CONSTRUCTION
PRODUCTS
EUROPE

Digital Construction

Workshop
Brussels, 7th October 2025

RAKENNUS· TEOLLISUUS

Advancing Digital Supply Chains in Construction Products through Standardisation

Finnish Association of Construction Products Industries

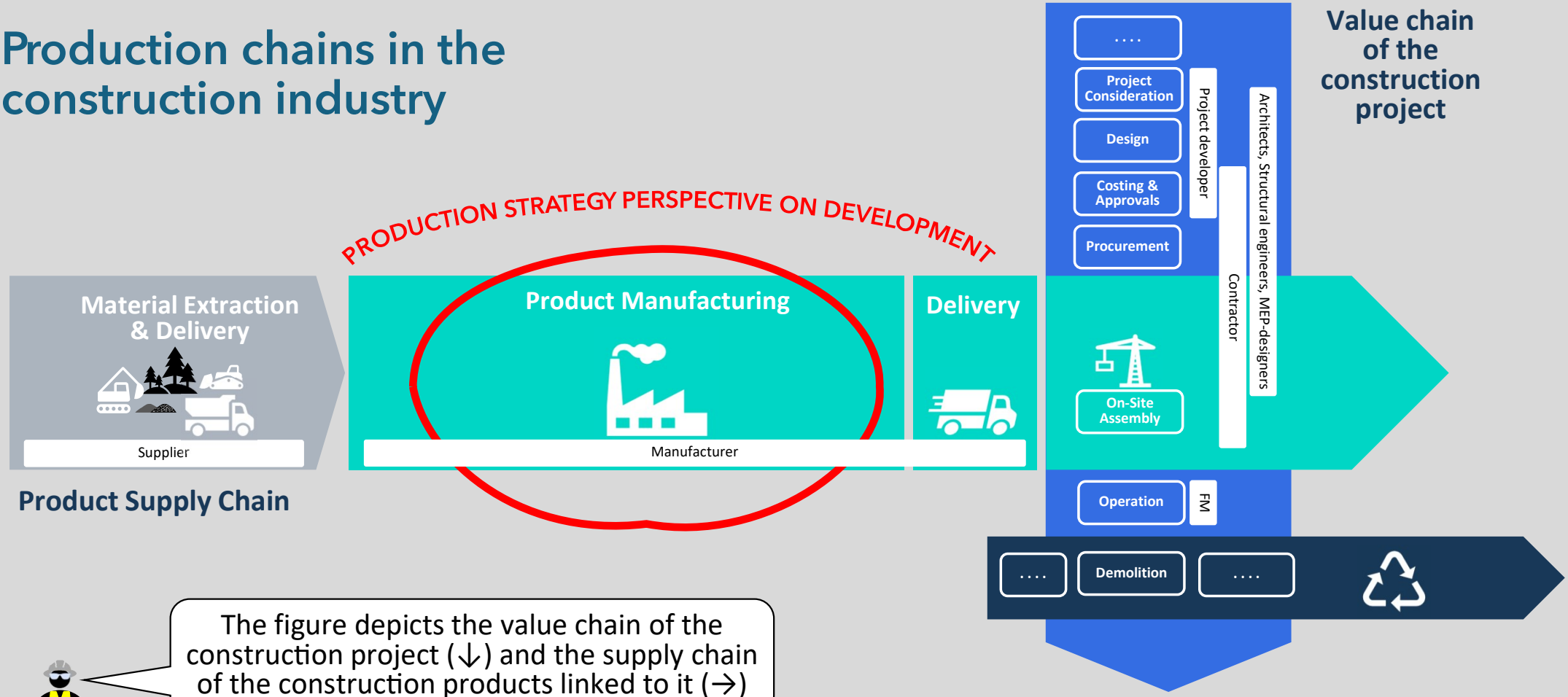
Teemu Alaluusua

2025-10-07 / Digital Construction Workshop – Construction Products Europe

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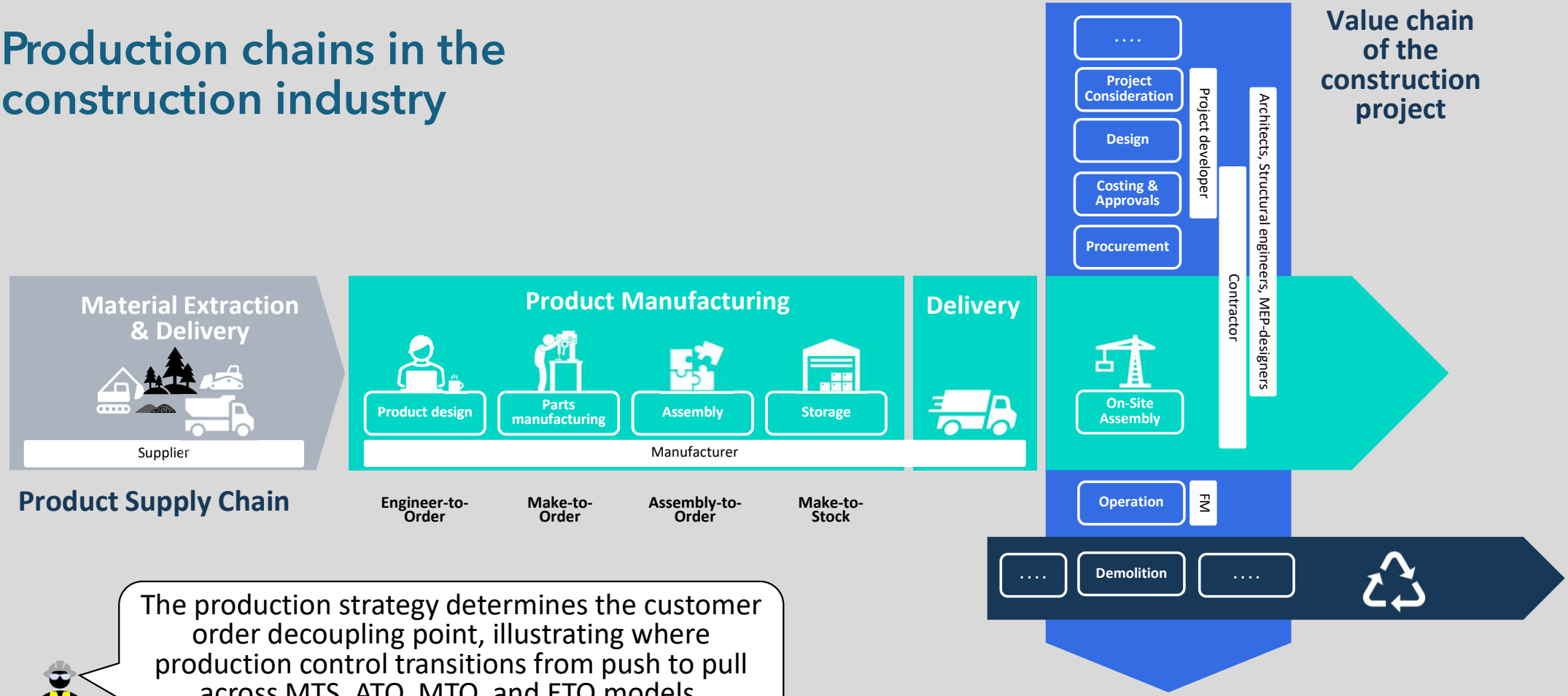
- Production strategies point of view for development
- Current state of digital supply chain management, Engineer-to-Order Precast Concrete
- Development Roadmap
  - Standards to Follow in Supply Chain Digitalization
  - Developed Implementation Guidelines for Supply Chain Data Exchange
- Future state data flow architecture, Engineer-to-Order Precast Concrete

Production chains in the construction industry



The figure depicts the value chain of the construction project (↓) and the supply chain of the construction products linked to it (→)

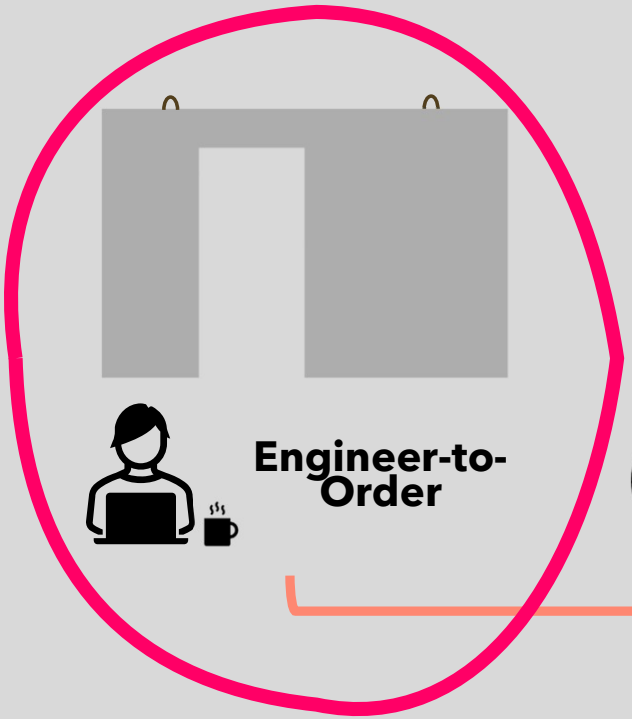
Production chains in the construction industry





The production strategy determines the customer order decoupling point, illustrating where production control transitions from push to pull across MTS, ATO, MTO, and ETO models.

Production strategies for building products

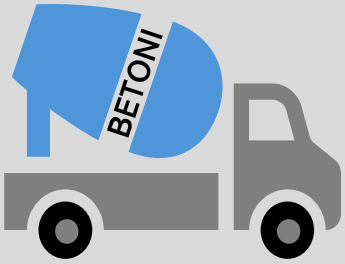


Engineer-to-Order



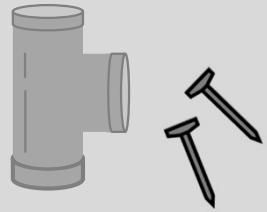


Make-to-Order





Assembly-to-Order





Make-to-Stock

Project-specific products

Standard products



Delivery

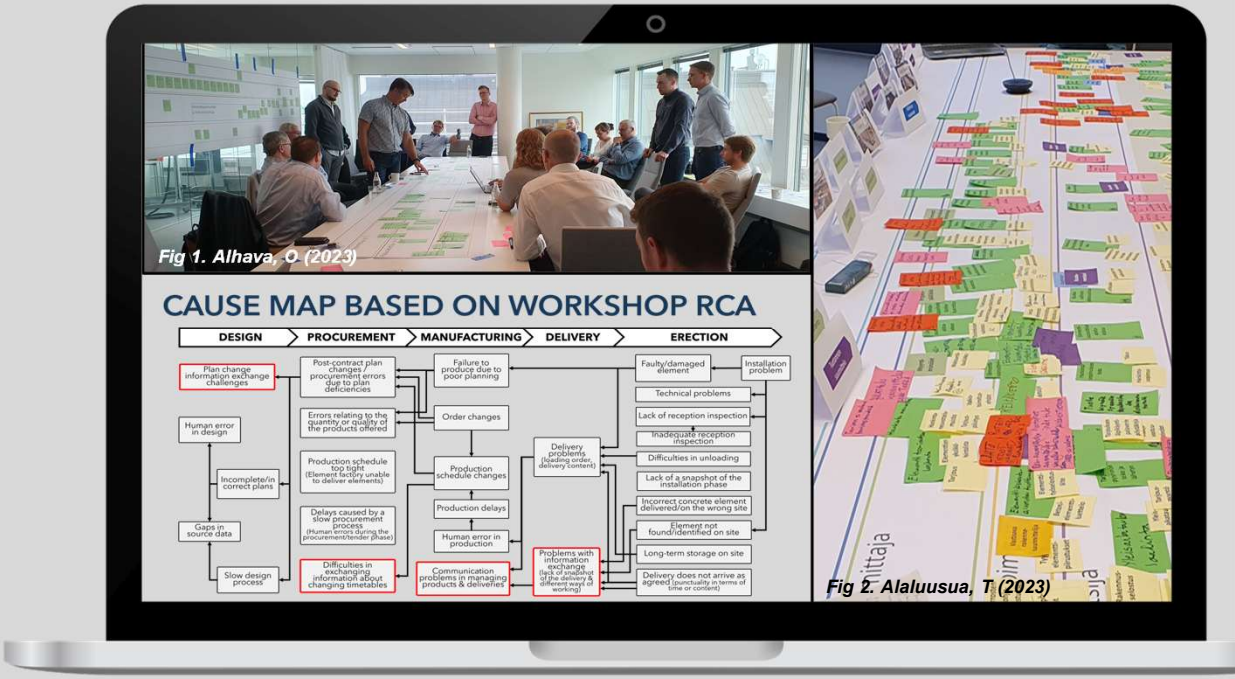


In Finland, we are currently working on the precast concrete supply chain as an Engineer-to-Order reference case

Current State

(Based on preliminary studies & workshops results)

- BIM data is not usable across the supply chain.
- Lack of linked building data prevents seamless information flow between stakeholders.
- Current data architecture is based on closed information exchange systems.
    - Point-to-point, customized integrations are inefficient and costly.
- Lack of interoperability between systems and platforms.
- Unstructured data (PDFs, images, phone calls, emails) dominates communication, making automation and analytics difficult.



Current State → Development roadmap → Future State

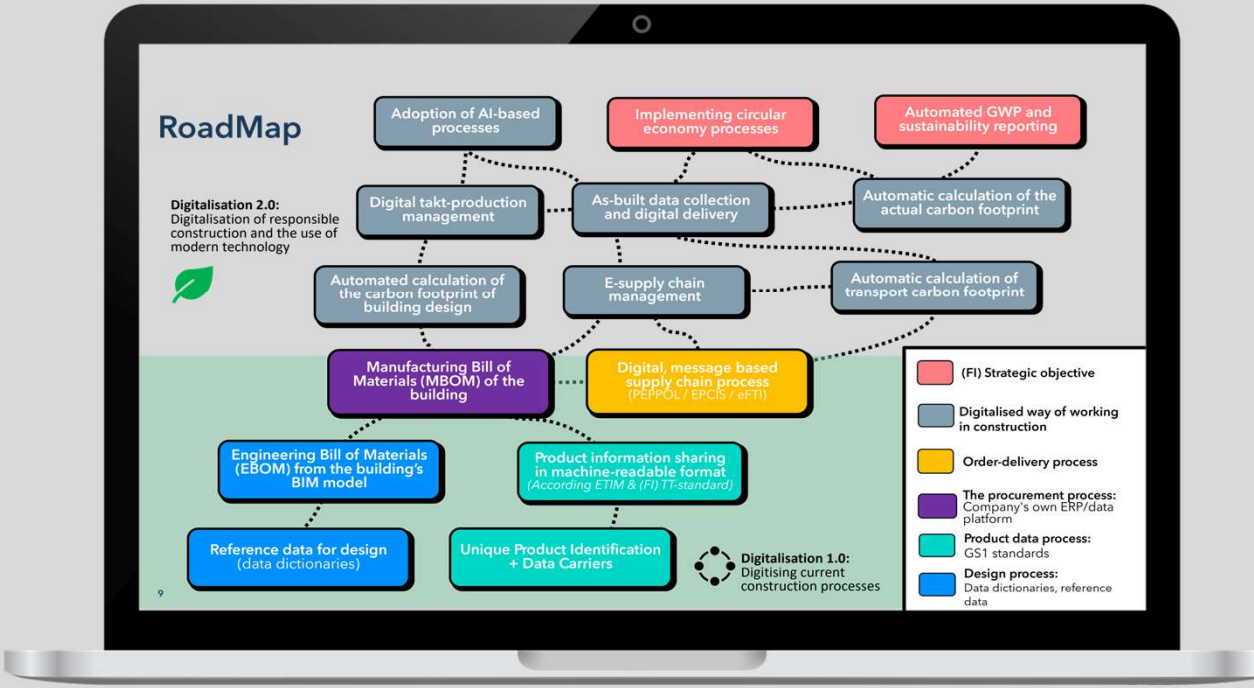
Ref. *Alaluusua, T. (2023) Digital management of information exchange in takt production supply chains*

Ref. *Alhava et al. (2024) Challenges and Opportunities in Digitalising Concrete Element Supply Chain: Proposed National Model*

Development Roadmap

- Based on the current state analysis, we developed a general development roadmap that covers all production strategies.
- Our findings show that advancing digital supply chains requires the comprehensive development of operations, information management, and technology systems.
- To achieve the best results, we collaborate with experts from various organizations, including academia, industry practitioners, non-profit associations, public authorities, and IT companies.

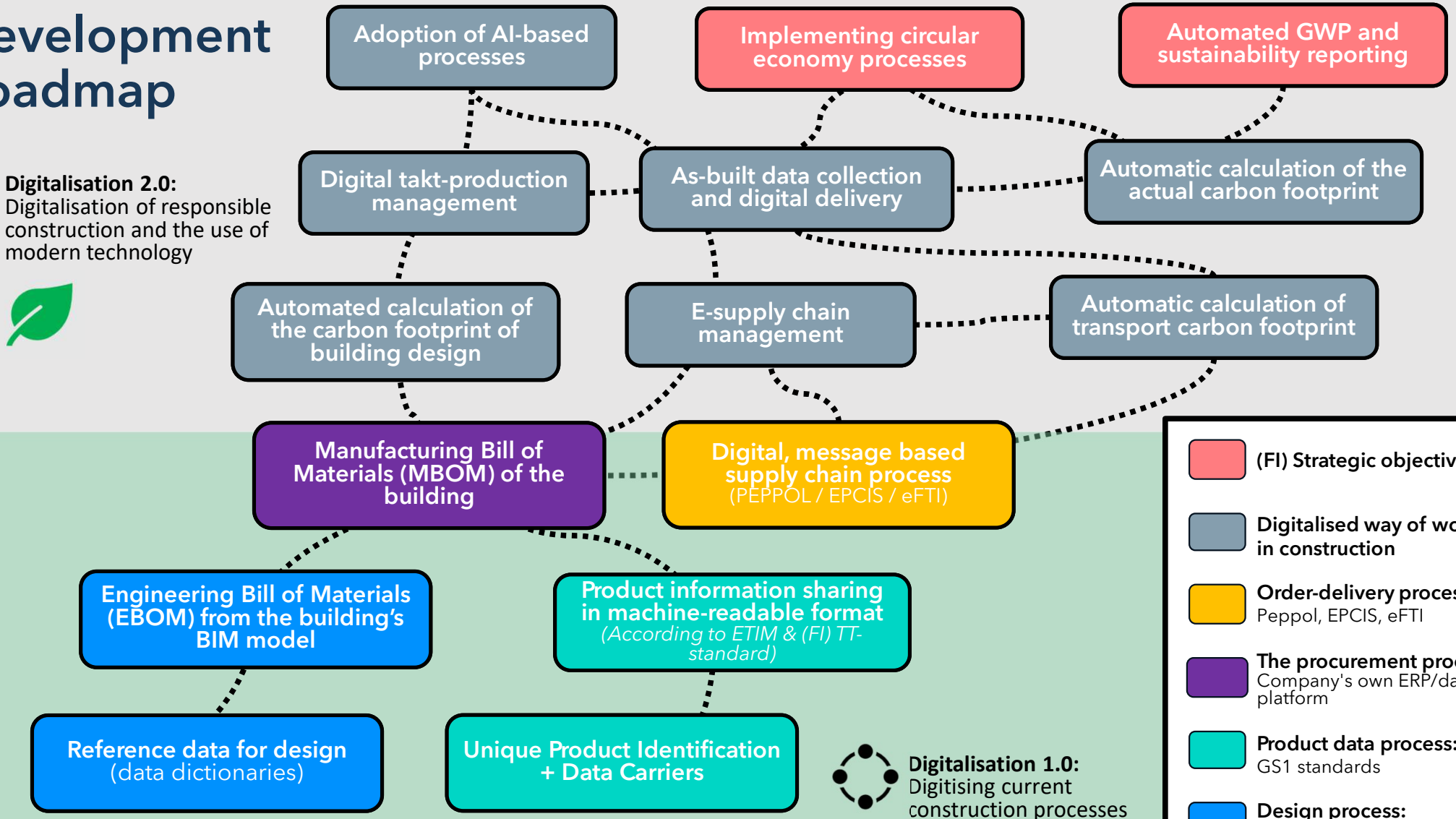




Current State → Development roadmap → Future State

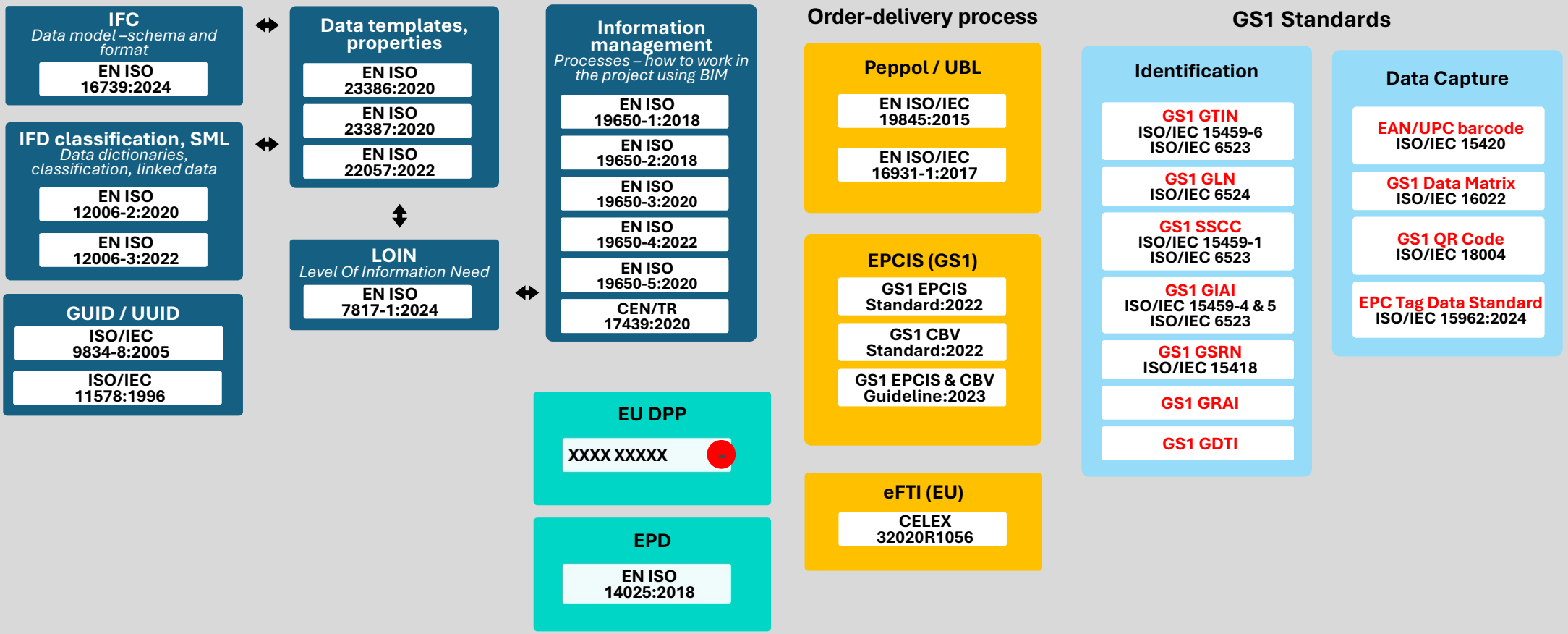
Development Roadmap

Digitalisation 2.0:
Digitalisation of responsible construction and the use of modern technology



Redrawn from: CC-BY 4.0: Arola, T., Alhava, O., June 12, 2024: Digitalization of the Construction Industry: Supply Chain Digitalization, RYHTI and Interoperability (presentation)

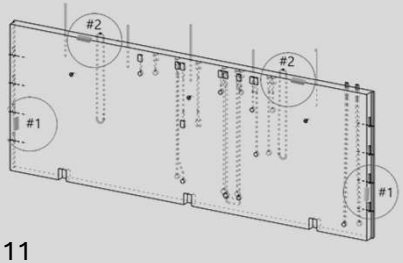
Standards to Follow in Supply Chain Digitalization



Implementation Guideline:

Unique Product Identification and Data Carriers for ETO Products

- Previously based on manufacturers' non-standardised internal codes
- A GTIN alone identifies a general product category, not a unique item
- Precast elements (ETO products) require a different approach for identification:
  - GTIN → identifies the base product type
  - MTO variant → identifies the specific variation
  - Serial number → distinguishes identical units









LEVELS OF PRODUCT IDENTIFICATION

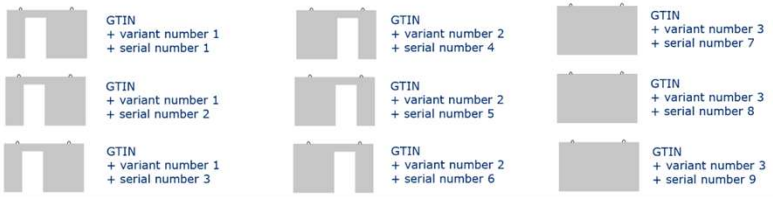
Level 1
Product identification (GTIN)



Level 2
Product variation identification (GTIN + MTO Variation number)



Level 3
Individual product identification [SGTIN] (GTIN + MTO Variation number + Serial number)

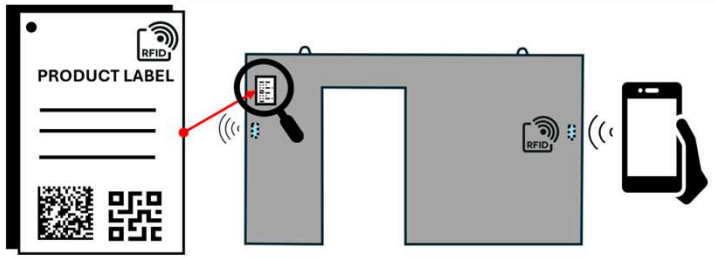


GS1 APPLICATION IDENTIFIERS (AI) TO IDENTIFY ENGINEER-TO-ORDER PRODUCT

Minimum information requirements for the identification	
(01) GTIN-koodi	06400001000247 Example
(242) Made-To-Order (MTO) variation number	123456 Example
(21) Serial number	12345678910 Example
***Additional information for precast concrete elements use case**	
(91) Finnish element classification	V1001 Example
(92) GUID	ba34cf17-0c4b-4c6f-9295-cae05aa74ad4 Example
(99) Domain name	id.rt.fi Example

DATA CARRIERS

GS1 Digital Link (2D Barcode)	**GS1 DataMatrix** (2D Barcode)	**EPC/RFID** (radio frequency remote sensing method)



Industry-specific Peppol Implementation guidelines

(Pan-European Public Procurement Online)

- **Peppol** is a **network**, not a standalone system.
- It aims to **optimize the supply chain**, not create a single central point.
- **Based on the international standard ISO/IEC 19845:2015** (UBL).
- **Already used in the construction industry** in several Nordic countries.
- **Each country may have its own Peppol Authority** responsible for national governance.
- To **connect to the Peppol network**, organizations need an **authorized Peppol service provider** and a **compatible system** (e.g., order management or ERP system).

Work in progress...

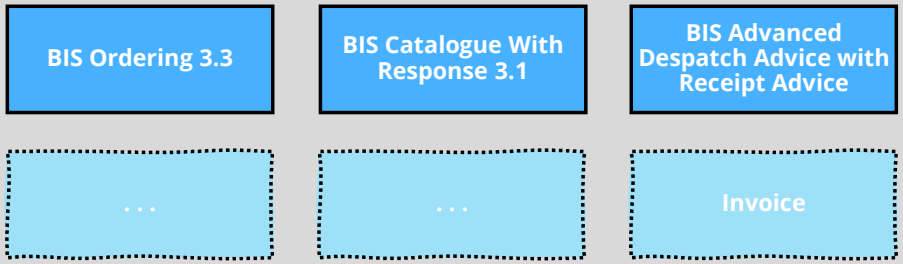
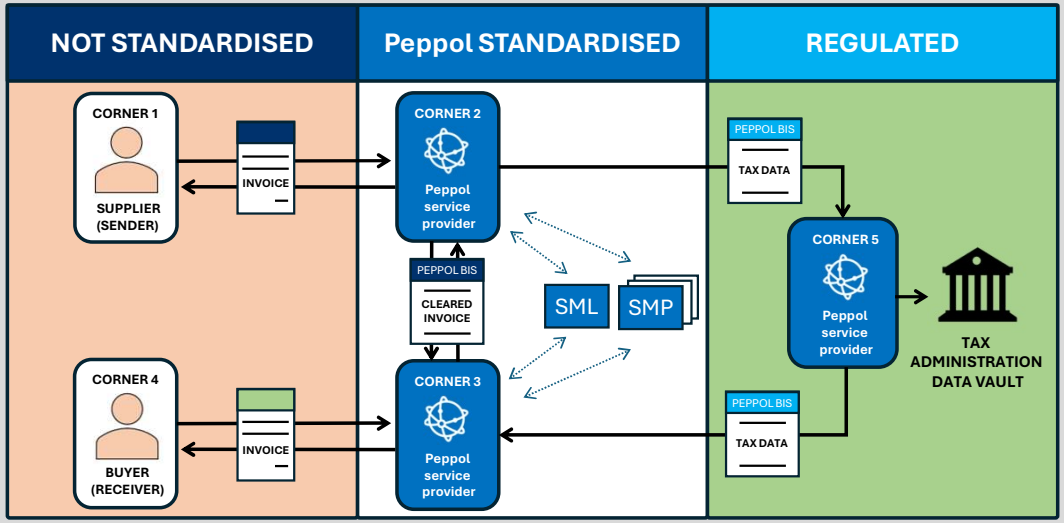


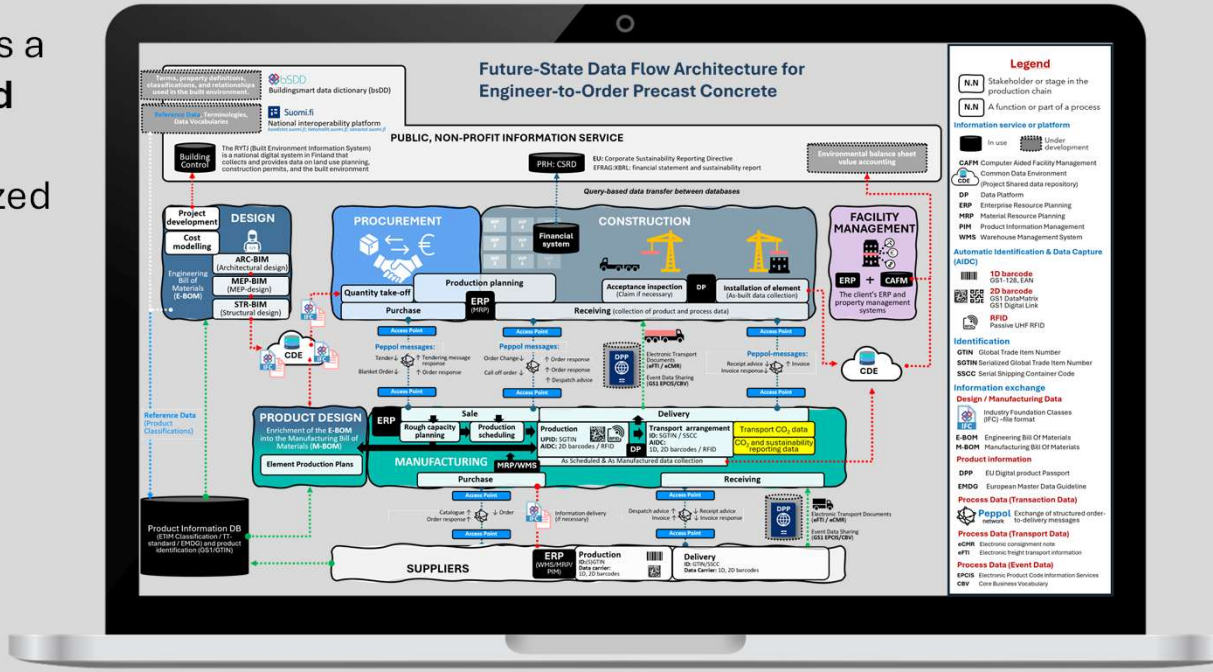
Fig. *Peppol, 5-corner model for e-invoicing (2021).*



*Service Metadata Provider (**SMP**), Service Metadata Locator (**SML**)*

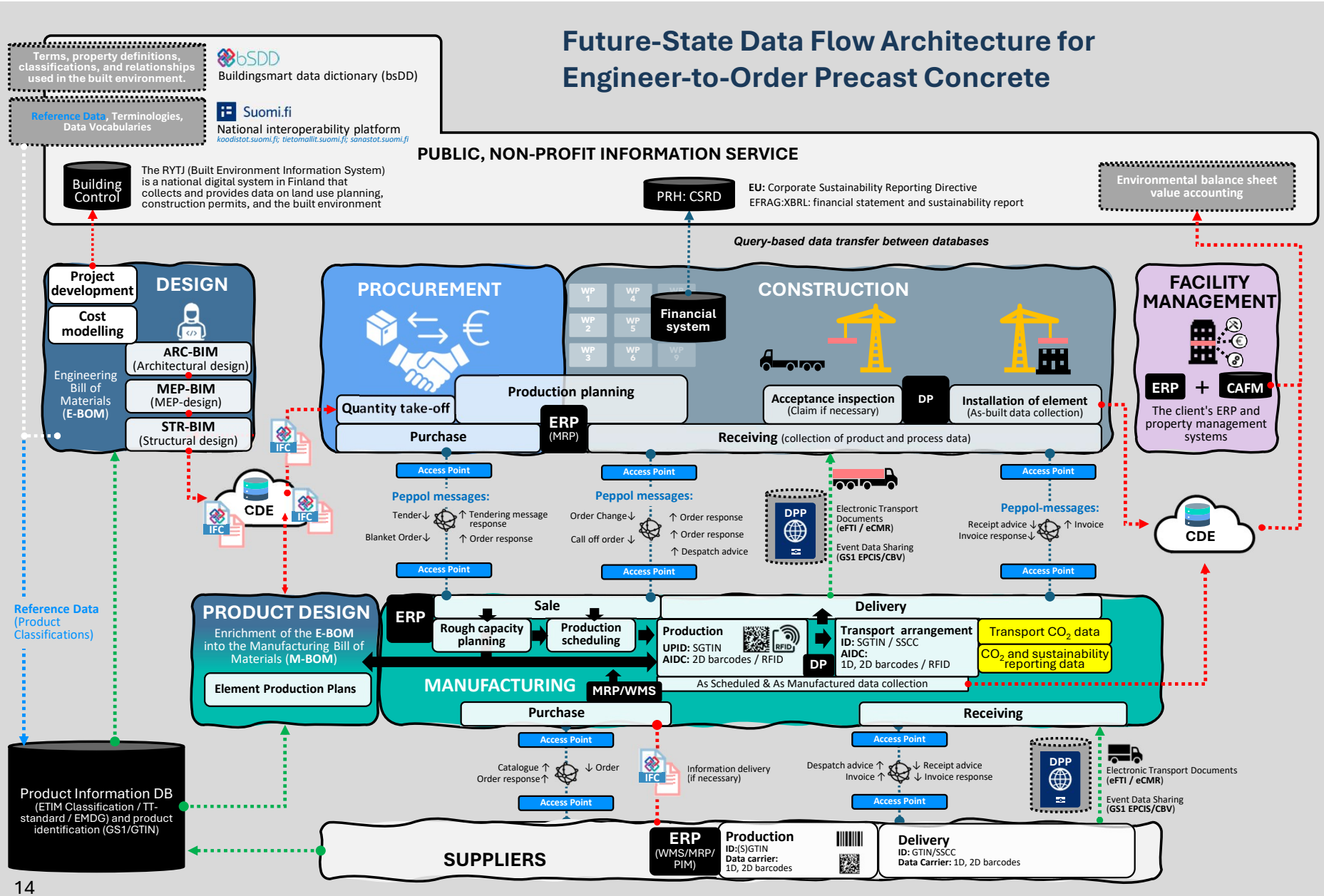
Future State Data Flow Architecture for Engineer-to-Order Precast Concrete

- Our development work follows the **TOGAF framework** and the **national JHS-179 architecture principles** to build an **industry-level architecture** for different production strategies.
- The **Future State Data Flow Architecture** serves as a key representation combining **process (action) and data architecture**. It illustrates **data repositories, interfaces, and core process functions** of a digitized supply chain.
- The **data architecture diagram** functions as an **evolving artefact** throughout the development project.



Current State → Development roadmap → Future State

Future-State Data Flow Architecture for Engineer-to-Order Precast Concrete



Legend

- N.N — Stakeholder or stage in the production chain
- N.N — A function or part of a process

Information service or platform

- In use
- Under development
- CAFM — Computer Aided Facility Management
- CDE — Common Data Environment (Project Shared data repository)
- DP — Data Platform
- ERP — Enterprise Resource Planning
- MRP — Material Resource Planning
- PIM — Product Information Management
- WMS — Warehouse Management System

Automatic Identification & Data Capture (AIDC)

- 1D barcode — GS1-128, EAN
- 2D barcode — GS1 DataMatrix, GS1 Digital Link
- RFID — Passive UHF RFID

Identification

- GTIN — Global Trade Item Number
- SGTIN — Serialized Global Trade Item Number
- SSCC — Serial Shipping Container Code

Information exchange

Design / Manufacturing Data

- IFC — Industry Foundation Classes (IFC) –file format
- E-BOM — Engineering Bill Of Materials
- M-BOM — Manufacturing Bill Of Materials

Product information

- DPP — EU Digital product Passport
- EMDG — European Master Data Guideline

Process Data (Transaction Data)

- Peppol network — Exchange of structured order-to-delivery messages

Process Data (Transport Data)

- eCMR — Electronic consignment note
- eFTI — Electronic freight transport information

Process Data (Event Data)

- EPCIS — Electronic Product Code Information Services
- CBV — Core Business Vocabulary

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