



IBM Software Group

Getting Requirements Right with Model Based Functional Analysis

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Requirements Engineering defined

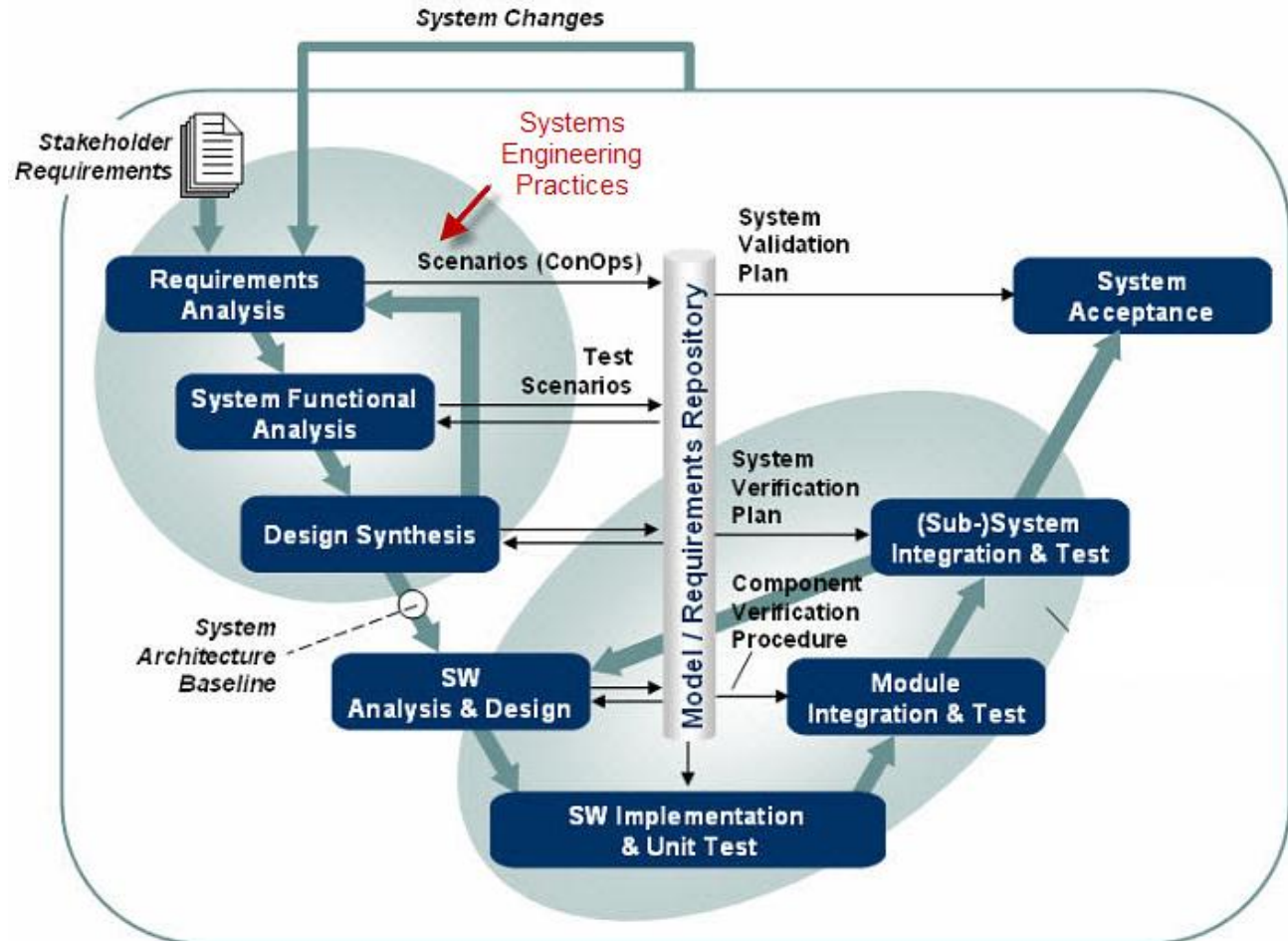
Model Based Functional Analysis defined

Rational solution



Scope of today's presentation

- Requirements Engineering at the system level (top left of V-model)



Requirements Engineering

- Requirements Engineering, by one definition, involves:
 - ▶ Requirements elicitation
 - ▶ Requirements analysis and negotiation
 - ▶ Requirements specification
 - ▶ Functional analysis
 - ▶ Requirements validation
 - ▶ Requirements management



Requirements Definition

- Requirements Engineering involves:
 - ▶ Requirements elicitation – gathering requirements from customers
 - ▶ Requirements analysis and negotiation – check clarity and completeness, resolve issues
 - ▶ Requirements specification – document with text, sometimes with use cases and scenarios
 - ▶ Functional analysis
 - ▶ Requirements validation
 - ▶ Requirements management



Requirements Management

- Requirements Engineering involves:
 - ▶ Requirements elicitation
 - ▶ Requirements analysis and negotiation
 - ▶ Requirements specification
 - ▶ Functional analysis
 - ▶ Requirements validation
 - ▶ Requirements management – continuous activity, traceability, requirement change handling



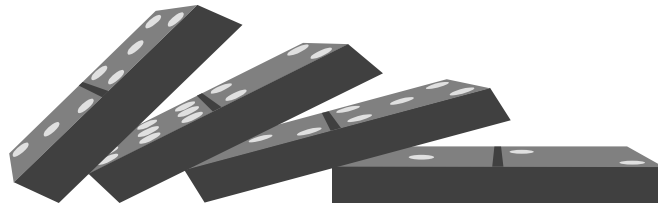
Requirements Definition and Management

- Requirements Engineering involves:
 - ▶ Requirements elicitation
 - ▶ Requirements analysis and negotiation
 - ▶ Requirements specification
 - ▶ Functional analysis
 - ▶ Requirements validation
 - ▶ Requirements management



Requirements Challenges

- Misunderstood requirements by stakeholders and analysts
- Poorly expressed requirements
- Misunderstanding or omission by development
- Missed test coverage
- Requirement change impact misunderstandings



Modeling in Requirements Engineering

- Requirements Engineering involves:
 - ▶ Requirements elicitation
 - ▶ Requirements analysis and negotiation
 - ▶ Requirements specification
 - ▶ Functional analysis
 - ▶ Requirements validation
 - ▶ Requirements management



Requirements Engineering defined

Model Based Functional Analysis defined

Rational solution



Model Based Systems Engineering (MBSE)

- A Systems Engineering analysis and design practice
- A visual approach to understanding requirements and realizing them into a robust system design
- Helps manage complexity through the use of abstraction and separation of concerns



2 Functional Requirements

2.1 Power car

2.1.1 Move car

2.1.1.1 Move forwards

The car shall be able to move forwards at all speeds from 0 to 200 kilometers per hour on standard flat roads with winds of 0 kilometers per hour, with 180 BHP.

2.1.1.2 Move backwards

The car shall be able to move backwards to a maximum speed of 20 Kilometers per hour on standard flat roads with winds of 0 kilometers per hour, with 180 BHP.

2.1.2 Accelerate car

The car shall be able to accelerate from 0 to 100 Kilometers per hour in 10 seconds on standard flat roads with winds of 0 kilometers per hour.

The car shall be able to accelerate from 100 to 150 kilometers per hour at a rate of 5 kilometers per second on standard flat roads with winds of 0 kilometers per hour.

The car shall be able to accelerate from 150 to 200 kilometers per hour at a rate of 3 kilometers per second on standard flat roads with winds of 0 kilometers per hour.

2.2 Control car

2.2.1 Switch on car

The car shall be able to discriminate which authorized people shall be able to switch on and operate the car.

2.2.2 Control speed

The car shall have a foot mechanism to control the speed of the car.

The speed control shall be infinitely variable from zero to maximum speed.

The speed of the car shall be controllable by automatic means.

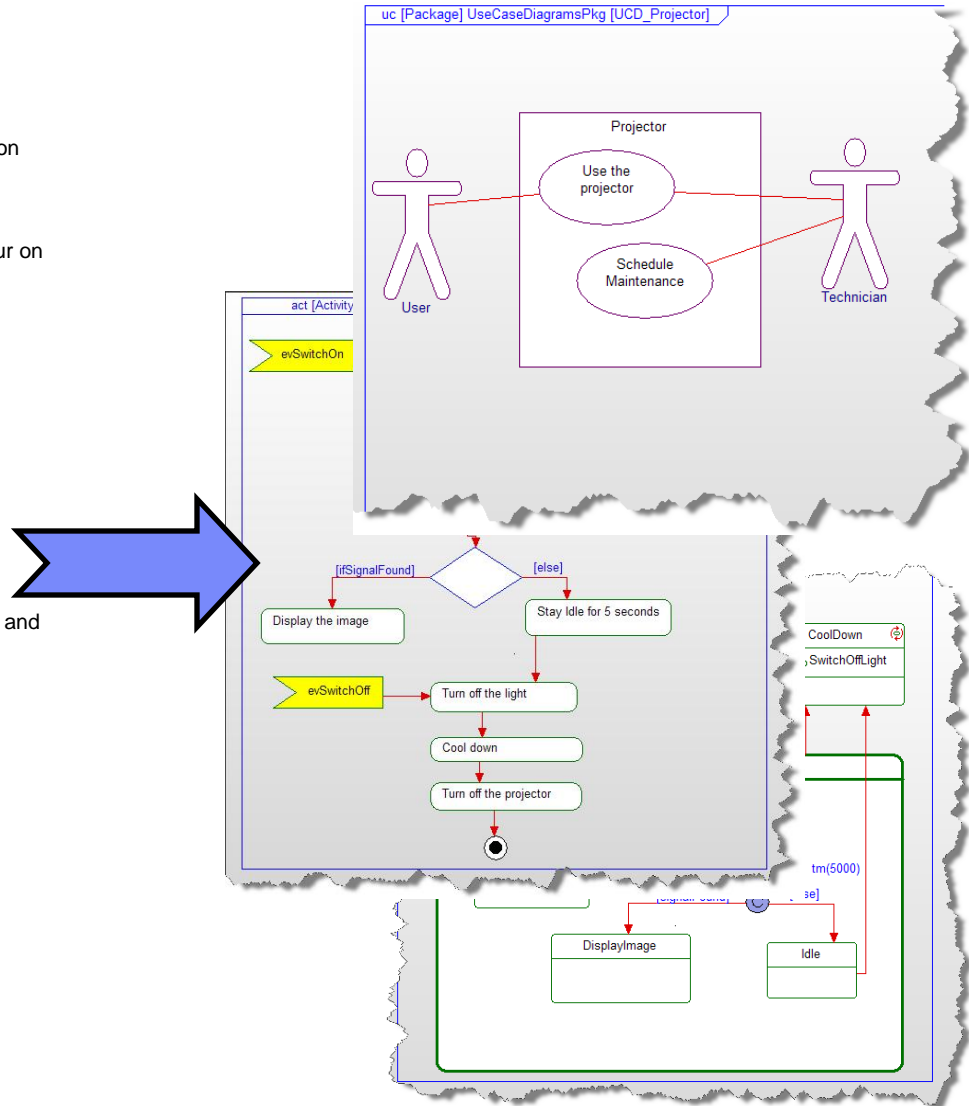
2.2.3 Brake car

The car shall be able to stop from 10 kilometers per hour to 0 kph in 2 seconds.

The car shall be able to stop from 30 kilometers per hour to 0 kph in 6 seconds.

The car shall be able to stop from 100 kilometers per hour to 0 kph in 30 seconds.

The car shall be able to stop from 200 kilometers per hour to 0 kph in 45 seconds.



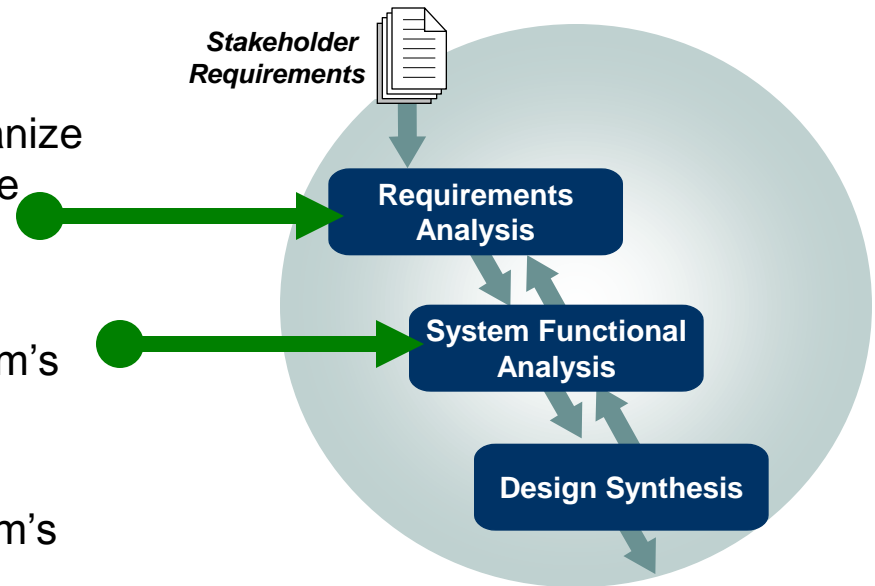
Modeling in Requirements Engineering

- Requirements Engineering involves:
 - ▶ Requirements elicitation
 - ▶ Requirements analysis and negotiation
 - ▶ Requirements specification – use cases and scenarios for describing user interactions
 - ▶ Functional analysis – functional flows, interface definition, documented rationale
 - ▶ Requirements validation – testing of requirements through model execution
 - ▶ Requirements management



Systems Engineering workflow

- ▶ MBSE complements traditional requirements analysis techniques
 - During Requirements Analysis, we organize requirements into functional groups (use cases)
 - During Functional Analysis, we identify system functions and explore the system's dynamic behavior using sequence diagrams and model execution
 - refines and improves upon the system's requirements



Requirements Engineering defined

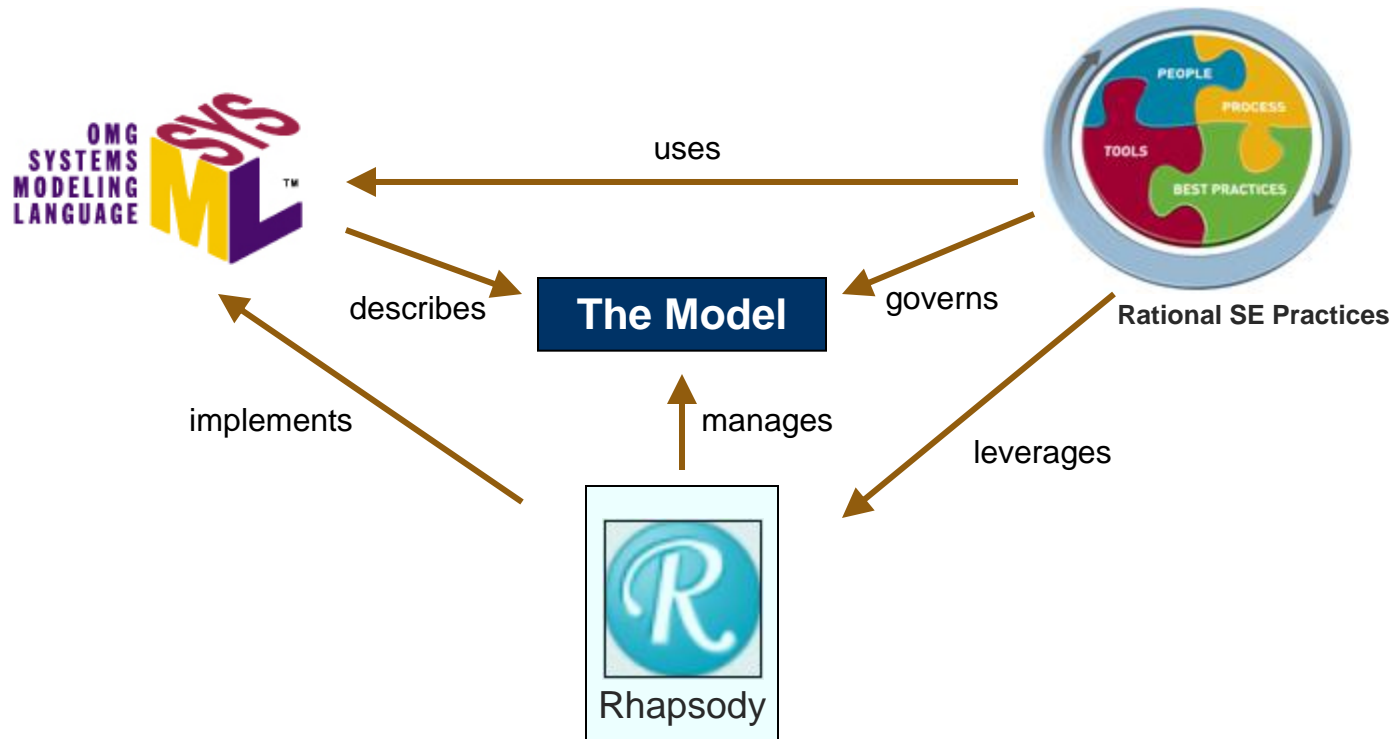
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Model Based Systems Engineering (MBSE) at Rational

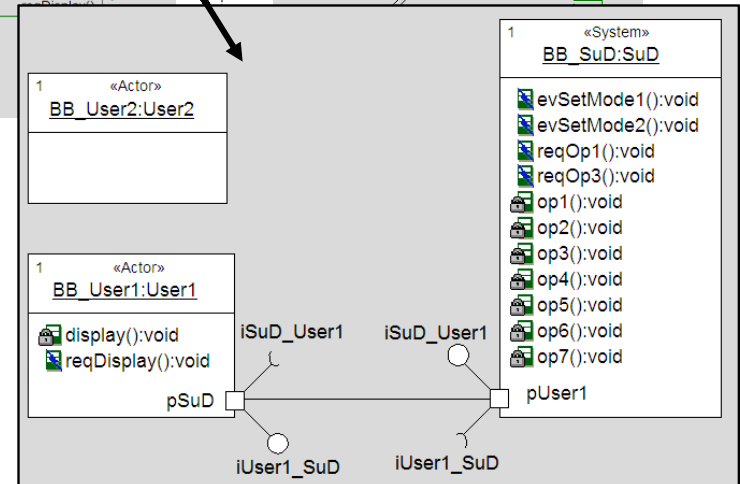
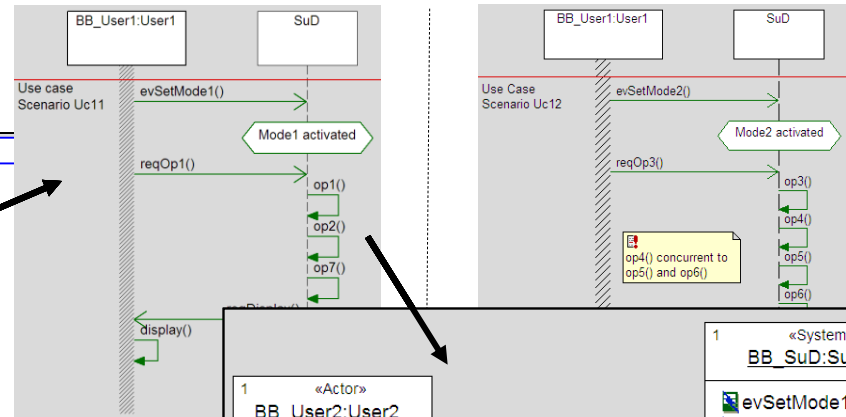
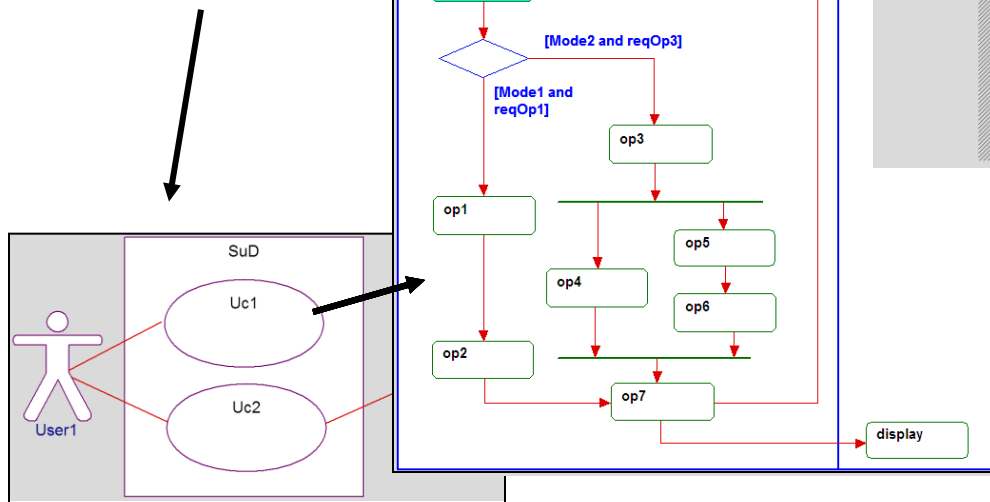
- MBSE is a standards based Systems Engineering practice that incorporates:
 - ▶ **Modeling language** – SysML
 - ▶ **Modeling process** – Rational Systems Engineering Practices
 - ▶ **Modeling tools** – Rhapsody Designer for Systems Engineers



Rational SE Practices provide step-by-step guidance

- Model Based Systems Engineering complements traditional requirements analysis techniques
 - during Requirements Analysis, we organize requirements into functional groups (use cases)
 - during Functional Analysis, we identify system functions and explore the system's dynamic behavior using sequence diagrams and model execution
 - After Functional Analysis, during Architectural Design, system operations are allocated to decomposed architectures

Object Id	Detailed Specifications of Requirements for Engineering Purposes
FR-181	The GDIDEMO Application shall supply the menu selections: Demo, Arrange and Help.
FR-140	The GDIDEMO shall supply the Demo menu selection in the Menu bar as the left-most item.
FR-141	The Demo menu selection shall offer the Random Shapes .
FR-182	The Demo menu selection shall offer the Random Shapes and PolyBezier .



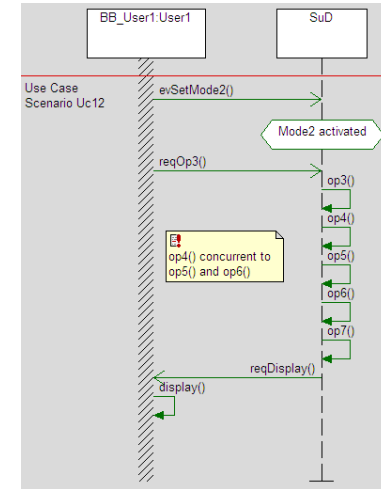
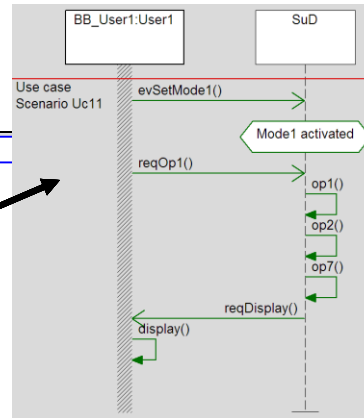
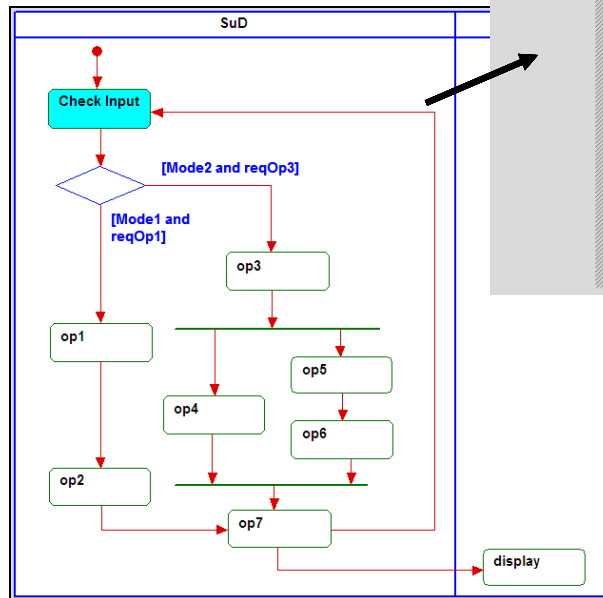
Activity view versus sequence diagram view

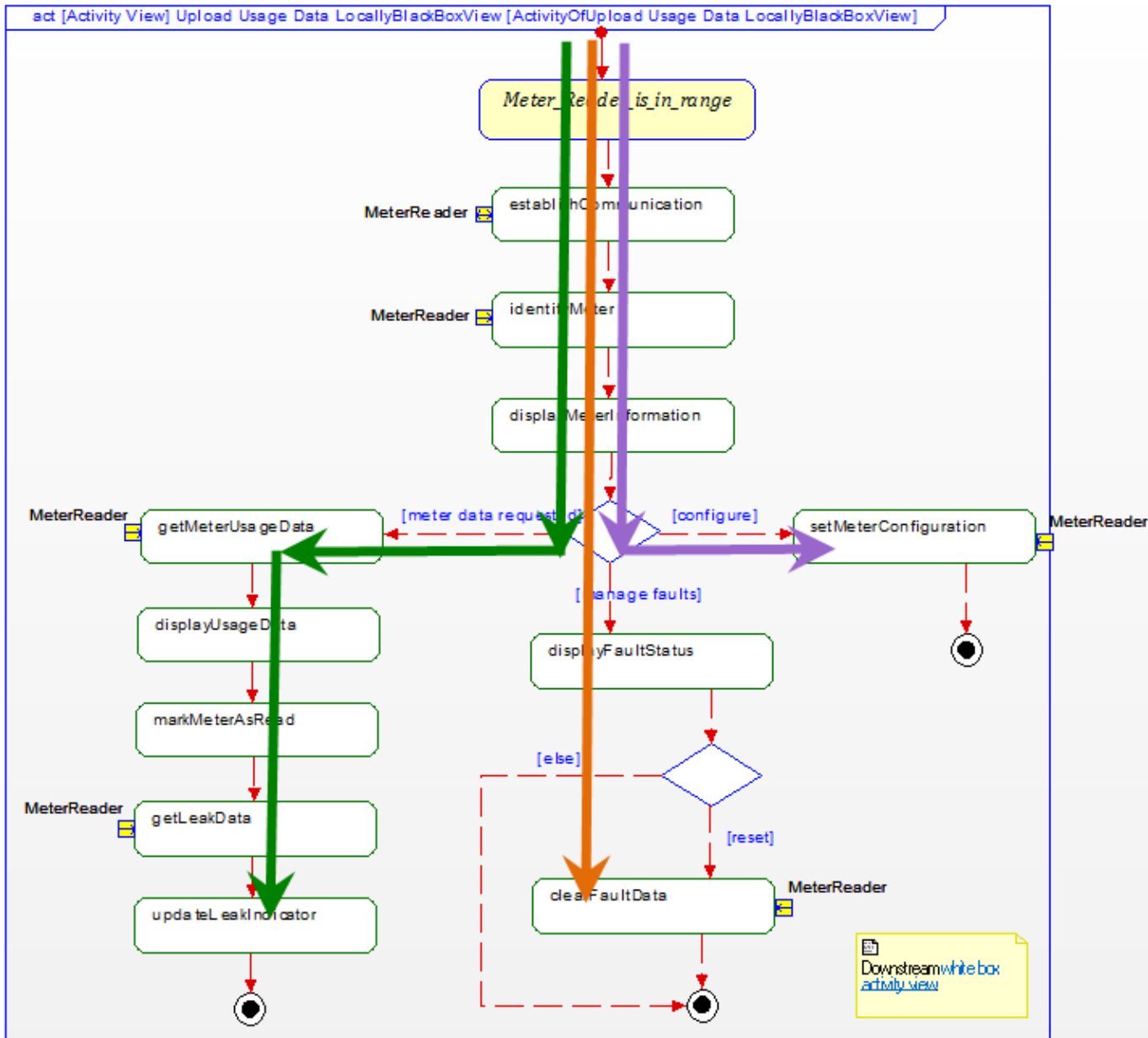
- The Activity View:

- ▶ Identifies:
 - The functional flow – major scenarios
 - The system functions
 - Where communication may occur
- ▶ Focuses on internal functionality

- The Scenario View:

- ▶ Is represented using a Sequence Diagram
- ▶ The nature of the communication
- ▶ Focuses on external communication





Summary

- Model Based Systems Engineering (MBSE) complements traditional requirements definition and management techniques
- Rational provides a SysML-based Systems Engineering practice library with application guidance, including for compliance with functional safety standards
- Functional Analysis ...
 - ▶ is a Requirements Engineering activity
 - ▶ emphasizes the transformation of functional system requirements into a coherent and dynamic description of system functions
 - ▶ improves upon the quality of system requirements





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