Expanding Digital Footprints to Drive Higher Levels of Operational Efficiency

Oleg Shilovitsky
OpenBOM
CEO & co-founder
Email: oleg@openbom.com

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Who’s Oleg Shilovitsky and OpenBOM?

Oleg Shilovitsky, CEO and Co-Founder:

- 20+ years with PDM/PLM development
- Worked for Dassault Systèmes and Autodesk
- Author of Beyond PLM from 2009
- Over 4,000 articles about PLM, engineering and manufacturing
- Co-founder of OpenBOM to change the way manufacturing companies are using data

OpenBOM:

- Trusted by over 400 customers and over 50,000 registrations
- Winner of G2’s 2023 & 2024 Best Software Award in CAD & PLM
- 600+ reviews in G2’s PLM category
- Discover customer stories and reviews

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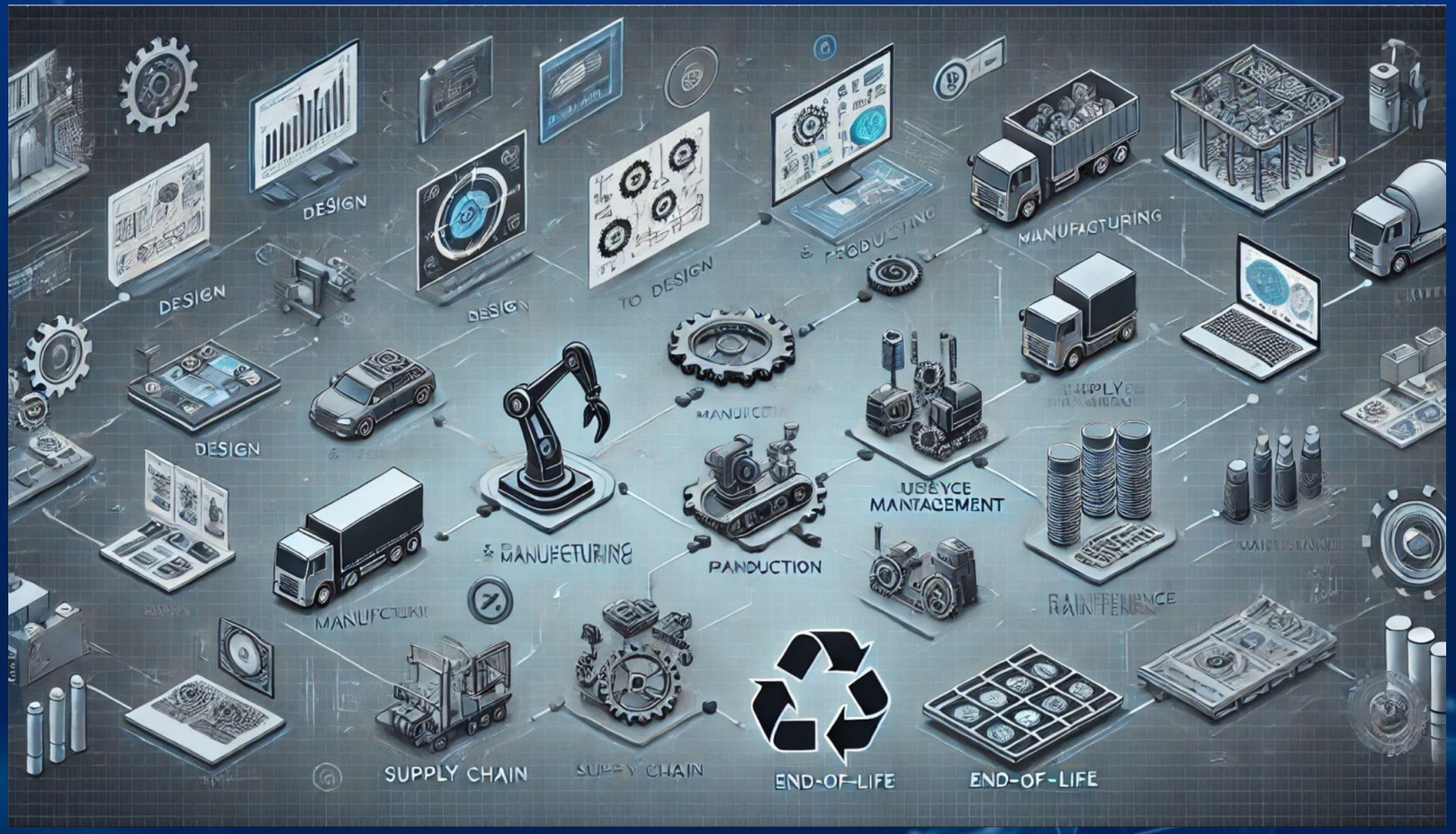
Digital Footprint - A Collection of Data Assets



- **Design Data**:
  CAD models, simulations, and revisions, creating a traceable product record.
- **Manufacturing Data**:
  Steps, quality checks, and instructions for consistency and improvement.
- **Supply Chain**:
  Tracks parts, vendors, and logistics for traceability.
- **Usage Data**:
  Product usage patterns and maintenance needs for lifecycle insights.
- **End-of-Life Data**:
  Recycling and disposal info for compliance and design feedback.
- **Collaboration**:
  Data from tools capturing decisions and team communication.

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The Factors Contributing to Expansion of Digital Footprint

Key Changes in Manufacturing Business Models

- Product-as-a-Service (PaaS)
- Predictive Maintenance
- Data-Driven Services
- Outcome-Based Models
- Flexible Financing

Digital Workflow Impact

- Data Insights
- Customer Engagement
- Connectivity

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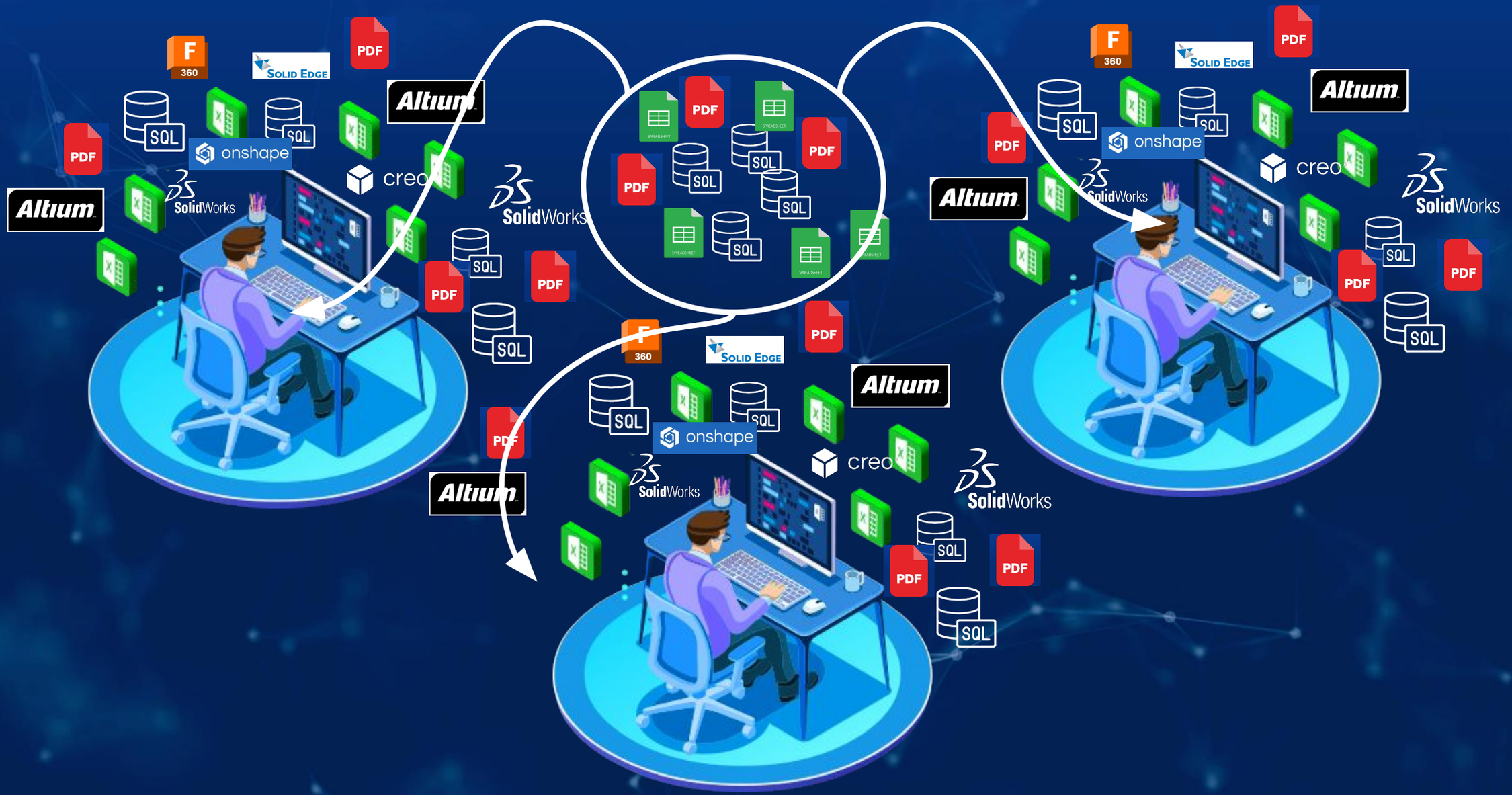
What is the problem with the digital footprint?



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The entire manufacturing eco-system is built from documents

While 68% of industrial companies CEOs are increasing digital investments, only 25% of manufacturers trust their data's organization and reliability.

Sources: Manufacturing 2030 NAM report, An EY research about trends in discrete manufacturing , CIMdata 2023 market research

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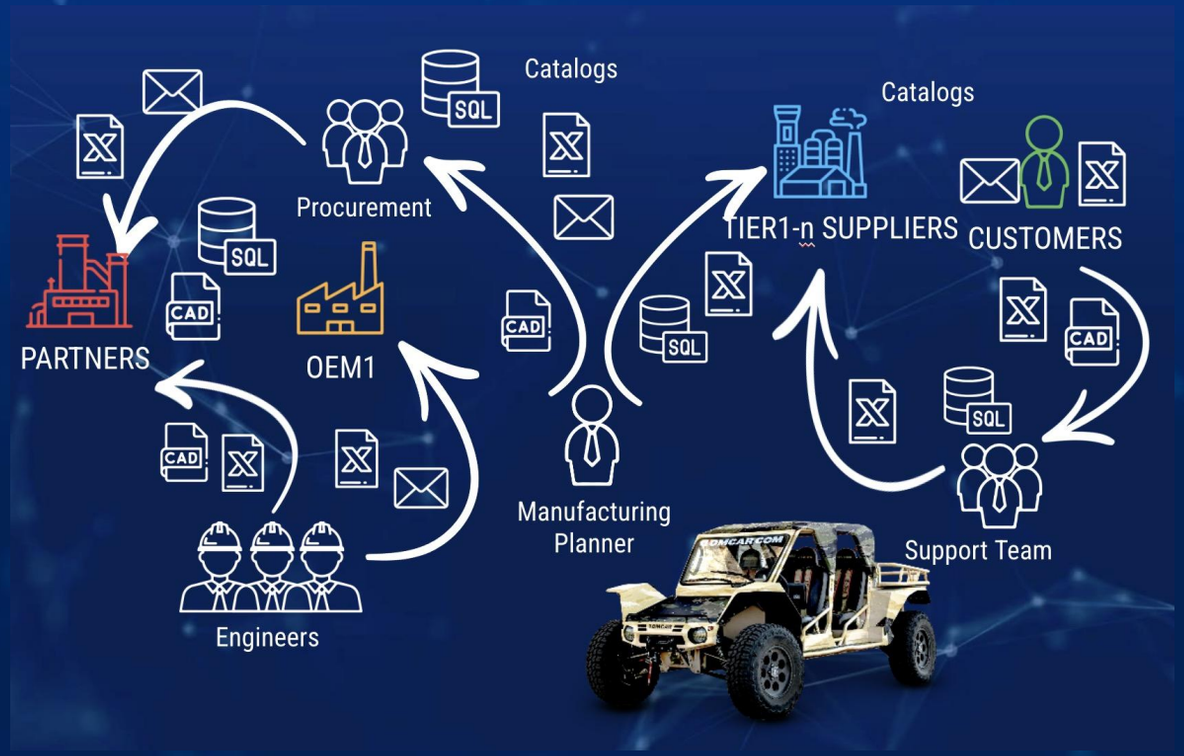
Engineering and Manufacturing Data Management Challenges



1. Product complexity growth
2. Cost and competition pressure
3. Supply Chain turbulence
4. Change Management traceability
5. New business models
6. Maintenance
7. Regulation and compliance
8. Sustainability

All these challenges come down to one thing: data!

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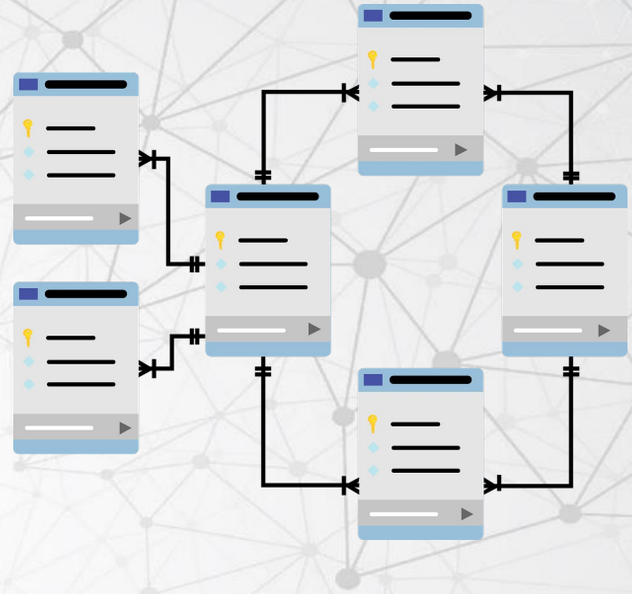
What are limitations of traditional solutions?

This is how traditional systems (aka PLM) looks like:

- Tables, tables…
- Relational databases
- Internal Keys
- Table Joins



	A	B	C	D	E	F
1	**Product Id**	**Part Id**	**Vendor**	**Description**	**Cost**	**Supplier**
2	10	P-100	FMPC	Screw	$2.30	W.W. Grainger.
3	20	P-101	FMPC	Screw	$1.20	Sonepar USA (Industrial)
4	30	P-102	DigiKey	Resistor	$1.40	DigiKey
5	40	P-103	Local Shop	Plastic Box	$12.30	HDS
6	50	P-104	Local Shop	Plastic Base	$10.20	ABC USA
7	60	P-105	Company A	Axle	$34.20	ABC USA
8	70	P-106	Company A	Wheel	$20.00	ABC USA

Huge complexity in connectivity between data coming from different sources

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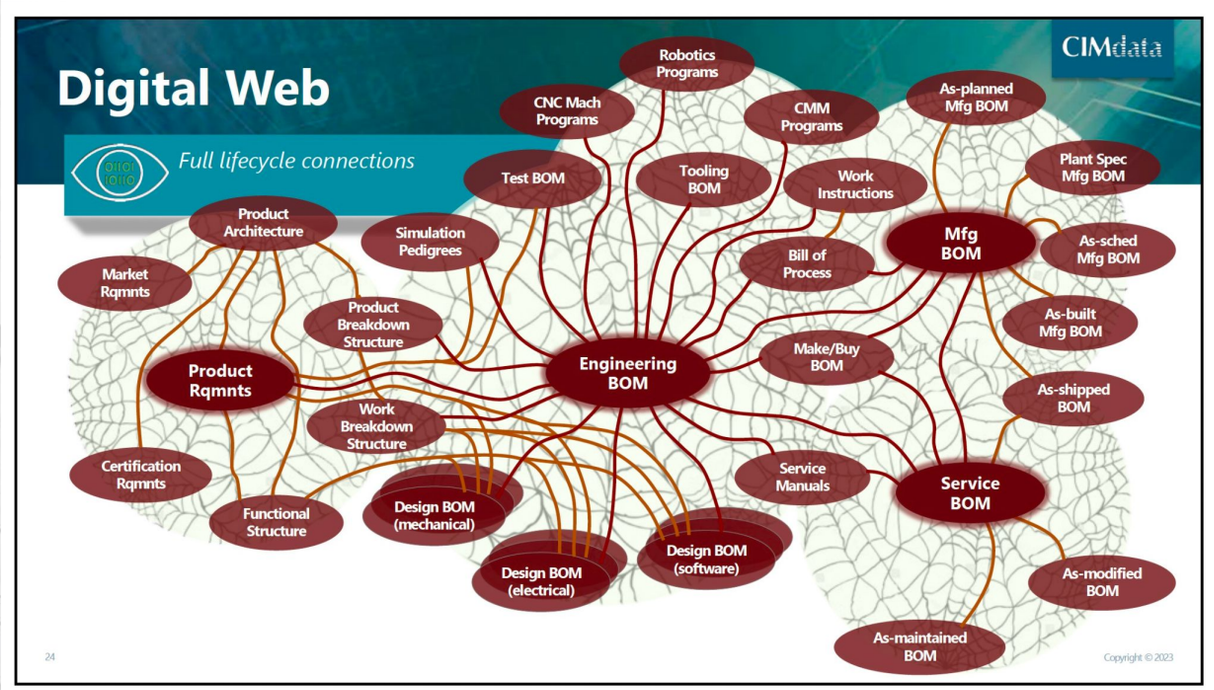
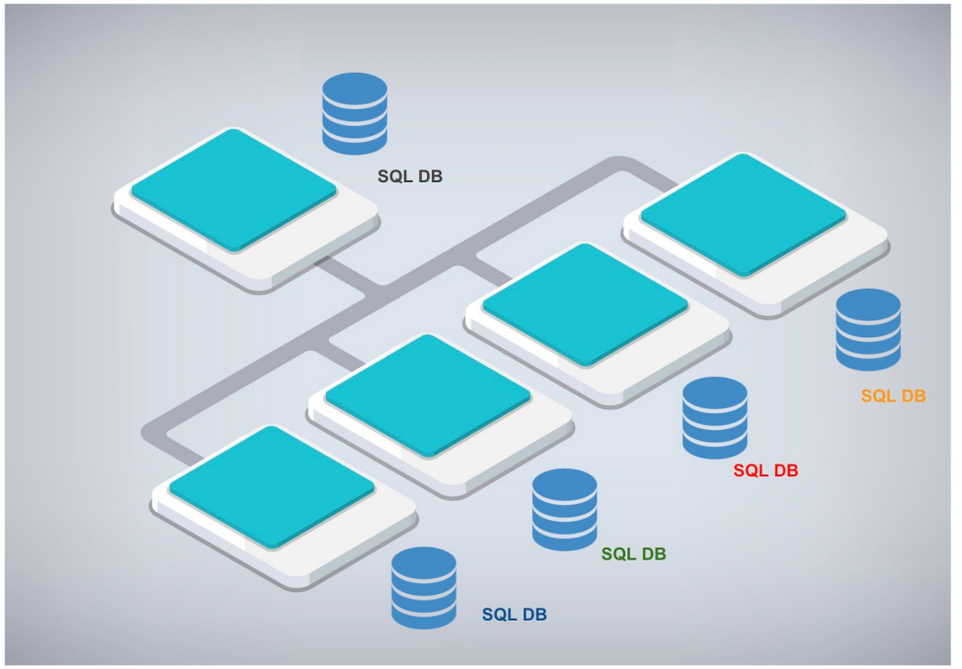
Traditional PLMs → Vision vs Reality

Vision



Reality



Credit: CIMdata

Traditional Architecture of PLM Systems Is Disconnected From Digital Web Vision

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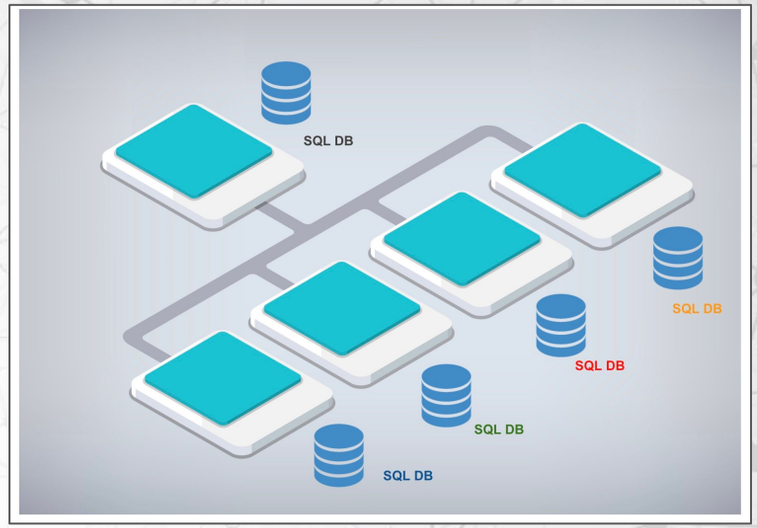
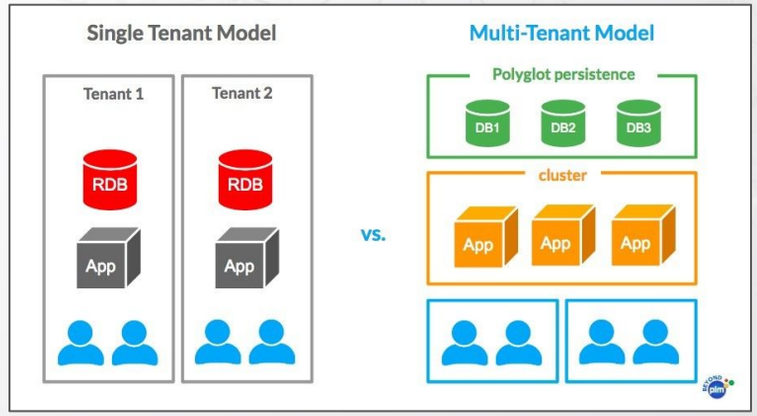
5 Problems with traditional PLM systems

1. Tables and local IDs is the foundation of PLM
2. Relational DB and single tenant architecture
3. No easy way to recombine the data
4. Find relationships between systems is hard
5. Application logic is tightly connected





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Technology Evolution (slide credit Prof. Martin Eigner)

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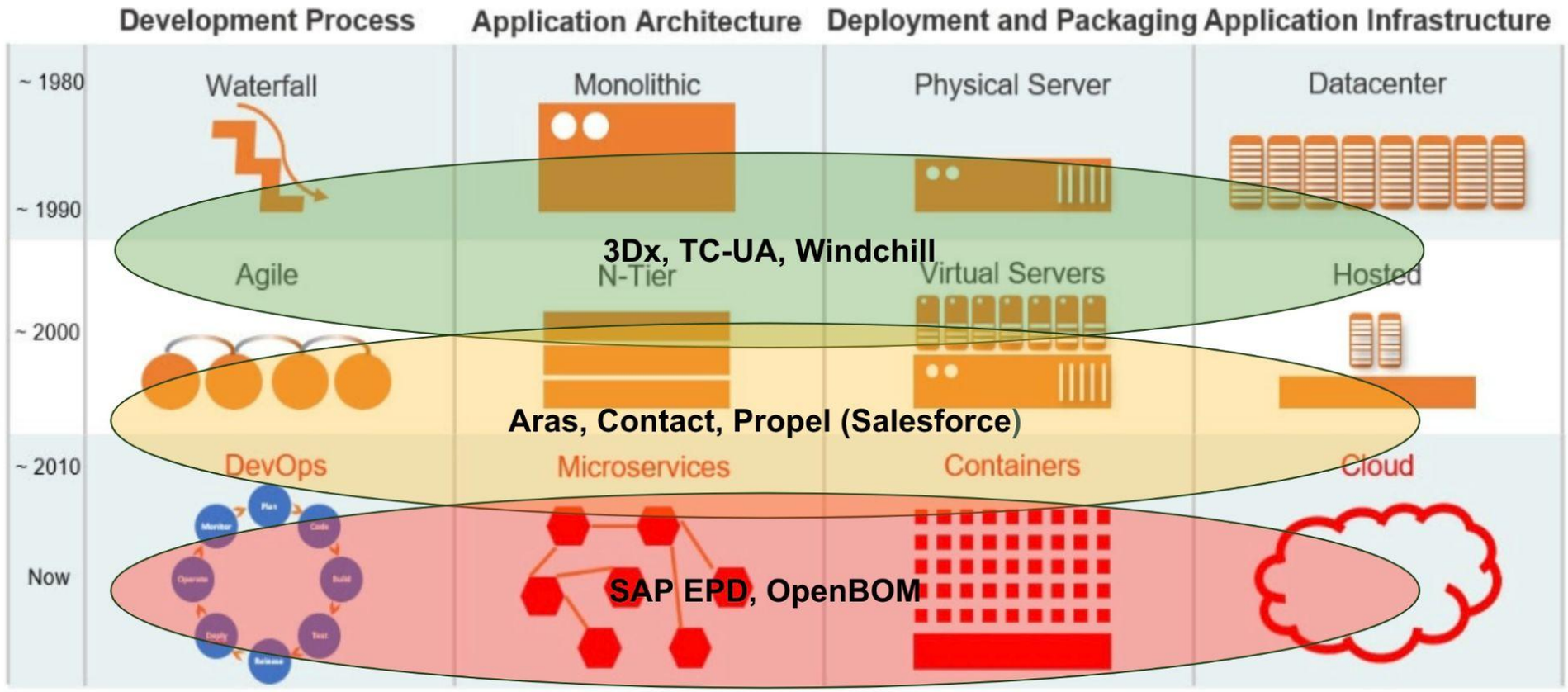
Software-Technology (Source: based on K21Academy)



K21Academy
Learn Cloud from Experts

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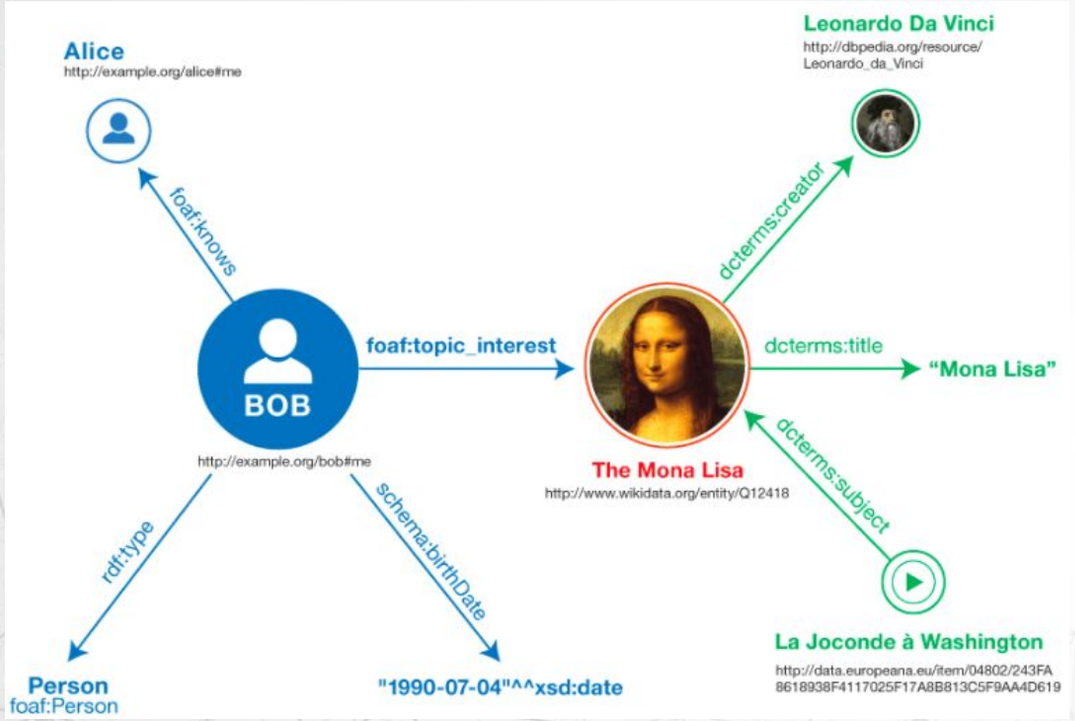
What is Semantic Web and Linked Data?



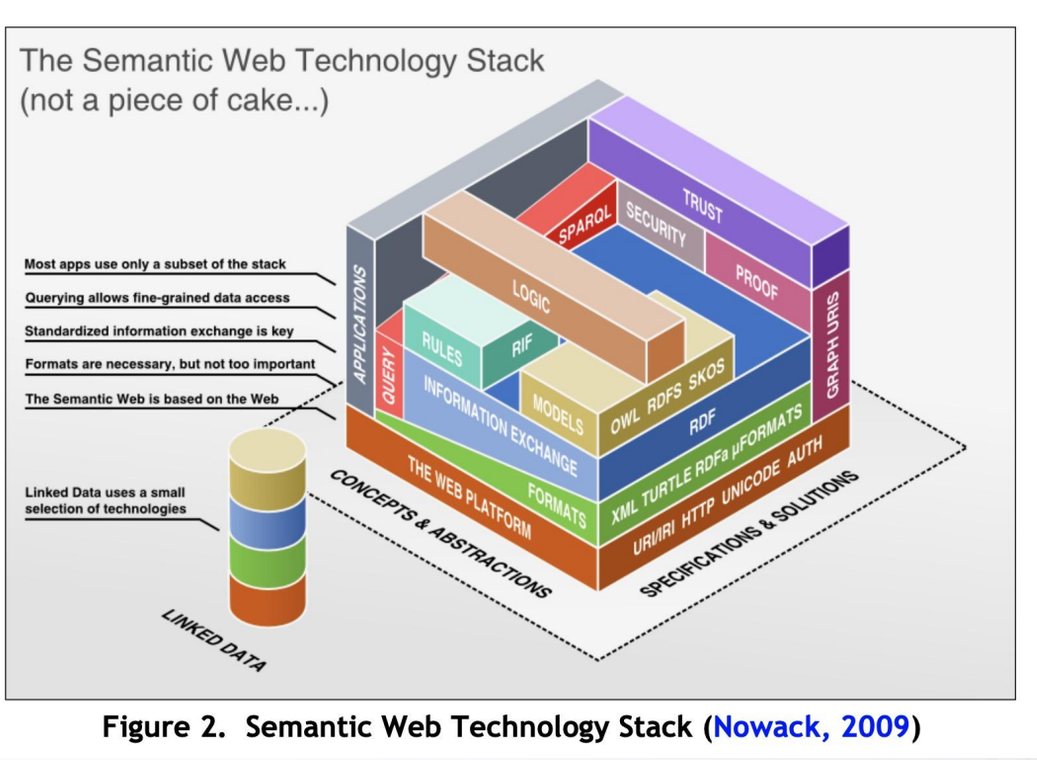


Figure 2. Semantic Web Technology Stack (Nowack, 2009)

In computing, **linked data** is structured data which is interlinked with other data so it becomes more useful through semantic queries. It builds upon standard Web technologies such as HTTP, RDF and URIs, but rather than using them to serve web pages only for human readers, it extends them to share information in a way that can be read automatically by computers. Part of the vision of linked data is for the Internet to become a global database.[1]

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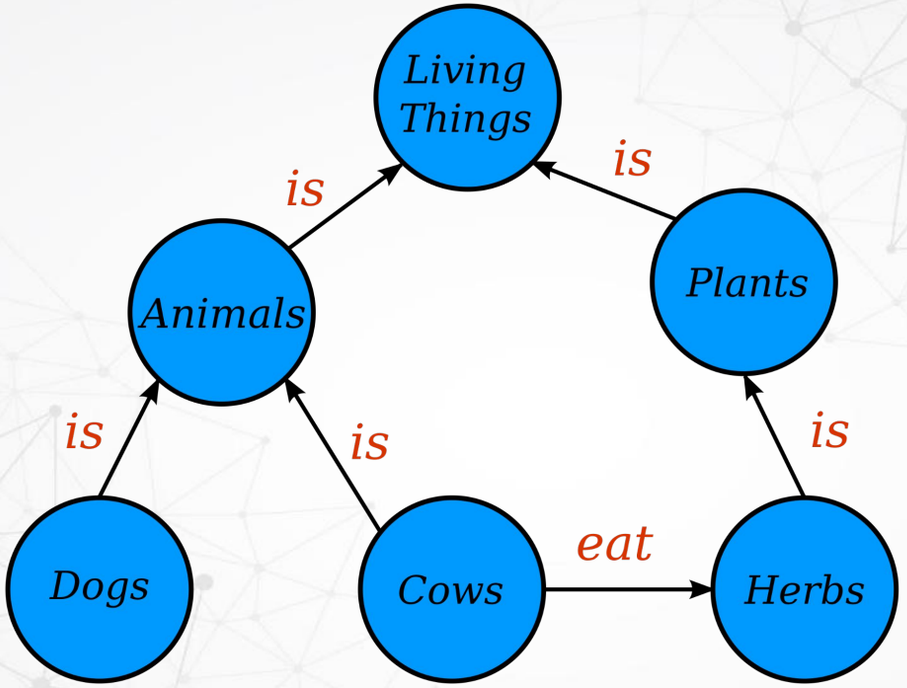
What is Knowledge Graph and Why it is important?



In knowledge representation and reasoning, **knowledge graph** is a knowledge base that uses a graph-structured data model or topology to integrate data. Knowledge graphs are often used to store interlinked descriptions of entities – objects, events, situations or abstract concepts – while also encoding the semantics underlying the used terminology.

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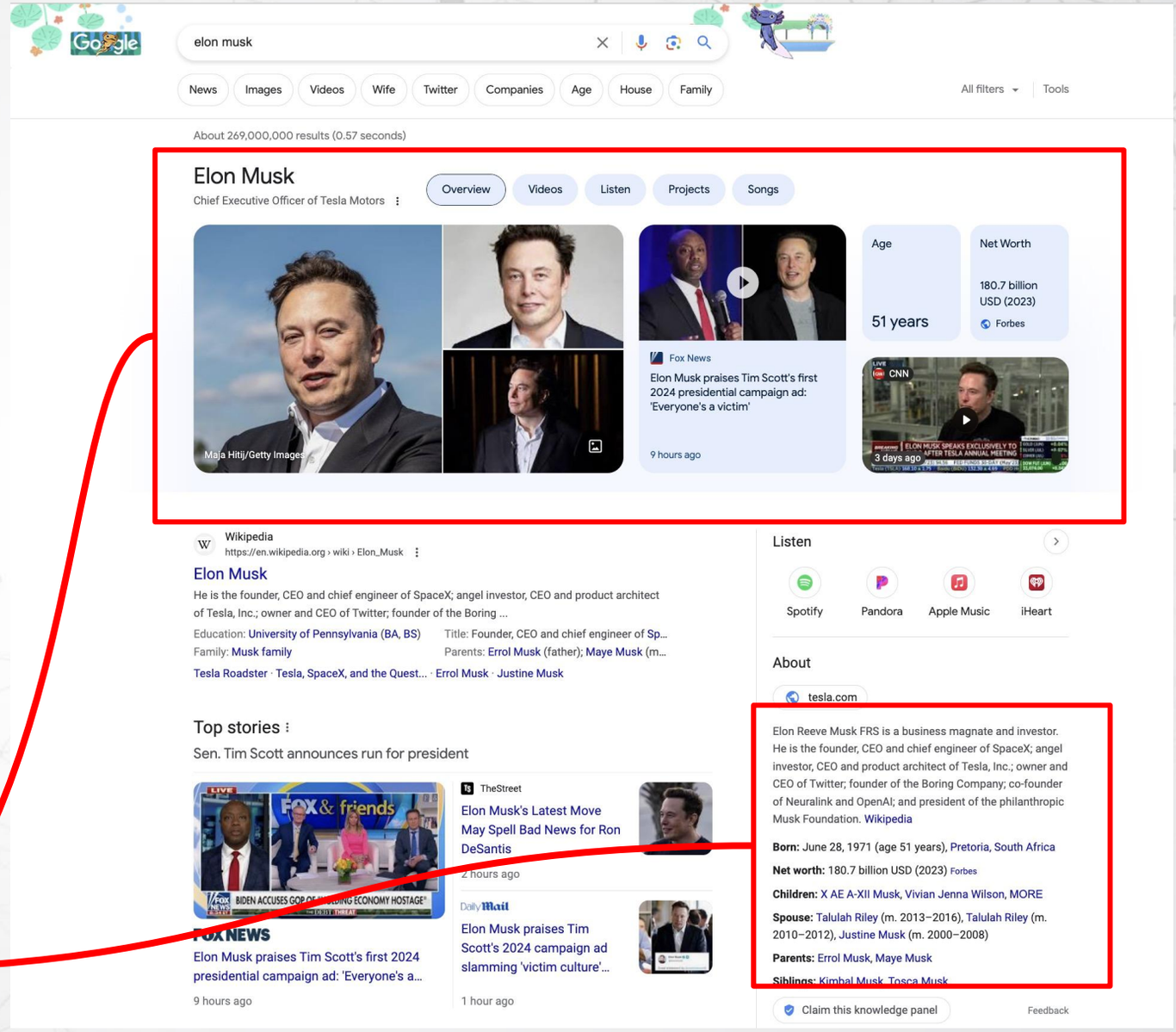
What is Knowledge Graph and LinkedIn Data?

10 years ago…

It is the way to present structured information…



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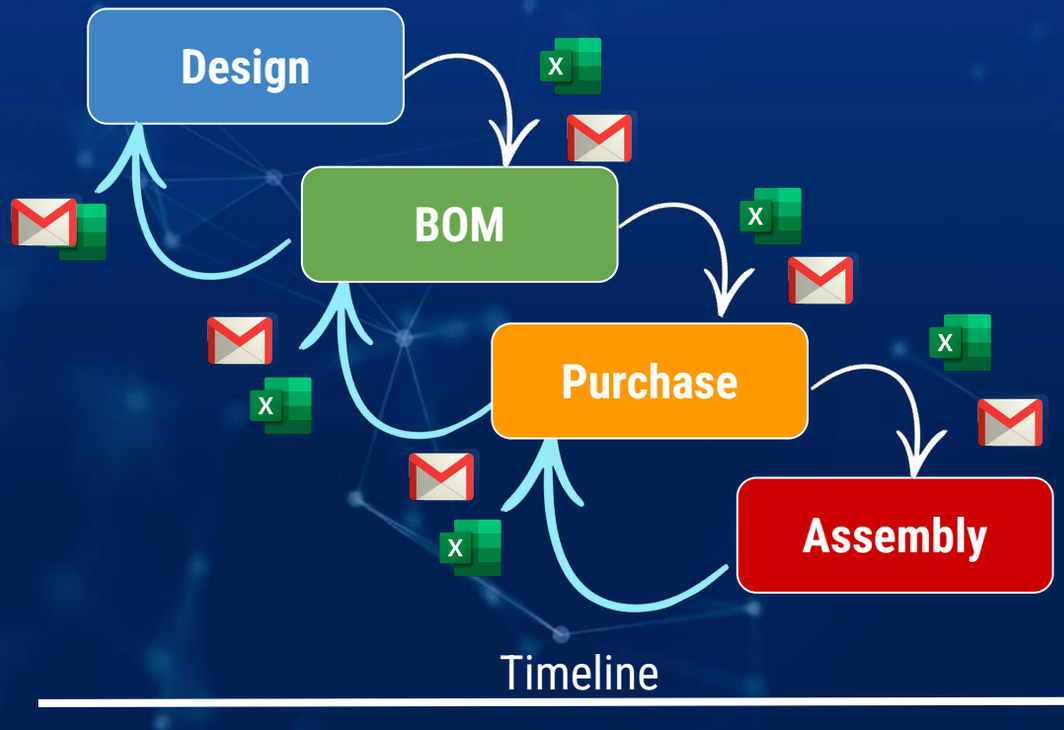
From Complex Email and Documents Flow to Connected Data Driven Process



⦿ Excel/STEP/PDF ⦿ Legacy DBs ⦿ CAD/PDM/ERP ⦿ Emails

Slow and Disconnected Process using emails and documents, the information is hidden

⦿ Online Data ⦿ Connected Systems ⦿ Digital Thread ⦿ Process

Agile and Connected Process using application manipulating granular data semantically connected

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What is a possible technical architecture and solution?

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Using Graph Based Digital Thread (slide credit Prof. Martin Eigner)

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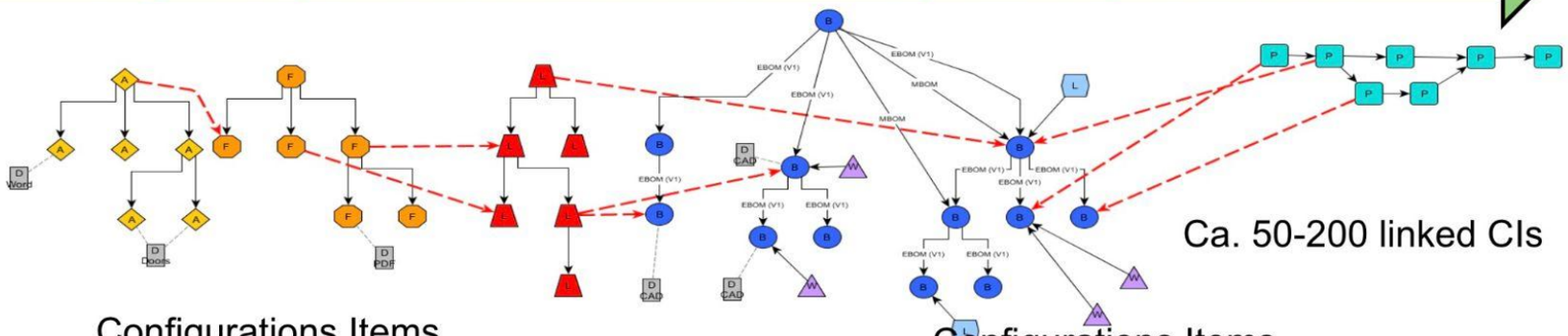
Digital Thread as Knowledge Graph of Connected CIs

Engineering Processes: ECR, ECM, Traceability, QMS, Digital Twin Core

SW-Technologie
- Low Code
- Interactive Repository
- Graph. DB
- Microservices
- Data Linkage RDF/REST
- Easy to configure
- Open



Ca. 50-200 linked CIs

Configurations Items (Cis)

Configurations Items (Cis)

CRM

CPQ

ALM

SAP EPD/PLM oder allg. PLM System

Master Data
E-BOM
Documents
M-BOM
BOP/MPP

SAP S/4HANA

SAP

MES/MOM

SCM

Digitale Fabrik

Prio 1 (ca 70-80% der Cis)

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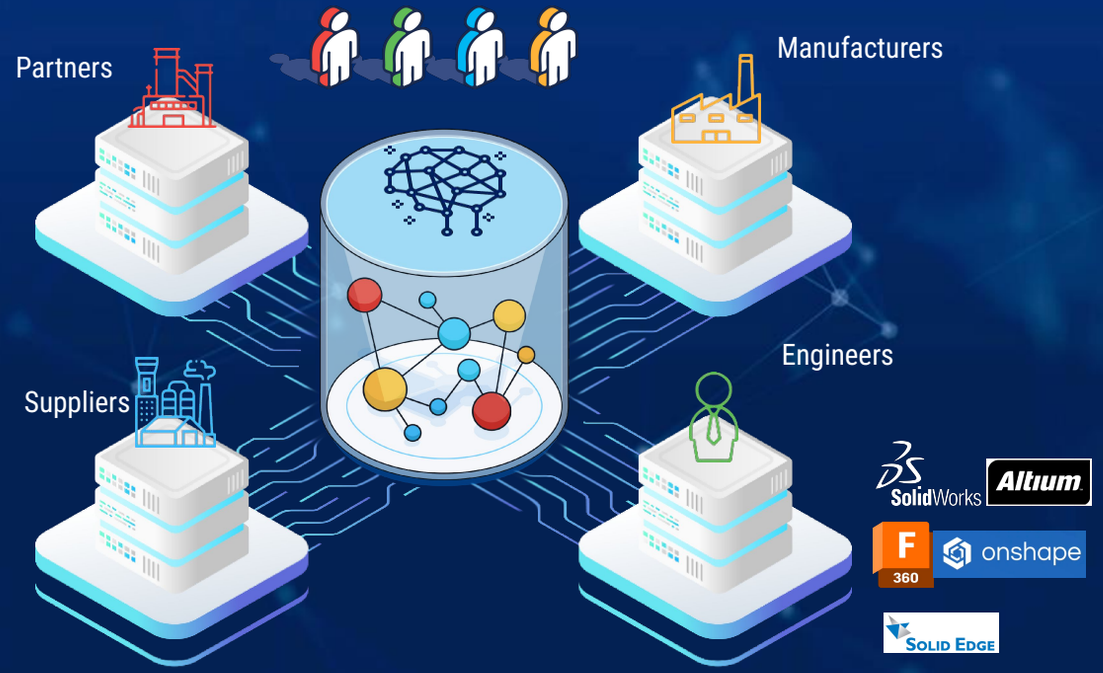
From Chaos of Disconnected Tools to Organized Product Data



⦿ Excel/STEP/PDF ⦿ Legacy DBs ⦿ CAD/PDM/ERP ⦿ Emails

Disconnected Process using emails and documents, the information is hidden in the documents

⦿ Online Data ⦿ Connected Systems ⦿ Digital Thread ⦿ Process

Connected Process using application manipulating granular data semantically connected together

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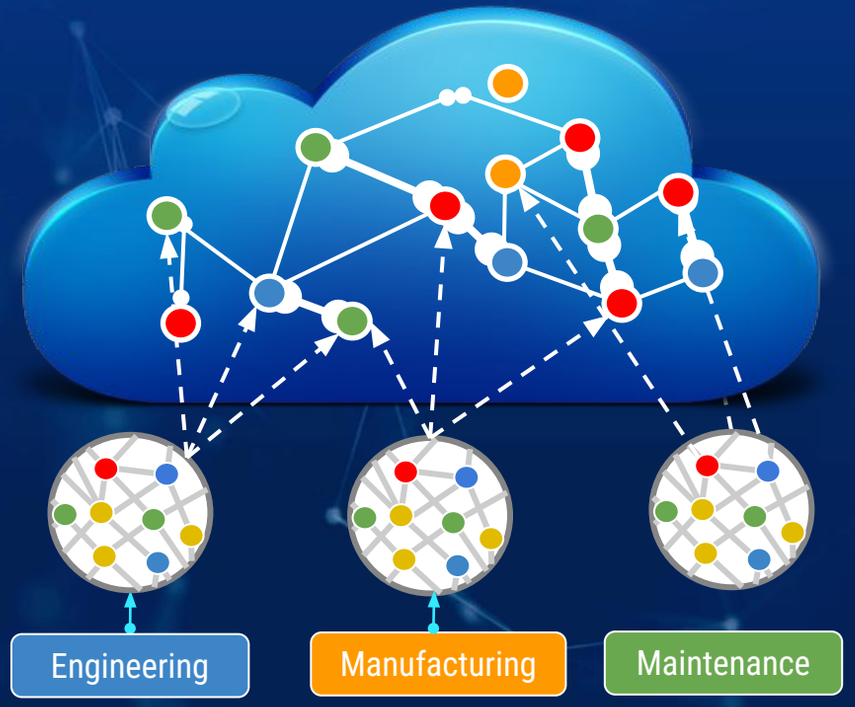
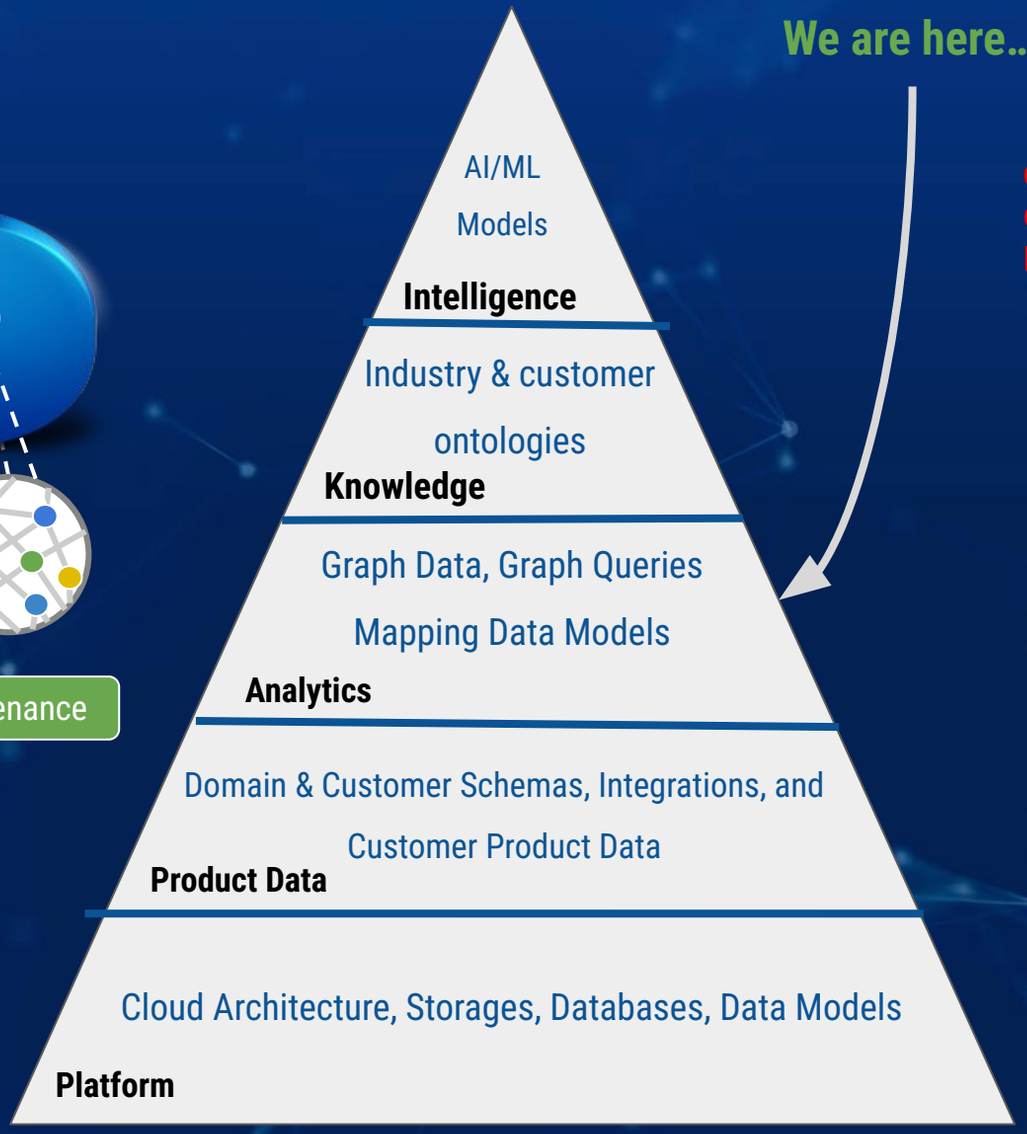
OpenBOM Platform: Product Knowledge Graph and AI



Industry or Enterprise Product Knowledge Graph Connecting Product Information across multiple companies and industries



We are here...

Co-pilot prototyping. Graph DB, LLM, RAGs

Research for industry ontologies and knowledge graph building

Graph queries to product data and application layers, integration, and graph navigation. Product model mergers and similarities.

Flexible data model, real-time collaborative services, integration services, integrations with major CAD, PDM, PLM, ERP and other sources

Multi-tenant platform, 60k regs, ~2k customers, global availability, microservices, polyglot persistence (Neo4j, MongoDB, Elastic, etc)

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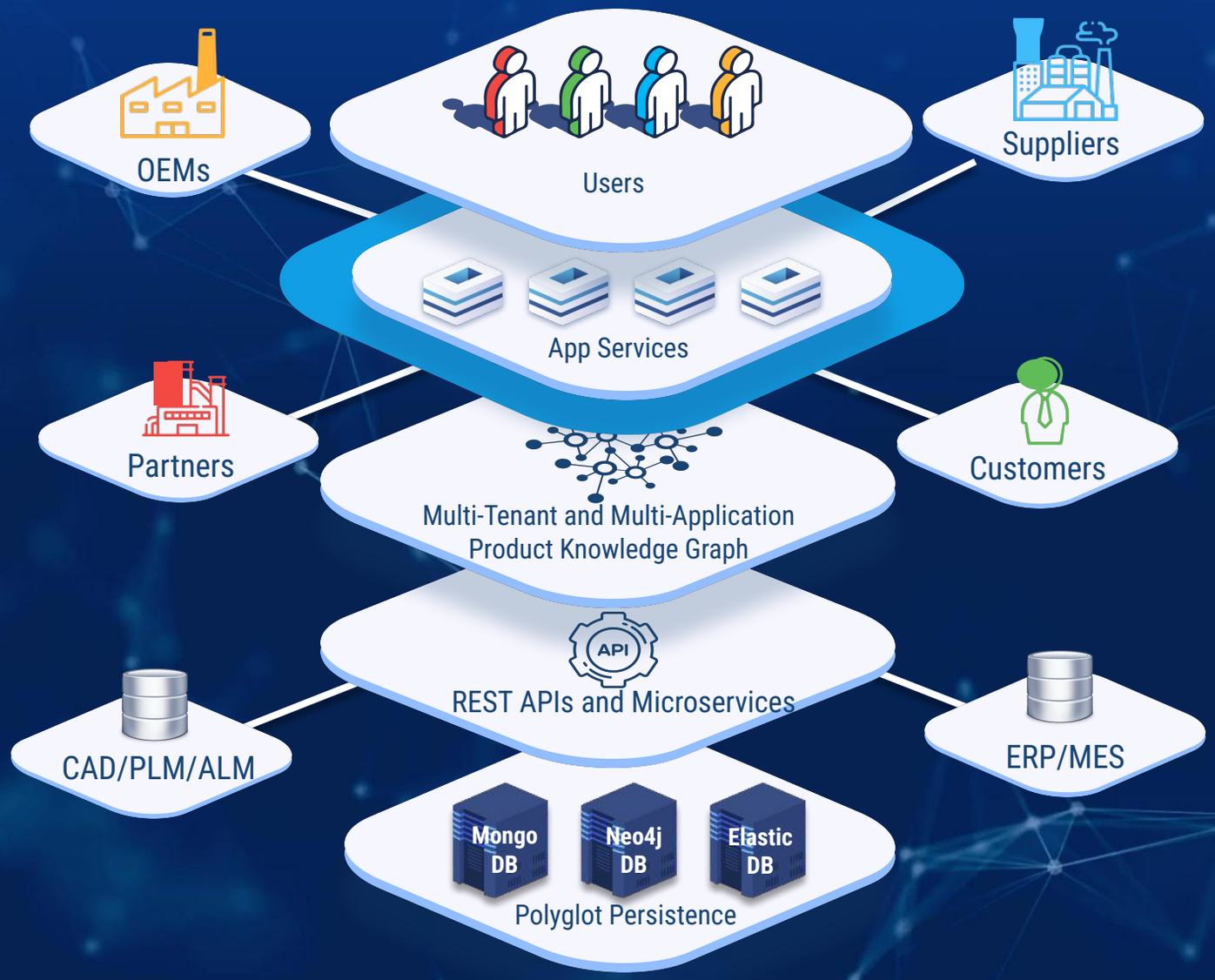
OpenBOM Technology Foundation



- Containers and web services
- Microservices Architecture
- Connected & federated (not monolithic)
- Multi-tenant data model (multi company)
- Polyglot persistence + graph based
- Flexible data model and global scale
- SaaS cloud services (applications)
- Data linkage/merge using REST & graphs
- Openness vision
- Easy to Configure and Customize
- Easy to Upgrade
- Patented real-time collaboration
- Simultaneous collaborative data editing
- Role-based instant data sharing
- Graph data science support
- AI/LLM support in research
- DBaaS for MongoDB/Neo4j/Elastic
- AWS ECS (pub, private) + DevOps

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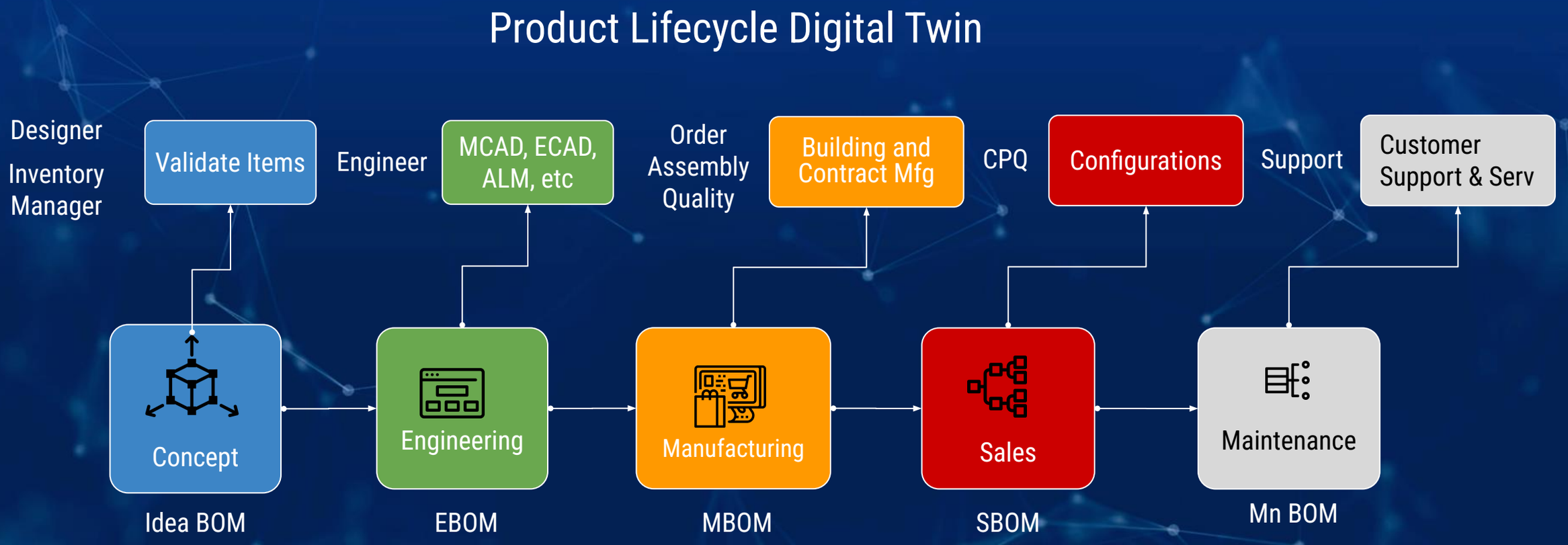
Digital BOM and Connected Product Lifecycle



⦿ Flexible Data Model ⦿ Revision Control ⦿ ECO/ECN ⦿ Graph Navigation ⦿ xBOM ⦿ Cost rollup ⦿ CAD/PDM/ERP ⦿ Role-based instant data sharing

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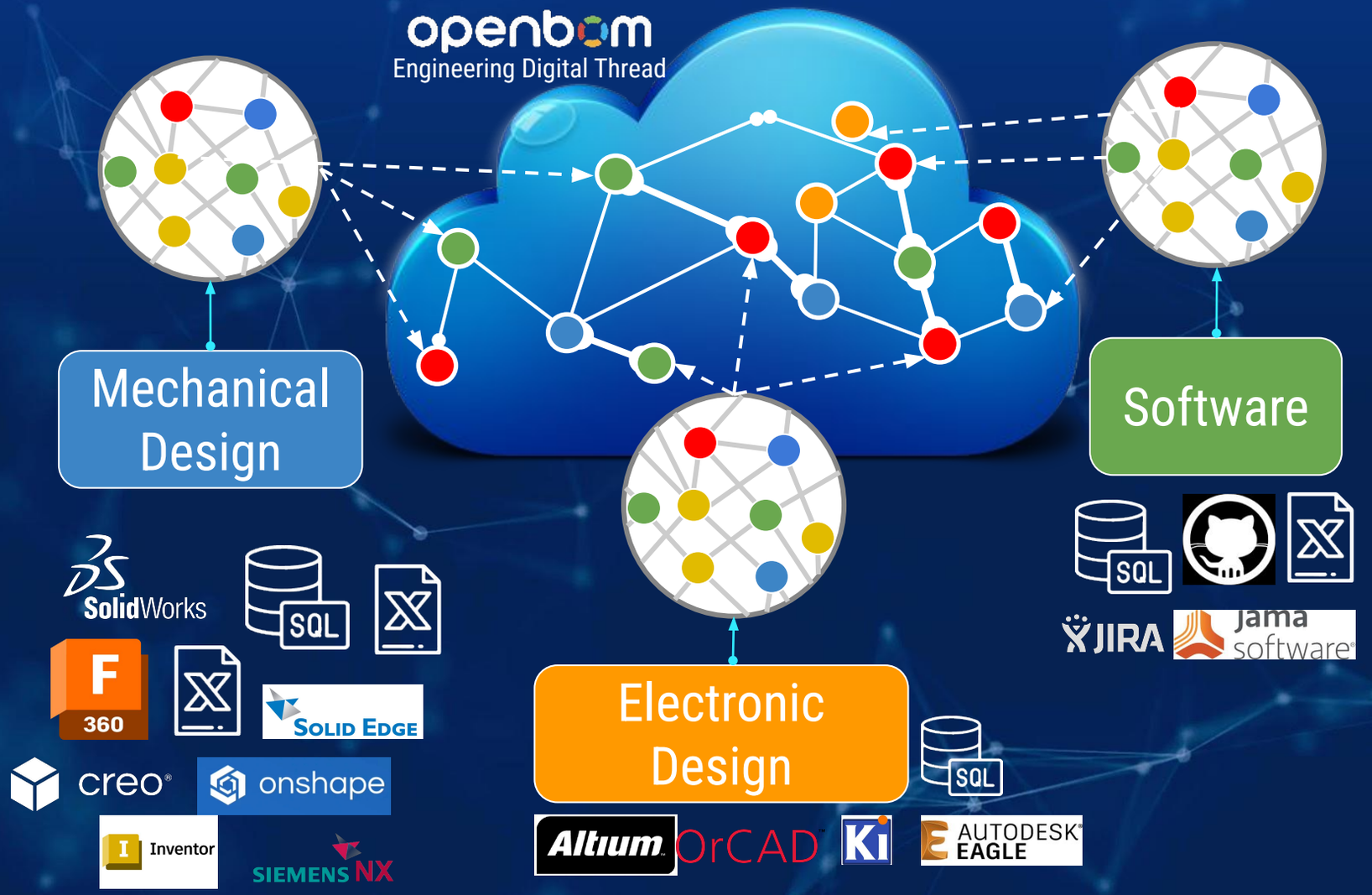
Seamless Design Integrations with Multi-CAD support



Multi-CAD Integration: Expertise in file and data capture from multiple engineering data sources

Dedicated Add-ins for CAD systems and specialized API Toolkit

Unified BOM Creation Across Systems MCAD, AECO, ECAD, Software

CAD File Management, Cloud Storage and Versions

Automatic Derivative Files (STEP, PDF, STP, etc)

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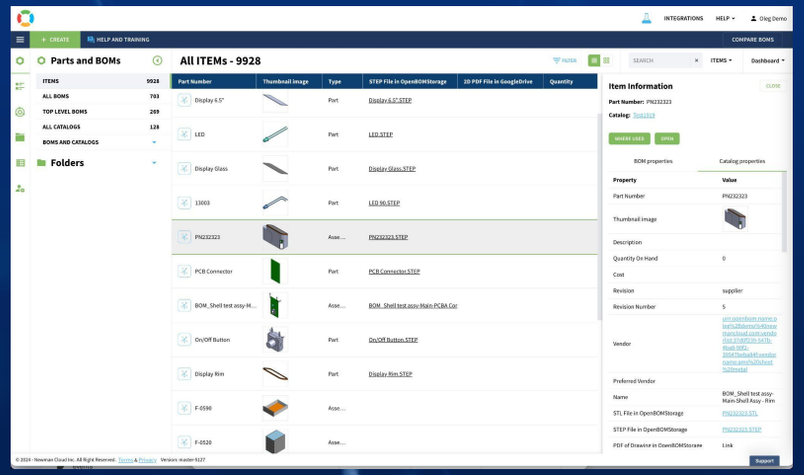
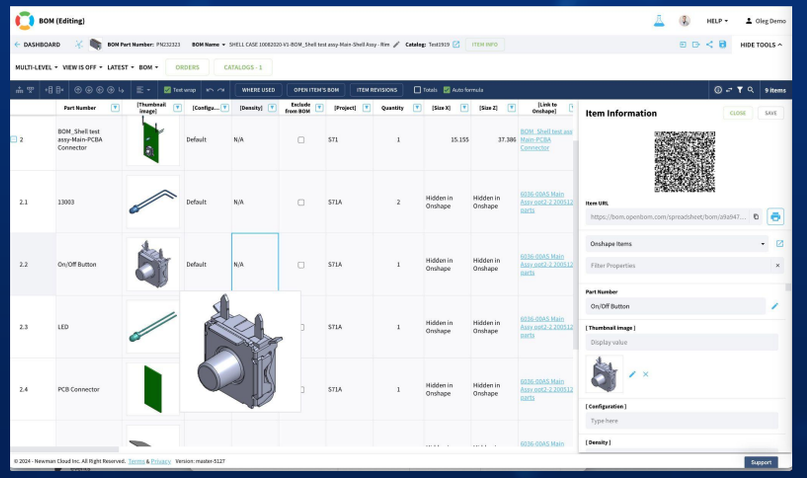
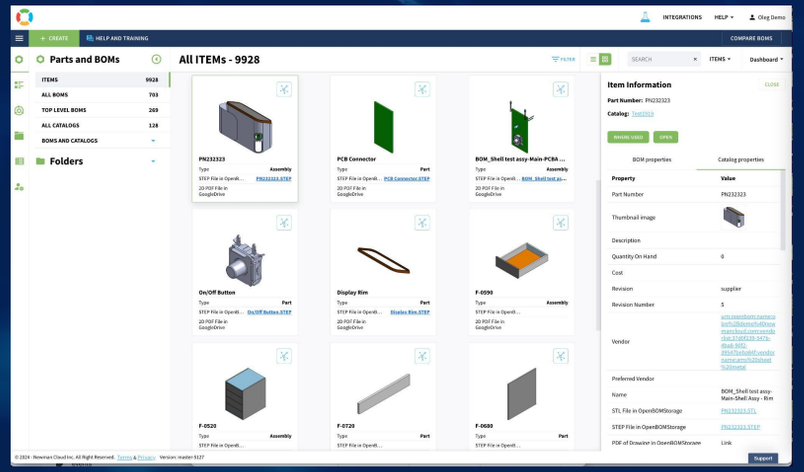
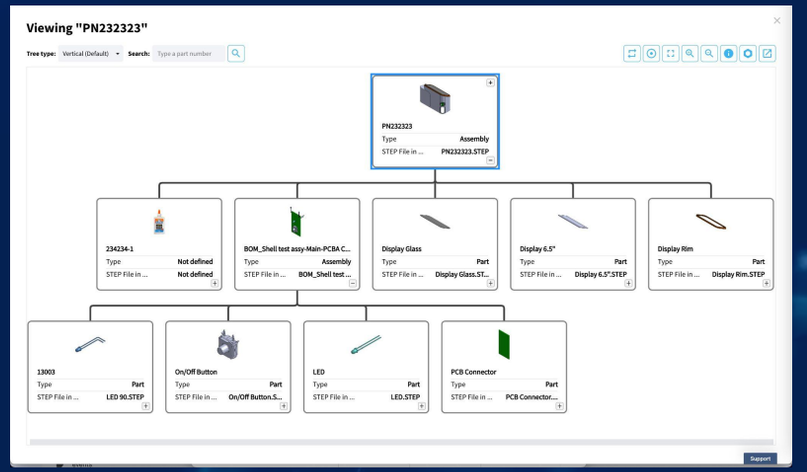
Simple and Easy User Experience Combined with Powerful Functions









- Flexible data
- Data driven user interface
- Real-time collaboration
- Instant data sharing
- Multi-view xBOM support
- BOM comparison
- Custom objects
- Real-time collaboration
- Graph Navigation
- CAD file management
- Revision control
- Change management
- Cost rollup
- Formula support

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Concluding Remarks

How to Expand the Digital Footprint and Achieve Operational Efficiency

- ✔ Strategy + Education: Paradigm shift from “document” → “data” → “intelligence”
- ✔ Technology: Create open, connected, and expandable data architecture
- ✔ Implementation: Connect existing data (both legacy and operational)
- ✔ Implementation: Build new application services for “systems of engagement”
- ✔ Implementation: Integrate app services into existing applications
- ✔ AI: Tools for improvement of decision effectiveness

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Thank you!