DSD update

Reorg of PMU

FSD initiative 2023: More focus on AI, implemented in 2024

New Digital Department
Consisting of WPAC (TSVV, ACH, DMP) and WPENR (grants,bottom up)

Vision: to have a stronger focus on modern digital tools and use recent developments in the **whole programme** (Digital for engineering, operation and safety..)
Clearly: New topics, new resources and extended organisation! (Else it does not make sense!)

TASK:
- develop the vision into a mature and consistent structure
- opportunities to: streamline processes, reduce the operational burden on experts, and ensure safe, reliable fusion plant operation

Boundary condition: Current WP structure does stay intact (at least until 2026)

Stakeholders: Include views of key stakeholders, TSVVs, HoDs, WPL, HoRUs as well as experts from outside fusion (but with deep knowledge of Digital) and outside EUROfusion (f.x. UK, US)

2.b PMU Reorganisation – (preliminary) vision for the DSD

Bridge knowledge gaps by ensuring reliable, validated digital models, to leverage rapidly advancing digital technologies (AI, ML, Digital Twins) for fusion

- Data & AI
  - Develop fusion-specific AI/ML tools and models, create digital twins for comprehensive simulations
  - Implement standardized data storage and tools

- Code Development
  - Develop, maintain, and optimize EUROfusion codebase, ensuring professional structure and validation
  - Introduce new functionalities and optimize performance

- Tools for Predictive Modelling
  - Integrate codes for simulating machines like ITER and DEMO
  - Provide training for end-users

- Enabling Research & Theory
  - Stimulate fundamental research, generate theoretical insights

- Infrastructure
  - Manage HPC resources, computational hubs, and long-term data storage for research support and security

Key Objectives for Digital Capabilities in EUROfusion

1. Leverage Advanced Digital Technologies

1. Apply cutting-edge digital tools (AI, ML, digital twins) across all fusion activities.
2. Enable comprehensive, integrated simulations (plasma, external systems, control actuators, interfaces).

2. Strengthen Foundation for Future Fusion Facilities

1. Enhance design, predictions, and optimization of ITER & DEMO.
2. Bridge gaps in fusion research through reliable, first-principles simulations.
3. Support plant safety and operational confidence through advanced digital methods.

3. Centralize Digital Expertise

1. Consolidate digital activities currently scattered across work packages and departments.
2. Establish a common point of reference to harness expertise from different areas.

DATA and AI

Focus Areas:
- Data preparation, management, and AI/ML applications.
- Digital twins and predictive modeling.
- Tools for safety, operations, and engineering data.

Key Roles:
- Prepare data for AI/ML and engineering.
- Develop and implement AI/ML models, including digital twins.
- Manage data storage, access, and consistency.

New Aspects:
- Expand AI/ML applications to plant design and operations.
- Integrate engineering data for enhanced analysis.
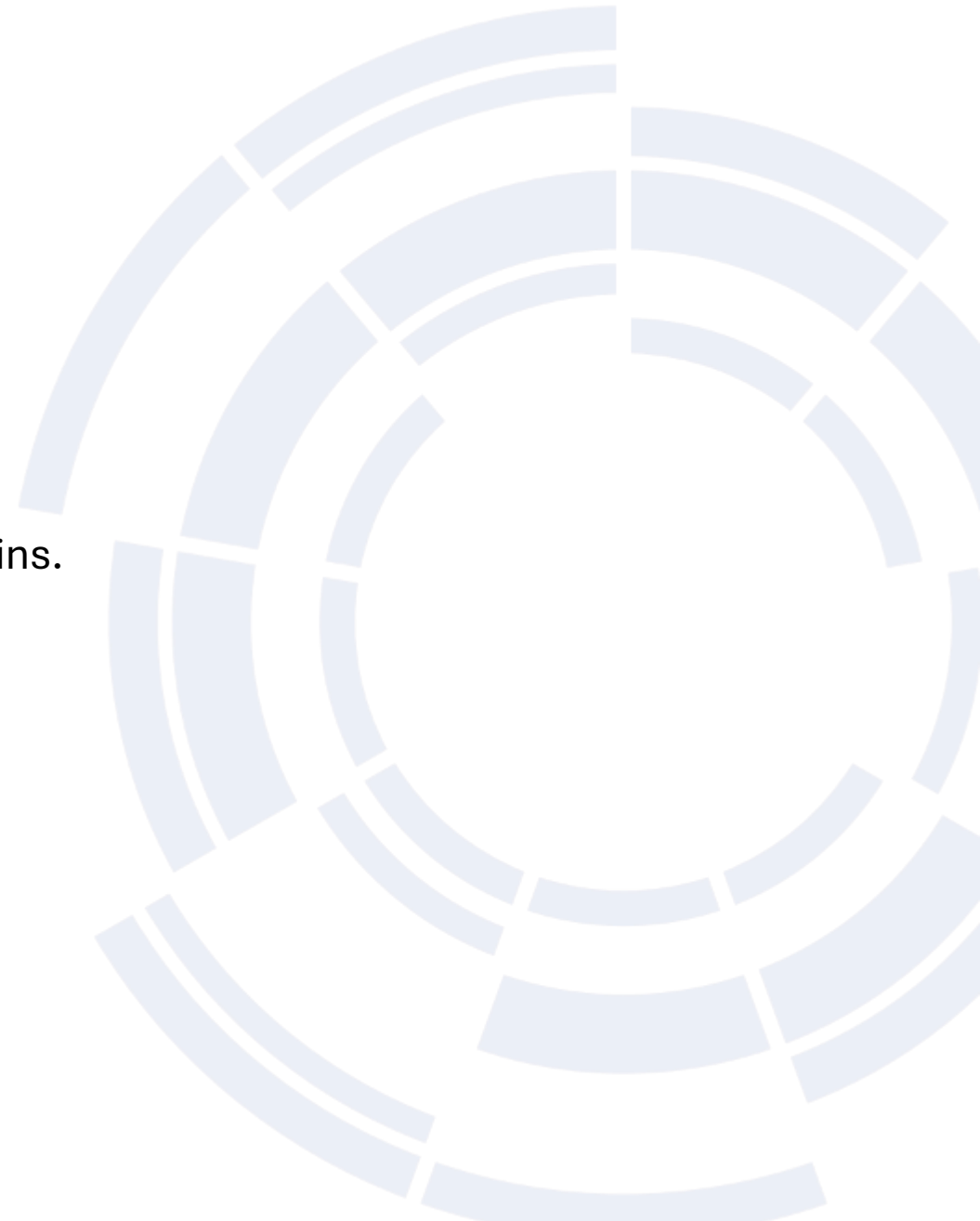
Code Development

Focus Areas:

- Develop and maintain EUROfusion code base.
- Trigger new code developments and optimize existing ones.
- Ensure codes are structured, documented, and validated.

Key Roles:

- Write, maintain, and enhance fusion codes.
- Perform testing and quality assurance.
- Conduct TSVVs and manage version control.

New Aspects:

- Include to engineering and operational software for nuclear facilities.
- Integrate engineering analysis and safety of operations.
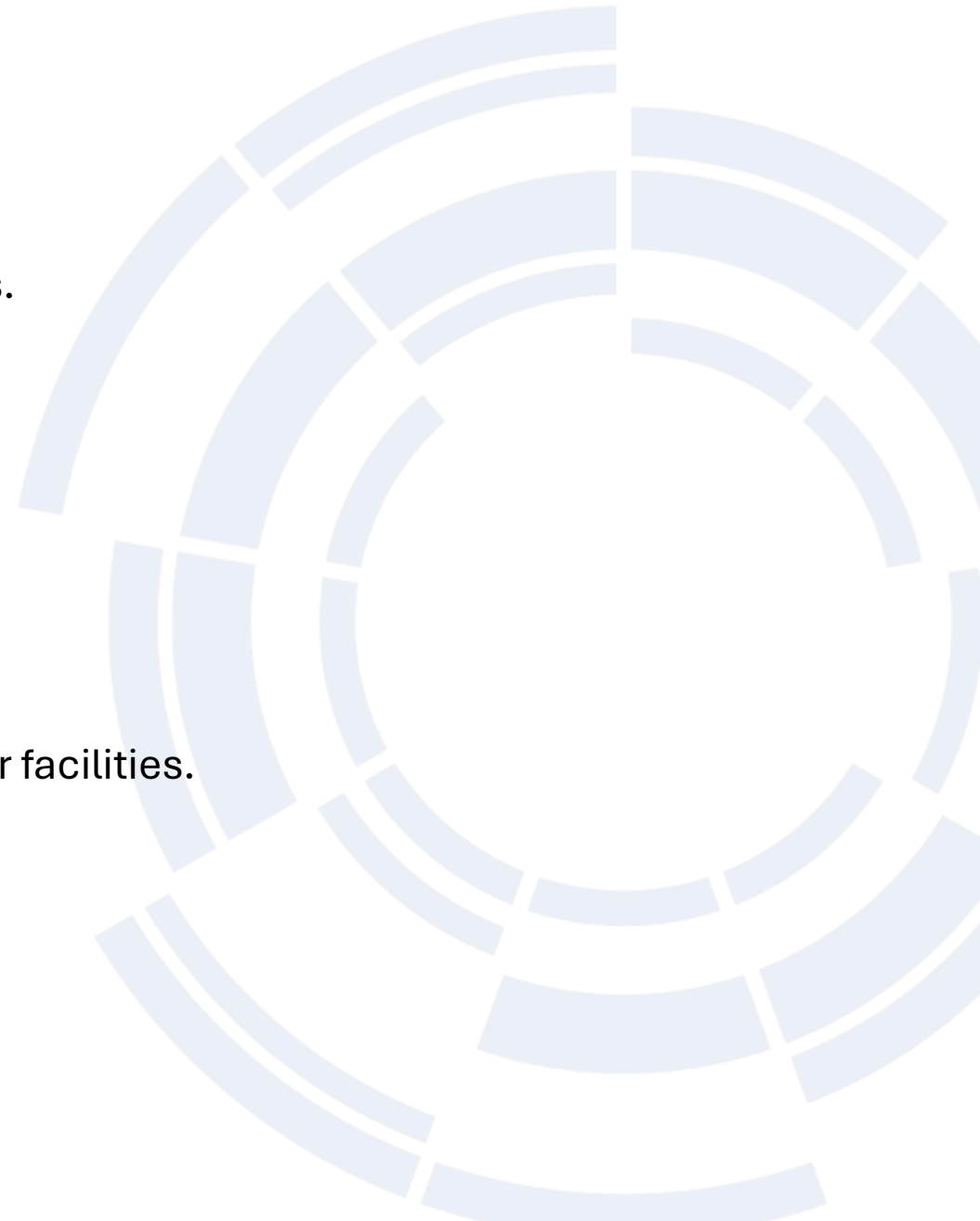
Predictive Modelling & Integration

Focus Areas:

- Integration of developed codes for predictive simulations.
- Whole-device modeling for ITER, DEMO, and beyond. (see also STAC comments!)
- Support for experiment analysis and engineering packages.

Key Roles:

- Run predictive simulations for new devices and optimize results.
- Train end-users on developed codes.
- Ensure continued validation and integration of tools.

New Aspects:

- Dedicated plasma **and** engineering modeling.
- Integration of software for engineering analysis in fusion facilities.

Infrastructure

Focus Areas:

- Management of High-Performance Computing (HPC) resources.
- JET Data Centre, ACHs, and long-term large data storage.
- Ensuring availability and distribution of computational resources.

Key Roles:

- Manage and maintain HPC and data centers.
- Support resource allocation for all work packages.
- Oversee data security and performance optimization.

New Aspects:

- Centralized access to digital infrastructure.
- Focus on long-term data storage and integrated digital solutions.

Work Package Enabling Research (WP ENR)

Focus Areas:

- Fundamental research across plasma, engineering, and operations.
- Long-term theory and framework development.
- Cross-departmental interdisciplinary projects.

Key Roles:

- Generate innovative ideas and theoretical models.
- Facilitate interdisciplinary collaboration.
- Integrate successful research into broader work packages.

(New) Aspects:

- Expand beyond plasma science to include engineering and operational frameworks.
- Allow longer-term theoretical research.

Status now

- Discussions with Digital Experts from outside fusion, STAC, E-TASC SB (upcoming at General Meeting) and some HoDs pending

- Important to have a stable setup, with reasonable interfaces (all Departments will use digital tools!)

- Start with new areas under AC and areas coordinators 2025

- Eventually grow areas into new workpackages 2026

Open and Transparent Process: Constructive input always welcome!

Thank you!