

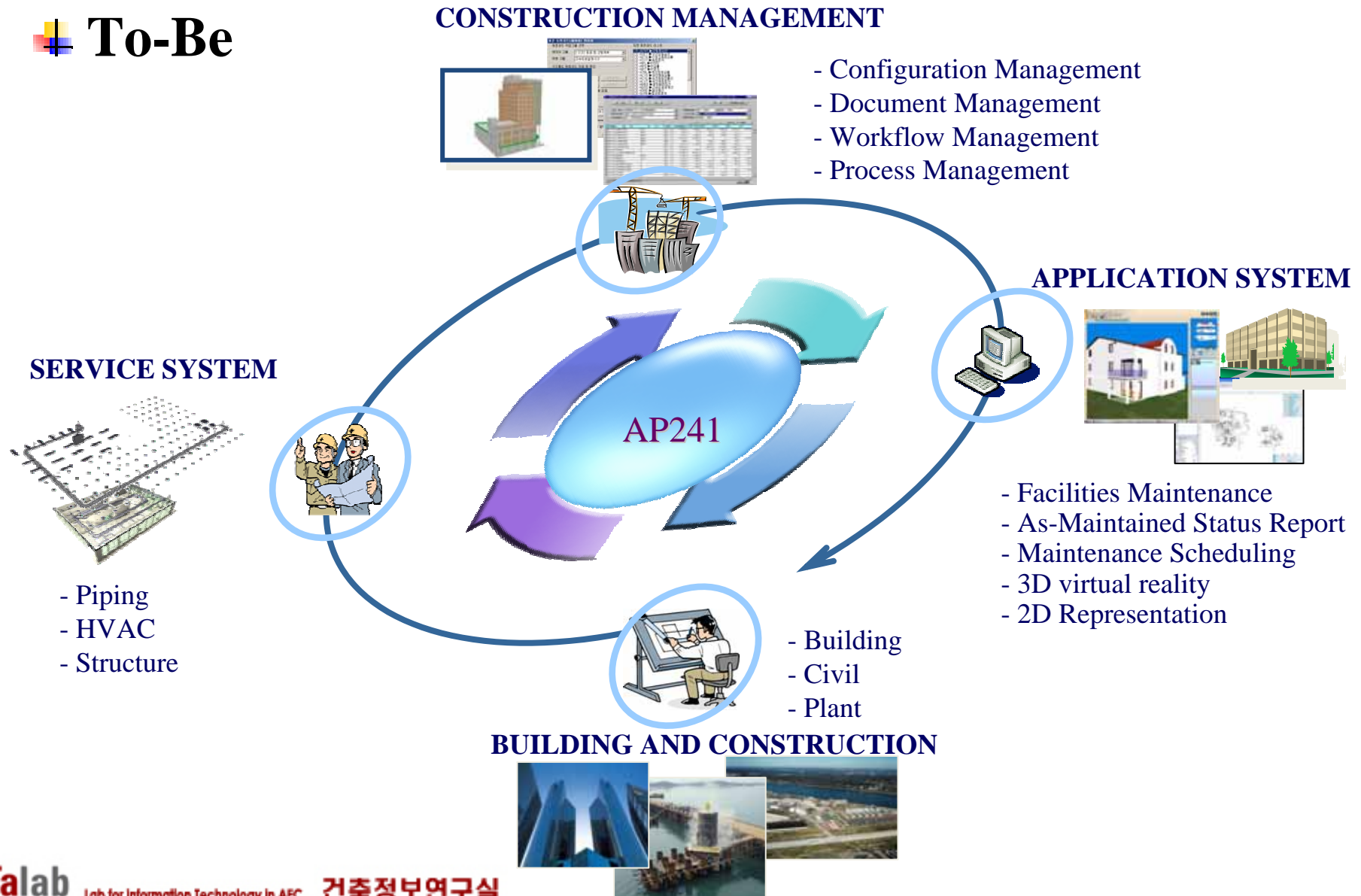
Generic AEC/FM Model: ISO 10303 AP241 at ISO TC184/SC4

19th October 2008

**Inhan Kim
KyungHee University**

Background

✚ To-Be



Aims of Research

◆ In this paper:

- **proposes a new model structure** which can represent AEC facilities and their maintenance history based on an AP241 core model
- introduces an overall structure and **data integration method of the AP241 data model**

◆ **The data model has high-level definition of facility information using facility product classification and their relationship.**

◆ **It would be of great interest to represent historical information of facilities based on AEC approach time variation.**

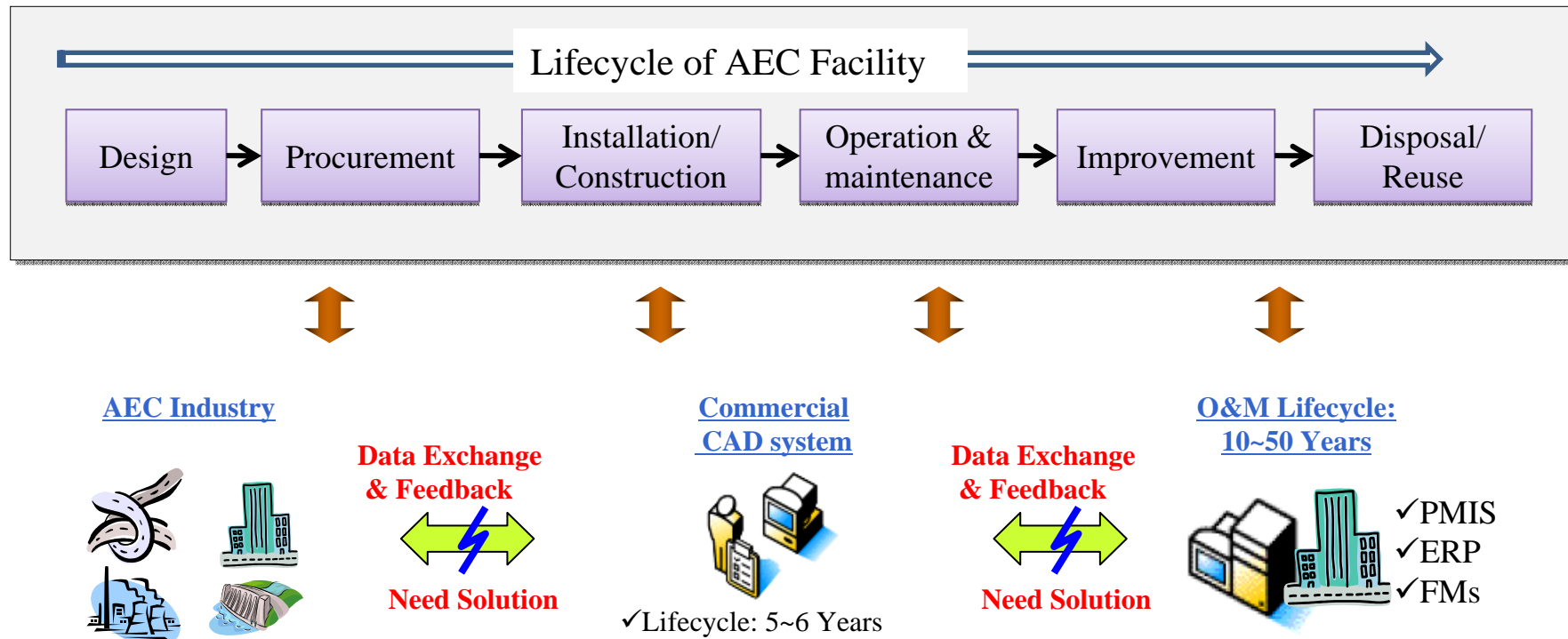
Background

Evidence of Industry Need for Generic Model

- ◆ Information about the AEC facilities are created and used by many different organizations throughout a lifecycle of facility.
- ◆ Concurrent engineering requires coordination of work of other disciplines such as planning, purchasing and logistical activities.
- ◆ Currently design, construction and maintenance of AEC facilities are performed using a great variety of software programs.
- ◆ However there exists no underlying common data model.
- ◆ Such an underlying common data model would enable high quality data exchange and data sharing during the complete life cycle of a facility.

Background

As-Is



Background

✚ Problems & Solutions

◆ data interoperability

→ using Neutral Data Format

→ using Reference Data Library as a Standard Reference Library

◆ long-term data archiving

→ using Open Standard. STEP

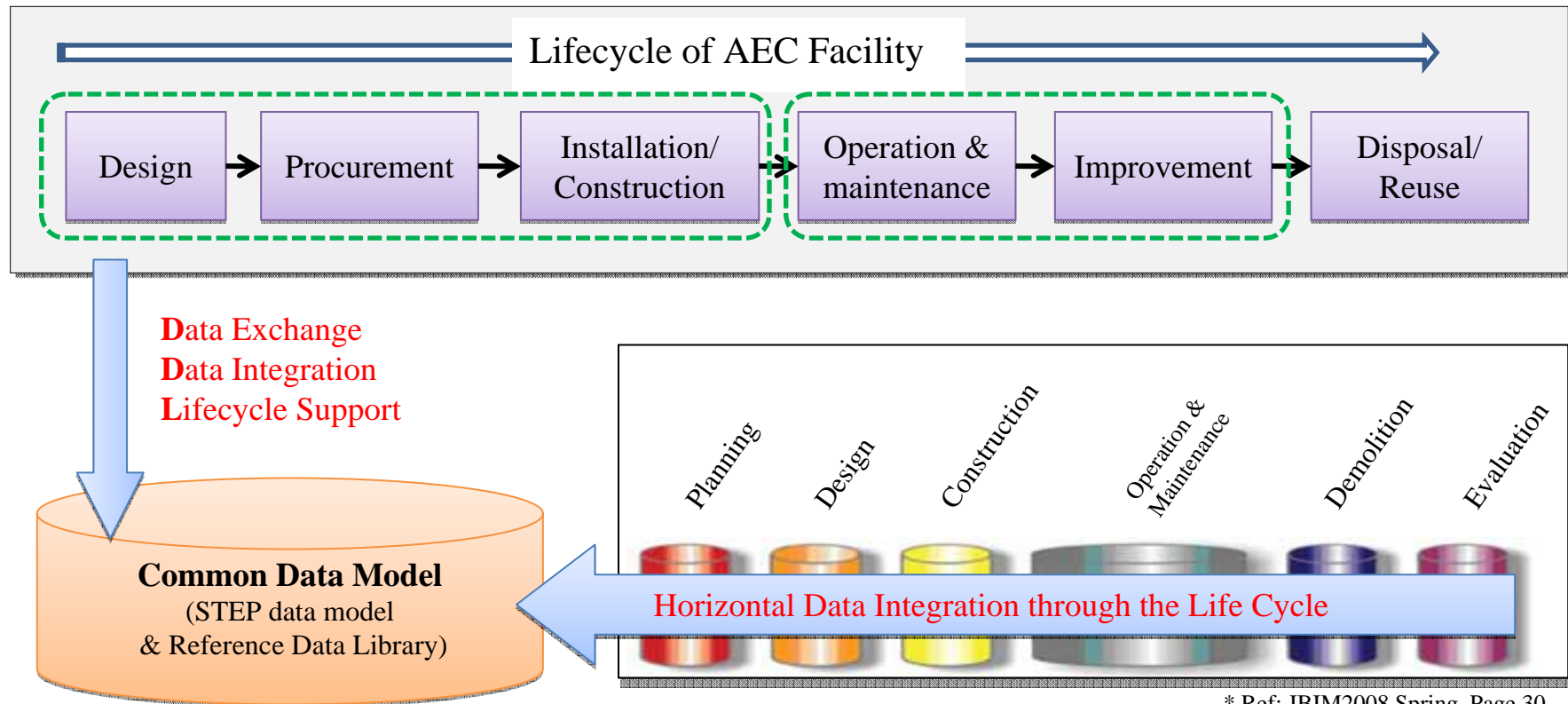
→ not only file based system but also STEP based Model Server

◆ represent facilities historical data

→ using AEC Generic model, Temporal relationship, and Standard Reference Library

Background

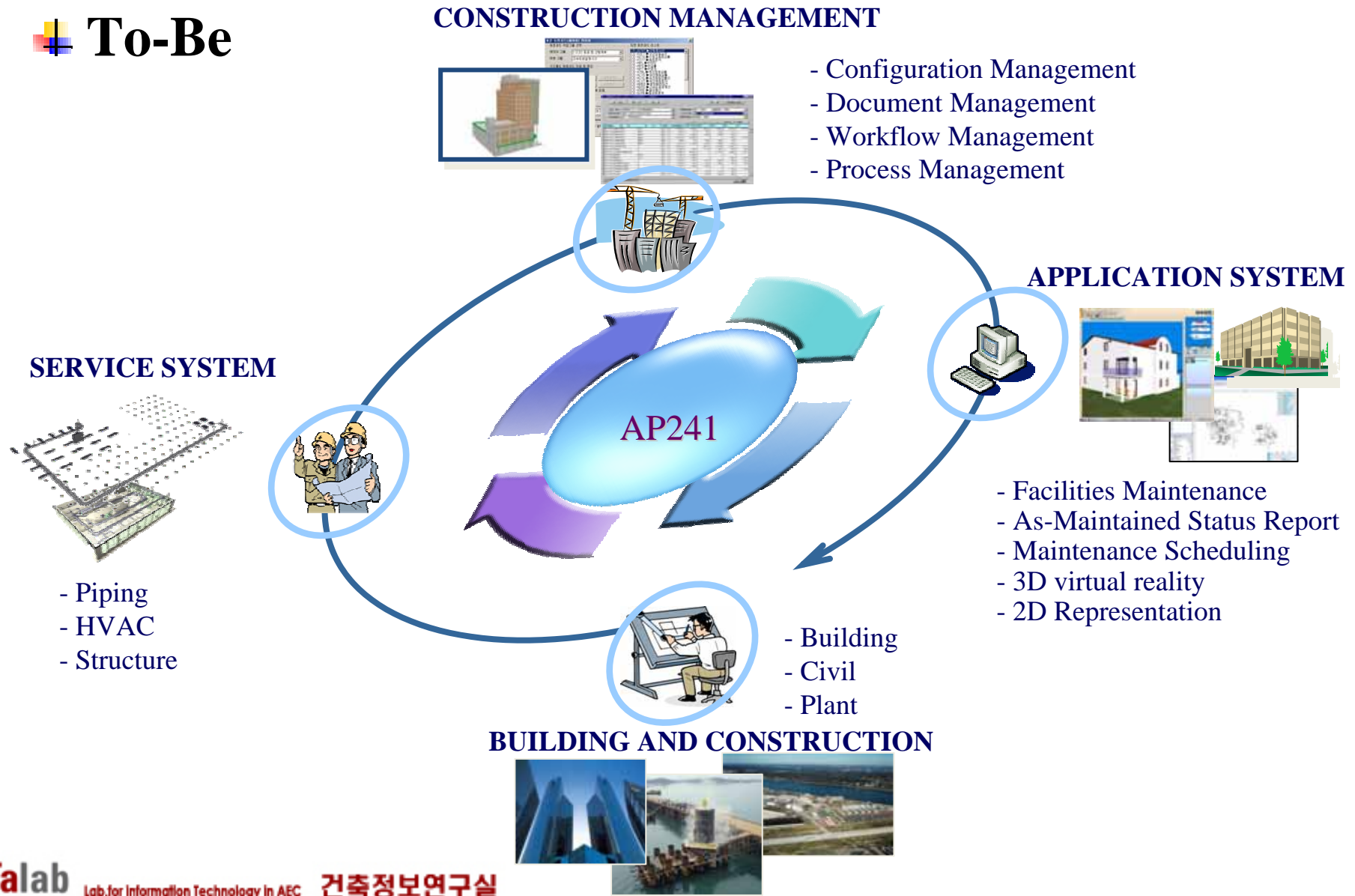
AP241 Strategy



* Ref: JBIM2008 Spring. Page 30

Background

✚ To-Be



AP241 Introduction

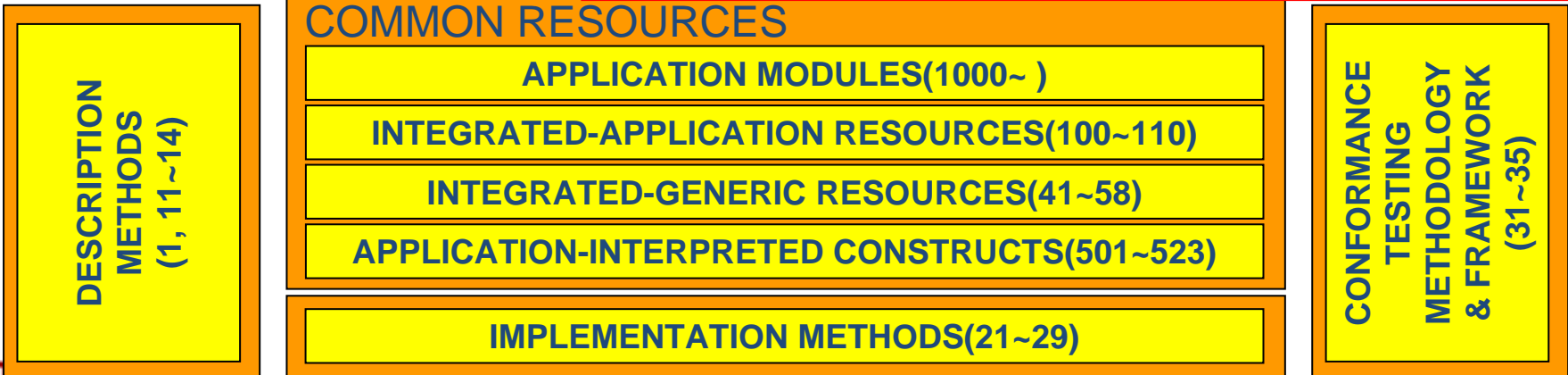
Overview

- ◆ **AP241 - Generic model for Lifecycle support of AEC facilities**
- ◆ **Org: ISO TC184/SC4/WG3/T22 - Building & Construction**
- ◆ **Project Leader: Inhan Kim(Kyunghee Univ.)**
- ◆ **Scope**
 - Spatial structure of the AEC facility;
 - Location of the elements that constitute an AEC facility;
 - Make use of shape representation including two dimensional and three dimensional shape;
 - Make use of drafting information that presents the AEC facility;
 - General representation of properties;
 - Classification of the elements and properties;
 - Change Management;
 - Association of approvals;
 - Association of constraints;
 - Maintenance and feedback of operational information concerning the AEC facility.

AP241 Introduction

APPLICATION PROTOCOLS AND ASSOCIATED ABSTRACT-TEST SUITES	
I 201 Explicit draughting [ATS 301 = X]	C 221 Functional data & their schem rep for process plant [X]
I 202 Associative draughting [X]	X 222 Design-manuf for composite structures [W]
I 203 Configuration-controlled design (c2=I,a1=I)[X]	X 223 Exch of design & mfg product info for cast parts [@]
I 204 Mechanical design using boundary rep [I]	I 224 Mech pdt def for p. plg using mach'n'g feat (e2=X,e3=A)
X 205 Mechanical design using surface rep [W]	I 225 Building elements using explicit shape rep [C] \[X,I]
X 206 Mechanical design using wireframe [X]	X 226 Ship mechanical systems [C]
I 207 Sheet metal die planning and design [I]	I 227 Plant spatial configuration(e2=C) [X]
X 208 Life-cycle product change process [X]	X 228 Building services: HVAC [X]
I 209 Composite & metal structural anal & related design[X]	X 229 Design & mfg product info for forged parts[X]
I 210 Electronic assy, interconnection & packaging design [X]	X 230 Building structural frame: steelwork [X]
X 211 Electronic P-C assy: test, diag, & remanuf[X]	X 231 Process-engineering data [X]
I 212 Electrotechnical design and installation [C]	I 232 Technical data packaging: core info & exch [I]
X 213 Num control (NC) process plans for mach'd parts [X]	W 233 Systems engineering data repr (to be PAS 20542)[X]
I 214 Core data for automotive mech design processes (e2=E)[F]	X 234 Ship operational logs, records, and messages[X]
E 215 Ship arrangement [X]	W 235 Materials info for des and verif of products [X]
E 216 Ship moulded forms [X]	W 236 Furniture product and project data[W]
X 217 Ship piping [X]	W 237 Computational Fluid Dynamics
E 218 Ship structures [X]	A 238 Computer numerical controllers
X 219 Dimension inspection [X]	W 239 Product life-cycle support
O 220 Proc. plg, mfg, assy of layered electrical products [X]	W 240 Process plans for machined products

A 241 Generic model for lifecycle support of AEC facilities



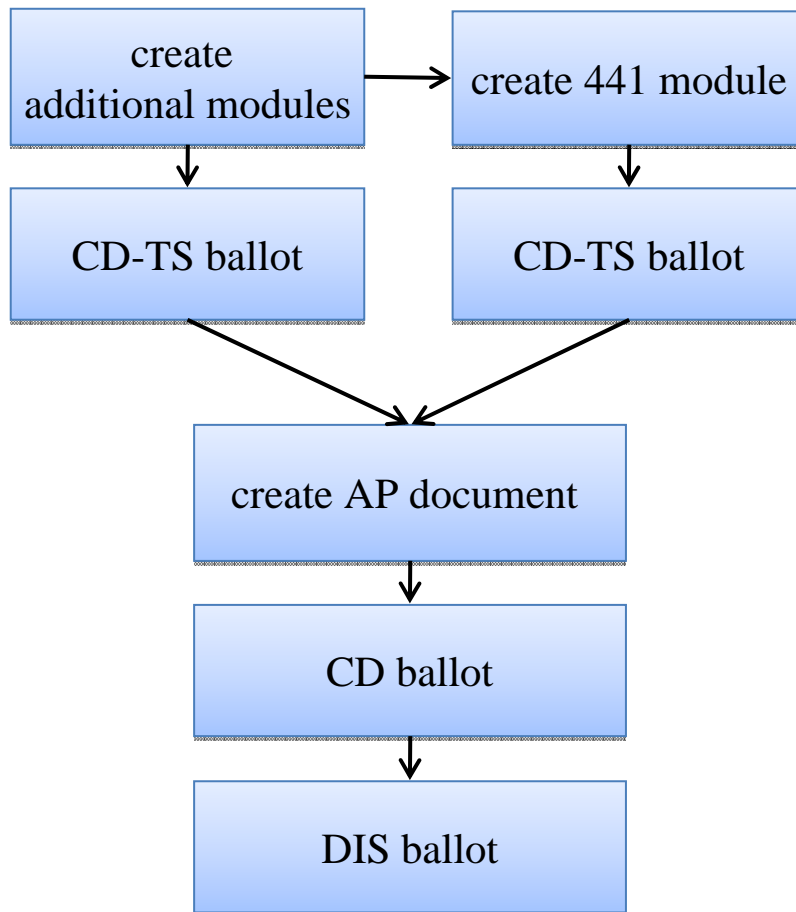
AP241 Introduction

STEP Part No. of AP241 Core Modules

Module Number	Title	Project Leader	Project Editor
10303-1388	Aec_functions_and_domains	Inhan Kim	Tatsuo Terai /Seong-Sig Kim
10303-1389	Aec_service_life	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1390	Cost_schedule	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1391	Data_creation_and_maintenance_activity	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1392	Project_resources	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1393	Root_things	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1394	Temporal_objects	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim
10303-1395	Work_control	Inhan Kim	Tatsuo Terai/ Seong-Sig Kim

AP241 Introduction

✚ Schedule for the Standardization



Stages	Schedules	Actions
WD Working Draft	already submitted for AP doc.	
CD Committee Draft	2008-11-14	Complete Module doc. For CD Ballot
	2008-11-05	Complete Module doc. for WD
	2008-11-30	CD for modules, draft AP doc. CD for AP doc.
DIS Draft for International Standard	2009-05-31	DIS for AP doc.
FDIS Final Draft for International Standard	2009-00-00	May be not needed
IS International Standard	2009-10-31	Same

AP241 Introduction

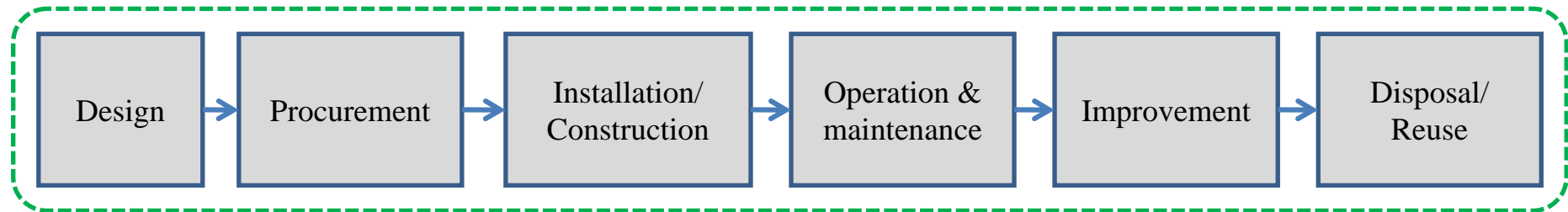
Aims of Development

- ◆ Assess in detail the information requirements of AEC facilities, resources, processes and controls.
- ◆ AP241 can be used for data exchange and sharing of combined 3D CAD product data at all stages of the lifecycle.
- ◆ From this Aims, AP241 will provide;
 - the overall definition of the foundation entities and their relationships
 - different participants and different applications software to use the definitions as a common basis for the exchange of project data and knowledge

AP241 Introduction

✚ AP241 provides environmental data & PLCS capability

Facility life cycle 



gathers environmental information of AEC area.
(Building, Plant, Bridge, Transportation, Tunnel, Dam)

support management of lifecycle data.

AP241

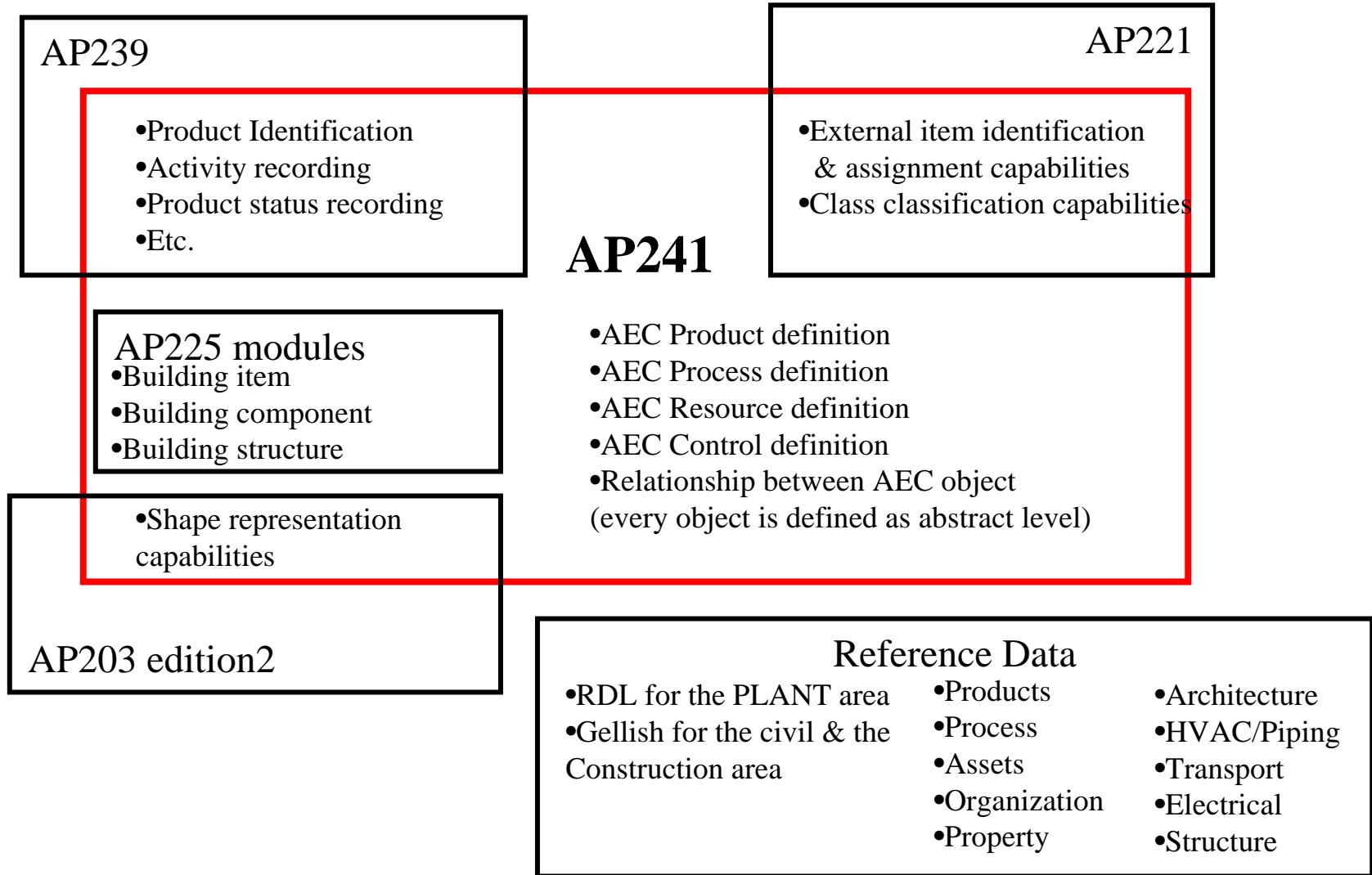
AP241 includes;

- AP203e2 shape representation
- AP221 functional data & symbolization
- PLCS modules

Use & accumulate Reference Data

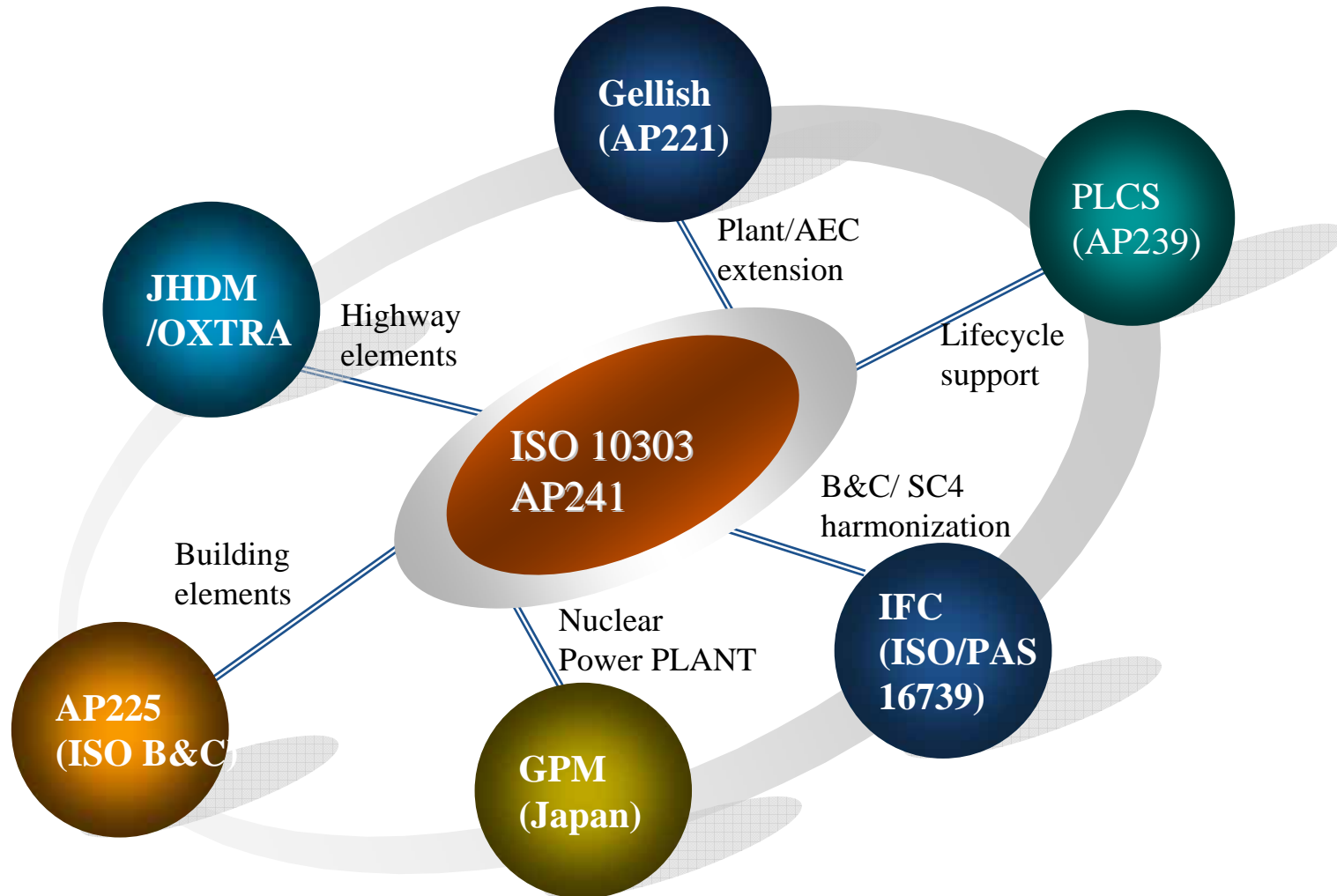
- ISO 15926 part 4
- Gellish

Related standard data model



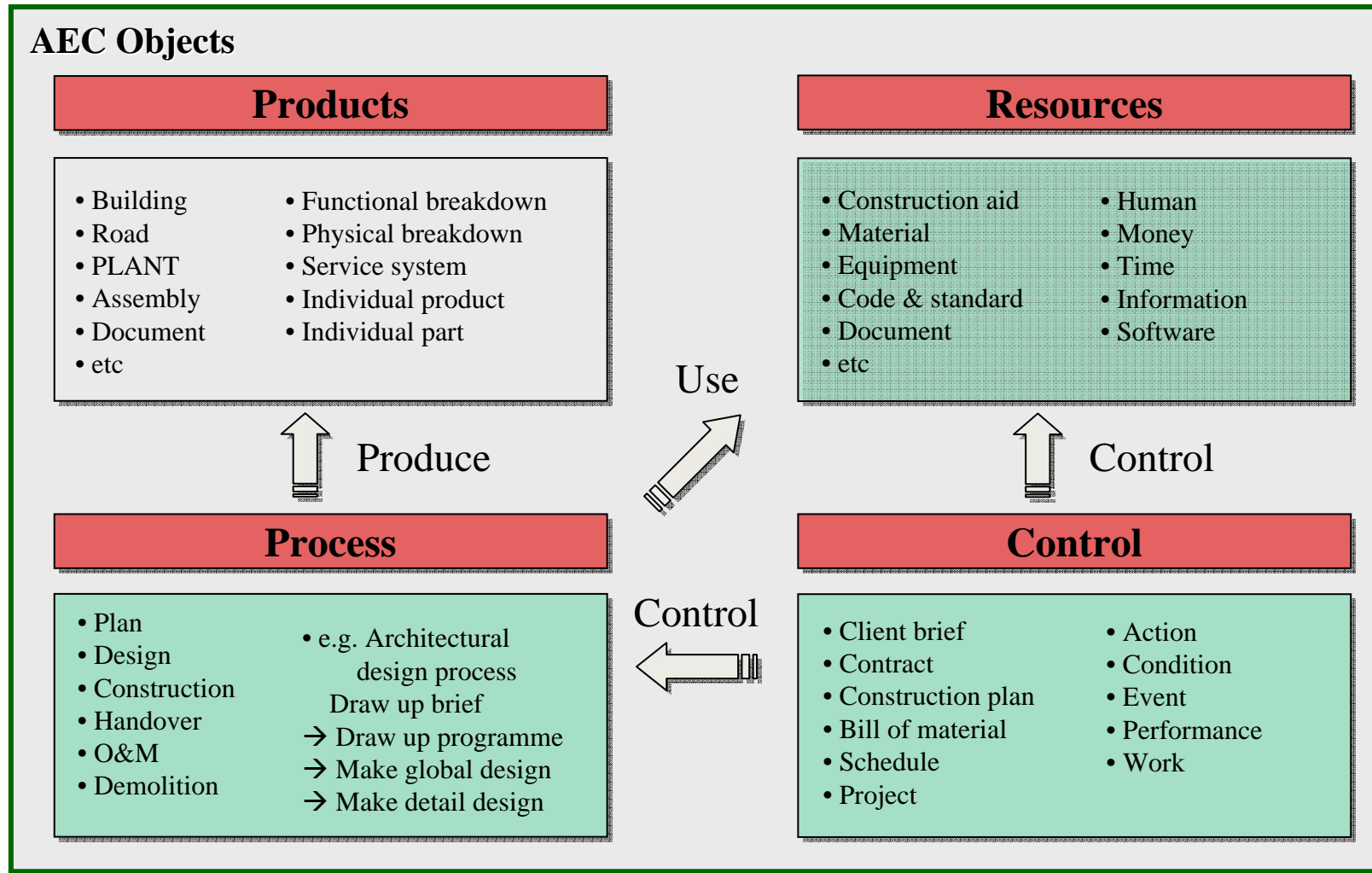
Related standard data model

International Cooperation



AP241 Basic Concepts

Real world objects



AP241 Basic Concepts

CO matrix table

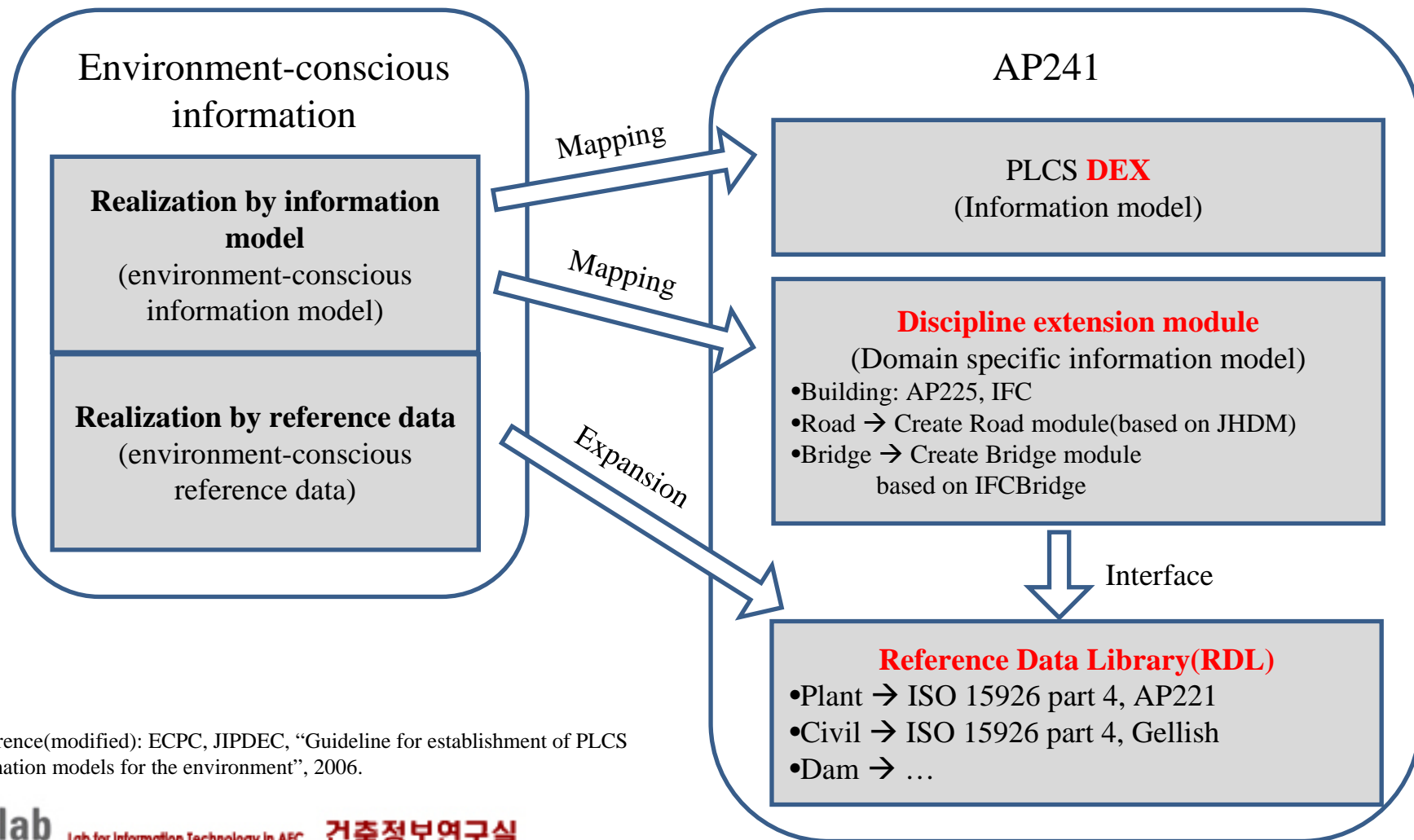
◆ Two-Dimensional Conformance Options.

- Vertical structure is associated with a type of AEC facility
- Horizontal structure is associated with view definitions for a certain type of AEC facility

Domain \ View Definition		Spatial/ Architecture	HVAC/Piping /Transport	Electrical	Structural
		Building	CO1	CO8	CO9
Transportation	Road	CO2	CO8	CO9	CO10
	Railway	CO3	CO8	CO9	CO10
Plant		CO4	CO8	CO9	CO10
Bridge		CO5	CO8	CO9	CO10
Tunnel		CO6	CO8	CO9	CO10
Dam		CO7	CO8	CO9	CO10

AP241 Data Integration Method

✚ Establishment of AP241 for the environment

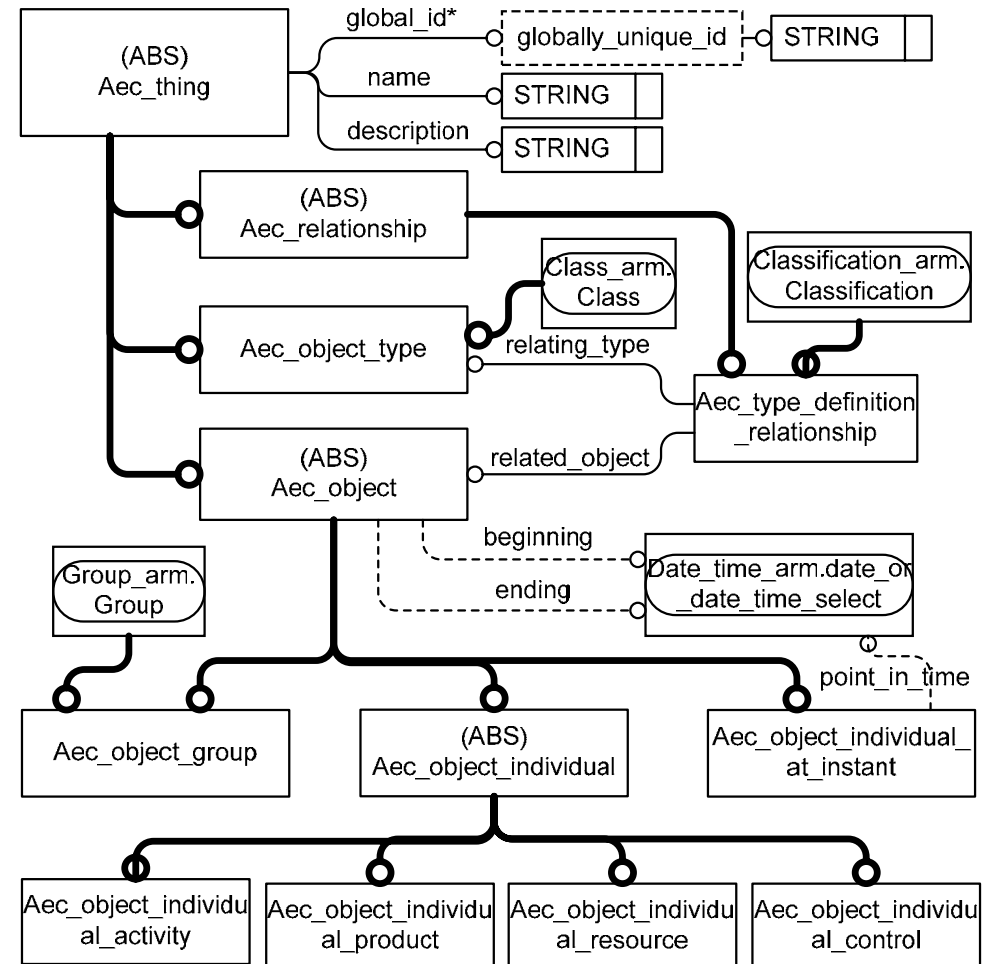


*Reference(modified): ECPC, JIPDEC, "Guideline for establishment of PLCS information models for the environment", 2006.

AP241 Data Model

AEC common supertype module

- ◆ **Aec_thing** is a super class of everything within the AEC industry. Root concept exists only for the AEC specific object definition. STEP data model do not have a root concept in general.
- ◆ **Aec_object** is an abstraction of any semantically treated things that exists in space and time including material objects, non-material objects and actions.
- ◆ **Aec_relationship** is an abstract generalization of all objectified relationships. This concept allows keeping the relationship specific properties to later handle relationship specific methods.



The Eiffel Tower lifecycle data representation

✚ Lightning striking the Eiffel Tower

- ◆ Eiffel Tower was struck by lightning on 3 June 1902, at 9:20 P.M.
- ◆ The damaged middle lighting illuminating the tower had to be replaced.
- This maintenance activity and individual objects can be described by AP241

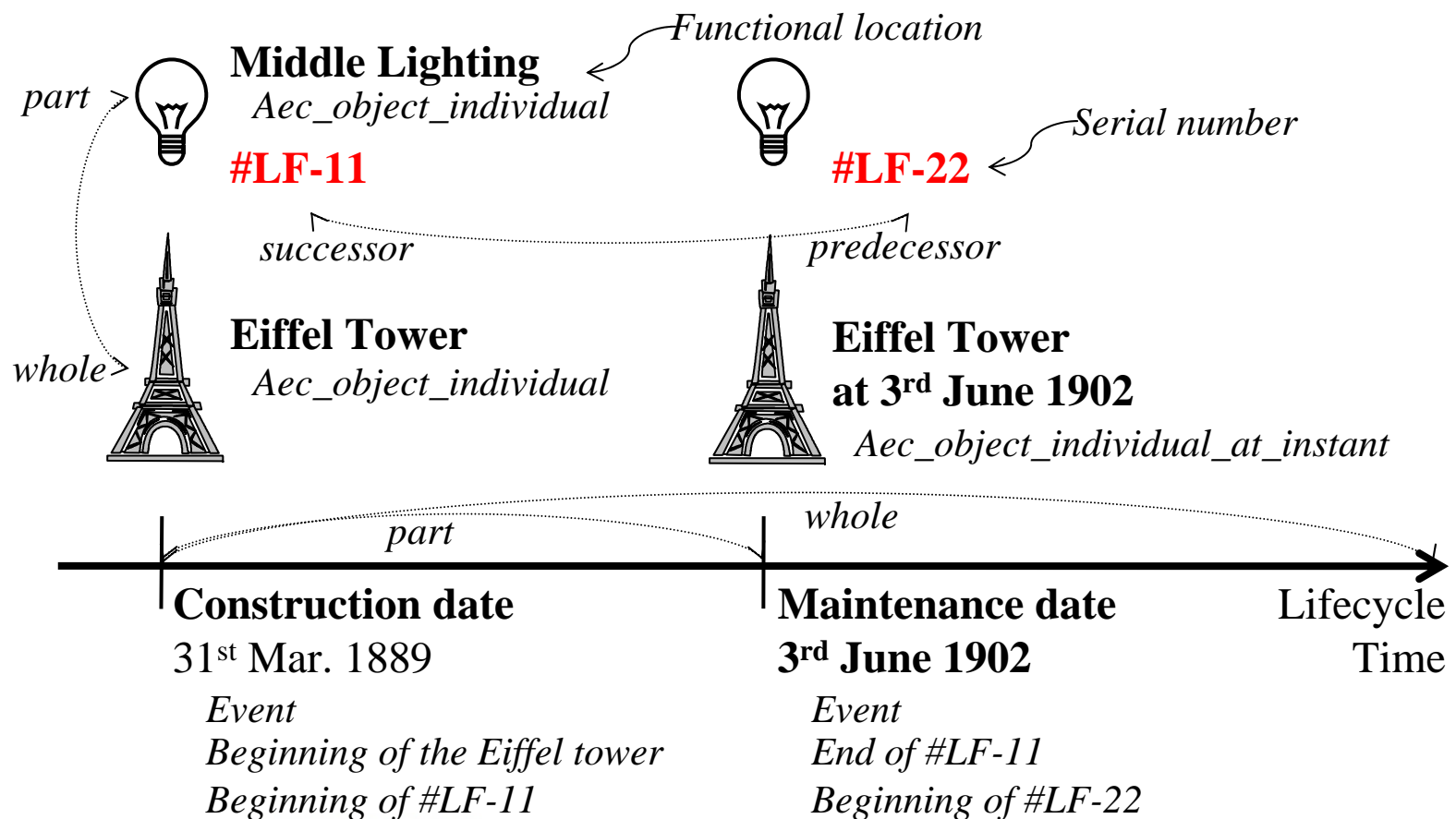


*Ref: NOAA's National Weather Service (NWS) Collection .
<http://www.photolib.noaa.gov/htmls/wea00602.htm>

The Eiffel Tower lifecycle data representation

Assumptions of maintenance history

- ◆ '#LF-11': serial number of the broken middle lighting
- ◆ '#LF-22' : serial number of the new lighting



The Eiffel Tower lifecycle data representation

Description of Required Entities

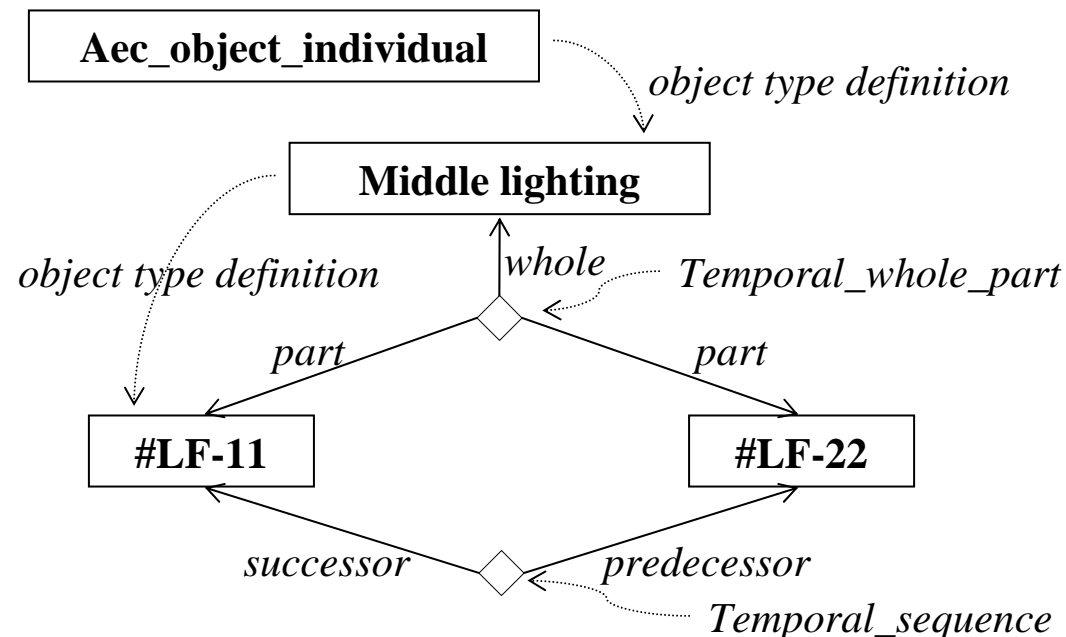
[**Aec_object_individual**] : The 'Eiffel Tower' which is located in Paris since its construction in 1889.

The 'middle lighting' known by the serial number '#LF-11' which is installed in the tower.

[**Aec_type_definition_relationship**] : The *Aec_object_type* that indicates the '#LF-11' is a member of the 'middle lighting' type.

[**Aec_object_individual_at_instant**] : The Eiffel Tower at the 'UTC 1902-06-03T21:20'.

[**Temporal_instant**] : The relationship that indicates that the 'Eiffel Tower at the UTC 1902-06-03T21:20' is an instant of the 'Eiffel Tower since 1889'.

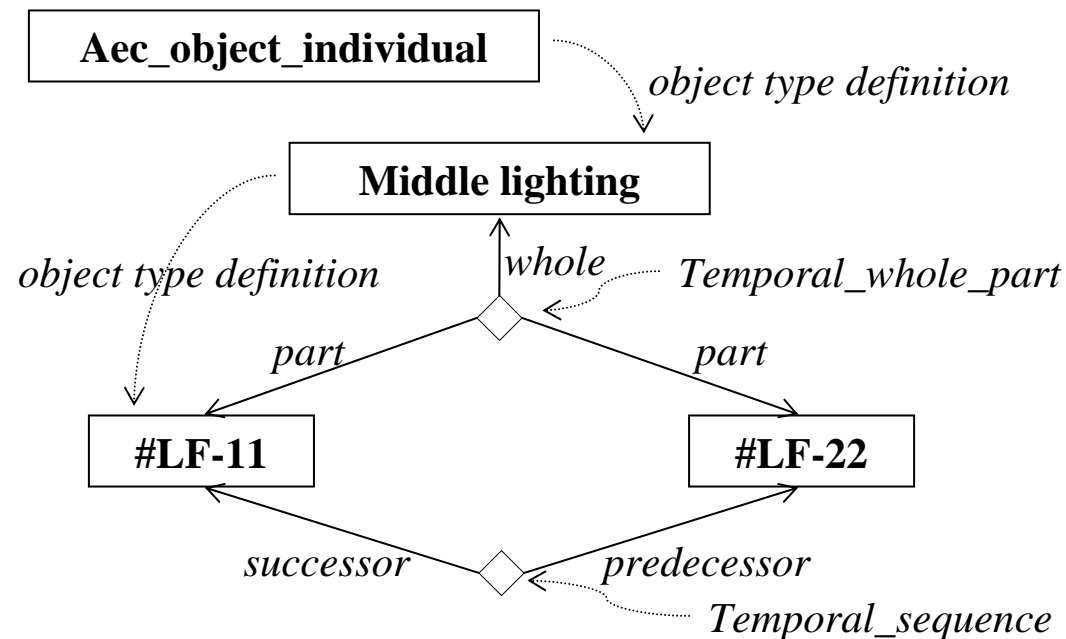


The Eiffel Tower lifecycle data representation

Description of Required Entities

[Temporal_whole_part] : The relation that indicates that the service period of '#LF-11' and '#LF-22' are temporal part of whole lifecycle of the 'Eiffel Tower'. The '#LF-11' was where the middle lighting is also part of the tower.

[Temporal_bounding] : The relation that indicates that a Calendar_date known as '31 March, 1889' marks the service start of the '#LF-11' is an instance of the Beginning. The relation that indicates that the Calendar_date known as '3 June, 1902' marks the service stopped of the '#LF-11' is an instance of the Ending.



Conclusions and Future Work

- ◆ This paper presents AEC industry specific requirements for data interoperability to represent historical data of facilities property
- ◆ AP241 data model can represent **geometrical shape and non-geometrical attributes**
- ◆ AP241 will be used for data exchange and sharing of combined 3D CAD product data **at all stages of the lifecycle**
- ◆ AP241 is allowed to **represent complex time variation**
- ◆ Model extension methods allow the AP241 data model more **flexible and extensible**
- ◆ **AP241 can be utilized by various domain actors** as a basis of their extended data model development
- ◆ Future work is required to develop a discipline extension module for the road and other relevant domains

Thank You!

Q&A

✚ iTALab at Kyunghee University <http://italab.khu.ac.kr>

✚ Contact Name : Inhan Kim

E-mail : ihkim@khu.ac.kr

Tel : +82-31-201-2926

AP241 Data Integration Method

✚ AP241 defines;

◆ Context Independent Information

- means independent within the domain of construction but not necessarily outside the domain of construction.
- includes for references within an ARM to external data models

◆ Information of Common Interest

- is that context independent information which may need to be exchanged or shared on a common basis
- It will not be all of the context independent information, some of which may be used in a context dependant manner.

AP241 Data Integration Method

✚ AP241 defines;

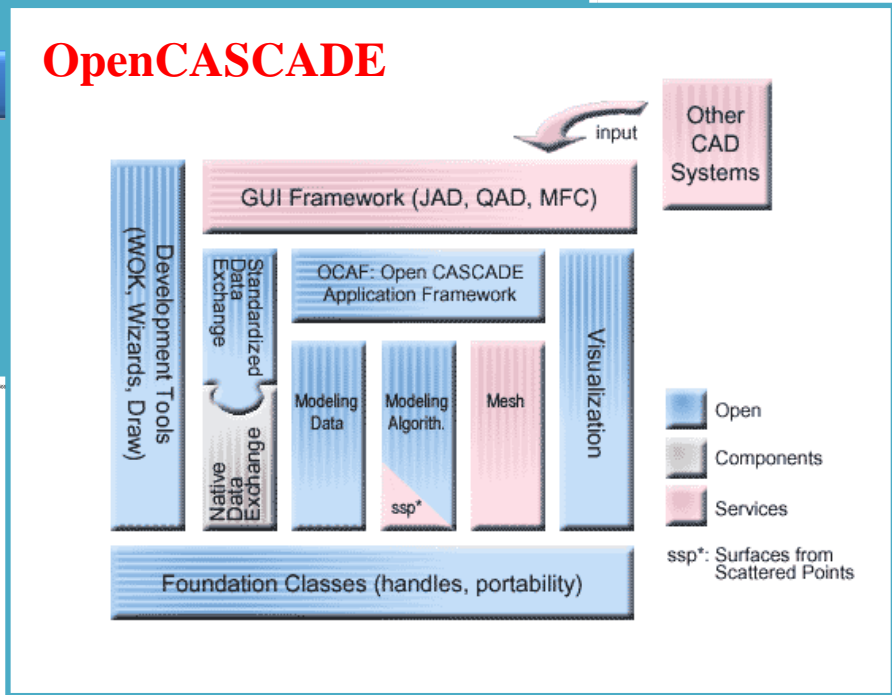
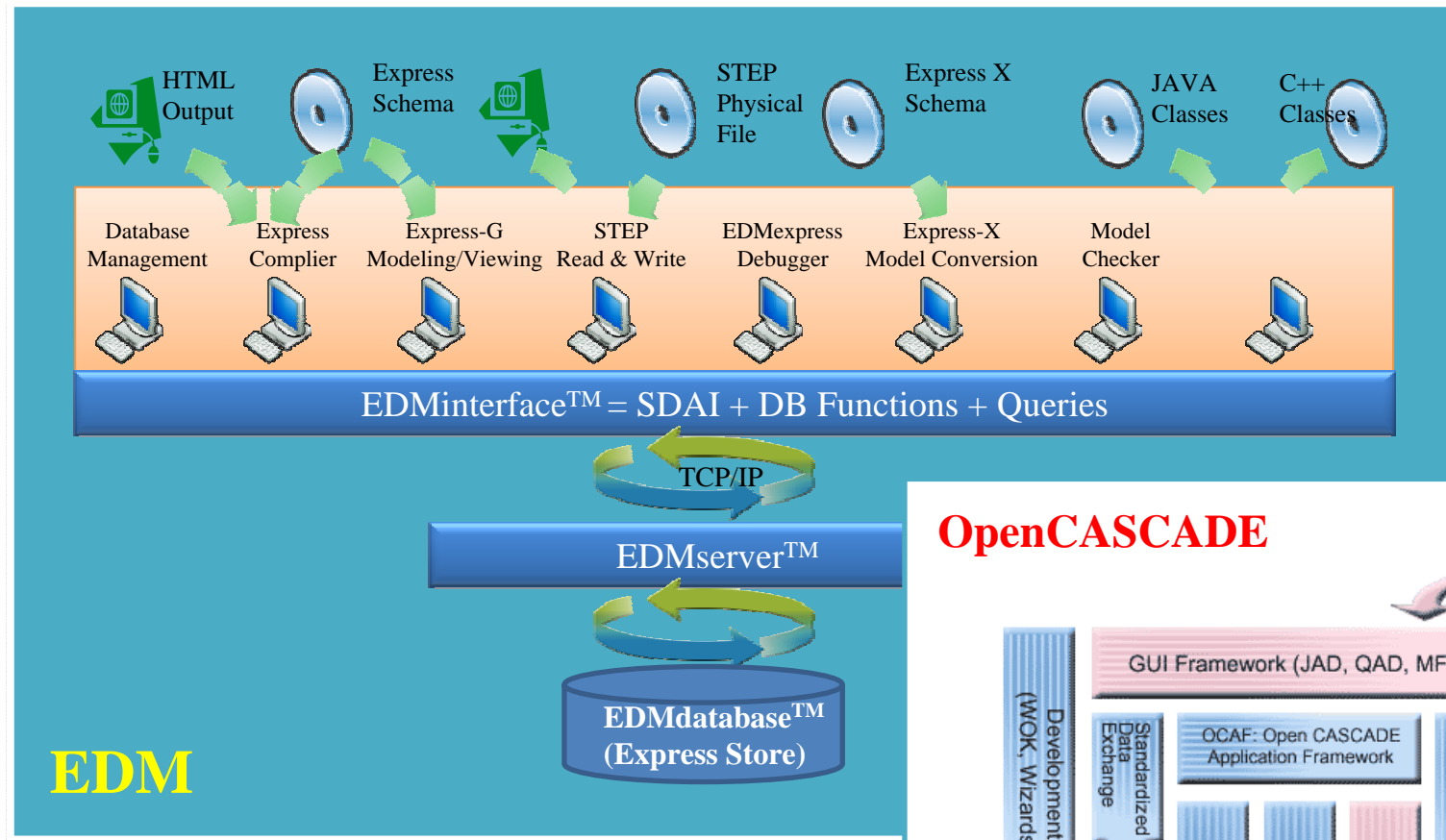
◆ Semantic level facility product data

- An exchange between different software within different disciplines which makes available only that information which is necessary.
- For example, an exchange between a building services application and a structural application would incorporate dimensional and weight information; other information being unnecessary.

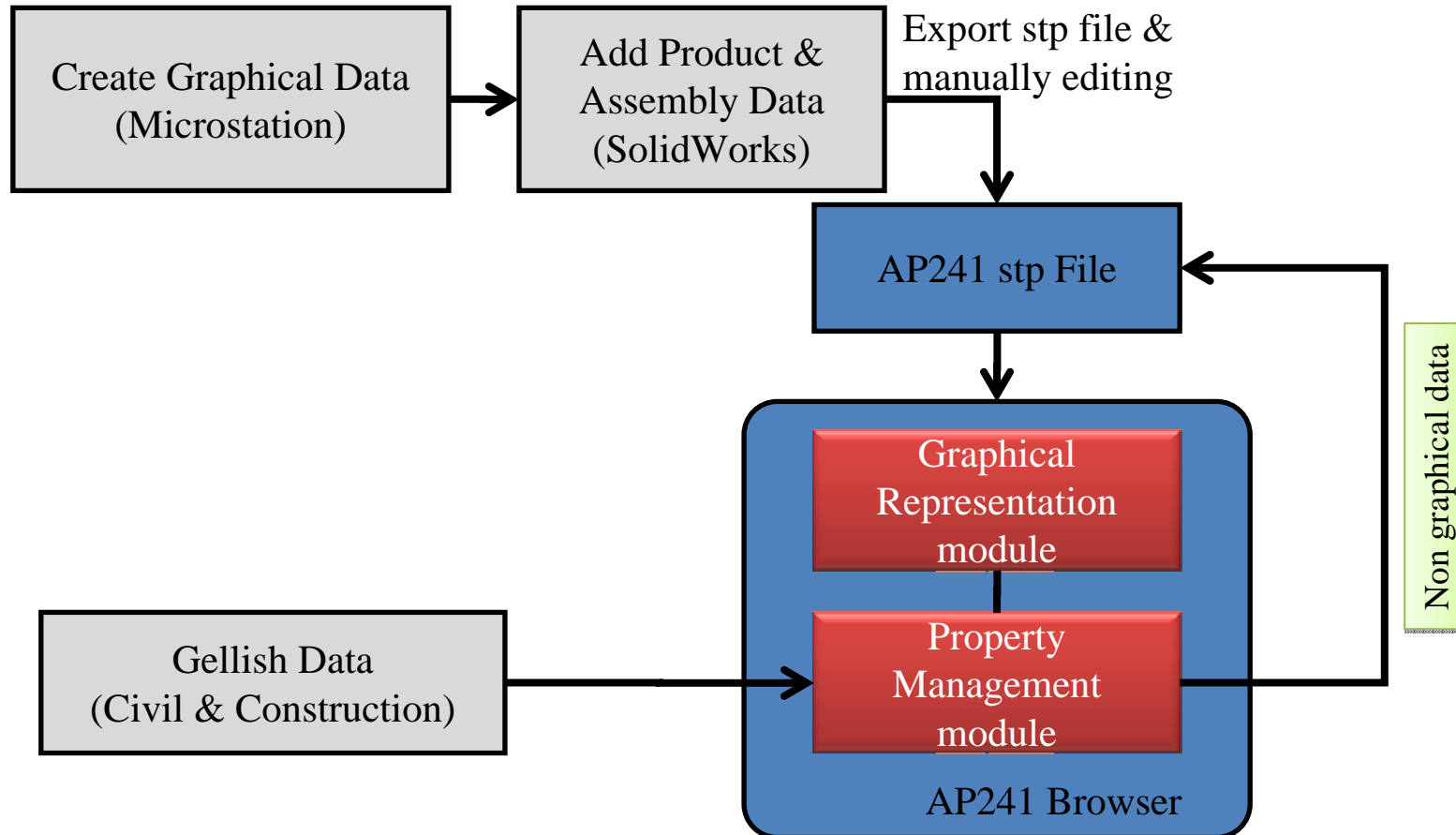
◆ Interfacing to the Reference Data/Extension Module

- For instance, the AP241 might establish a foundation set of information for a beam
- However, to progress the structural application from design to fabrication would require a more detailed definition.
- The objective is that the detailed definition would use the AP241 definition and then extend it using Reference Data or discipline extension module.

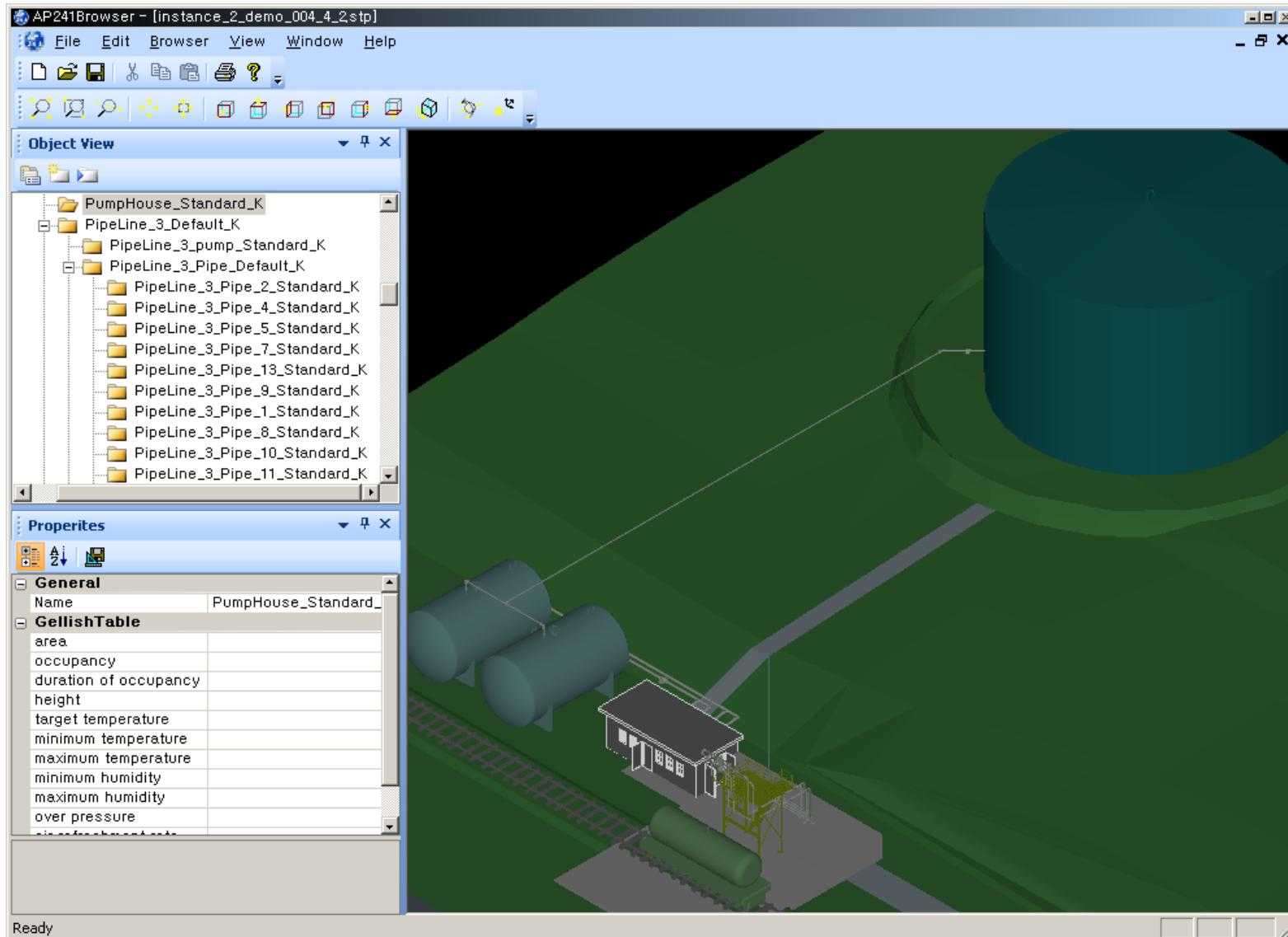
AP241 Browser prototype



AP241 Browser prototype



AP241 Browser prototype



AP241 based Data Exchange Scenario

