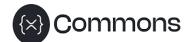


# QUESTIONS & ANSWERS



## BLOCKCHAIN AND INTEROPERABILITY

Enterprise and Technical Perspectives  
for Effective Collaboration.

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# WHO I AM

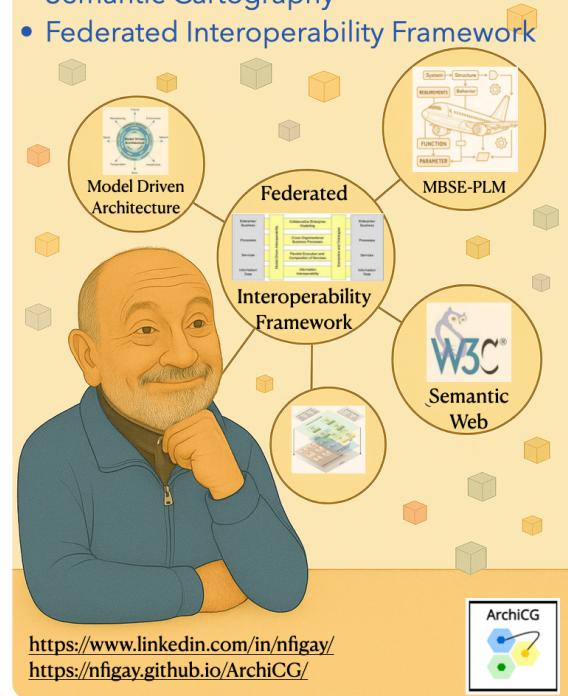
## DR. NICOLAS FIGAY

- Expert in Enterprise Application Interoperability
- Creator of **ArchiCG** — an open-source tool for semantic cartography
- Doctor and **HDR-qualified researcher**, recognized in the academic and scientific community
- External collaborator with LIRIS (Laboratoire d'Informatique en Image et Systèmes d'information), working with **Prof. Parisa Ghodous** at Université Lyon 1
- International expert on **PLM interoperability, MBSE, EA**
- Contributor to major European projects on interoperability and digital continuity
- Former lead at **Airbus**
- Specialist in **ISO STEP standards, ontology-based modeling, and open ecosystems**

*To share my experience and carrier path in order to give you perspective for future development path while contextualizing software development in a more global enterprises digitalisation context.*

### Continuous Operational Interoperability

- Technical Enterprise Applications
- Collaborative Working Environments
- Semantic Cartography
- Federated Interoperability Framework



## OBJECTIVE OF THE PRESENTATION

Introduce enterprise application interoperability in digital ecosystems

Preparing and building continuous operational interoperability imply to:

- Identify brakes and enablers to effective collaboration
- Prepare systems for **blockchain-based collaboration**
- Promote **open standards** and model-driven approaches
- Bridge strategic vision with technical implementation

## KEY MESSAGE

*Interoperability is not a feature of blockchain.*

*It is a prerequisite for blockchain-based collaboration.*

- Semantic Coherence
- Shared Understanding of Processes
- Trusted and Traceable Integration

# **WHAT IS ENTERPRISE APPLICATION INTEROPERABILITY?**



# ENTERPRISE APPLICATION

*An Enterprise Application is a software system designed to support and automate various business processes within an organization. These applications facilitate the integration of information across departments, enhancing efficiency and decision-making.*



## Key Characteristics

- **Process Integration:** Connects disparate business functions such as finance, human resources, and supply chain.
- **Data Consistency:** Ensures uniform data across the organization.
- **Scalability:** Handles increasing amounts of data and users.
- **Customization:** Adaptable to specific organizational needs.
- **Interoperability:** Facilitates communication with other systems and applications.



# TECHNICAL ENTERPRISE APPLICATION

*A Technical Enterprise Application is a specialized software system designed to support and automate **technical and engineering processes** within an enterprise. These applications manage complex data and workflows across the **product lifecycle**, including design, simulation, manufacturing, and maintenance, ensuring integration within the enterprise's information system.*



## Key Characteristics

- **Domain-Specific Functionality:** Tailored to engineering and technical domains, such as CAD, CAE, and PLM systems.
- **Lifecycle Integration:** Supports various phases of the product lifecycle, facilitating seamless transitions between stages.
- **Interoperability:** Designed to interact with other enterprise applications and systems, often through standardized protocols and data formats.
- **Complex Data Management:** Handles intricate datasets, including 3D models, simulations, and technical documentation.
- **Scalability and Flexibility:** Capable of adapting to evolving technical requirements and integrating new technologies.



# ENTERPRISE APPLICATION INTEROPERABILITY

*Enterprise Application Interoperability refers to the capability of diverse enterprise applications to seamlessly exchange, share, and aggregate information across organizational boundaries. This interoperability ensures continuous operational collaboration by aligning business processes, applications, and underlying technologies.*



## Key Characteristics

- **Governance and Architecture:** Establishes governance structures and architectural frameworks to support interoperability.
- **Standardization:** Utilizes open and governed standards to facilitate consistent data exchange.
- **Semantic Preservation:** Maintains the meaning and context of information across different systems.
- **Resilience and Agility:** Enhances the organization's ability to adapt to changes and recover from disruptions.
- **Collaborative Processes:** Supports synchronized business processes across multiple organizations.



## CONTINUOUS OPERATIONAL INTEROPERABILITY

*Continuous Operational Interoperability refers to the sustained ability of diverse and evolving enterprise systems to seamlessly collaborate, ensuring uninterrupted information exchange and process integration across organizational boundaries. This concept emphasizes the need for ongoing alignment between business processes, supporting applications, and underlying technologies to maintain effective collaboration in dynamic environments.*

### 📌 Key Aspects

- **Governance and Architecture:** Establishes strategic governance structures and architectural frameworks to support interoperability.
- **Standardization:** Utilizes open and governed standards to facilitate consistent data exchange.
- **Semantic Preservation:** Maintains the meaning and context of information across different systems.
- **Resilience and Agility:** Enhances the organization's ability to adapt to changes and recover from disruptions.
- **Collaborative Processes:** Supports synchronized business processes across multiple organizations.



## TYPES OF INTEROPERABILITY

We can identify five critical dimensions of interoperability essential for seamless enterprise collaboration:

- **Data Interoperability:** Ensures that data can be exchanged and understood across different systems, maintaining consistency and accuracy.
- **Process Interoperability:** Aligns business processes across organizations, enabling coordinated workflows and shared objectives.
- **Semantic Interoperability:** Guarantees that the meaning of exchanged information is preserved and understood, facilitating accurate interpretation.
- **Technical Interoperability:** Establishes the technical infrastructure and standards that allow systems to connect and communicate effectively.
- **Organizational Interoperability:** Aligns organizational structures, policies, and cultures to support collaborative efforts and shared goals.

These dimensions collectively contribute to achieving continuous operational interoperability, ensuring that enterprise systems can collaborate effectively and adapt to dynamic environments.



# COLLABORATIVE MANUFACTURING DEVELOPMENT AS DEFINED IN RISESTEP, IMAGINE OR SIP RESEARCH PROJECTS

The **RISESTEP**, **IMAGINE** or **SIP** European projects exemplify collaborative efforts in the aerospace industry, focusing on the development of aircraft through distributed Digital Mock-Up (DMU) and system modeling. These initiatives address interoperability challenges by integrating diverse tools and processes across organizations.

The following video provides an overview of these collaborative projects:

Dynamic Manufacturing Network



# **KEY CHALLENGES IN ACHIEVING INTEROPERABILITY**



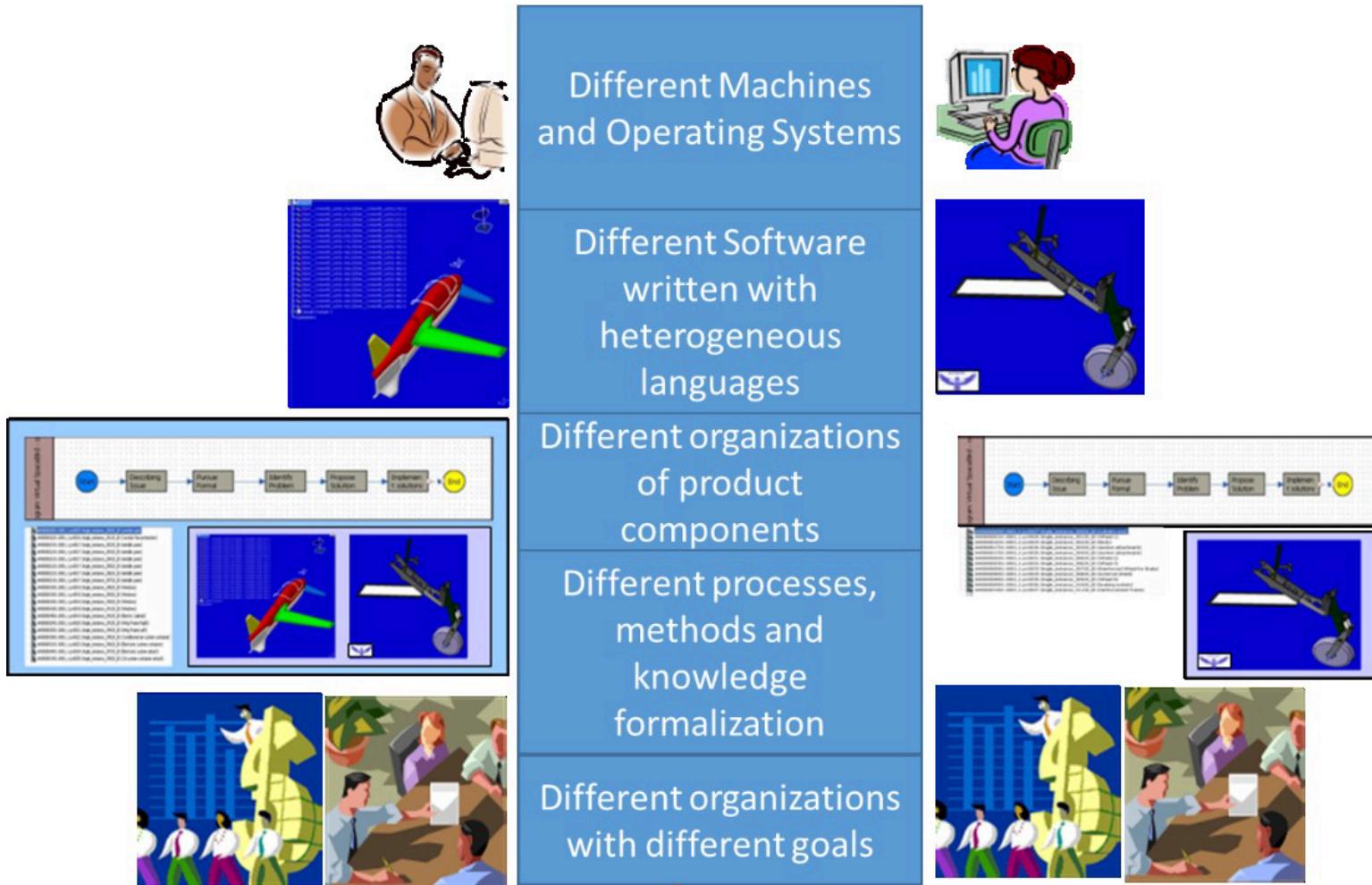
## KEY CHALLENGES IN ACHIEVING INTEROPERABILITY

Here are several critical challenges that organizations face when striving for continuous operational interoperability:

- **Legacy Systems:** Outdated systems with proprietary architectures hinder integration with modern technologies.
- **Organizational Silos:** Departments operating in isolation lead to fragmented processes and data, impeding collaboration.
- **Semantic Mismatches:** Inconsistent terminologies and data interpretations across systems cause misunderstandings and errors.
- **Change Management:** Resistance to change and lack of stakeholder engagement can derail interoperability initiatives.
- **Functional redundancy:** of software products which are in addition often incompatible
- **Cost of Integration:** High expenses associated with system upgrades, training, and process reengineering can be prohibitive.

Addressing these challenges requires a strategic approach that encompasses technological upgrades, organizational restructuring, and stakeholder engagement.

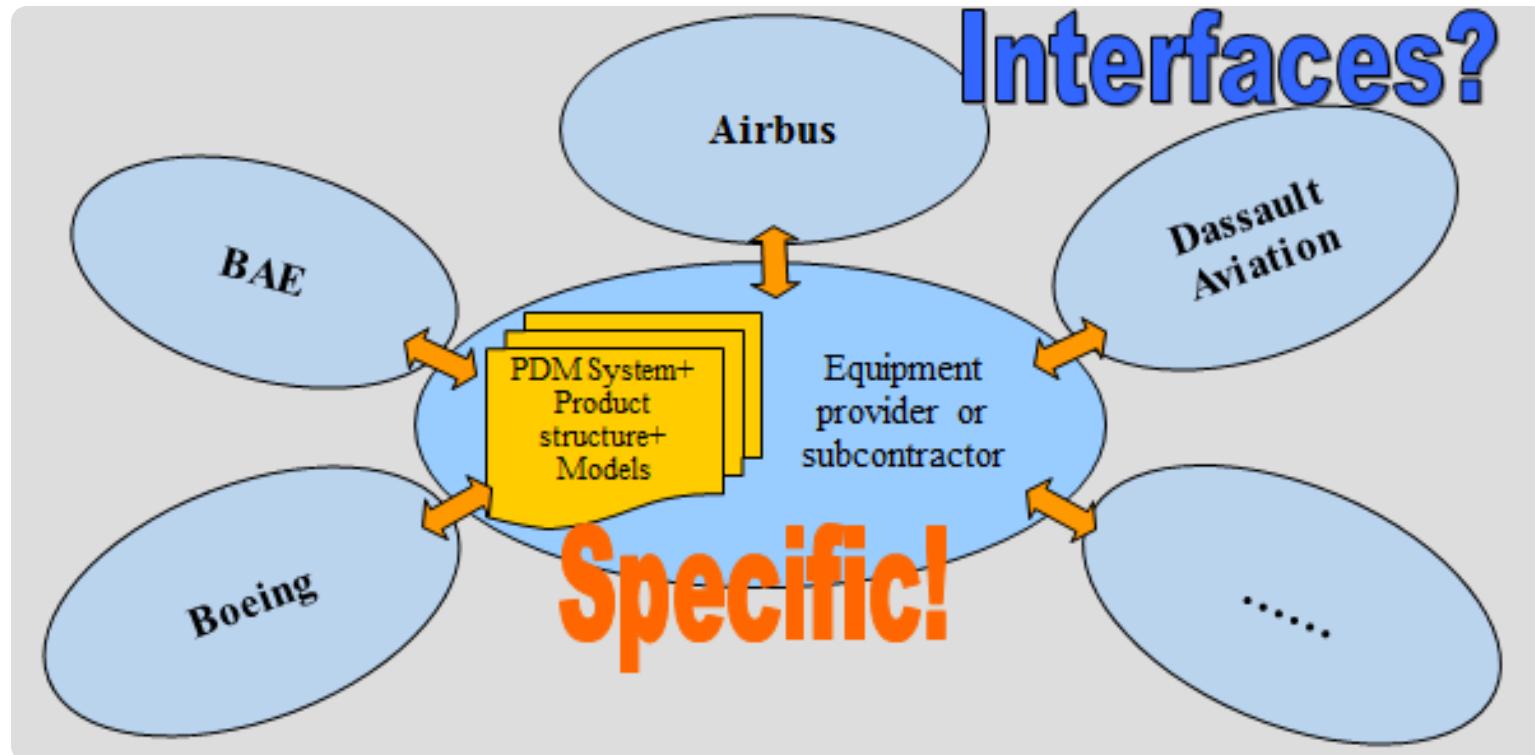
# 💰 CHALLENGE: INTEROPERABILITY BARRIERS



# Interoperability Barriers



## CHALLENGE: DIFFICULT SUBCONTRACTORS' CONDITIONS

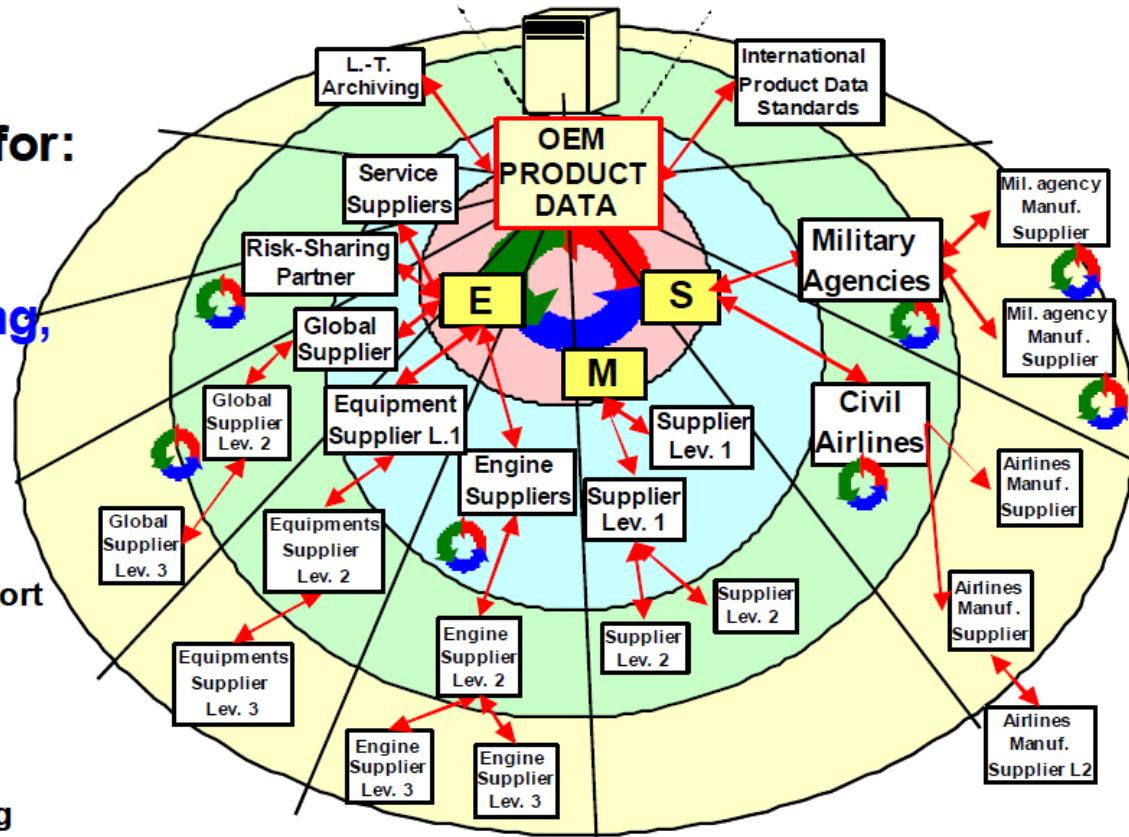




# CHALLENGE: HUGE SUPPLY CHAINS

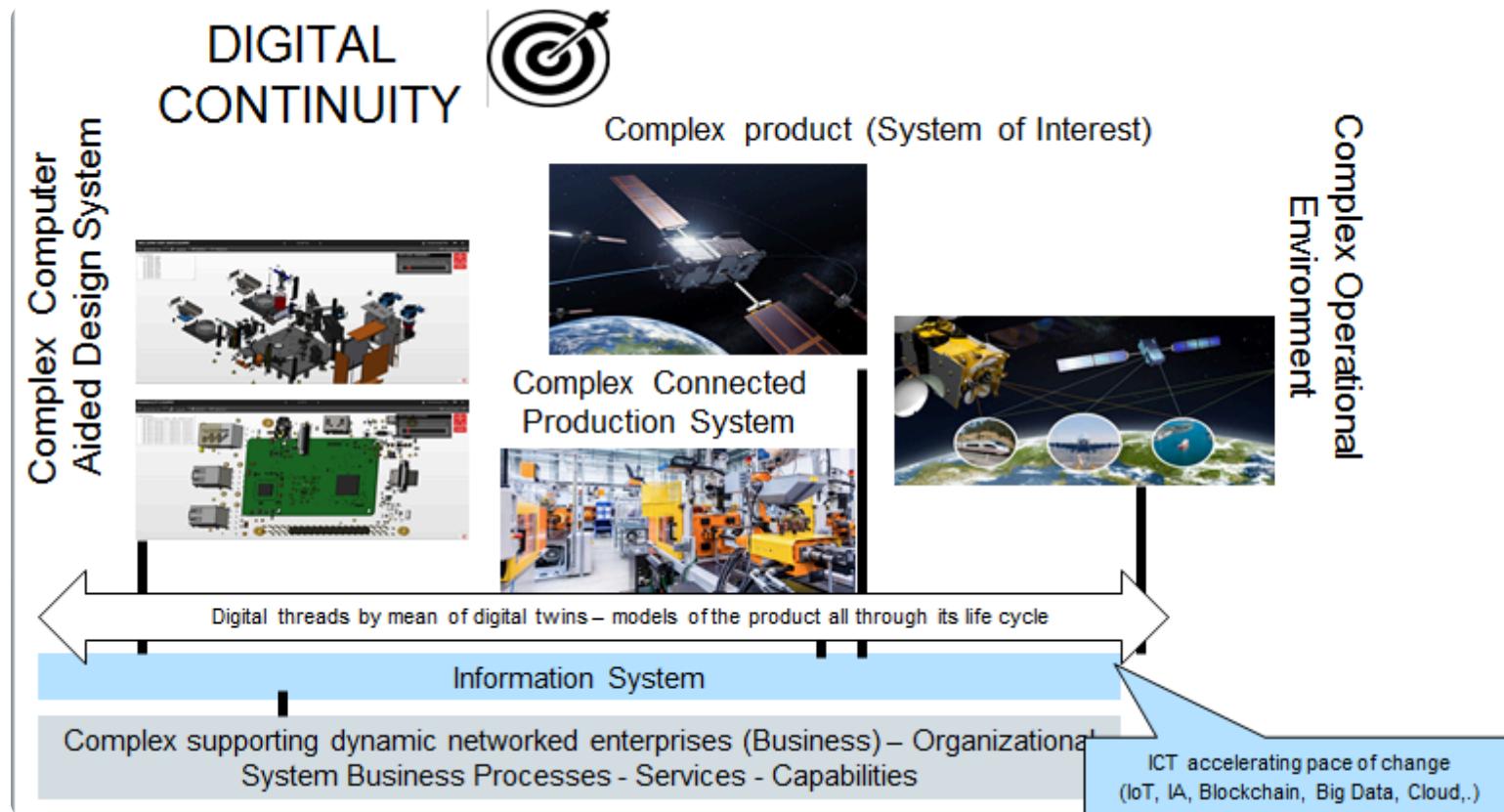
**Configured & Controlled Product Data for:**  
**- Design,**  
**- Simulation,**  
**- Manufacturing,**  
**- & Support**

Engineering      Support  
E                  S  
Manufacturing    M





## CHALLENGE: RICHING DIGITAL CONTINUITY DESPITE COMPLEXITY



# **INTEROPERABILITY BRAKES AND ENABLERS**



# BRAKES AND ENABLERS OF INTEROPERABILITY



## BRAKES

- **Cultural Barriers:** Resistance to change and lack of shared vision among stakeholders.
- **Organizational Silos:** Fragmented structures that impede information flow and collaboration.
- **Semantic Misalignments:** Inconsistent terminologies and data interpretations across systems.
- **Technical Incompatibilities:** Diverse systems and technologies lacking standard interfaces.
- **Economic Constraints:** Limited resources allocated for integration initiatives.
- **Continuous Change and Innovation:** with growing pace of change with disruption.



## ENABLERS

- **Distributed Technical Service Oriented Platforms:** with appropriate integration technologies
- **Semantic Alignment:** Developing shared vocabularies and ontologies to harmonize data interpretations.
- **Organizational Alignment and Appropriated Governance:** Structuring organizations to promote cross-functional collaboration.
- **Strategic Governance:** Allocating resources to support interoperability projects and training.
- **Adoption of Standards:** Implementing open standards like STEP and ISA-95 to ensure consistency.
- **Model-Driven Engineering (MDE):** Utilizes MDE to create adaptable models that can bridge diverse systems and processes.

Unleashing these brakes and leveraging the enablers federating interoperability framework are crucial steps toward achieving continuous operational interoperability.

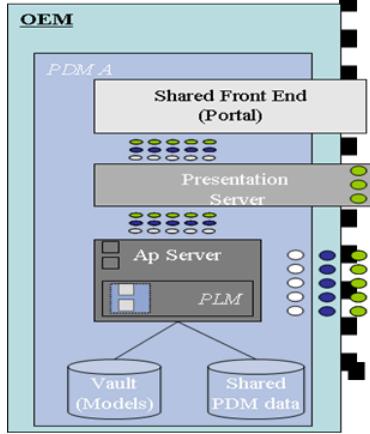
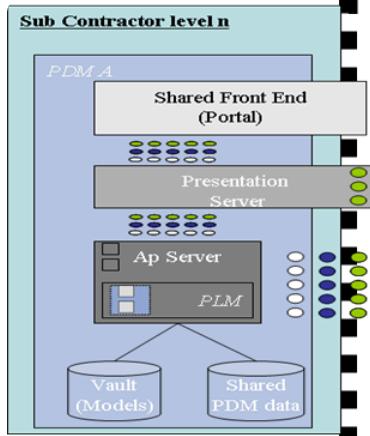
# SOME SOLUTIONS AND THEIR ACCURACY FOR BLOCKCHAIN

- **cPlatform:** Iterative building of collaboration hub based on standardized protocols and components
- **Living Lab:** Involving users on experimenting in order to build their collaborative processes.
- **Model Driven approach:** projection of business logic on execution platform.
- **Dynamic Manufacturing Network:** Services for managing and qualifying collaboration partners according to standardized cross organisational collaboration scenarios.
- **Testbed:** Assessing PLM standards adherence to collaboration processes on top of a testbed in order to derive test plan and test data sets for unitary and integration tests, but also enabling monitoring of actual collaboration
- **Model Driven Engineering:** Using Model Driven Architecture related technologies for project business logic on execution platform
- **Extended Hypermodel for Interoperability:** Ensuring Semantic Preservation and preventic data loss when changing platforms

# CPLATFORM

Iterative building of collaboration hub based on standardized protocols and components

# Collaborative Space of ecosystem



## Collaboration processes

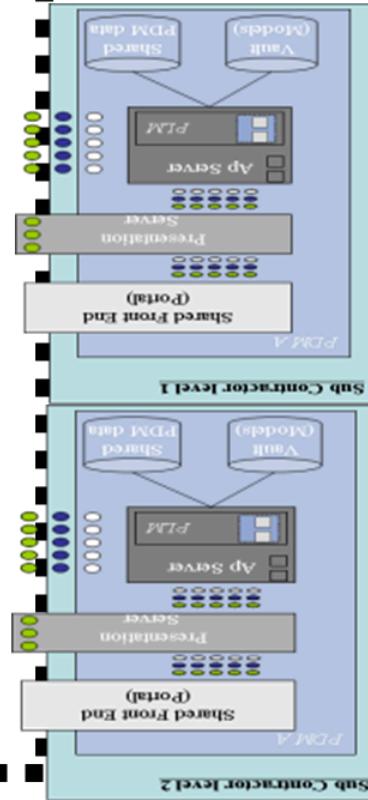
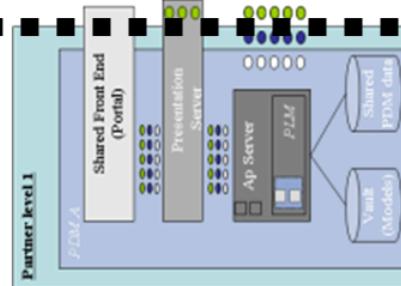
- Technical Data Package
- Change Management...

## PLM services

- OMG PLM services
- PLCS PLM Services V2
- Crescendo Services

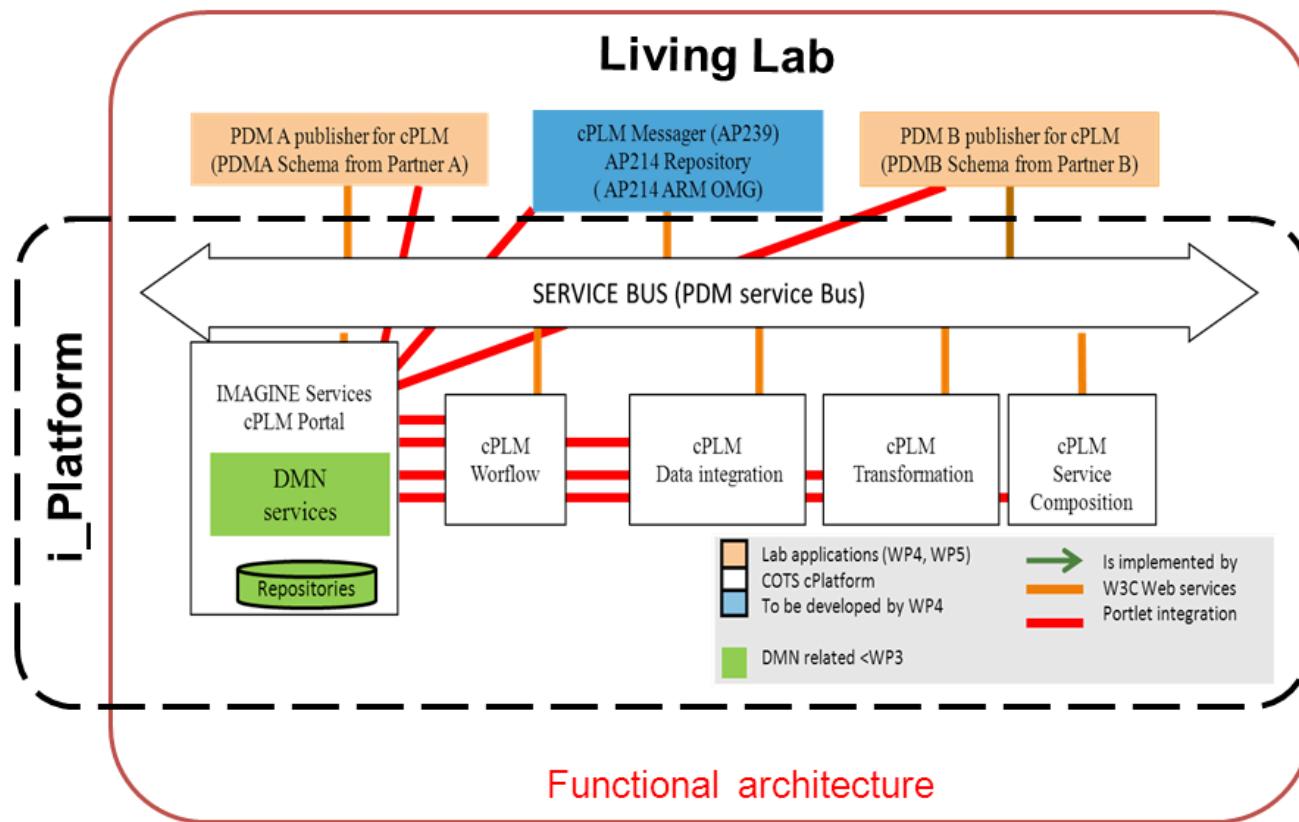
## Neutral Business Information Model

- AP214 ARM/AP242 XML
- AP239 ARM
- AP233/AP239 XML or ARM



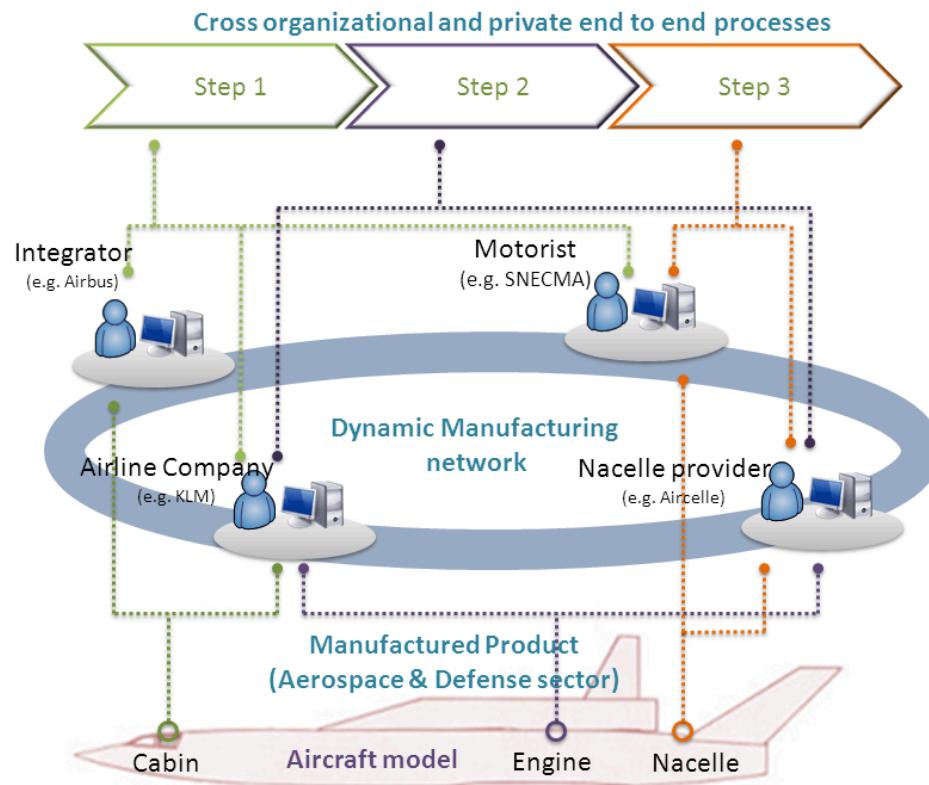
# LIVING LAB

Involving users on experimenting in order to build their collaborative processes.



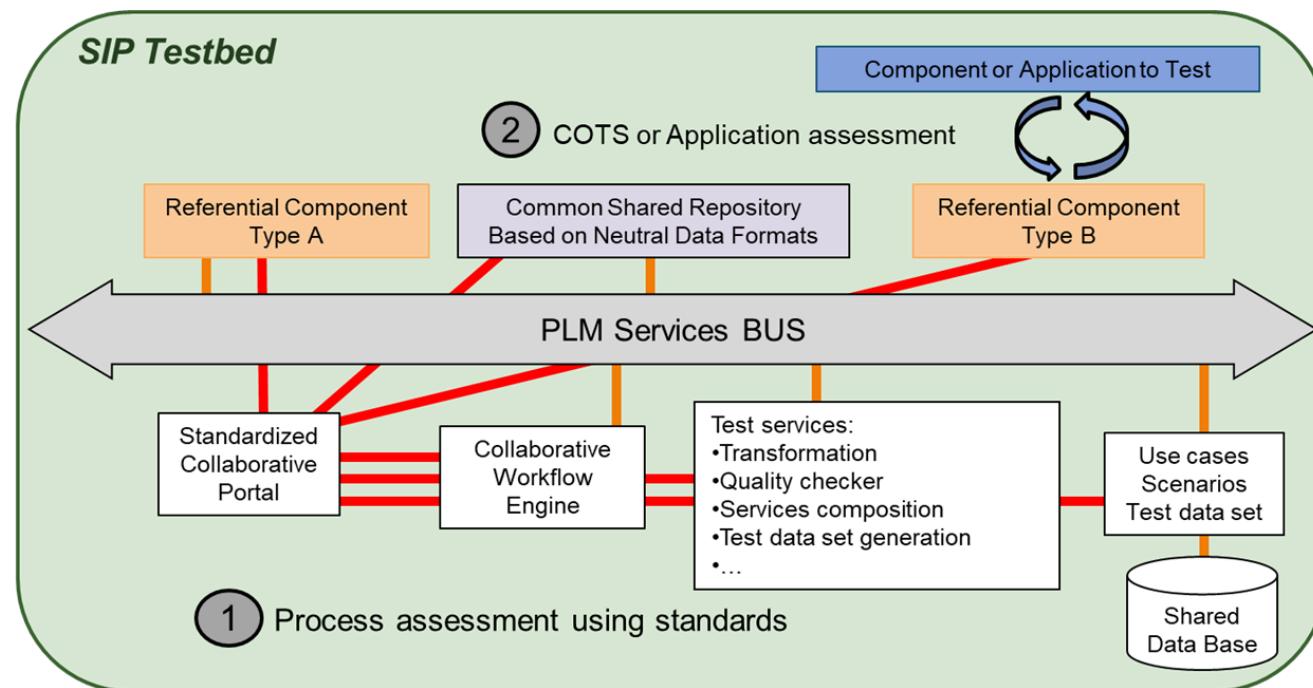
# DYNAMIC MANUFACTURING NETWORK

Services for managing and qualifying collaboration partners according to standardized cross organisational collaboration scenarios



# TESTBED

Assessing PLM standards adherence to collaboration processes on top of a testbed in order to derive test plan and test data sets for unitary and integration tests, but also enabling monitoring of actual collaboration

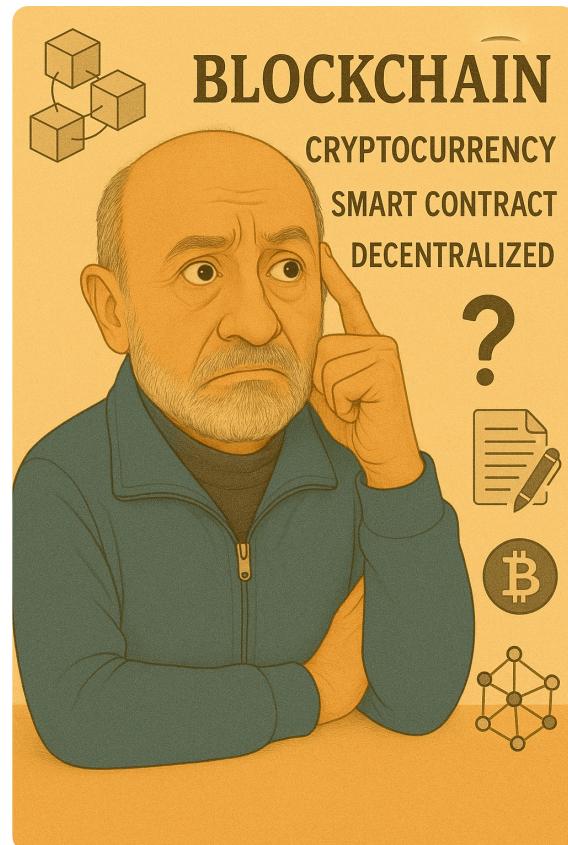


- Composant de référence open source
- Application ou COTS à tester
- Application ou COTS à tester
- W3C Web services
- Portlet integration

# BLOCKCHAIN AND INTEROPERABILITY

- How to ensure continuous operational interoperability when including blockchains in enterprises?
- How to ensure end to end processes and cross organisational interoperability?
- How to ensure deal with digital continuity with evolution of Blockchain Technologies?
- Any architecture of reference?
- Open standards and maturity of the Digital Business Ecosystem in terms of interoperability?
- Other particular issues?
- Perspective leading to a growing usage and importance of blockchain technologies?

This implies a dialog between architects and blockchain solution providers



# PROCESS INTEROPERABILITY AND BLOCKCHAIN

Challenges in integrating operational processes with blockchain systems.

A working topic at AFNOR with the White Book\* "Business Process Interoperability supported by blockchain" produced in 2023

Proposal and illustration of a model based approach based on ArchiMate and BPMN standards

Still some work to be done for reaching an actual maturity!

\* freely available from [here](#)



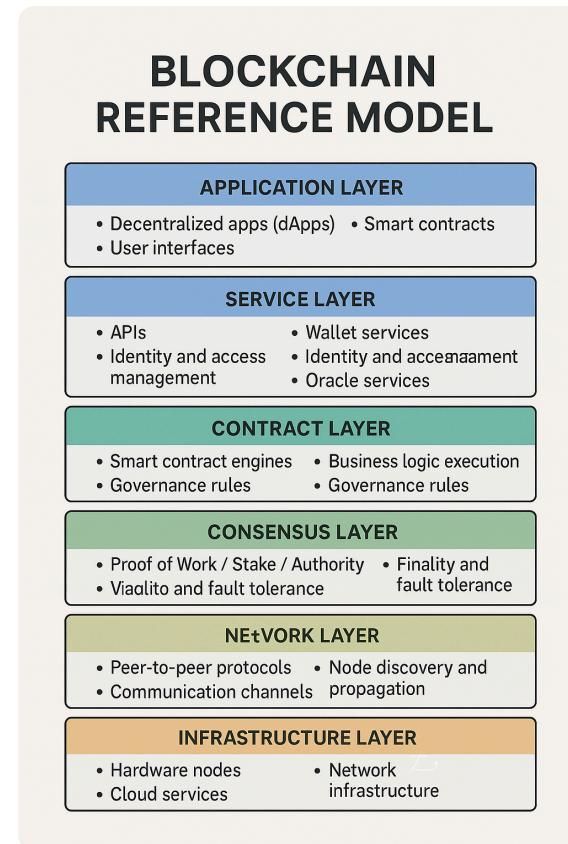
## **CONTINUOUS INTEROPERABILITY WITH ARCHICG**

Using ArchiMate and ArchiCG to model blueprints  
in order to maintain continuity across blockchain-enabled systems.

# BLOCKCHAIN ARCHITECTURE OF REFERENCE

- Layered architecture: ledger, consensus, identity, interfaces.
- Key principles for enterprise adoption.

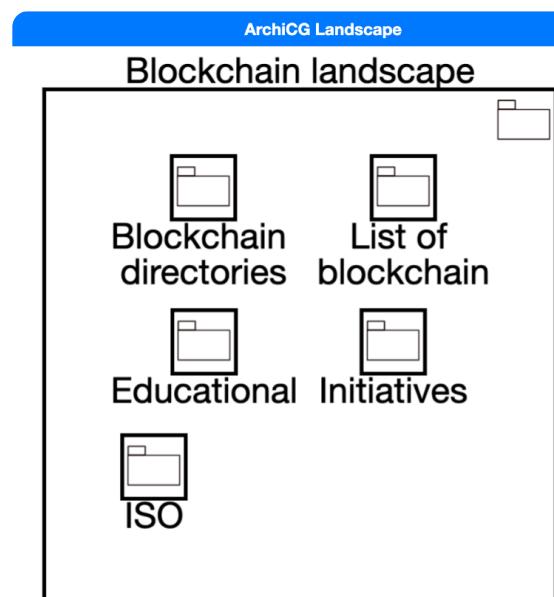
Is it something we can find in standard document or a given work place?



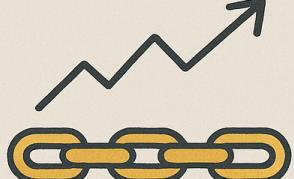
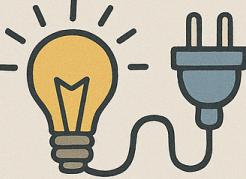
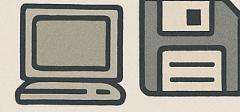
# OPEN STANDARDS AND BLOCKCHAIN ECOSYSTEMS

- Importance of open standards (e.g. ISO) for interoperability in blockchain ecosystems.
- What are the current standards produced by standardization?
- Are they aligned with the current digital business ecosystem?

Let's initiate a Blockchain digital business ecosystem semantic cartography with ArchiCG you can access to through the Online Editor link at <https://nfigay.github.io/ArchiCG/> Let's open the graph available [here](#) after downloading it on your machine, through the menu File>>Load



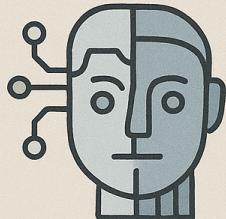
# BLOCKCHAIN-SPECIFIC ISSUES

BLOCKCHAIN-SPECIFIC ISSUES	
 Scalability	
 Governance	 Energy use
 Integration with legacy	 with legacy

# PERSPECTIVES AND FUTURE OUTLOOK

## PERSPECTIVES AND FUTURE OUTLOOK

Blockchain convergence with AI, IoT, digital identity, and trusted execution environments.



AI



IoT



Digital  
identity

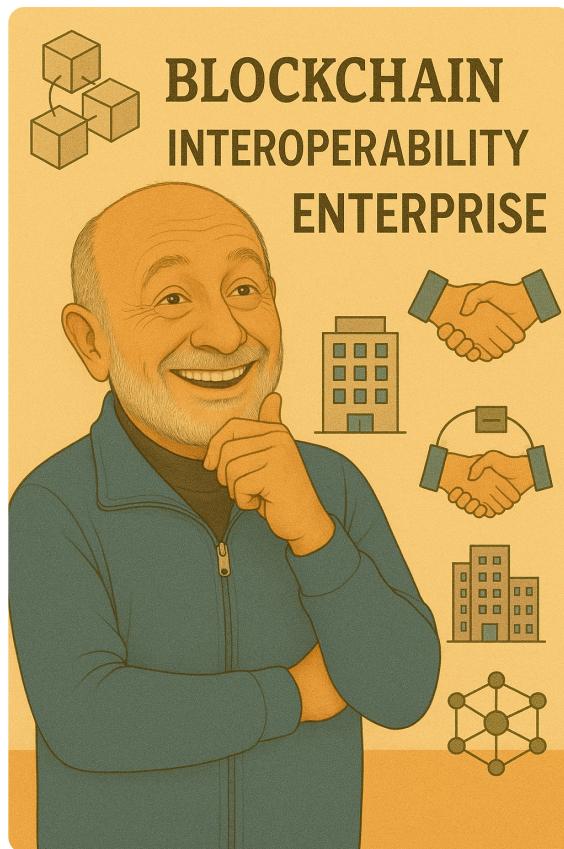


Trusted  
execution  
environments

# CONCLUSION

- I presented you Continuous Operational Interoperability of enterprise applications
- It impacts how you will design and develop solution based on blockchain
- This is not only technical and it involves collaboration with various kind of architects and complementary technologies
- Blockchain technologies are quite young and interoperability maturity is still to be built

A Master Thesis is under preparation concerning Blockchain Interoperability involving XPRL commons and LIRIS



Open floor for participants to raise issues, give feedback, share insights.