

Practical MBE: Standards, Maturity, and Impact

Ben Hopper

Principal Technologist – Advanced Design
Co-Chair HVM Catapult MBE Working
Group



NCC part of the High Value Manufacturing Catapult

Proud to be part of the **High Value Manufacturing Catapult**



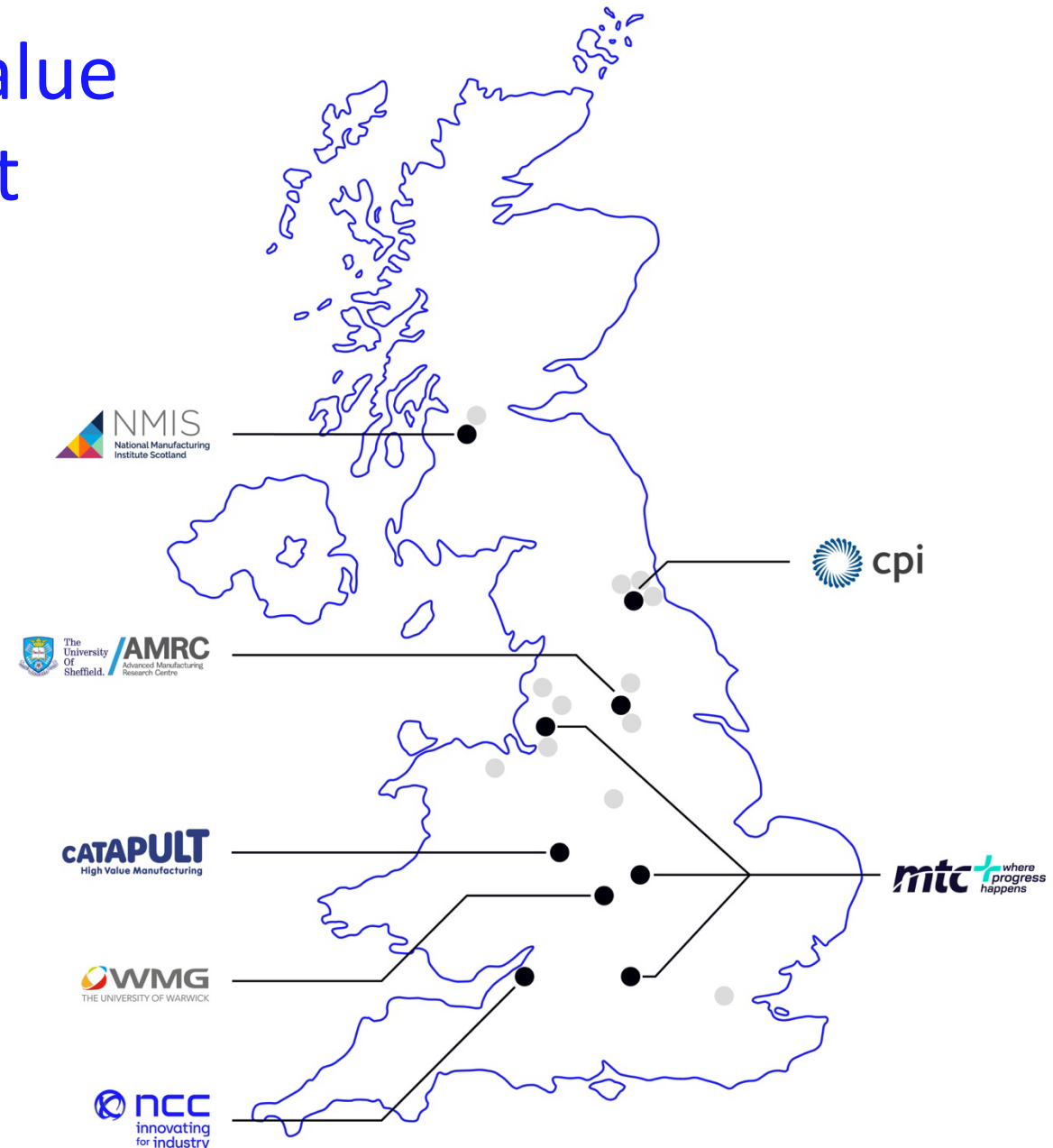
Established by
Innovate UK in 2011



6 centre's of industrial innovation across 25 sites
working together on the future of manufacturing.

Delivering impact:

- **£500m+** (\$665m+ USD) generated R&D spend each year
- **£609m** (\$810m USD) net additional GVA each year
- **5,500+** businesses worked with (60% SMEs)



HVM Catapult: Delivering industrial transformation in critical sectors for the UK

Over the past five years, we've turned **£1.6bn** (\$2.1bn USD) in public funding into **£7.7bn** (\$10.2bn USD) in GVA - supporting more than **6,000 firms**, 55% of which are SMEs

- Industry's innovation partner
- Not-for-profit organisation
- Full scale industrial demonstration of capabilities
- Extensive industrial & academic networks



NCC at a glance...



Over 100
academic partners



10 state-of-the-art
technologies

300
businesses
supported
per annum



More than 400
specialist engineers



£50m turnover
(\$66m USD)

£300m
(\$400m USD)
invested in
capabilities



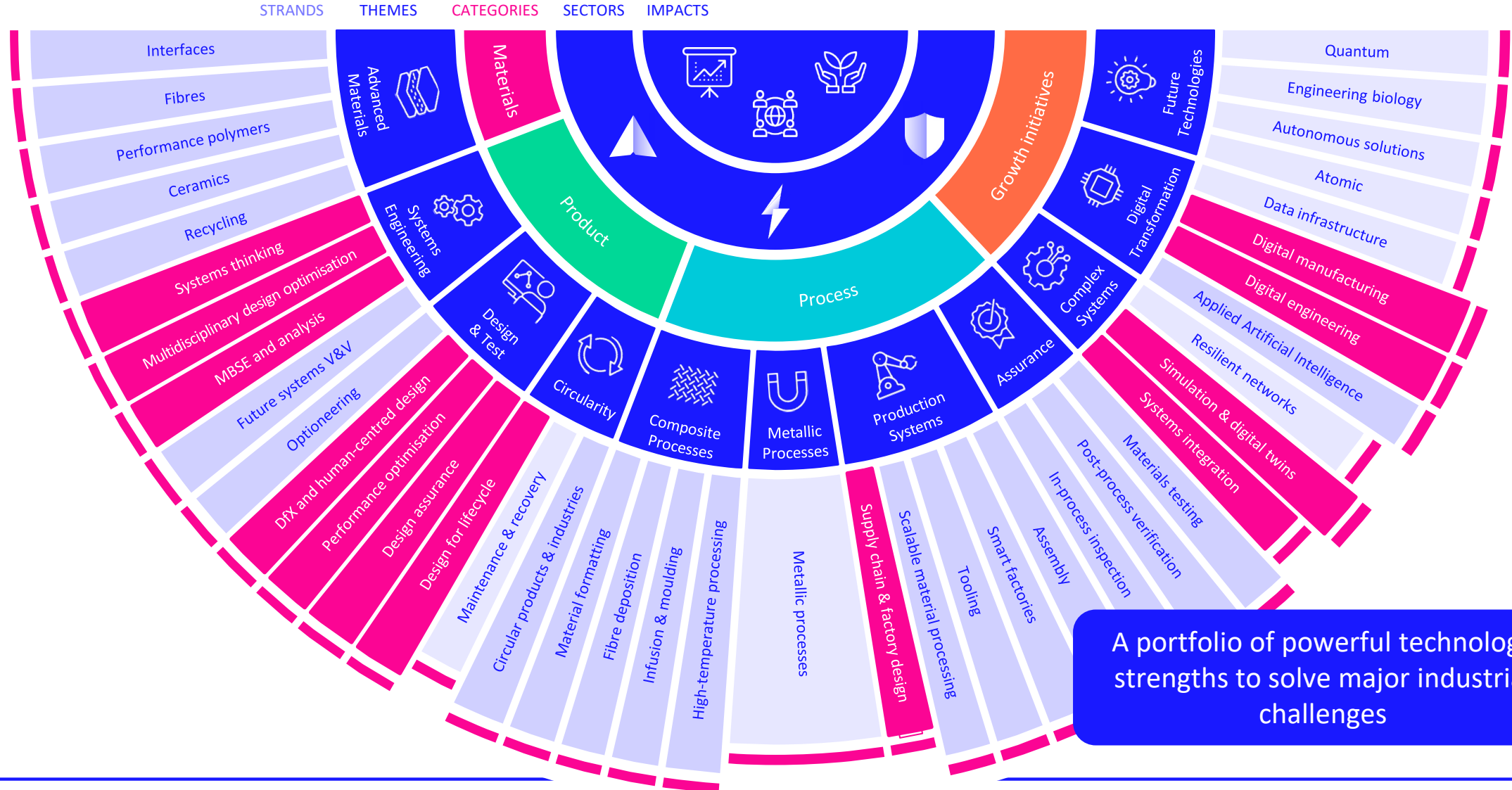
Over 70 members



3 locations

NCC is a world-leading innovation organisation that transforms cutting-edge research and technology into industrial impact.

Technology portfolio



A portfolio of powerful technology strengths to solve major industrial challenges

The HVM Catapult MBE Working Group

What It Is

- All HVM Catapult centres work together on common challenges.
- Centres support each other with specialist skills.
- The group shapes national guidance for MBE.
- Helps industry gain consistent, predictable data.

What It Does

- Creates shared terminology and simple, consistent modelling rules.
- Sets common PMI, TDP and workflow practices across all centres.
- Uses evidence from projects like **IMPACT** to improve guidance and the **MBE Handbook**.
- Centres test each other's workflows to check data behaviour end-to-end.
- Runs the **MBE Industrial User Group** to ensure guidance matches real supplier needs.



Advanced
Manufacturing
Research Centre



Centre for Process
Industries



Manufacturing
Technology Centre



NCC



National
Manufacturing
Institute Scotland



Warwick
Manufacturing
Group



Advanced
Manufacturing
Innovation Centre

The MBE Industrial User Group (IUG)



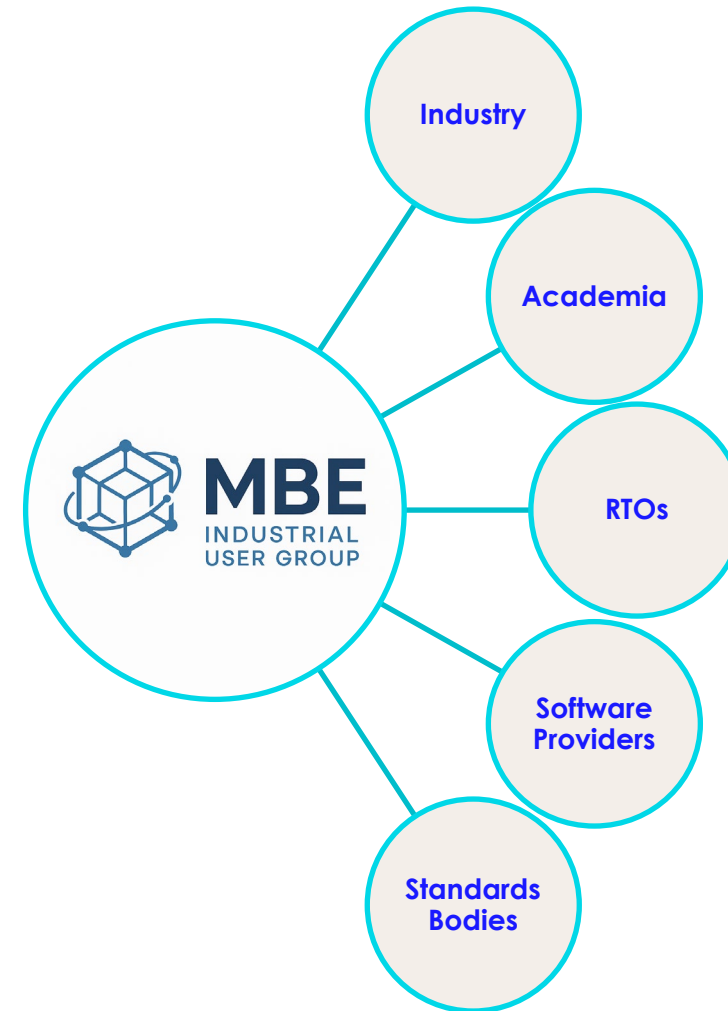
MBE IUG
LinkedIn Group

What It is

- A UK-wide community
 - OEMs
 - SMEs
 - RTOs
 - Software providers

What It Does

- Tests whether guidance works in real company workflows.
- Helps highlight supplier challenges early.
- Gives industry a voice in shaping MBE standards.
- Helps align expectations between OEMs and suppliers.
- Acts as a “reality check” for all HVM Catapult work
- Ensures guidance is practical, supplier-friendly, and tool-agnostic



The Reality of MBE Adoption

Adoption remains
inconsistent across
organisations

Pilots are common
but scaled
deployment is rare

The digital thread
breaks when
processes vary or
tools don't align

Industry is telling us...



PMI often breaks during
translation



Modelling practice
varies widely



Suppliers use different
tools and levels of
capability



Organisations manage
data in different, often
incompatible ways

Why Standards Alone Are Not Enough

STEP and QIF are
implemented
differently by each
software vendor

Datum definitions
are often missing or
unclear

Human processes
introduce
inconsistencies that
technology cannot
fix

Our Framework for Practical MBE



MBE Maturity Index

Recommended **baseline**



MBE Handbook

Turns standards into **actionable guidance**



IMPACT programme

Real testing across tools and centres



IUG feedback

Keeps everything **practical and grounded**

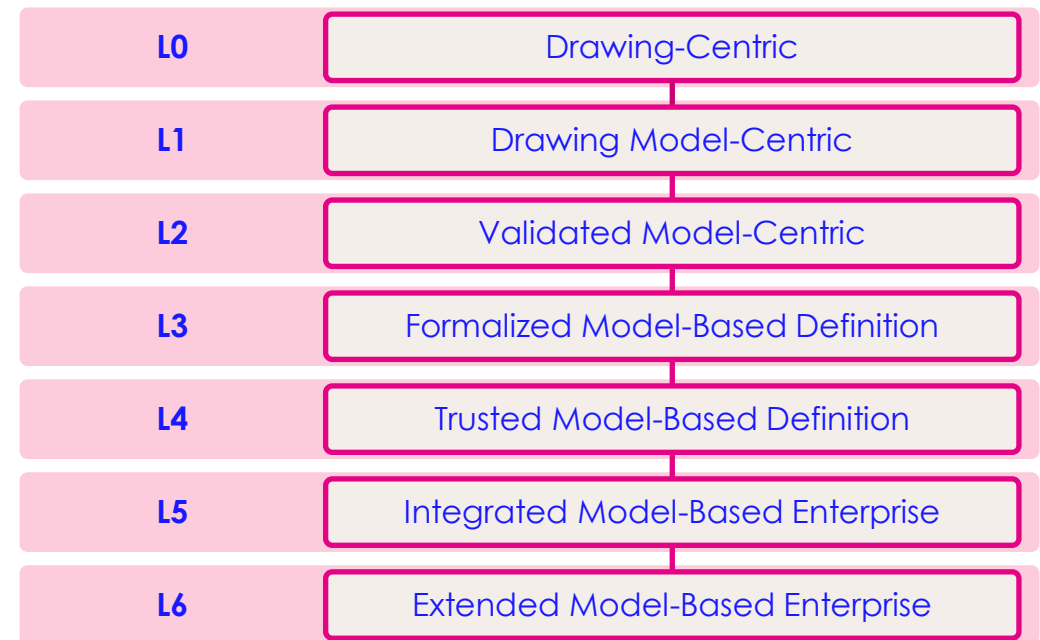
MBE Maturity Index

What It Is

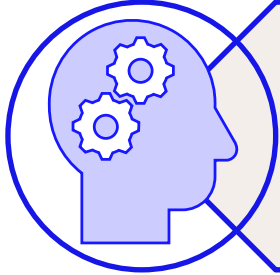
- Developed by US National Security Enterprise (NSE)
- Well-established, openly available maturity model
- Recognised across the MBE community
- Assesses capability, readiness, and adoption
- Helps organisations understand their current and future state

Why We Use It

- Neutral and tool-agnostic
- Works for both large organisations and SMEs
- Provides a common vocabulary for MBE progress
- Already familiar to many attending this Summit

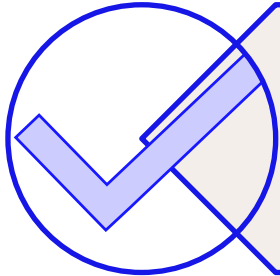


MBE Handbook



Purpose

- Converts standards into practical steps
- Provides templates and patterns for consistent workflows
- Supports decision-making at different maturity levels



Includes

- Two versions: detailed and "lightweight"
- Modelling and PMI guidance
- TDP patterns and minimum viable digital thread workflows
- Recommendations for traceability and version control



Need

- IMPACT revealed inconsistent practice and interoperability gaps
- Organisations needed a shared reference point
- Suppliers needed clear and realistic expectations



Available soon!

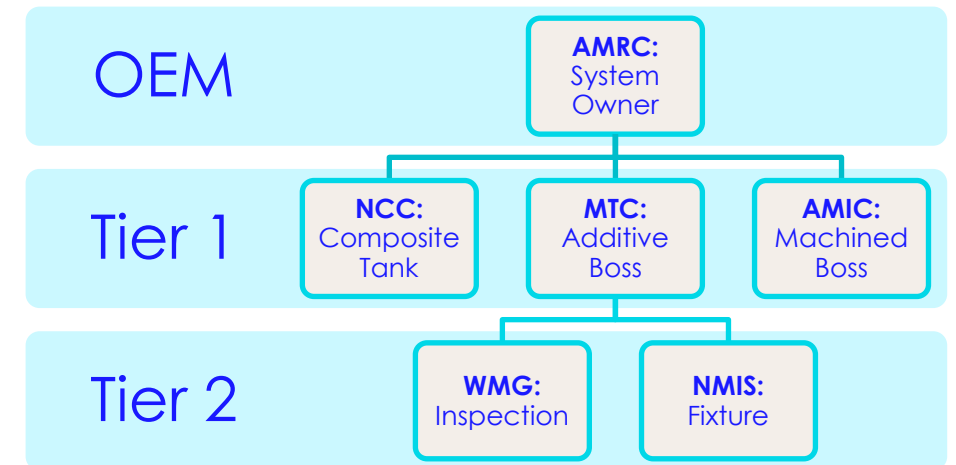
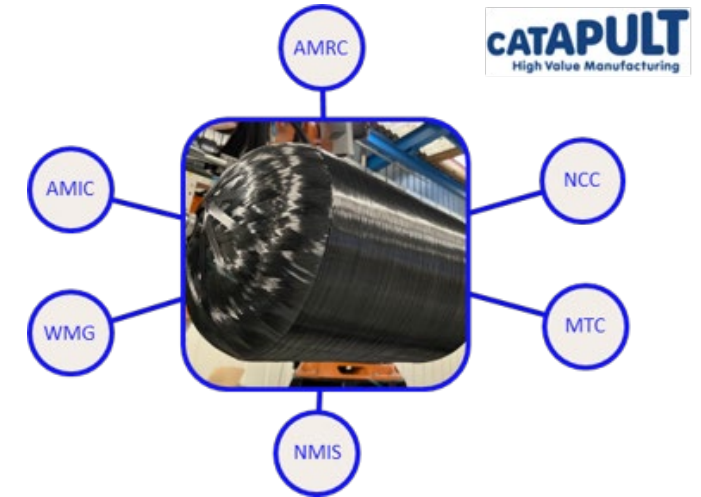
IMPACT Programme

Integrated Model-Based Practices for Advanced Collaborative Technologies

- Digital thread demonstrator
- Focused on real industrial workflows
- Cross-centre collaboration across HVM Catapult and AMIC
- Testing interoperability across CAD, CAM, Inspection, PLM

Tools

- **Design Layer:**
 - CAD tools with semantic PMI
 - STEP AP242, JT
- **Manufacturing Layer:**
 - CAM integration
 - CNC automation
- **Inspection Layer:**
 - CMM workflows
 - QIF-based validation
- **Data Backbone:**
 - PLM interoperability
 - Traceability and versioning

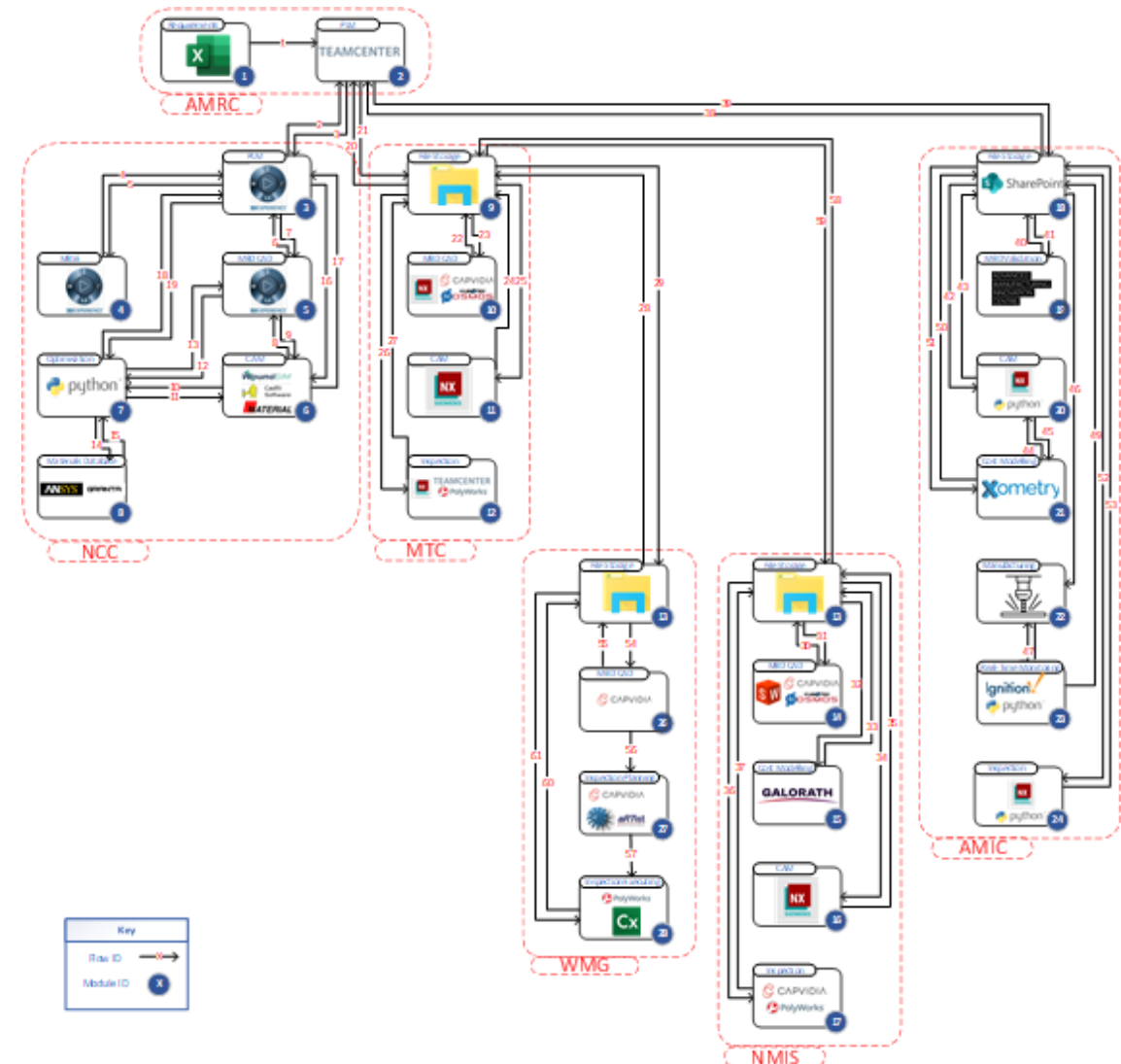


IMPACT Programme: System Architecture

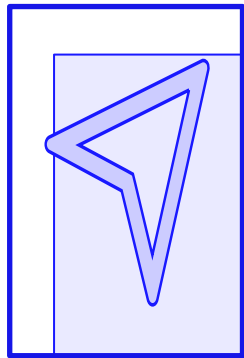
Requirements Categories:

1. Requirements Management
2. Product Lifecycle Management Processes
3. System Modelling and Architecture
4. Model-Based Definition and PMI
5. Manufacturing Process Planning
6. Design and Process Optimisation
7. Materials Management
8. Cost Modelling
9. Inspection and Quality Assurance
10. Real-Time Monitoring
11. File Storage and Synchronisation
12. Non-Functional MBE Requirements

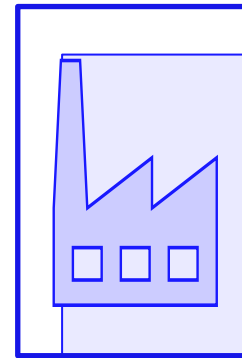
Many of the **requirements being tested are aspirational** and failure doesn't necessarily mean it is worse than the current methods.



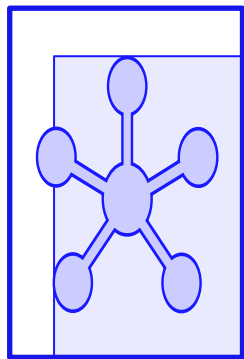
NCC's Role in the IMPACT Supply Chain



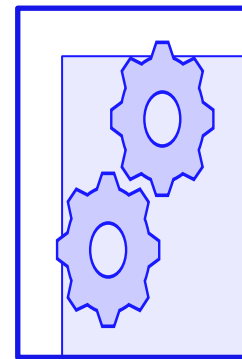
Overall technical lead



Tier 1 Supplier of carbon composite pressure vessel and its liner



Built on internal Capability Development activities to strengthen NCC's digital engineering workflows and internal readiness.



Connected into the broader IMPACT programme to enable shared tools, aligned processes, and repeatable digital workflows across the HVM Catapult network.

What NCC Delivered



End-to-end digital thread demonstrator for the pressure-vessel use case (requirements → modelling → design → analysis).



A rebuilt and fully version-controlled PVAAST (“Definitive Edition”) that supports collaboration and automation.



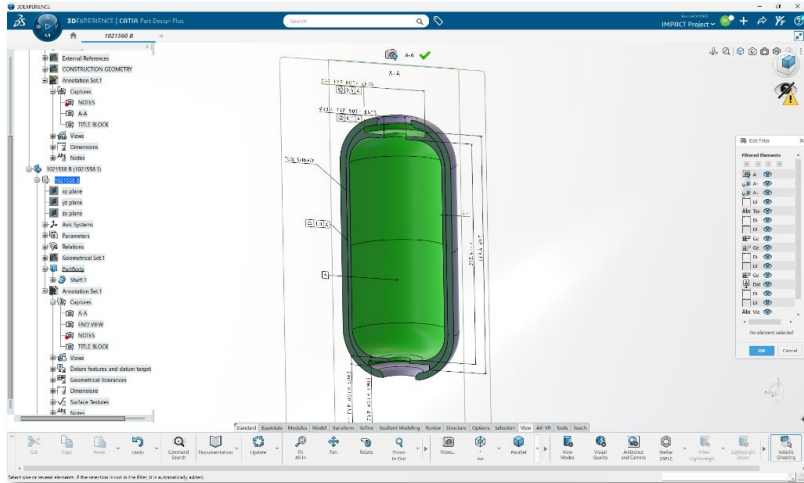
CompoST schema expanded for pressure vessels and winding workflows.



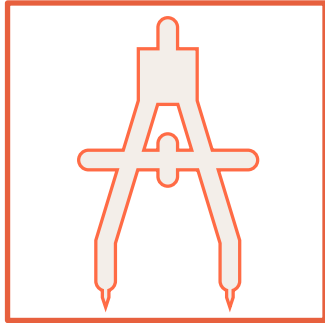
WoundSimWrap tool for automated import and partial Abaqus preparation.



MBE Roadmap, wiki, training module, and internal guidance for standardised practice.



Pressure VAAST & CompoST



Pressure VAAST (PVAAST)

A digital engineering tool that:

- Calculates and defines pressure-vessel geometry from key parameters.
- Supports model-based definition by generating consistent, parameter-driven data.
- Acts as the upstream source of truth for later CAD, analysis, and winding workflows.

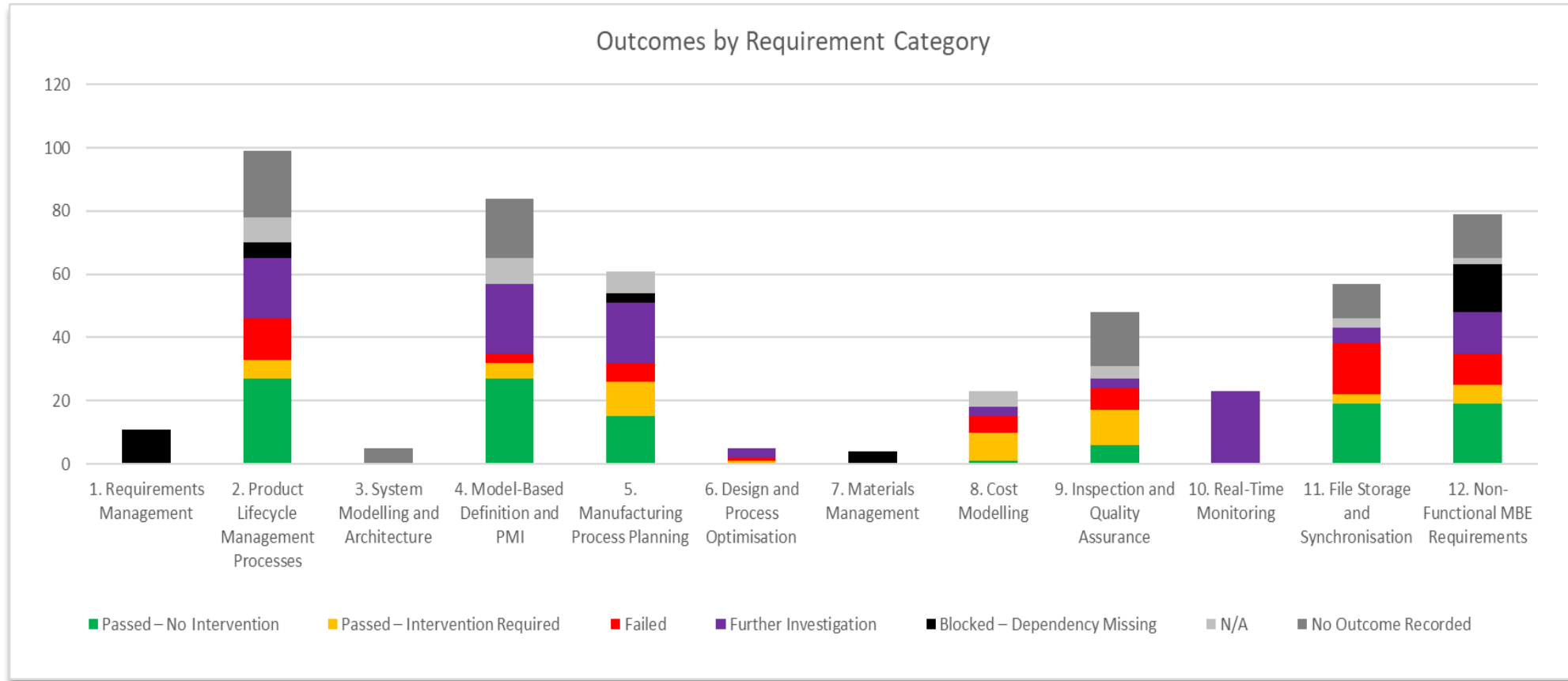


CompoST

A digital data standard that:

- Defines a consistent, structured format for composite part information.
- Captures both nominal and as-manufactured data for use across engineering workflows.
- Enables reliable data exchange between design, manufacturing, inspection, and analysis tools.

Overall Test Results



Notes:

- Many of **the requirements being tested are aspirational** and failure doesn't necessarily mean it is worse than the current methods
- Agreed to only use existing software in the centres
- Generally, we have not approached vendors/resellers for support
- Testing is ~75% complete so remaining tests may affect the conclusions

What Worked Well

Centres can create high-quality PMI and MBD models

- Every centre produced models with PMI following agreed standards.
- This shows MBE capability exists inside the centres.

Workflows inside a single tool generally succeed

- NX → NX works.
- 3DX → 3DX works.
- SolidWorks → SolidWorks works.
- No surprise: tools work best with themselves.

Inspection works when PMI is clean

- Tools like PolyWorks, NX Inspector, and Capvidia can produce measurement plan as long as the PMI is simple and consistent.

Costing tools can ingest geometry reliably

- Even if PMI is patchy, costing tools could still open and use the models.

Key message: Inside one environment, things usually work. Problems appear when data moves between tools or centres.

What DID NOT Work

PMI interoperability is weak

- Some PMI disappears when exported from NX to STEP.
- Centreline datums fail in PolyWorks.
- Threaded holes break downstream models.
- QIF imports were inconsistent.

PLM systems don't talk to each other well

- 3DX ↔ Teamcenter often failed or required manual workarounds.
- SharePoint and OneDrive create "personal silos", not shared repositories.
- Briefcase transfers often broke metadata or version integrity.

CAM automation is not mature

- PMI wasn't reliable enough to drive automatic toolpath creation.
- Some centres lacked the right postprocessors.
- Turning workflows failed because capability didn't exist.

File storage and versioning were inconsistent

- Parallel copies appear everywhere.
- File naming varied from centre to centre.
- Some centres could not share files directly due to tool or security limitations.

Key message: These problems reflect the real UK supply chain. This is exactly what suppliers struggle with every day.

Cross-Cutting Lessons

Requirements didn't stay connected

- IDs existed but were not carried through every stage.
- Without traceability, you don't have a real digital thread.

Small modelling choices create big problems

- Using a centreline instead of a face
- Creating a hole the "wrong way"
- Using supplemental geometry
- These subtle choices broke entire workflows.

Standards aren't enough

- STEP 242 and QIF are not interpreted the same way by every tool.
- A file that works in one tool may crash another.

People and process matter more than tools

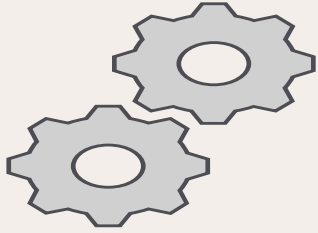
- Most failures came from:
 - naming conventions,
 - missing version discipline,
 - inconsistent workflows,
 - unclear rules.

Lower-tier suppliers would struggle even more

- Most do not have PLM or MBD tools.
- Many cannot open QIF or semantic PMI
- Fallback workflows are essential.

Key message: The digital thread breaks at the points where humans and processes are inconsistent — not just because of technology.

What It All Means



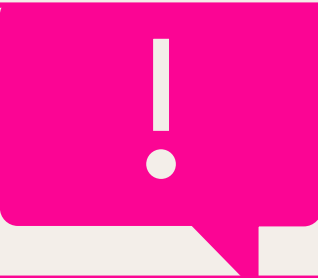
Where Industry Wants Us to Focus Next

- Integrated model-based practices for collaboration
- Digital thread demonstrator
- Based on real industrial workflows
- Cross-centre work across HVM Catapult and AMIC
- Interoperability testing across CAD, CAM, Inspection, and PLM



Bringing It All Together

- Standards form the basis
- MBE Maturity Index guides improvement
- Handbook turns standards into practice
- IMPACT proves what works
- Industrial User Group keeps it practical



Key Takeaways

- Practical MBE requires maturity, consistency, and discipline
- MBE Maturity Index is the right baseline
- IMPACT shows where data flows succeed and fail
- MBE IUG ensures everything remains grounded in the real world

And Finally...

Thank you for listening

Ben Hopper

- Principal Technologist – Advanced Design, NCC
- Co-chair HVM Catapult MBE Working Group
- ben.hopper@nccuk.com



My LinkedIn



MBE IUG
LinkedIn Group

