Holistic Traceability within System Lifecycle

Best-Practice and Advancement potentials

Julien Mrowka | Dr. Chantal Sinnwell

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

Julien Raphael Mrowka

Product Architect for MBSE

julien.mrowka@siemens.com

Dr.-Ing. Chantal Sinnwell

Solution Architect for MBSE & MBPE

chantal.sinnwell@siemens.com

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

“It is the **relationships** between the elements that give the system its **added value**.”

(Eberhardt Rechtin)

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

Global megatrends and the need for understanding relational interdependencies in complex Systems of Systems

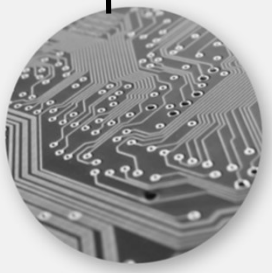
Lifecycle-spanning topics ask for a wider perspective in Systems Engineering.

“Digital” is the new standard for Systems like products, companies or infrastructure.

SD-X (software defined everything) is one of the key-paradigms and enabler for Smart Systems.

1. Sustainability

2. Interdependent World



3. Digital Transformation

4. Industry 4.0/ Society 5.0

5. Smart Systems

All megatrends have in common, that they add to the already high complexity of Systems as well as their Engineering.

6. Complexity Growth

Systems of Systems emerge and interrelate over boundaries of countries, industries and domains.

Systems Engineering successively extends its viewpoints to fields like Manufacturing or Lifecycle Engineering.

Adapted from INCOSE Systems Engineering Vision 2035, p. 3

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

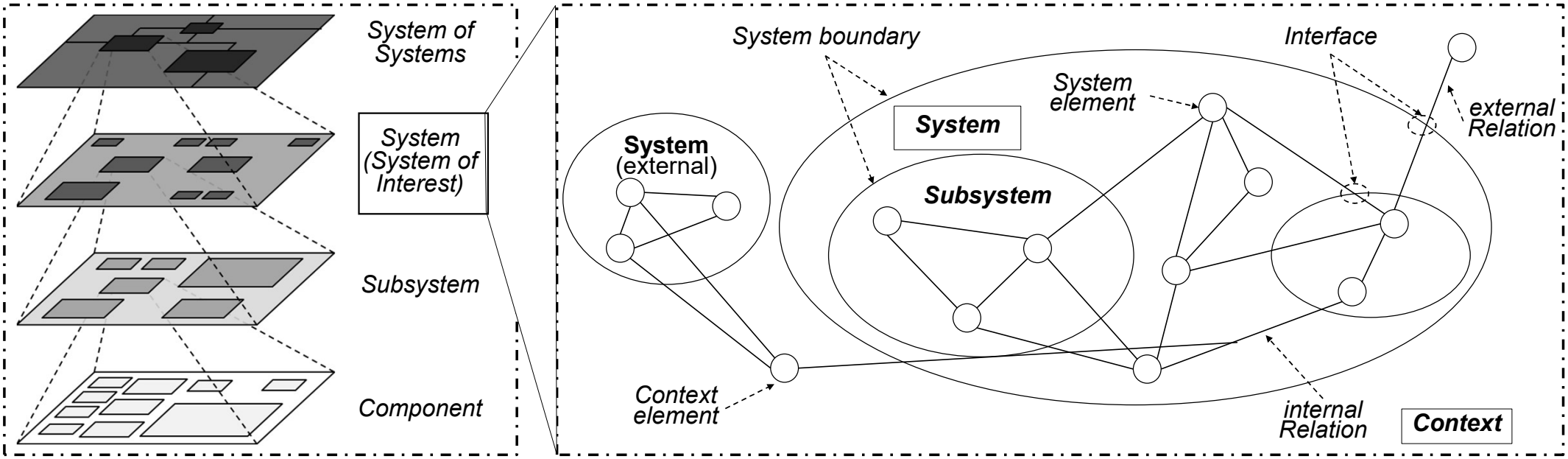
SE contains a **holistic** systems view that includes the **system elements** and the **relationships** between them, the supporting systems, and the environment.

(SE Principle #2 from the 15 Systems Engineering Principles)

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

System Theory (System, System of Systems, System of Interest)

Systemic Decomposition

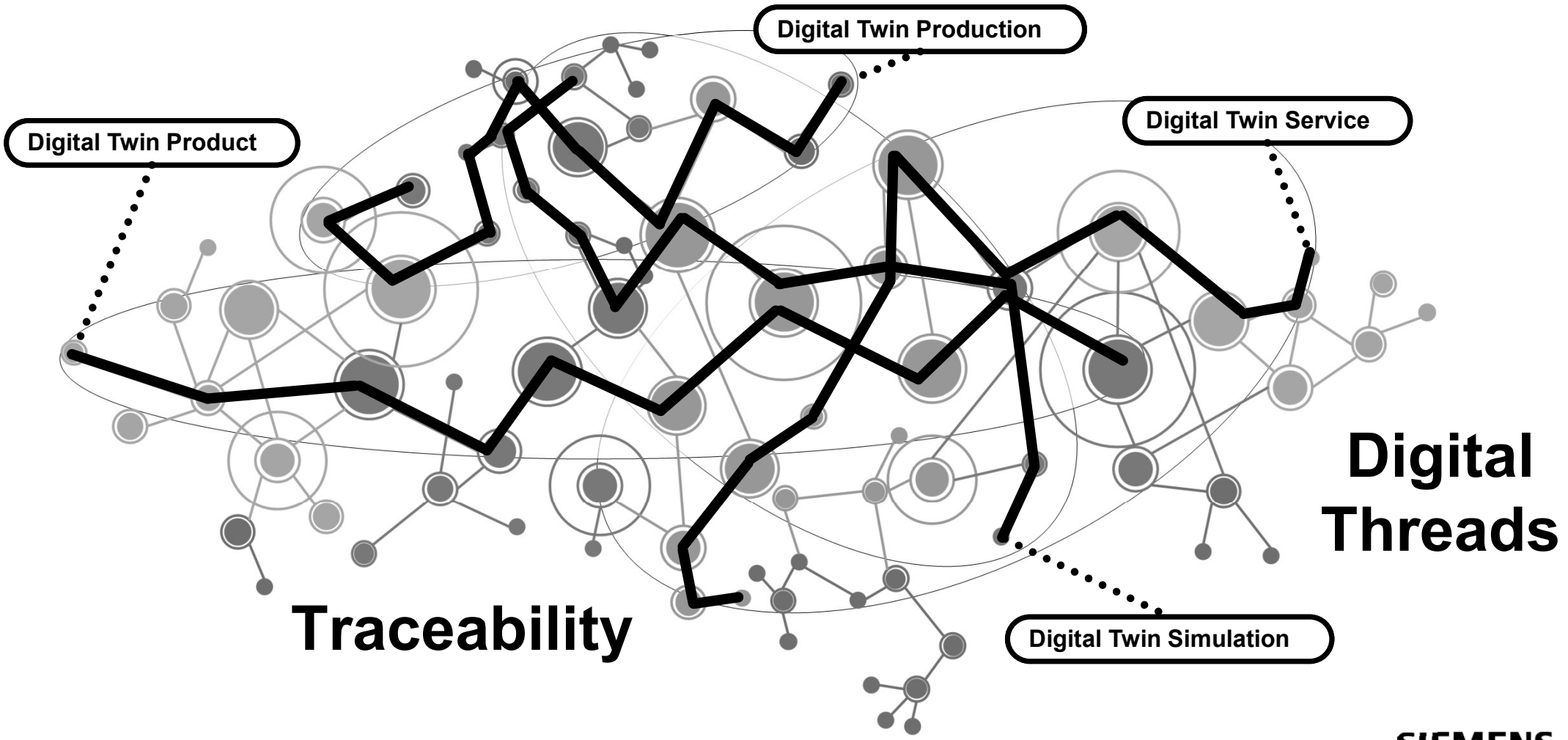


Hierarchical Decomposition
(System of Systems)

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

Traceability in the context of Digital Thread & Digital Twin

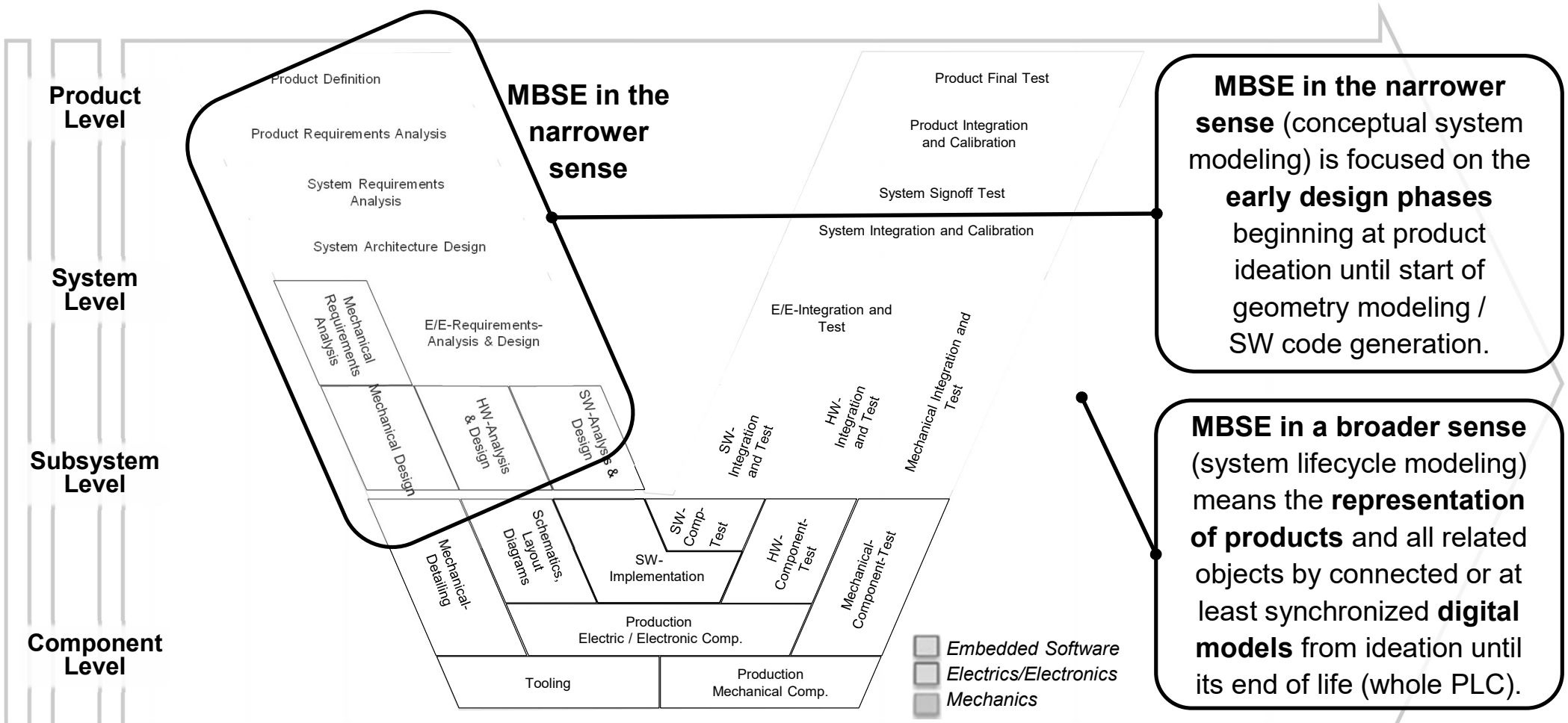


Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

MBSE in the narrower and broader sense

Existing traceability concepts often refer only to narrower perspective



MBSE in the narrower sense (conceptual system modeling) is focused on the **early design phases** beginning at product ideation until start of geometry modeling / SW code generation.

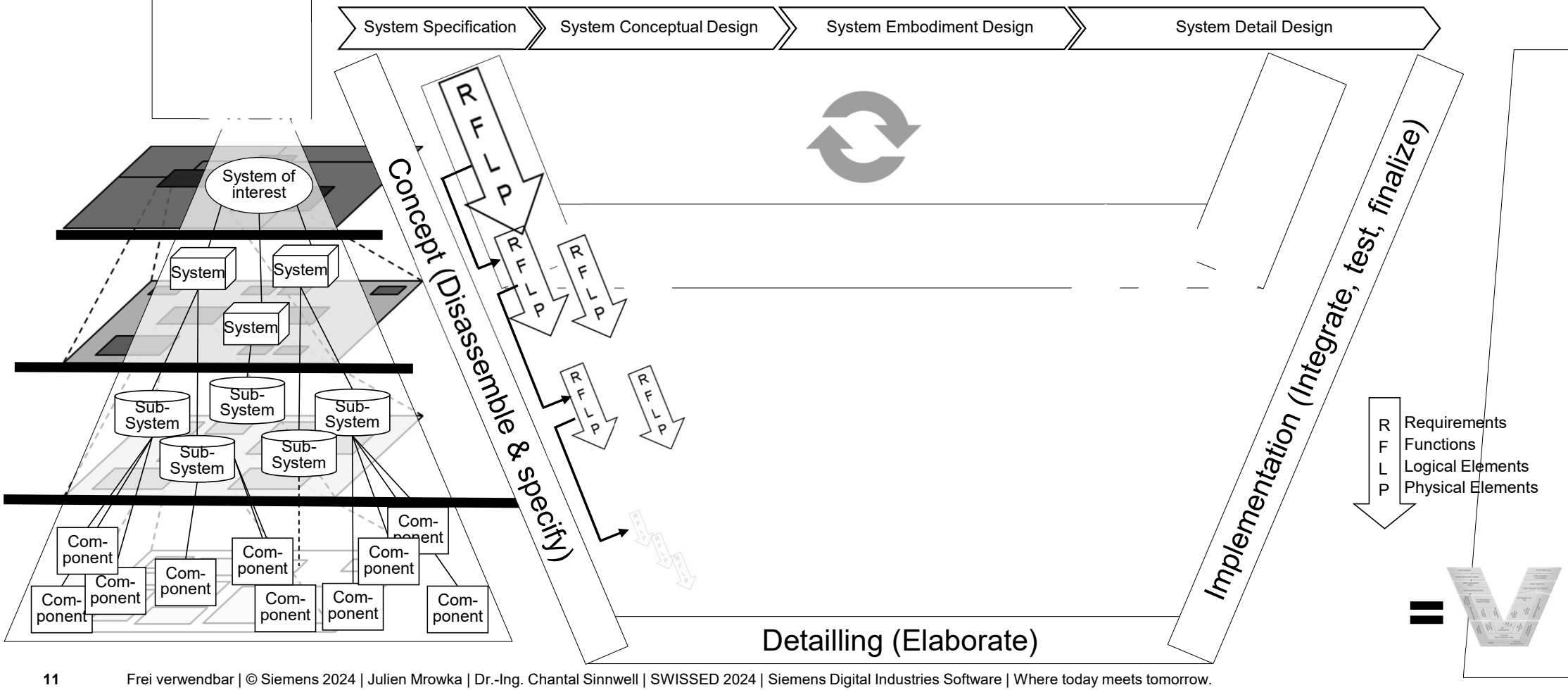
MBSE in a broader sense (system lifecycle modeling) means the **representation of products** and all related objects by connected or at least synchronized **digital models** from ideation until its end of life (whole PLC).

V-Model (VDI 2206 Standard)

SIEMENS

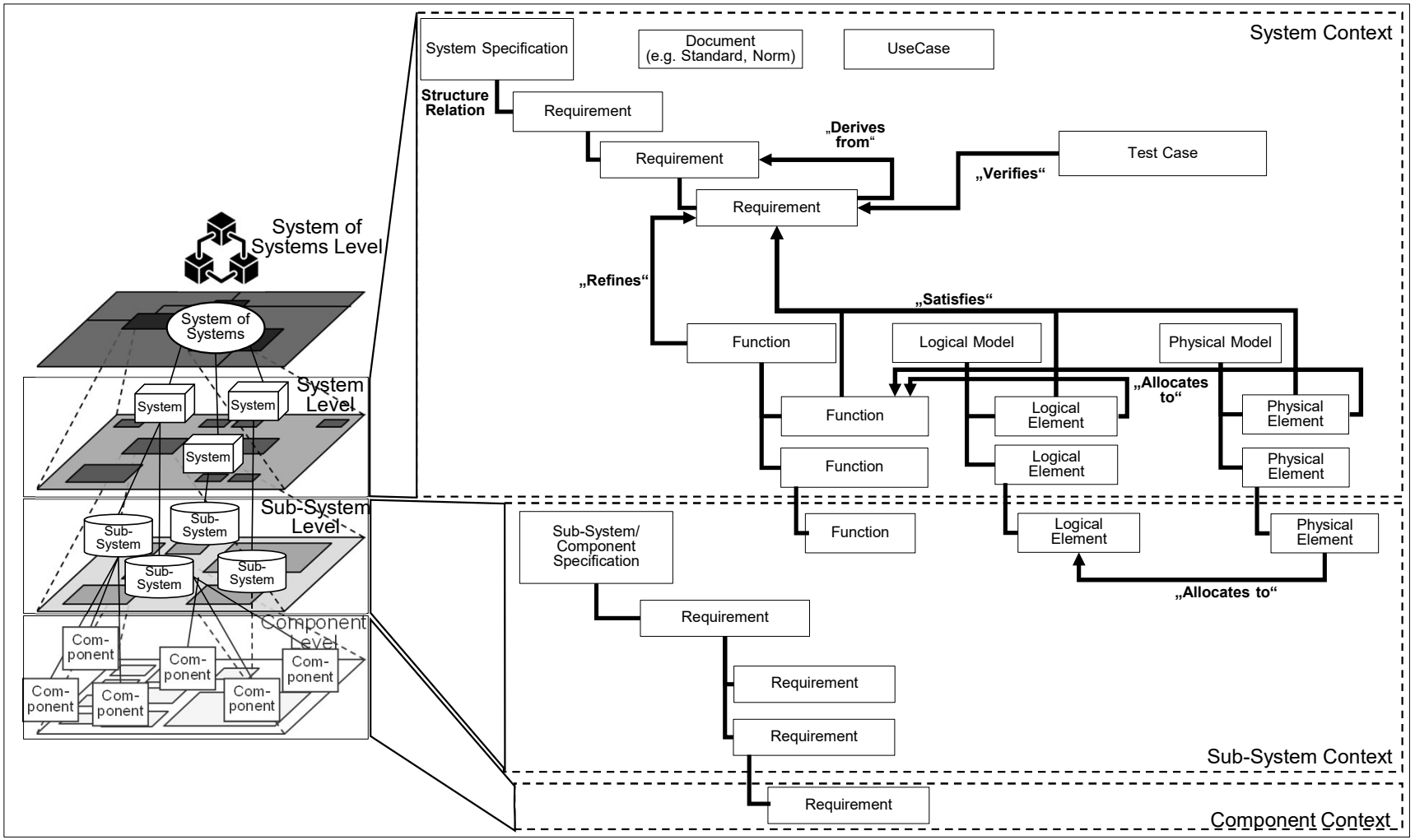
MBSE supports handling complexity and collaboration for System of Systems decomposition

Existing traceability concepts do not support interrelations across systems or system levels



Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

Traceability concept provided by SysML v1 Standard



Source:
OMG Systems Modeling Language (OMG SysML™) *Version 1.6*

SIEMENS

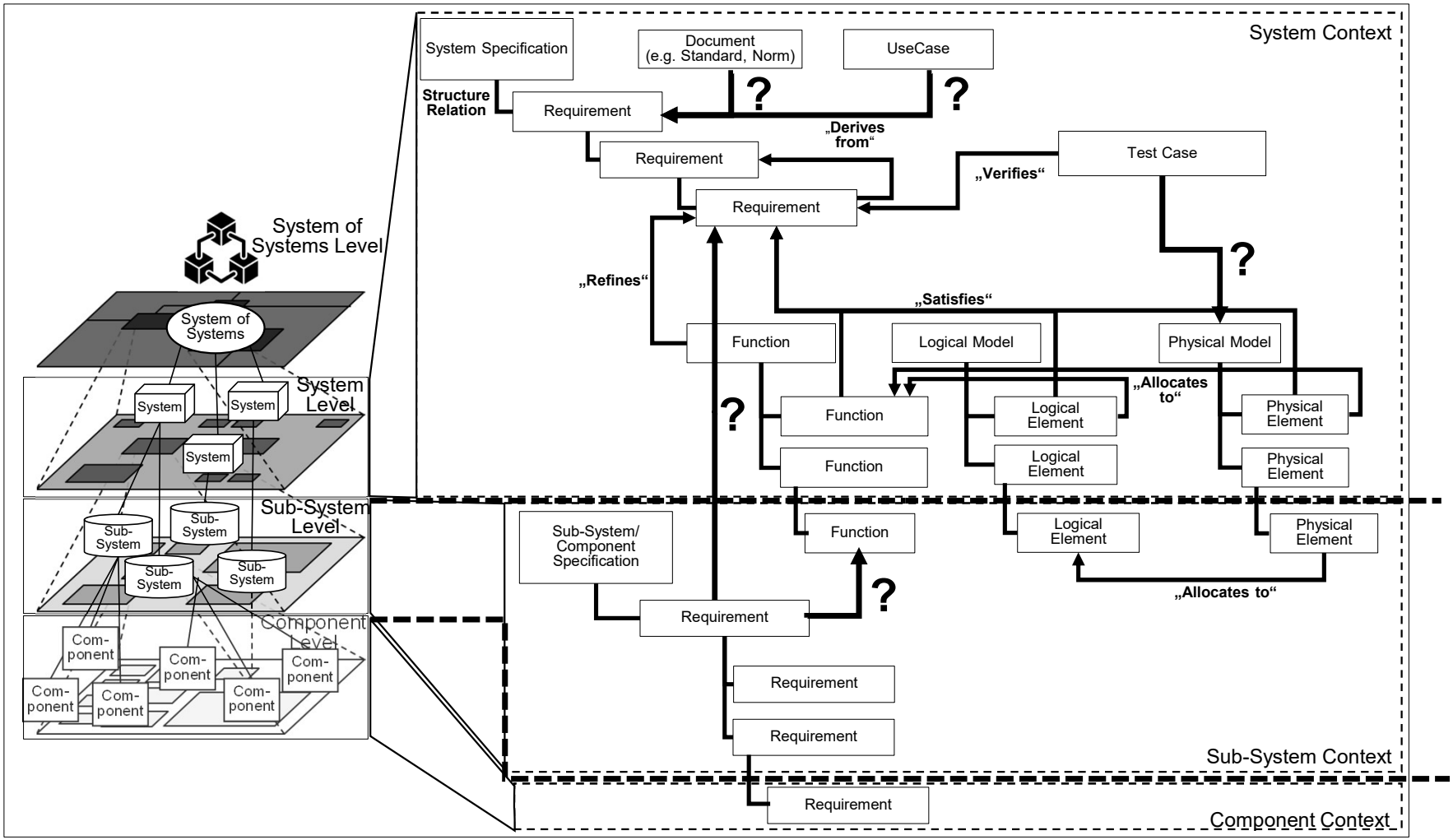
Open questions and gaps in existing traceability concepts

- Cross-system and across system-level dependencies?
- “Derive” only between requirements?
- Verifying of model elements?
- Only one tracelink type in between model elements?
- Trace of domain models (mechanic, E/E) or simulation models?
- Trace of downstream processes (e.g. production planning)?

Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

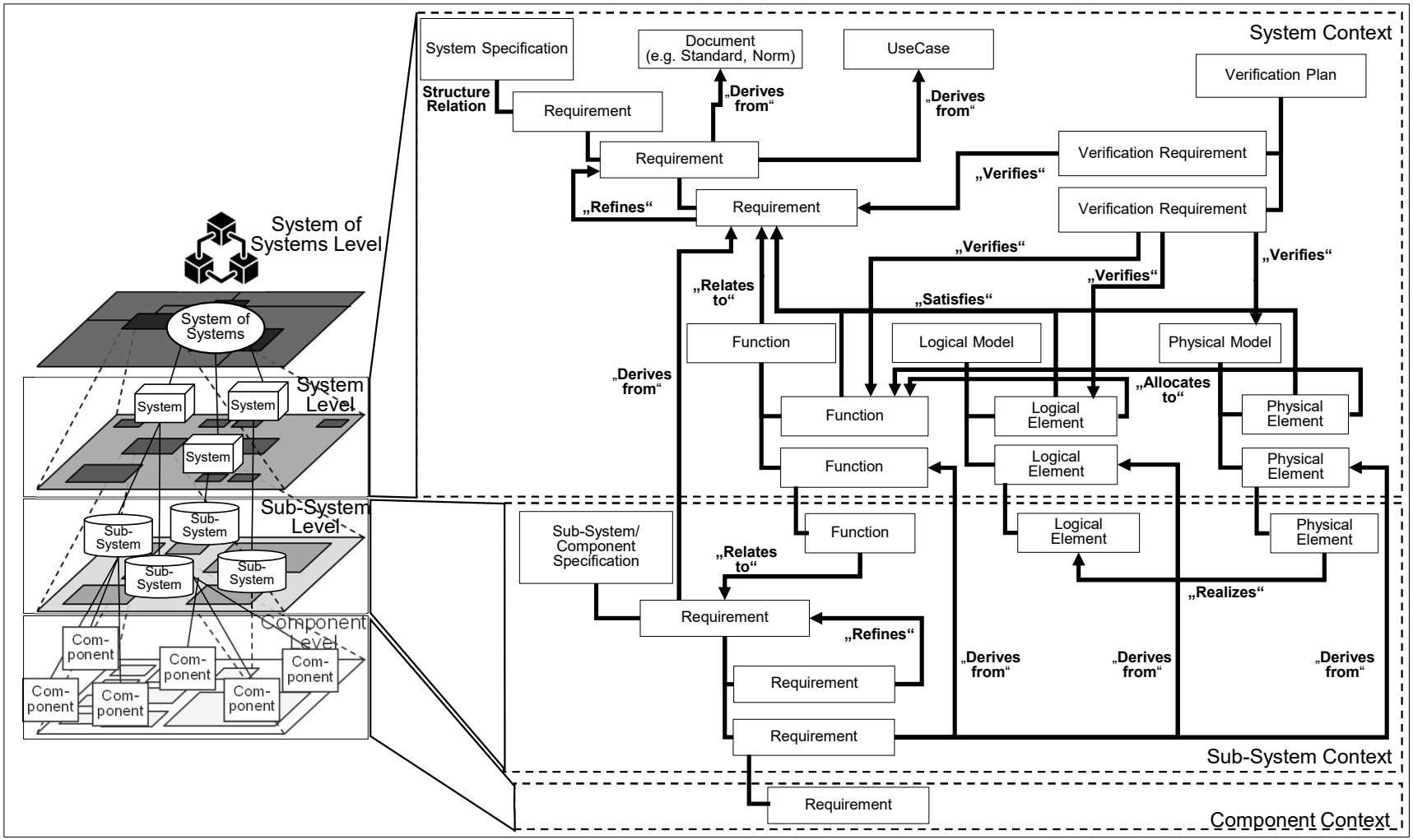
SIEMENS

Open questions and gaps in existing traceability concepts



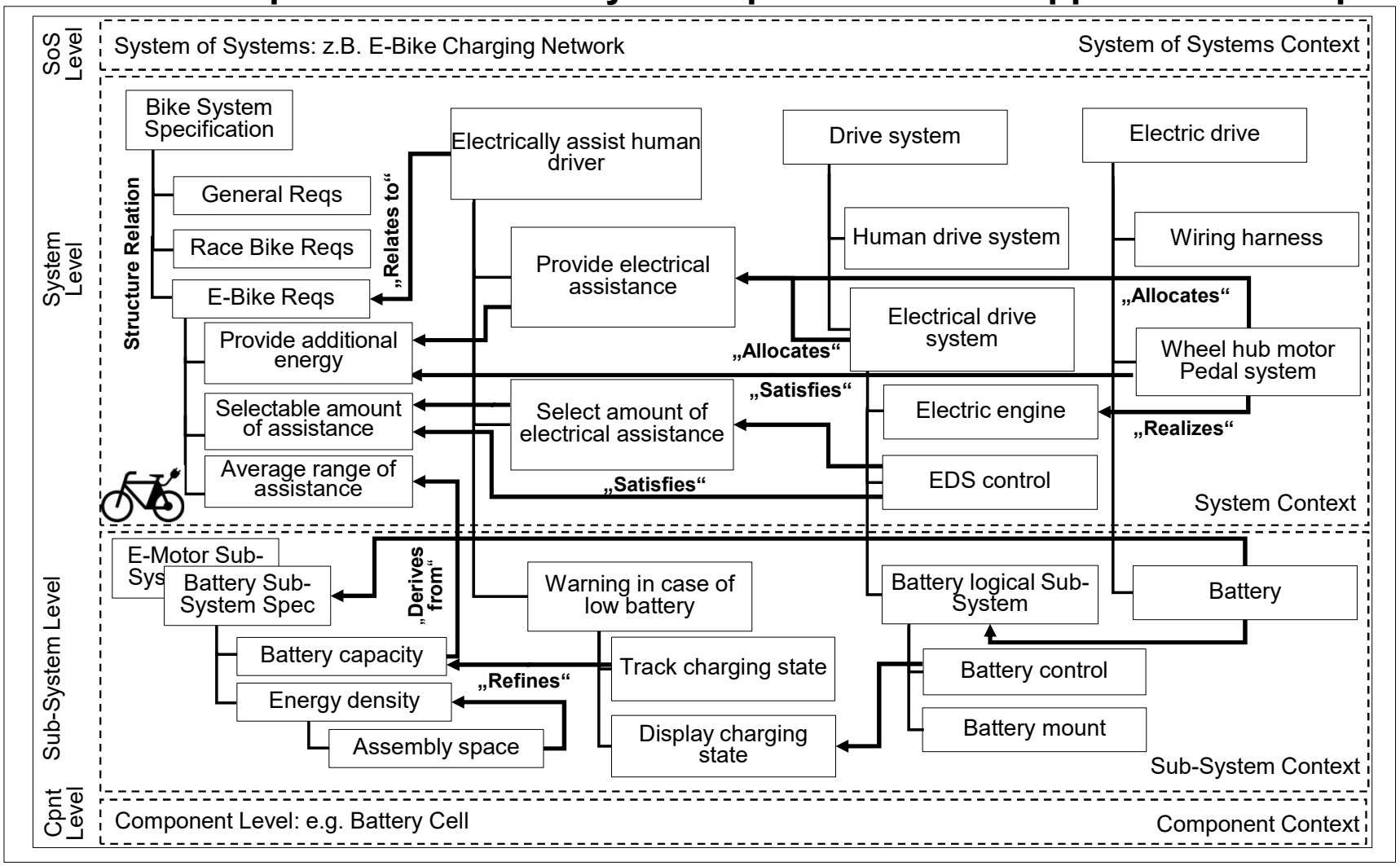
SIEMENS

Adaptation and description of a best-practice traceability concept



SIEMENS

Illustration of best-practice traceability concept based on an application example



Frei verwendbar | © Siemens 2024 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | SWISSED 2024 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS

Conclusion, summary and need for development

Conclusion & summary

More extensive and clearly defined tracelink types required

80% solution with potential of industry or company-specific extension

Need for development

KI evaluations of tracelink architectures

Common data management layer

SysML v2 Standard

SIEMENS

Q & A

Thank you for your attention!

Frei verwendbar | © Siemens 2023 | Julien Mrowka | Dr.-Ing. Chantal Sinnwell | TdSE 2023 | Siemens Digital Industries Software | Where today meets tomorrow.

SIEMENS