Model-Based Systems Engineering → Semantics + Data Mining

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Overview

Part 1

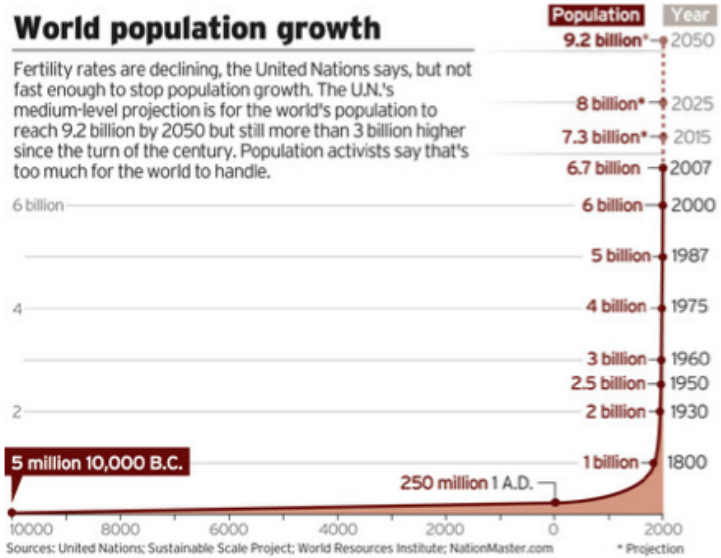
Systems Engineering Drivers

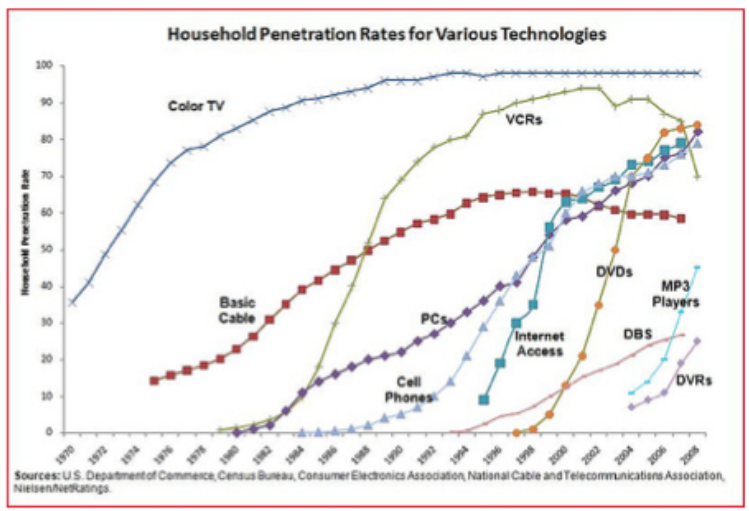
Need for Model-Based Systems Engineering (MBSE) and Software Development

Systems Engineering Drivers

Systems Engineering Drivers

- Increasing demand for limited resources;
- Rapid changes in technology;
- Fast time-to-market most critical;
- Increasing higher performance requirements;
- Increasing complexity of systems/ products;
- Increasing pressure to lower costs;
- Increased presence of embedded information and automation systems that must work correctly;
- Failures due to lack of systems engineering.

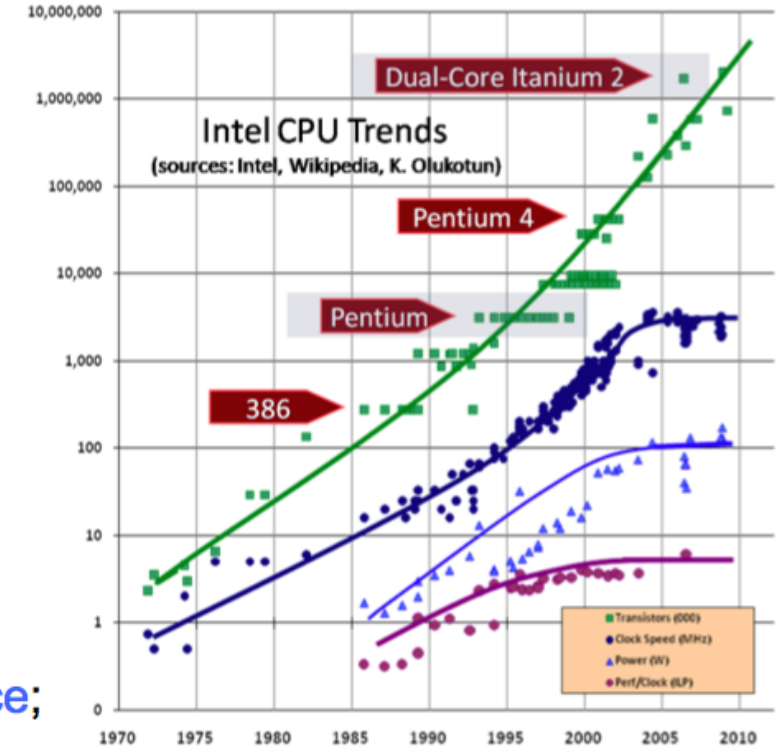




Systems Engineering Drivers

Features of a good design:

- Works correctly;
- Has a wide range of functionality;
- Has great performance;
- Is economical;
- Is resilient to attack;
- Easily adaptable to new functionality.



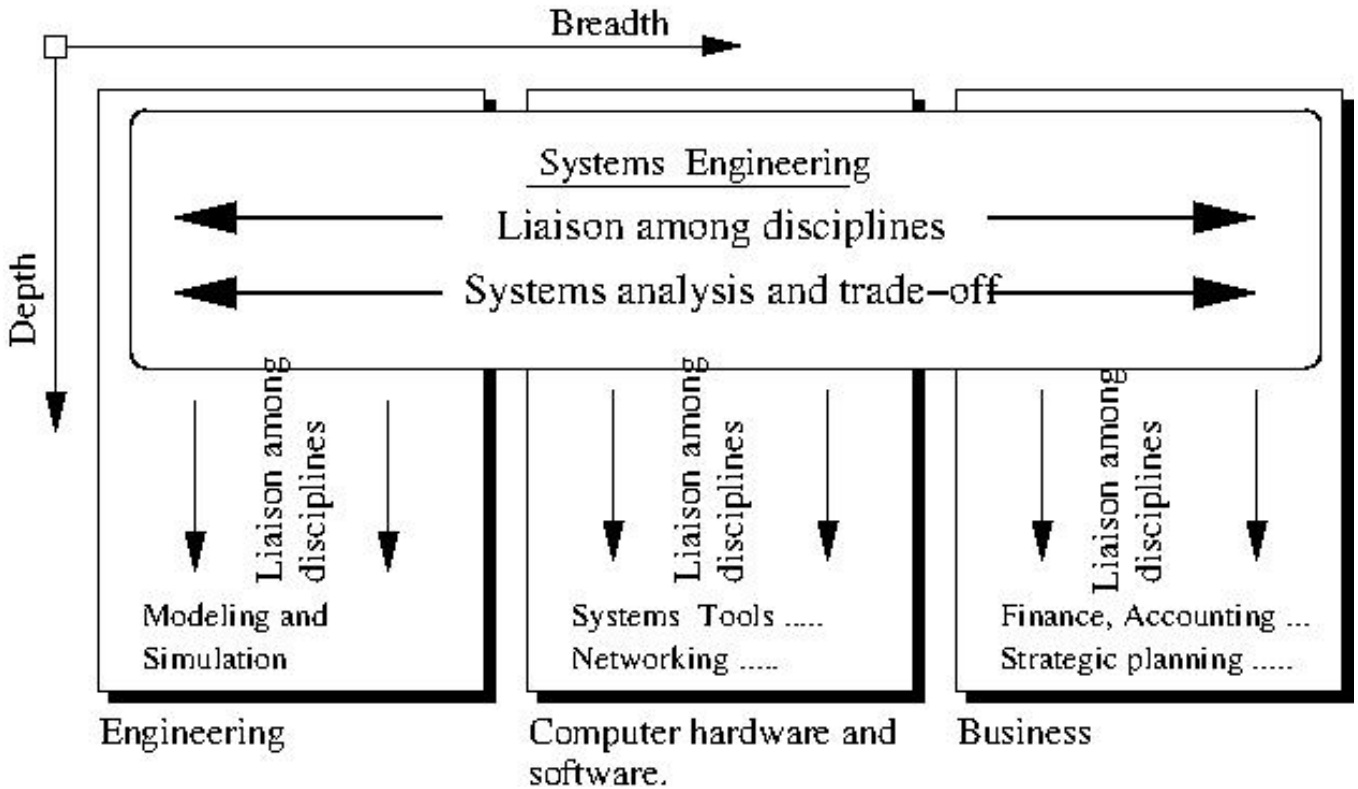
Opportunities for Systems Engineering

- Enhanced levels of attainable performance;
- Create new forms of functionality;
- Improved economics and operational efficiency (zero-energy)
- Improved resiliency and agility …
- New processes and supply chains for creating systems.

Model-based Systems Engineering

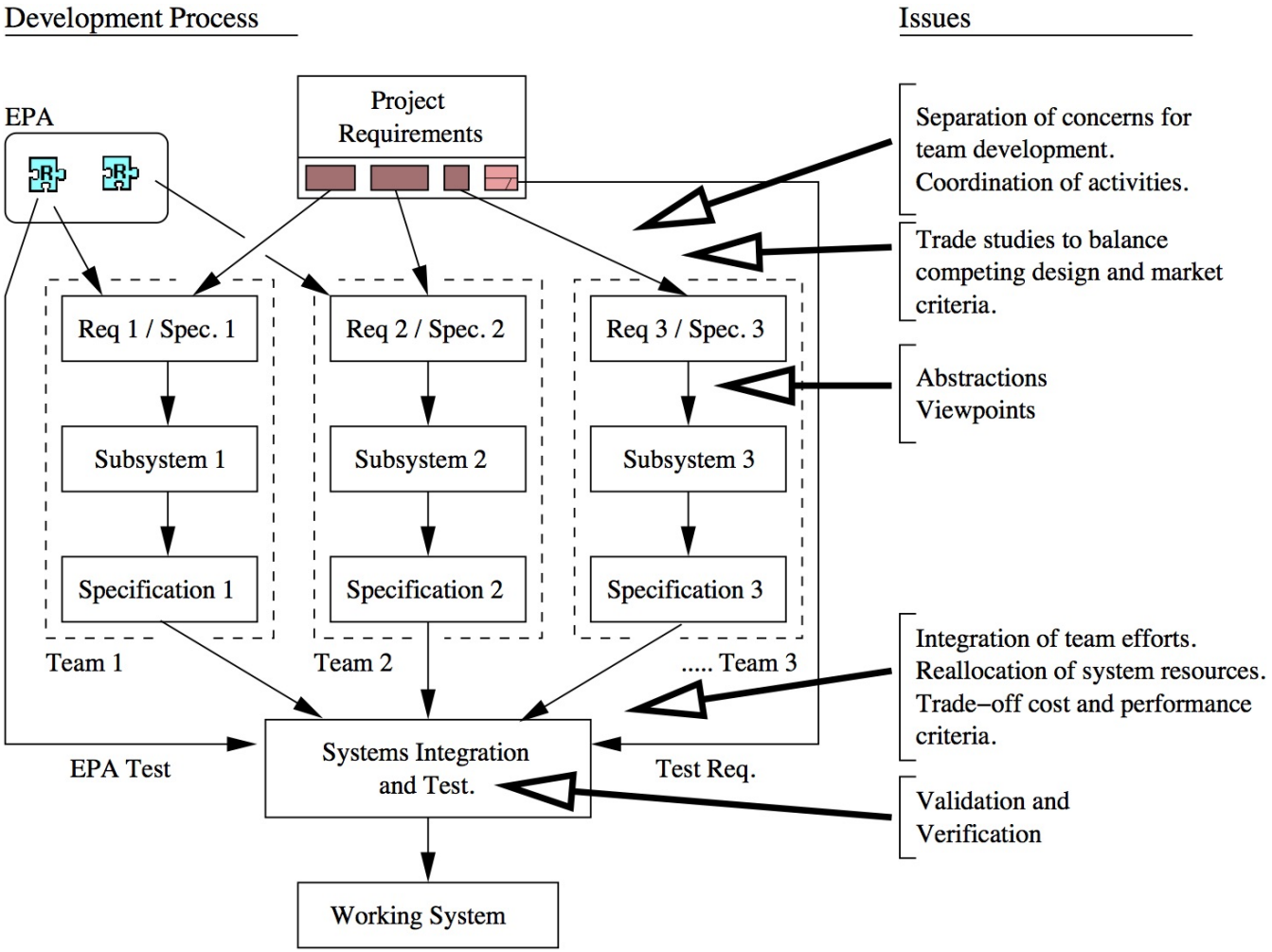
MBSE Concerns

Focus on liaison among disciplines supported by formal methods for systems analysis and design.



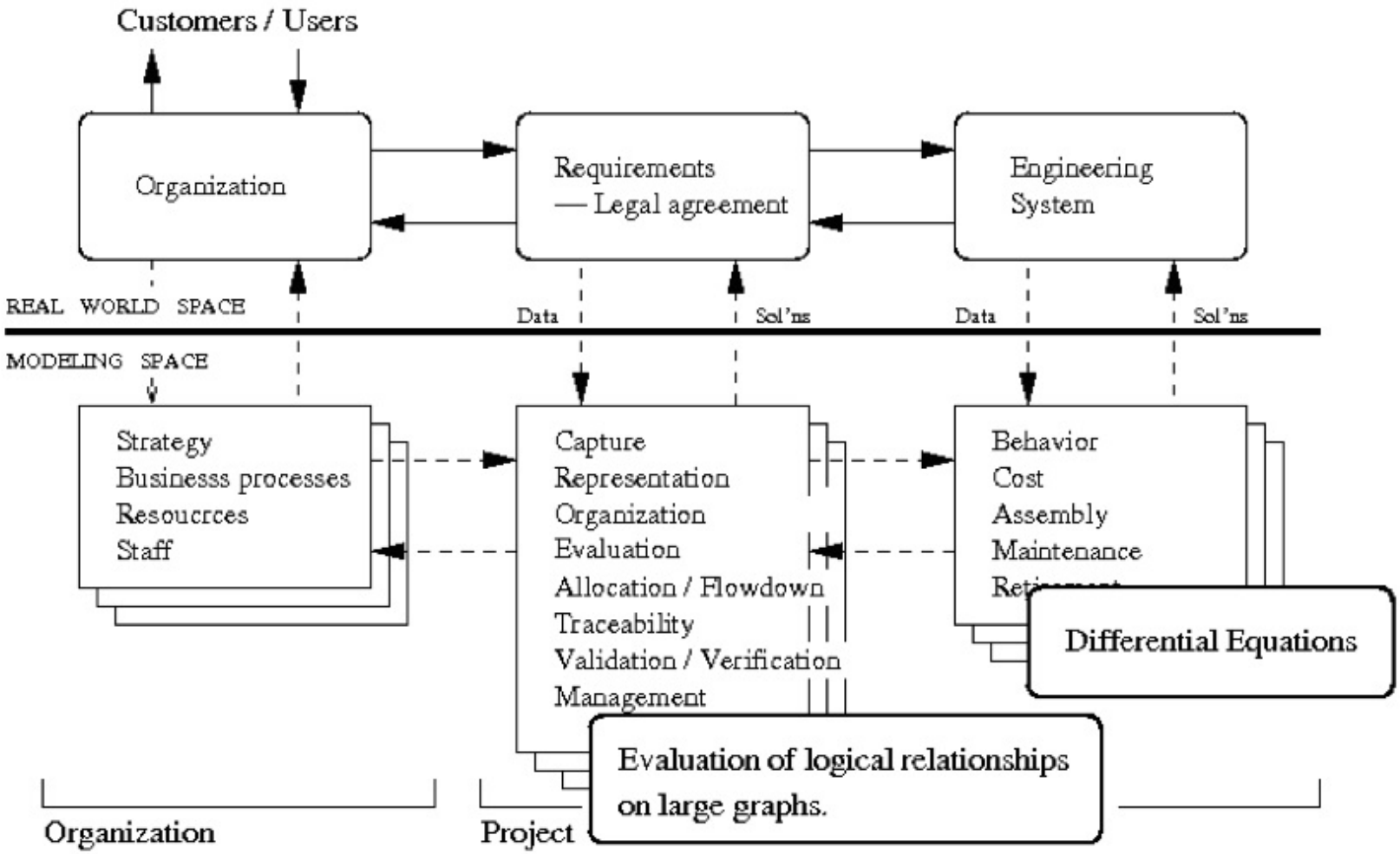
MBSE Concerns

Systems are developed by teams of engineers who must be able to understand one-another's work.



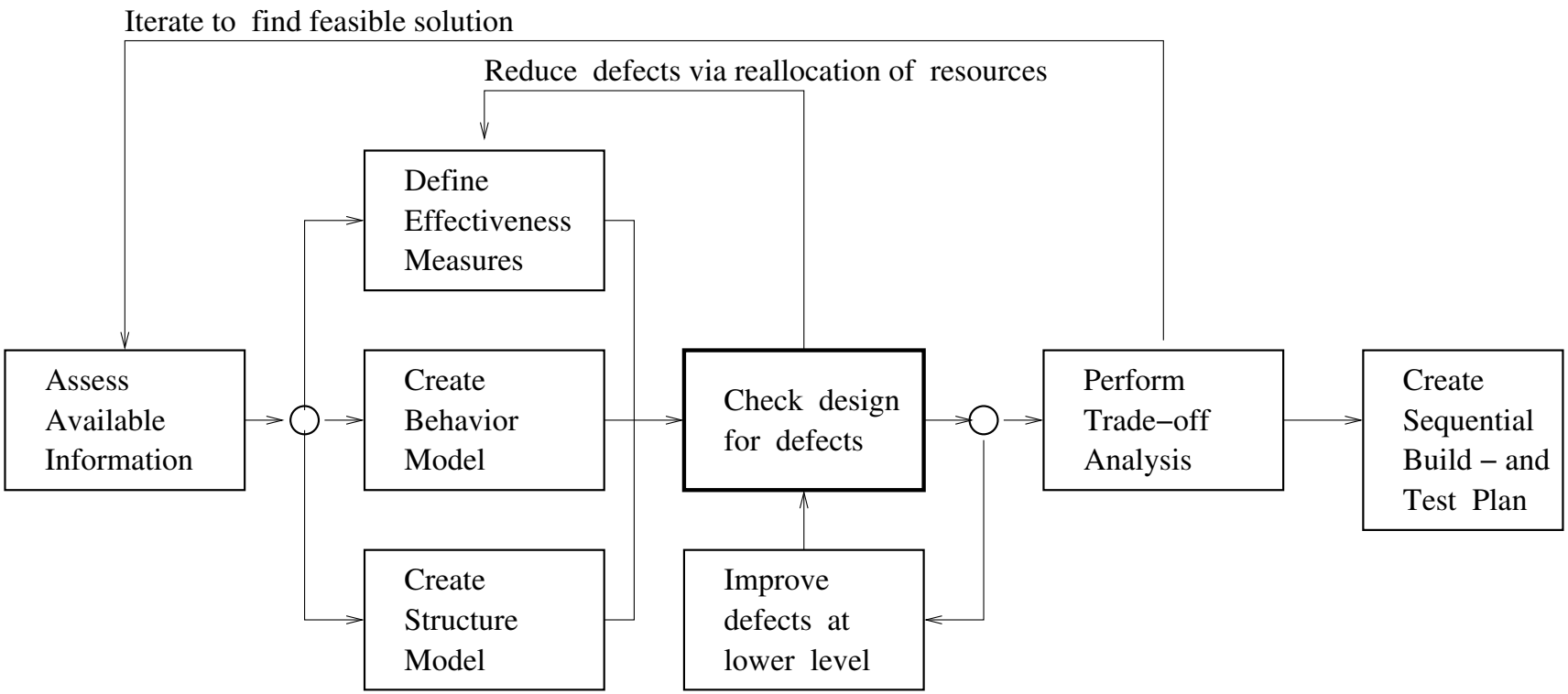
System Modeling Techniques

Organization-Requirements-Engineering Pipeline:



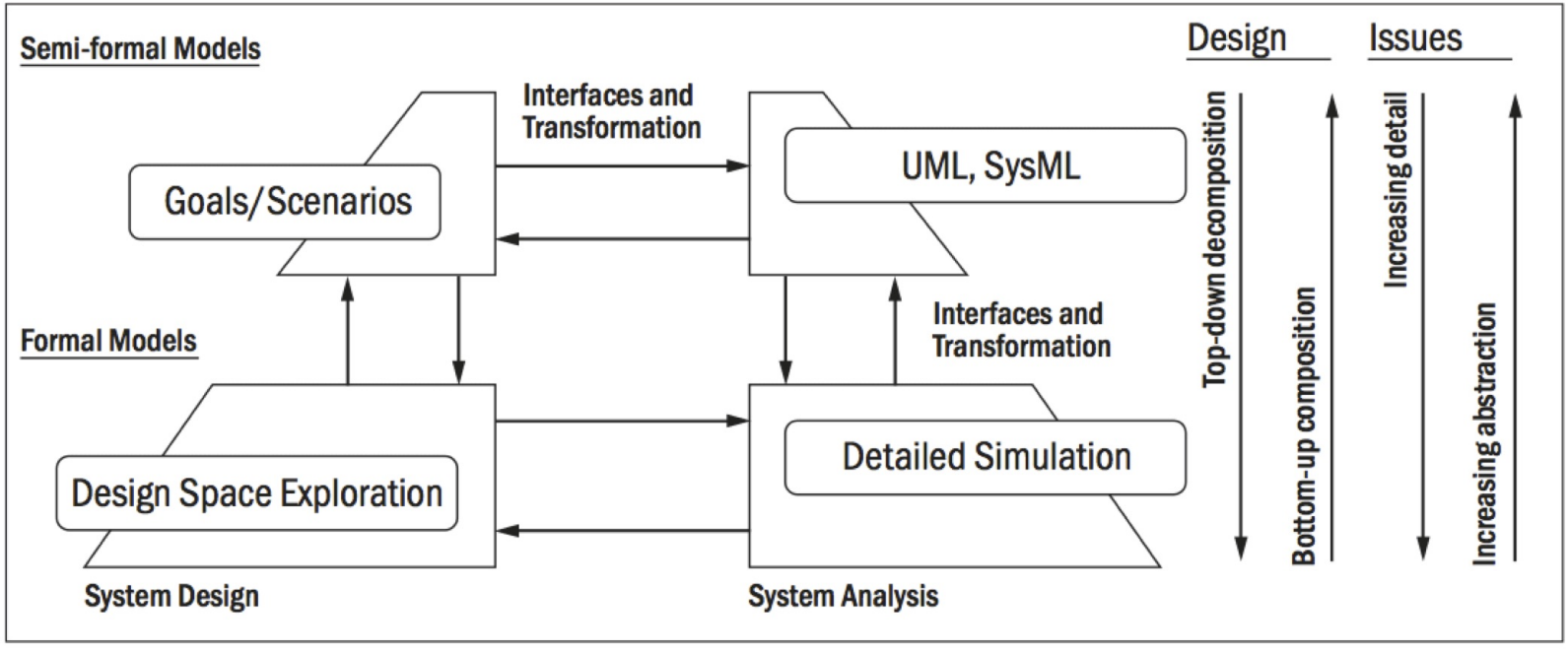
System Modeling Techniques

Core Technical Processes at General Electric:



System Modeling Techniques

Use multi-scale approaches to system modeling:



- Semi-Formal Models: View the complete system (efficiency).
- Formal Models: Detailed view of the actual system (accuracy).

System Modeling Techniques

Semi-Formal Models:

- Provide efficient representation of ideas (e.g., goals and scenarios) and preliminary/tentative design.

Formal Models:

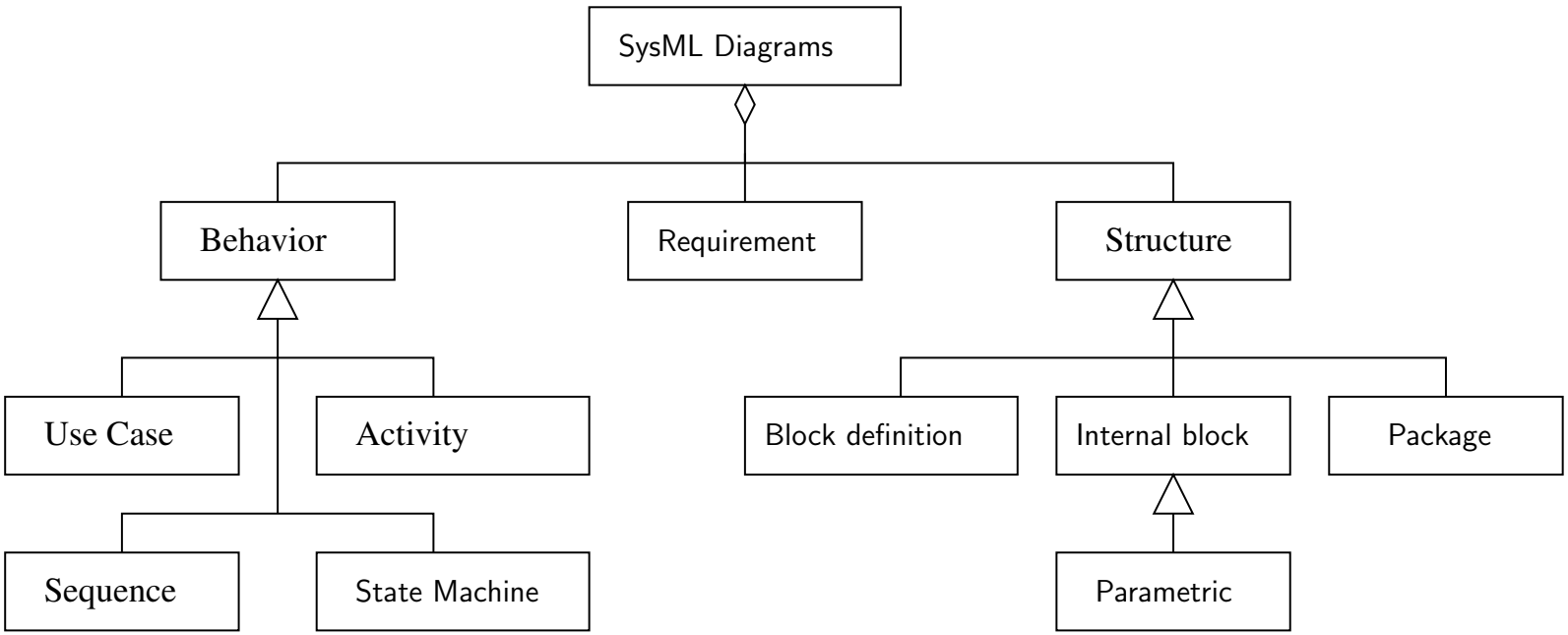
- Formal Models: To help prevent serious flaws in detailed design and operation, design representations and validation/verification procedures need to be based on formal languages having precise semantics.

Abstraction:

- Eliminate details that are of no importance when evaluating system functionality, system performance, and/or checking that a design satisfies a particular property.

System Modeling Techniques

Taxonomy of diagrams in SysML:



Pillars of SysML: Structure, Behavior, Requirements, and Parametric Diagrams.

INCOSE: MBSE Capability 2020-2025