Dr. Mark Schneeberger| EAT BEER Biotech GmbH
Dr. Chantal Sinnwell | Siemens Industry Software GmbH

SUSTAINABLE AND LIFECYCLE ENGINEERING – INDUSTRIAL HANDS-ON EXPERIENCE OF SYSTEMS ENGINEERING IN THE FOOD AND BEVERAGE INDUSTRY

Swiss Systems Engineering Day 2025, Zürich, 15.09.2025

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OUR TEAM TODAY

- Dr.-Ing. Mark Schneeberger
- CTO
- EAT BEER Biotech

- Dr.-Ing. Chantal Sinnwell
- Domain Lead Systems Engineering
- Siemens Digital Industry Software

- Jan Malte Nordmann
- CEO & Founder
- EAT BEER / Störtebeker

- Dr.-Ing. Michael Bitzer
- Head of Science, Academics & Transfer
- Siemens Digital Industry Software

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AGENDA

1. Business Challenge & Need
2. Industrial Example
3. Lessons Learned & Outlook

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SOCIETY & INDUSTRY TRENDS

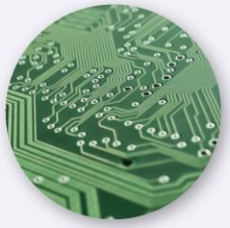
Volatility

Megatrends*

MEGATRENDS expected to influence systems engineering through 2035.


1. Sustainability


2. Interdependent World


3. Digital Transformation


4. Industry 4.0/ Society 5.0


5. Smart Systems


6. Complexity Growth

Strategic Sovereignty**

Innovation

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*INCOSE Vision 2035
**https://www.acatech.de/publikation/sicherheit-resilienz-und-nachhaltigkeit/

TECHNOLOGY & ENGINEERING | TRENDS

Digital Technology Trends

1. **Digital Platforms & Cloud-technology**
2. **Artificial Intelligence**
3. **Connectivity & Internet Of Things**

Engineering Trends

A. **Formalization And Integration Of Knowledge**

B. **Model-Based**

C. **Leverage Digital Technologies**

Systems Engineering

Source: Dumitrescu, R.; Albers, A.; Riedel, O.; Stark, R.; Gausemeier, J. (Eds.): Engineering in Germany - The status quo in business and science, a contribution to Advanced Systems Engineering, Paderborn, 2021

Source: following: International Council of Systems Engineering (INCOSE) and US Department of Defense (DoD) – in SE Book of Knowledge: https://sebokwiki.org/wiki/Fundamentals_for_Digital_Engineering

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TYPICAL REGULATORY CHALLENGES IN F&B

Geographies & Regions

- Democraphic Structure
- Economical Structure
- Cultural Structures

Laws & Regulations

- Localized Laws
- Regulatory Bodies
- Subsidies & Insurance

Quality & Compliance

- Registration & Audit Files
- Wet-Signature
- Market Access

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AGENDA

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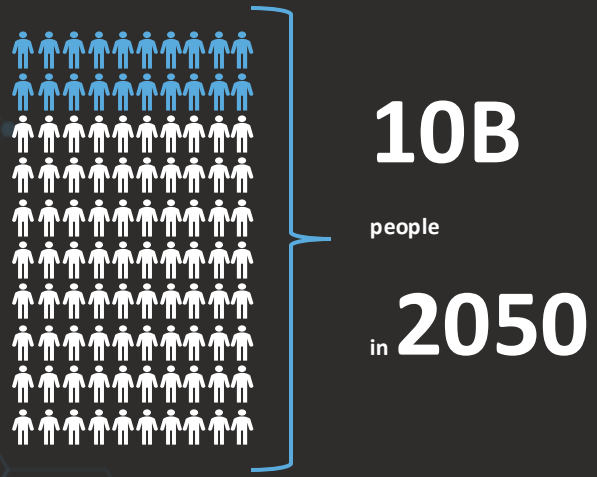
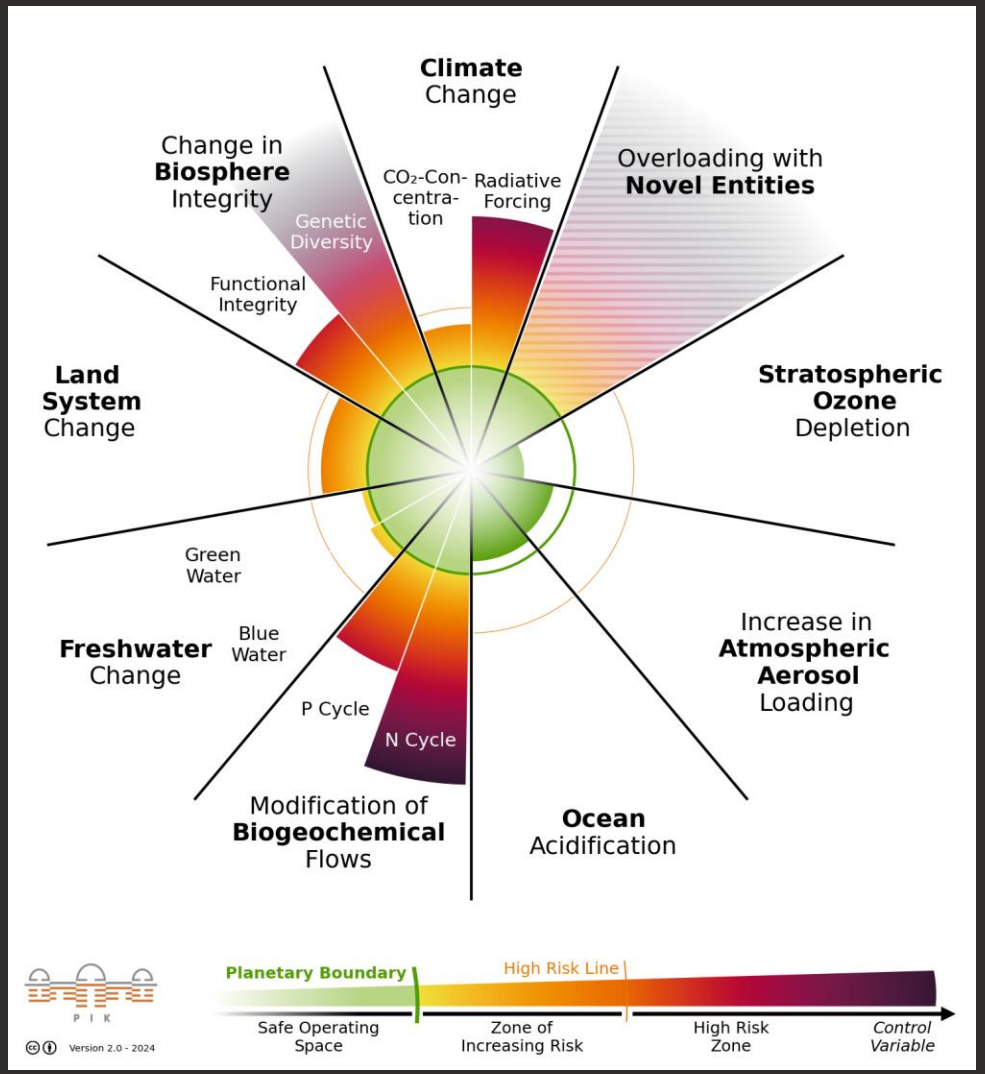
> Nature risk is business risk
>
> - Julia Binder, IMD

> Can we feed the world without destroying the planet?
>
> -Tim Searchinger (WRI and Princeton University)



10B people in **2050**



Sources:
https://www.pik-potsdam.de/en/output/infodesk/planetary-boundaries
https://ourworldindata.org/environmental-impacts-of-food

Jürgen Nordmann
Owner Kontor-N

8000 MT Spent grains/a ?

KONTOR N
BRAUEN VERLEGEN AUSSCHENKEN

Störtebeker
BRAUSPEZIALITÄTEN

BECKRÖGE
Für die Gastfreundschaft. Seit 1872.

LOGIPACK
BEVERAGE SYSTEM INTELLIGENCE

EAT BEER BIOTECH

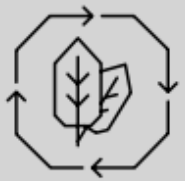
Vom Reststoff zum Rohstoff – das EAT BEER Verfahren.


Landwirtschaft


Mälzerei


Brauerei


Bier


Recycling

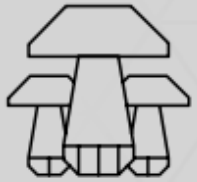

Konsumenten


Treber

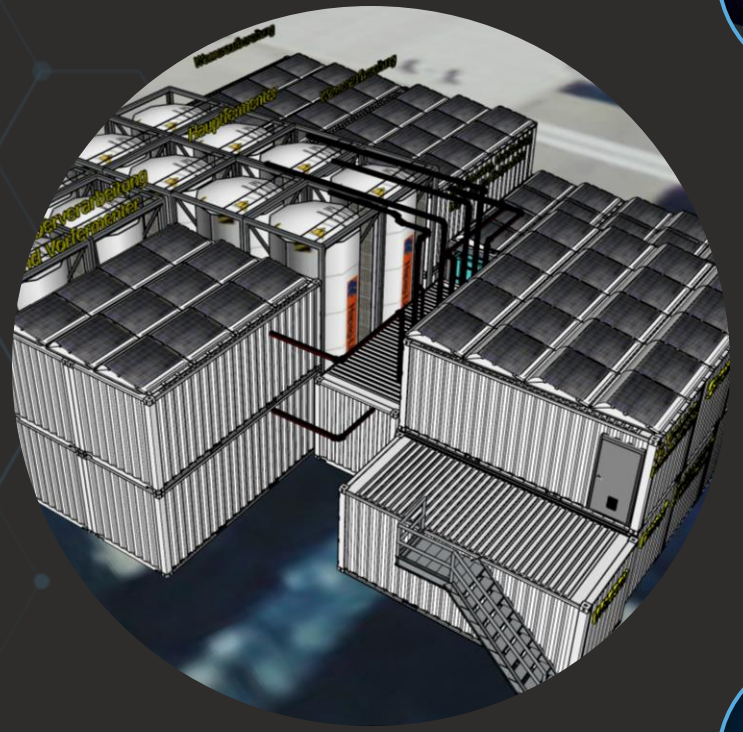

Produktion

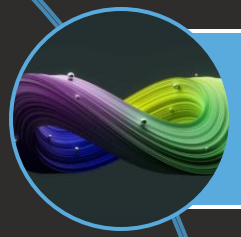

Substrat


Pilzfermentation


Pilzmasse

THE IDEA





Innovative solution for upcycling of side streams from brewing industry

Usage of side-streams as substrate
-> Entire valorization of grain for dual purposes

Container-based, modular plant design, adatped to brewerys requirements

Dark-Factory -> intelligent plant, remote-controlled

WHY IS THERE A NEED FOR ADVANCED APROACH?

Reduction of Development Risks

- *As a start-up with limited resources, design errors are particularly costly. MBSE enables early simulation and validation before physical prototypes need to be built → saving time and money.*

Mastering Complexity

- *EAT BEER projects combine process engineering, food technology, regulatory requirements, and supply chains. MBSE links these areas through a "digital thread" so that changes in one place do not unintentionally jeopardize other parts.*

Faster Time-to-Market

- *Through parallel work (instead of a sequential V-model), different teams can build on the same system architecture simultaneously. This shortens development cycles – crucial to secure competitive advantages in the food-tech market.*

Regulatory Compliance & Traceability

- *Food & beverage is subject to strict hygiene and food safety regulations. MBSE provides full traceability from requirements to implementation and verification – simplifying audits and certifications.*

Improved Stakeholder Communication

- *Visual models and architectures are easier for investors, partners, and authorities to understand than long documents. This supports alignment between engineering, business development, and marketing.*

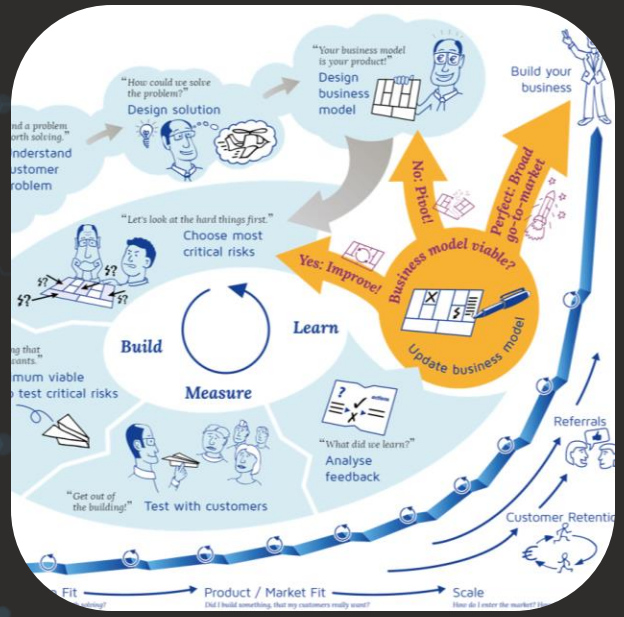
Scalability & Reusability

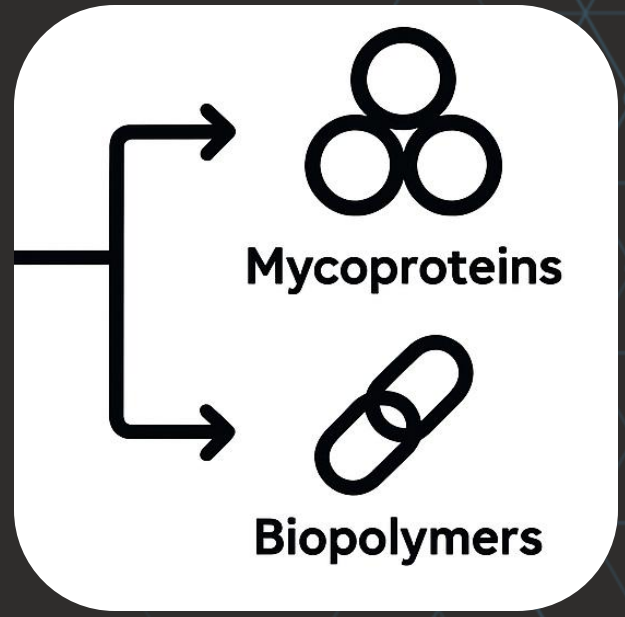
- *System models can be reused for new products or variants (e.g., different raw materials, different target markets). This protects know-how and facilitates technology transfer.*

IP Protection and Modular Collaboration

- *MBSE allows sharing only the relevant part of the overall model with suppliers. This keeps intellectual property protected while enabling efficient cooperation.*

WHAT COULD HAPPEN IN BETWEEN?

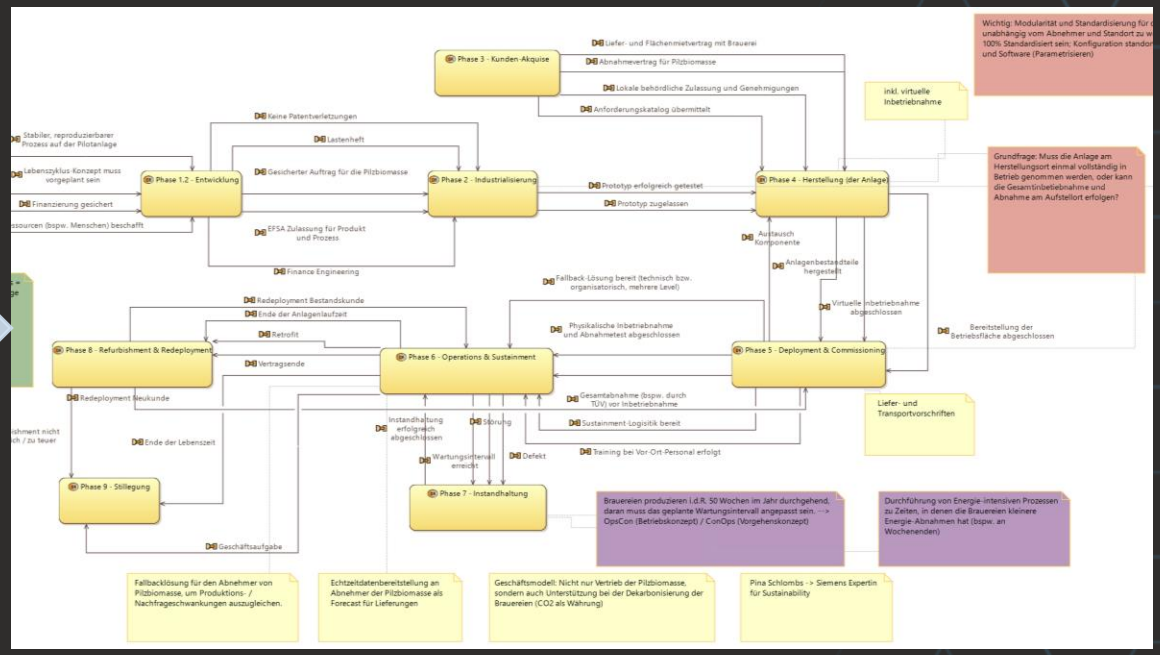




SYSTEM MODEL

Operational-Analysis

- Life-Cycle analysis from "Concept" to "Decommissioning"
- Identification of “Stage-Gates” between different phases of the life cycle



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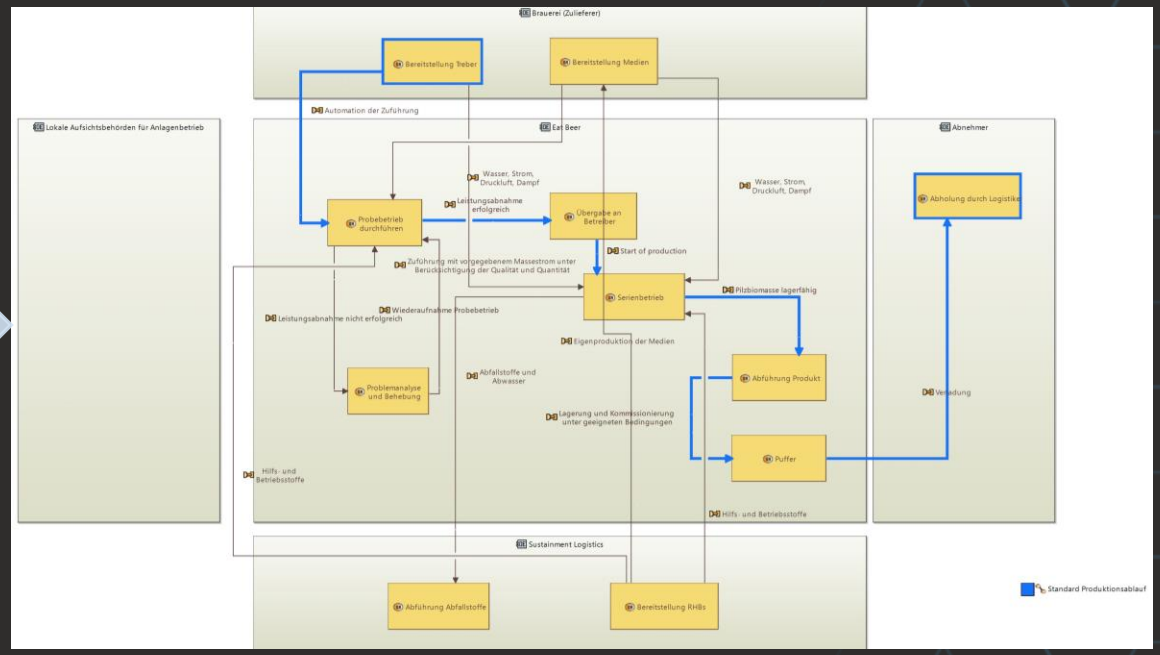
SYSTEM MODEL

Operational-Analysis

- Identification of various stakeholders
- Description of interactions between stakeholders
- Determining **operational capabilities** and **limits**
- Recognized system limits can also lead to **adjustments** to our **business model**



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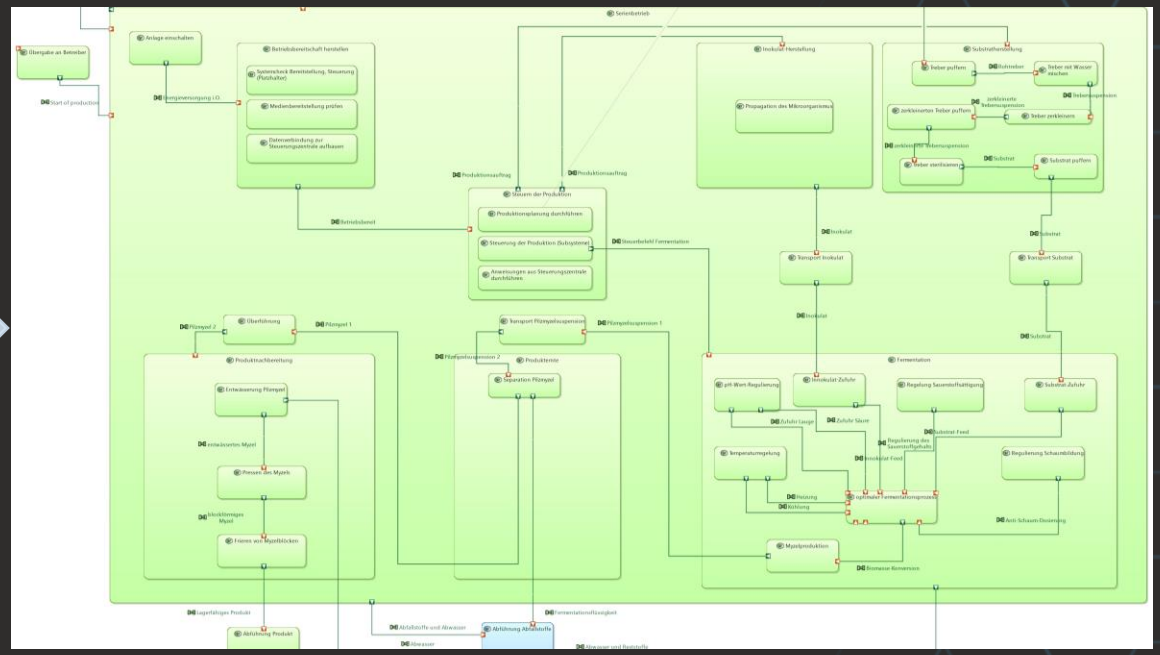
SYSTEM MODEL

System-Analysis

- Translate **operational capabilities** into **system-level functional requirements**
- Identify the **main system functions**
- Structure these functions into a **functional architecture**
- Describe the **expected interactions** and data exchanges



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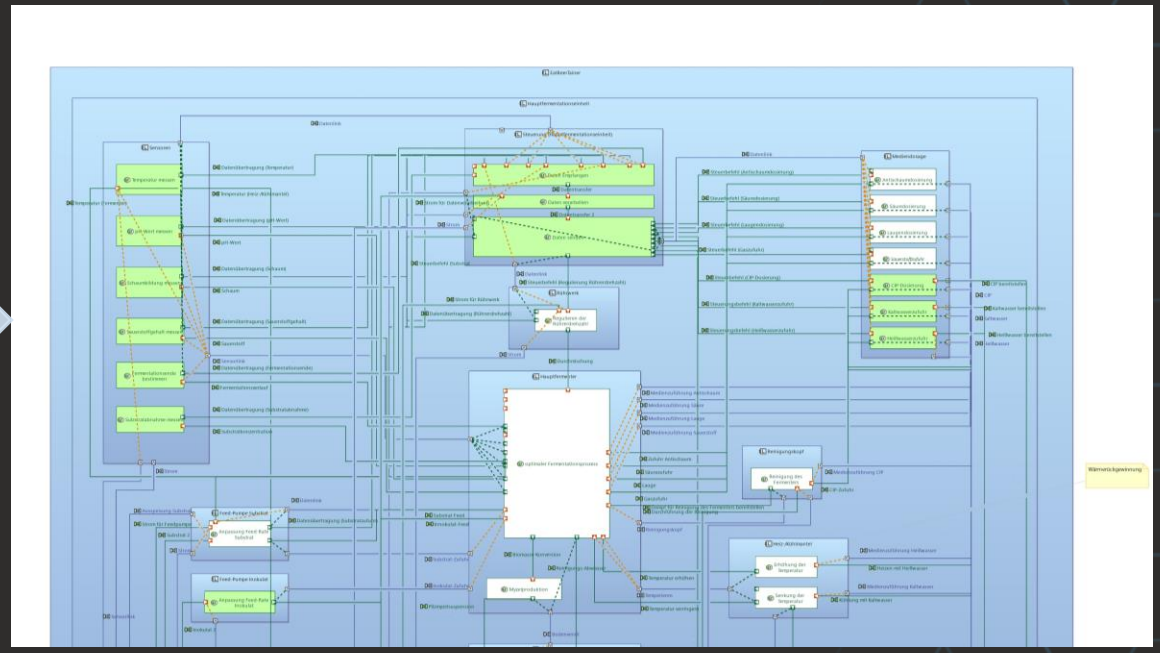
SYSTEM MODEL

Logical-Architecture:

- Identify and structure **logical functions**
- Group these functions into **logical components**
- Define **logical interfaces** between components and exchanges with other systems



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WHY AREN'T WE MODELING THE PHYSICAL LAYER?

- We want to purposely abstract in order to not anticipate the solution on a physical level.
- external partners have more freedom to implement their own solutions - as long as they meet the functional requirements.

Greater flexibility for partners and suppliers

- Our area of expertise is the process, in other words: the interaction of the various systems, not the physical components themselves.
- Without complex physical modeling, the effort is reduced as resources in the team are limited

Focus on functional/logical clarity instead of technical detail

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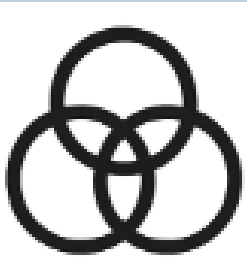
GAINS & BENEFITS

NOW



Clarity Across Disciplines
Visual models bridge gaps between biotech, engineering, and operations.

Faster Learning Curve
Teams without engineering backgrounds can quickly grasp system logic.

Early Error Detection
Simulations help identify design flaws before costly prototype are built.

FUTURE

Scalable & Reusable Designs
Modular models support future expansion and adaptation to new side streams or locations

Standardized documentation
System Models support the generation of regulatory documents - an advantage in the highly regulated food industry

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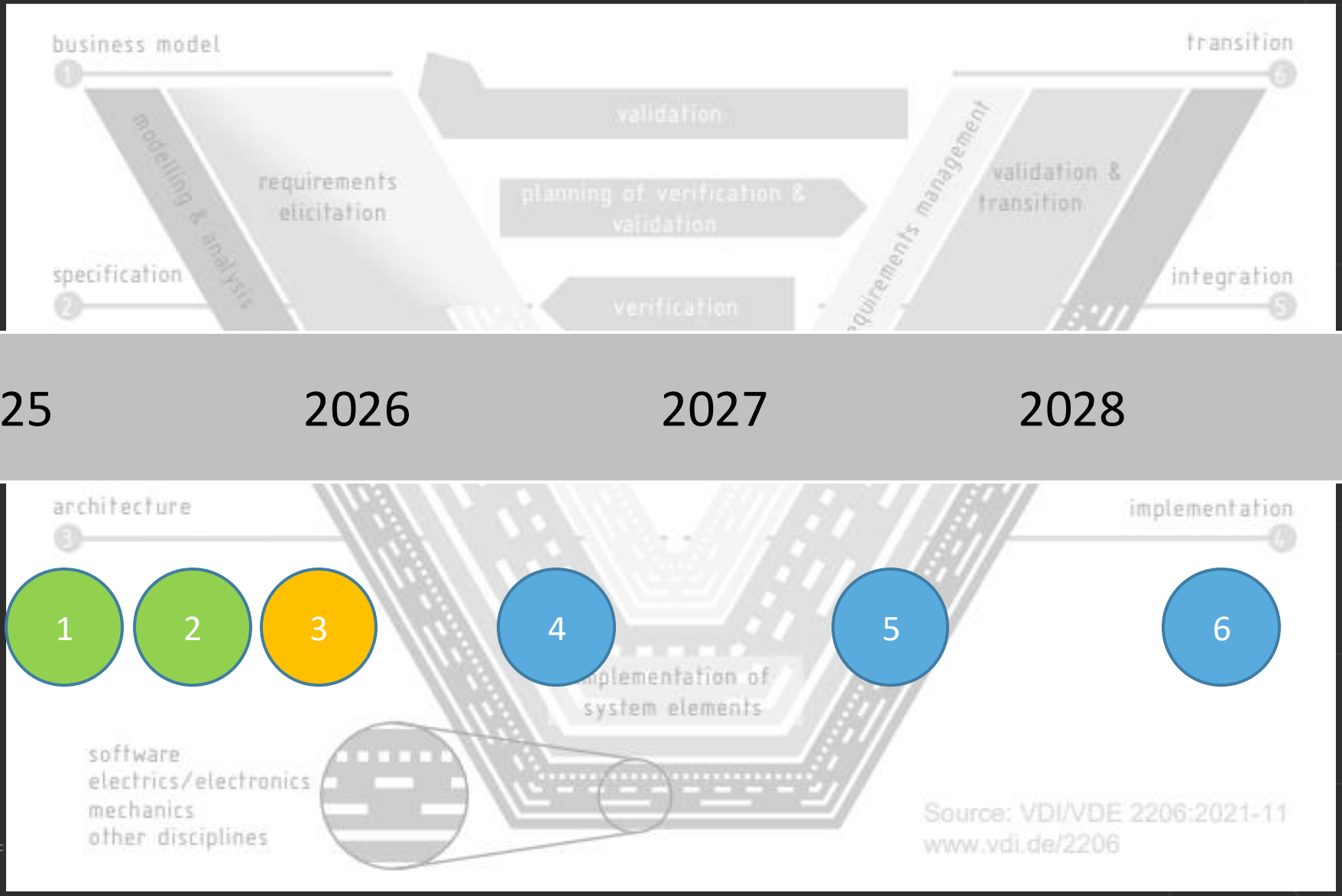
WHERE ARE WE NOW?



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SUMMARY & OUTLOOK

A	**Megatrends** Industry Context is changing with higher frequency, where enterprises need to adapt faster
B	**Eco-System Modelling** Products and enterprise work in eco-systems, where enterprises need to understand the dependencies
C	**Lifecycle Engineering** For sovereign products all phases of the lifecycle are “managed”, enterprises need to consider this already in engineering

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