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Enabling Exascale Fluid Dynamics Simulations
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D4.9 – Collaboration Report

WP4: Dissemination and Exploitation

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Executive Summary

This deliverable contains the strategic plan for the ExaFLOW collaboration and standardisation activities. It is intended to complement the exploitation and dissemination plans described in project deliverables D4.6 and D4.1, describe the collaboration objectives and priorities of the project, the collaboration strategy and the planned collaboration and standardisation activities. The document also contains a preliminary calendar of collaboration events listing the events scheduled within the first project year. Finally, this deliverable outlines the necessary process for undertaking standardisation activities and lists the initial thoughts of the consortium on standards and standardisation bodies to be considered.

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1 Introduction

The primary aim of this document is to describe the mechanisms through which the project will determine appropriate collaboration options and the mechanisms for reporting the planning and execution of these engagements.
This document will undergo continuous update and so will be considered a living document until the end of the project. The aim of this is to ensure that changes in the ambitions of ExaFLOW and the engagement opportunities found may be documented in a coherent manner throughout the project. The timed deliverables will represent a snapshot of the document.
The engagement described consists of a number of routes, such as through collaboration with EC and other EU projects, and designed to foster co-operative working and results sharing. In addition to the formal groups we recognise that there will be a number of opportunities for bi-lateral interactions between ExaFLOW and other activities. This document will set out the process for undertaking these engagements from the gaining of initial approval of the wider project team through to effective reporting of meetings and visits.
Alongside the mandated H2020 collaboration we acknowledge and pursue collaboration with other projects, funded by other-than-the-EC funding schemes, i.e. local and national governments and international sources. Again this document will lay out the processes for these engagements to ensure that there is no inappropriate activity and that the benefits of the ExaFLOW project remain within the European Economic Area (EEA).
ExaFLOW plans to contribute to standardisation processes where applicable. Through partnerships with other projects, ExaFLOW will connect with relevant stakeholders such as technology platforms, standardisation bodies and governance stakeholders. These partnerships and strategic actions will position ExaFLOW at an important juncture between research, infrastructure building and impact generation.

2 Planning collaboration activities

2.1 Objectives of wider collaboration

The collaboration activities aim to define a set of ambitions that cut across multiple projects/initiatives and then to foster mutual co-operation and sharing of ideas in a multi-lateral manner. ExaFLOW also acknowledges that there are a number of additional opportunities for bi-lateral collaborations, deeper in nature as we believe that authoring appropriate mutual non-disclosure agreements on a bi-lateral basis will prove easier than for a large collaboration group. It is also likely that bi-lateral engagements directly between appropriate partners of ExaFLOW and third parties may occur, as opposed to a full project engagement.
ExaFLOW believes that engagement with communities/alliances created by finalised FP7 funded projects will also allow us to leverage know-how that has been developed through previous funding schemes. These engagements will be undertaken with a strict ambition of reducing the potential for the same work to be undertaken in multiple locations in isolation. Through collaboration with such activities we will be able to provide a more complete solution to the challenge of CFD for exascale computing.

The geographic distribution of collaboration actions will be centred on the EEA, however the ExaFLOW project does not wish to restrict itself to this geography. A thorough scanning of the project's environment to identify further collaboration possibilities will take place. There are many projects operating in other parts of the world that we will aim to maintain an awareness of, whilst ensuring that there is no leakage of technology benefits from ExaFLOW to organisations outside the EEA. We acknowledge that this is a challenging ambition but there have already been projects elsewhere in the world that are complementary to our project and we may benefit from using their technical developments. Thus, in terms of dissemination and awareness creation, the consortium will also use respective opportunities to establish the message of ExaFLOW and, if successful, enter collaboration possibilities.

2.2 Process for identifying collaboration opportunities

All partners are encouraged to maintain awareness of the world-wide context of their work. This enables partners to identify other research efforts that have relevance to them. In addition, partners are encouraged to regularly assess the EC funded project landscape for new and existing projects where there may be mutual benefit from collaboration.

If a partner identifies an opportunity for collaboration they should:

1. Write a description of the opportunity including the type of opportunity and the proposed level of engagement. This will be uploaded into the relevant project workspace BSCW.
2. Inform the EB about the collaboration opportunity via the dedicated mailing list and discuss during the next EB call. If the opportunity is associated with a tight deadline there will be the option of requesting that a special call is convened to discuss the opportunity.

In its discussions the consortium will consider:

1. Technology advancements that accrue to ExaFLOW
2. Level of engagement requested
3. Potential for cost reductions for dissemination or training
4. Potential for creation of an exploitation route
5. Cost of engagement in terms of both financial commitment and technology fed into the opportunity.

The partner interested in this opportunity should try to provide initial answers to the above questions.

The recommendation of EB will be one of the following (and also include clear explanations for these recommendations):

1. Stop engagement with the potential collaborator(s), in case collaboration harms partner or consortium interests or violates EU regulations;
2. Collect specified further information and return to the consortium; in case purpose or timeline of collaboration is unclear;
3. Progress with collaboration as requested, in case consortium and/or partners benefit from collaboration;
4. Progress with collaboration with an alternative level of engagement (note that this may be lesser or greater than the originally suggested level of

engagement), in case current level of engagement does not serve consortium or partner interests at maximum possibility.

If the partner identifying the opportunity is in disagreement with the decision of the consortium they shall have the right and opportunity to raise an issue with the steering board. The steering board will consider the opportunity using the same criteria and their decision will be binding (subject to conflict resolution guidelines as stipulated in the consortium agreement).

2.3 Collaboration opportunities with EC funded projects/initiatives

In this section we provide currently identified EU funded research projects, which the ExaFLOW project can potentially cooperate with, as well as exploit specific components or approaches.
We provide two tables, describing the finished (Table 2) and still running (Table 3) projects, respectively. Each table provides the basic data about the project, and the relevant outputs that could be amalgamated with ExaFLOW's objectives and outputs.
The list in Table 2 is based on the FP7 projects. The consortium intends to contact the groups/alliances/communities formed after the finalisation of each project (if any) in order to contribute to the reuse and sustainability of results.

Table 2 – Finalised FP7 projects with results potentially exploitable by ExaFLOW

Project	*Research area*	Relevant outputs/What is to be re-used	Partner
CRESTA	Co-design	Initial work on AMR, exploitation of GPUs	KTH, HLRS, EPCC
EPiGRAM	Programming Models	Efficient usage of MPI, hybrid models, experiences with PGAS approaches	KTH, EPCC
IDIHOM	Industrial application of high order methods	Parallelisation for explicit DG methods and mesh generation	ICL

Table 3 shows the still running EU projects that are to be contacted and where ExaFLOW technology and ideas and information can be shared in order to increase the impact of the ExaFLOW project. The list is based on H2020 projects and will be updated further when new projects are funded. For those projects, which have no common partner with ExaFLOW a responsible person will be defined once the contact shall be established.

Table 3 - H2020 projects that could increase the impact of ExaFLOW

Project	*Research area*	Relevant outputs/What is to be re-used	Partner
Intertwine	Programming Models	Efficient use of hybrid programming models	KTH, EPCC
NextGenIO	Memory & Storage	New memory and storage concepts - relevant for ExaFLOW's I/O and fault	EPCC

		tolerance work	
SAGE	Memory & Storage	New memory and storage concepts - relevant for ExaFLOW's I/O and fault tolerance work	KTH
ESCAPE	Accelerators	Application of Accelerator technology to explicit DG methods	ICL

2.4 Collaboration with EU technology platforms

Several members of the consortium are already involved in the European Technology Platform for High Performance Computing (ETP4HPC) technology platform, helping shape its Research Agenda. These partners will constitute the channel to advocate for ExaFLOW's interests. The objective of the strategic research agenda (SRA) of ETP4HPC is to outline a roadmap for the implementation of a research programme aiming at the development of European HPC technologies. The approach followed to structure the SRA has been to combine ETP4HPC members technical and market knowledge (internal) with that coming from external experts and sources alike. In its activities ETP4HPC gets inputs from other important HPC networks such as PRACE. At the same time input is obtained from HPC end-users and ISVs.

2.5 Collaboration opportunities with national level projects

As far for projects or initiatives allowing for collaboration on a national level the ICL and SOTON are part of the UK Turbulence Consortium. Neil Sandham of the University of Southampton is the Principal Investigator and will pursue this opportunity for collaboration in the months to come. KTH is the lead partner of the Swedish e-Science Research Center, SeRC and the Linné FLOW center. Through SeRC, collaborations on efficient implementations and exascale technologies will be pursued, while ExaFLOW is connected to the Linné FLOW Centre both through the research areas of "e-Science" and "Turbulence"; the latter is mainly relevant for the physical interpretation of the ExaFLOW test cases (wings, jet in crossflow).

2.6 Collaboration with the wider world

This section refers to collaboration of ExaFLOW with projects geographically outside EU. ExaFLOW will collaborate with non EEA projects where there is mutual benefit from so-doing. This engagement is likely to be a lightweight 'monitoring' and exchange of public domain information but may extend further.

The following levels of engagement have been determined:

Monitoring: Partners within ExaFLOW will be free to discuss public domain information from ExaFLOW with projects outside the EEA in return for which we expect the non-EEA project to discuss and describe its public domain information. The benefit of opening discussion comes from the additional description around the public information. Since this process is part of normal

scientific endeavour it will not be subject to approval by the ExaFLOW technical committee.

Partner level bi-lateral: Partners within ExaFLOW will be free to discuss IP that they have both developed within ExaFLOW and have full ownership of with non-EEA collaborators. In return for this ExaFLOW partners expect to be given similar levels of access to information. It is important to note that the IP of other partners within ExaFLOW is not available for discussion although the 3rd party collaborator will need to be aware of the potential for high level discussion of their IP with the wider ExaFLOW consortium. This type of engagement will be discussed in the technical committee calls prior to its commencement. Partners wishing to engage in this type of interaction will be encouraged to consult the ExaFLOW consortium agreement to ensure that all terms are adhered to.

Full engagement: There may be occasions when the ExaFLOW project can benefit from a full, formal, engagement with a project not located within the EEA. These benefits may include the fostering of inter-operability of solutions and the opportunity for exploitation of ExaFLOW technologies.

The above set of guidelines will enable partners to make appropriate judgements as and when appropriate opportunities for collaboration arise. At the current time the following organisations have been identified outside the EEA with which ExaFLOW can collaborate.

- NCSA, UUIC: collaboration on Nek5000
- University of Utah: Mike Kirby Collaborators on Nektar++
- Honda, Cray and NEC: collaboration as members from the ASCS network

3 Reporting on collaboration activities

3.1 Reporting process

As already identified in D4.6 “Dissemination and Communication – Initial Plan” and D4.1 “Exploitation Plan”, the project should extract value from the external research and business communities, and vice versa the potential value of ExaFLOW technology should bring exploitation opportunities to other research groups and industries. For this process to be successful, clear outcomes and scope must be demonstrated prior to the participation in each collaboration activity.

3.1.1 Prior to a collaboration event

About 20 days prior to the meeting, the involved partner should inform the consortium about the event, its purpose and what is expected to be presented as contribution. Possible benefits also derived from this meeting could be helpful. The agreement of the Consortium on the content presented should be pursued. This should always be implemented when sharing technical know-how in the development of which more than one partners where involved.
With respect to each collaboration event, a ExaFLOW strategy shall be identified in order to ensure that ExaFLOW always speaks with one voice.

3.1.2 After a collaboration event

After the event, details on the activity should be added to the "Collaboration Activities Log" and a brief description shall be sent out to the consortium in order to be included in according deliverables and reports and in the project website. This description will contain details on the activity (time, place, involved parties). Furthermore it will contain references and details about the information published under the ExaFLOW logo (e.g. presentations). Finally, the results of this activity, problems stated, conclusions reached and possible action items that are produced during the event, shall be described.

3.2 First collaboration activities report

Below is the table of collaboration actions (Table 4), in which partners have already participated. It is compiled based on partner inputs.

Table 4 – Past collaboration events overview

Date	Location	Event description
9-12 May 2016	Prague, CZ	European HPC Summit Week organised by European Extreme Data & Computing Initiative
23 September 2015	Rome, IT	European eXtreme Data and Computing Initiative workshop in Rome for FET projects and Centres of Excellence (CoE) related to HPC
8 March 2016	Reading, UK	Presentation at the European Centre for Medium Range Weather Forecasts
23 February 2016	Leinfelden-Echterdingen, DE	Key note presentation and poster presentation at the ASCS workshop "Simulation Driven Design for Computational Fluid Dynamics"
12 May 2016	Leinfelden-Echterdingen, DE	Presentation of the ExaFLOW project at the ascs general assembly 2016

3.3 Planned collaboration activities

Below is the table of planned collaboration actions (Table 5), in which partners will participate in the future. It is compiled based on partner inputs.

Table 5 – Future collaboration events calendar

Date	Location	Event description
31 May - 4 June 2016	Kyoto, Japan	The 25th international symposium on high performance parallel and distributed computing (HPDC'16)
7-8 June 2016	London, UK	Nektar++ workshop organised by ICL
8-10 June 2016	Lausanne, Switzerland	Platform for Advanced Scientific Computing Conference (PASC'16)

19-23 June 2016	Frankfurt, Germany	ISC High Performance 2016
24-28 June	Rio, Brazil	ICOSAHOM: International Conference on Spectral and High Order Methods Methods
13-18 November	Salt Lake City, USA	SC 2016, International Conference for High Performance Computing, Networking, Storage and Analysis
Spring 2017	Leinfelden-Echterdingen, Germany	Presentation at the Ascs simpulseday from the department "Vehicle Physics
June 2017	Leinfelden-Echterdingen, Germany	Presentation of the ExaFLOW project at the ascs general assembly 2017

4 Standardisation

The objective of the standardisation activities is to assess, track and contribute to relevant standardisation possibilities and acts as a collaboration gateway to relevant standardisation bodies.

The project partners will embrace and enhance open standards where possible in order to allow for the best possible exploitation of the project results. While for the developments proposed in this project there are no standardization bodies as such, the community is impacted through large community events like ECCOMAS, ERCOFTAC, EUROMECH, ICOSAHOM, and ICCFD, which will particularly be targeted by the dissemination activities described below. This is complemented through national efforts like the UK Turbulence Consortium (UKTC). In addition, the developments of ExaFLOW will use and follow the developments of standards and community best practices for exascale computing such as MPI, OpenMP, OpenACC/CUDA, etc. At a later stage, depending on the outcomes produced by the project, the consortium will decide its strategy for standardisation.

5 Conclusions – Next steps

This deliverable D4.9 is the first of the three deliverables which will be dealing with collaboration and standardisation activities within the ExaFLOW project. Its main purpose is to plan for academic as well as commercial pre-competitive sharing of knowledge and its preservation in the form of standards where possible.

In the beginning, this deliverable highlights the collaboration activates planned to be initiated during the next year. In particular, the process for the initialisation of a collaboration and/or a standardisation activity is described thoroughly and then information about current and future on-site and online collaboration

meetings is detailed to show the progress for task 4.3. Afterwards, the potential standardisation issues of the ExaFLOW project have been described.
In order to create sustainable results and to create impact, in the next year the strategies presented in this document will be put in motion and tested. Projects within EU clusters, other relevant EU funded initiatives as well as associations and communities existing out of the EU funding schemes that build the basis for fostering of ExaFLOW results will be contacted.
Finally, as soon as the first project results coming into light, ExaFLOW plans to include more precise standardisation activities description both on project level as well as individual partner involvement.