ENCOMPASS – An Integrated Design Decision Support Solution

Harrison Raybould

Research Engineer

Data & Information Systems, Digital Engineering

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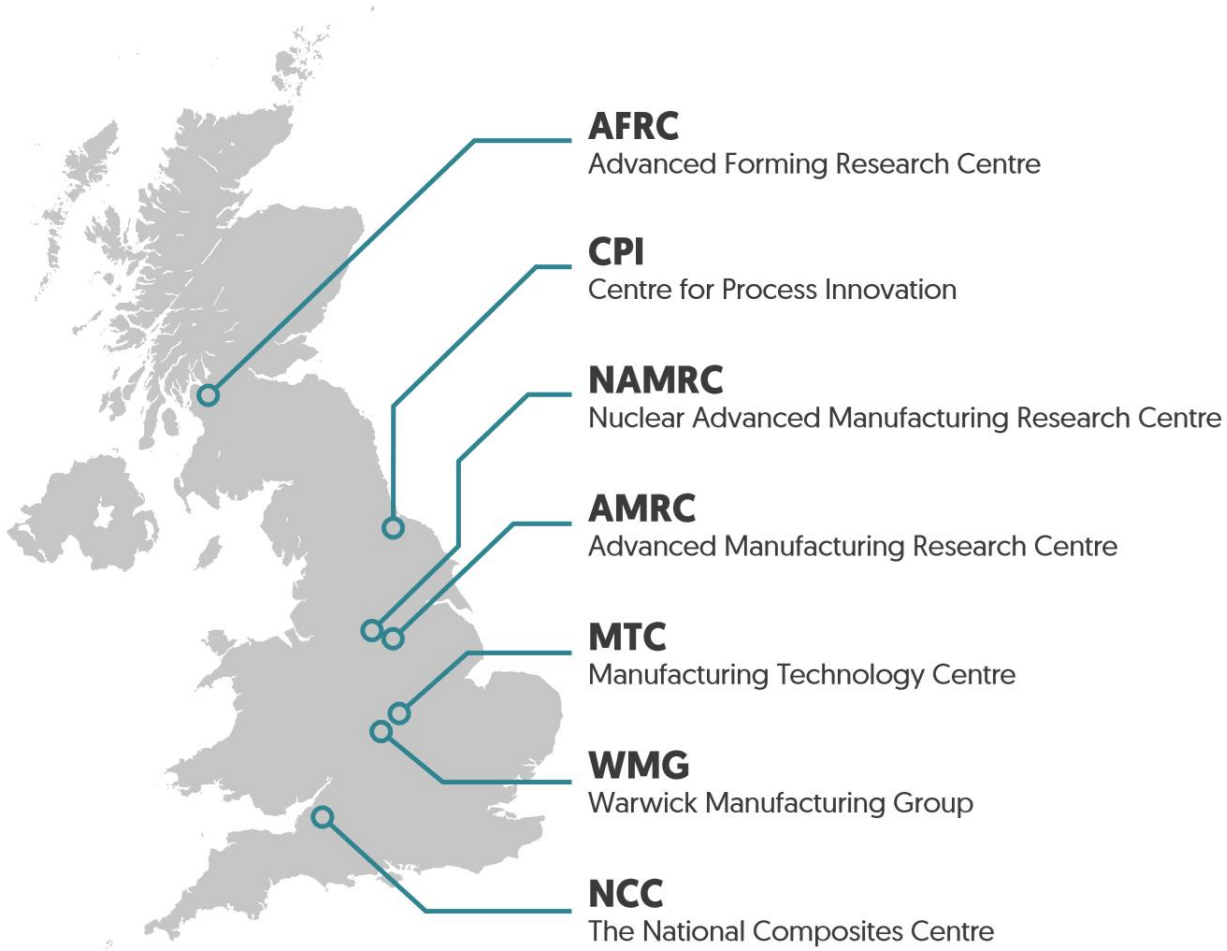
Introduction



The Manufacturing Technology Centre

- Independent UK Research Technology Organisation
- Bridge the ‘valley of death’ between Academia and Industry
- Over 100 industrial members
- Home to the National Centre for Additive Manufacturing

NATIONAL CENTRE ADDITIVE MANUFACTURING

- The largest of the High Value Manufacturing Catapult centres

Today

- Challenges of Additive Manufacturing
- The MTC’s Strategy for AM
- The ENCOMPASS Project
- Integrated Design Decision Support (IDDS) Solution

Challenges of Additive Manufacturing

- No digital coverage over the whole AM process chain
  - To enable effective management of the large amounts of data available from AM the relevant knowledge must be captured, stored and properly managed for easy query and analysis
- Highly expensive and time consuming to get from component design to pre-production runs and through the whole process chain
- Lack of expert knowledge
- Variable quality outcomes
  - Lack of reliability and robustness for the process
- Slow uptake

The MTC's Strategy for AM

NATIONAL CENTRE ADDITIVE MANUFACTURING

1. Create a platform for partners to test digital tools
    1. Host members at the National Centre for Additive Manufacturing
    2. Provide access to very latest technology
    3. Environment to get and manage data, to understand the IT infrastructure required

2. Develop and showcase tools that improve the AM process chain
    1. Increase confidence in AM
    2. Reduce time (and cost!) to manufacture

3. Provide a Knowledge Base & Insights
    1. De-risk AM adoption

Flagship AM Projects:

- Engineering Compass (ENCOMPASS)
- Digitally Reconfigurable Additive Manufacturing for Aerospace (DRAMA)

ENCOMPASS
INTEGRATED DESIGN DECISION SUPPORT SYSTEM

DRAMA

The ENCOMPASS Project

Overview

- Funding:
  - European Commission – H2020 project
- Project Length:
  - October 2016 – September 2019 (extended to December 2019)
- Aim:
  - Create a fully integrated design decision support (IDDS) system to cover the manufacturing chain for a laser powder bed fusion (L-PBF) process.
- Consortium Members:

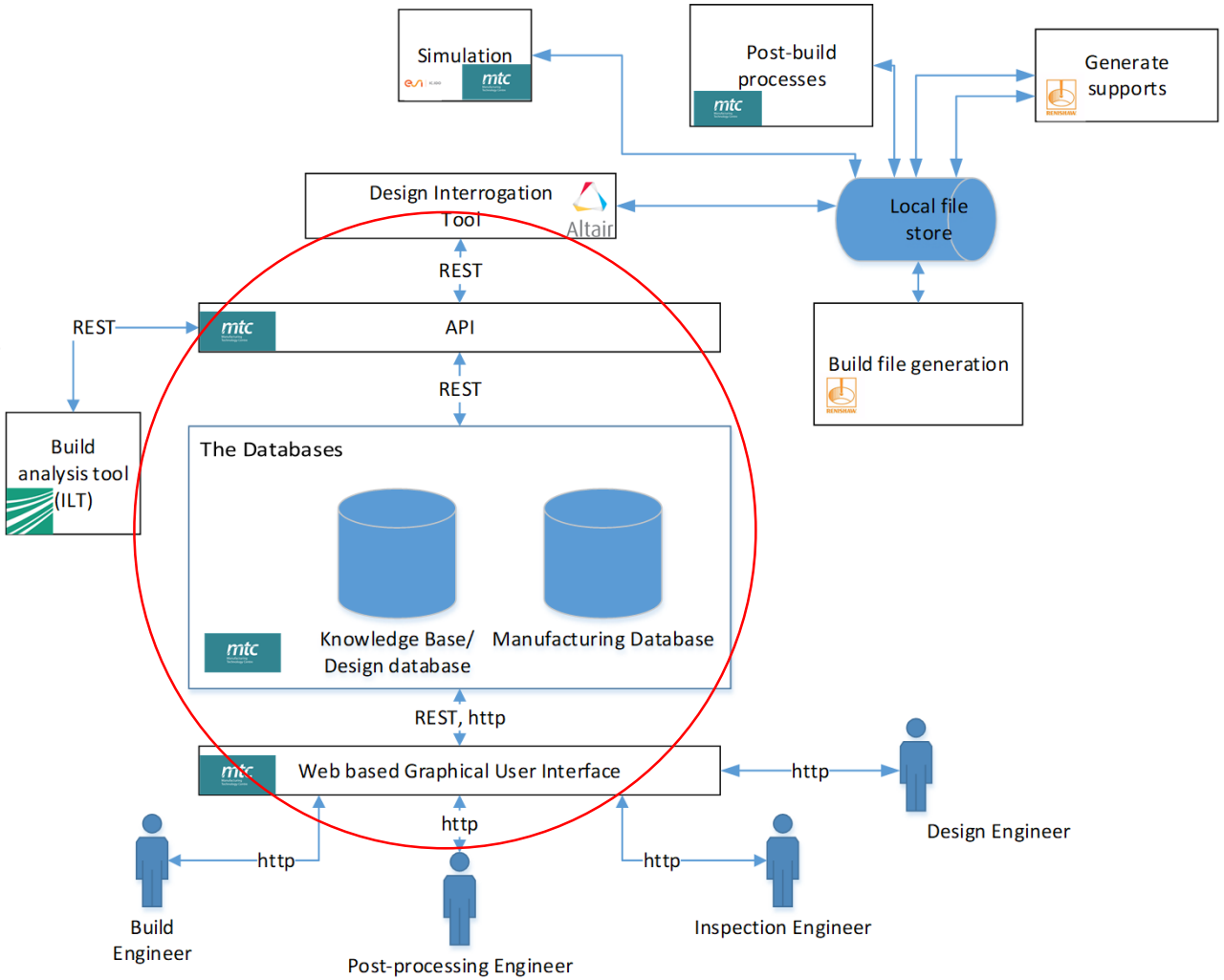
ENCOMPASS
INTEGRATED DESIGN DECISION SUPPORT SYSTEM

Rolls-Royce · RENISHAW apply innovation™ · Altair · UNIVERSITY OF LIVERPOOL · DePuy Synthes People inspired™ · CRF CENTRO RICERCHE FIAT · Fraunhofer ILT · esi get it right® · EWF · ITP the power of talent

The ENCOMPASS Project

Solution

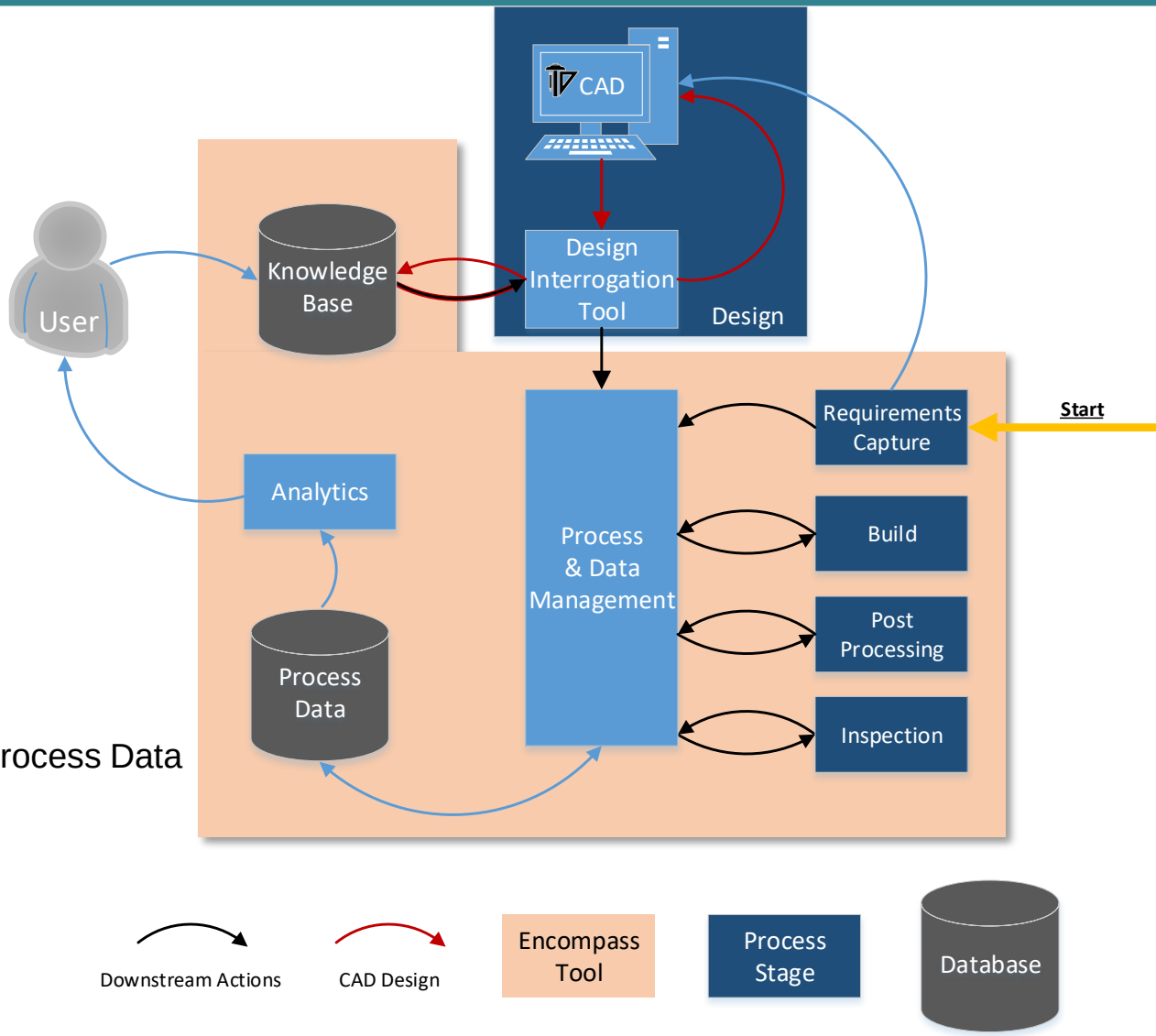
- A **knowledge repository**
  - Design rules, recommended strategies, etc.
- Interfaces to capture knowledge from the relevant sources
- A **Design Interrogation System (DIT)** that evaluates the part design for its buildability with AM
- Support across the full AM process chain with data capture & storage, and subsequent analysis



Integrated Design Decision Support (IDDS) Solution

Overview

- Part designed to requirement specification
- CAD Model loaded into the “Design Interrogation Tool” (DIT)
  - Design evaluated against Knowledge Base’s Design Rules
- Downstream Actions sent from Database via DIT
- Process data captured
- User considers changes to Design Rules based on Analytics of Process Data



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INTEGRATED DESIGN DECISION SUPPORT SYSTEM

mtc

European Commission

Project Database | Knowledge Hub | Analytics | Analyse this Project | Logout | Admin

Requirements Capture | Design | Build | Post Processing | Inspection

Test Project: 99999-01

Mark Stage Incomplete

Guided Workflow

1. **Requirements Capture**
   i. Upload Component Information (Drawing, Document, PMI etc.).
   See right text box
   ii. Specify process requirements (if any).
   See right text box
2. **Design**
   i. Launch Design Interrogation Tool (DIT)
   ii. Set up design evaluation in DIT
   iii. Complete design evaluation in DIT
   iv. Export downstream plan and output (*.pdf, *.json, etc.)
   v. Sign off from DIT
3. **Build**
   i. Invoke/query relevant input (flags *) from Matchbox
   ii. Review actions with input and use of Matchbox
   iii. Update downstream plan
4. **Post Processing**
   i. Invoke/query relevant tool
   ii. Review actions with input and use of the tool
   iii. Update downstream plan
5. **Inspection**
   i. Invoke/query relevant tool
   ii. Review actions with input and use of the tool
   iii. Update downstream plan

Add Note

Note Location

Add a note...

Add Note

Add Documents

Document Location

Choose file... | Browse

Enter a description...

Add Attachment

Design Actions

Download Incomplete Actions | Download All Actions

Change the orientation in order to average out the minimal cross sectional area through the part to balance the thermal stress

Action Completed

Add supports as a heat sink on on areas which are loaded with thermal stress and to improve supports to facilitate the strong connections to platform

Where simulation results show areas of distortion, apply Distortion compensation to the design

Action Completed

Reject Action

Project Notes

Download All Notes | Expand All | Collapse All

Requirements Capture

Design

No notes added...

Design Simulation

Build

Post Processing

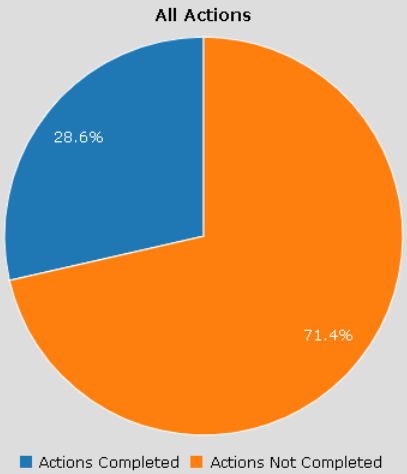
Inspection

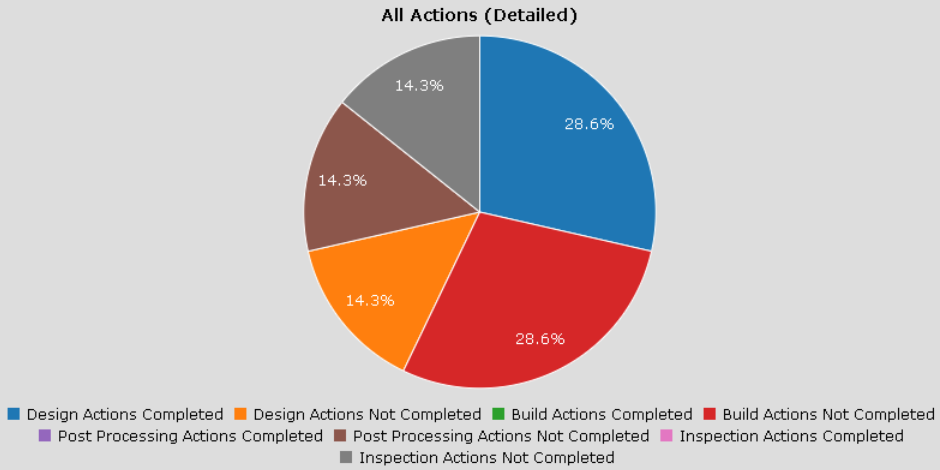
Miscellaneous

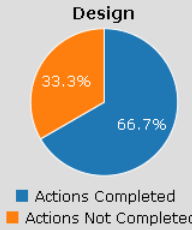
Analytics

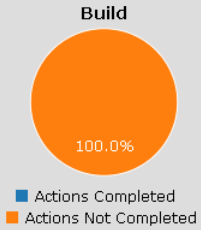
Test Project: 99999-01

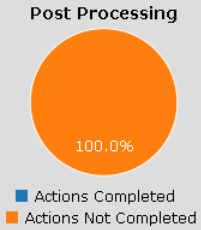
Test Project | 6 items selected

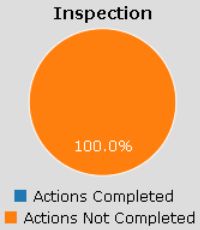












Not Completed

Action Completed	Stage	Description	Qualities Affected: Completion	Geometry	Surface	Integrity
No	De	sults show areas of distortion, apply Distortion compensation to	?	?	✖	?
No	Build	Select the most appropriate melt strategy to keep distortion to minimum	✔	✔	✔	✔

This **Action** has not been completed, but indicates that it is strongly linked to *Geometry*; consider doing one of the following:
- Complete this action, if possible
- **Update** this action to reflect that it has *little* or *no* effect on *Geometry*

Inspection Results

Completion	Pass
Geometry	Fail
Surface	Pass
Integrity	Pass

Go to the Project to update the Inspection Results.

Design Simulation Documents

Go to the Project for all Documents and Notes

Analytics

Test Project: 99999-01

Test Project | 3 items selected

Completed, Rejected, Not Completed

Action Completed	Stage	Description	Qualities Affected: Completion	Geometry	Surface	Integrity
Rejected	Design	Change the orientation in order to average out the minimal cross sectional area through the part to balance the thermal stress	✔	✖	?	✖
Yes	Design	Add supports as a heat sink on on areas which are loaded with thermal stress and to improve supports to facilitate the strong connections to platform	✔	✖	✔	✖
No	Design	Where simulation results show areas of distortion, apply Distortion compensation to the design	?	?	✖	?
No	Build	Select the most appropriate melt strategy to keep distortion to minimum	✔	✔	✔	✔
No	Build	Use of elevated bed/platform temperature	?	?	?	?
No	Post Processing	Conduct Stress Relieving heat treatment cycle without remove parts and supports from the platform to ease of the residual stress built up in the parts	✖	✔	?	?
No	Inspection	Conduct geometrical inspection to measure distortion against the nominal CAD requirements	✖	✖	✖	✖

Inspection Results

Completion	Pass
Geometry	Fail
Surface	Pass
Integrity	Pass

Go to the Project to update the Inspection Results.

Design Simulation Documents

Go to the Project for all Documents and Notes

Manufacturing Technology Centre

Thank You

Technology Manager

Nandini.Chakravorti@the-mtc.org

Research Engineer

Harrison.Raybould@the-mtc.org

CATAPULT High Value Manufacturing