Towards a Reference Architecture for Advanced Planning Systems

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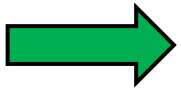
Advanced Planning Systems (APS)

APS are part of many organizations and are linked to the Enterprise Systems (ES) aiming to optimize raw materials, inventory, production plans, etc., to improve the economy of the company (Stadtler, 2005).



SAP APO

ORACLE
Advanced Supply Chain Planning Ascp

MOTIVATION

Small an medium size companies do not have access to world class ERPs ⟹ Perform their applications AD-HOC without a methodology guiding this process

APS from Software Engineering (SE) POINT OF VIEW

Previous work

APS characterization:

- ✓ Functional Requirements
- ✓ Quality Attributes
- ✓ Reference Model

EVALUATE FUNCTIONAL REQUIREMENTS

✓Comparison with SAP and ORACLE

EVOLVE THE REFERENCE MODEL

Reference Model to a Reference Architecture.

- ✓ Employ several views ISO/IEC 42010:2011
- ✓ Follow Krutchen's "4+1" View Model

Concepts and Definitions

- *Enterprise Systems* (ES), includes ERPs, transactional systems and other information systems that manages data in an organization
- *Solving Approach* (SA), umbrella term for methods and technics used to solve advanced planning problems. Includes operations research, genetic algorithms, game theory, and others.
- *Optimization Point* (OP) is a specific planning problem solved through an APS.
- *Model* specific solution for an individual factory planning problem, using any SA.
- *Objective* is what the model seeks to optimize.

Factory Planning: mostly at short-term.
Supply Chain Planning: factory planning problems beyond the company limits, at mid and long term time horizons.

Functional Requirements Analysis (1/2)

Elicited from industrial applications made and from the literature

Generic, suitable for a wide definition that can work as a frame

"Related to the system" and "related to the solving approach"

Requirements			
Group 1	**Group 2**	**Group 3**	**Group 4**
N: Algorithm Integration	*Input Checking*	H: Input Data	E: Scenario Generation
B: Models Management	I: Consistency Check	*Demand Planner*	A: Optimization Points Management
C: Objective Management	O: Bottleneck Check	*Orders Planner*	F: Scenario Storage
D: Parameters Setting			G: Scenario Comparison
			J: Output Data
			M: Open/Saving Results

Functional Requirements Analysis (2/2)

SAP APO

1. APO works with two planning levels: Supply Network Planning (SNP) is midterm/long term planning, while Production Planning/Detailed Scheduling is short term.
2. Users can optimize while working on the system in parallel; results are in friendly manner and include historical data.
3. Input data: demand planning, sales orders, and even ETO, transferred from SAP ERP via the Core Interface.
4. APO checks consistency and bottlenecks, and evaluates rescheduling.

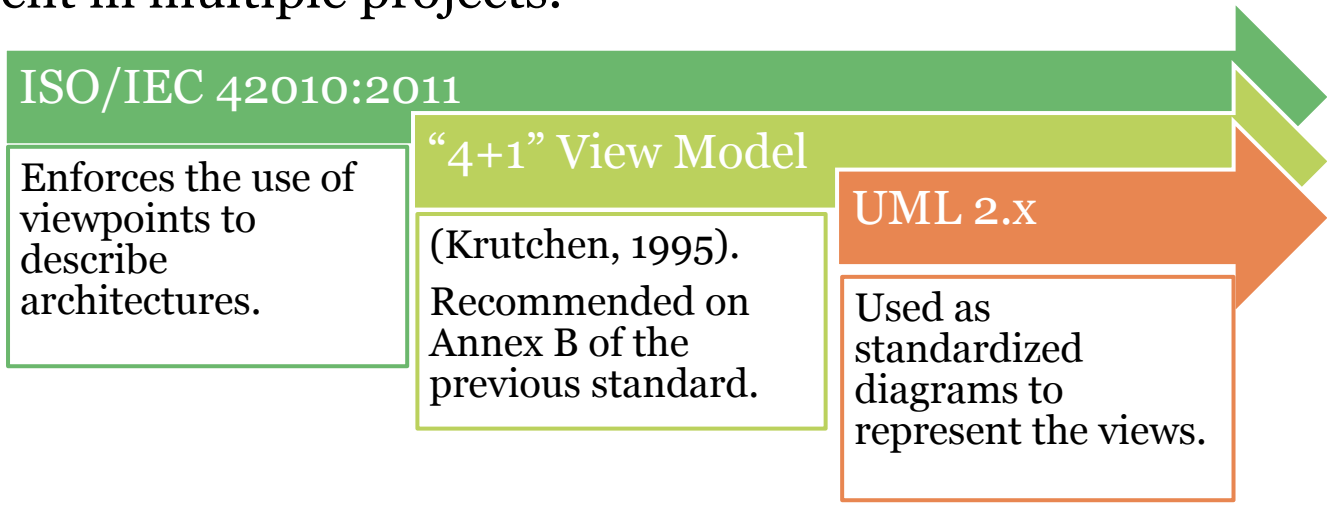
ORACLE ASCP

1. Considers Usability as one of the main QA of the system.
2. Each model has available objectives, and parameters management.
3. Each planner (user) can configure the interface, while the Planner Workbench offers scenario comparison.
4. ASCP uses any input data synchronized from any ES (forecasts through an external module, sales orders and ETO data), and allows deciding where to store the output data.
5. It also provides bottleneck detection.

Reference Architecture APS-RA (1/6)

Reference Model (RM) is a division of functionalities with data flow between pieces, working as a standard decomposition of a known problem.

Reference Architectures (RA) are abstractions of concrete software architectures from a certain domain to facilitate system design and development in multiple projects.



Variability guide are variation points to accomplish modifications in pre-planned ways, adding changes during development for specific study cases.

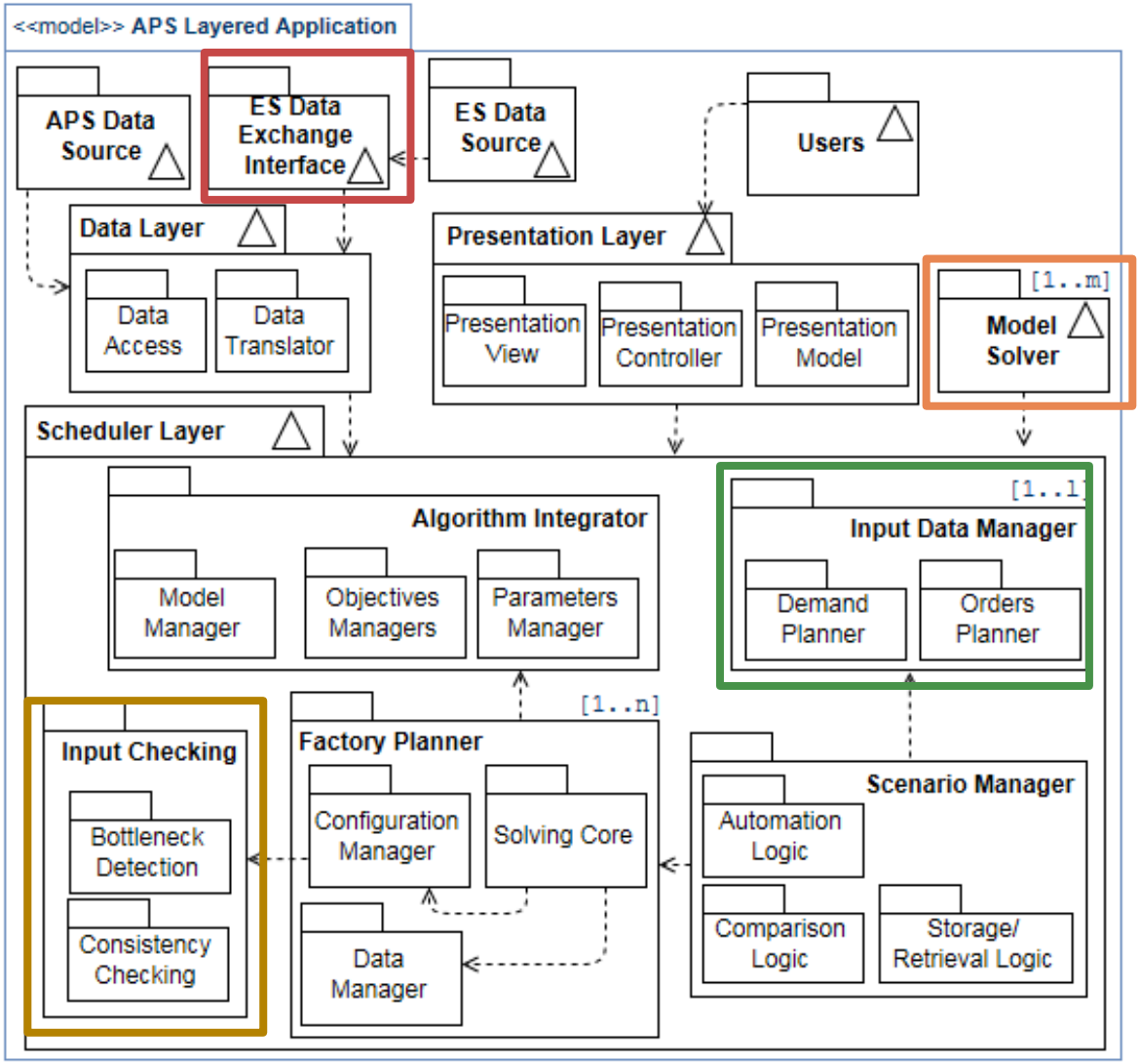
APS-RA: Logical View (2/6)

- First view developed from the FR and RM➔ what the system should provide as services to its users.
- The elements are “key abstractions" manifested as objects, components or packages
- Presented with Model Diagrams to show the specific view of a system, describing its architectural, logical or behavioral.

Functional Requirements	Reference Model Blocks	Logic View Packages
S: Database Use	APS Database Control	APS Data Source
K: Output Data L: Information Exchange	ES Database Control	Package: Data Access. External Systems: ES-DS and ES-DEI
B: Models Management, C: Objective Management D: Parameters Setting N: Algorithm Integration		Algorithm Integrator: ▪Model Manager ▪Objective Manager ▪Parameters Manager
H: Input Data L: Information Exchange	Demand Planning	Input Data Manager: ▪Demand Planner, Orders Planner
I: Consistency Check O: Bottleneck Detection	Consistency Checking	Input Checking: ▪Consistency and Bottleneck Checking
E: Scenario Generation F: Scenario Storage G: Scenario Comparison M: Open/Saving Results	Scenario Manager	Scenario Manager: ▪Storage/Retrieval Logic, Comparison Logic and Automation Logic
A: Optimization Points Management E: Scenario Generation N: Algorithm Integration	Factory Planning	Factory Planner ▪Configuration/Data Manager, Data Manager and Solving Core

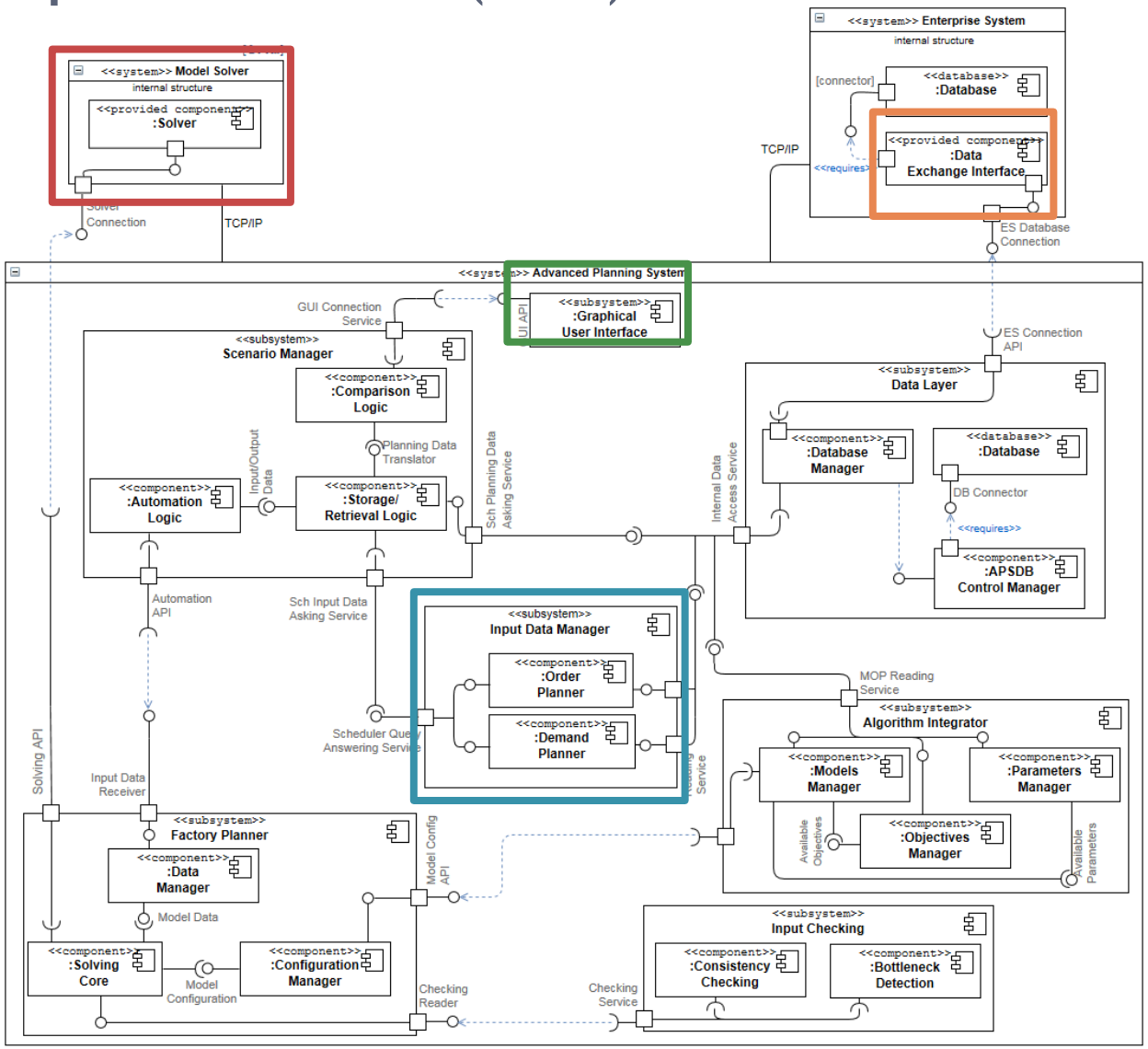
APS-RA: Logical View (3/6)

- 5 actors: APS Data Source, ES Data Exchange Interface, ES Data Source, Model Solver, and Users.
- 3 layers: Data, Scheduler and Presentation.
- Includes variation points.



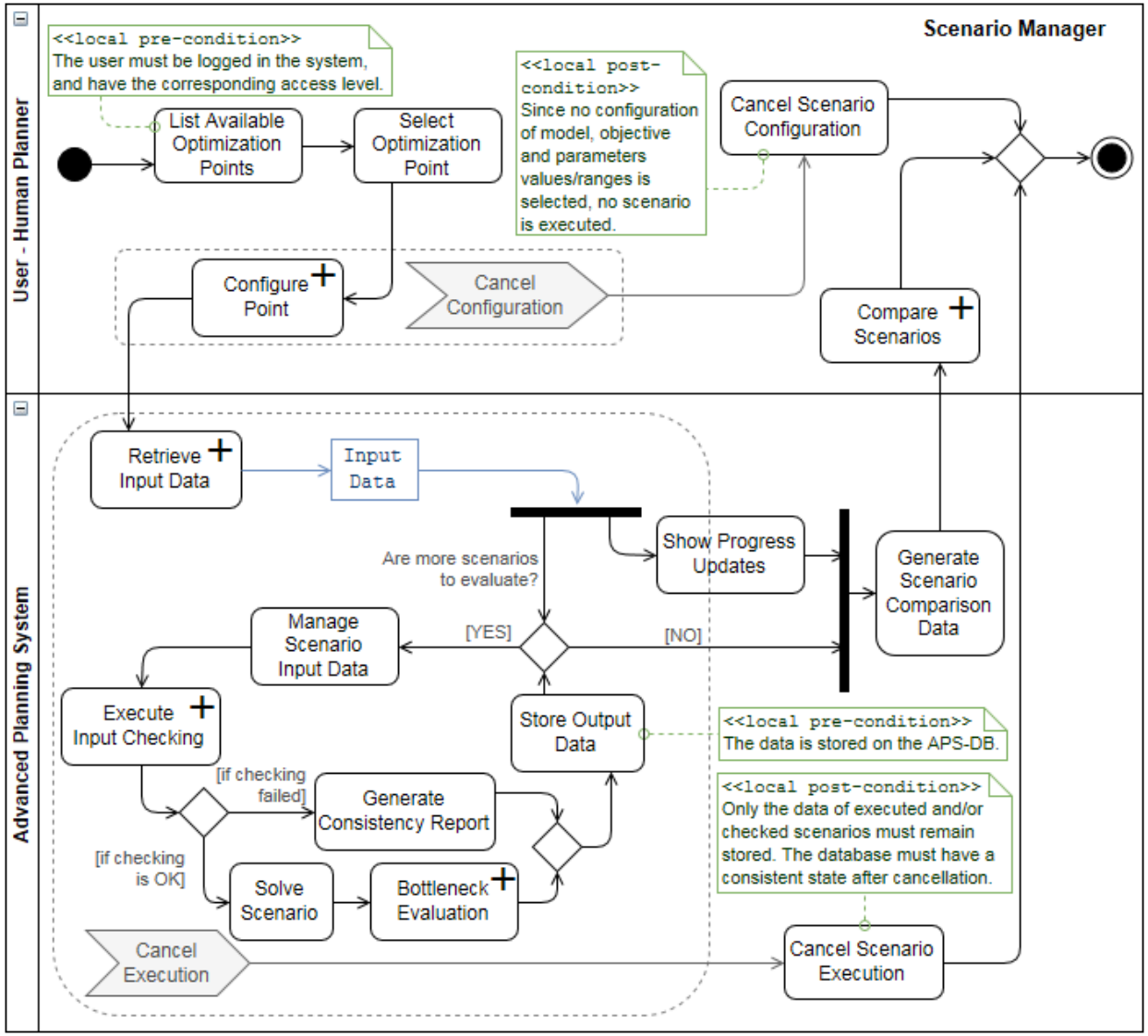
APS-RA: Development View (4/6)

- The view shows the organization of modules, libraries, subsystems, and development units, mapping software to environment
- Presented with UML Component Diagrams, which can denote either logical or physical elements
- The Component Diagram of represents logical components, which may have different levels abstraction.
- External actors included as systems.



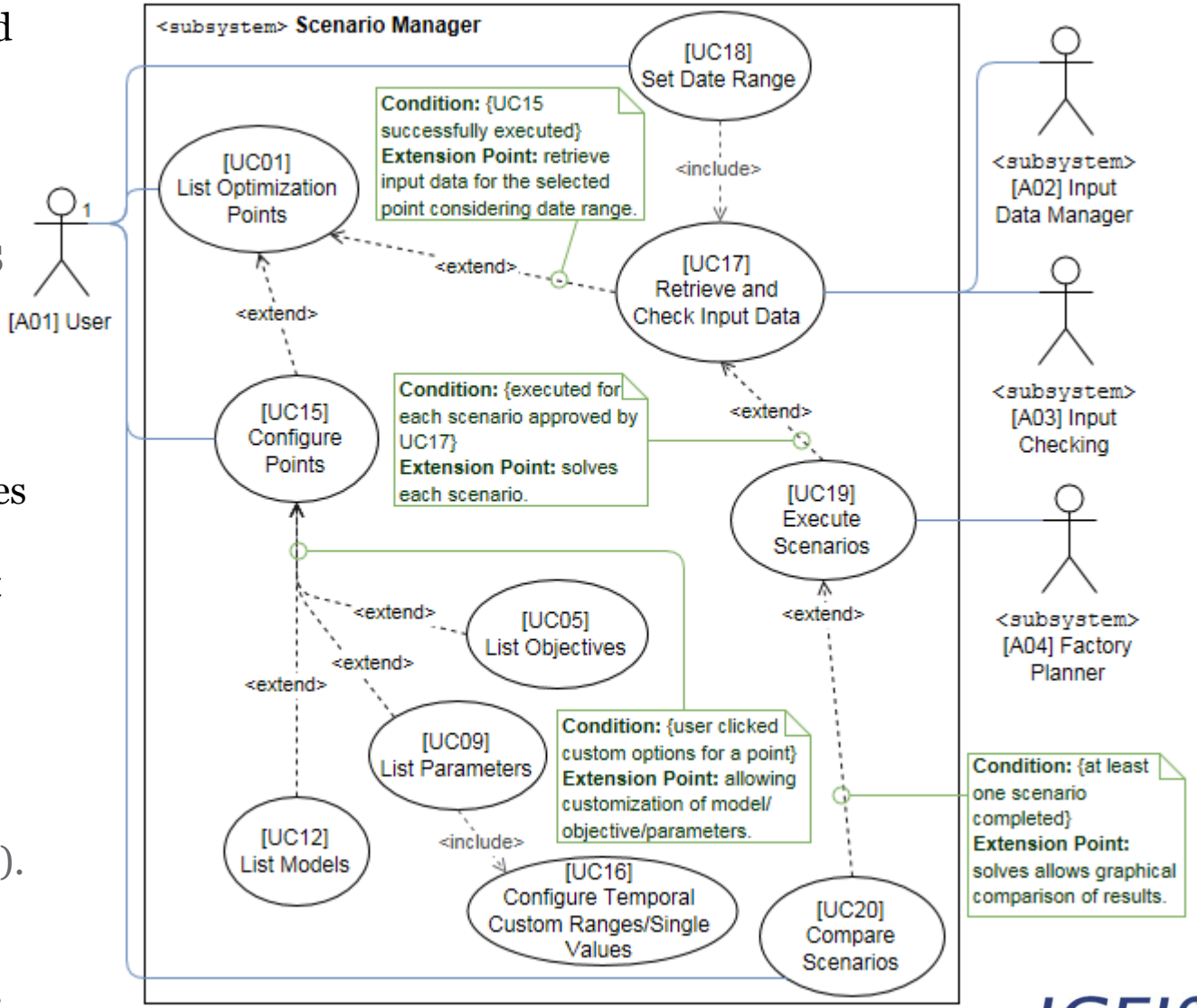
APS-RA: Process View (5/6)

- This view is composed by more than one diagram.
- Actions with a (+) symbol are later detailed on an exclusive Activity Diagram.
- The Activity Diagrams show the workflow of the system and how functionalities relate to each other.
- Swim-lanes detail which actor or system is performing each action.



APS-RA: Scenarios View (6/6)

- This view is represented by Use Case Diagrams, and is composed of several diagrams.
- Sub-systems of the APS are also represented as actors to show their interrelation.
- The use cases have codes to denote that a case may appear in different diagrams.
- This view links all the views together, can be used to develop tests (verification/validation).



Conclusions

1. We present a work in progress towards a Reference Architecture for an APS (APS-RA), based on Functional Requirements previously elicited through a study of the literature.

2. The FR are compared to the main features of commercial leading suites (SAP APO and Oracle e-Business ASCP), to validate the proposed requirements, obtaining a good match between them.

3. This work offers the beginning of a framework to support the implementation, helping to define and clarify the functionality of each component. It adheres to standardized SE methods, without adding load to the development process.

4. This increases the quality of the development, providing the essential base for a clean design with intrinsic relations between FR, QA and the RA.

5. It allows the project team to efficiently and effectively asses the quality and extensiveness of existing systems, guiding the modification and adaptation of existing systems to new developments.

Future Works

1. Complete all the views for the Reference Architecture, including Process View, Physical View and Scenarios.
2. Use the Quality Attributes that were previously elicited along with the FR to generate QA Scenarios and supplement them with metrics and indicators based on the international standard series ISO/IEC 2500n "Quality Management Series".
3. Evaluate the commitment of the APS-RA with those QA, by applying a Software Evaluation method, such as ATAM (Architecture Trade-off Analysis Method).
4. Create a specific implementation of a study case, applying real-case data, and using the elements generated throughout this works (FR, QA, and the APS-RA).

Thank you!

Questions?