



We are the “Performance” in HPC

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HORIZON-EUROHPC-JU-2023-COE



EuroHPC
Joint Undertaking

1 January 2024– 31 December 2026

Grant Agreement No 101143931



- A **Centre of Excellence**
 - On **Performance Optimisation and Productivity**
 - Promoting **best practices in parallel programming**
- Providing **FREE Services**
 - Precise understanding of application and system behaviour
 - Suggestion/support on how to refactor code in the most productive way
- **Horizontal**
 - Transversal across application areas, platforms, scales
- **For (EuroHPC) academic AND industrial codes and users !**

Partners



• Who?

- BSC, ES (coordinator)
- HLRS, DE
- INESC-ID, PT
- IT4I, CZ
- JSC, DE
- RWTH Aachen, IT Center, DE
- TERATEC, FR
- UVSQ, FR



A team with

- Excellence in performance tools and tuning
- Excellence in programming models and practices
- Research and development background AND proven commitment in application to real academic and industrial use cases



Why?

- Complexity of machines and codes
 - ⇒ Frequent lack of quantified understanding of actual behaviour
 - ⇒ Not clear most productive direction of code refactoring
- Important to maximize efficiency (performance, power) of compute intensive applications and productivity of the development efforts

What?

- Parallel programs, mainly MPI/OpenMP
 - Although also CUDA, OpenCL, OpenACC, Python, ...

The Service Process ...



When?

Januar 2024 – December 2026

How?

- Apply
 - Fill in small questionnaire describing application and needs
<https://pop-coe.eu/request-service-form>
 - Questions? Ask pop@bsc.es
- Selection/assignment process
- Install tools @ your production machine (local, PRACE, ...)
- Interactively: Gather data → Analysis → Report

The screenshot shows the 'Request Service Form' on the Performance Optimisation and Productivity (POP) website. The form is divided into several sections:

- Contact Details:** Fields for Applicant's Name, Institution, and e-mail.
- Code:** Fields for Name of the code, Scientific/technical area and class of problems it solves (dropdown), and Contribution (radio buttons for Core developer, Module developer, User).
- Access to sources:** Radio buttons for Yes and No.
- Programming languages:** Checkboxes for C, C++, Java, Fortran, Python, and Others.
- Parallel programming models:** Checkboxes for MPI, OpenMP, OpenMPs, Pthreads, CUDA, OpenCL, and Others.
- Performance Service:** A dropdown menu for Service request and a text area to describe the performance problem.

On the left side of the page, there is a navigation menu with options like News, Blog, Newsletter, Partners, Tools, Services, Request Service Form (highlighted), Target Customers, Success Stories, Customer Code List, Further information, Learning Material, and Contact. Below the menu is a 'Subscribe to our Newsletter' section with an email input field and a 'Subscribe' button.



- **Parallel Application Performance Assessment**

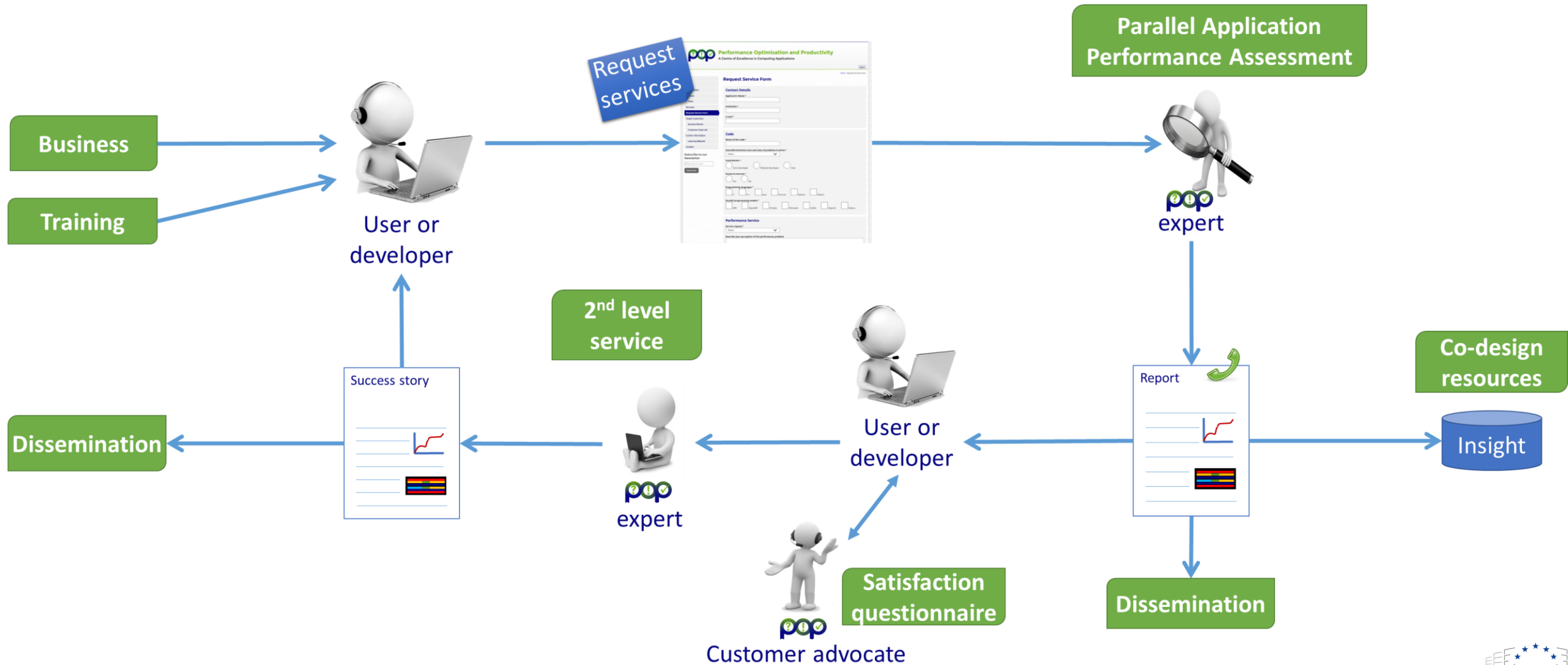
- Primary service
- Initial analysis measuring a [range of performance metrics](#) to assess quality of performance and identify the issues affecting performance (at customer site)
- If needed, undertakes further performance evaluations to identify the root causes of the issues found and qualify and quantify approaches to address them (recommendations)

- **Second Level Services**

- Second level services may follow after conclusion of an initial performance assessment:
 - **Proof-of-concept**: explore the potential benefit of proposed optimisations by applying them to selected regions of the applications
 - **Correctness-check**: evaluate the correctness of hybrid MPI + OpenMP applications
 - **Energy-efficiency study**: investigate improvements of energy consumption or efficiency
 - **Advisory study**: ongoing consultancy for customers that choose to implement proposed optimisations on their own

- **Note: Effort shared between our experts and customer!**

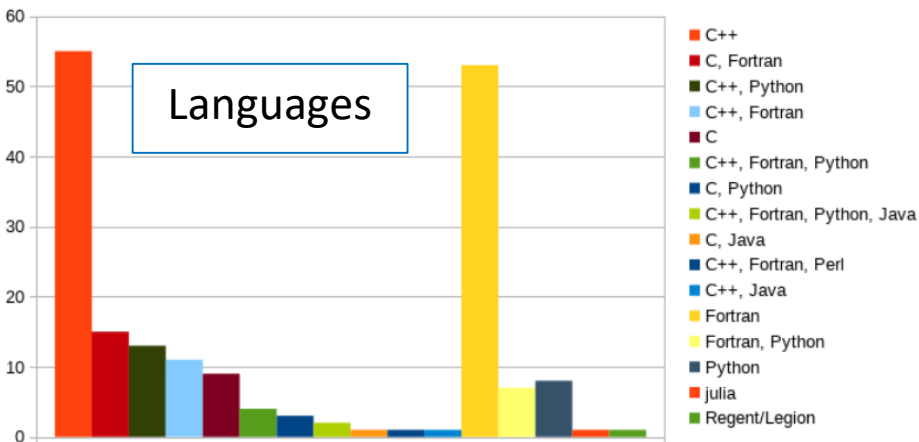
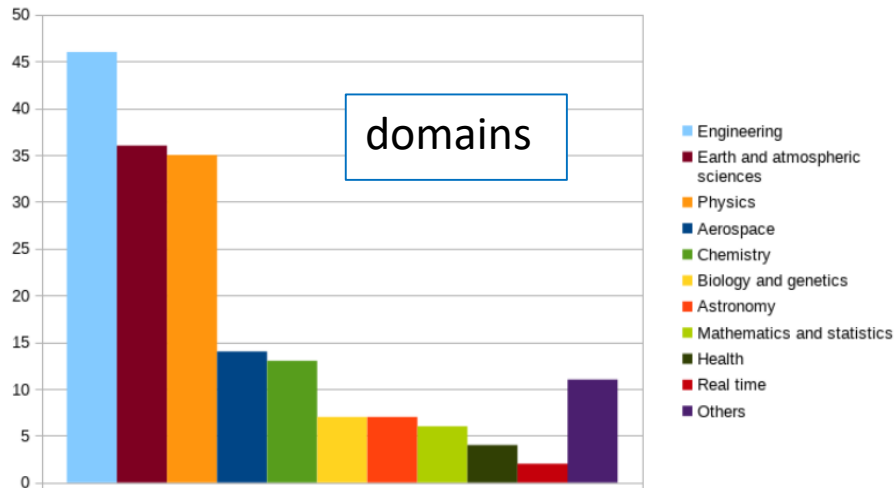
The Service Process ...



Past POP Assessments



- Large number of services

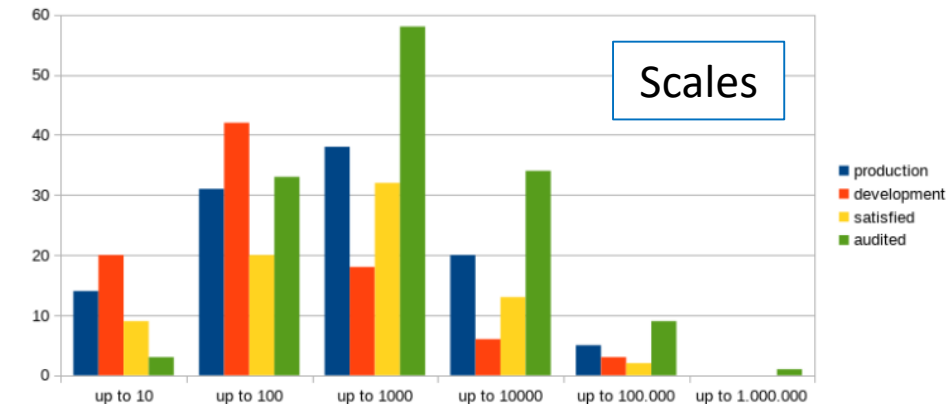
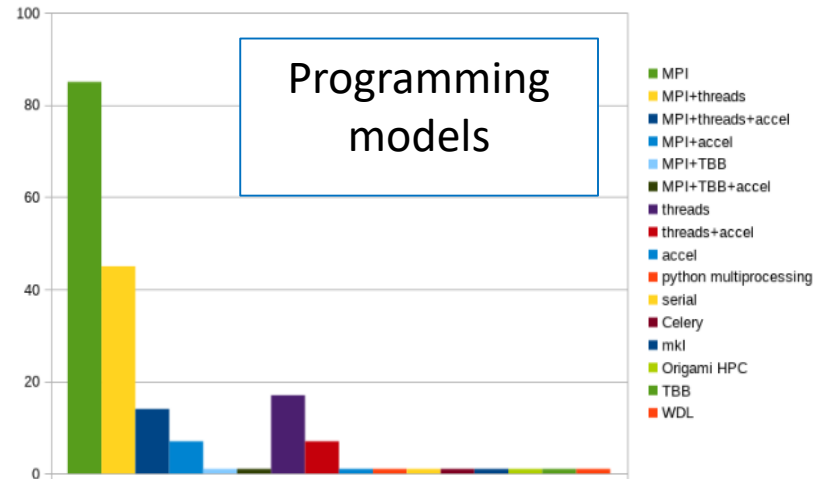


POP1 & POP2 each

- > 140 Assessments
- > 25 Proof of Concept

customer

- ~80% Research
- ~20% Industry



Some PoC Success Stories



- See [⇒ https://pop-coe.eu/blog/tags/success-stories](https://pop-coe.eu/blog/tags/success-stories)



Performance Improvements for SCM's ADF Modeling Suite



3x Speed Improvement for zCFD Computational Fluid Dynamics Solver



25% Faster time-to-solution for Urban Microclimate Simulations



2x performance improvement for SCM ADF code



Proof of Concept for BPMF leads to around **40% runtime reduction**



POP audit helps developers **double their code performance**



10-fold scalability improvement from POP services



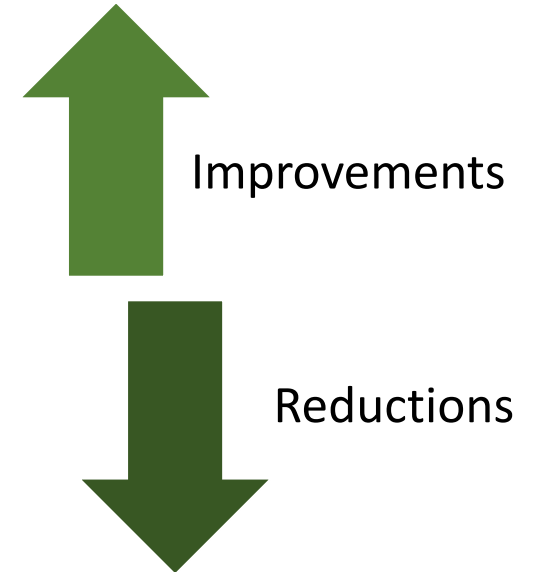
POP performance study improves performance **up to a factor 6**



POP Proof-of-Concept study leads to **nearly 50% higher performance**



POP Proof-of-Concept study leads to **10X performance improvement** for customer





Application Savings after POP Proof-of-Concept

- POP PoC resulted in 72% faster-time-to-solution
- Production runs on ARCHER (UK national academic supercomputer)
- Improved code saves €15.58 per run
- Yearly savings of around €56,000 (from monthly usage data)

Application Savings after POP Performance Plan

- Cost for customer implementing POP recommendations: €2,000
- Achieved improvement of 62%
- €20,000 yearly operating cost
- Resulted in yearly saving of €12,400 in compute costs \Rightarrow ROI of 620%

Webinars / YouTube



- See <https://pop-coe.eu/blog/tags/webinar>
- Or  [YouTube Channel](#)
- Recordings of 26 webinars already available!



Online Training Modules



POP Performance Optimisation and Productivity
A Centre of Excellence in HPC

Home / Further Information / Online Training

Online Training

This is the homepage for the POP online training course. The aim of this course is to give an overview of the POP performance analysis methodology and the POP analysis tools. These are the tools and techniques used by POP experts when doing performance analyses and proof-of-concept work.

Upon completing this course you will have an understanding of:

- The challenges involved in HPC performance analysis
- How the POP Metrics aid understanding of application performance
- How to calculate the POP Metrics for your own HPC applications
- What POP tools are available and how they can be installed
- How to capture and analyse performance data with the POP tools

POP Online Training Modules

- [An Introduction to the POP Centre of Excellence](#)
- [Understanding Application Performance with the POP Metrics](#)

Advanced POP Online Training Modules

- [Installing POP Tools: Exrae, Paraver](#)
- [Using POP Tools: Exrae](#)
- [Using POP Tools: Paraver](#) (Introduction, Timelines, Tables, Semantic Functions)

Event Recordings

- 20th VI-HPS Tuning Workshop, 2016 (RIKEN AICS, Kobe, Japan)
 - [Agenda and Slides](#)
 - [Video recordings](#)
- 34th POP/VI-HPS Tuning Workshop, 2020 (EPCC, Scotland)
 - [Agenda and Slides](#)
 - [Video recordings](#)
- POP Performance Analysis Methodology Workshop, 2021 (Durham University, UK)
 - [Video recording and Slides](#)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 676553 and 824080.

POP Performance Optimisation and Productivity
A Centre of Excellence in HPC

Home / Using POP Tools: Cube

Using POP Tools: Cube

What you will learn

- How to analyze Score-P profiles or Scalasca trace profiles of HPC applications with the POP tool Cube

Prerequisites

- Access to HPC cluster or Linux workstation/laptop
- [POP tools Score-P and Scalasca installed](#)
- [Measurement\(s\) of parallel application\(s\) performed with Score-P and Scalasca](#)

Training module

Module 7: Using POP Tools: Cube
Bernd Mohr

Material

- [Presentation slides](#)
- [TeaLeaf trace file](#) used in demo
- [TeaLeaf source code](#)

Cube

- Support: scalasca@fz-juelich.de

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- 8 basic topics modules
- 4 advanced topics modules
- 3 (+1) Tool Talks in coop with HPC.NRW
- Modules / video recordings from other events



Performance Optimisation and Productivity 3

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Contact:

 <https://www.pop-coe.eu>

 pop@bsc.es

 [@POP_HPC](#)

 [youtube.com/POPHPC](https://www.youtube.com/POPHPC)

