

ANSI/ISA-95 (IEC/ISO 62264)

Industrial Systems Interoperability Operations Management Overview

3

Integrated Manufacturing Systems
in the Context of Industry 4.0

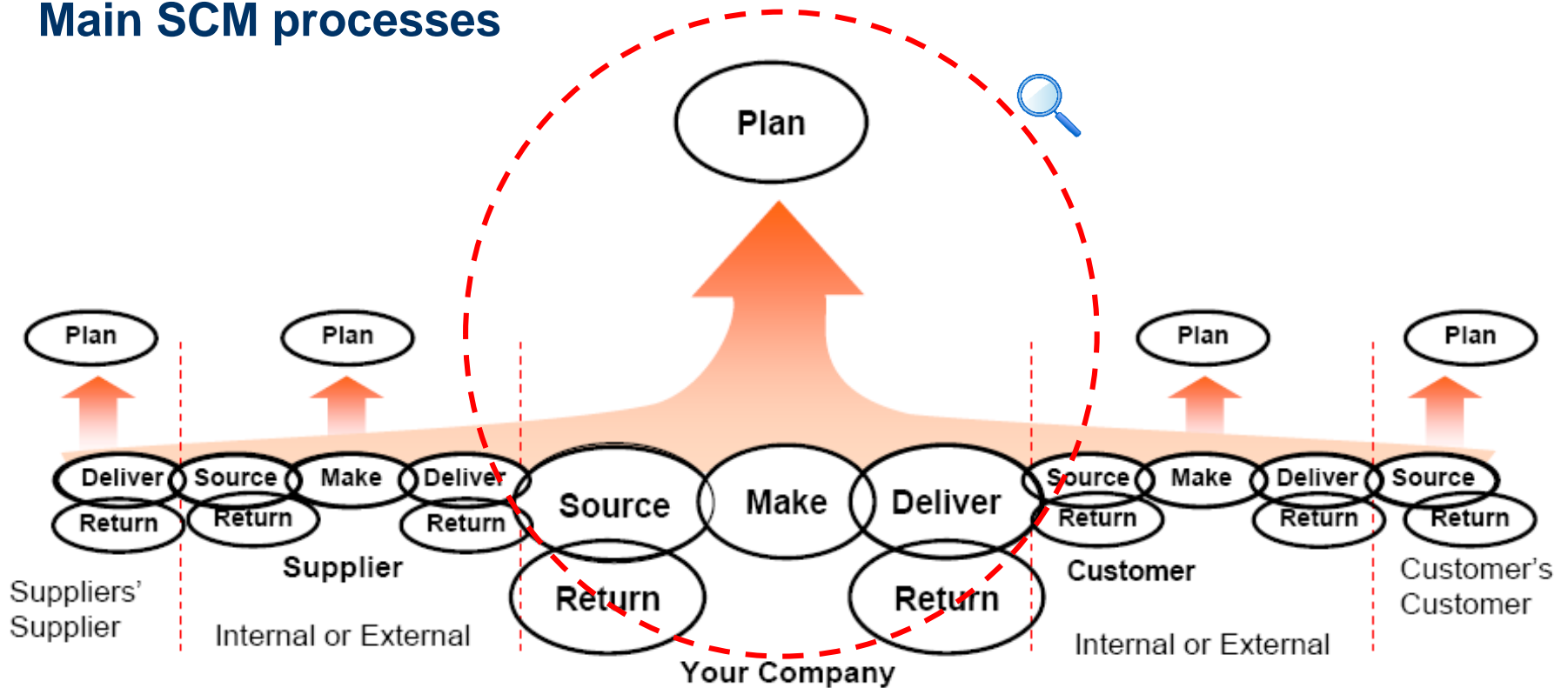


Agenda

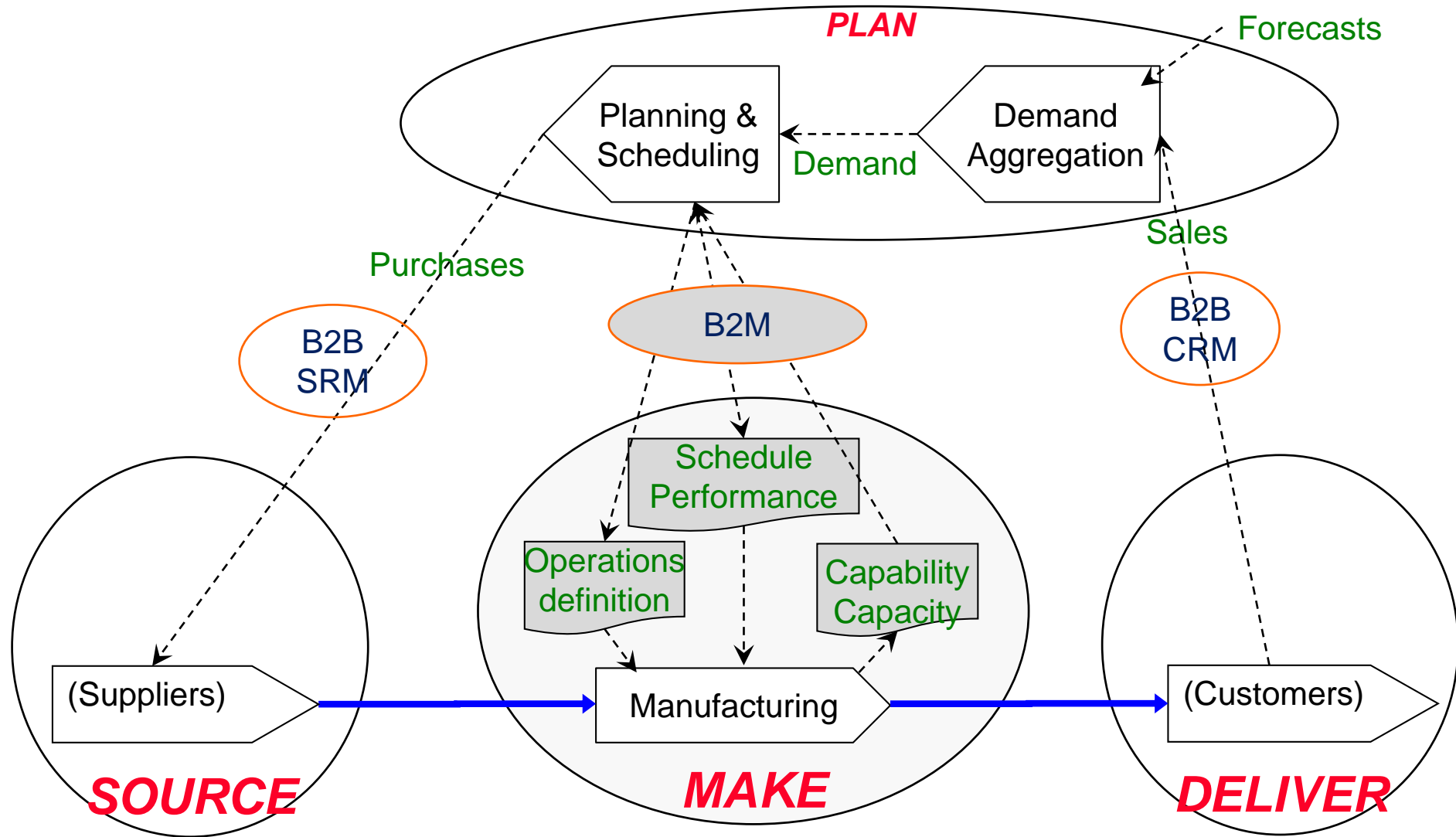
- **ISA-95 scope**
- **ISA-95 (inferred) ontology**
- **ISA-95 content**
- **ISA-95 usage examples**

Supply Chain SCOR Model

Main SCM processes



Supply Chain information flows – ISA-95 scope



ISA95 snapshot

■ B2M: Collaboration Business / Execution

- Communication between execution systems (MES/MOM, DCS, MMS, LIMS, WES, SCADA,...) and business systems (ERP, SCM)
- Master data management

■ MES/MOM : Functional definition

■ Data and Activity models

- Description of resources, capability, products, work order requests and reports
- Definition of operation management activities (MES)

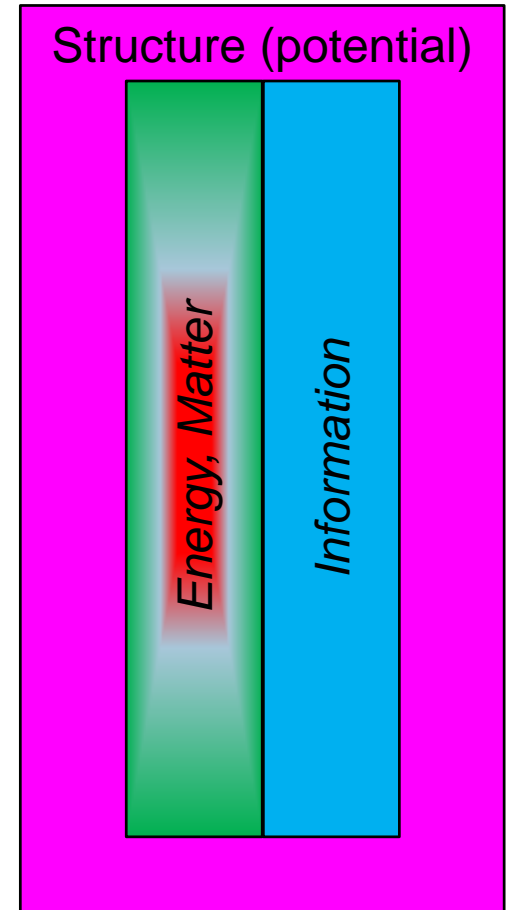
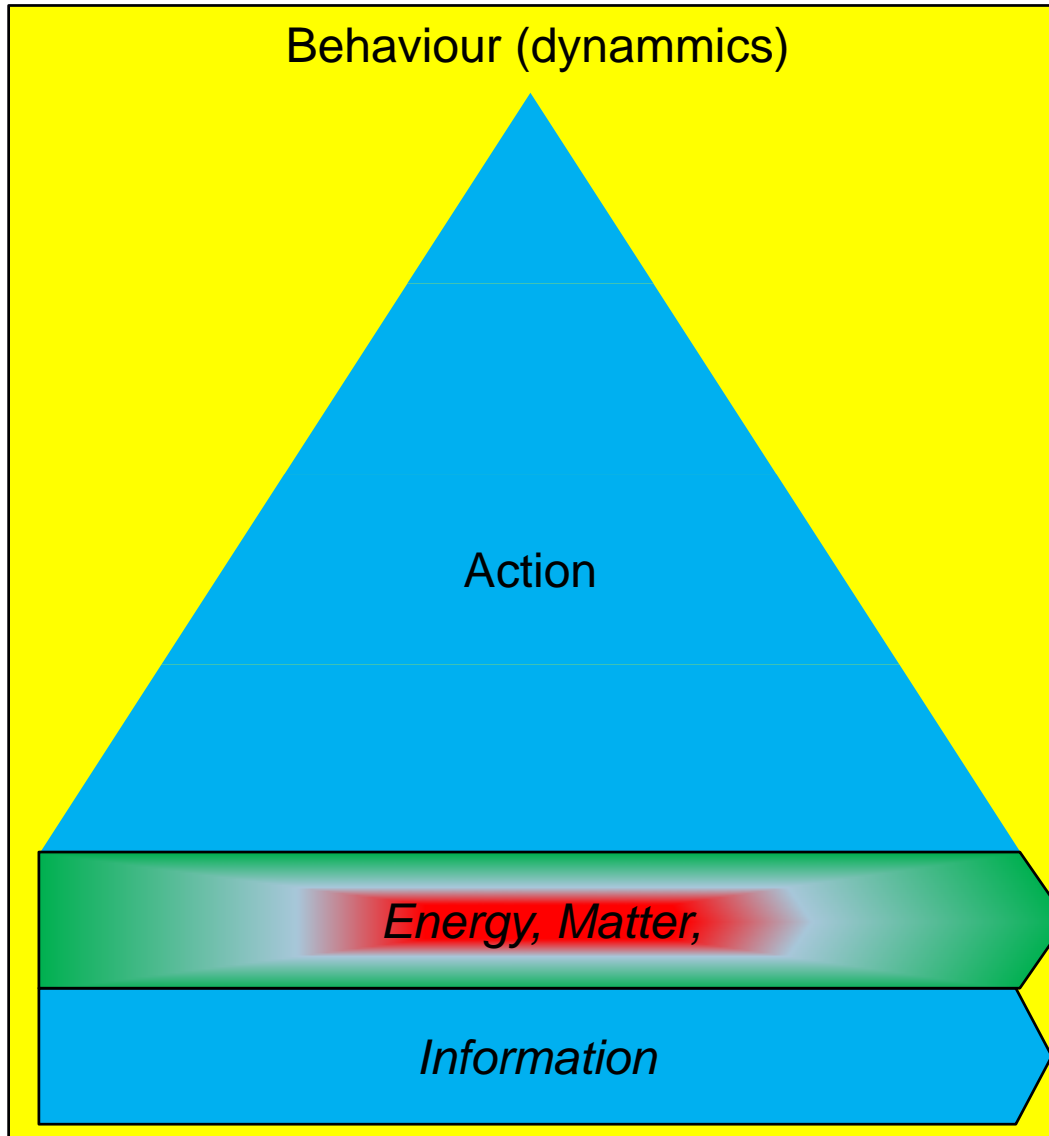
■ Applications:

- User requirements and functional specification of MES and B2M interfaces
- Native B2M connectors - MES/ERP (B2MML)
- Possible basis for developing MES applications and software...

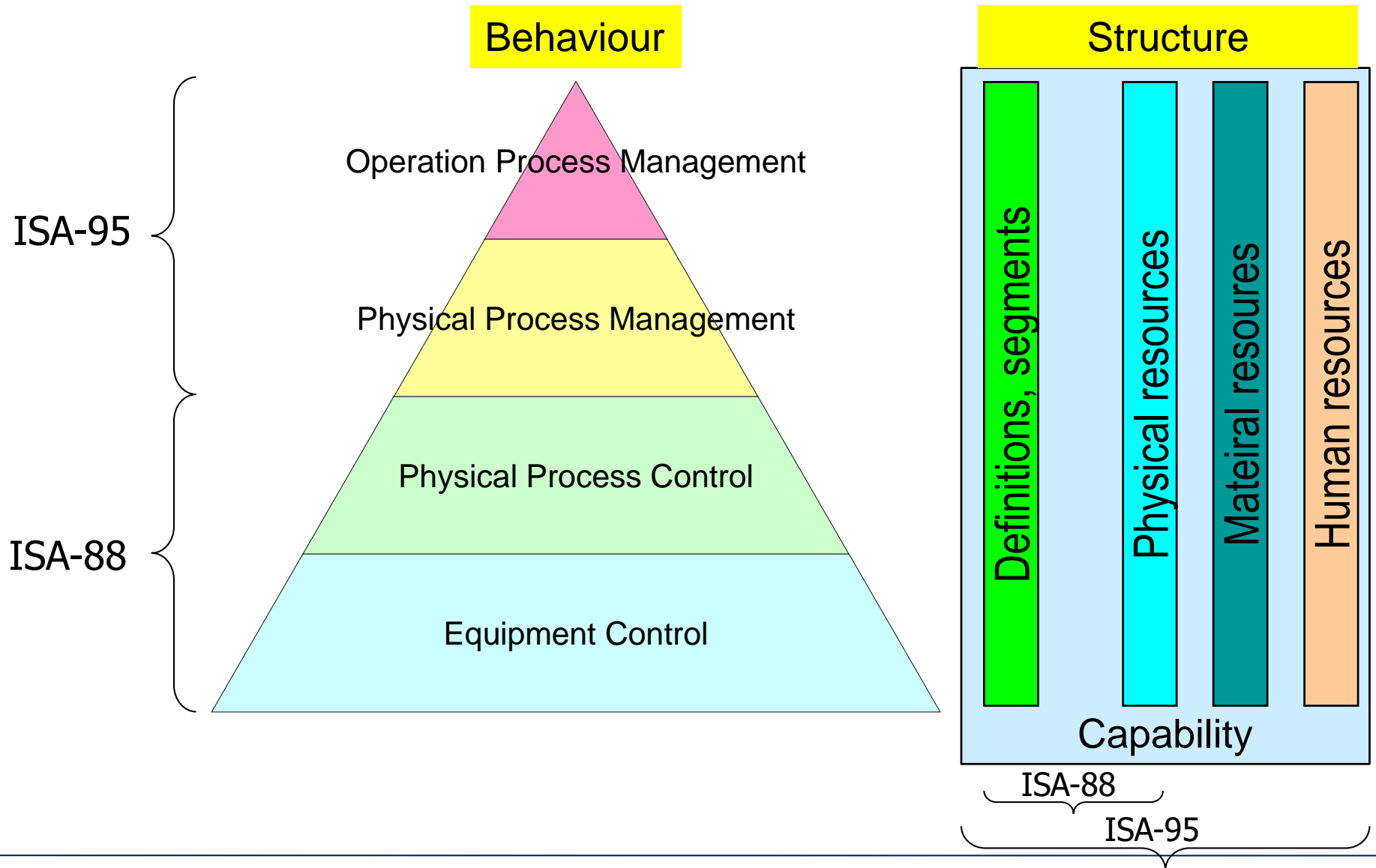
Agenda

- ISA-95 scope
- ISA-95 (inferred) ontology
- ISA-95 content
- ISA-95 usage examples

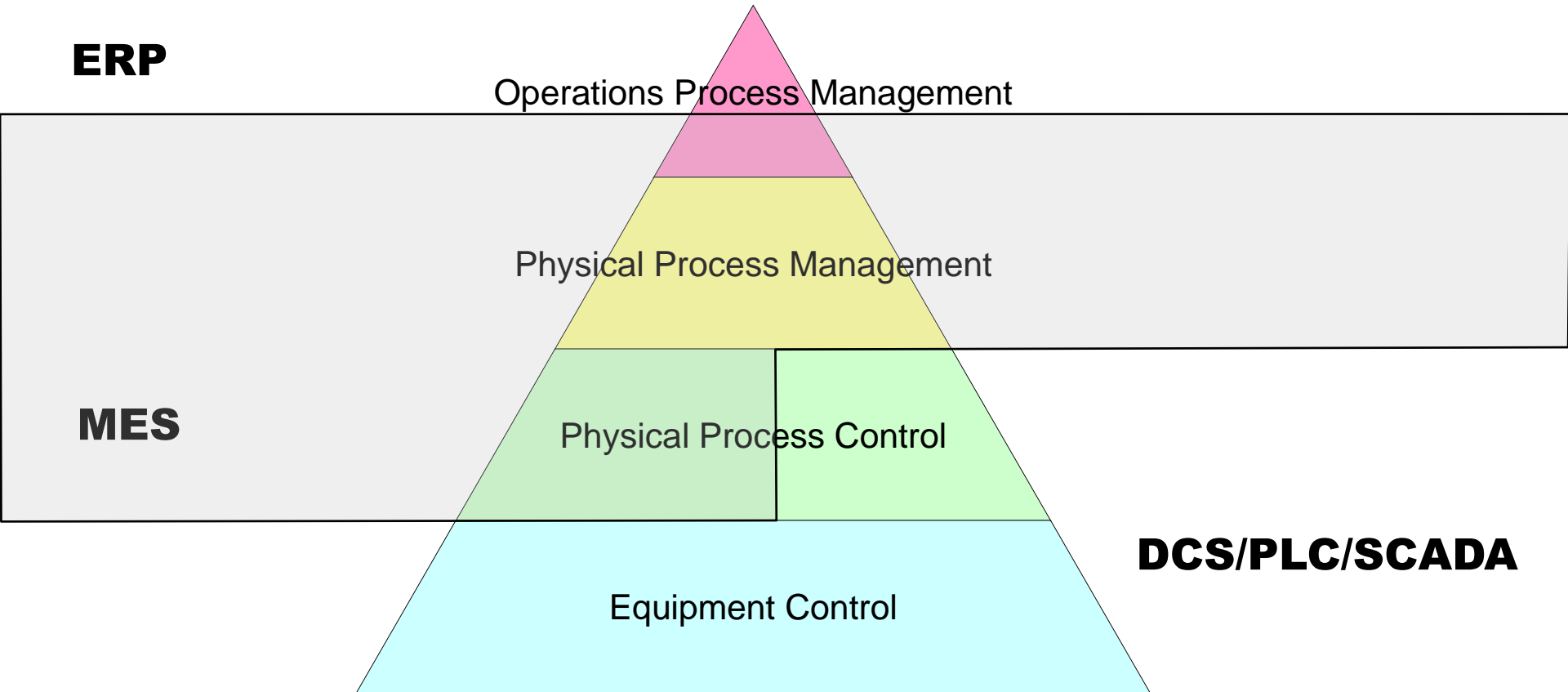
Abstract system model



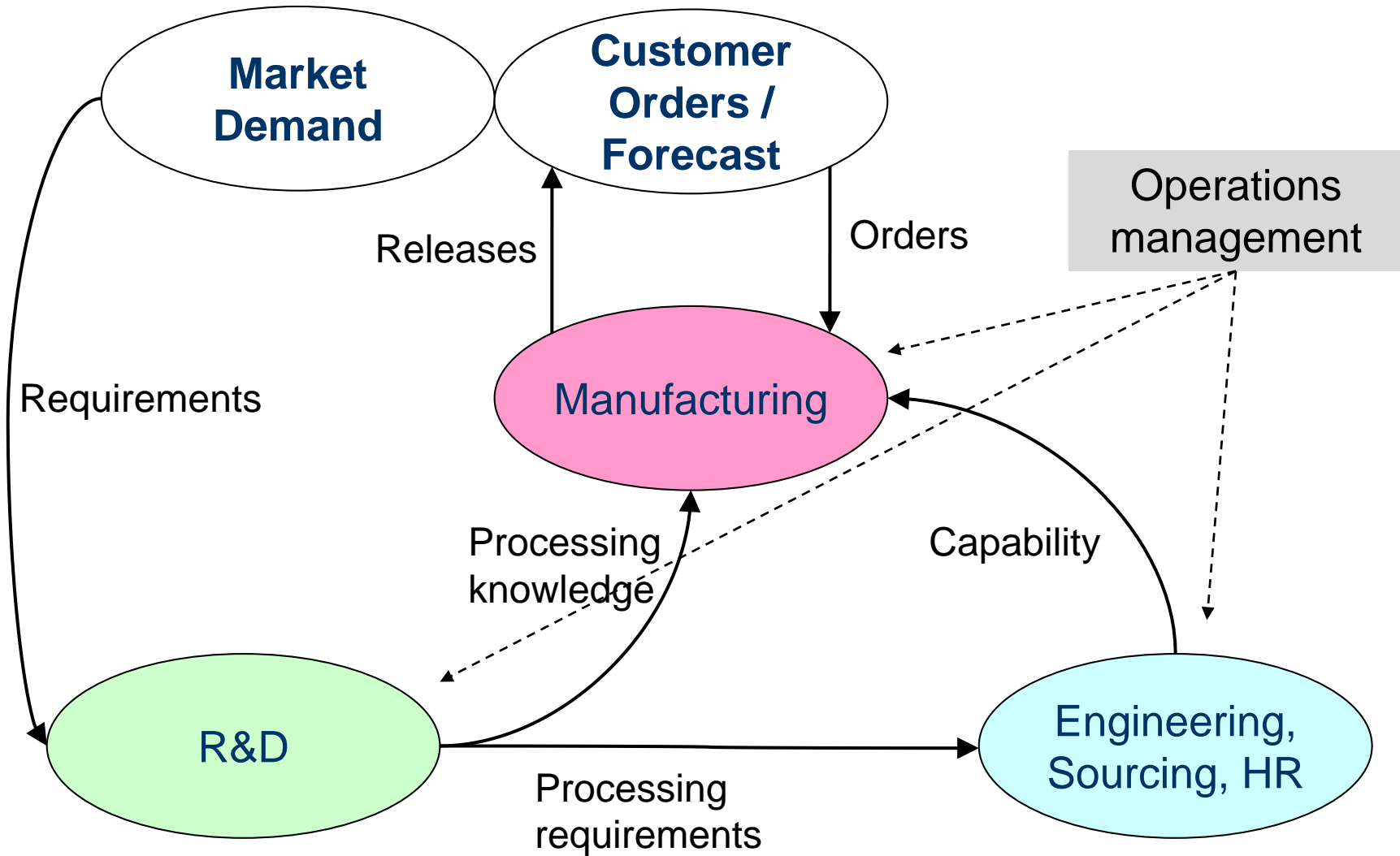
ISA-88/95 industrial system upper ontology



IT systems involved (example)



Industrial system general process map

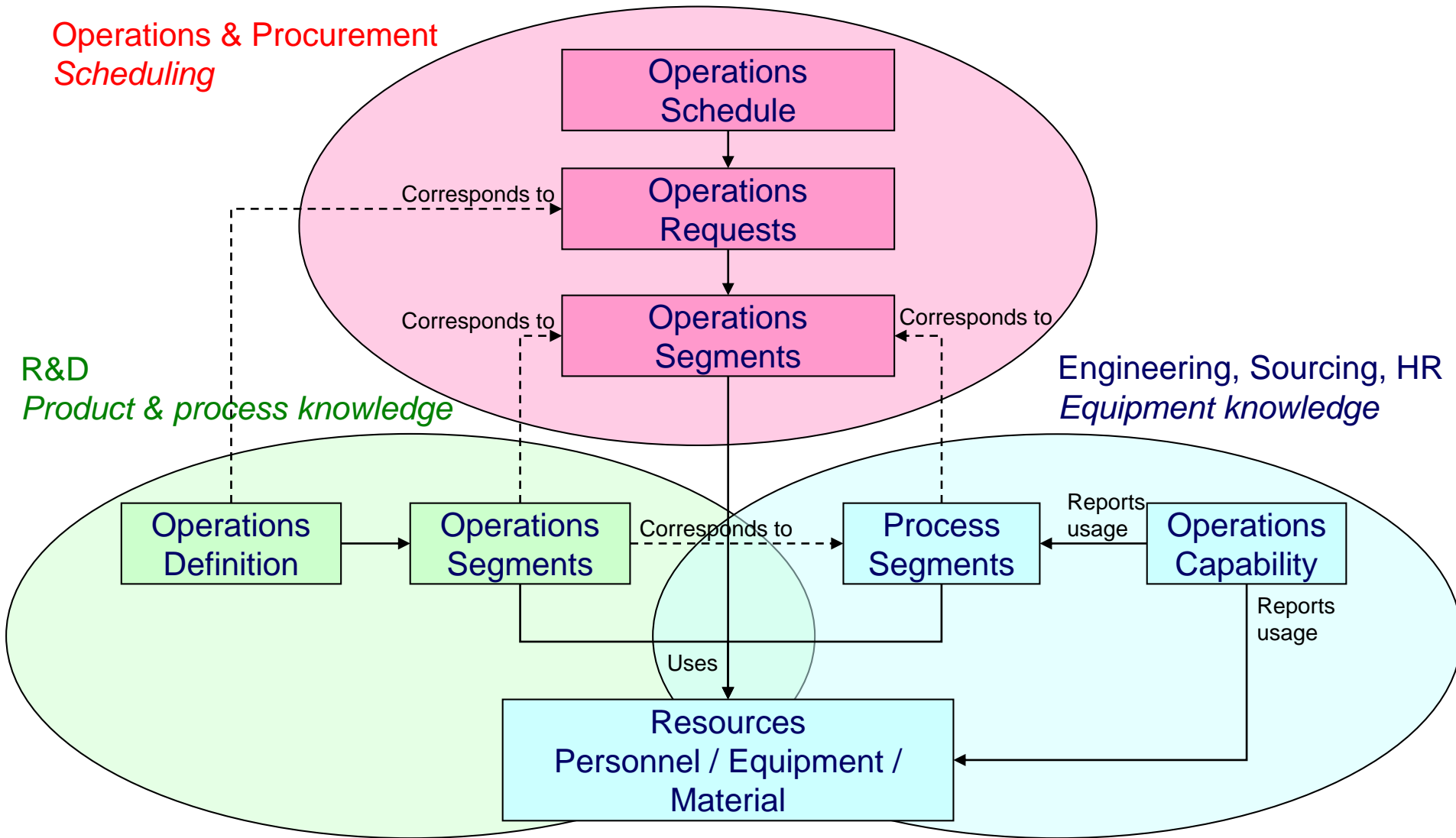


ISA-95 concepts for operations management

Operations & Procurement
Scheduling

R&D
Product & process knowledge

Engineering, Sourcing, HR
Equipment knowledge



Agenda

- ISA-95 scope
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- ISA-95 usage examples

What is ISA-95?

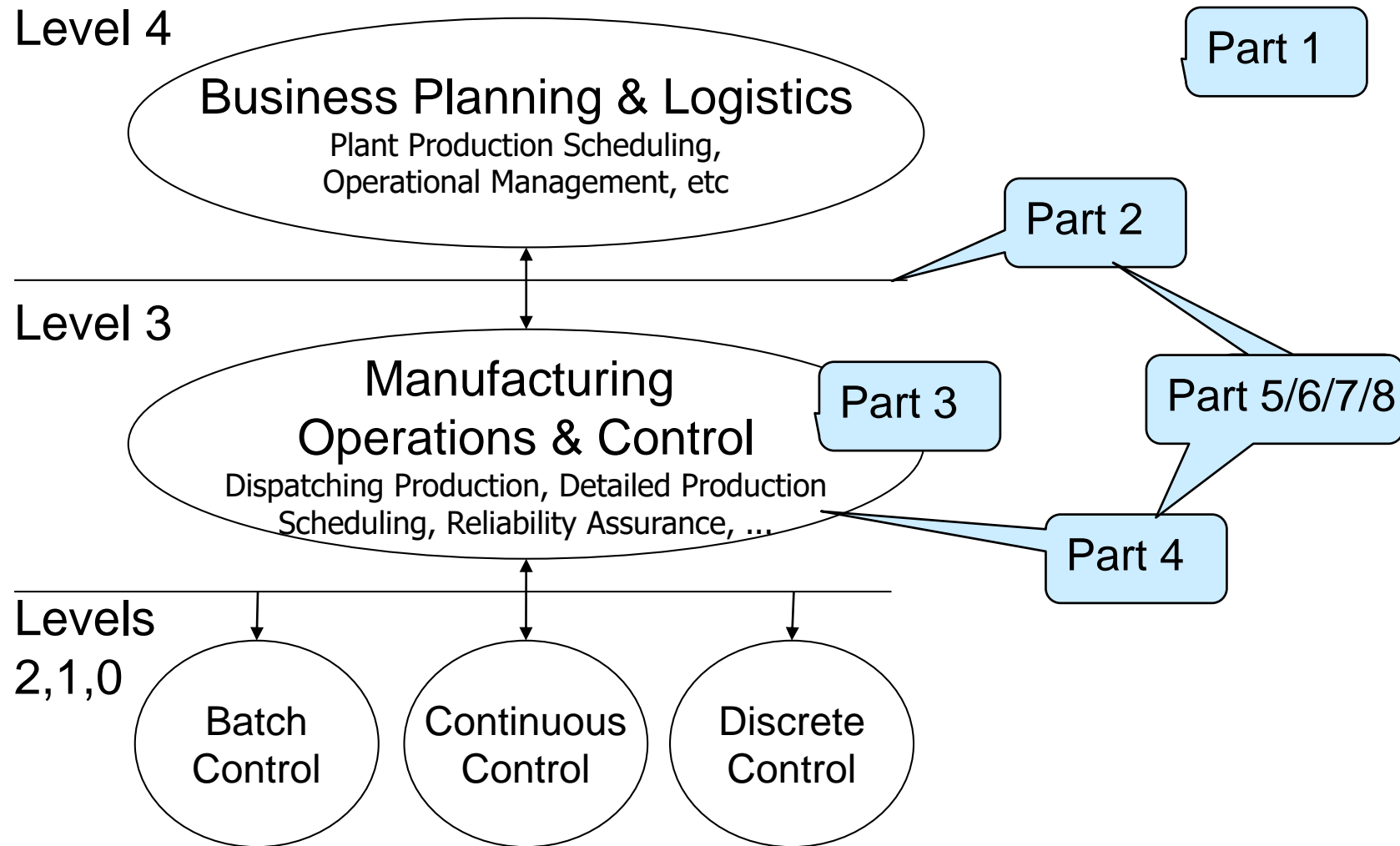
Grayed standards are studied in JVI4 course

■ US & International standard “Enterprise - Control System Integration”

- The ISA95 committee develops the ISA-95 US standard
- The ISO/IEC JWG5 develops the ISO/IEC62264 international standard

| US standard | INTL Standard | Sub Title |
|-------------------------|----------------------|------------------------------------------------------------------------------------|
| ANSI/ISA-95.00.01:2010 | IEC62264-1:2013 | Part 1: Models and Terminology |
| ANSI/ISA-95.00.02:2018 | IEC62264-2:2015 | Part 2: Object models attributes |
| ANSI/ISA-95.00.03:2013 | IEC62264-3:2016 | Part 3: Activity Models of Manufacturing Operations Management |
| ANSI/ISA 95.00.04:2018 | IEC 62264-4:2015 | Part 4: Objects and attributes for manufacturing operations management integration |
| ANSI/ISA-95.00.05: 2018 | IEC 62264-5:2016 | Part 5: Business to Manufacturing Transactions |
| ANSI/ISA-95.00.06: 2014 | IEC PAS 62264-4:2016 | Part 6: Messaging Service Model |
| ANSI/ISA-95.00.07:2017 | - | Part 7: Alias Service Model |
| ANSI/ISA-95.00.08:2020 | - | Part 8: Manufacturing Operations Management Information Exchange Profiles |
| ISA-TR88.95.01-2008 | | Using ISA-88 and ISA-95 Together |
| ISA-TR95.01-2018 | | Master Data Profile Template |

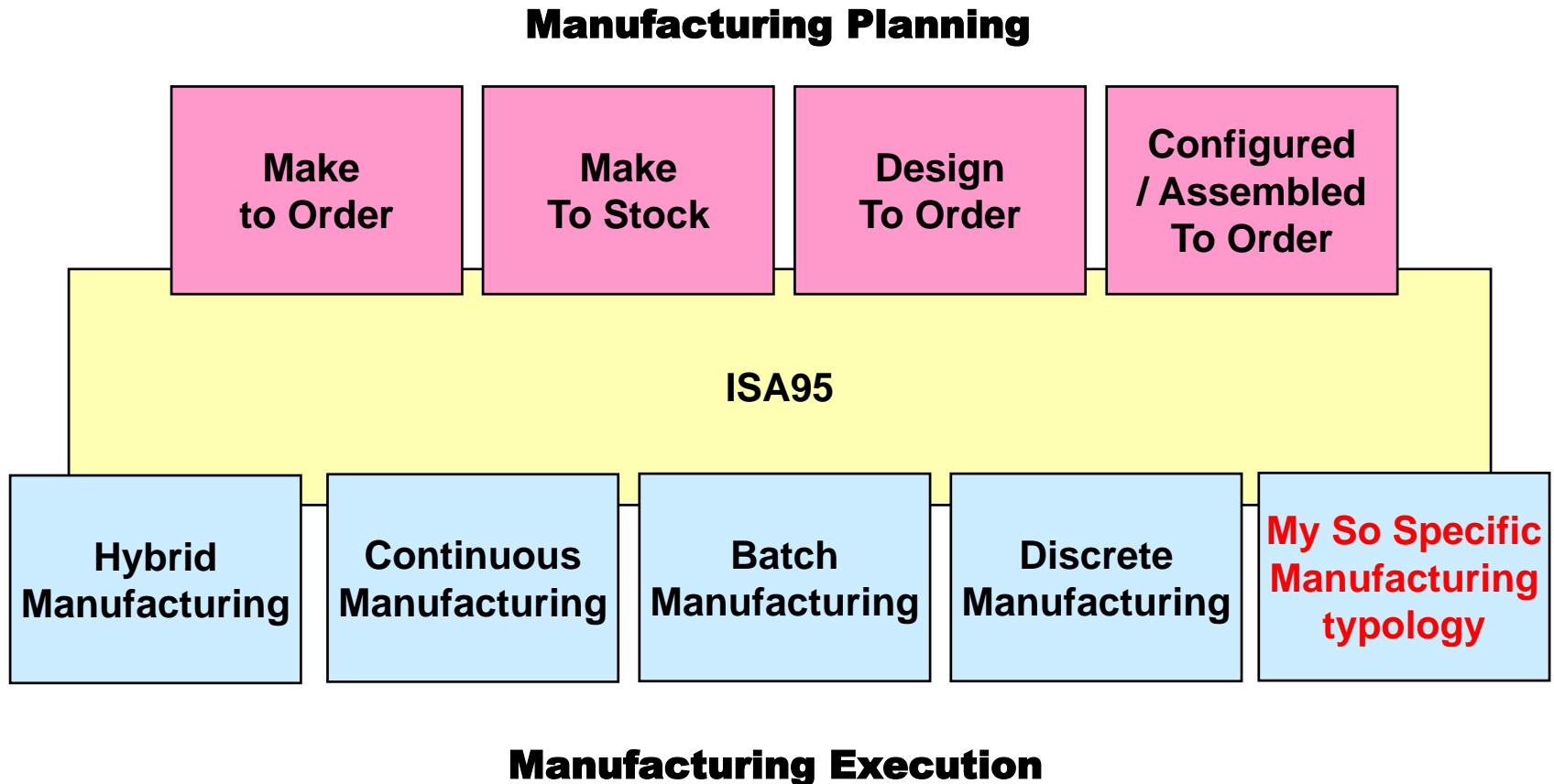
ISA-95 Scope overview



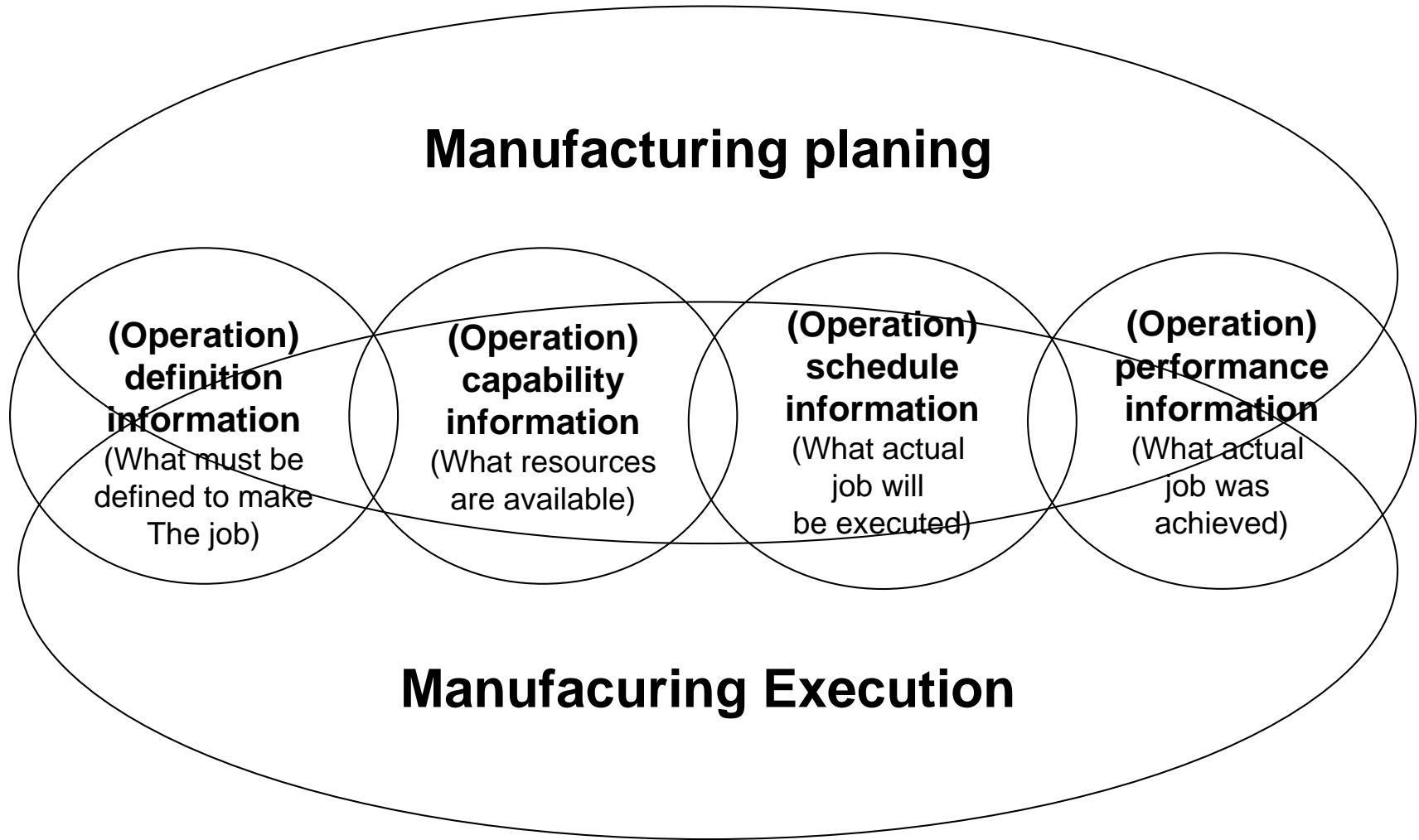
Part 1: Models and Terminology

- An introduction to the standard
- Explains its background from PRM (Purdue Reference Model)
- Only one normative item: physical hierarchy

Part 1: planning vs execution processes

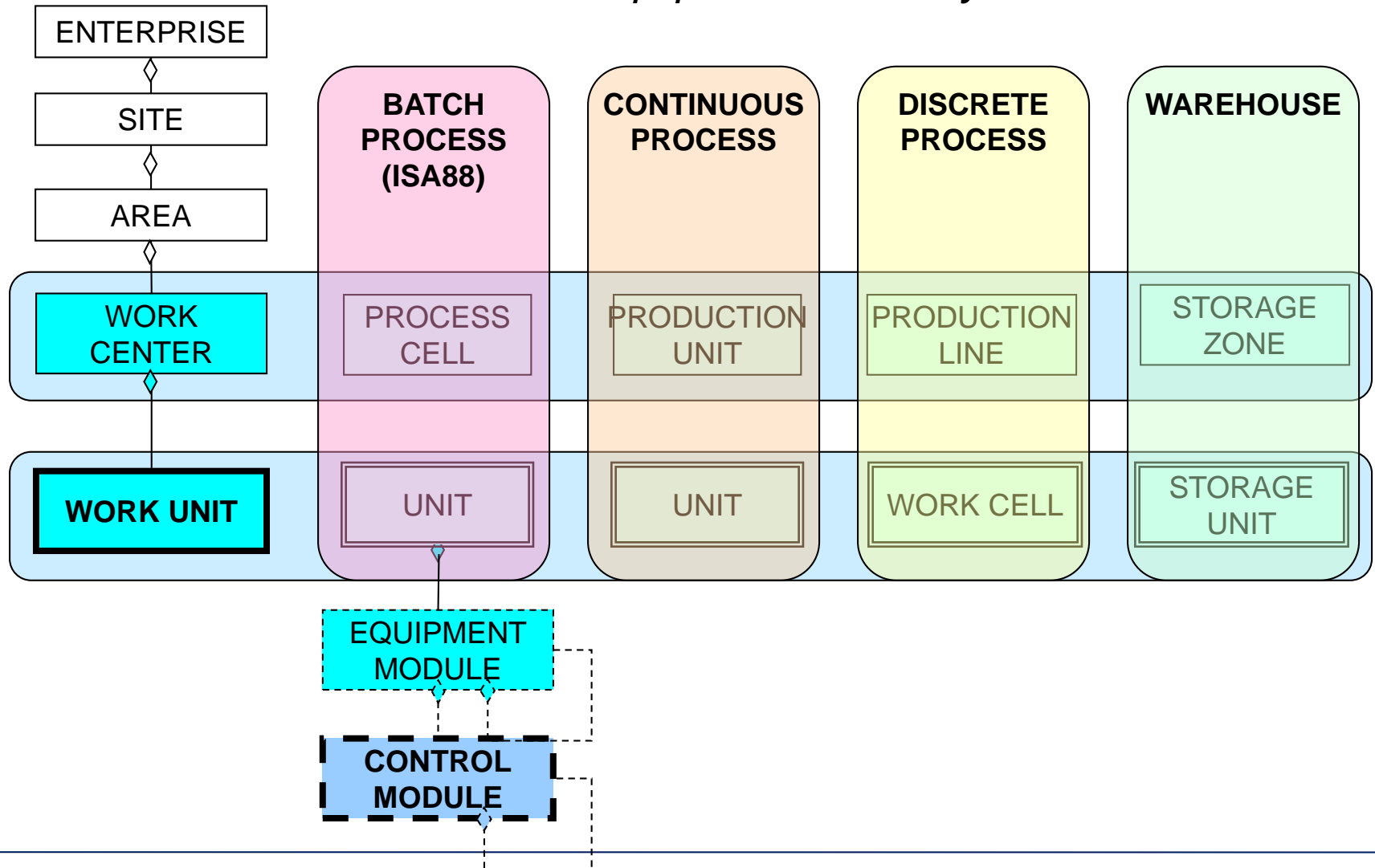


Part 1: information categories



Part 1: ISA95 extended physical model

Role based equipment hierarchy



Part 2: Object models attributes

- **This standard describes the information models for exchanging information between business and control systems**

Part 2: Scope

Level 4

Business Planning & Logistics

Plant Production Scheduling,
Operational Management, etc

Level 3

Manufacturing Operations & Control

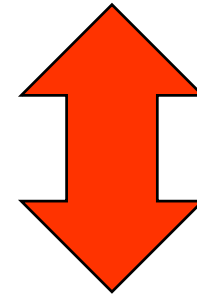
Dispatching Production, Detailed Production
Scheduling, Reliability Assurance, ...

Levels
2,1,0

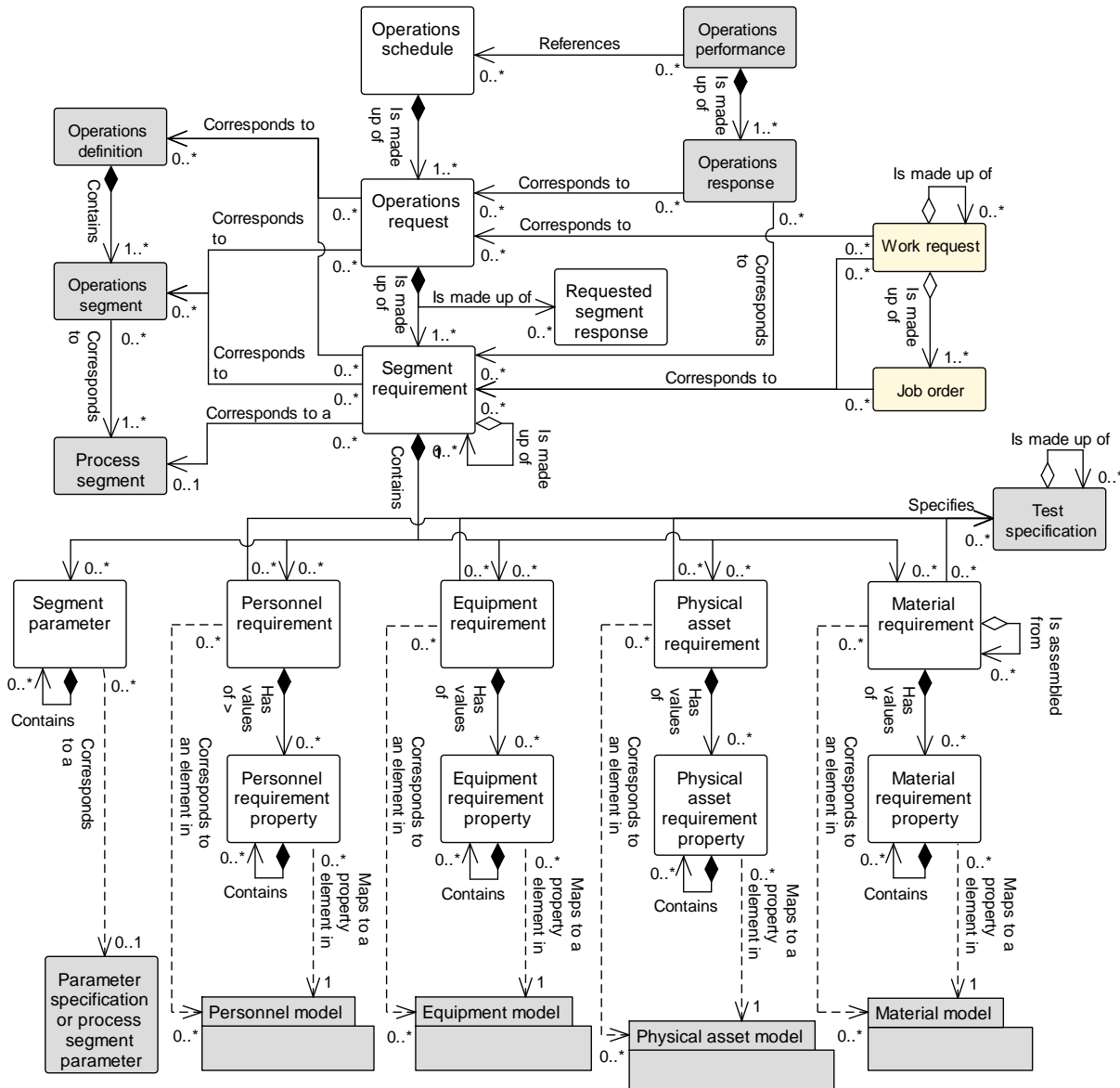
Batch
Control

Continuous
Control

Discrete
Control



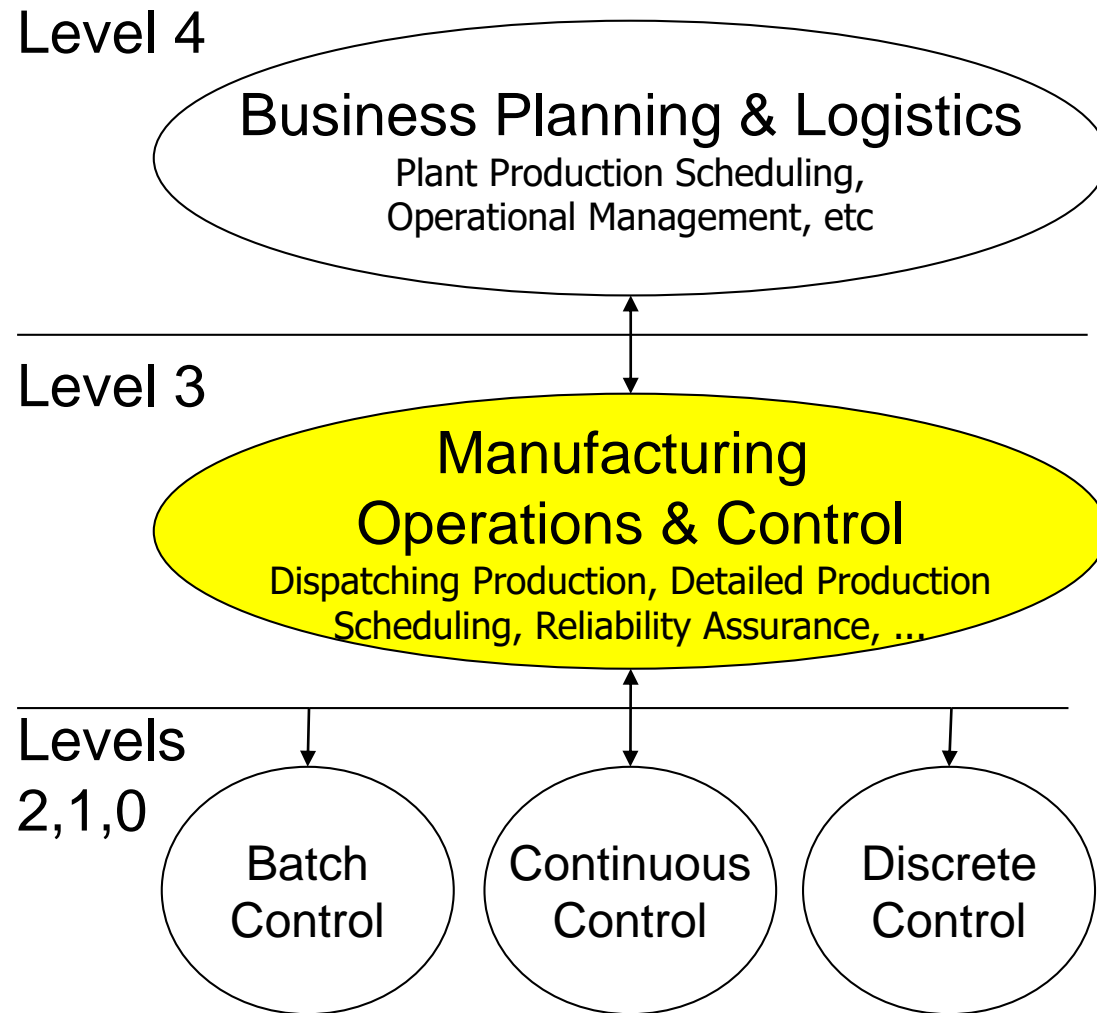
Part 2: Example - Operations schedule model



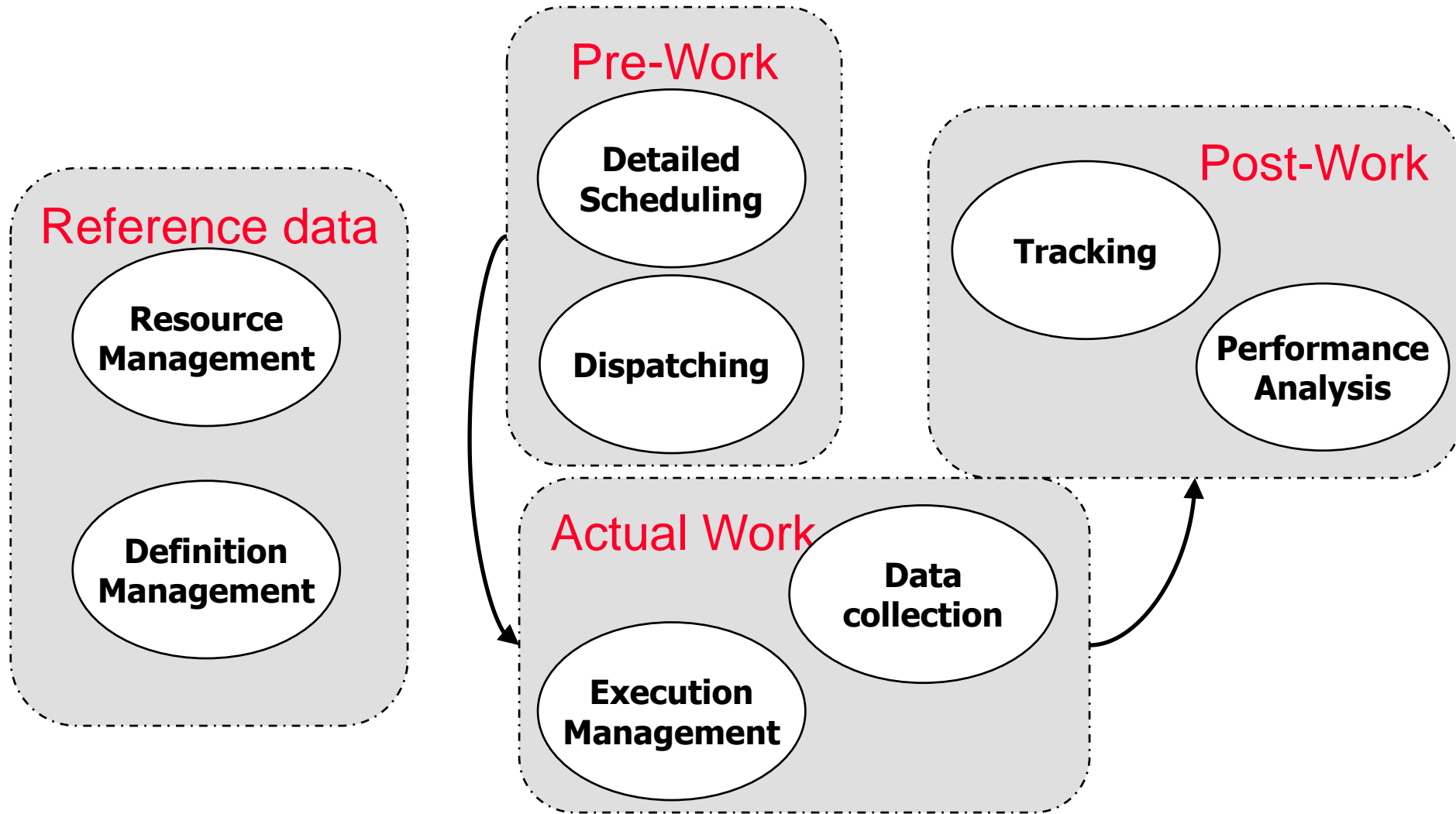
Part 3: Activity Models of Manufacturing Operations Management

- **This part of ISA-95 defines activity models of manufacturing operations management that enable enterprise system to control system integration. It includes**
 - a model of the activities associated with manufacturing operations management, Level 3 functions;
 - an identification of some of the data exchanged between Level 3 activities
 - *Note that the data flows in this part are unusable*
 - *They are incomplete and inconsistent with part 2/4 information models*
- **This part of the standard provides a documentation structure for**
 - Business requirement
 - Functional specifications
 - Software solution marketing

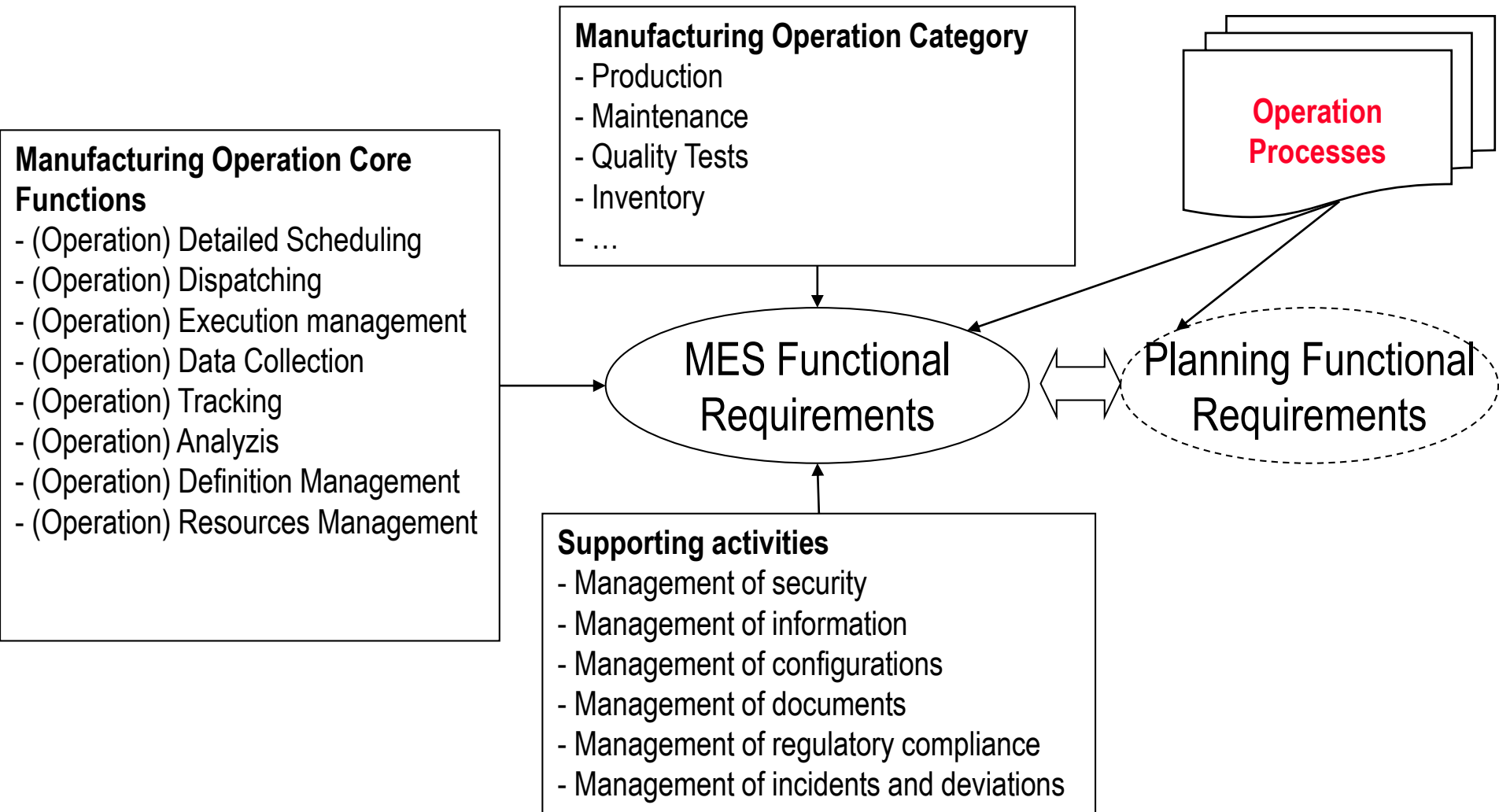
Part 3: Scope



(3) Timing focus MES Main Functional areas



Part 3: A Tri-dimension functional framework



Agenda

- **ISA-95 scope**
- **ISA-95 (inferred) ontology**
- **ISA-95 content**
- **ISA-95 usage examples**

- Case 1 : Large company (>100 plants)
- Case 2 : medium company (3 plants)
- Case 3 : small company (single facility)

Context and challenge

- **Central ERP system + hundreds of factories worldwide**
- **3 selected control/MES vendors**
- **Difficult decision taken between**
 - Let vendors taking care of integration
 - Adopt a company wide interoperability language : vendor neutral / company responsible ISA-95 interface
- **Designed in Europe, developed in India, implemented and used everywhere**

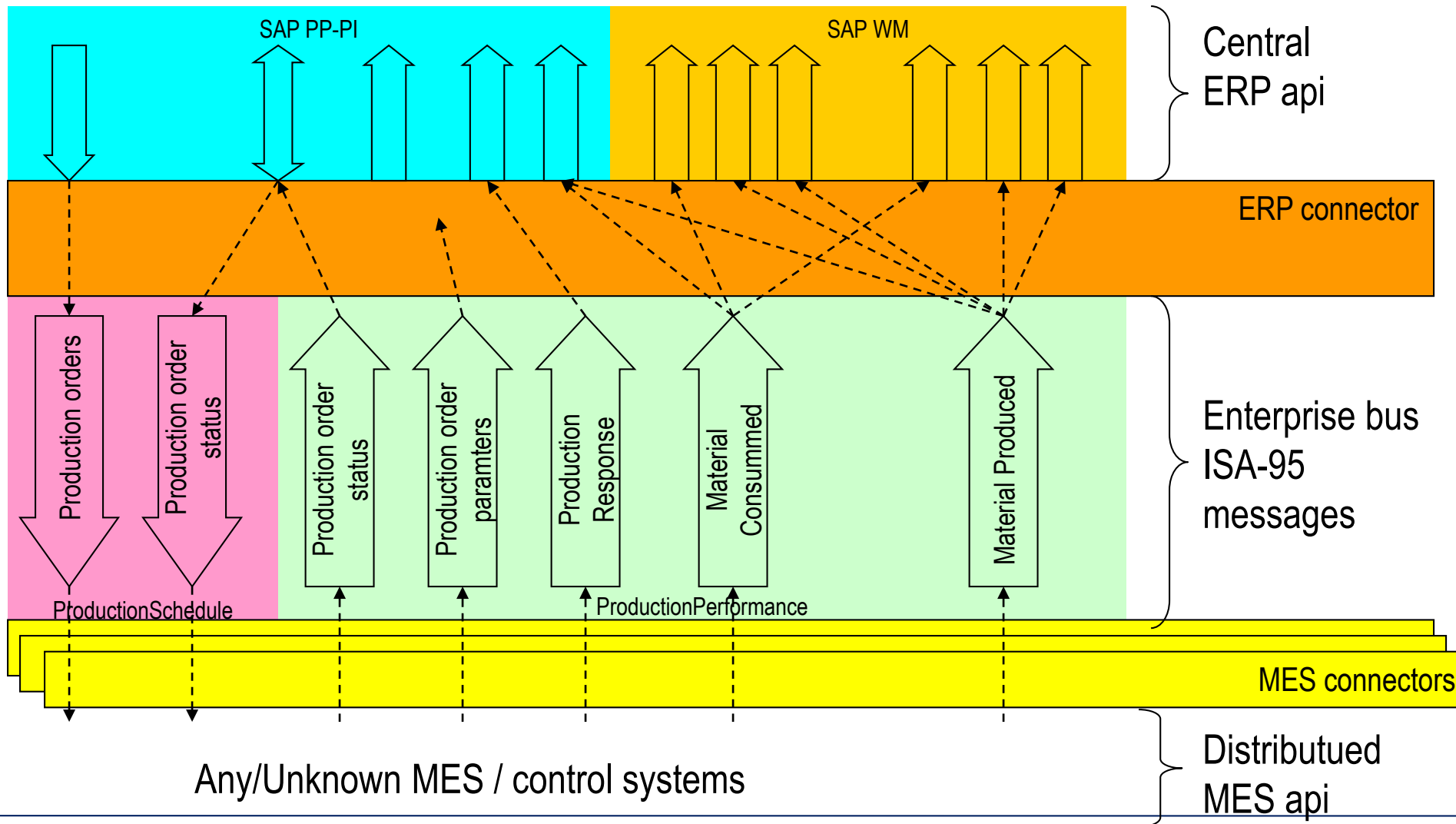
Interface scope : 20 messages (phase 1)

| | ERP->MES | MES-> ERP |
|------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Production transaction | <ul style="list-style-type: none">• Production Orders• PO status change | <ul style="list-style-type: none">• PO reports : material produced, consumed, down times• PO status change |
| Logistics transactions | <ul style="list-style-type: none">• Transfer Orders – in and inter plants | <ul style="list-style-type: none">• TO reports and cancellation• “Spontaneous” transfer• Raw material reception |
| Inventory transactions | <ul style="list-style-type: none">• Material status change• Inventory response | <ul style="list-style-type: none">• Material status change• Inventory query |

Work methodology

- **Messages identification and content provided by ERP functional consultants**
 - Factories IT, MES vendors / integrators were never invited!
 - Opportunistic design, no high level guidance
- **Mapping of message through workshops involving**
 - ERP consultants, ISA-95 expert
- **Extension and adaptation of ISA-95, B2MML**
 - Company specific B2MML and ISA-95 extensions to overcome their limitations at this time (2004) – a major input for the next releases
 - ISA-95: Handling of inventory (and other) operations types
 - B2MML: Custom extensions

Example



Outcome

■ Outcome

- Design of ERP/MES through ISA-95 like enterprise language
 - only needs to be considered from ERP – can ignore MES
 - No need for ERP / MES meetings
- Interface deployed worldwide
- « Perfect delivery »
 - the initial spec/schemas are still in use - no update after 8 years
- Subsequent extension for Quality

■ ISA-95 support : 40 days / 1 year

- Detailed message definition, Functional specification writing
- Many meetings...

Agenda

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Context and challenge

- **Central ERP system + 3 factories in Europe**
- **ESB Messaging framework available but deemed too expensive / complex => abandoned**
- **Objective :**
 - Enterprise controlled interfaces
 - Integration implemented by MES vendor using native systems interfaces

Interface scope : 14 messages

| | ERP->MES | MES-> ERP |
|--------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Production transaction | <ul style="list-style-type: none">• Production Orders• PO change | <ul style="list-style-type: none">• PO reports : material produced, consumed, |
| Inventory transactions | <ul style="list-style-type: none">• Sync material lots | |
| Master data transactions | <ul style="list-style-type: none">• Sync material definitions• Sync Equipment definitions | |

Work methodology

- **Messages identification and content provided by company's business consultants**
- **Build a taxonomy of the enterprise language**
- **Provide a mapping**
 - based on business terms
 - Providing translation in ERP and MES terminology
- **Only 3 meetings to gather requirements and wrap up the whole detailed mapping specification**

Outcome

■ Outcome

- A handy spec detailing all messages in 3 languages : ERP, MES and Business
 - understandable by all stakeholders
- Only a specification
 - No messaging involved,
 - Direct peer to peer connexion between MES and ERP under vendor's responsibility

■ ISA-95 support: 15 days / 1 month

- Detailed message definition

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Context and challenge

- **A complex interface project involving 7 different systems**
 - The most complex among these 3 use cases
- **Strictly limited budget for external support**
 - 2 days workshop planned for knowledge transfer
 - Design to realized internally

Interface scope : 20 messages

| | ERP/MDM/LIMS/SCADA ->MES | MES-> ERP/LIMS/SCADA |
|--------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Production transaction | <ul style="list-style-type: none">• PO reports• Temperature reports | <ul style="list-style-type: none">• deviation reports and ack• Production orders |
| Logistics transactions | | <ul style="list-style-type: none">• Material movements |
| Quality transactions | <ul style="list-style-type: none">•Quality report | Quality order |
| Inventory transactions | <ul style="list-style-type: none">• Material reception• Material quality | <ul style="list-style-type: none">• Weight control order |
| Master data transactions | <ul style="list-style-type: none">• Sync material definitions | |

Work methodology

Only 2 days budget :

■ 1st day :

- Teach ISA-95+B2MML: High speed knowledge transfer
- Team's brain overload
- Manager's desperation : "Find another way by tomorrow"

■ 2nd day

- All 20 messages identified and drafted
- Definition of an XML enforced company language +ISA-95 spirit
 - Using an ISA-95 (really simple) meta-model

■ 3rd day (over-budget)

- Review of the internal team work

Outcome

■ Outcome

- Full autonomy achieved in 3 days
- Smart design
- Low cost

■ ISA-95 support : 3 days / 1week

- Get the team thinking the ISA-95 way

Thank You !