Overview of the ANSI-ISA88 – IEC61512 standard concepts

Journée technique ISA88 CETIM – 30/09/2004

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With credits to Tom Fisher, Lynn Craig,, James Parshall, Dave Emerson, Dennis Brandl, Lou Pillai, Darin Flemming, Bernard Cubizolles
for their inputs

Speaker

Experience

Process control, Production/ERP integration, Finite capacity scheduling, MES, LIMS, historians.

Industries : Pulp & paper, textile, wood, metallurgy, chemical, pharmaceutical, food & beverage, electronics…

Consulting with final users, solution providers, integrators and academics

Standardization and professional organizations involvement

Member of SP88 “Batch Control Systems” and SP95 “Enterprise-Control System Integration” ISA committees,

ISA District 12 Vice president 2003-2004,

ISA France section 2000-2001 president,

World Batch Forum, WBF “Flow Analysis” WG chair,

French Batch Forum founder

What is ISA ?

ISA–The Instrumentation, Systems, and Automation Society

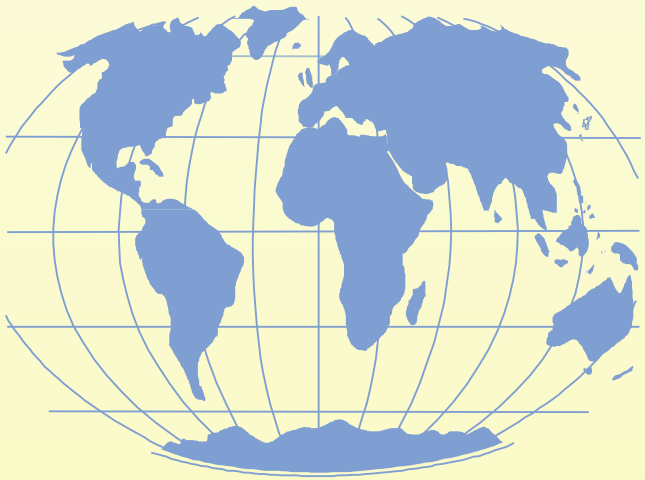
The Instrumentation, Systems and Automation Society

Formerly « The Instrumentation Society of America »

A non for profit organization founded in 1945

38 000 individual members

14 districts
110 countries
300 sections
20 technical divisions



Adresses

Instrumentation and Automation
In all industries

ISA value

ISA–The Instrumentation, Systems, and Automation Society

Professional network

Technical information

- Conferences
- WEB sites
- Magazines
- Publications
- Newsletters
- Instrumentation directory
- Standards and Guides

ISA88 among > 100 standards

Training and education

Exhibitions : ISA Show

Local regular and student sections

What is ISA 88?

ISA–The Instrumentation, Systems, and Automation Society

IEC Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

A “Batch Control” US and International standard

ISA SP88 committee develops the standard

US standard	INTL Standard	Sub Title
ANSI/ISA88.00.01: 1995	**IEC 61512-1: 1997**	**Part 1: Models and Terminology”**
ANSI/ISA88.00.02: 2001	**IEC 61512 -2: 2001**	**Part 2: Data structures and guidelines for languages**
ANSI/ISA88.00.03: 2003	**-**	**Part 3: General and Site Recipe - Models and Representation**
ISA draft 88.00.04: D5 03/2004		**Part 4: Production Records**
ISA draft 95.00.05: D1 03/2004		**Part 5: Recipe Equipment Interface – Procedural Elements**

Autres groupes

WBF www.wbf.org

Goals are to publicize the SP88 standards and related batch documents and show people how to apply them

Conferences

- Prochaine à Mechelen (Belgique) 10-13 octobre

Working groups

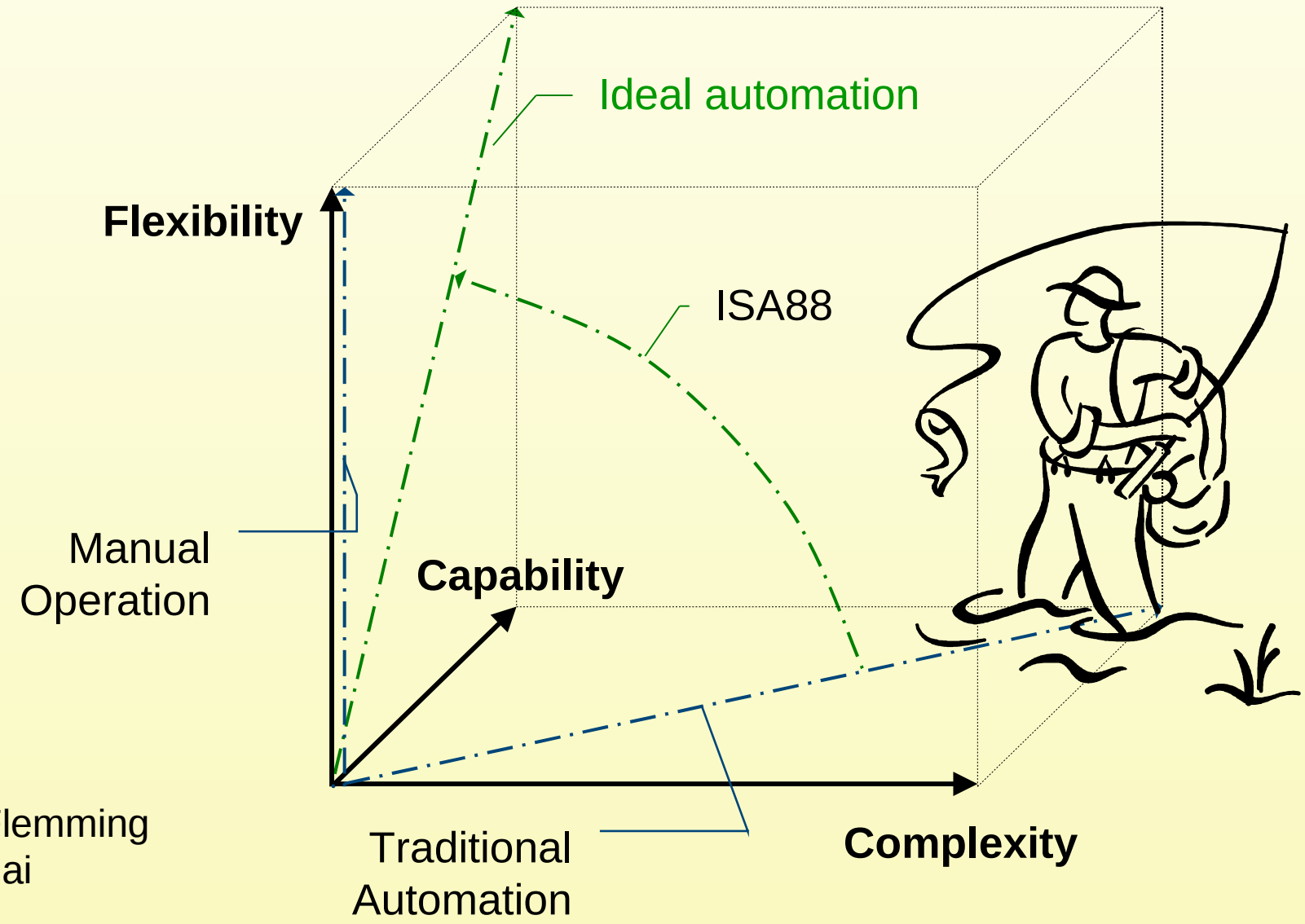
- XML applying to ISA88 and ISA95
- Flow Analysis

FBF www.frenchbatchforum.org

« Imitation » française du World Batch Forum www.wbf.org

Cercle thématique N°3 du Club 18 « Automatique et Automatismes Industriels » de la SEE, « Société de l'Électricité, de l'Électronique et des Technologies de l'Information et de la Communication »

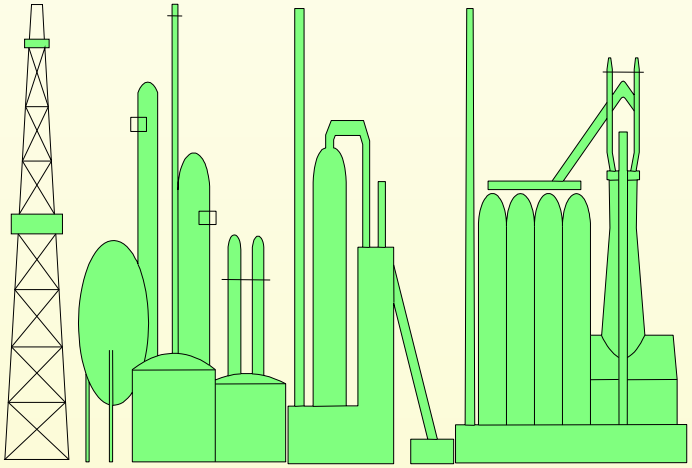
Automation Challenge



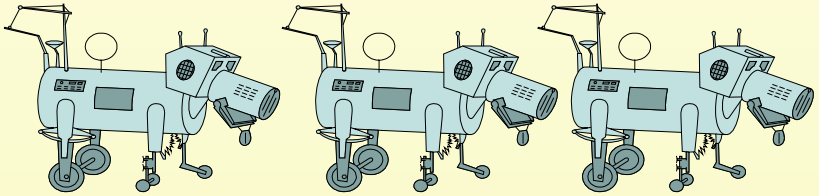
Darin Flemming
Lou Pillai

Types of Manufacturing Processes

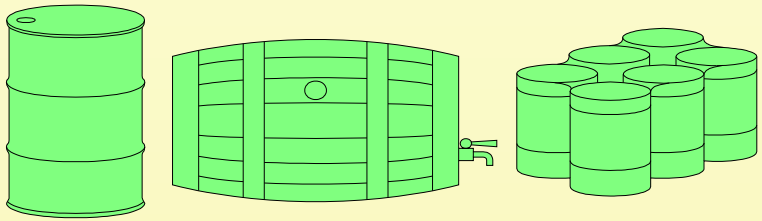
Continuous



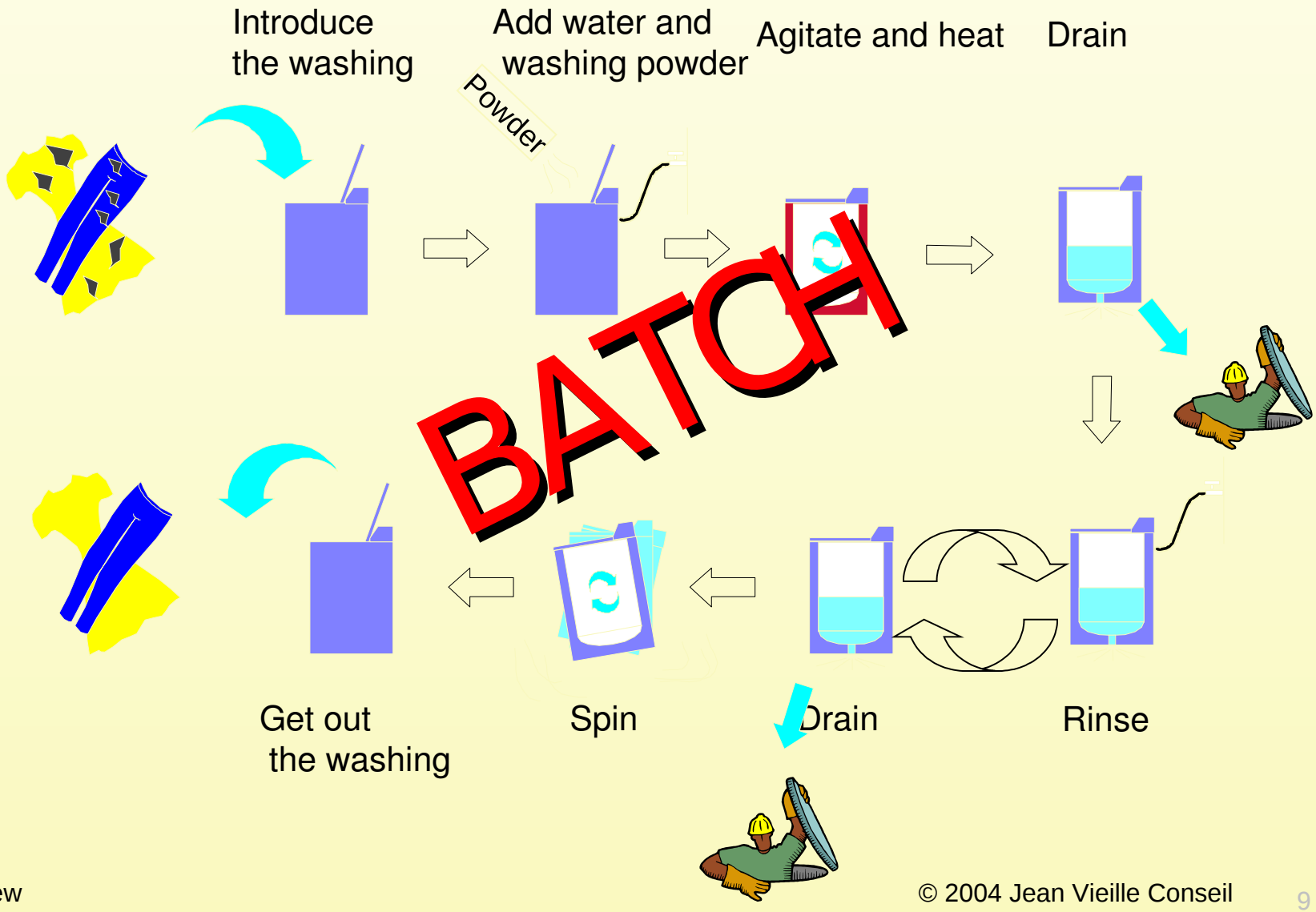
Discrete parts



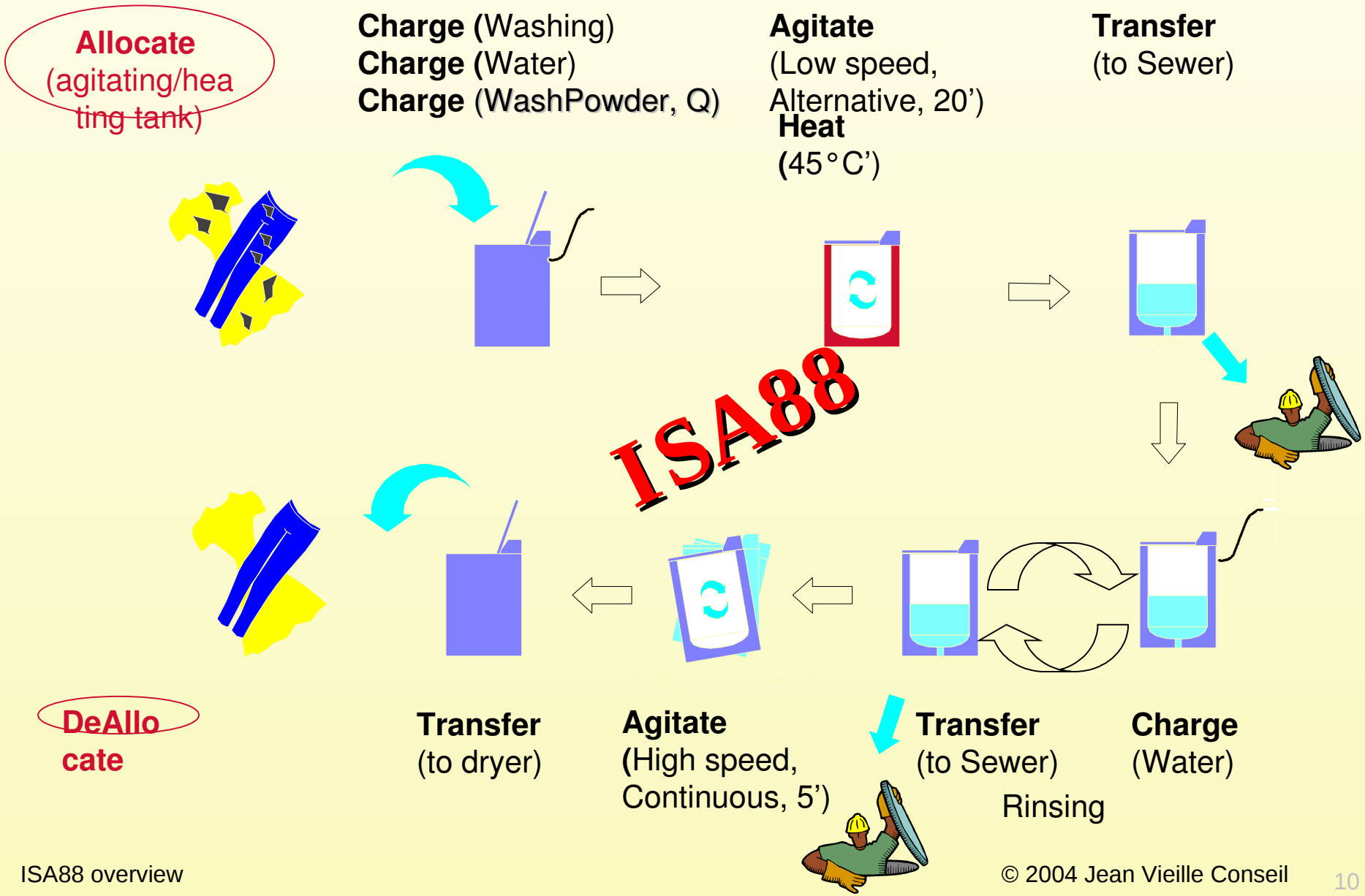
Batch



How to transform …



A washing machine…



Into a Coffee machine !

Allocate (agitating/heating tank)

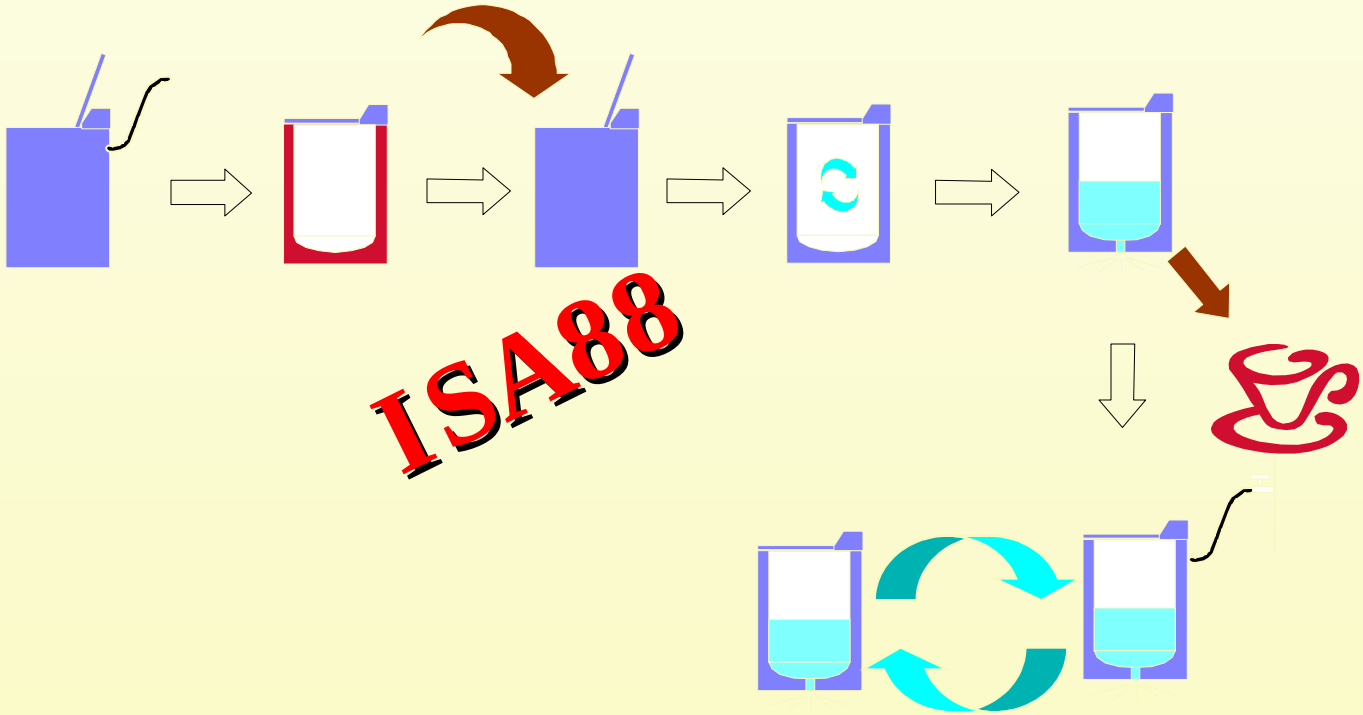
Charge (Water)

Heat (40°C')

Charge (CoffeePowder, Q)

Agitate (Low speed, Continuous, 1')

Transfer (to Cups)



DeAllocate

Transfer (to Sewer)

Charge (Water)

Cleaning

Or something else

Il brasse de la bière dans un lave-linge

Un prêtre allemand a eu l'idée de brasser de la bière dans un vieux lave-linge. Cela lui permet d'abreuver à moindres frais les groupes de jeunes qu'il emmène en sorties. « Tout ce qu'il me fallait, c'était quelque chose pour chauffer et remuer le mélange. Pourquoi pas une machine à laver ? », a déclaré le curé de Duisbourg. Avec ce moyen rustique, il brasse vingt litres de bière en dix heures.

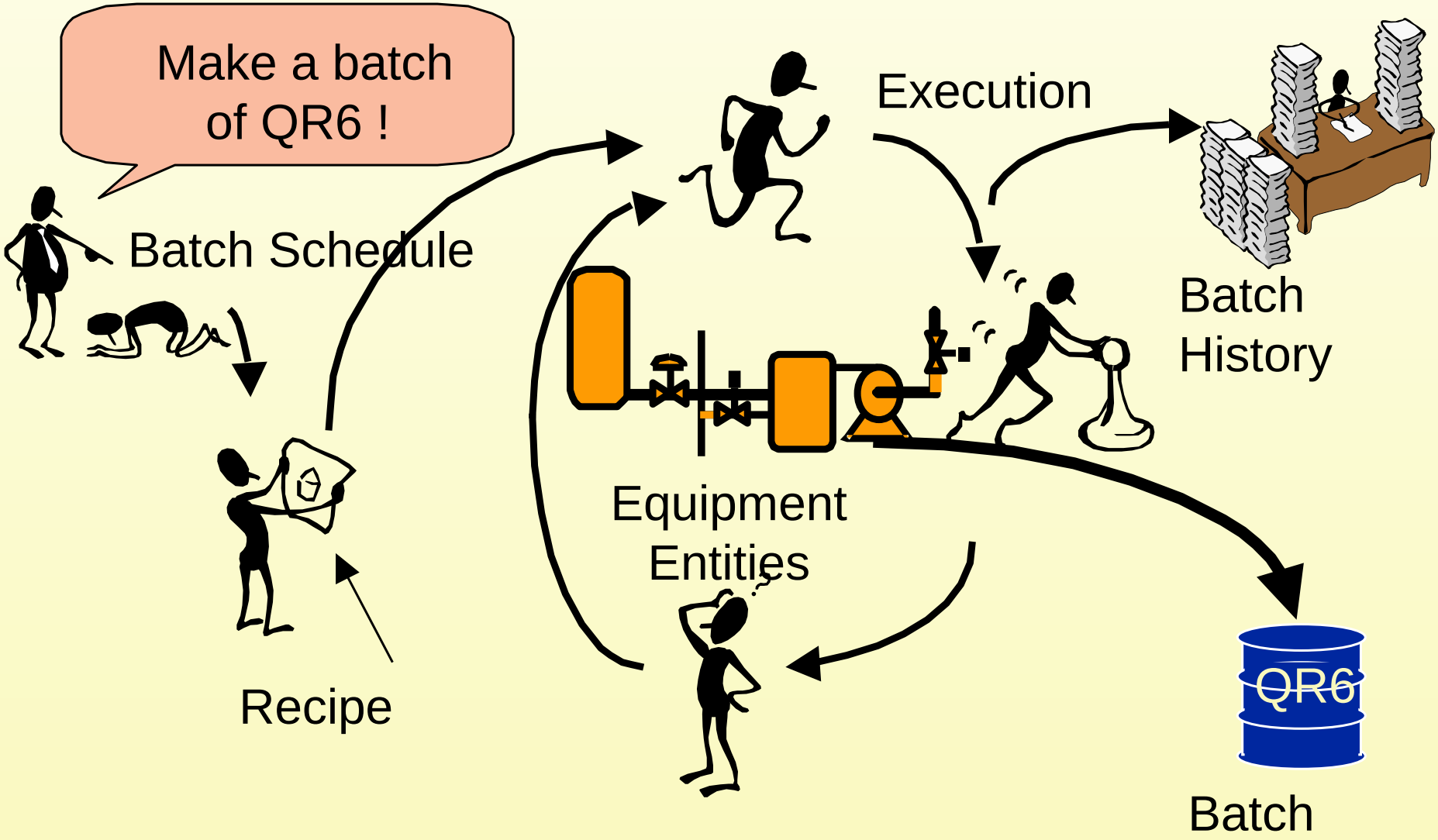
He brews his beer in a washing machine!

A german prayer thought about brewing beer into a old washing machine. That allows him to offer drink at low expense the youths he drives in outings.

« All what he needed was something to heat and stir the blend. Why not a washing machine? »

With this rustic mean, he brews 20 litres of beer in 10 hours.

Executing production schedule



ISA88 key concepts

Concept 1: Object oriented specification

Concept 2: Equipment entity

Concept 3: Models et terminology

Concept 4: Equipment / process separation

Concept 1: OO specification

Applying software reuse techniques should help for:

- improving reliability and long-term maintainability
- lowering first cost

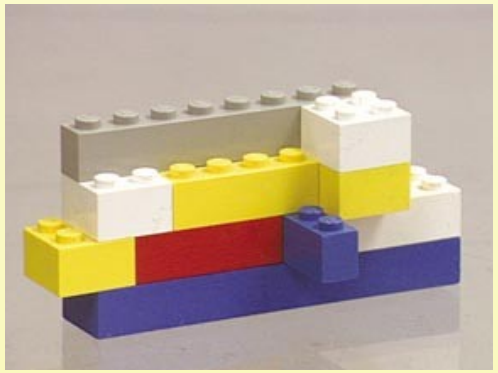
Object oriented design is not ISA88 specific

Object oriented specification allows:

- Development consistency and productivity
- Knowledge management

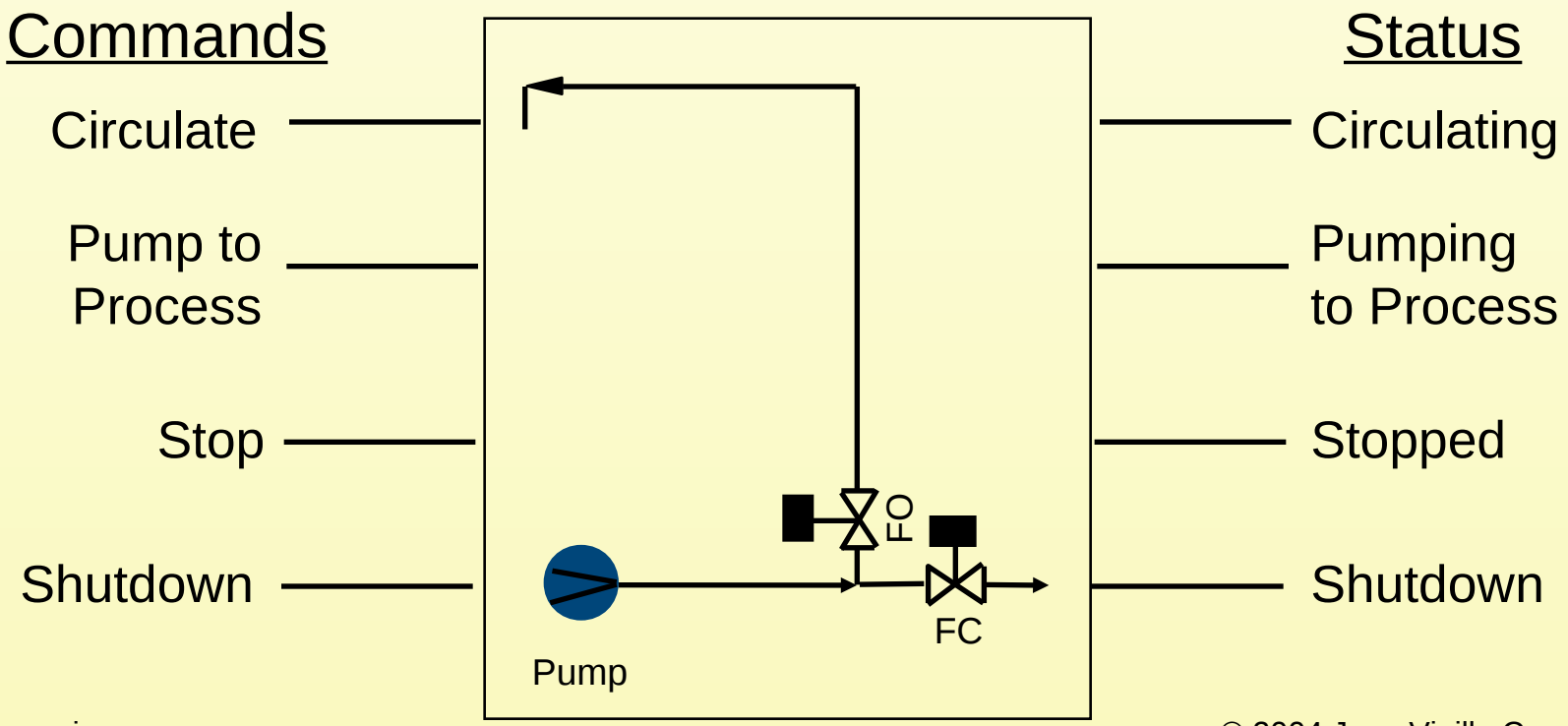
ISA88 models provide a good basis for reusability

- Howver, OOD is generally not directly implementable on available control systems



C1. Object example: Control Modules

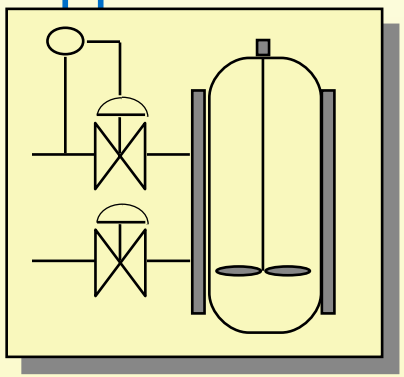
Treating as a control module simplifies the interface to this group of objects



Concept 2: Equipment entity

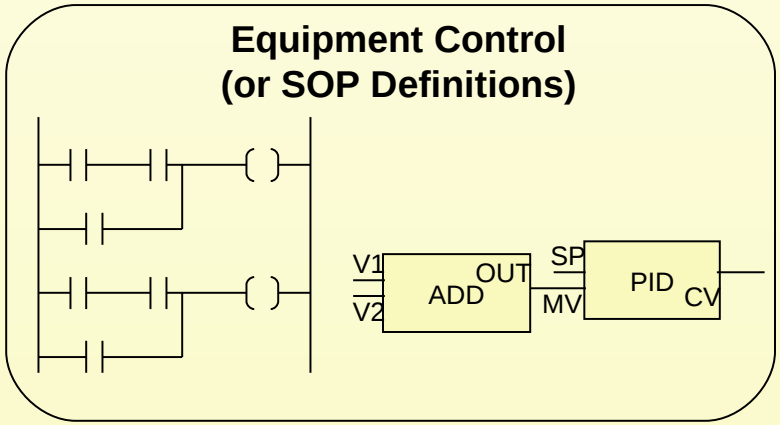
Control is part of equipment

- Tight integration: control is embedded within the equipment, not a separate function
- Physical hierarchy defines the backbone of the control application



Physical Equipment

+



Equipment or Manual Control Capability

- **Instruments**
- **Basic control**
- **Coordination control**
- **Procedural control**

Equipment Entity

Concept 3: Models and terminology

Allows to consistently verbalize system's requirements

- Users / Designers mutual understanding

Includes 4 hierachical, conceptual models:

1. Physical model
2. Procedural model
3. Process model
4. Recipe Model

Includes 1

5. Control Activity model

Provide a precise Terminology (65 definitions)

C3.1 Physical Model

7 levels are defined :

Organizational Upper levels

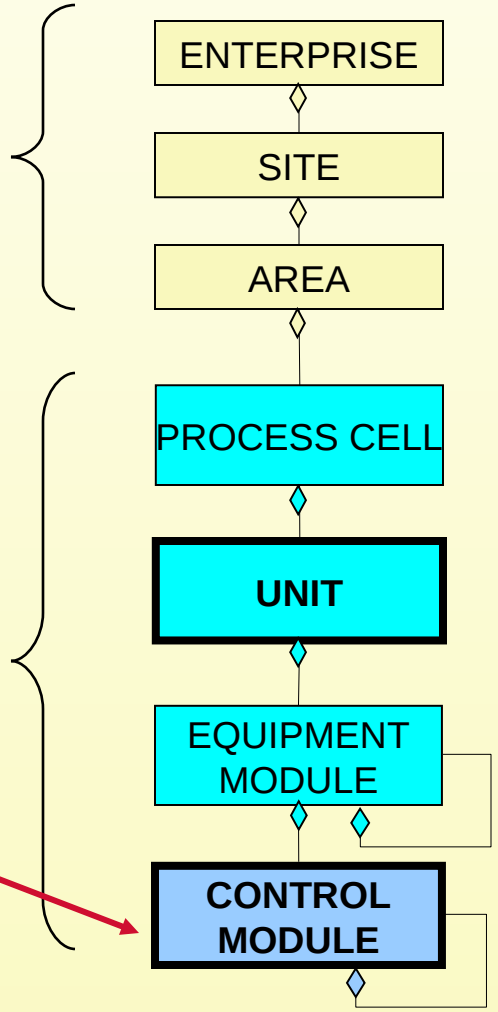
- Entreprise, Site, Area

Technical Lower levels

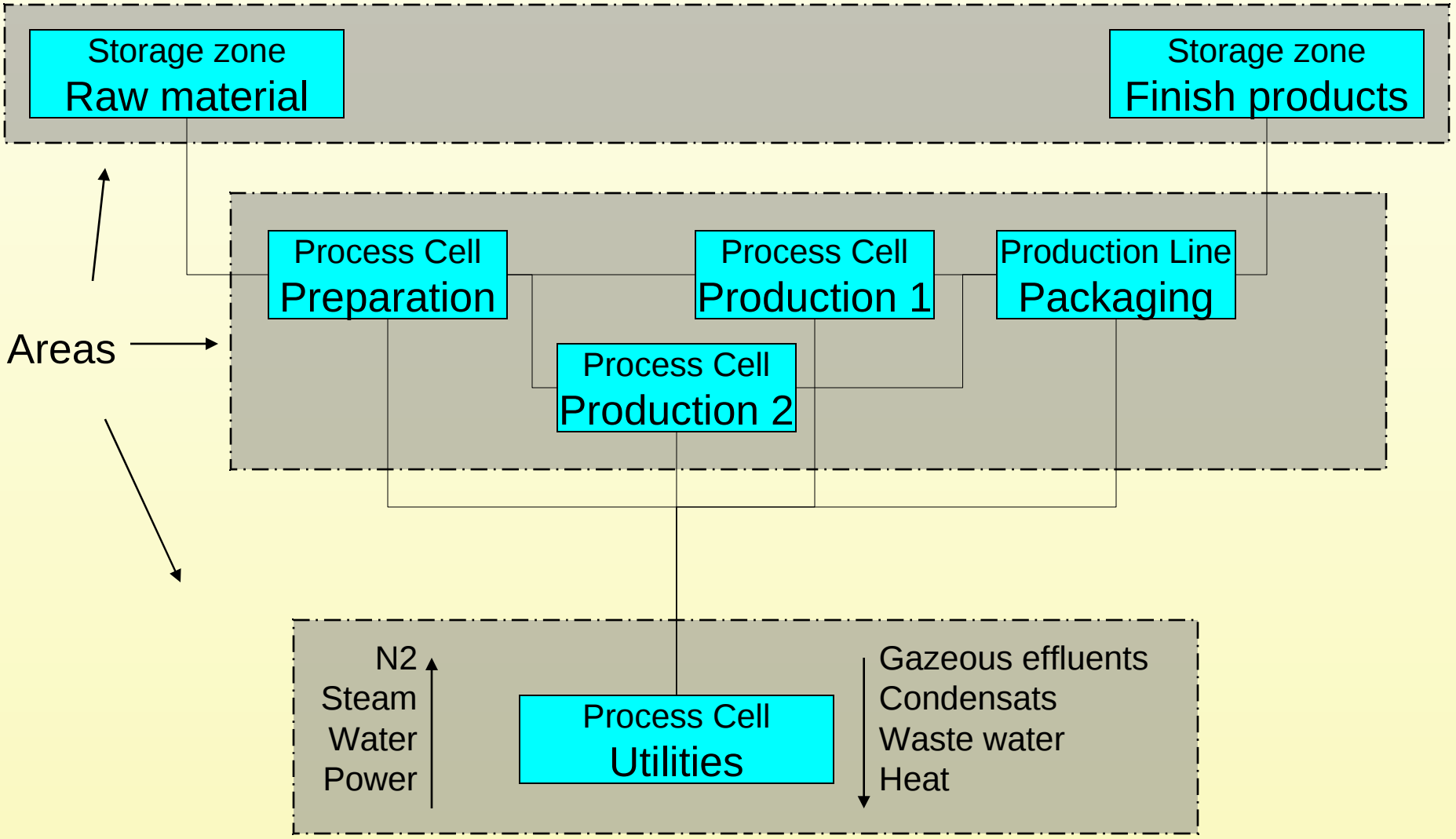
- Process Cell, **Unit**, Equipment Module, **Control Module**
- Address flexibility

Control Modules (Lowest level) correspond to the actual equipment.

- Other level are compositions of lower levels



C3.1 Example of upper level modeling



C3.1 Lower physical model

Process cell

A logical grouping of equipment required for production of one or more batches

Units

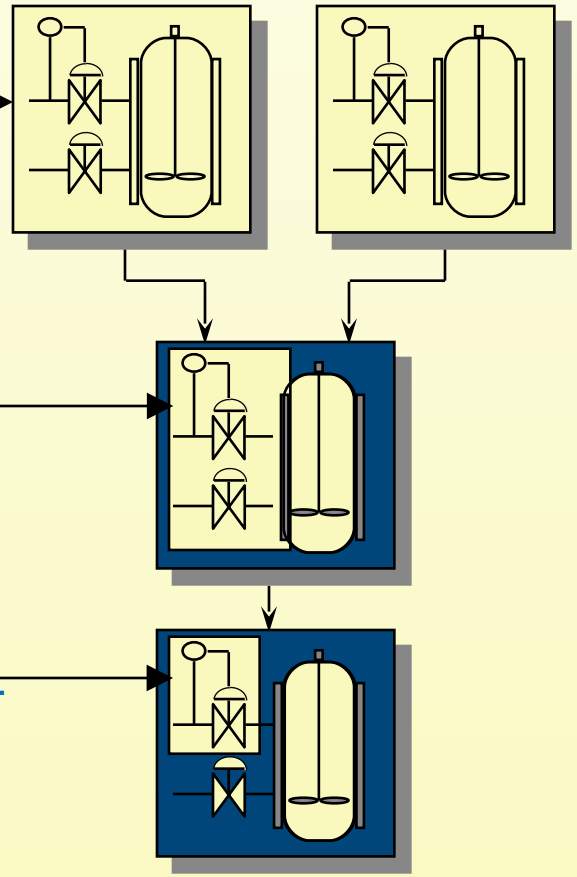
A collection of related control modules and equipment modules that can carry out one or more processing activities (contain EPEs)

Equipment modules

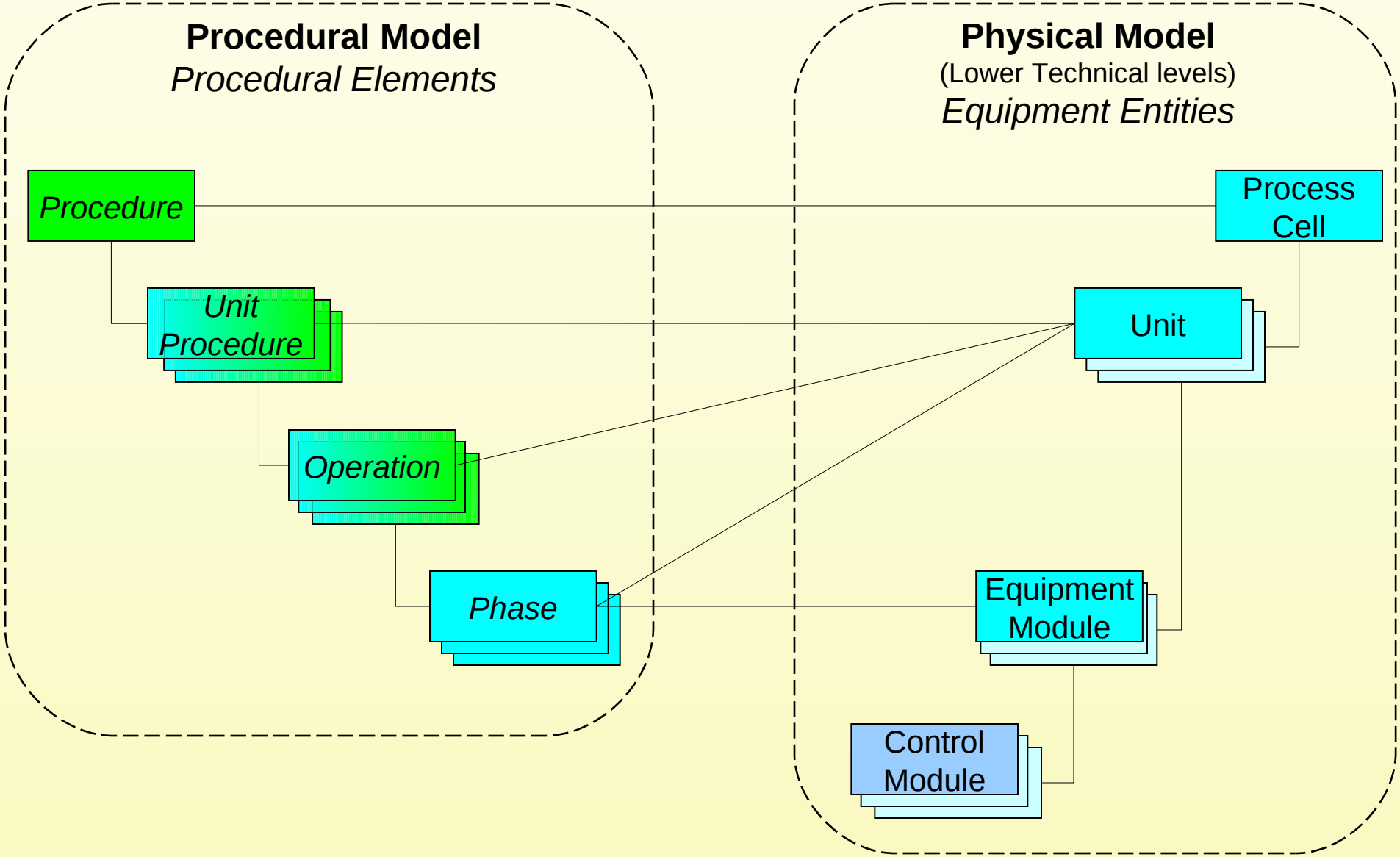
A functional group of equipment and/or control modules that can carry out a finite number of specific processing activities (contain EPEs)

Control modules

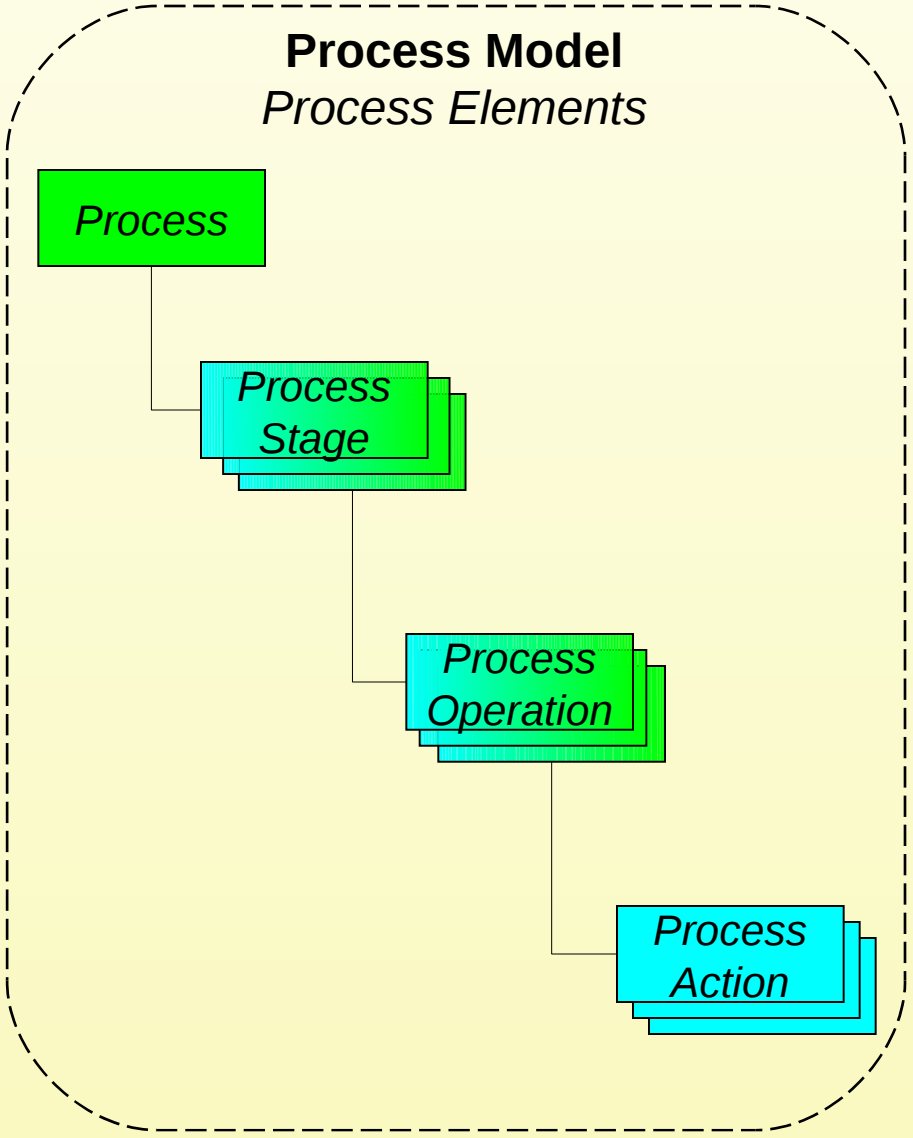
A regulating device, a state oriented device, or a combination of both that is operated as a single device



C3.2 Procedural / physical models mapping



C3.3 Process model: non-equipment linked processing requirements



A Process is made up of an ordered set of one or more Process Stages: Major product change

A Process Stage is made up of an ordered set of one or more Process Operations: Minor product change

A Process Operation is made up of an ordered set of one or more Process Actions: How to changes

A Process Action represent elementary processing activities that can be classified end genericized within a particular company or industry segment

C3.4 Recipe Model / Types

Recipe:

The necessary set of information that uniquely defines the production requirements of a specific product

Equipment independent recipes:

General Recipe: Enterprise wide information

Site Recipe: Site specific information derived from the general recipe

Based on Process Model

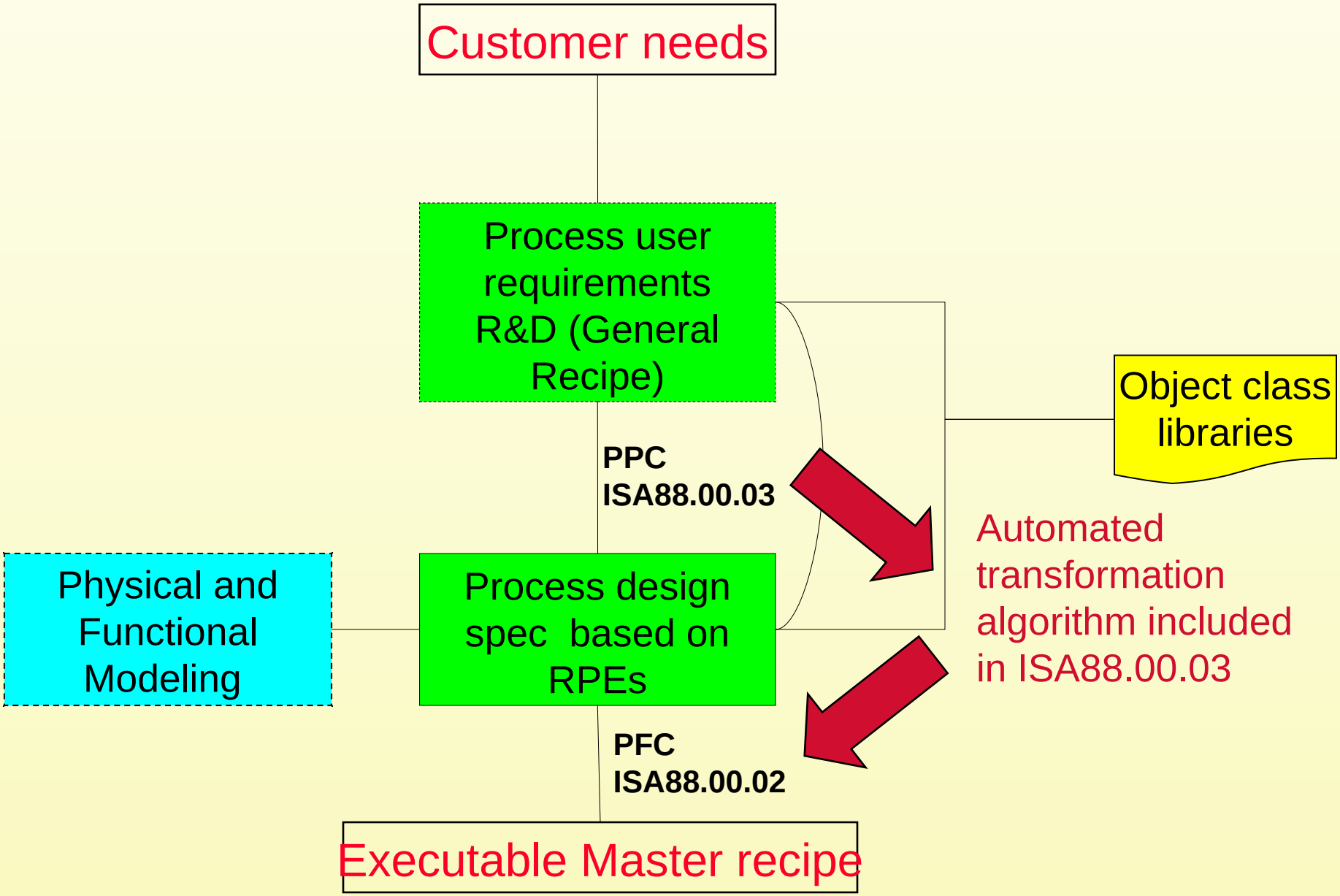
Equipment dependent recipes:

Master Recipe: Process cell specific information

Control Recipe: Batch specific information

Based on Procedural Control Model

C3.4 From EIR to EDR: Process industrialization



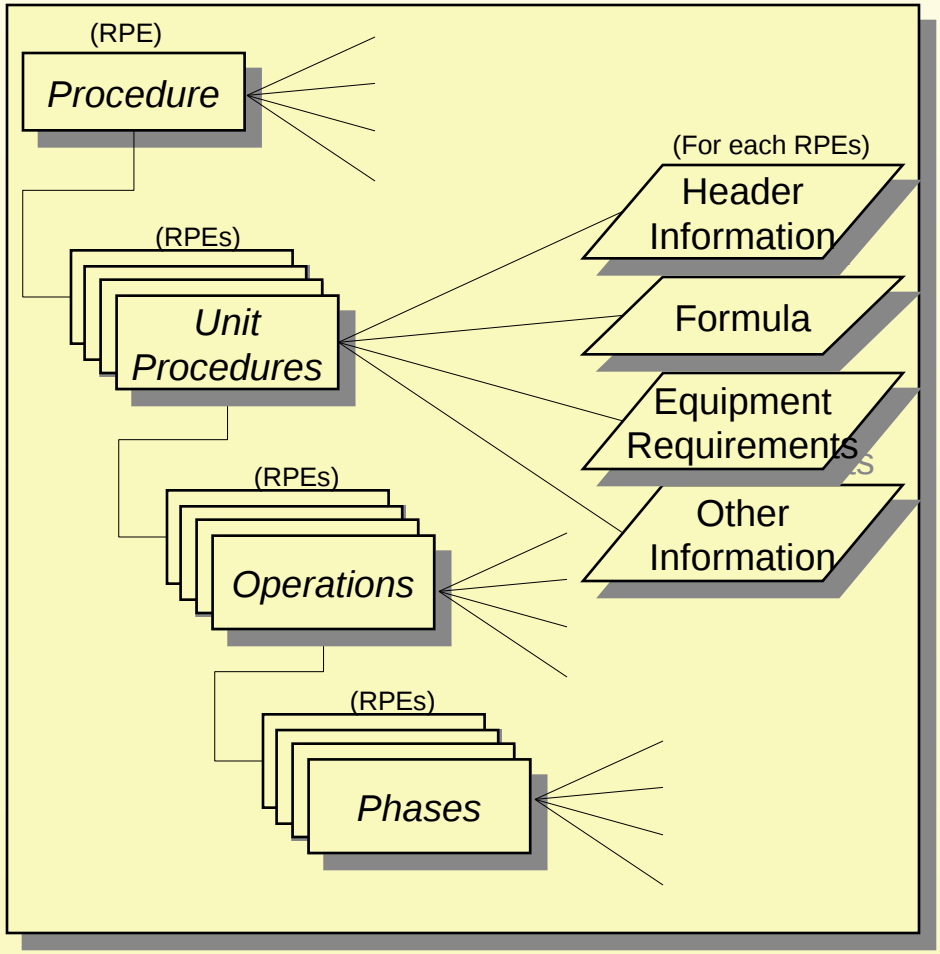
C3.4 Recipes structure (applying to MR and CR)

Procedure

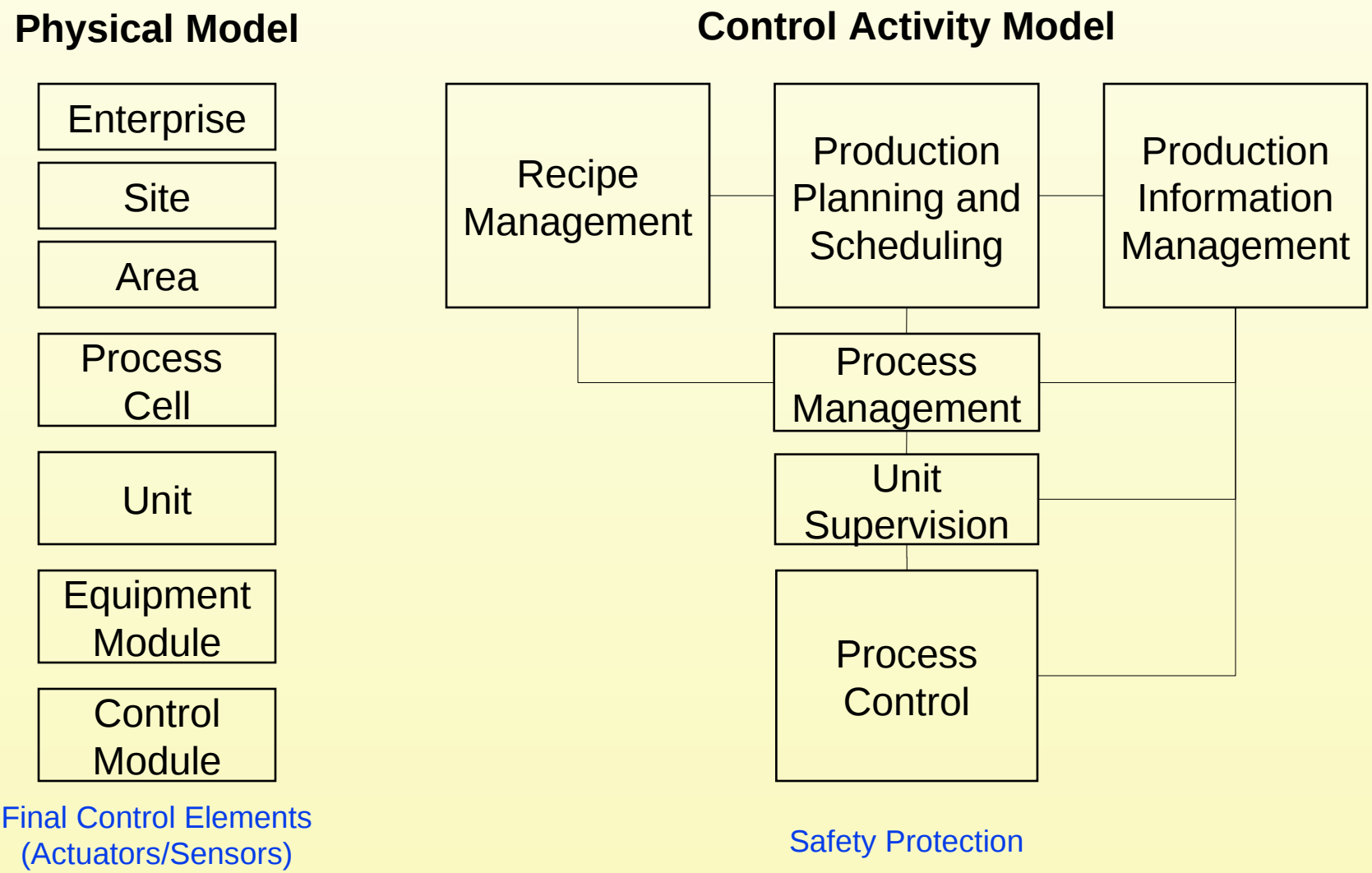
- Defines the functional sequencing
- Made of RPE, a RPE itself

Each RPE has

- Header information
  - Identification, version control
- Formula:
  - Process inputs
  - Process outputs
  - Process parameters
- Equipment needs
- Other information



C3.5 Control Activity Model



Concept 4: Equipment / Process separation

ISA88.01 separate

Equipment Capabilities = Equipment control that provides generic purpose, process independent inherent services that can be used for production

Product Knowledge = Process control that uses previous equipment services to accomplish its objective (Making a product, fulfill a service) by executing predefined parameterized rules (Recipes)

Both must be independent (weak coupling)

Results

Allow recipe development without the services of a control systems engineer 'No control system programming' required

- More flexible and reusable Equipment control
- Improved long term maintenability
- Simpler and more reusable recipes

2 well differenciated domains of responsibilities

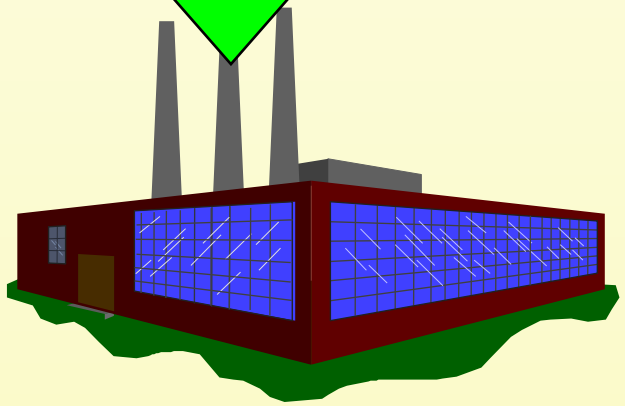
- Easy portability of recipes from one system to another
- Simplified validation

C4. Recipes and Equipment

Recipe
Defines the information required to manufacture a product

Procedure
Unit Procedure
Operation
Phase
RPE

Runs Against Equipment

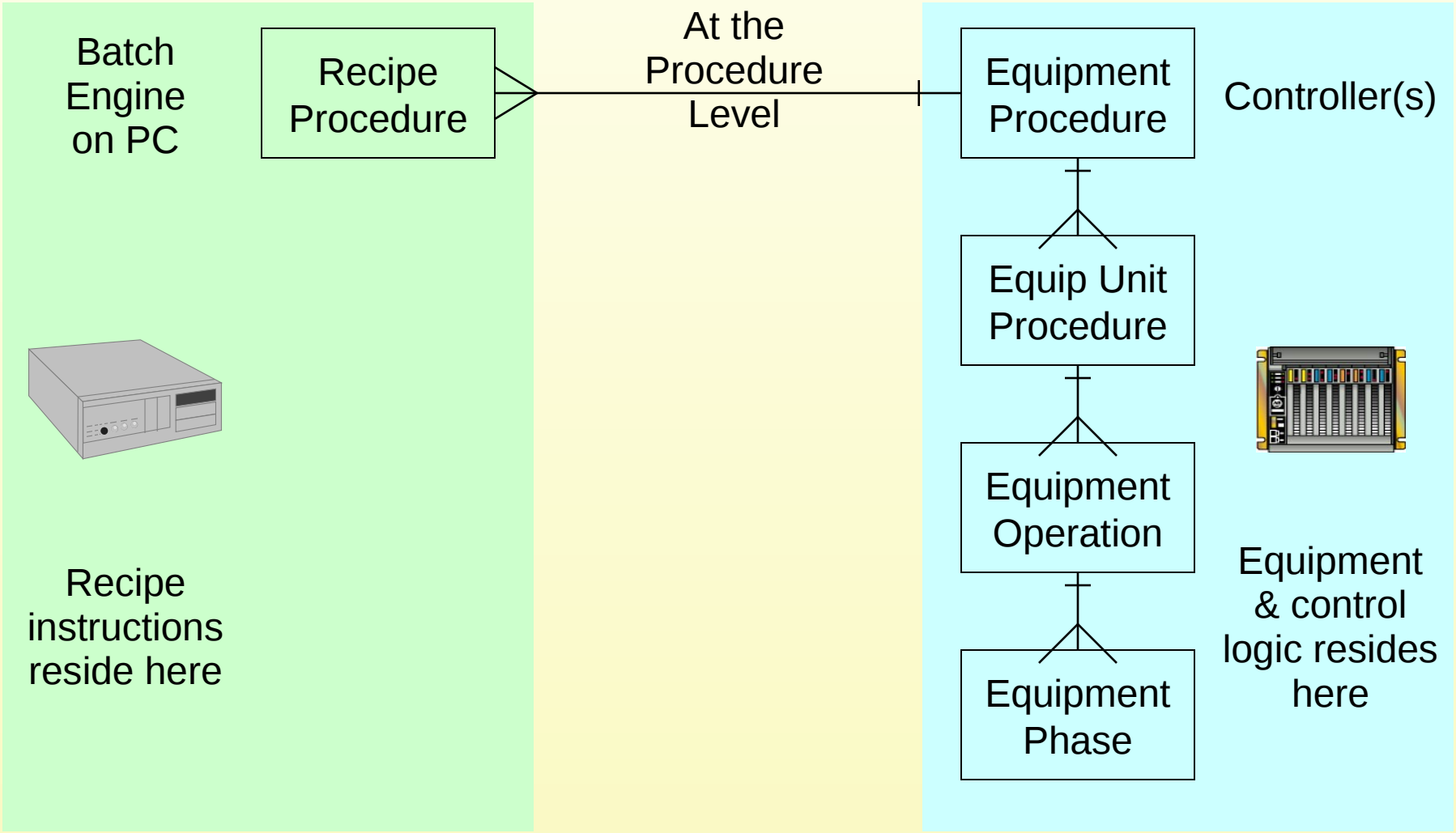


Provides Process Capabilities for

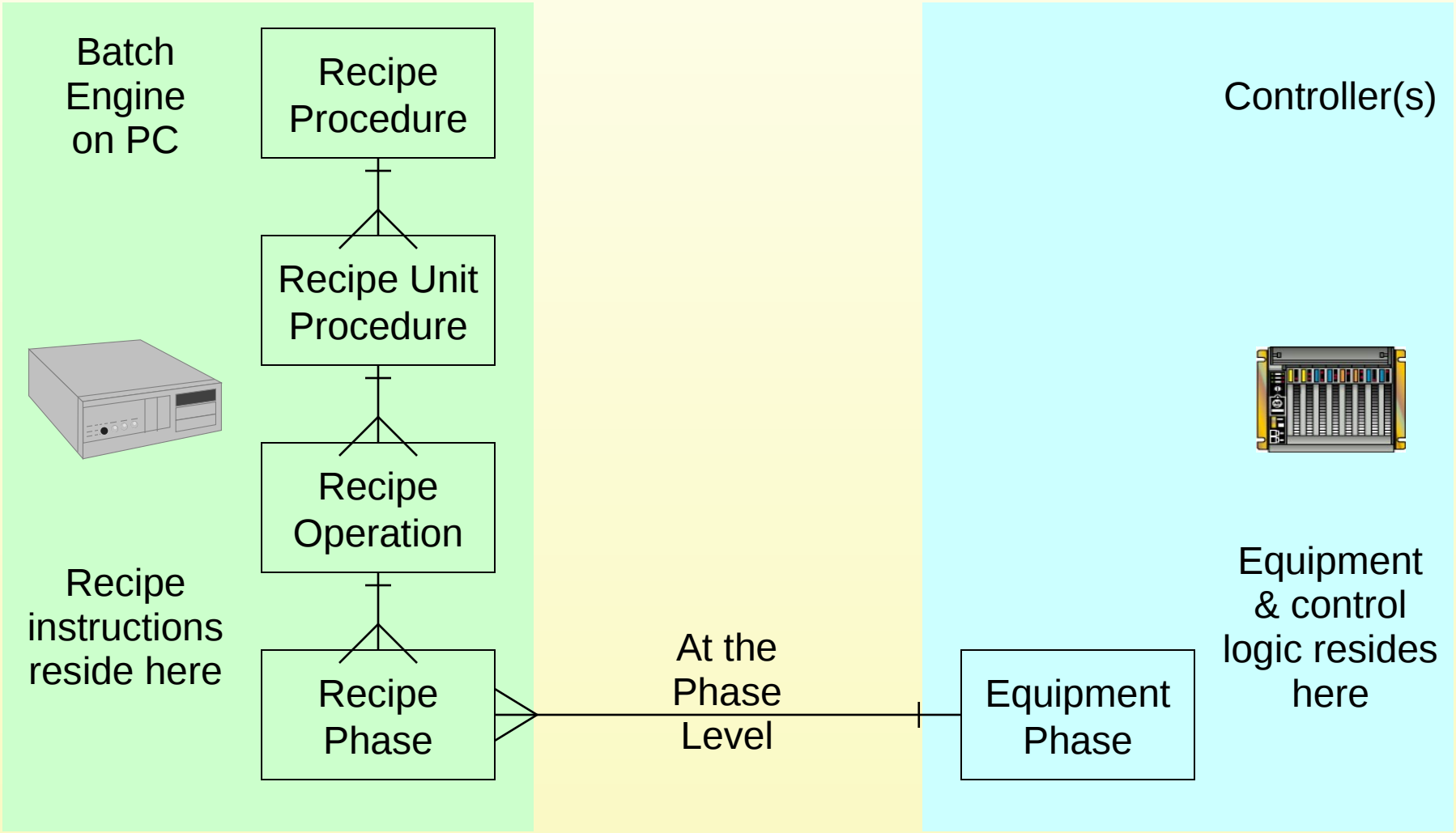
Procedure
Unit Procedure
Operation
Phase
EPE

Equipment
Defines the equipment capability available to manufacture a product

C4. A Link Must Exist at Some Level



C4. The Most Frequent Link with batch packages



ISA88.01Deliverables

Terminology and models that

apply to

- all types of control systems
- both automated and manually-controlled
- Both simple and complex processes
- Batch processes as well as other manufacturing types

make functional requirements understandable

are Expandable and Collapsible

A modular structure facilitating reusability

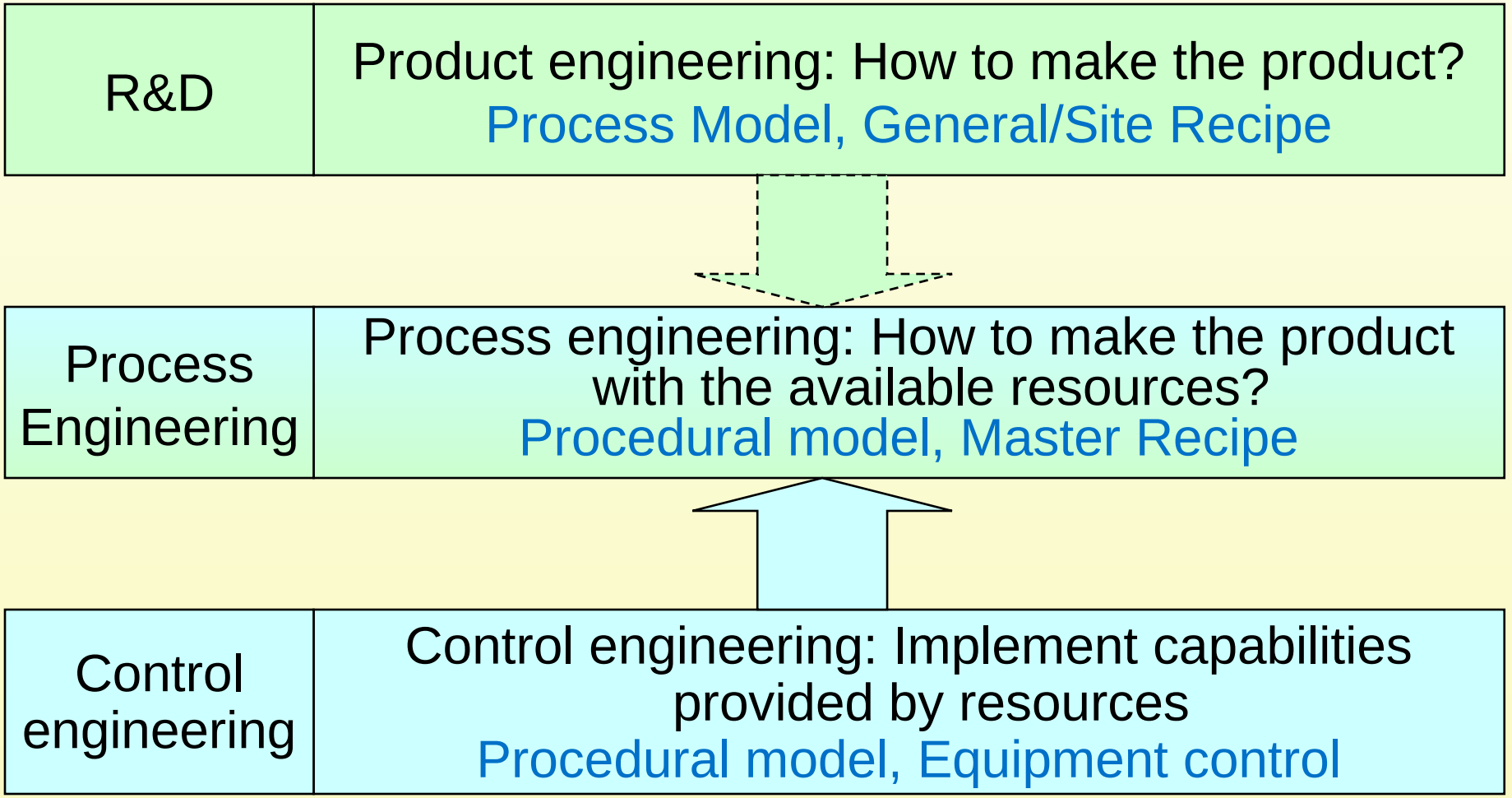
A concept that separates

the process to be executed (Recipe)

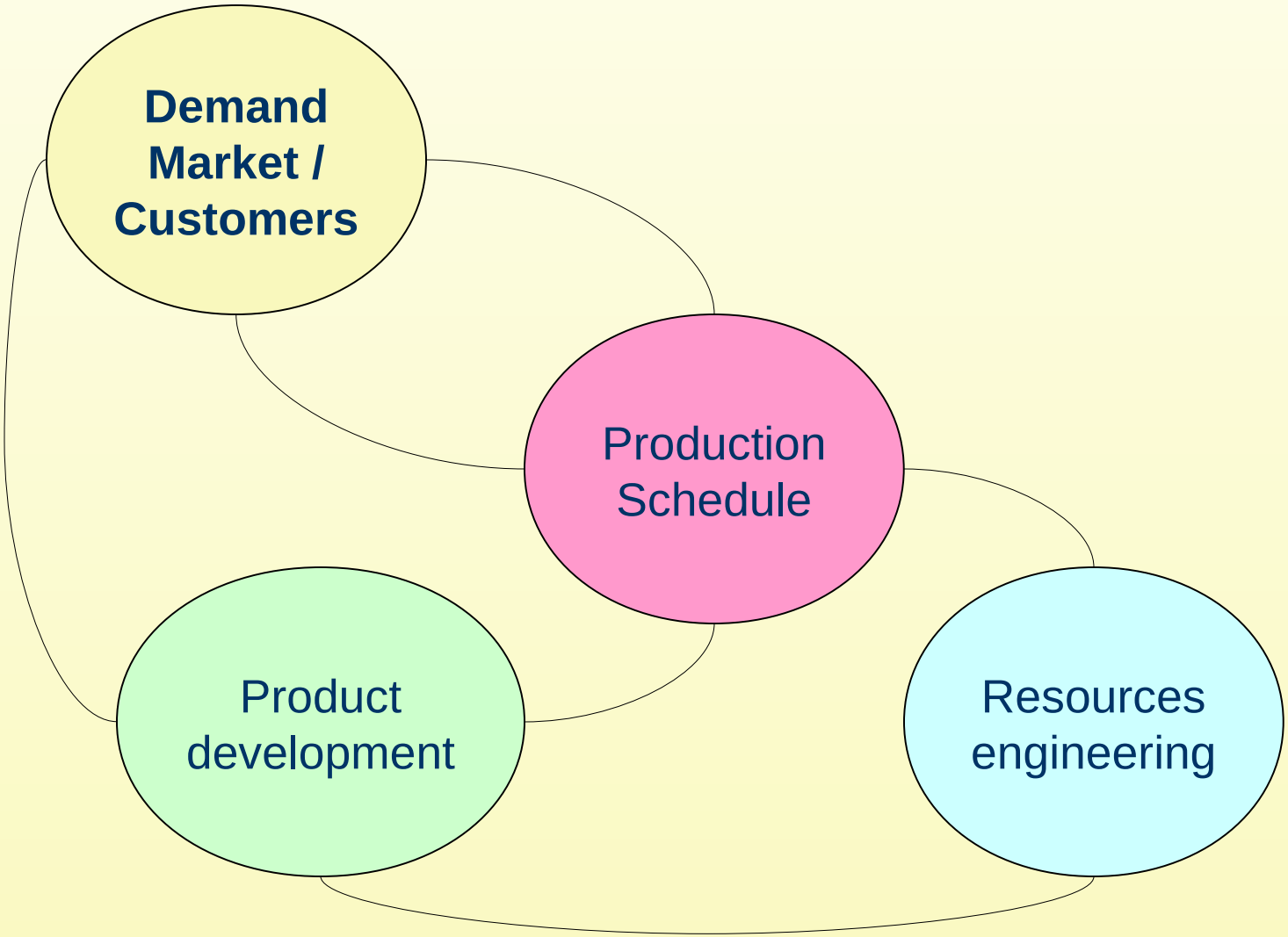
from the equipment that is involved (Equipment entities)

Good engineering practices for control functional design of all elements of a production system

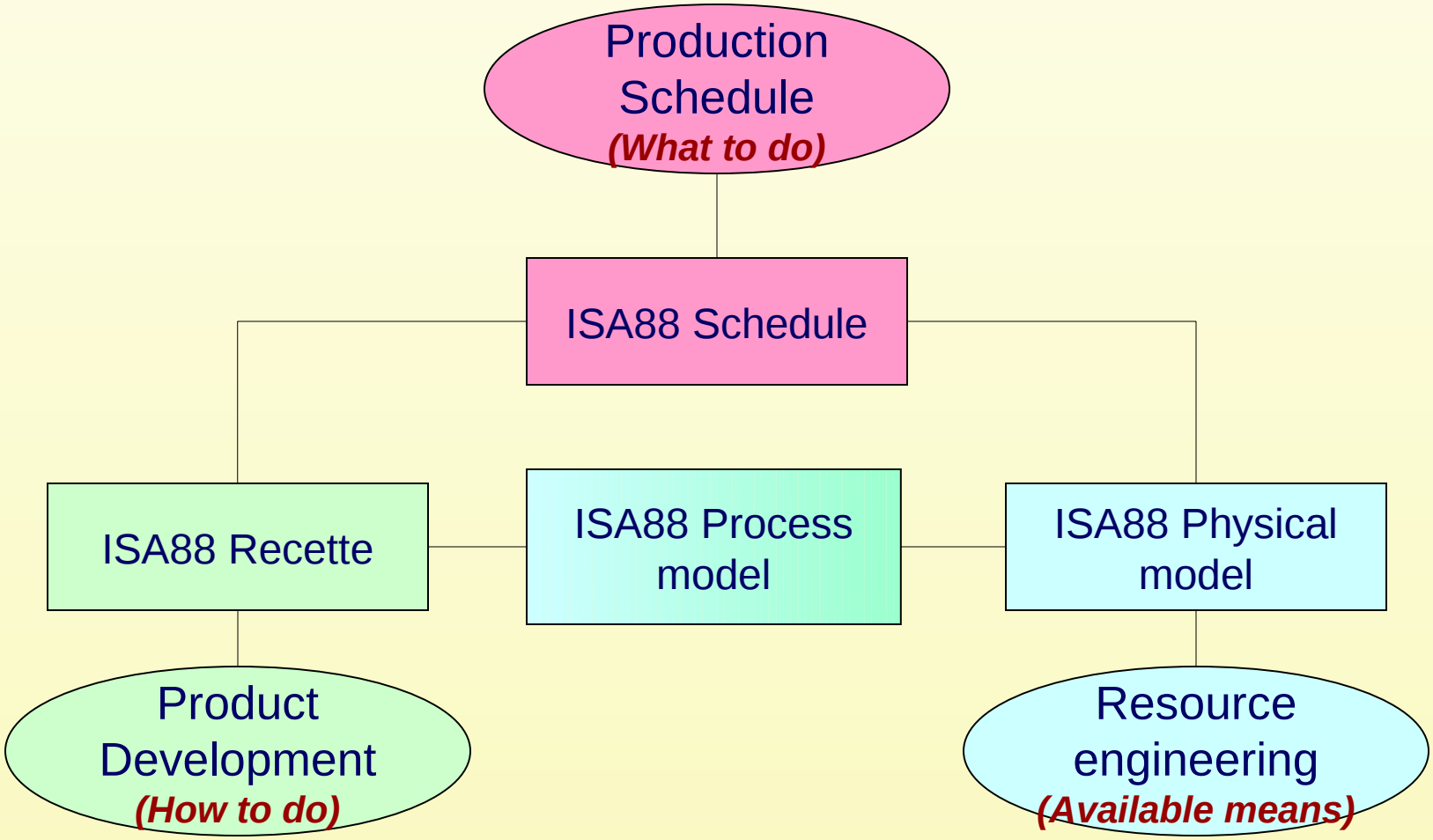
Product – Resource engineering matching



Production lifecycles



ISA88 in production lifecyles



Summary

ISA88 isn’t just a standard for software, equipment and procedures

- It’s a way of thinking, a design philosophy

The concept of separation of product information (recipes) from equipment capability is key to designing flexible systems

Understanding ISA88.01 will help you better design your processes and manufacture your products

Defines a 'design pattern' for the architecture of batch systems that works

- for complex or simple problems
- for any level of automation,
- for any type of automation equipment
- As well as for any other manufacturing typology

The benefits of applying ISA88 are real and proven

MERCI

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