Materials e-Infrastructure

- Reliable materials data remains central to exploiting superconducting and zero-carbon technology in many fields
- Absence of materials data leads to sub-optimal design and reliance on historic materials, e.g.
  - “What polymers can I use in a high radiation, cryogenic environment?”
  - “What composites can be used in cryogenic pressure vessels?”
- Aim: A reliable database that answers engineering decisions and easily links to modelling
- ***What follows is the previous proposal and will need updating…***

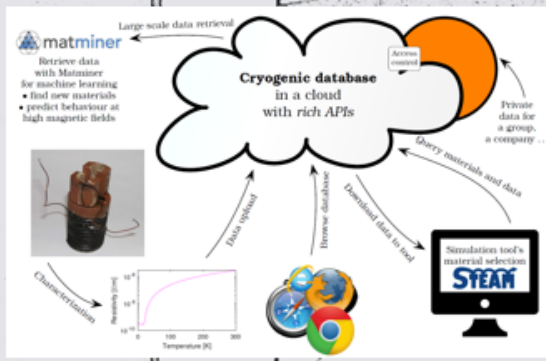
- **Phase 1** Creates an e-infrastructure, collects, reviews existing data; builds and commissions a sustainable, cryocooled test station to demonstrate multiphysical testing (e.g. thermal conductivity under stress at relevant temperatures)
- **Phase 2** Data Production, with test station as a user facility

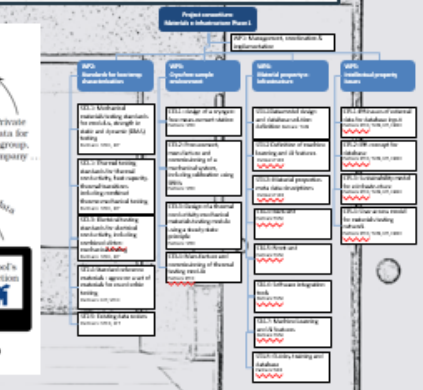
- **Objectives**
- To link to and support other tasks in Fusumatech, particularly by providing reliable data for the quench modelling task and materials testing of the high strength materials task
- To form a panel of expert reviewers who specialise in materials and/or measurement areas
- To identify which data sets can be used with regards to IP
- To critically review the existing data sets, identifying gaps
- To prioritise which measurements need to be performed
- To plan and demonstrate multiphysical testing infrastructure
- To develop an e-infrastructure that includes a materials database, linked to simulation software and machine learning frameworks such as “matminer”

Future Superconducting Magnet Technology

FuSuMaTech

T4.2 Materials e-infrastructure





A new database of materials properties at cryogenic temperature

Partners: STFC, KIT, CERN, TUNI (associate member of Fusumatech)

We aim to enable safe and confident design of superconducting systems, by providing validated materials solutions: suggesting suitable materials with supporting data for design and simulation.

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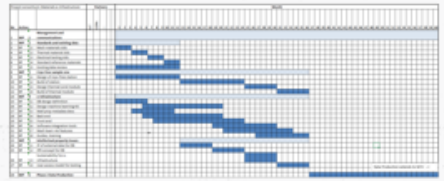
Key Milestones

M2.1 Review of existing cryogenic materials testing data, standards and standard reference materials M12 (type: report)
M2.2 Review of multiphysical materials testing M18 (report)
M3.1 Concept design report on cryogen-free environment (type: report)
M3.2 Results of SRM cryo-mechanical tests M24 (report)
M4.2 ML&AI concept M12 (report)
M5.1 IPR guide to import data from external sources M18 (report)
M5.2 IPR concept of e-infrastructure for new data M24 (report)
M5.3 Sustainability model for the e-infrastructure M36 (report)
M5.4 User access model for the new characterization station M36 (report)

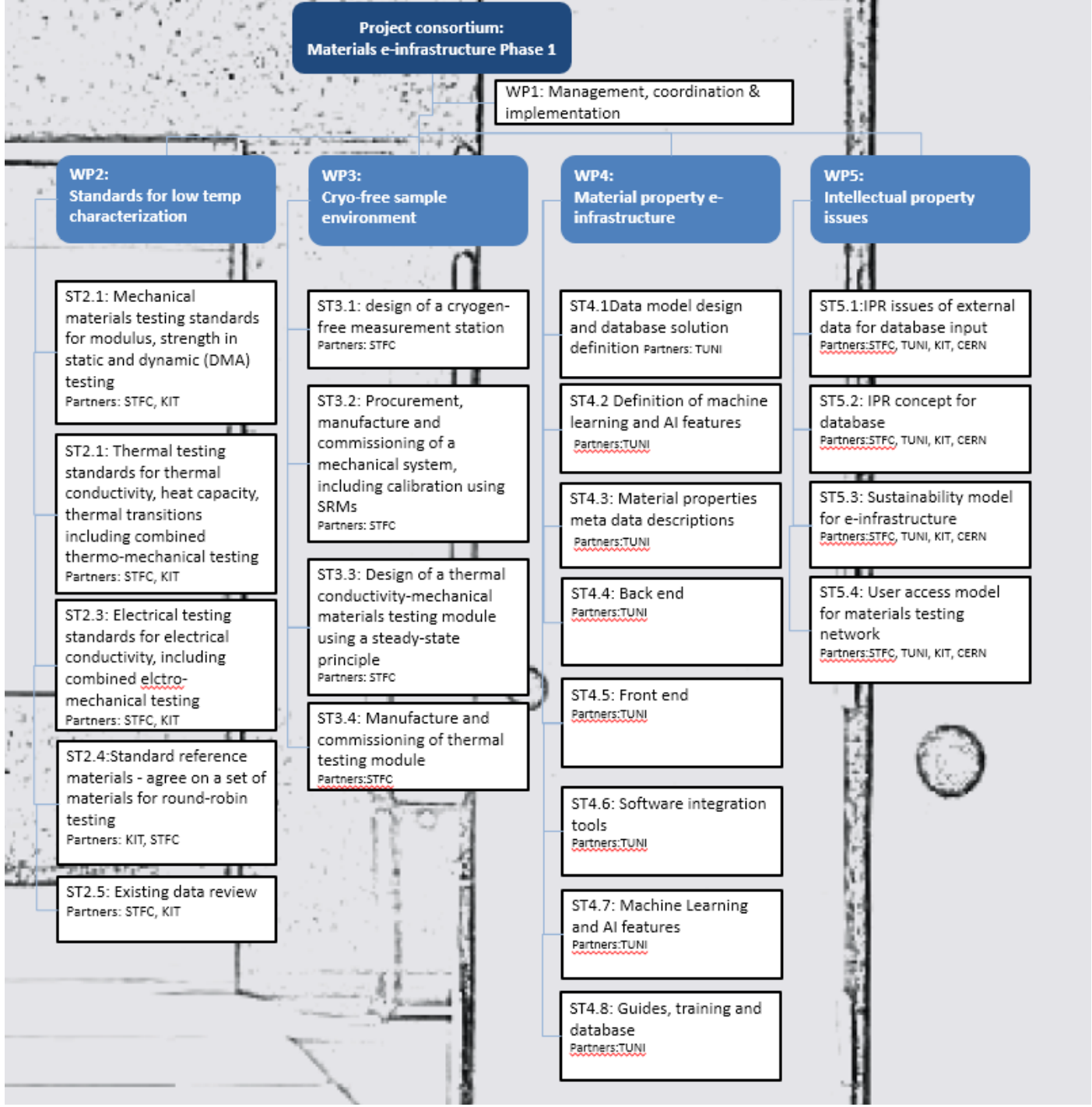


Deliverables

D1.1 Final report M36 (report)
D2.1 Final Report M36 (report)
D3.1 Commissioning of testing system M36 (testing machine)
D4.5 Commissioned e-infrastructure M36 (type: software)

Estimated costs (over 6 years) Total 3.1MEu

WP1 160kEu, WP2 150kEu, WP3 870kEu, WP4 908kEu, WP5 300kEu, WP6 735kEu


Project consortium:
Materials e-infrastructure Phase 1
WP1: Management, coordination & implementation
WP2:
Standards for low temp characterization
WP3:
Cryo-free sample environment
WP4:
Material property e-infrastructure
WP5:
Intellectual property issues
ST2.1: Mechanical materials testing standards for modulus, strength in static and dynamic (DMA) testing
Partners: STFC, KIT
ST2.1: Thermal testing standards for thermal conductivity, heat capacity, thermal transitions including combined thermo-mechanical testing
Partners: STFC, KIT
ST2.3: Electrical testing standards for electrical conductivity, including combined elctro-mechanical testing
Partners: STFC, KIT
ST2.4:Standard reference materials - agree on a set of materials for round-robin testing
Partners: KIT, STFC
ST2.5: Existing data review
Partners: STFC, KIT
ST3.1: design of a cryogen-free measurement station
Partners: STFC
ST3.2: Procurement, manufacture and commissioning of a mechanical system, including calibration using SRMs
Partners: STFC
ST3.3: Design of a thermal conductivity-mechanical materials testing module using a steady-state principle
Partners: STFC
ST3.4: Manufacture and commissioning of thermal testing module
Partners:STFC
ST4.1Data model design and database solution definition Partners: TUNI
ST4.2 Definition of machine learning and AI features
Partners:TUNI
ST4.3: Material properties meta data descriptions
Partners:TUNI
ST4.4: Back end
Partners:TUNI
ST4.5: Front end
Partners:TUNI
ST4.6: Software integration tools
Partners:TUNI
ST4.7: Machine Learning and AI features
Partners:TUNI
ST4.8: Guides, training and database
Partners:TUNI
ST5.1:IPR issues of external data for database input
Partners:STFC, TUNI, KIT, CERN
ST5.2: IPR concept for database
Partners:STFC, TUNI, KIT, CERN
ST5.3: Sustainability model for e-infrastructure
Partners:STFC, TUNI, KIT, CERN
ST5.4: User access model for materials testing network
Partners:STFC, TUNI, KIT, CERN

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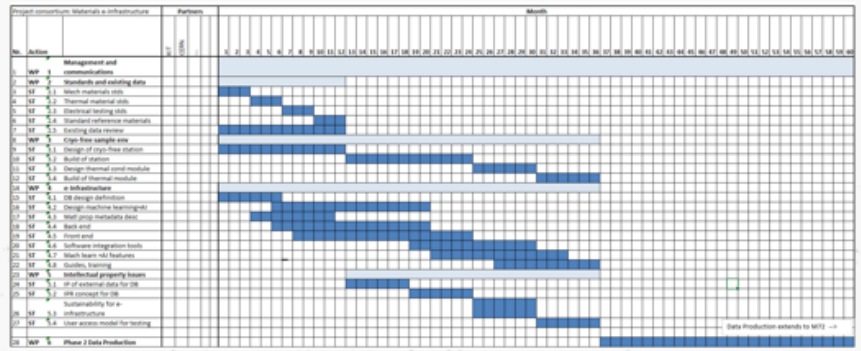

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We are looking for:

- Interest in these areas:
  - Standards
  - Low temperature testing facilities (inc. multiphysical)
  - Expert panel to review data
  - e-Infrastructure
  - Intellectual property

simon.canfer@stfc.ac.uk