    - ▪ But Control Modules ARE NOT instruments (see Device Modules)
  - ➤ Acts as a single entity from a control standpoint
  - ➤ Do not contain / cannot execute procedural elements
  - ➤ The only real physical entity
    - ▪ All upper levels are more or less focused orgainsational views
  - ➤ Unknown by the Recipe

Control modules and flow analysis

- **Rules**
  - None in ISA88
- **WBF Flow analysis concepts:**
  - Physical flows get through tangible equipment entities (Control modules)
  - A proper breakdown allows to control flows regardless the functional intent. Control modules control … flows
  - Breakdown rules for control modules
    - CMs are elementary flow sections
    - Extension of Delta Nodes / Astrid methodologies
  - The resulting breakdown highlights consistent generic equipment entities

PROCESS CELL

UNIT

EQUIPMENT MODULE
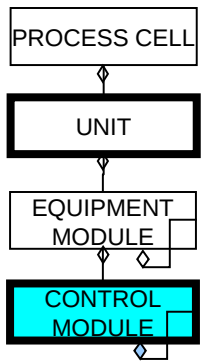
CONTROL MODULE

Flow Analysis rules for breaking down a facility into CMs
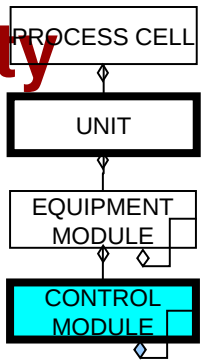
- **Identify all flow breaking devices**
  - ➤ Shut-off valves
  - ➤ Doors
  - ➤ Traffic lights
  - ➤ Removable pipe / Blind flanges
  - ➤ …
- **Control modules are bounded by these devices**
- **Several flows may run through a given equipment**
  - ➤ This equipment may be split into several control modules
    - ▪ Liquid and gaseous part of a tank

Control Module examples

Pump

Recirc XV

Process XV

Commands | | States
Circulate | | Circulating
To Process | | Sending
Stop | | Stopped
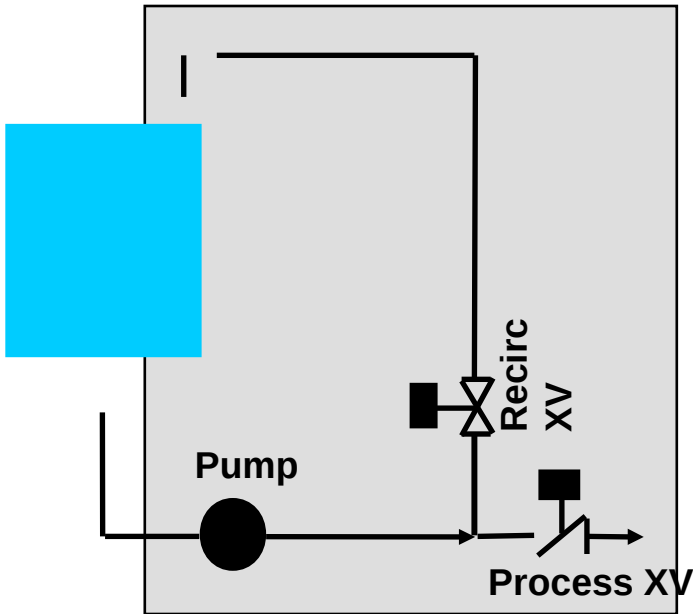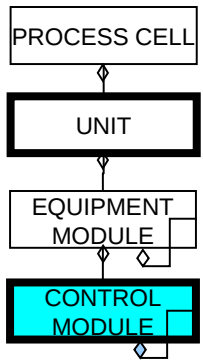
	Circulate	ToProcess	Stop
Start Pompe	**1**	**1**	**0**
Stop Pompe	**0**	**0**	**1**
Open Recirc XV	**1**	**0**	**1**
Close Recirc XV	**0**	**1**	**0**
Open Process XV	**0**	**1**	**0**
Close Process XV	**1**	**0**	**1**

Control Module examples

Control Module examples

Material Selection
Control Module
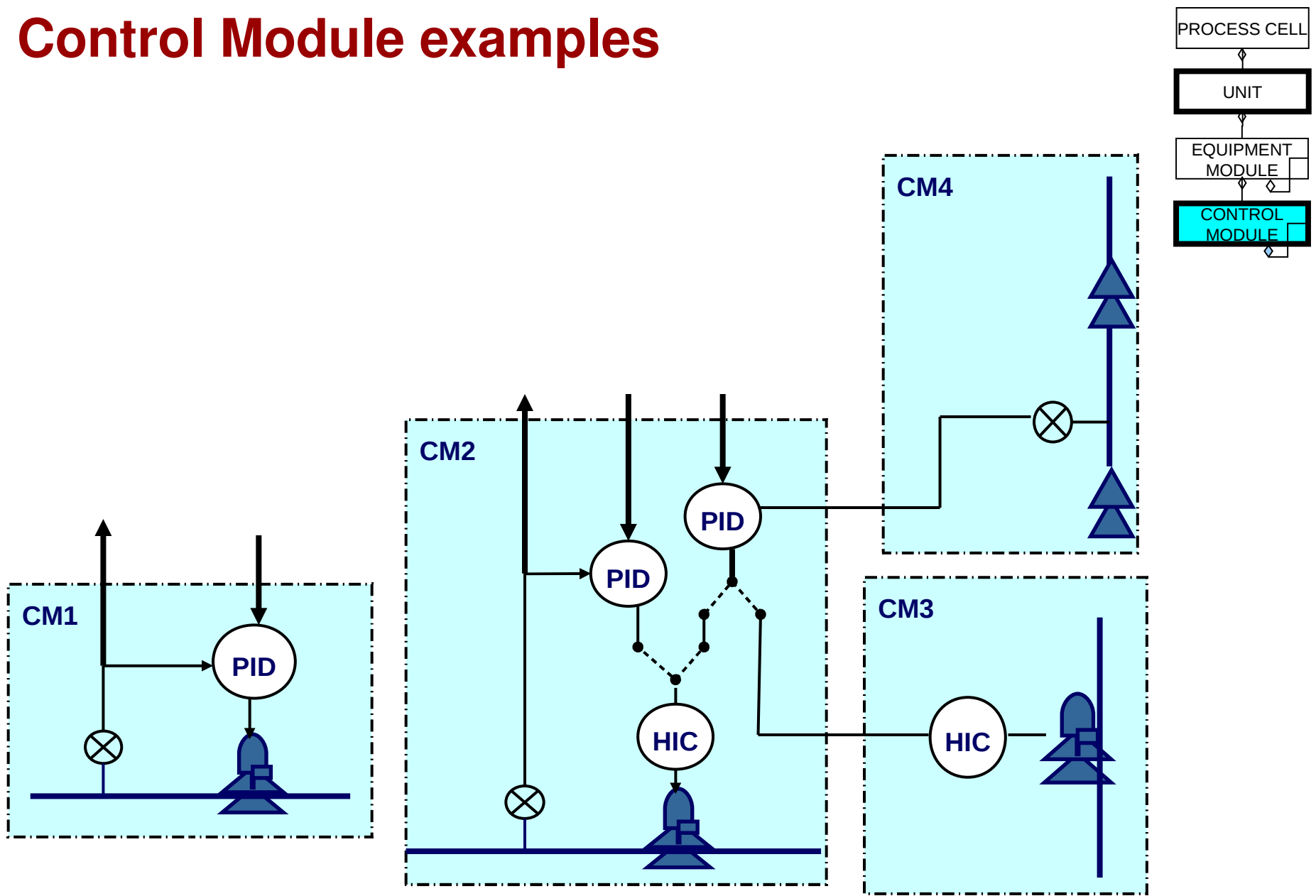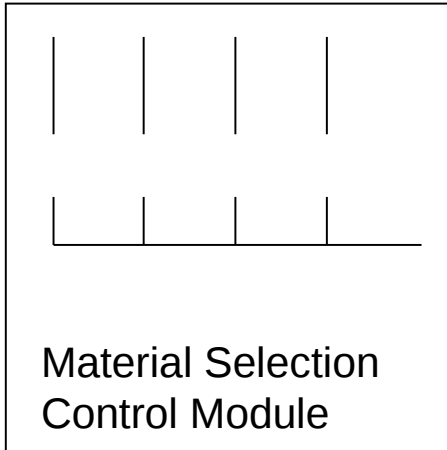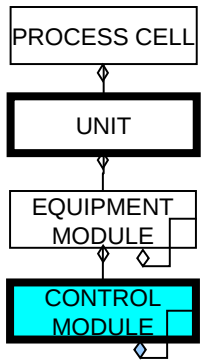
Raw_Matl_Req as enum:

    0   None
    1   Cream
    2   Milk
    3   Corn Syrup
    4   Water

Pump
Control Module
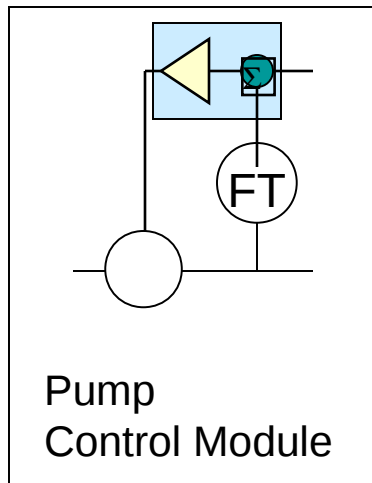
Define **Discharge_Flow_SP** as
    0 - 60 GPM

Define **Recirc_Flow_SP** as
    0 - 60 GPM

Define **CIP_Flow_SP** as
    0 - 140 GPM

PROCESS CELL

UNIT

EQUIPMENT
MODULE

CONTROL
MODULE

Agenda

- **Introduction**
- **ISA88/95 Physical hierarchy model**
- **ISA88 Equipment entity model**
  - Process Cell / Work Center
  - Unit / Work Unit
  - Equipment Module
  - Control Module
  - Device Module
  - Exploit the model
- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

Device Module

- **Sensors and actuators are not defined in the standard**
- **Sensors and actuators can be considered as:**
  - First level control modules
    - Possible because of the recursive nature of the control module
    - Common practice
  - Device modules, an additional element
    - The standard allows extensions
    - Allows to preserve the true nature of the Control Module as an abstraction layer: a control module does not necessarily hold instruments…
    - Proposed in ISA88 part 5

PROCESS CELL

UNIT

EQUIPMENT MODULE

CONTROL MODULE
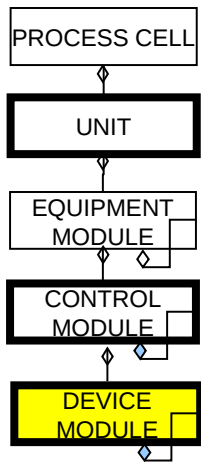
DEVICE MODULE

Flow Analysis: Device modules attachment to CMs

PROCESS CELL

UNIT

EQUIPMENT MODULE

CONTROL MODULE

DEVICE MODULE

- **DM are attached to the supporting CM**
- **Flow breaking devices are between 2 or more CMs. They may be considered as:**
  - Independent CMs : More flexible, WBF current work proposed approach (Directing nodes)
  - Device modules attached to one of the adjacent CM (Current ASTRID or DELTA NODE methods)
    - Rule 1: A flow breaking device is attached to the upstream CM
    - Rule 2: A flow breaking device is attached to the user of a shared flow (utility for example)
    - Rule 3: The second rule prevails on the first one

Device safety and control
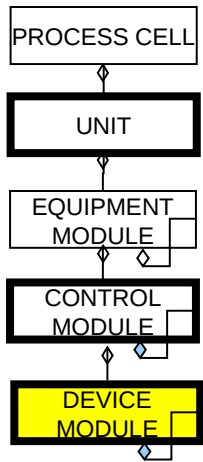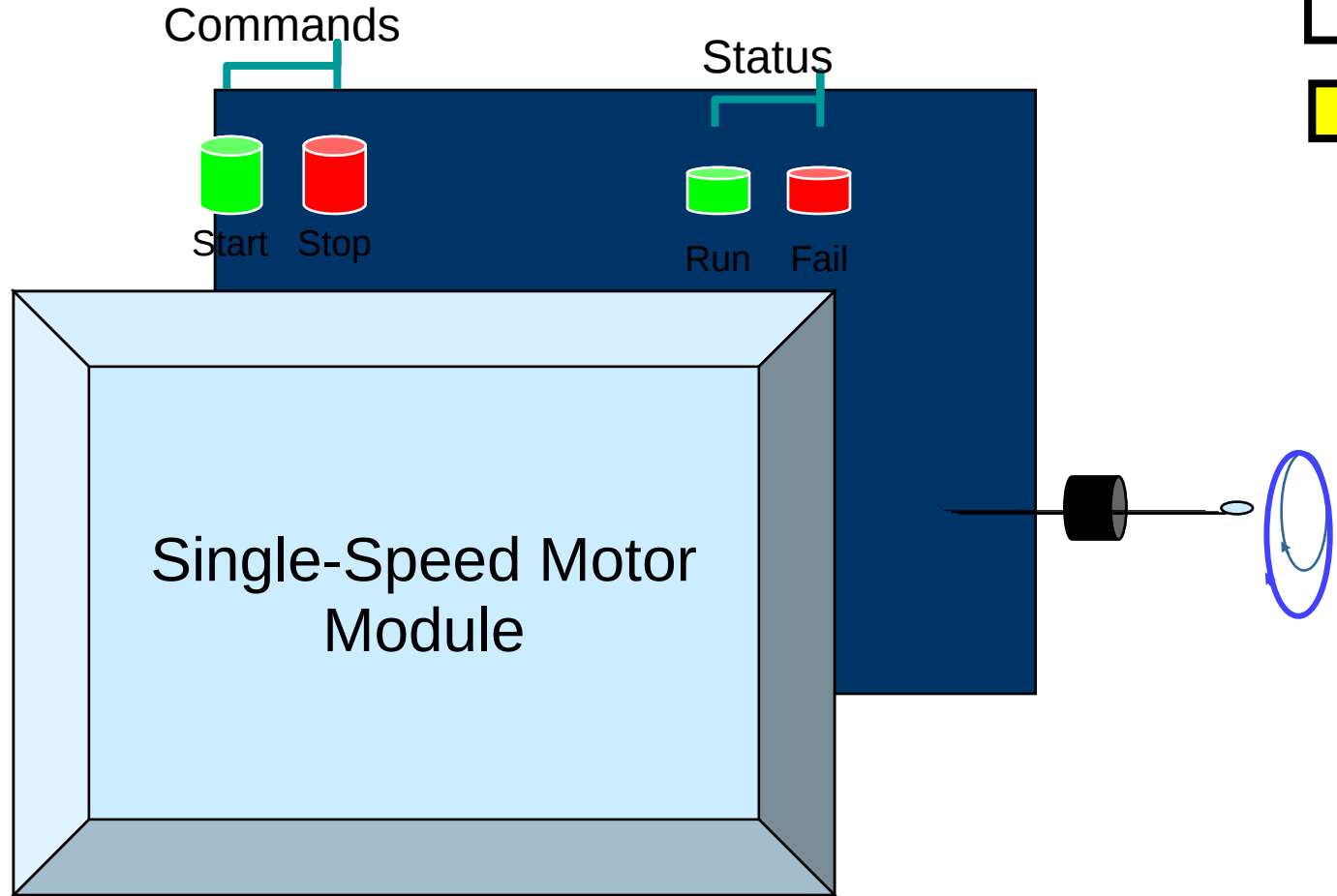
Operator (HMI)

Owning CM
(automatic control)

Adjacent CM
(Flow control)

Interlocking task
Product and equipment
protection

Safety task
Personnel and
environment protection
(external safety system)

Manual
control

Automatic
control

Flow interlocks

Flow integrity

*Content
compatibility*

*Capacity
constraints*

Acting device

PROCESS CELL

UNIT

EQUIPMENT
MODULE

CONTROL
MODULE

DEVICE
MODULE

———— Commands
.... Flow Information
.... Interlock

A Motor Device Module

Commands

Status

Start Stop

Run Fail

Single-Speed Motor Module

PROCESS CELL

UNIT

EQUIPMENT MODULE

CONTROL MODULE
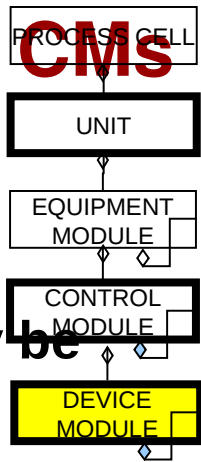
DEVICE MODULE

Agenda

- **Introduction**
- **ISA88/95 Physical hierarchy model**
- **ISA88 Equipment entity model**
    - Process Cell / Work Center
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- **ISA95 Equipment Model**
- **Practice**

Equipment Modules vs. Control Modules

Equipment Module	Control Module
Can contain an EPE	Cannot contain an EPE
Must interface to the process via a control module	Directly interfaces to the process via Device Modules
Commonly used as stand alone and shared equipment by other Units or EMs	
Commonly used to deal with transfers	
Can contain other EMs and CMs	Can contain other CMS, not EMs
May have a direct link to the recipe procedure via the EPE	Has no direct link to the recipe procedure

Control modules and Equipment modules : Unit ownership

- **By design, CMs and EMs**
  - ➢ can be attached permanently to a unit
  - ➢ Can be independent of any unit, part of the whole Process Cell / Work Center
    - CM et EM can be temporarily attached to any unit to provide the needed Equipment (CMs) or Process (Ems) services needed to achieve its processing function
    - CM and EM can also be commanded independently

Example of ISA88 physical hierarchy

Example of ISA88 physical hierarchy (Cont'd)
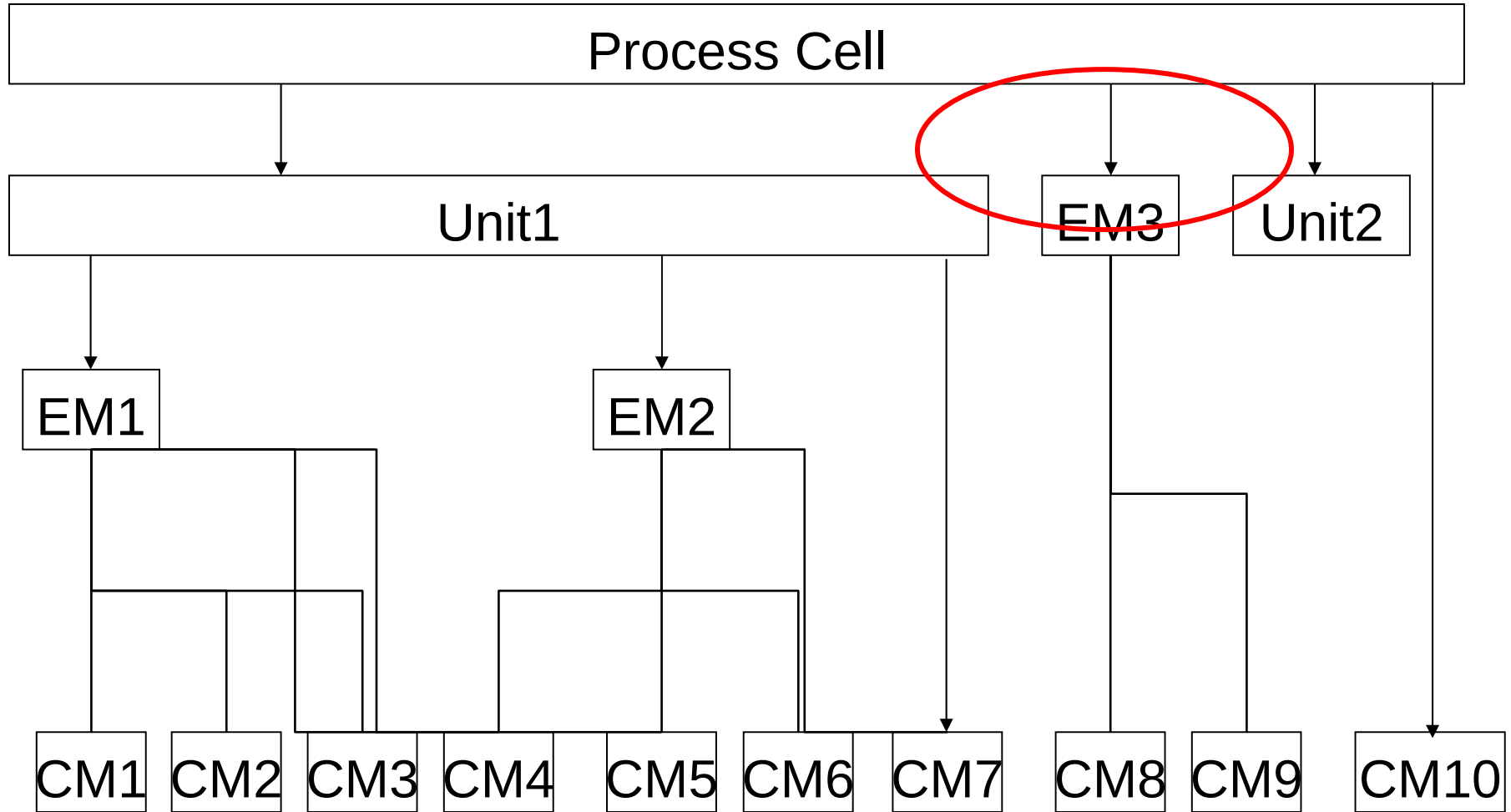
Example of ISA88 physical hierarchy (Cont'd)
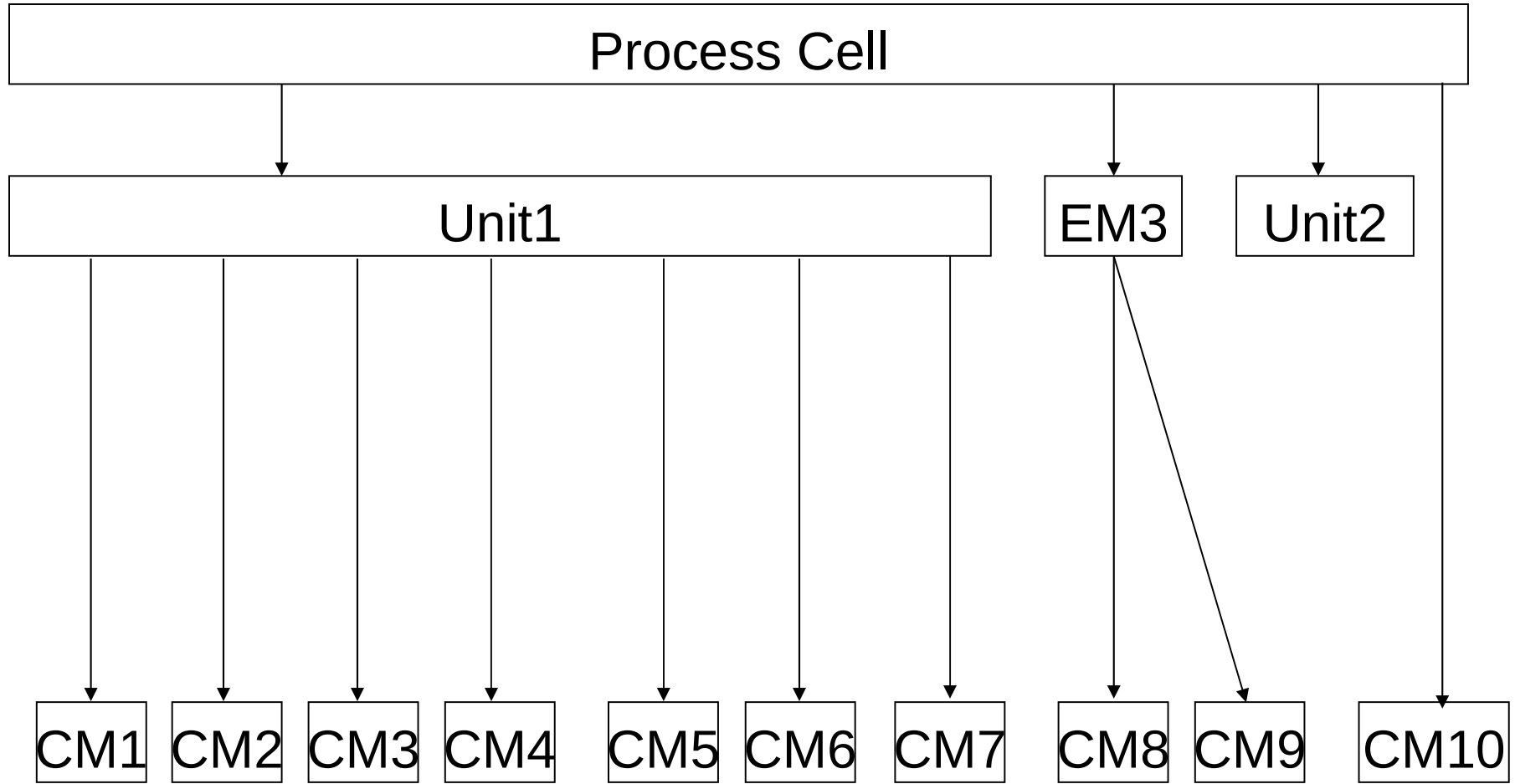
Example of ISA88 physical hierarchy (Cont'd)
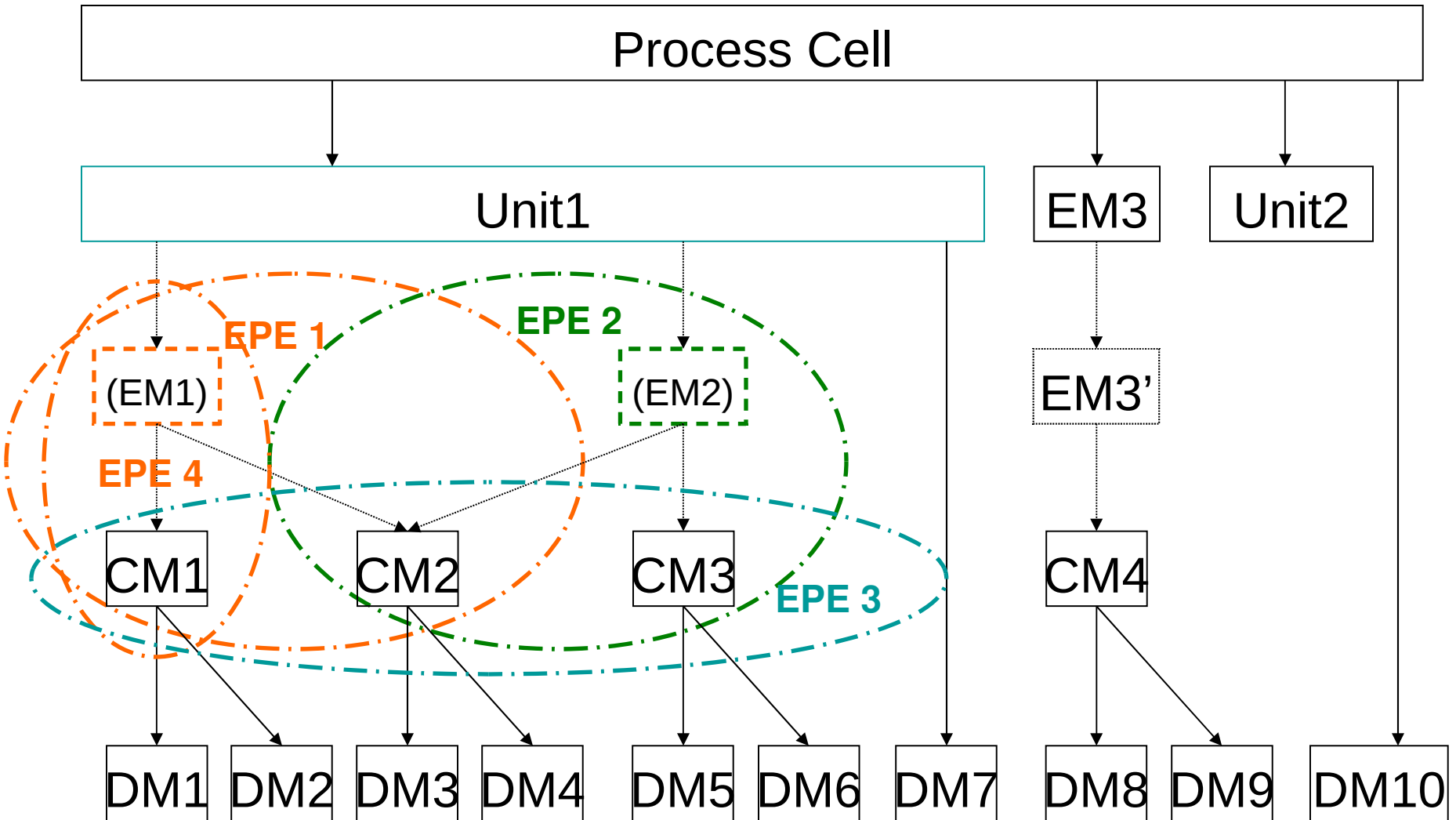
Example of ISA88 physical hierarchy (Cont'd)
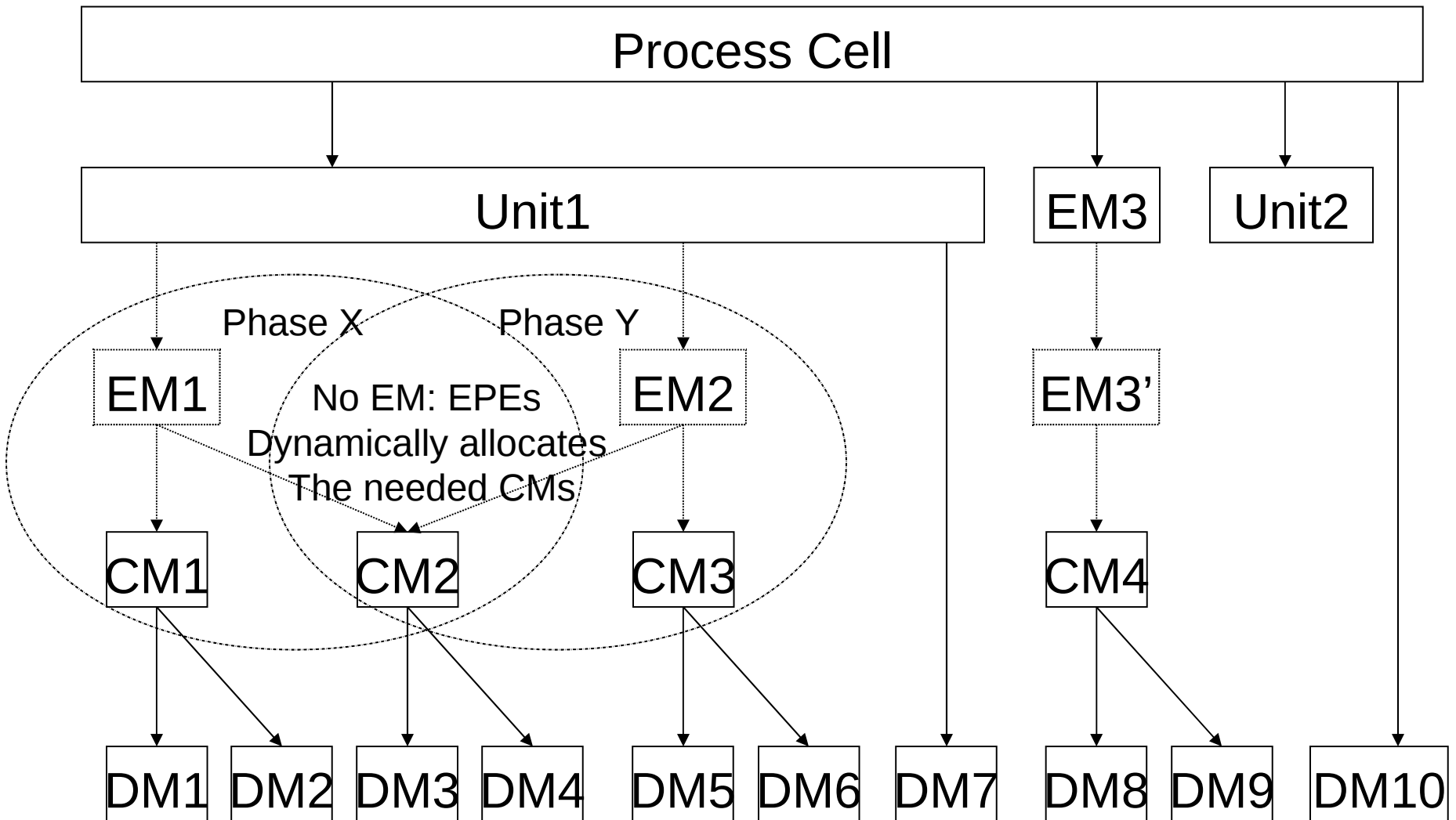
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  - ➢ Process Cell / Work Center
  - ➢ Unit / Work Unit
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  - ➢ Control Module
  - ➢ Device Module
  - ➢ Exploit the model
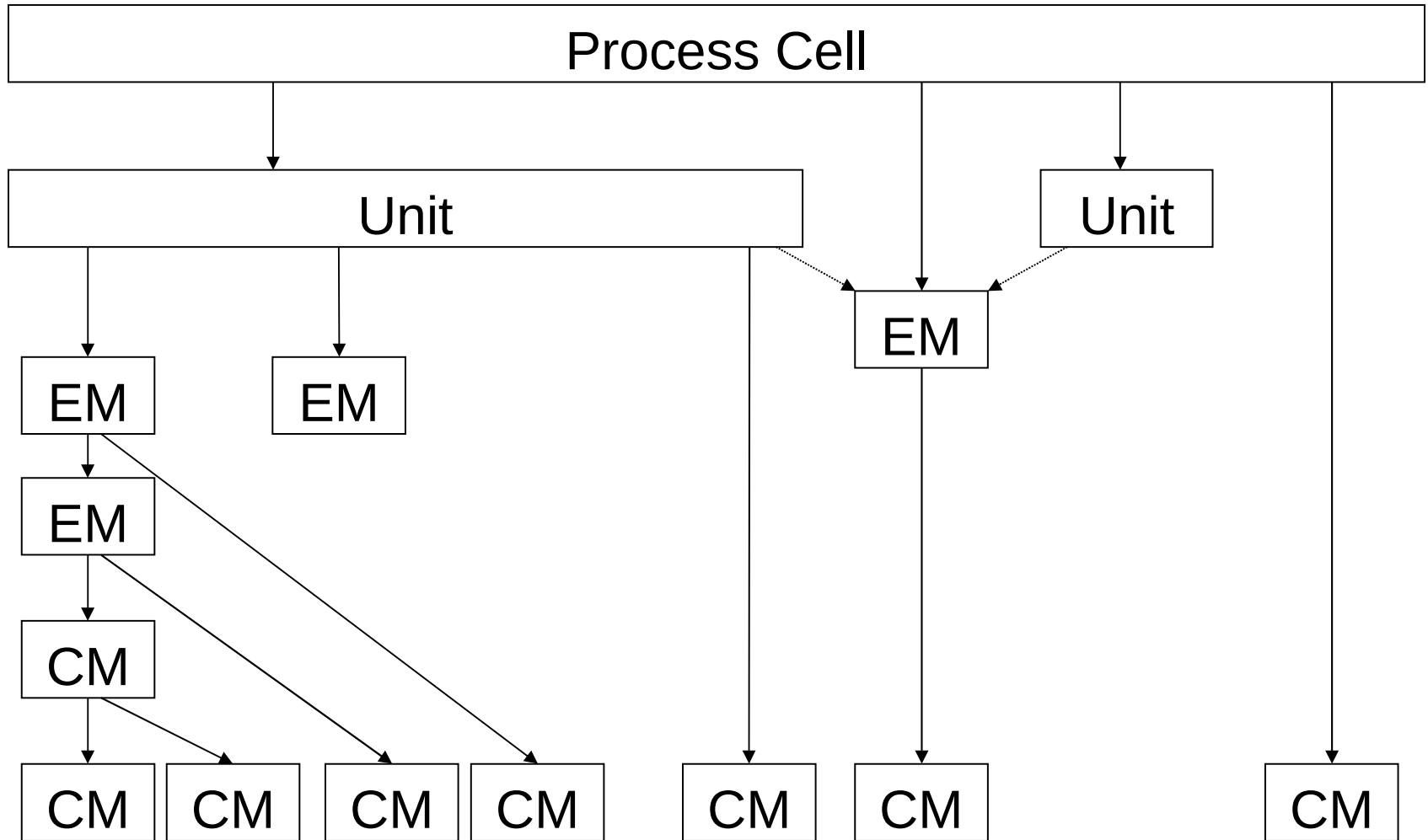- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

ISA-95 Hierarchy scope

- **ISA-95 attaches "Hierarchy scope" to all information objects**
  - ➤ Resources, process segment, product definition,
  - ➤ Previously named "Location"
  - ➤ "Hierarchy scope is an attribute used in many other objects. The hierarchy scope attribute identifies where the exchanged information fits within the role based equipment hierarchy. It defines the scope of the exchanged information, such as which site or which area the information is relevant for. The hierarchy scope identifies the associated instance in the role based
- **While ISA-88 attaches "control" to the physical hierarchy, ISA-95 takes the other way around: it attaches a physical hierarchy information to information objects**

Example

ISA-88

Unit
(Equipment Entity)

Procedural
Element
(Control)

ISA-95

Process
Segment
(Information object)

Work
Center
(Hierarchy scope)

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  - ➢ Control Module
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- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
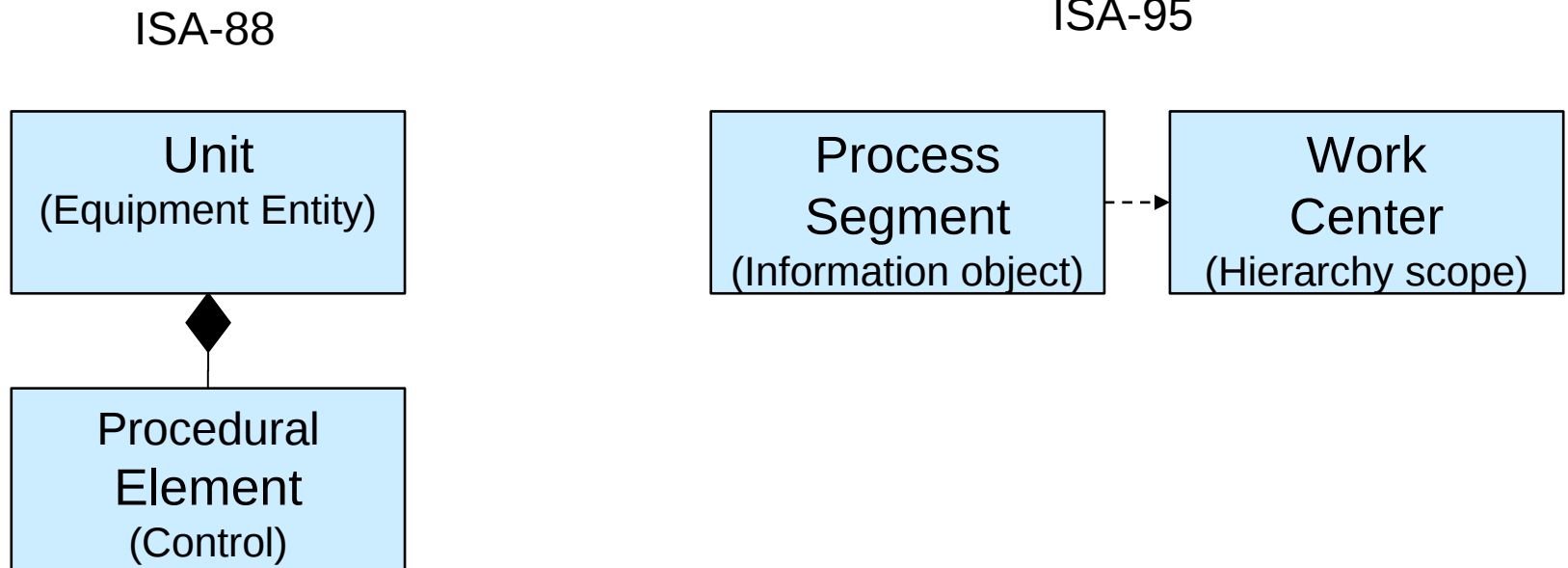- **Practice**

ISA95 equipment models

- **These models identify the physical assets**
  - ➤ by their role in the facility
    - ▪ The function performed by a machine at the explicit location
    - ▪ Not necessarily always the same, can be replaced without affecting the role
  - ➤ By their asset / inventory aspect
    - ▪ The unique machine identifiable by its serial number
    - ▪ Only for "maintainable" equipments,
      - ▪ *not all physical – organisational – entities*
    - ▪ Similar to Inventory asset
- **Features**
  - ➤ Implements the physical hierarchy model
  - ➤ Defines properties of physical elements
  - ➤ Allows Class based definition

ISA95 Equipment Resource Model: Role based Equipment

< May be made up of

0..n

0..n

Equipment Class

0..n

< Defined by

Equipment

0..n

Has properties of >

0..n

Is tested by an >

0..n

Is tested by an >

Has values for >

0..n

0..n

Equipment Capability Test Specification

0..n

0..n

Is tested by an >

Defines a procedure for obtaining an >

< Records the execution of

Equipment Capability Test Result

0..n

0..n

0..n

Equipment Class Property

0..n

Maps to

0..n

Equipment Property

0..n

0..n

< may contain nested

< may contain nested

ISA95 Equipment Resource Model: Physical Asset

> May be made up of

0..n

Physical Asset

> is an instance of

0..n

1..1

Physical Asset Class

0..n

0..n

Has values for >

Is tested by an >

Is tested by an >

0..n

0..n

Has properties of >

Physical Asset Capability Test Specification

Physical Asset Capability Test Result

< records the testing of

0..n

0..n

Defines a procedure for obtaining an <

Is tested by an <

0..n

0..n

Physical Asset Property

0..n   Maps to

0..n

Physical Asset Class Property

0..n

0..n

< may contain nested

< may contain nested

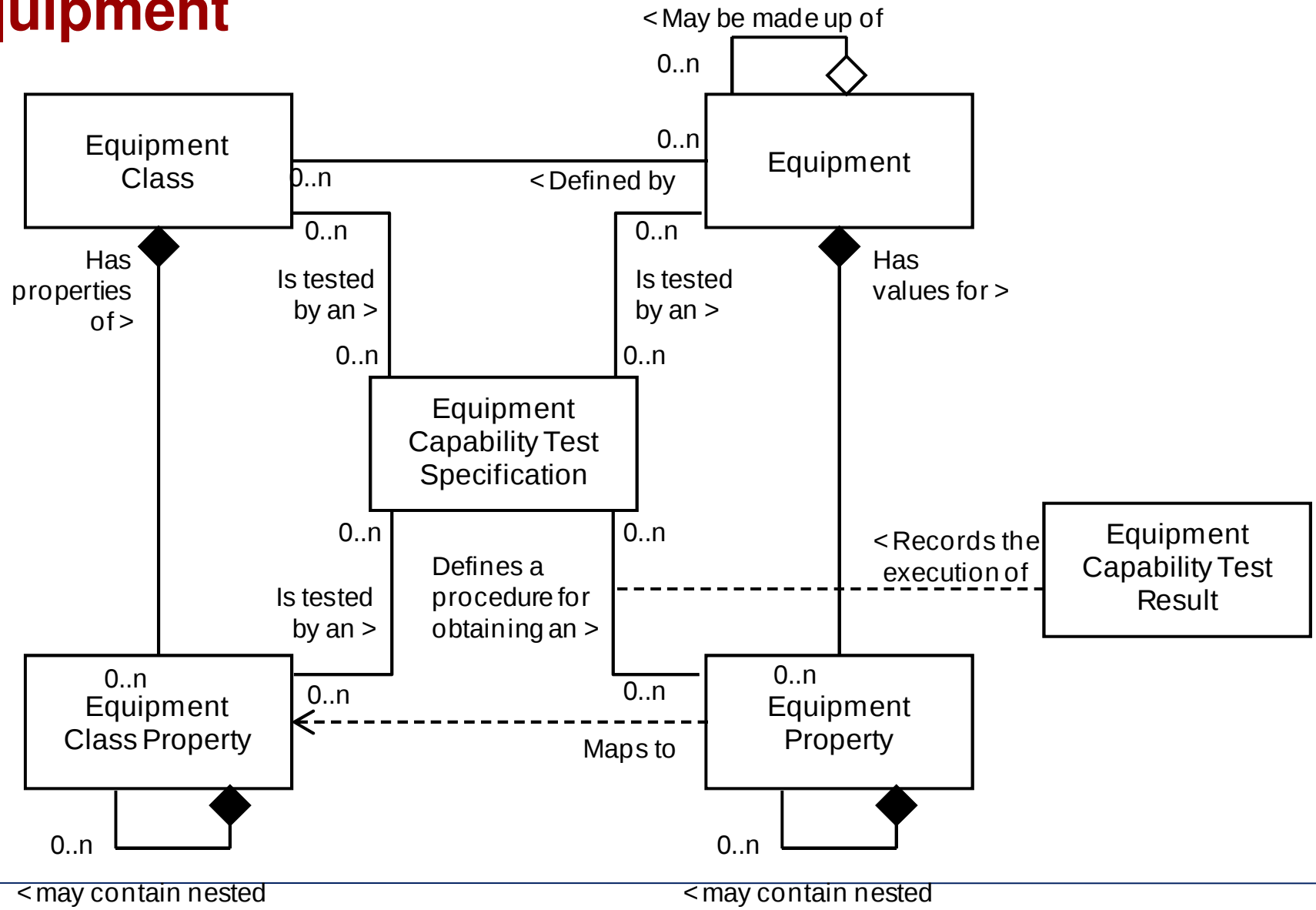# ISA95 global Equipment Resource Model
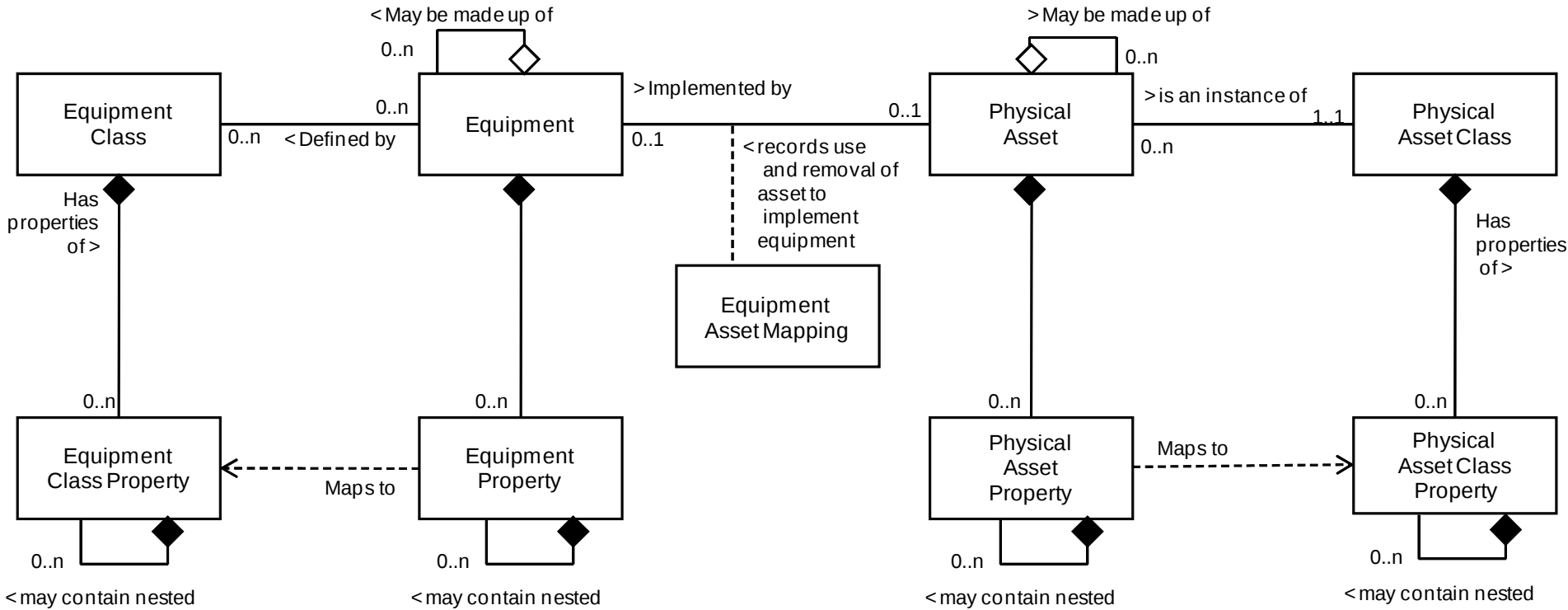
Agenda

- **Introduction**
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- **ISA88 Equipment entity model**
  - ➢ Process Cell / Work Center
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  - ➢ Control Module
  - ➢ Device Module
  - ➢ Exploit the model
- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

Physical Asset Models elements (common RBE/PhA)

- **Properties (Definition)**
  - ➢ "object denoting an implementation specific characteristic of an entity"
  - ➢ Characterization entities for Equipment Classes/Equipment
    - ▪ Ex: Capacity, Max Pressure, NominalSpeed, NbOfBagsPerMintute …
  - ➢ Some properties can match the Equipment constraints defined in Process Element (Product Asset, Process Definition)
- **Property (Value)**
  - ➢ Valuation of the property as a requirement (for Equipment Class/Equipment)
  - ➢ Valuation of a property from actual assessment (For Physical Asset)
    - ▪ Ex: NbOfBagsPerMintute = 1643
- **Test specification**
  - ➢ "identify a test for one or more equipment properties"
- **Test Result**
  - ➢ "Results from a equipment capability test for a specific piece of equipment / physical asset"

Physical Asset Models elements (specific RBE/PhA)

- **Role based Equipment**
  - Equipment
    - "A representation of the elements of the equipment hierarchy model"
  - Equipment Class
    - "a grouping of role based equipment with similar characteristics for purposes of scheduling and planning"
- **Physical Asset**
  - Physical Asset
    - represents information about a physical piece of equipment
  - Physical Asset Class
    - "grouping of physical assets with similar characteristics for purposes of repair and replacement"

Agenda

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  - ➢ Control Module
  - ➢ Device Module
  - ➢ Exploit the model
- **ISA95 Hierarchy scope**
- **ISA95 Equipment Model**
- **Practice**

Exercise (1) : Unit, Equipment module or Control module?

	Is a Unit	Isn't a Unit (EM or CM)
Reactor		
Fluid Bed Dryer		
Pasteurizer		
Pump		
Multi pump set		
Ingredient storage tank		
Washing machine		
Kitchen blender (& cook)		
Refrigerator		
Dishwasher		
Iron		
Bred cooker		
Oven		

Exercise (2) - Excel spreadsheet

- **(2.1) Physical Hierarchy**
  - ➢ Give possible names and examples for the physical hierarchy level

#1 —FQIC—⧑

#2 —FQIC—⧑

#3 —FQIC—⧑

#4 —FQIC—⧑

Premix1

V11
Vent
V3
V1
PIC
N2
V12
Premix1
FSL

Rxtr 1

V1
V5
V11
Vent
PIC
V12
N2
Cond V13
C-H2O V14
TIC
Rxtr 1
Steam V15
H2O-R V16
Catalyst
V10
V6
WI
V8
V7

V1

V1

Premix2

V1
V11
VENT
PIC
V12
N2
Premix2
LI
FSL

Rxtr 2

V1
V5
V2
V4
V11
Vent
PIC
V12
N2
Cond V13
C-H2O V14
TIC
Rxtr 2
LI
Steam V15
H2O-R V16
Catalyst
V10
V6
V8
V7
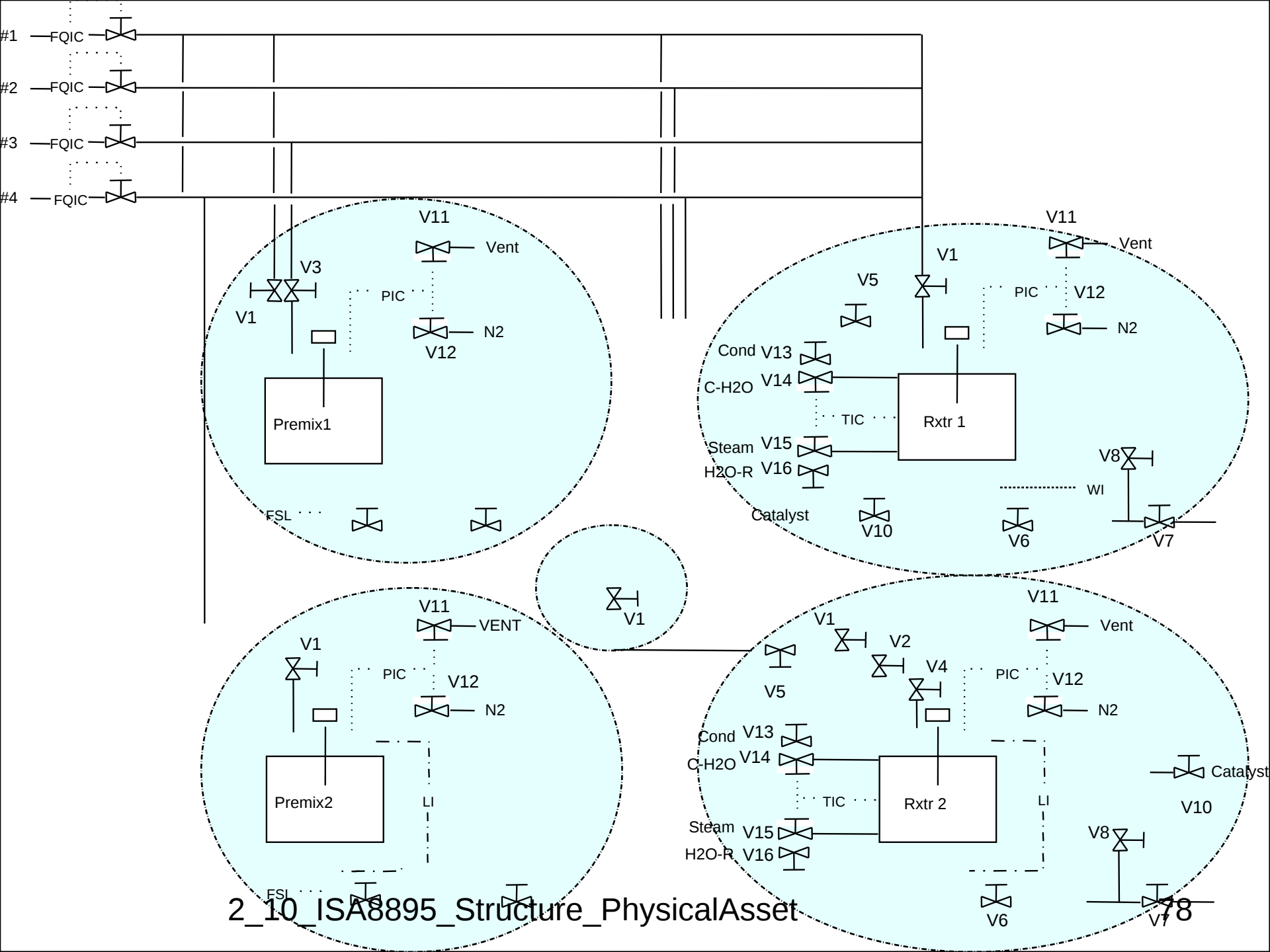
2_10_ISA8895_Structure_PhysicalAsset

78

Exercise (3) : Excel spreadsheet - Physical modeling

- **(1.1) Properties**
  - Identify some typical equipment properties: name, range,
- **(1.2) Equipment Test Specification**
  - Identify typical Test Specifications
- **(2.2) Equipment classes**
  - Identify certain Equipment roles, For different level: WU, EM, CM, DM
- **(2.3) Equipment**
  - identify
    - Enterprise, Site, Area, Work Centers/Process Cells
    - Work Units / Units, Device Modules, Flow breaking devices
    - Control modules: Within the process cell, Peripheral facilities: storage, utilities
- **(3.1) Physical Asset Hierarchy**
  - Identify a possible maintenance oriented physical hierarchy
- **(3.2) Physical Asset Class**
  - Identify certain machines types
- **(3.3) Physical Asset**
  - Identify certain machines

Thank You !