

# exaFOAM Workshop

*exa*FOAM

**Exploitation of Exascale Systems for Open-Source  
Computational Fluid Dynamics by Mainstream Industry**

**Funding Body:** EuroHPC-03-2019

**Call:** H2020-JTI-EuroHPC-2019-1

**Project Number:** 9564167

**Project Duration:** 1<sup>st</sup> April 2021 to 31<sup>st</sup> March 2024

**Thanks for hosting:**  
HLRS – Stuttgart

22 March 2024

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Welcome to

# exaFOAM

A EuroHPC-JV Project sponsored by  
European National Funding Agencies



**EuroHPC**  
Joint Undertaking



# Project aims

Overview: Exploit exascale systems in industry using opensource CFD

	Aims
1.	Demonstrate <b>one or more orders-of-magnitude</b> performance improvement on industry-based <b>grand challenges</b>
2.	Release technology advances realised during this project via OpenFOAMvYYXX respecting the terms of GPLv3
3.	Exploit performance gains among European Industry partners vested in exaFOAM as supporters/stakeholders in coordination with the <u>OpenFOAM Governance Structure</u>

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- H2020-FETHPC proposed by the OpenFOAM HPC Technical Committee in 2017
- Successful in this call H2020-JTI-EuroHPC-2019-1
- Benchmark from 2016-2017 OpenFOAM performance demonstrated
  - on 100,000 cores
  - Achievement of 0.1 x petaFLOPS based on 3GHz proc, ~0.3 CFD operations per clock-cycle
- Targeting accelerations based on this datum

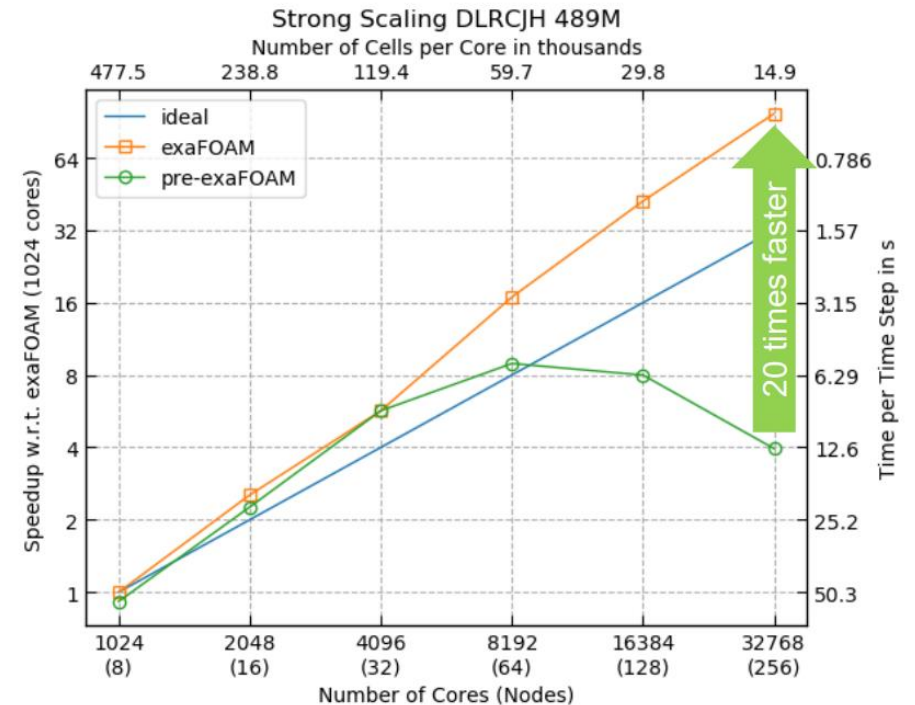


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- Benchmark from 2016-2017 OpenFOAM performance demonstrated
  - on 100,000 cores (current status – **500,000 cores**)
  - Achievement of 0.1 x petaFLOPS based on 3GHz proc, ~0.3 CFD operations per clock-cycle (current status – **0.5pFLOPs**)
  - (Current status) **1-to-2 orders improved scaling** at high-core count for IC/GrandChallenge

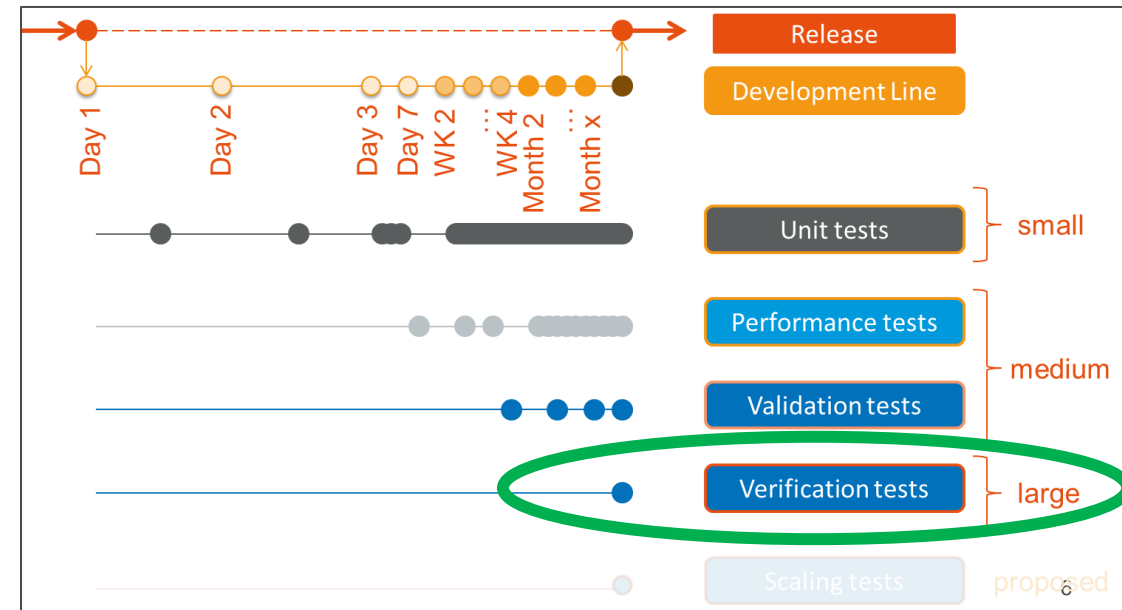


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- An **Opensource** model built with commercial code standards for Quality Assurance
  - ISO-9001 accreditation for
    - Development
    - Support and Maintenance
  - Six-monthly releases with continuous verification, validation and regression testing;
    - Large test-battery and Scaling tests based on customer production design
    - exaFOAM **WP2 MBs /IC** directly supplement these



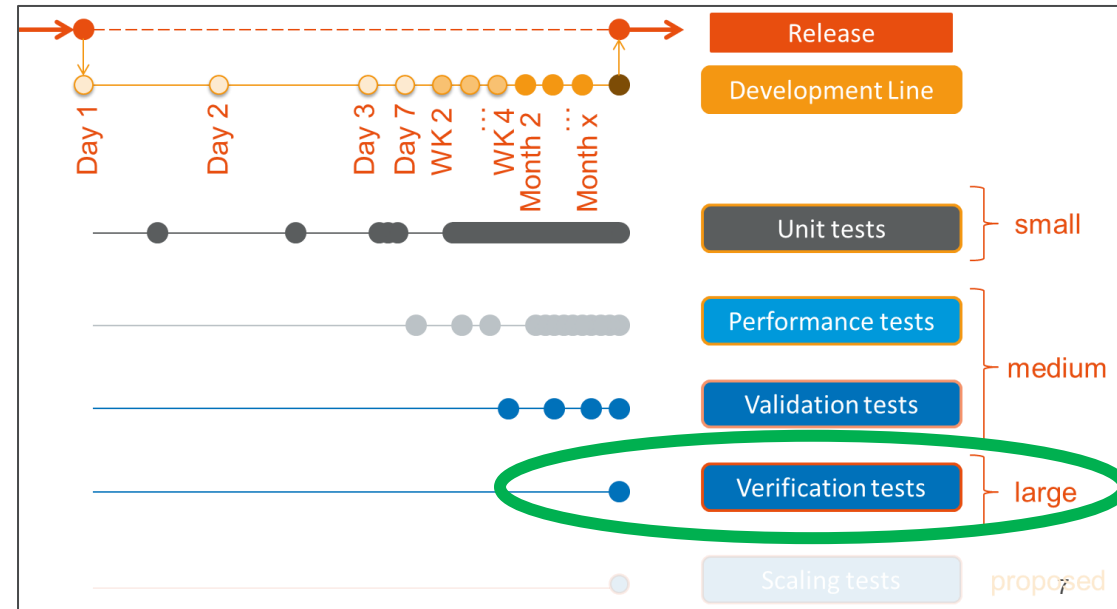
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• Outcomes of exaFOAM to be released in the latter part of the project and immediately after, targeting

- **Efficient data structures\***
- **Algorithmic process improvements\***
- **Linear solver acceleration**
- **I/O optimisation**
- **Utility of External solvers\***
- **Message passing / Load balancing optimisation**



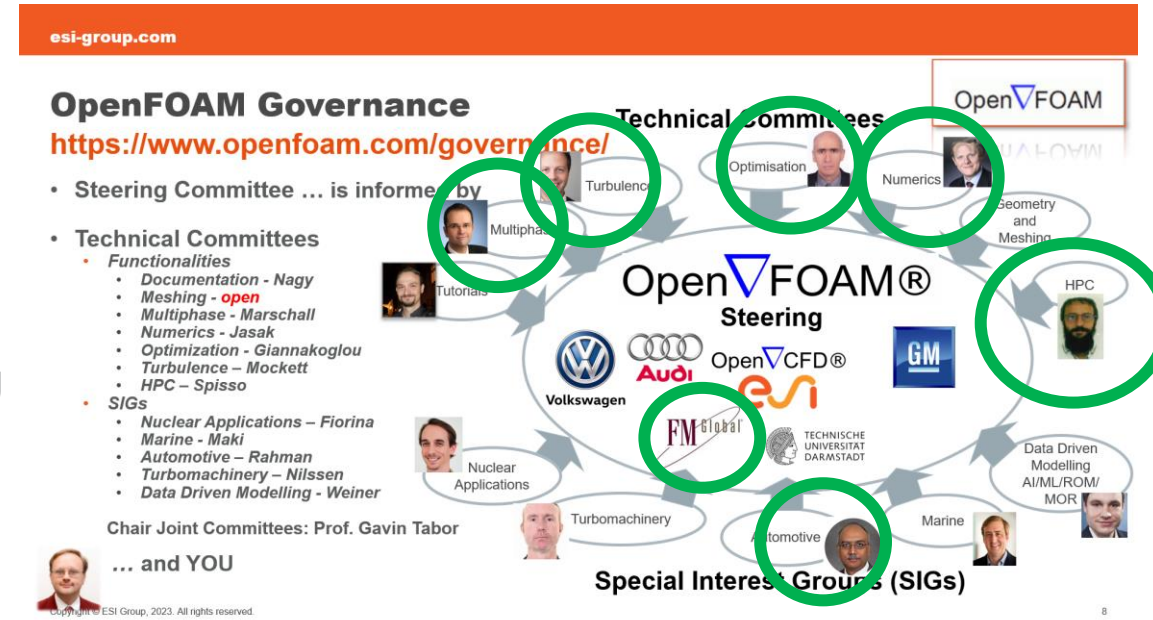


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- Impact of OpenFOAM Governance
  - exaFOAM participants were originally filtered via the HPC-Technical Committee
    - Representatives from Numerics, Optimisation, Turbulence, Multiphase are all represented among the Beneficiaries
    - Representatives from HPC and Automotive-SIG among the Stakeholders
  - HPC-TC repositories during and after exaFOAM will be publicly hosted via the HPC-TC





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- Highly qualified and growing list of supporters.
  - OpenFOAM is named as **top-10 target application** by **AMD**, **Nvidia**, Huawei, RIST
    - Directly engaging in the design and testing of new architectures
  - New stakeholders?
    - AMD**
    - Nvidia-partners**

**Supporter:** letter of support during the proposal phase

**Stakeholder:** with resources commitment and test case challenges provided

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### OpenFOAM Governance

<https://www.openfoam.com/governance/>

- Steering Committee ... is informed by
- Technical Committees
  - Functionalities
    - Documentation - Nagy
    - Meshing - open
    - Multiphase - Marschall
    - Numerics - Jasak
    - Optimization - Giannakoglou
    - Turbulence - Mockett
    - HPC - Spisso
  - SIGs
    - Nuclear Applications - Fiorina
    - Marine - Maki
    - Automotive - Rahman
    - Turbomachinery - Nilssen
    - Data Driven Modelling - Weiner

Chair Joint Committees: Prof. Gavin Tabor and YOU

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