Exa-MA

Methods and Algorithms for Exascale

Representative: Lydie Grospellier (CEA)

Exa-MA / Methods and Algorithms for Exascale

Project : Exa-MA

Challenges:

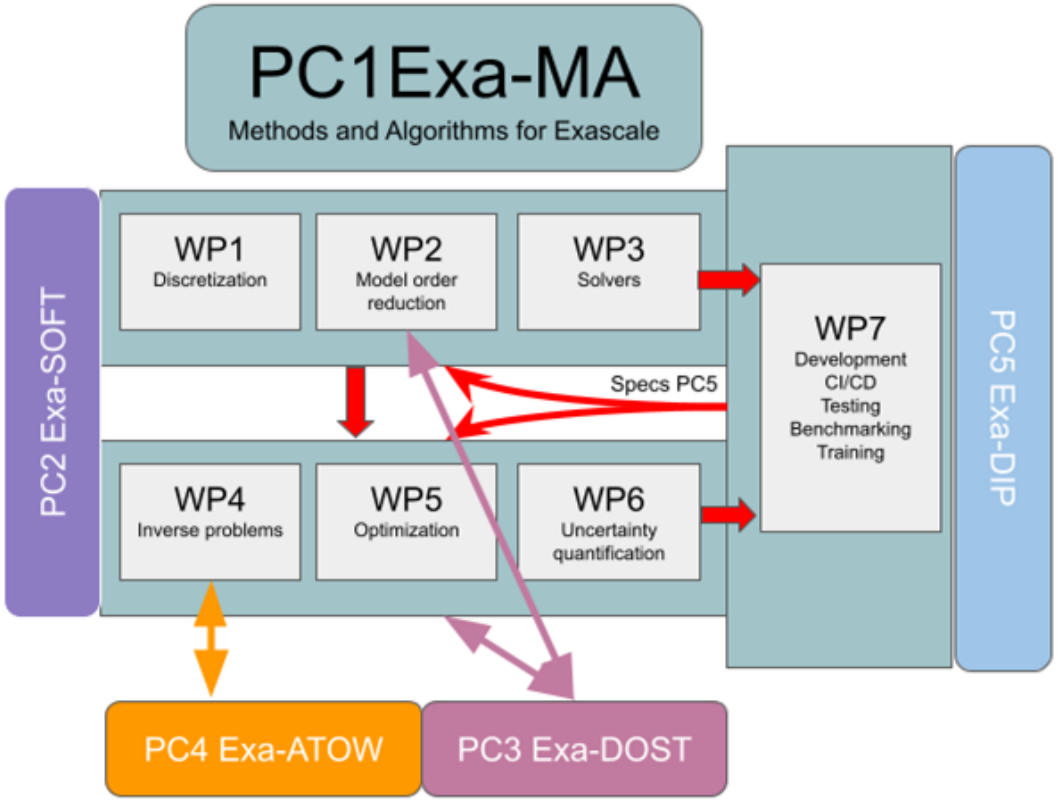
- Enable extreme scale computing for vastly more accurate predictive models
- Create digital copies of physical assets
- Apply to environmental, health, energy, industrial and fundamental knowledge challenges

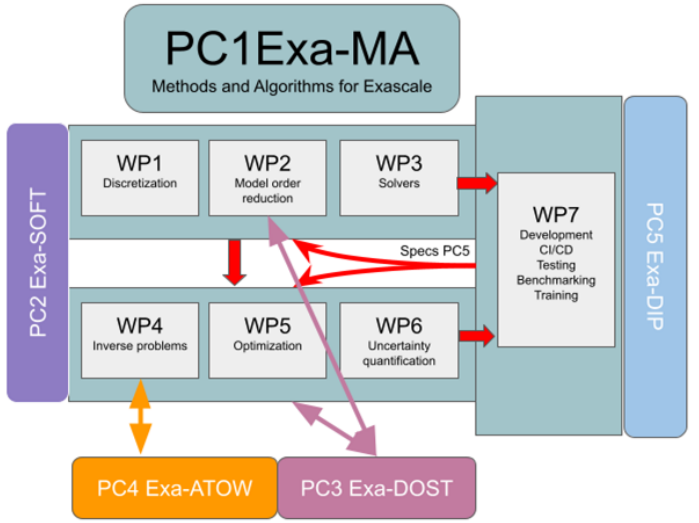
Objectives:

- ***to develop methods, algorithms, and implementations*** *that, taking advantage of the exascale architectures empower modeling, solving, assimilating model and data, optimizing and quantifying uncertainty, at levels that are unreachable at present*
- ***to develop and contribute to software libraries*** *for the exascale software stack*
- ***to identify and co-design Methodological and Algorithmic Patterns*** *at exascale*
- ***to enable AI algorithms*** *to achieve performances at exascale*
- ***to provide demonstrators*** *: mini-apps and proxy-apps openly available*
- ***to create, animate and foster a community*** *around Exascale (and HPC) computing*

Beneficiary Partners:

CEA, École Polytechnique, Inria, Sorbonne Université, Université de Strasbourg
Requested Budget: *6,255 M€* ***Total Budget:*** *24,417 M€*



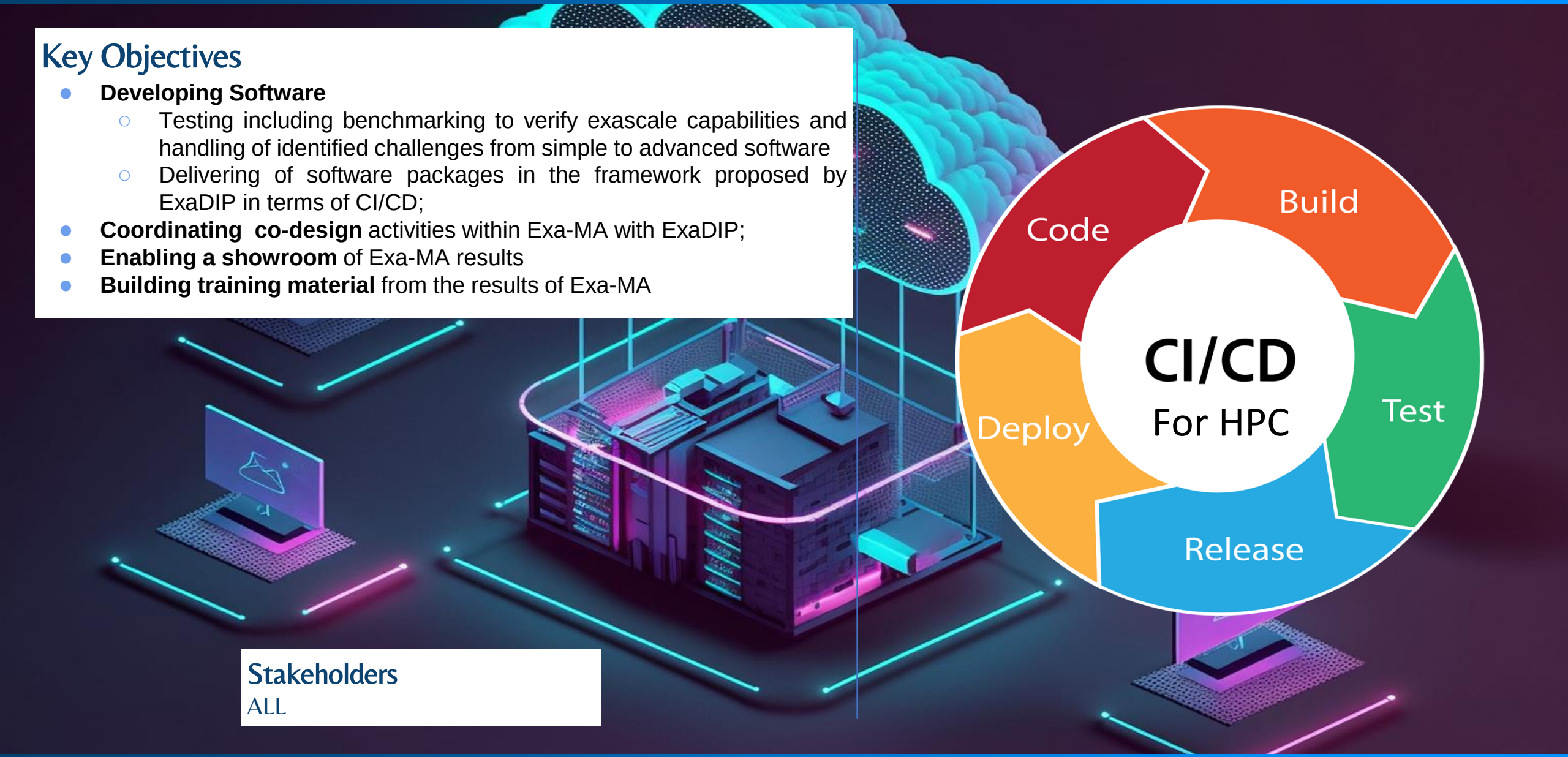


Development, Testing Benchmarking, Co-design, Showroom, Training

Lydies Grospellier (CEA), Christophe Prud'homme (UNISTRA)

Key Objectives

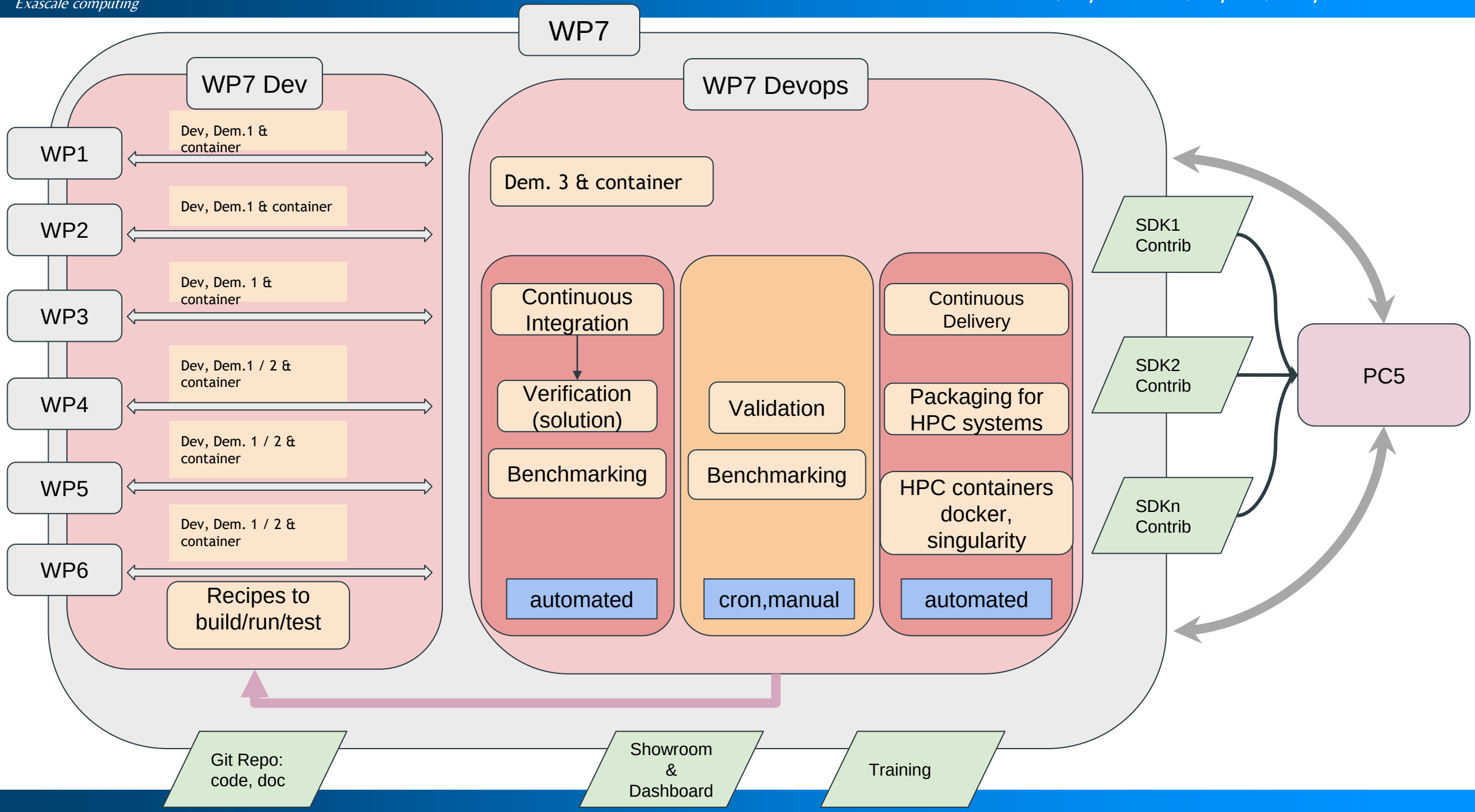
- **Developing Software**
  - Testing including benchmarking to verify exascale capabilities and handling of identified challenges from simple to advanced software
  - Delivering of software packages in the framework proposed by ExaDIP in terms of CI/CD;
- **Coordinating co-design** activities within Exa-MA with ExaDIP;
- **Enabling a showroom** of Exa-MA results
- **Building training material** from the results of Exa-MA



Stakeholders

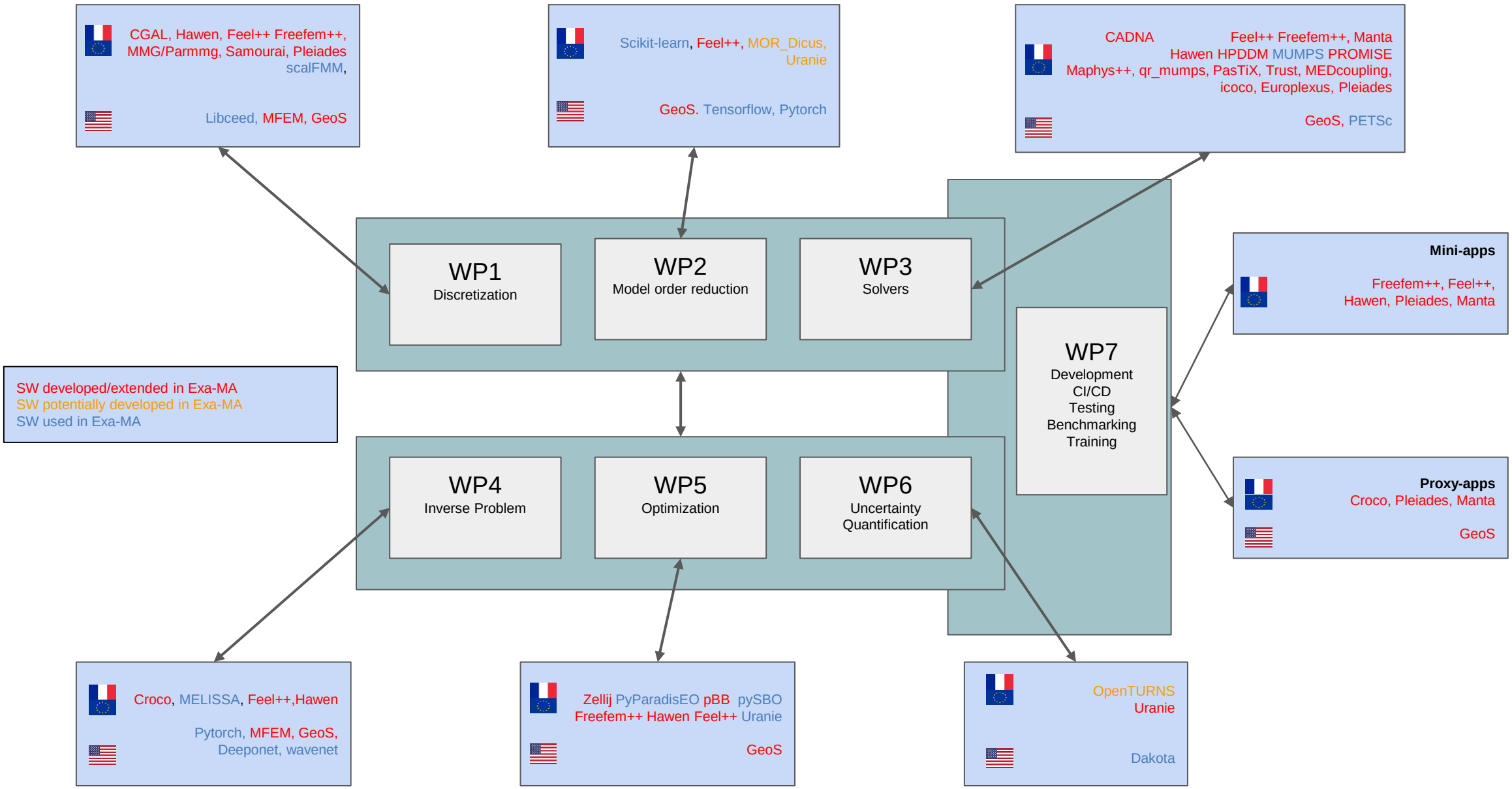
ALL

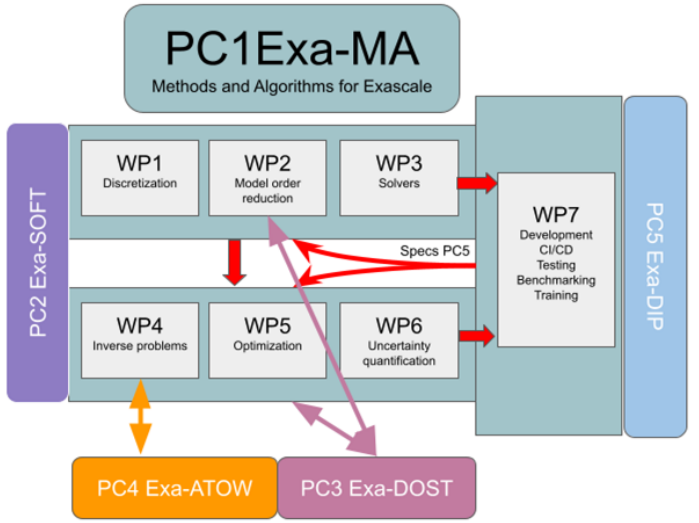
WP7 - Workflow, Operations, Inputs, outputs



SDK=Software Development Kit

WP7 - Software





Exa-MA DOE Software Stack Analysis

The point of view of Exa-MA (19 votes)

No vote is allowed if software is unknown or not used.

June 13 version

Solver Libraries (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High		Hypre, Scipy, MFEM Solvers, Sundials, Zoltan/Zoltan2, ARPACK		
	Medium		PETSc, SuperLU, Eigen	KokkosKernels, PARDISO, Trilinos, SuperLU-Dist, STRUMPACK, SPARSKIT, SparsePACK	
	Low	BLAS, LAPACK		PyMatLib	Krino

Math, Meshing, Discretization (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High		MFEM		
	Medium		METIS, ParMETIS	Sculpt, libigl	Overlink
	Low			SAMRAI, Portage, Tangram	STK, UMR, Axom

Compilers, Runtimes, Languages (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High		C	PyKokkos, KokkosRemoteMemorySpaces	Legion
	Medium	C++, GCC	MPICH, OpenMPI, Fortran, HIP, CUDA, Python, OpenMP, LLVM, PyTorch, TensorFlow, Boost	Kokkos, MPI, Intel Compiler Suite, Intel MPI	
	Low		RAJA Suite, Flang	FleCSI	Perl

System Imaging, Monitoring (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High				
	Medium		SLURM	CharlieCloud, VmWare, LSF	LDMS, Flux, SICM, AppSysFusion, GMI, Maestro/Merlin, Splunk
	Low				

Visualisation And Analysis (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High				
	Medium		VTK/VTKm, Paraview	Visit, Catalyst, Conduit	Cinema, Ascent
	Low				

Build, Development, Software (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High		Spack		
	Medium	CMake	Ninja, gdb, git, Gitlab, git-lfs, Valgrind, AllineaForge, TotalView	Caliper, PAPI, KokkosTools	Archer, CDash, STAT
	Low		Autoconf/Automake	BLT	

IO Storage, Data Management (19 responses) Exa-MA		Impact of not having software product/tool/library available			
		Very High	High	Medium	Low
Likelihood of Risk	Very High				
	High	HDF5/Parallel-HDF5			
	Medium		NetCDF, pNetCDF, SEACAS	UnifyFS, HPSS, MarFS, SILO, Exodus, yamlcpp, CGNS, libz, ADIOS, szip/AEC	ZFP, GUFI, HIO, SCR, Sina/Kosh, DB2, Matio
	Low				