Telelogic
An IBM Company

Frontiers 2008 Panel
Georgia Tec, 05-13-08

"Tool Vendor Perspectives – SysML Thus Far"

Hans-Peter Hoffmann, Ph.D

Chief Systems Methodologist
Telelogic, Systems & Software Modeling Business Unit

Peter.Hoffmann@telelogic.com

Telelogic
An IBM Company

Tool Vendor Perspectives – SysML Thus Far

- SysML defines the standardized “vocabulary” of the language for model-based systems engineering. As a standard, this vocabulary needs to cover all possible applications.
- SysML does not specify, how to apply these “words”.
- Systems engineering is strongly communication-driven.
  Systems engineers have to communicate with stakeholders from different domains, e.g.
  - mechanical engineers
  - electrical engineers
  - software engineers,
  - test engineers, and not to forget
  - customers, who not necessarily have an engineering background.
- In such an environment it is paramount to keep the language domain independent and easy understandable.
- Compliance to a standard does not mean that all elements of this standard have to be applied.
- It is recommended to *standardize* the usage of the SysML within the organization, if a company wants to deploy SysML-based systems engineering.

Tool Vendor Perspectives – SysML Thus Far

- In many cases, customers - even if they are quite familiar with the SysML - struggle with the usage of the appropriate SysML diagrams because there is an overlap between the different diagrams.
- Key for a successful usage of the SysML is a *systems engineering process* that is an integral part of the model-driven development (MDD) process.
- The systems engineering process should define the essential SysML artifacts that are needed to enable a seamless transition to the subsequent HW/SW development, e.g.

  Telelogic Integrated System/Embedded Software Development Process Harmony.
- Our recommendation is, that the OMG, INCOSE, and associated groups should address this issue in respective forums.

Tool Vendor Perspectives – SysML Thus Far

- Key requirement for model-based systems engineering is *model execution*.
  - In the functional analysis phase, model execution assures that the requirements are correct, complete, and unambiguous.
  - In the design synthesis phase, model execution verifies and validates the system architectural design incl. associated interfaces.
- The OMG is working on this topic. The Telelogic tool *Rhapsody* already supports model execution. Important is, that model execution does not require that the user has to write code.
- With regard to model execution, SysML parametric diagrams also need to be executable.
- Currently, engineers put a lot of effort in to produce a decent parametric diagram, but it does nothing as a result of all this work.
  What is gained is an understanding of the mathematical principles which govern a particular problem, but it cannot be taken any further.

Backup Slides

Telelogic
An IBM Company

Rhapsody 7.2
Advances in Systems Engineering

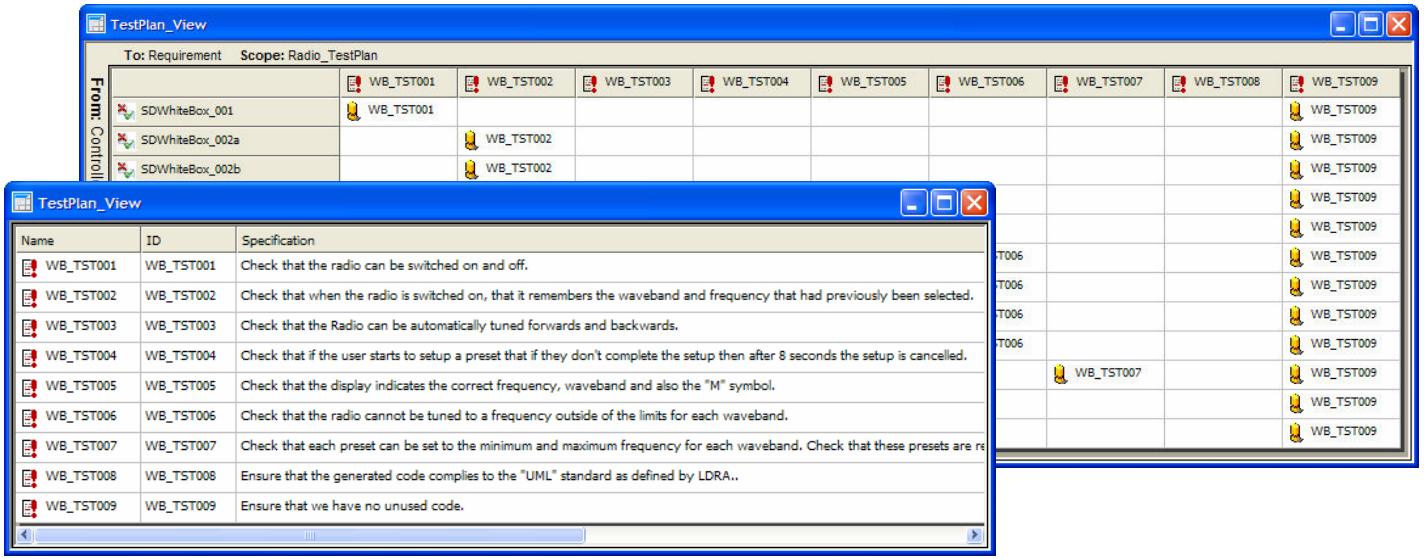
Telelogic
An IBM Company

Advances in Systems Engineering

- OMG SysML™ 1.0 enhancements to better organize and communicate information effectively
  - Requirements Tables, Allocation Tables, N-2 Matrix
  - Value Types, Dimensions, Units help in trade study analysis
  - XMI 2.1 for SysML
    - Independently certified by NIST (National Institute of Standards and Technology)
- Improved design consistency
  - Improved user interface to pinpoint design errors in model
  - Create customizable checks to ensure compliance to company/project standards
- Integrated graphical panels validate design correctness

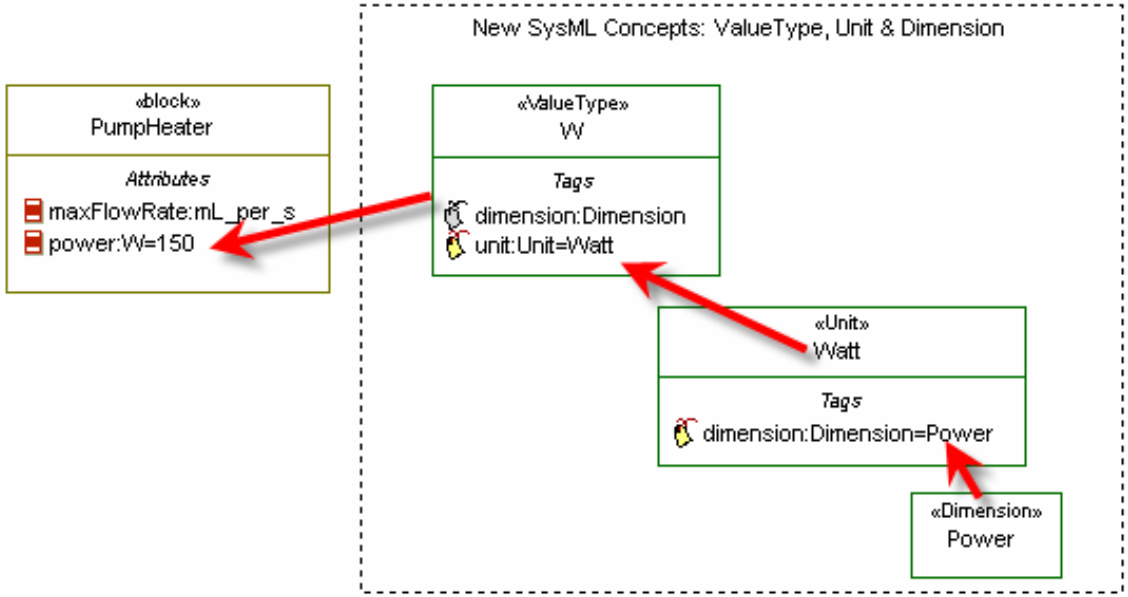
Tables and Matrix Views

- Organize large amounts of information concisely
- Requirements tables summarize requirements information
- Allocation tables show key information — how blocks are allocated
- N-2 matrices show how model elements are connected
- Define tables and matrices to organize any desired information



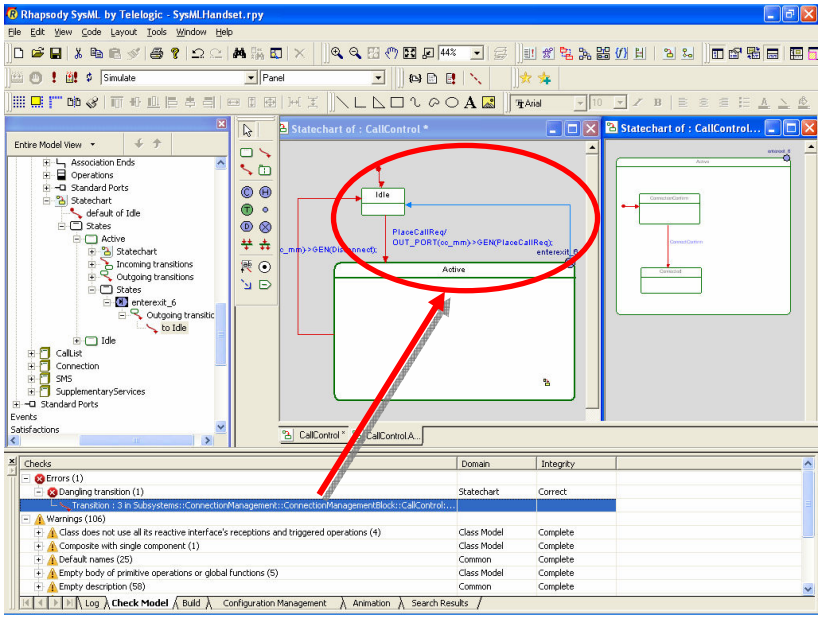
Value Types, Units, Dimensions

- Model physical dimensions and measurement units
- Enable trade study analysis of different designs by comparing units
- Ensure proper units are being used for system integration and parametrics
- Standard SI library includes standard units



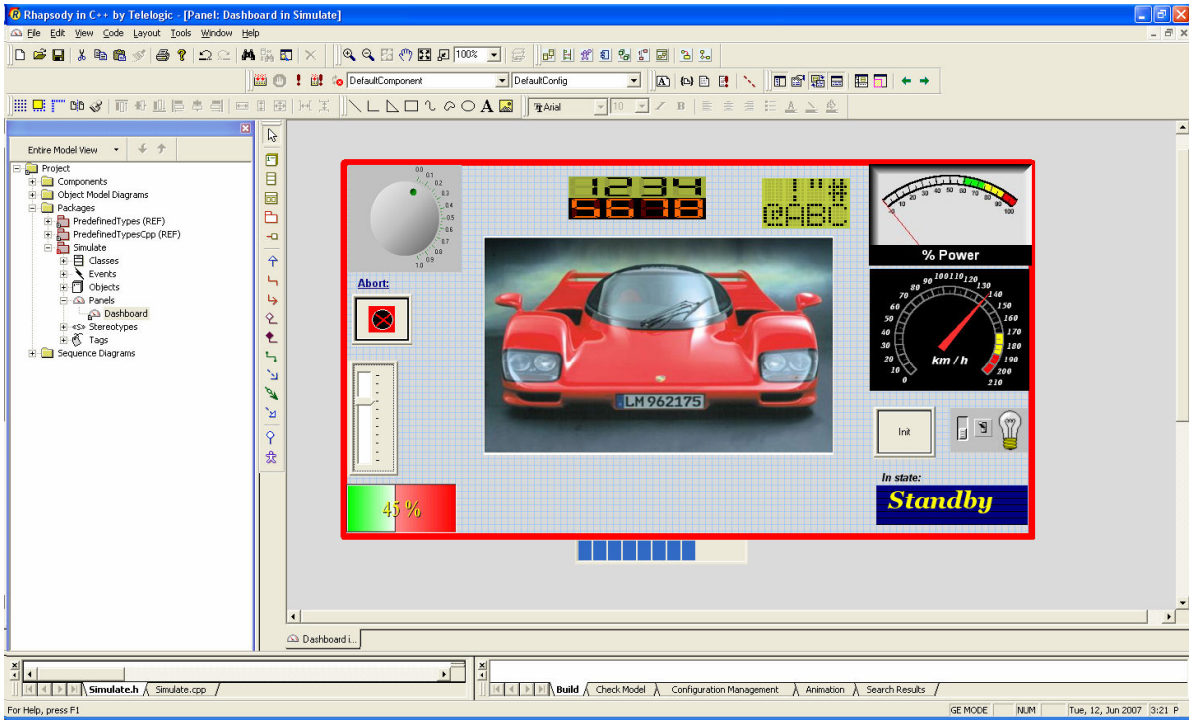
Improved Model Consistency Checks

- Check for completeness, model integrity and correctness of the design
- Design quality into the model
- Configure the check model dialog easily
- Navigate directly to model errors
- Include your own check scripts to ensure the design meets your company standards



Graphical Panels

- Create mock ups of interface to effectively communicate intended design behavior to customers
- Easily modify, monitor and analyze data values during simulation to ensure the design is correct early in the process



Telelogic

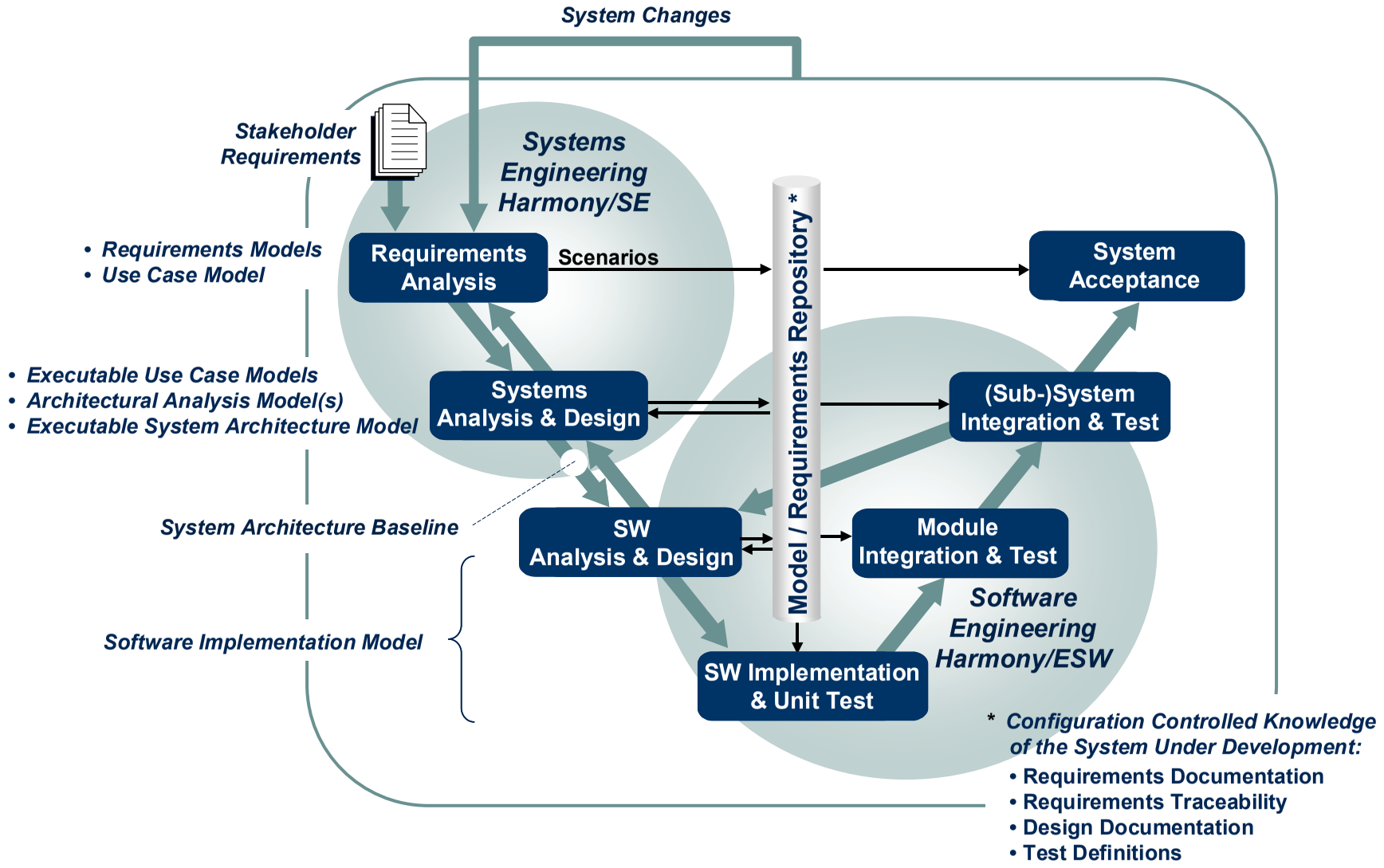
An IBM Company

Harmony/SE
Model-Based Systems Engineering

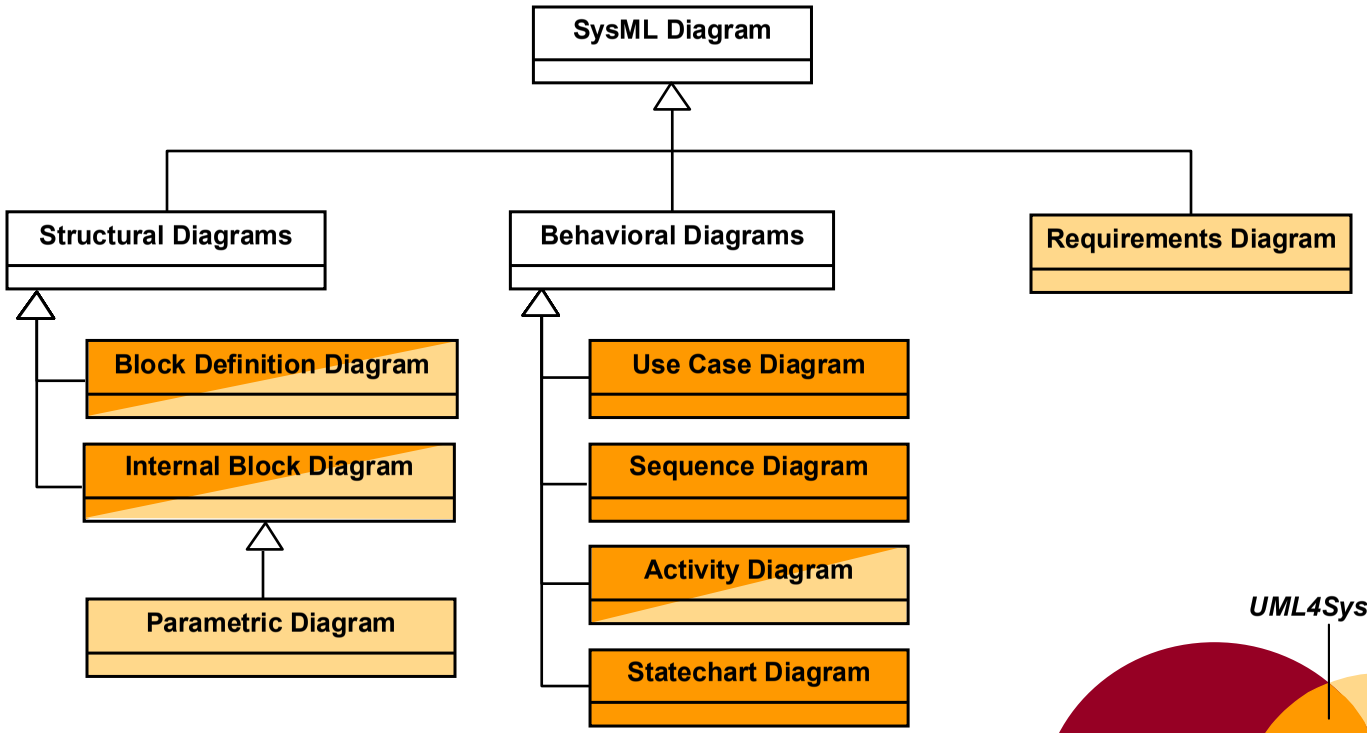
Telelogic
An IBM Company

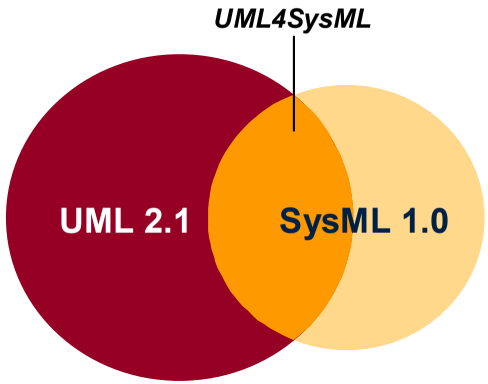
Integrated System / Embedded Software Development Process *Harmony*

Model-Driven Development of Embedded Systems



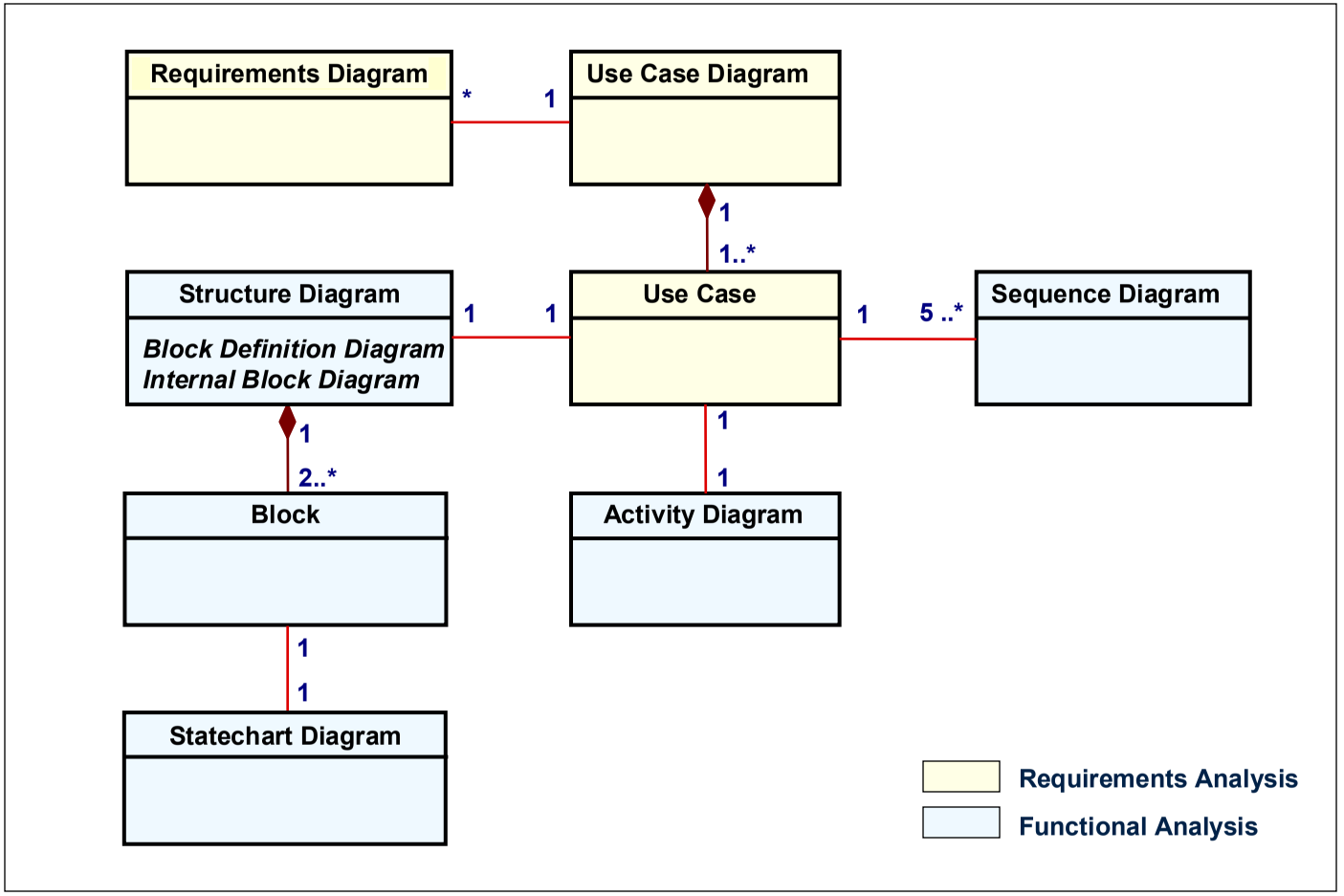
Essential SysML Artifacts for Model-Based Systems Engineering



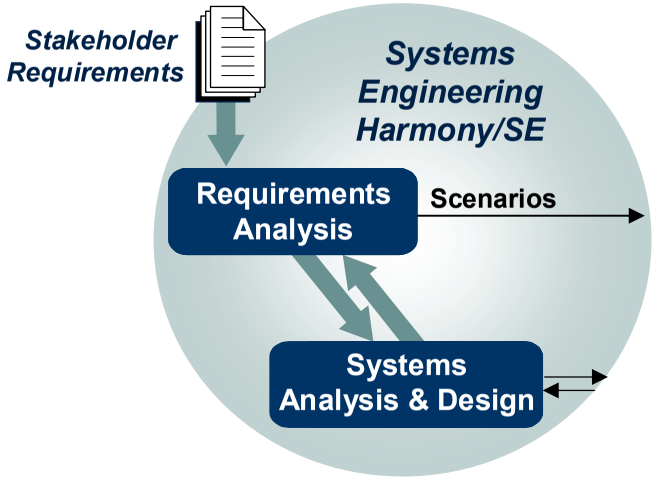


Model-Based Systems Engineering (*Harmony/SE*)

Artifact Relationships at the Requirements Analysis / Functional Analysis Level



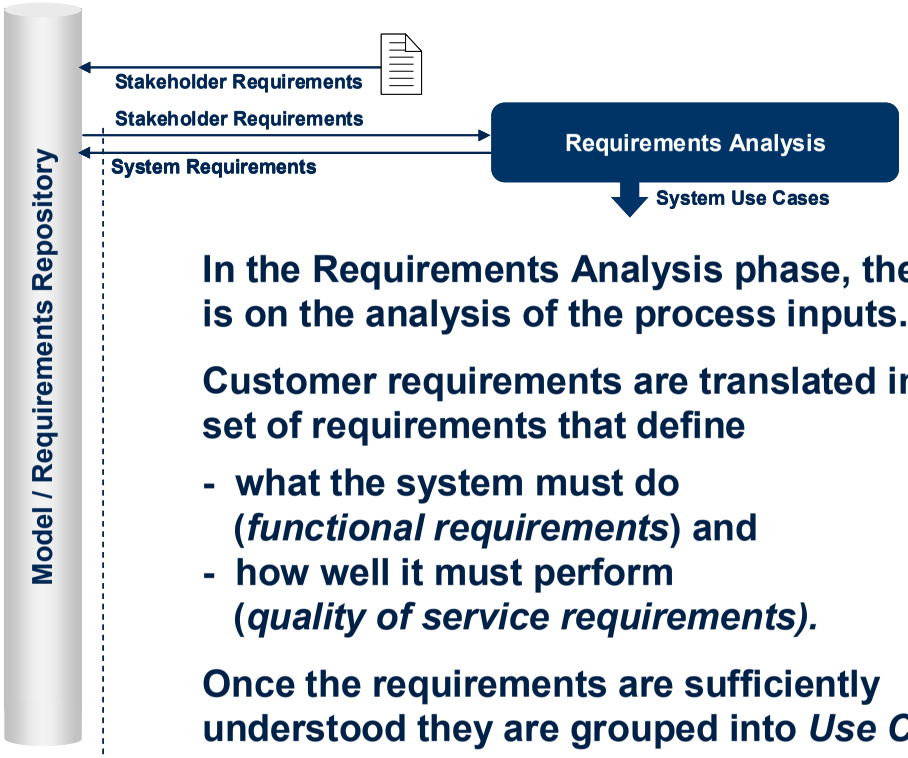
Key Objectives of the Model-Based Systems Engineering Process *Harmony/SE*



- Identify / derive required system functionality
- Identify associated system modes and states
- Allocate system functionality / modes to a physical architecture

Model-Based Systems Engineering (*Harmony/SE*)

Requirements Analysis



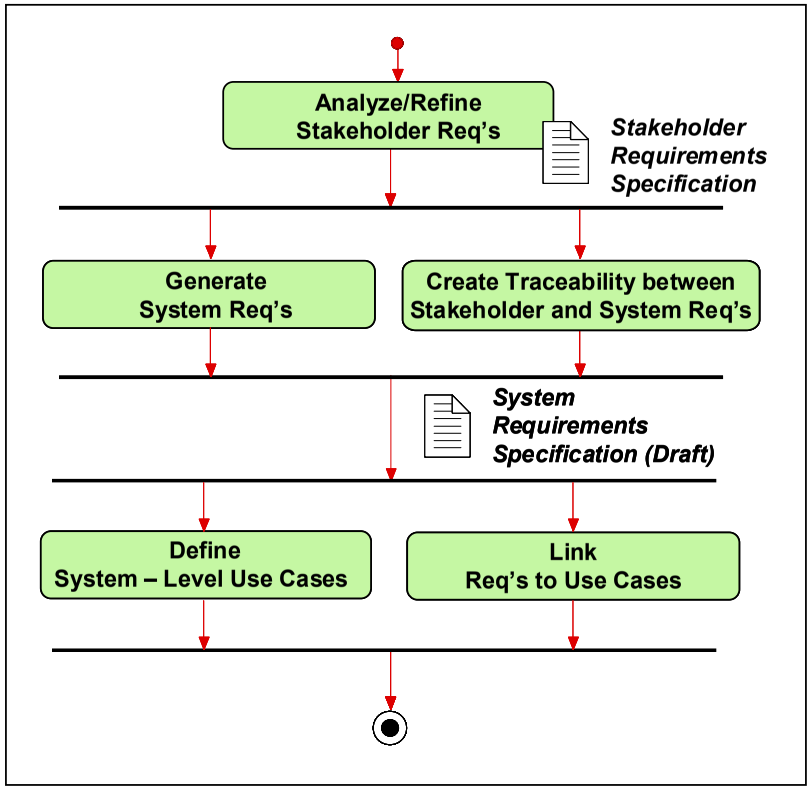
In the Requirements Analysis phase, the focus is on the analysis of the process inputs.

Customer requirements are translated into a set of requirements that define

- **what the system must do (*functional requirements*) and**
- **how well it must perform (*quality of service requirements).***

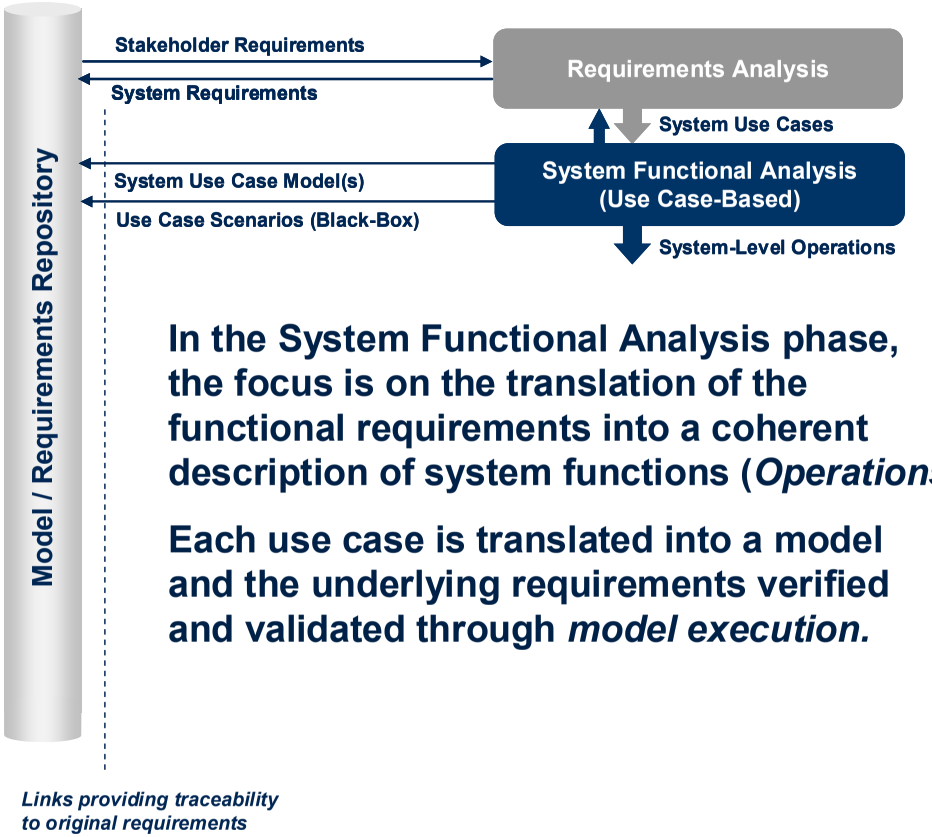
Once the requirements are sufficiently understood they are grouped into *Use Cases*.

Links providing traceability to original requirements



Model-Based Systems Engineering (*Harmony/SE*)

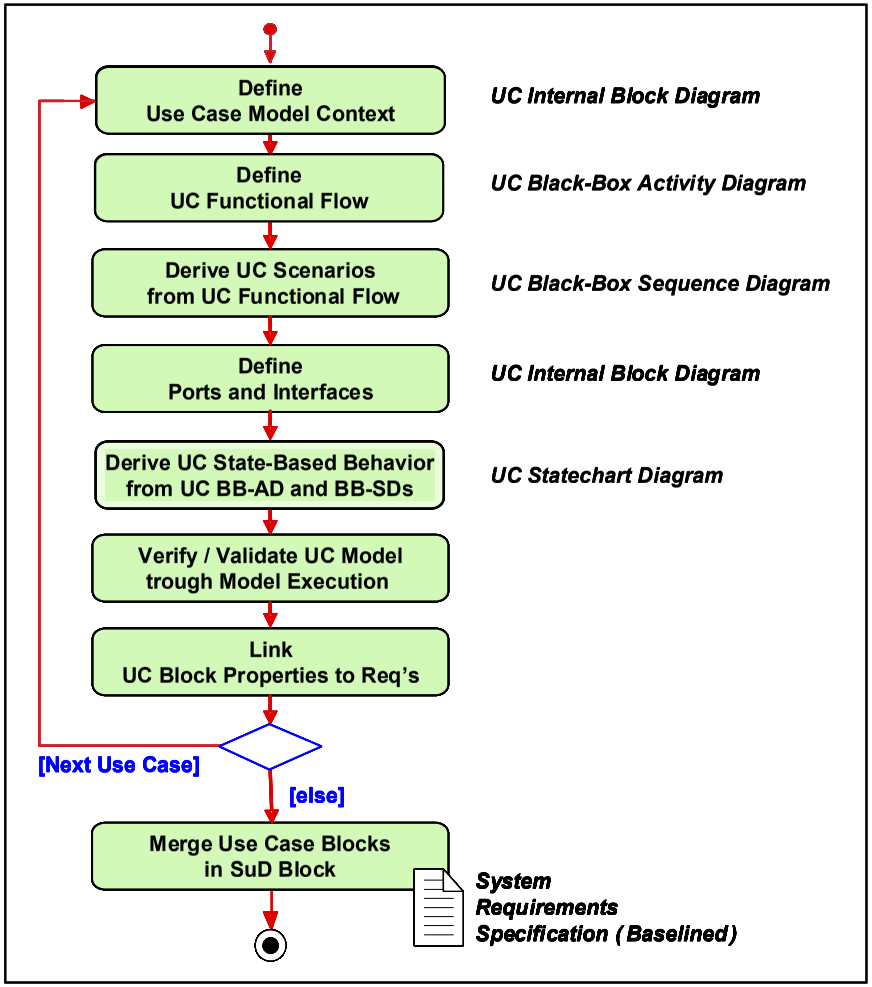
System Functional Analysis



Links providing traceability to original requirements

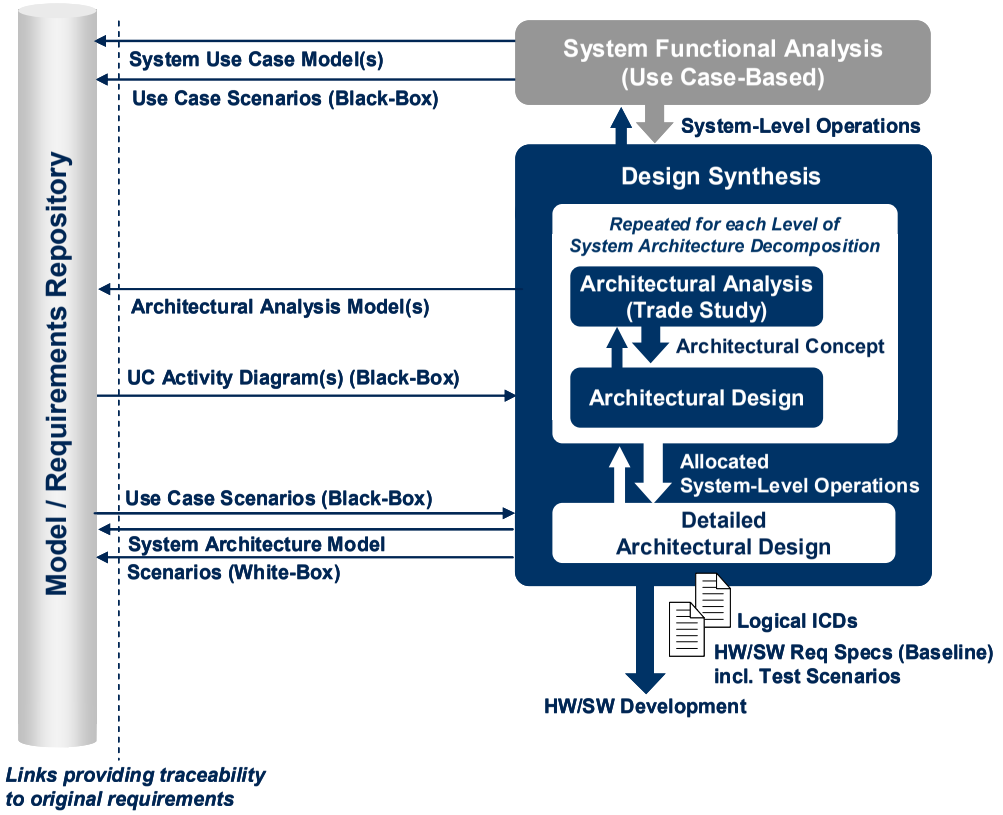
In the System Functional Analysis phase, the focus is on the translation of the functional requirements into a coherent description of system functions (*Operations*).

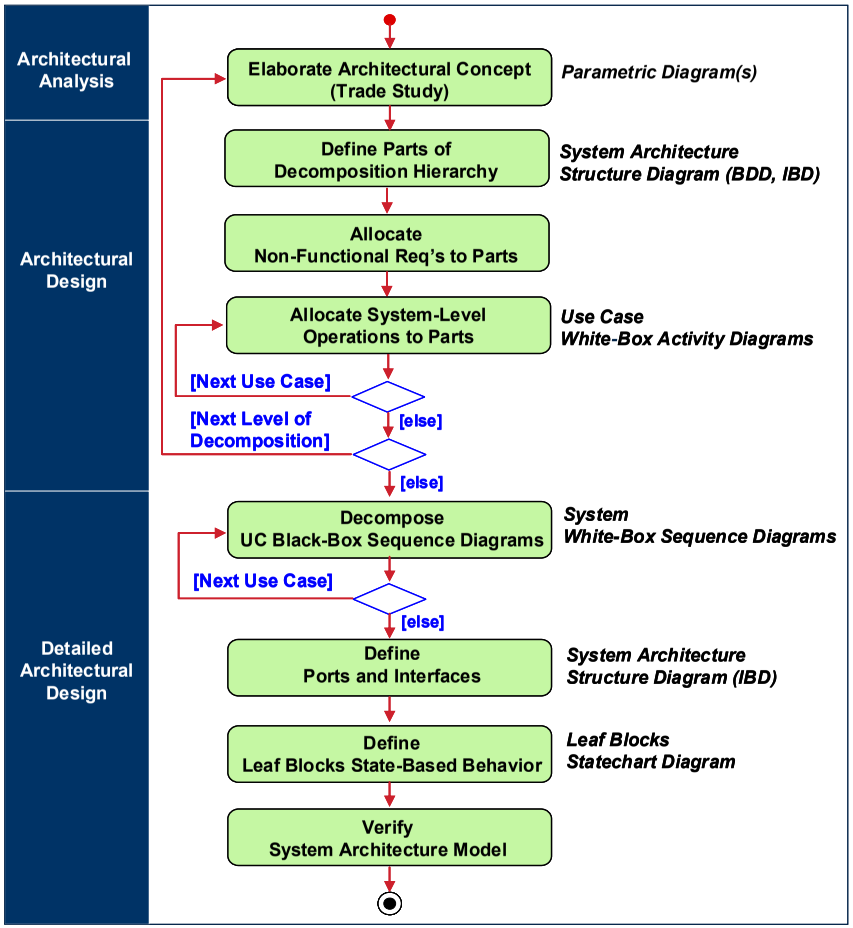
Each use case is translated into a model and the underlying requirements verified and validated through *model execution.*



Model-Based Systems Engineering (*Harmony/SE*)

Design Synthesis





In the Design Synthesis phase, the focus is on the allocation of system-level operations to a system architecture - optionally elaborated through trade studies - and on the definition of ports / interfaces and state-based behavior at the lowest level of the structural decomposition.

Model-Based Systems Engineering