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A vision on Engineering mid-term Challenges and Need for Tooling Support

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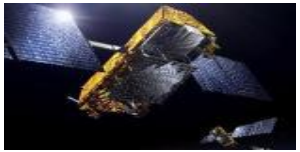
Scope: highly constrained, Trustable, Mission-Critical Solutions

(Thales example here)



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Challenges in Mission-critical Engineering

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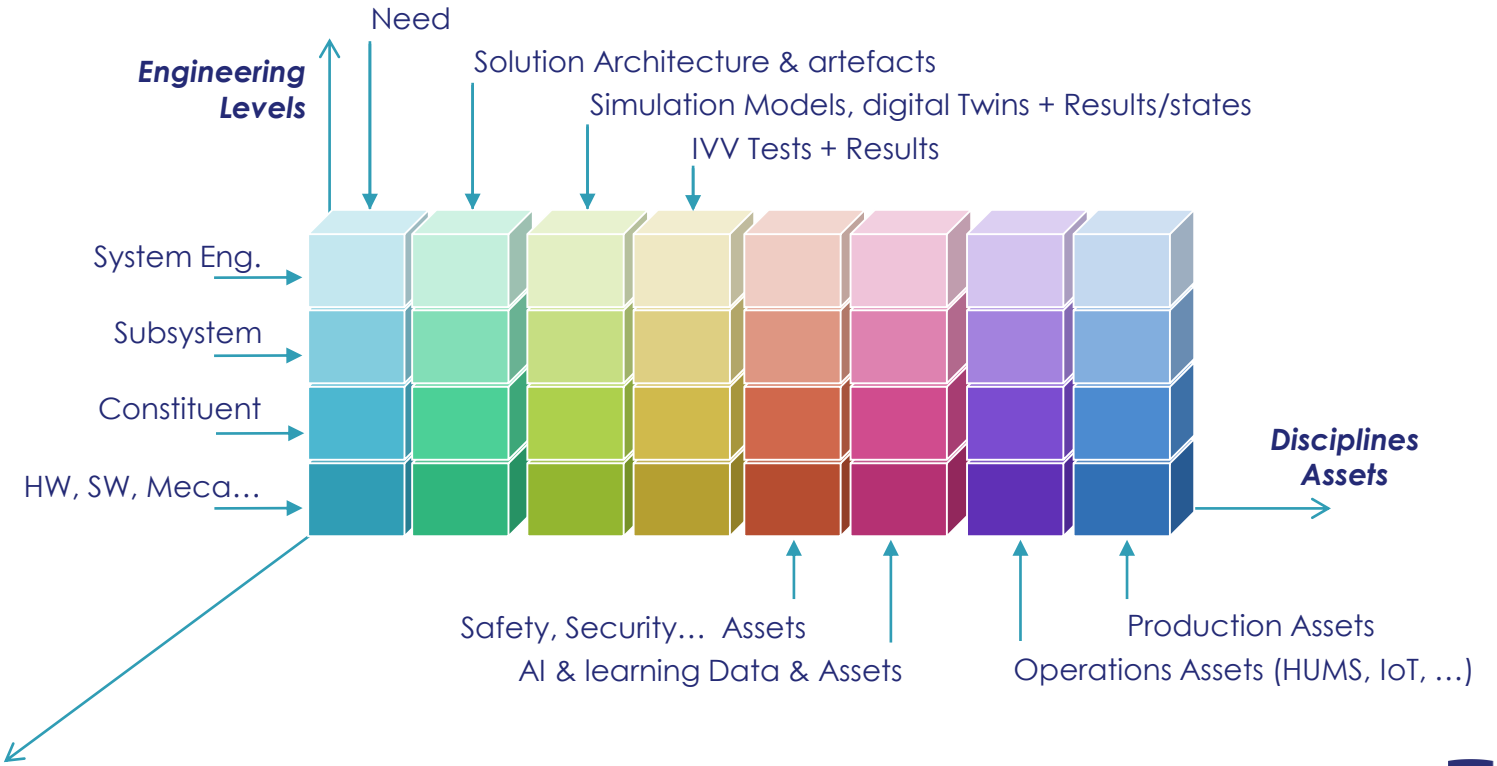
Challenge #1: mastering big Data (Engineering Assets)



IVV: Integration Verification Validation; AI: Artificial Intelligence; SW: Software, HW: Hardware ; HUMS: Health & Usage Monitoring; IoT: Internet of Things

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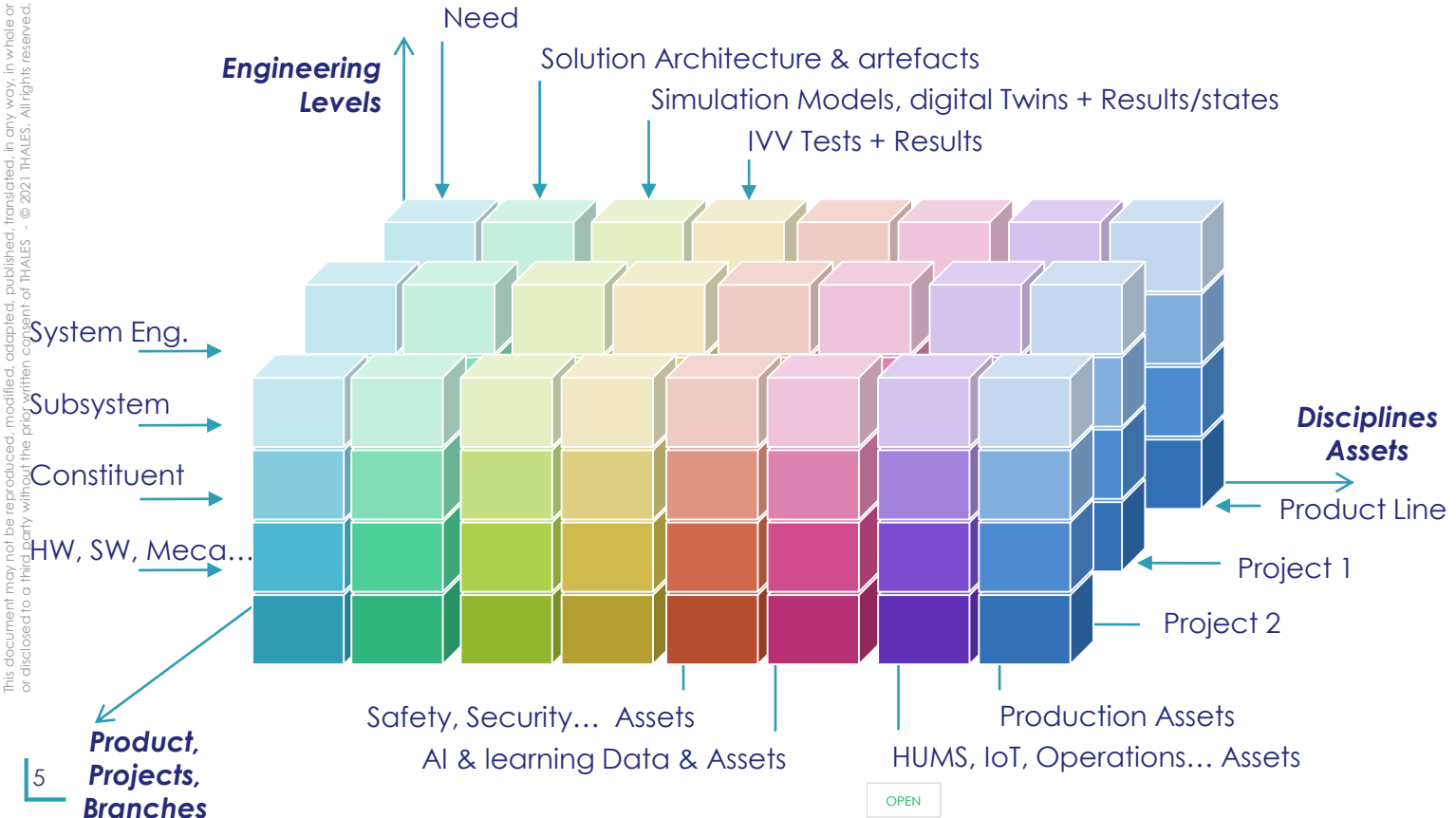
Challenge #1: mastering big Data (Engineering Assets)



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Challenge #1: mastering big Data (Engineering Assets)

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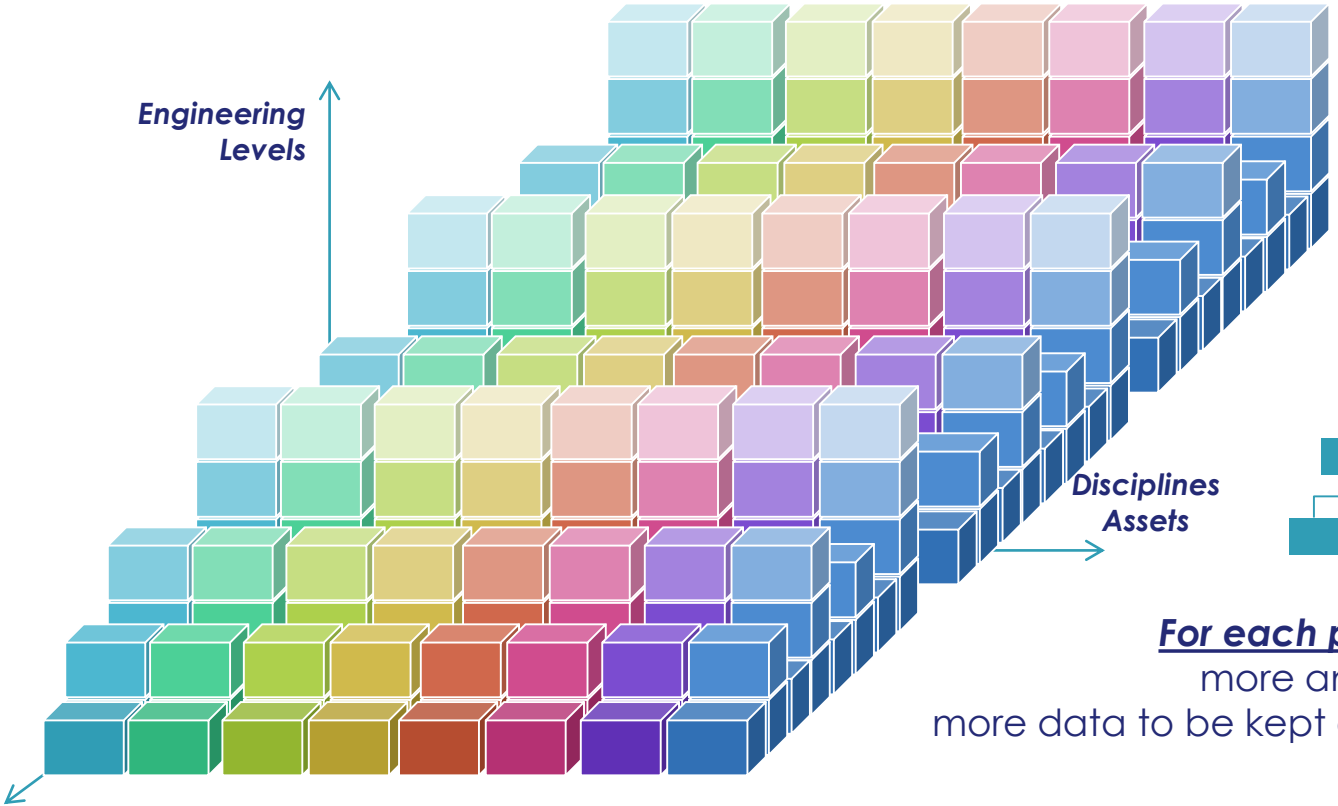

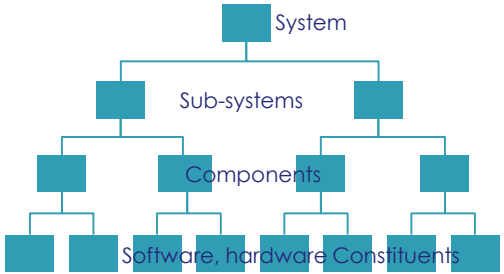

For each project : Each level adds more and more complexity and more data to be kept coherent and consistent

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Challenge #1: mastering big Data (Engineering Assets)

Today most engineering assets are built, linked, exploited manually

- How much time & resources to build and link all these data?
- How to safely analyse the impact of changes?
- How to update and verify?
- How to keep the whole in coherence?

100,000+ engineering data & links elaborated, updated and verified *in a few months???*

Here is Engineering Digital ~~Transformation~~ REVOLUTION !

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Challenge #2: the wall of Complexity

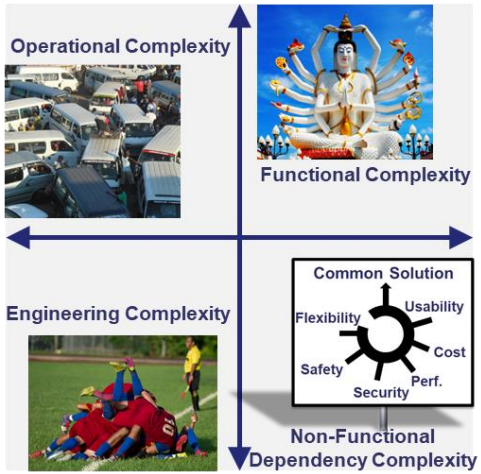
How to adapt Organisations and Practices?

More flexible, intelligent, low-cost, ***but*** still trustable, real-time and embedded

New Use Cases

New Capabilities

- Autonomy
- Human-Machine Teaming
- Systems of Systems Urbanisation
- Social, environmental & ethical Responsibility
- …



- Safety+Security+Cyber,
- IT Vs OT,
- HPC Vs SWaP,
- Cloud Vs CyberSec,
- Customer first vs PLE,
- AI Vs Trust,
- Cost Vs Quality of Service,
- …

- « Do more, do it faster, ***but*** Still do it well »
- Team with Partners, suppliers…

New Constraints with more Stakeholders

New Disciplines & ***diverging*** Constraints

IT/OT: information/operational Technologies; HPC: High Performance Computing; SWaP: Size Weight & Power; PLE: Product Line Engineering; AI: Artificial Intelligence; SW: Software ; COTS: commercial off-the-shelf

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Challenge #3: Design for Trust

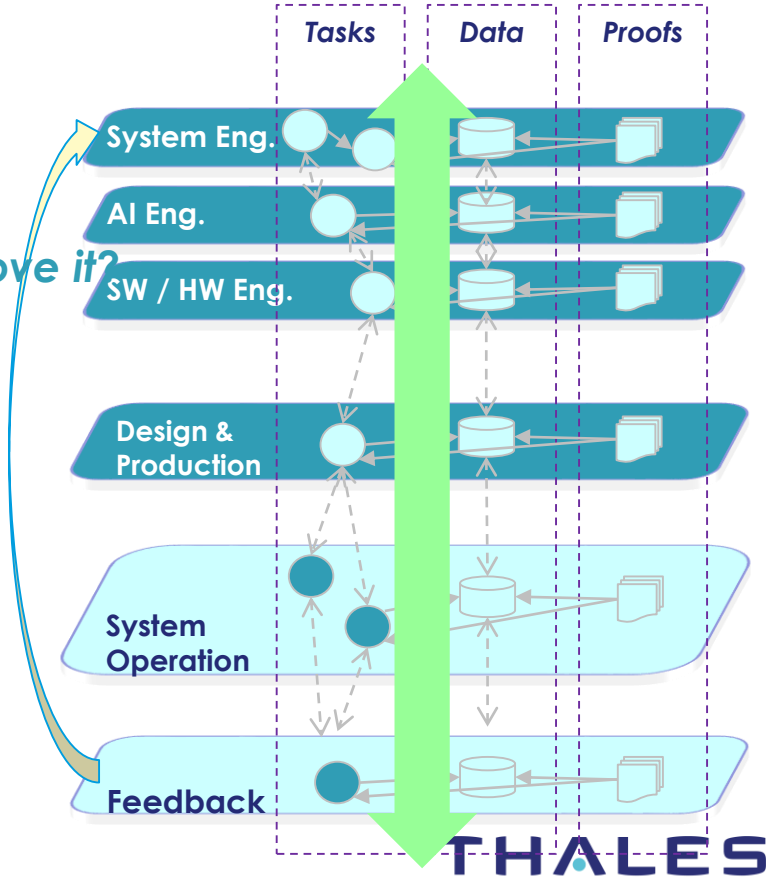
Need for Trust Assurance grows heavily

- Safety+Security+Cyber, Human-Machine Teaming, Autonomy, SoS, ESR…

How to ensure Trust by construction *and jusfify/prove it?*

- **Trust Assurance requires *certified/justifiable***
  Continuity,
  Coherency,
  Consistency,
  Completeness,
  Impact Analysis
  on the full Lifecycle
  between practices and between engineering data

- **Mastering Feedback with Operations is Key**



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Evolutions in Engineering Practices

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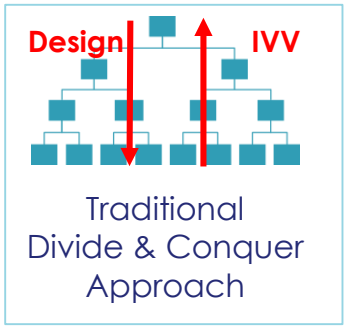
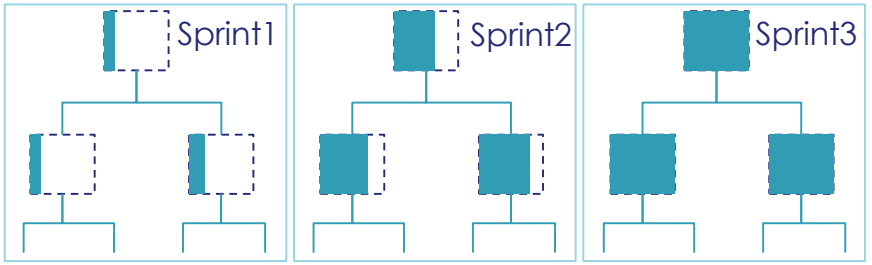
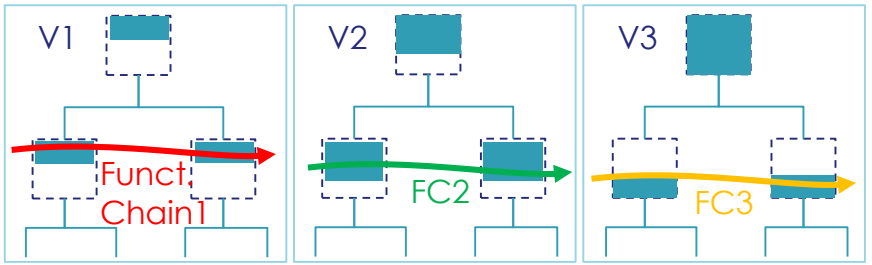
Practices are less and less compatible with hierarchical Flow



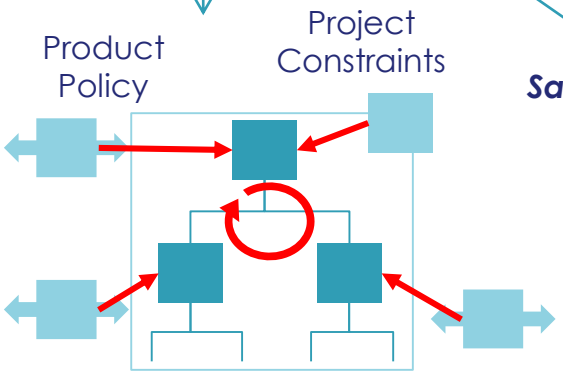
Agile, DevOps



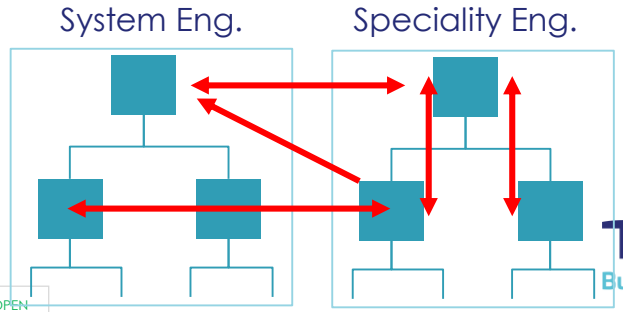
Capability-driven Design & IVV



Product Line Engineering



Safety, Security, AI…



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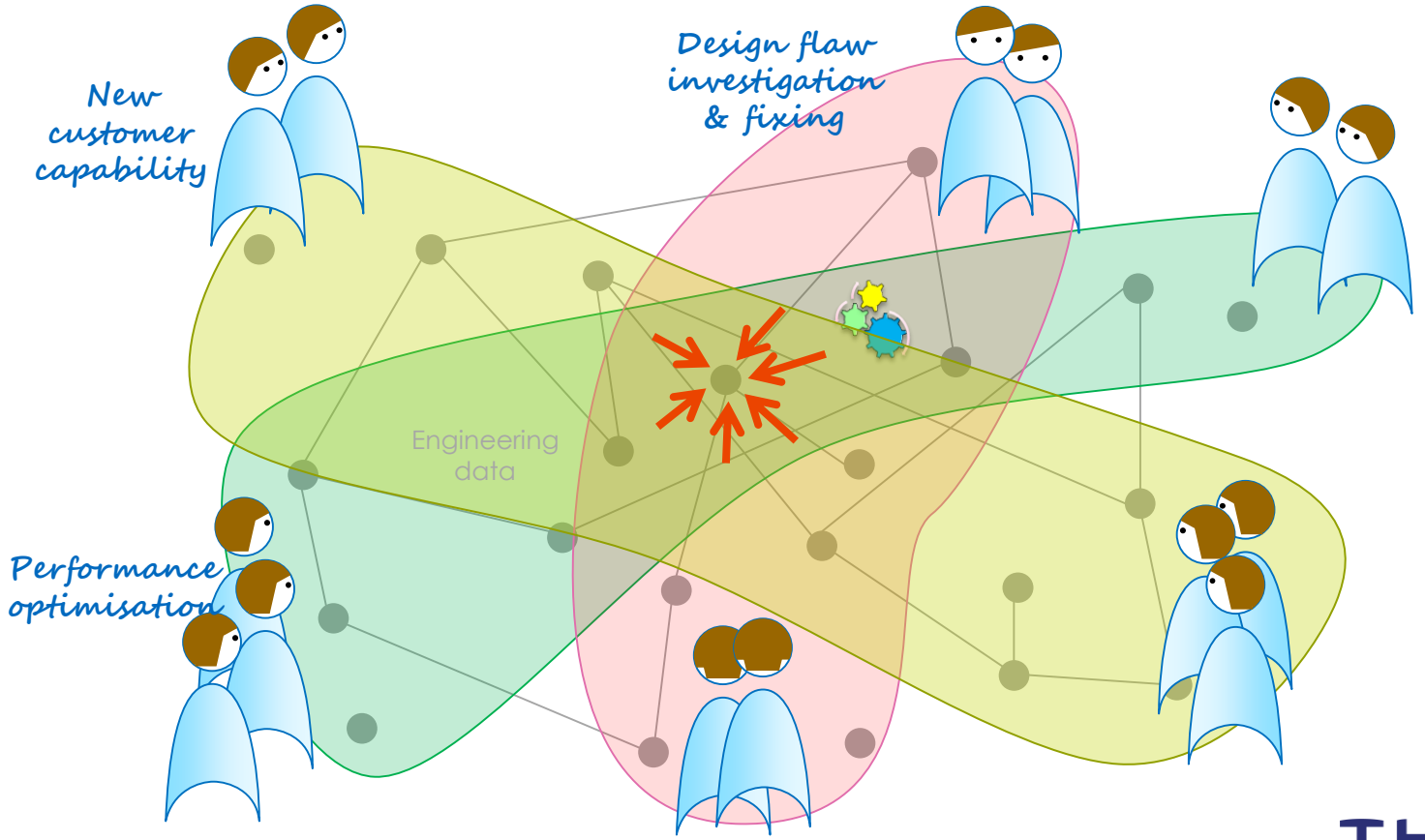
Goal-driven Concurrent & collaborative elaboration of Solution Assets



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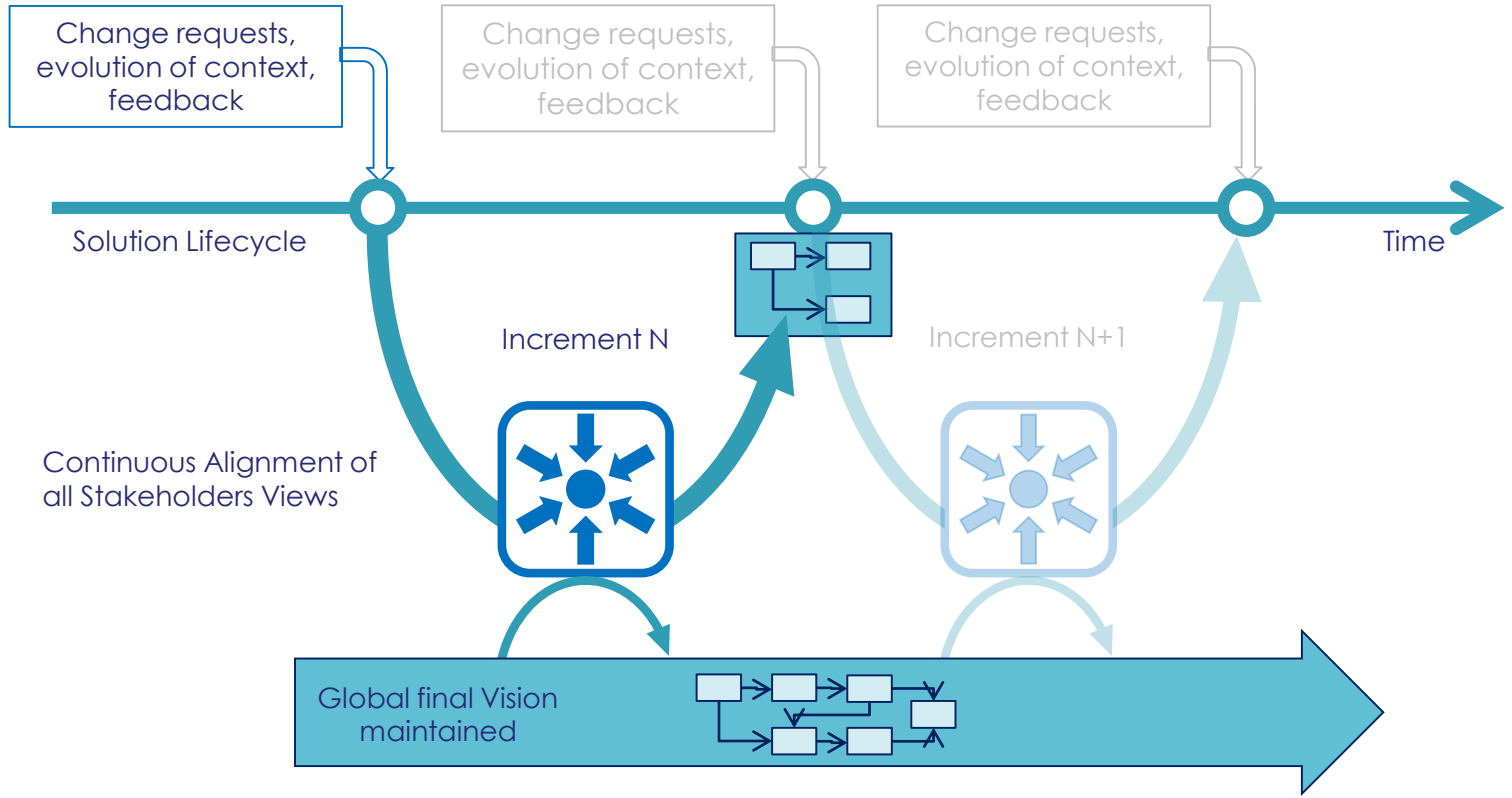
Agile, reactive Engineering: global compromise in constant evolution



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~~System~~ Engineering Tooling Support Key Enablers & Show Stoppers

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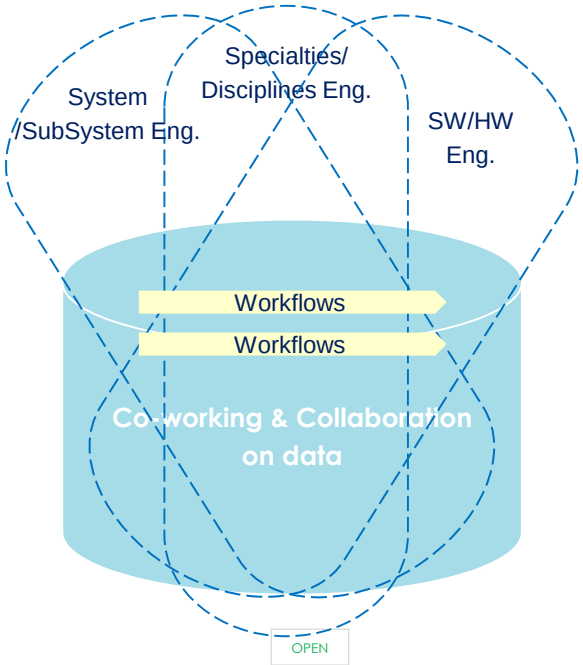
Key Enabler #1: a true workflow- & data-driven Engineering Support

- **Collaborative Processes and workflows** drive engineering
- They traverse all engineering disciplines, using **seamless accessible & shared data**
- Constant monitoring/analytics of **data uses and manipulations** ensures consistency



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Key Enabler #2: Guiding, assisting, justifying Activities and Results

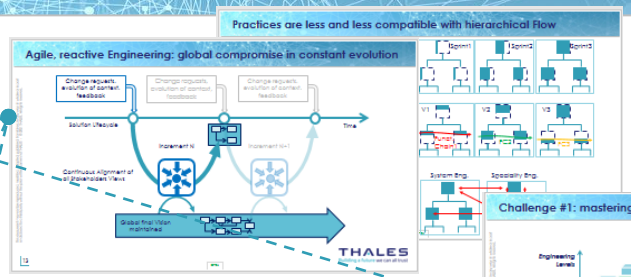
Building **automated digital Workflows**

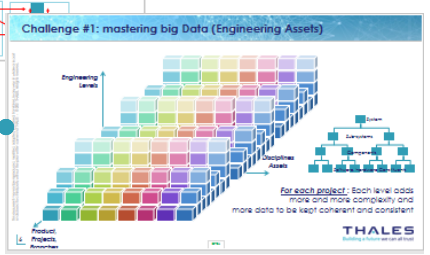
Guiding Users in applying Processes & Workflows

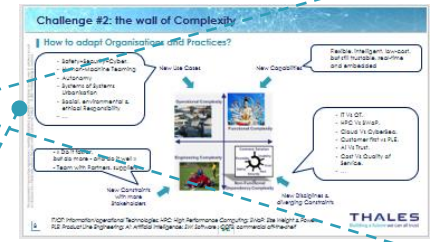
Monitoring Engineering Activities & Outcomes

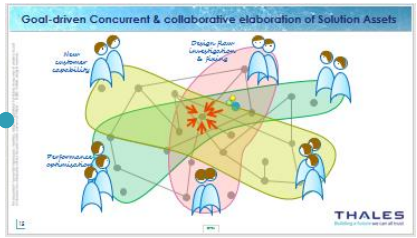
Assisting Quality Assurance & Cooperation

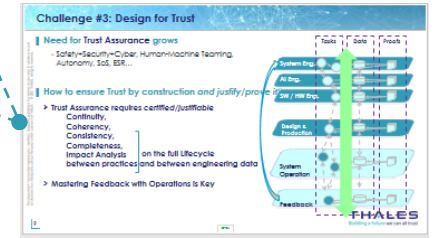
Building **justifications for Trust**











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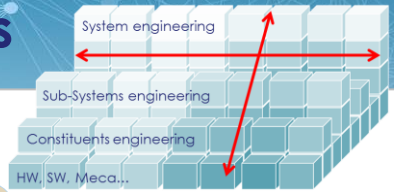
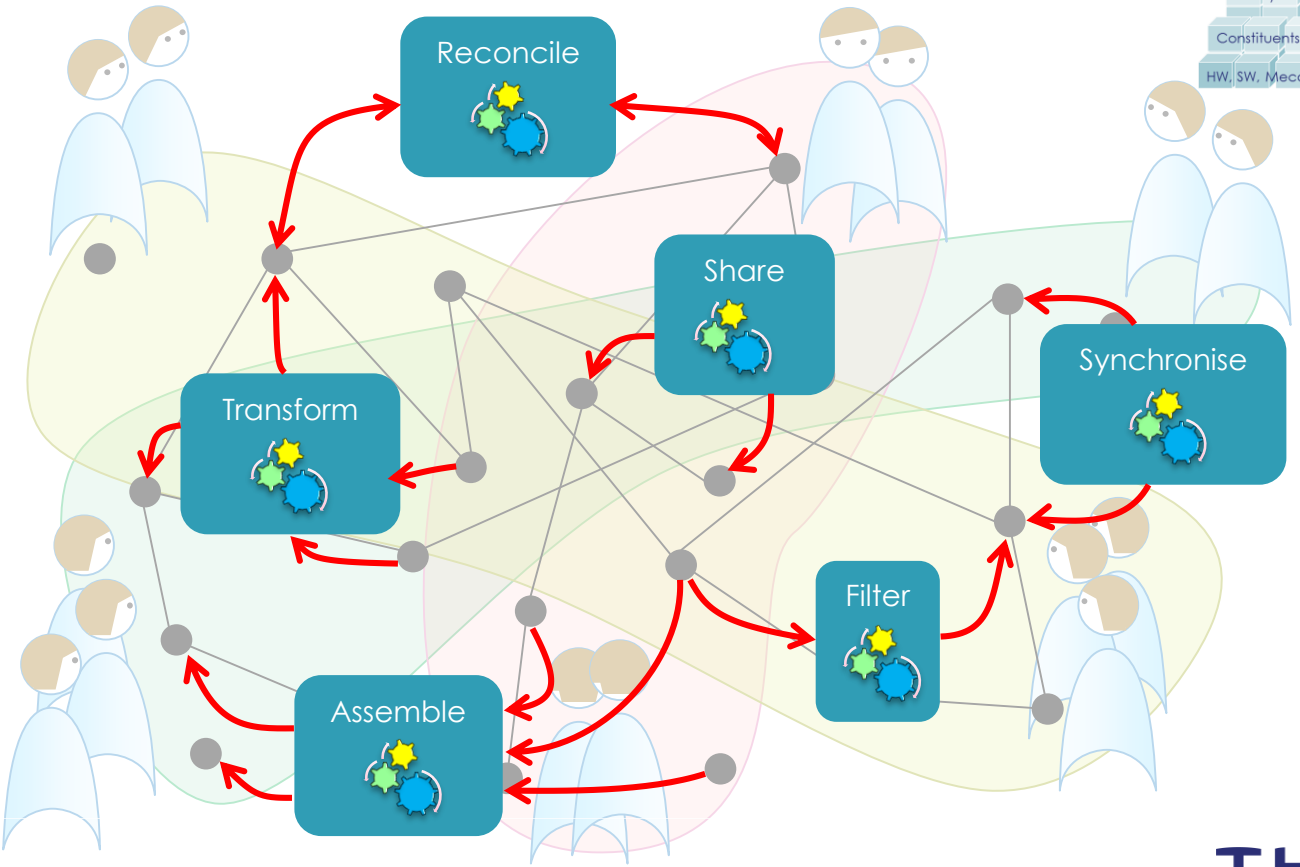
Key Enabler #3: Impact Analysis and automation Services





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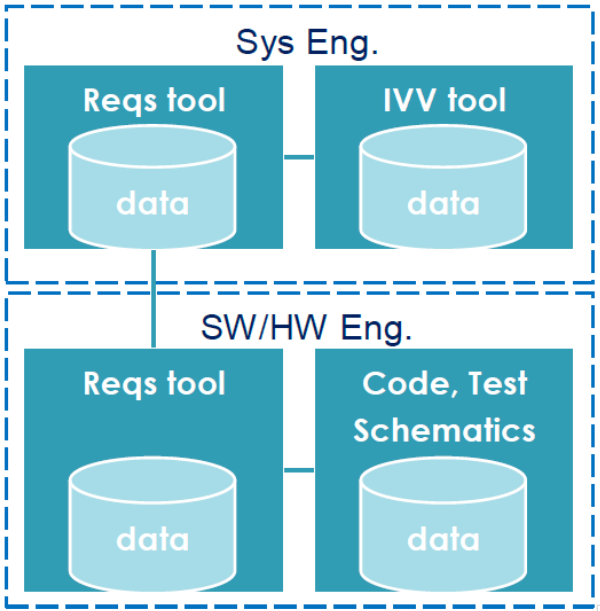
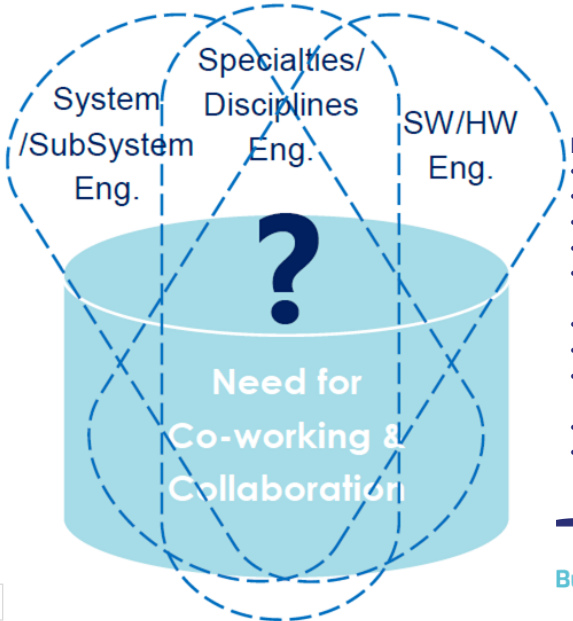
Show Stopper #1: Silos in Engineering Data & Tools

State-of-the-art of legacy engineering environments tool vendors

Most engineering tools manage **their own data**, delivering benefit in creating & exploiting them…

…but this heavily hampers **data-driven engineering**, data **continuity & coherency**





Examples:

- Impact Analysis & justification
- Interface management
- Hybrid simulation
- Alternative trade-offs
- Regulation compliance demonstration
- Cyber-security analysis
- Product to project derivation
- Digital twins (design, operations)
- AI & algorithm tuning
- Etc.

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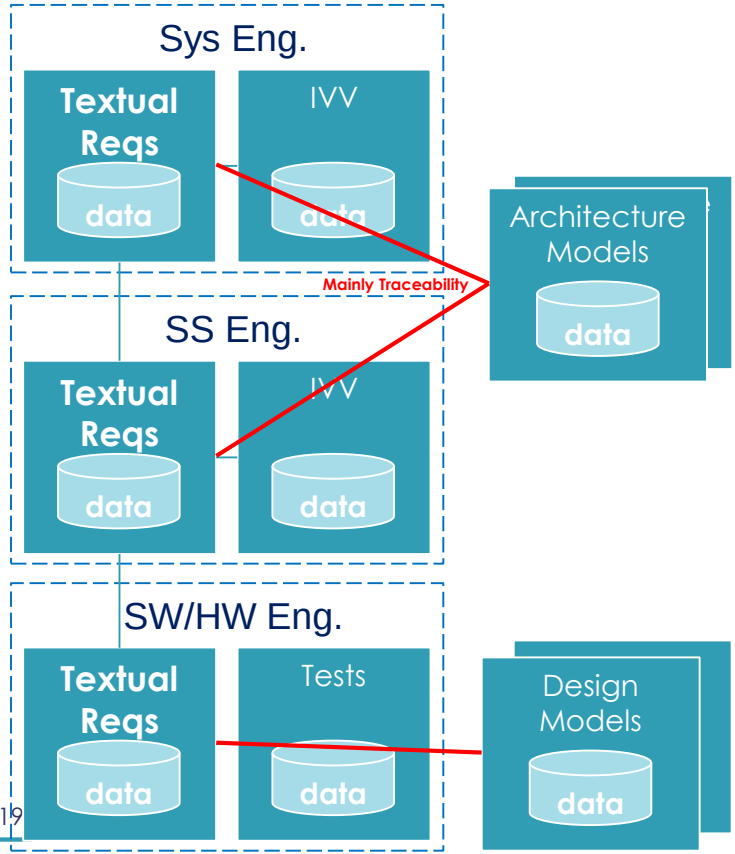
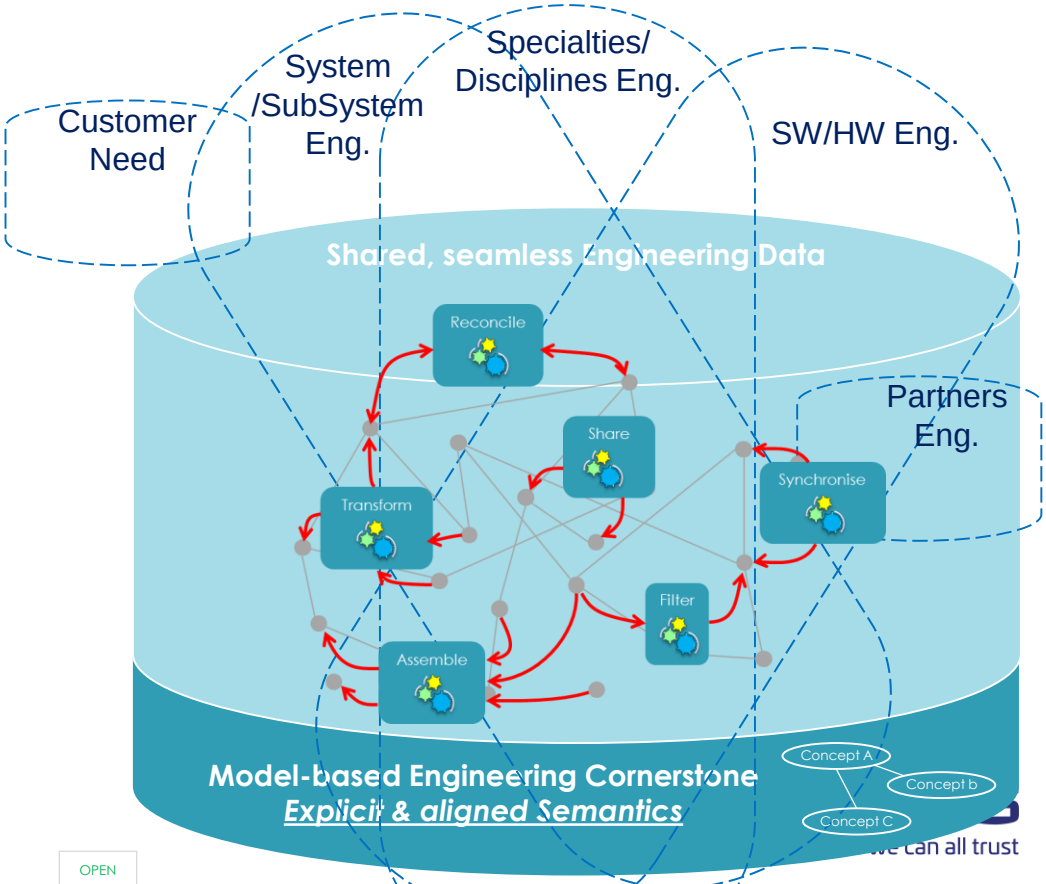
Show Stopper #2: Semantic Silos on manually built/linked Data

What we have



What we need



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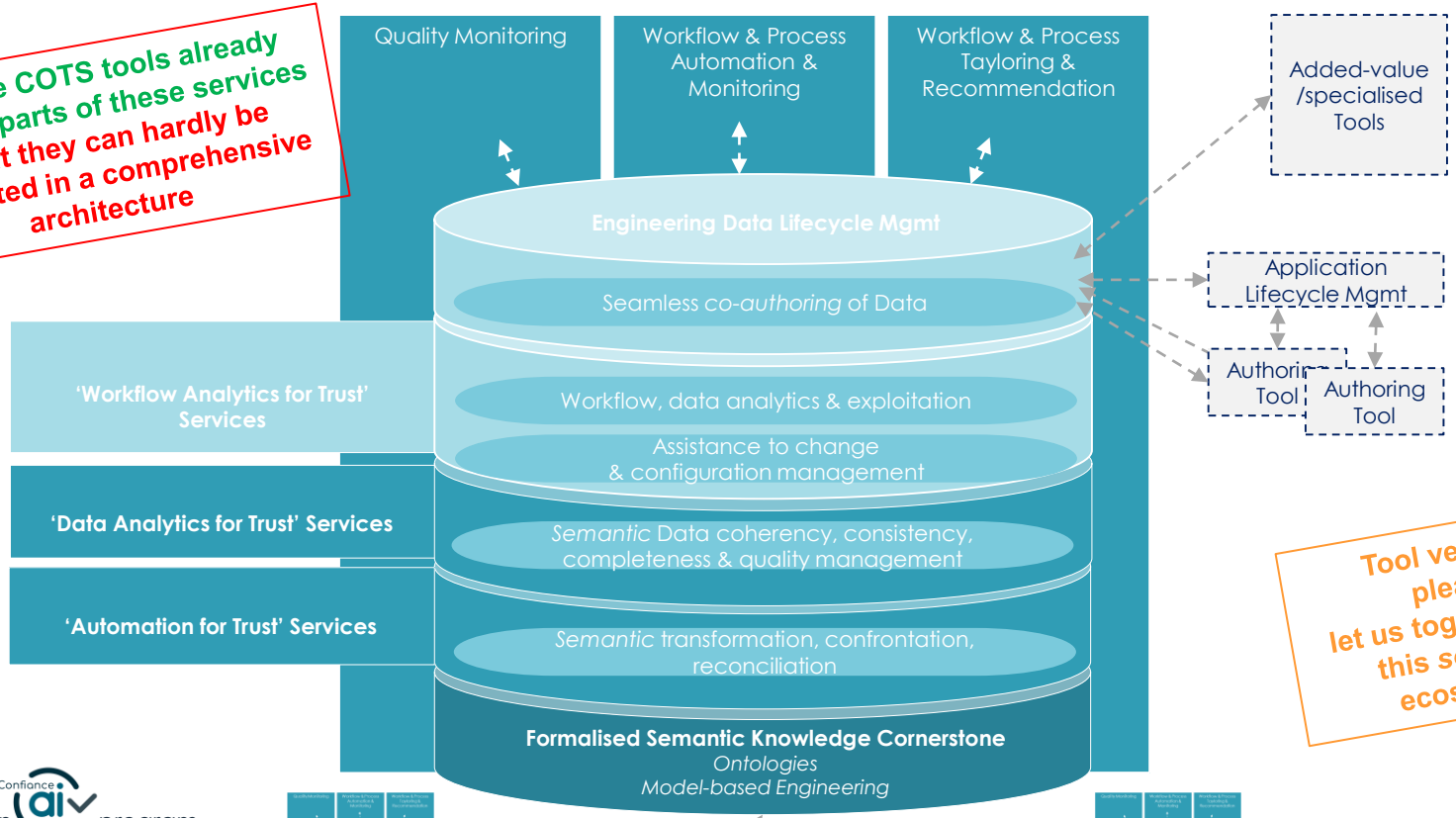
Notional View of required Eng. Tooling Support Architecture

☺ Some COTS tools already address parts of these services
☹ But they can hardly be integrated in a comprehensive architecture



Tool vendors, please, let us together build this seamless ecosystem!

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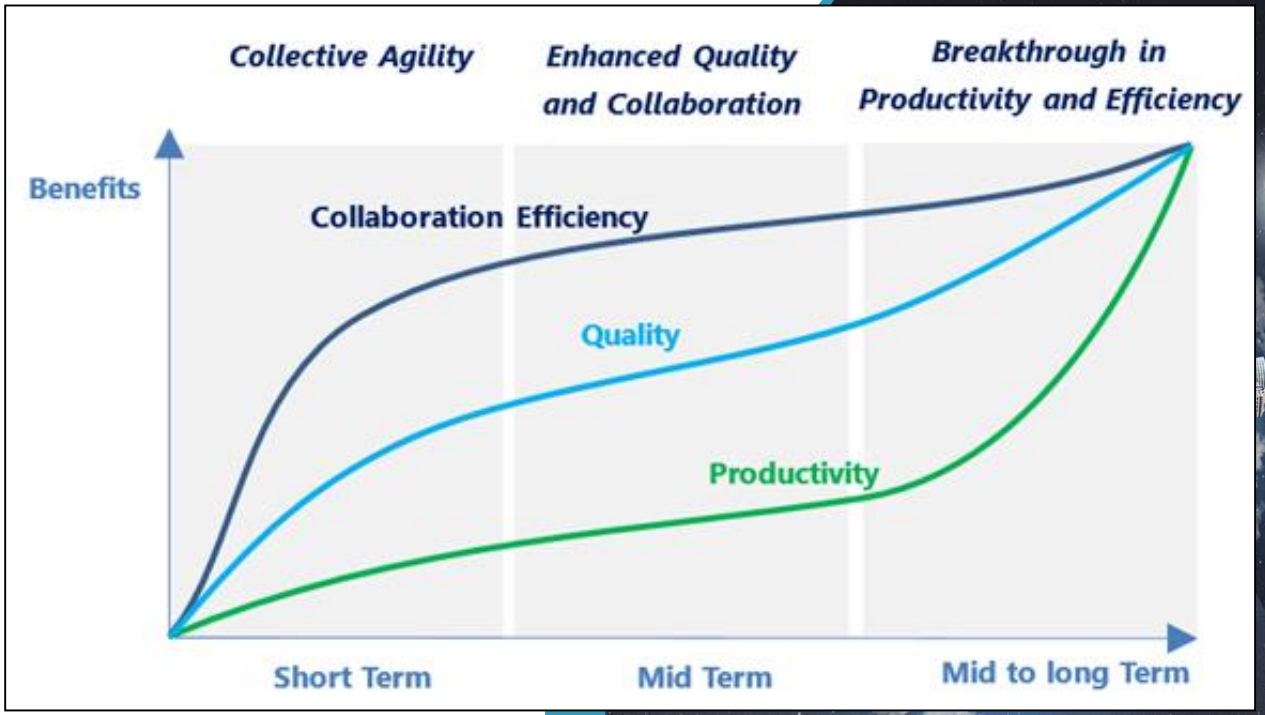
Conclusion



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Engineering Game Changers

Moving from Today…	Towards Tomorrow
Among all, master **Solution**	Among all, master **Need Satisfaction**
Focus on **individual Tasks**	Focus on **collective Goals**
Sequential lifecycles on stabilized Need	**Agile** Collaboration, **reactive** to events in **short loops**, up to disposal
Delegation-based Practices & Organisations in **Silos**	Cooperative **multi-discipline Workflows**, driven by common Goals
Siloed Tools, each managing separate Data	**Continuum** of cooperative Workflows on **seamlessly shared** Data
EE* **formalizes** Engineering Data	EE* assists in Data **building & Analytics**, and **automates** tedious Tasks

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*EE: Engineering Environment

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