CDF | Concurrent Design Facility

ESA ESTEC

10/09/2021

The Concurrent Design Facility

What is it?

- The ESTEC Concurrent Design Facility is an Integrated Design Environment (IDE) available to all ESA programmes and external partners for interdisciplinary and inter-directorate applications, based on Concurrent Engineering methodology.

When did it start?

- Implementation started in Nov.1998, on an experimental basis with support of the General Studies Programme (GSP).

What is it used for?

- Initially conceived for the assessment and the conceptual design of future space missions (i.e. internal pre-Phase A / feasibility studies).
- Currently also used for reviews, project lessons capture, educational activities…

The Concurrent Design Facility

Where do the CDF Studies and activities come from?

- ESA Directorates preparing for future missions;
- Technology Programmes, Technology Transfer Unit, Knowledge Management Office;
- External stakeholders, including LSI, SMEs, Academia;
- ESA Projects for reviews of industrial work;
- Non space entities (oil and gas, ship builders, logistically complex entities, Dutch ministry offices, …);
- International partners (space agencies interested in learning methodology and cooperate with ESA).

What are the essential elements of the CDF?

- Team of specialists;
- Integration of tools, models and data (e.g. of the missions and system being studied);
- Simultaneous participation of all mission domains (incl. Operations, Programmatics/AIV, Cost Engineering, Risk Analysis, CAD, Simulation and of the customer.

Concurrent Design Facility (CDF)

ESTEC CDF is an Integrated Design Environment based on Concurrent Engineering Methodology

Main Features

- Team
- Design Process
- Simultaneous participation of all mission domains, incl. Operations, Programmatics/AIV, Cost Engineering, Risk Analysis, CAD, Simulation

Methodology

- Iterative presentations
- Debate
- Consensus
- System awareness

Approach

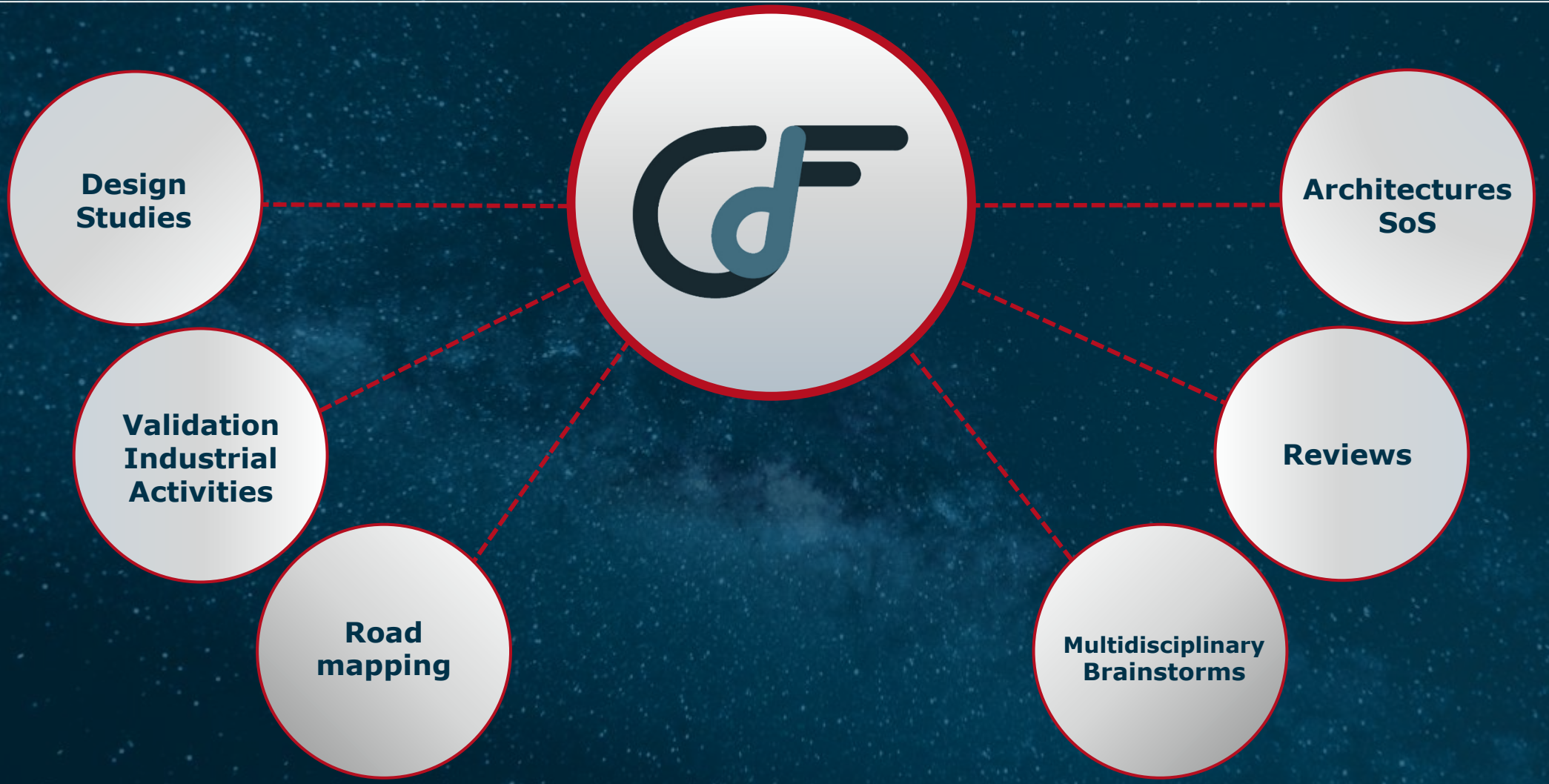
- Multidisciplinary
- Holistic
- Systematic
- Centralized
- Focus on Customer expectations.

On-line interdisciplinary communication & collaboration

- Models linked to graphical representations
- 3D computer-aided design (CAD)
- Simulation
- Digital mock-up
- Rapid prototyping (RP)
- Work in progress: Augmented Reality

ESA CDF Website: http://www.esa.int/CDF

CE Applications



CDF: An essential **tool for the ESA Decision Making** processes

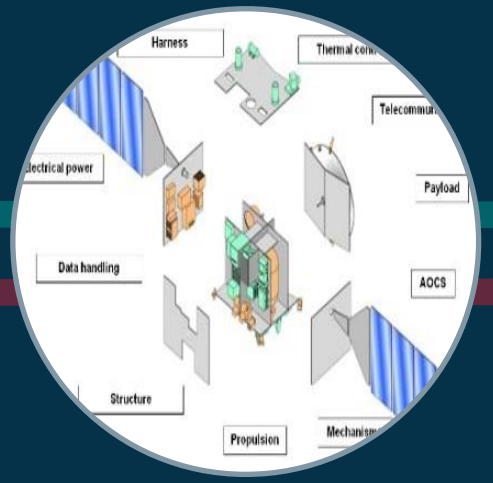
Why Concurrent Engineering?

Design Phases: To overcome the communication gaps between the “designer” (who produces design information) and the “user” (who utilizes the design information).

Sequential Design (‘over-the-fence’ approach)

Development Phase: To reduce the risk of engineering changes in later phases, which imply to halt the development and go back to the “drawing table”.

When is CE Recommended? A Methodology for Complex Systems



Design (from concept to DD)

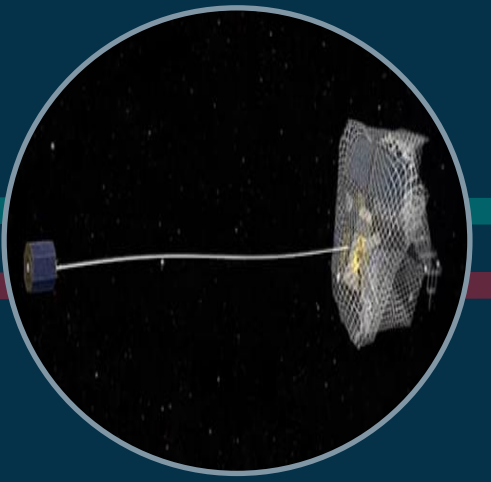
Development / AIV

Launch

Life cycle

Ground segment

Development / AIV



EoM Disposal

Benefits

Performances (typical pre-Phase A study):

- Study duration (Design phase): 3-6 weeks (cp. 6-9 months!)
- Factor 4 reduction in time
- Factor 2 reduction in cost (management, administration, infrastructure have costs)
- Increased number of studies per year

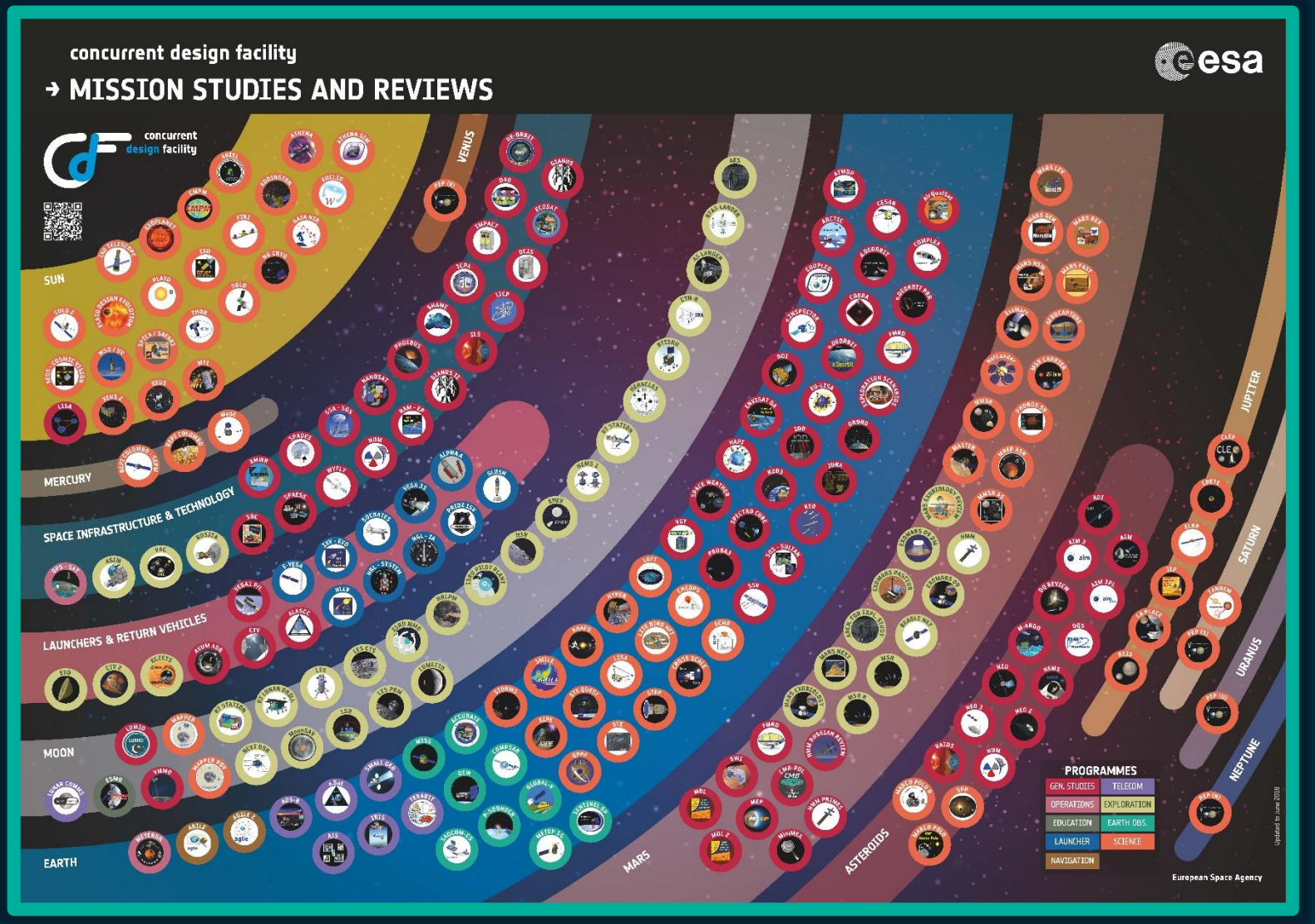
Improvement in quality, providing quick, consistent and complete mission design, incl. technical feasibility, programmatics, risk, cost

Technical report becomes part of the specs for subsequent industrial activity,
Cost report remains the ESA independent reference

Capitalisation of corporate knowledge for further reusability

CDF has become an essential tool to support ESA Decision Making and Risk Management processes

CDF Mission Studies and Reviews



CDF: More than 20 Years of Successful Usage and Evolution

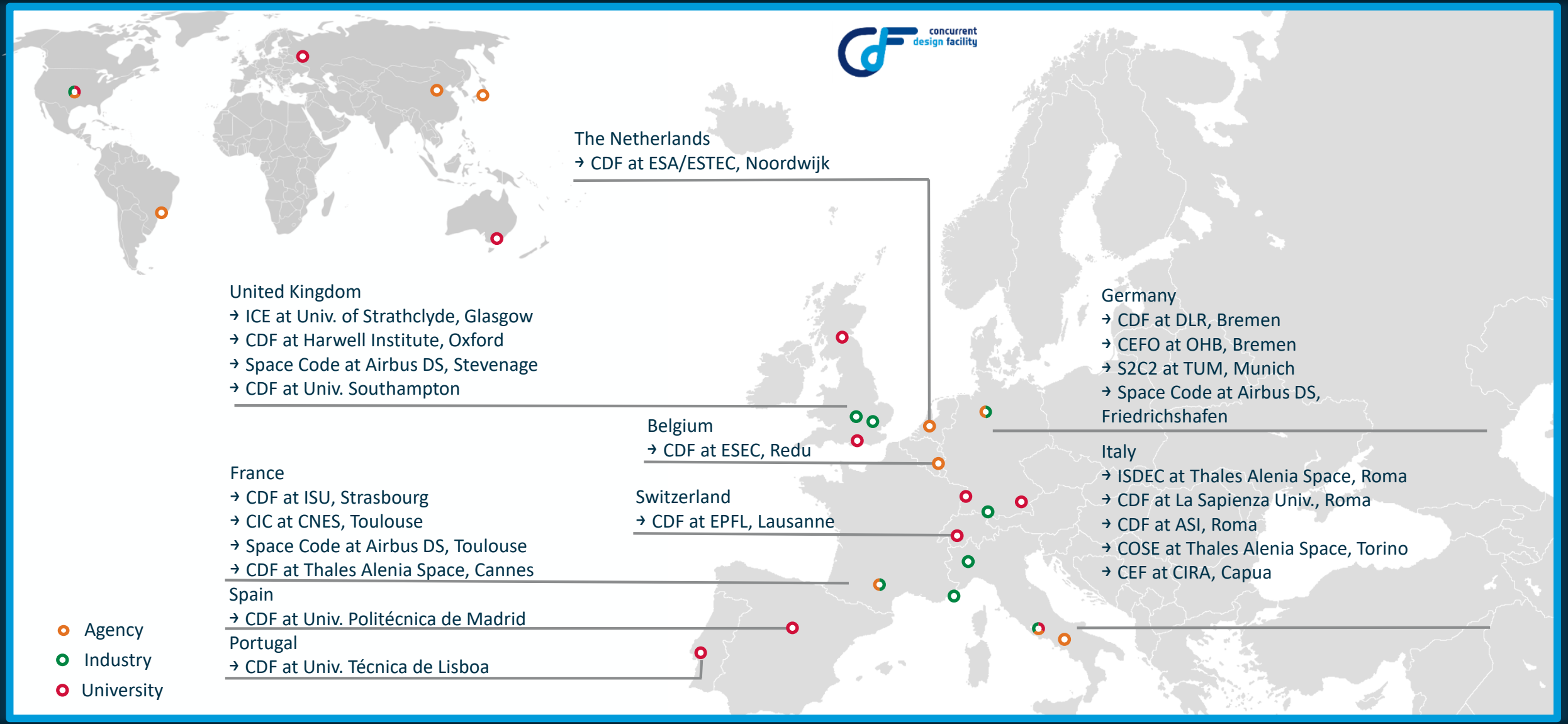
18 Nov. 1998

2000-2007

2008-2018

2019 …

Concurrent Design Centers Inspired by ESA CDF



ESA Institutional Partners

CNES – CIC
Inauguration Nov. 2005

DLR (Bremen) CEF
Inauguration 8 Dec. 2008

Institutional Partners

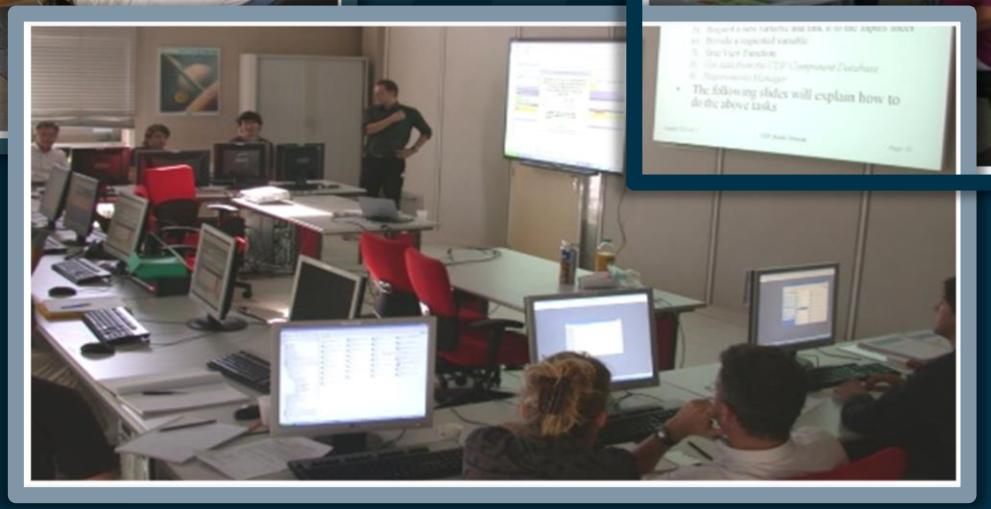
ASI - CEF

First implementation: 13 July 2008

New facility inaugurated: 25 Nov. 2013

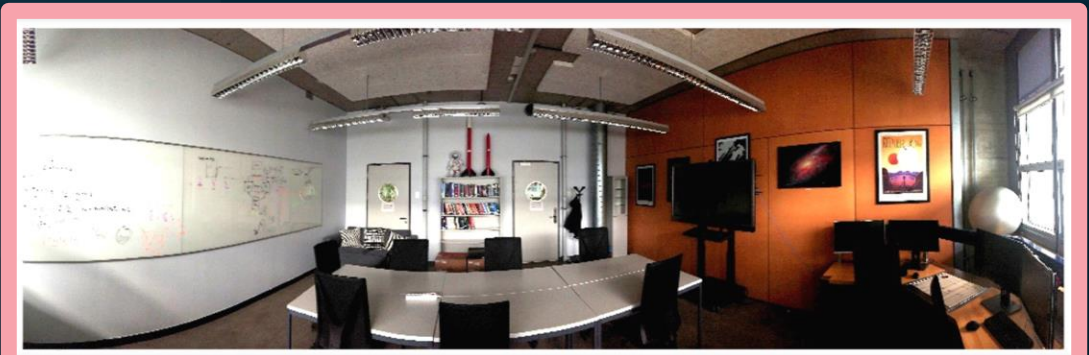
Industry

TAS-I & F (Torino, Roma, Cannes) | CDF



Academia (in Europe)

ISU
Strasbourg
France



EPFL
Lausanne
Switzerland

Strathclyde University
Glasgow
United Kingdom

Academia (outside Europe)

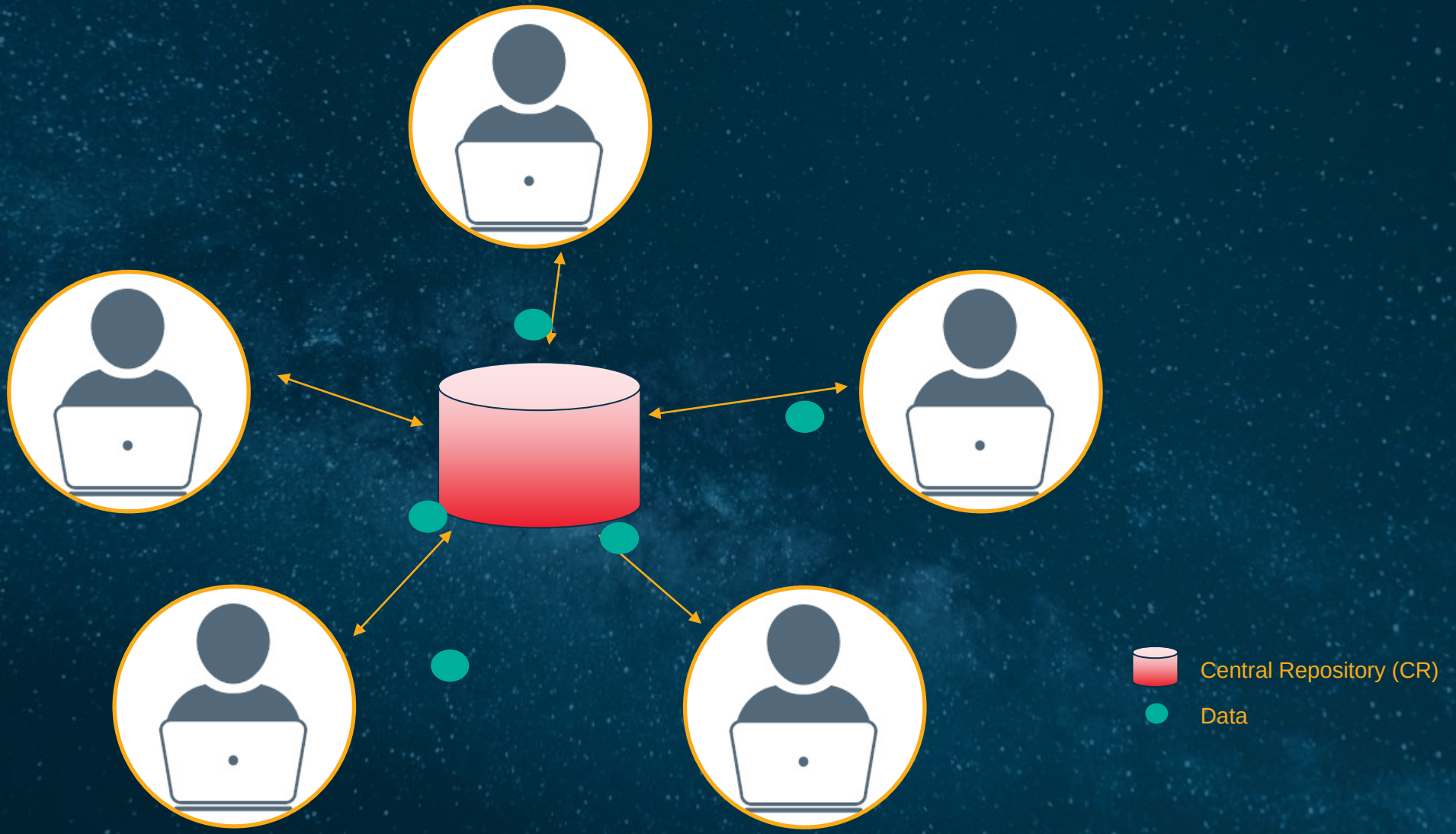
Melbourne
Australia

Victorian Space Science
Education Centre
(VSSEC)

Zoom-in

Methodology, Tools, Infrastructure

Team Dynamics, around a Central Data Repository



Concurrent Design Tools: the past

Integrated Design Model IDM in MS Excel® - ESA CDF first design tool

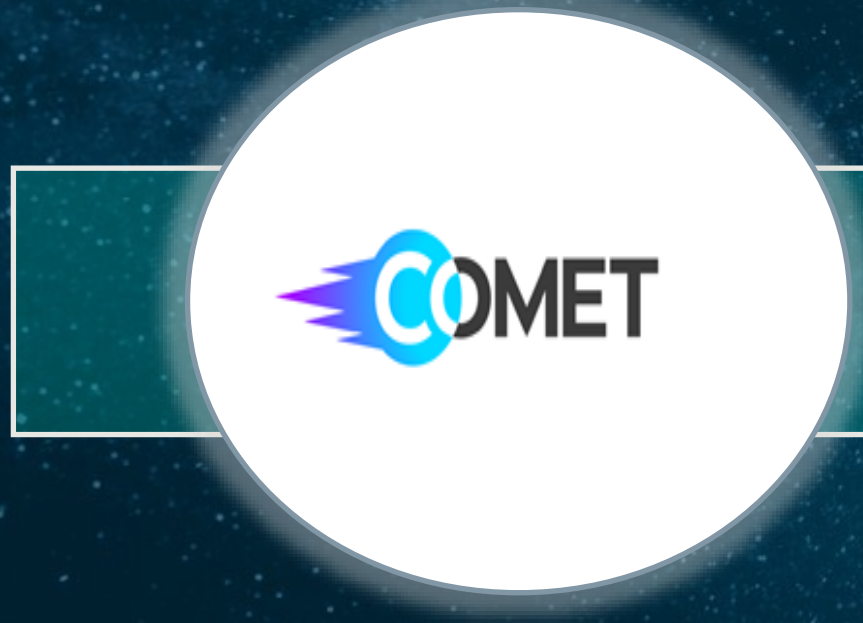
- End-user tool and data exchange via file server
- Very successful to develop and support the concurrent design process as easy to use
- Provided to and deployed in many European concurrent design centers
- However, reached limits of what could reasonably be done in Excel® (in particular w.r.t. software maintenance and integration with other tools)

OCDT - modern extendible tool for ESA CDF and the CD community

- Based on ECSS-E-TM-10-25 data model developed in 2006-2010
- Including the good features of IDM and lessons learned
- Maintainable client-server architecture with robust data base server
- Based on open source components to allow wide use
- Including methods and toolkits for integration of Domain Specific Tools
- Extendible to multi-site distributed design teams
- Supported with a Community Portal for developers and end users

Concurrent Model-based Engineering Tool: the present

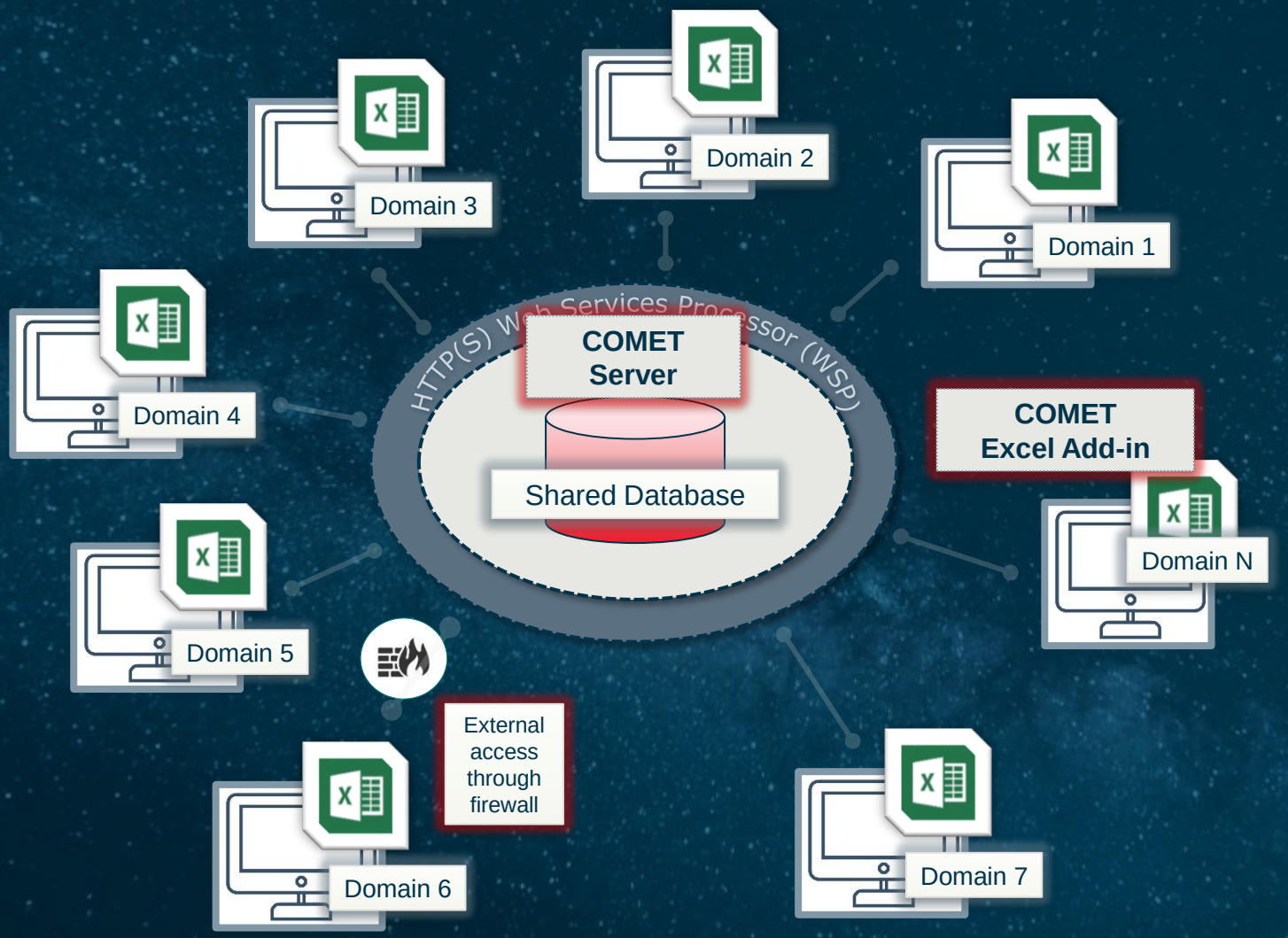
COMET (Concurrent Model-based Engineering Tool) replaces OCDT in January 2022



- **Open-source (not limited to ESA member states)**
- Supported and maintained by RHEA
- No license fees for community editions
- **Modern interface, better user experience**
- Additional Excel add-in (reuse of OCDT workbooks)
- **Advanced reporting features (mass, power budgets)**
- Server deployed on ESA cloud (ESTEC local node), Operational since August 2021 (180 models)
- Client deployed on VCDF, ESA365 deployment (via self-help service catalogue) under investigation
- **Will be used in all CDF studies as from 2022**
- 2022 outlook: Evolution on **integration of domain specific tools (*Digital Engineering Hub Pathfinder*)**

ESA Concurrent Design Tool

Implementing ECSS-E-TM-10-25 and available to all members of the Community



CE Methodology: Interdisciplinary Communication

Approach:

- Multidisciplinary
- Holistic
- Systematic
- Centralized
- Focus on Customer expectations
- …

Methodology:

- Iterative presentations
- Debate
- Consensus
- System awareness
- …

CE Methodology: Interdisciplinary, Simultaneous Collaboration

Effective rendering and visualisation obtained by means of:

- Models linked to graphical representations
- 3-dimensional (3D) computer-aided design (CAD)
- Simulation
- Digital mock-up
- Rapid prototyping (RP)
- Work in progress: Augmented Reality

Additional Information:

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