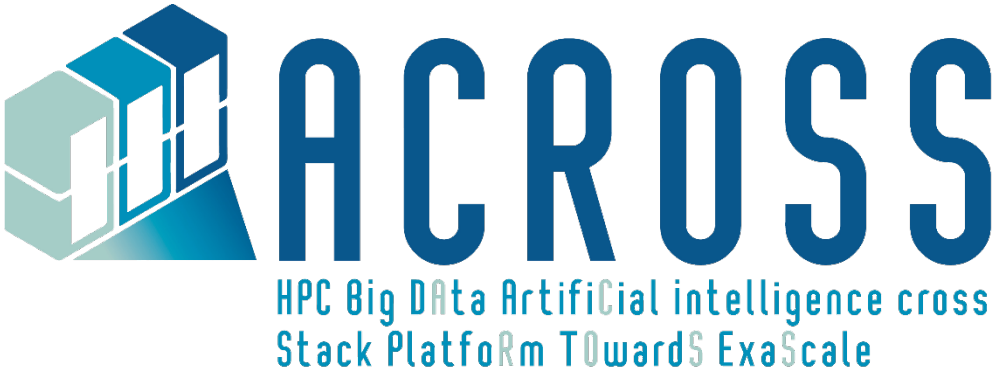

D8.5 – Report on dissemination, exploitation and communication activities

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Deliverable Title	Report on dissemination, exploitation and communication activities
Work Package	WP8
Dissemination Level	PUBLIC
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Main Contributors	S. Rogodis (NP), A. Scionti (LINKS), S. Zeng (ATOS)

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0.2	2022-07-22	ATOS	Updated ToC and first contributions
1.0	2022-08-05	All	Ready for review
1.1	2022-08-31	NP, LINKS	Reviewers comment implemented, minor corrections, final check

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Glossary

Acronym	Explanation
AI	Artificial Intelligence
ANN	Artificial Neural Network
BD	Big Data
BMC	Business Model Canvas
BIM	Business and Innovation Manager

CA	Consortium Agreement
CWL	Common Workflow Language
CCS	Carbon Capture and Storage
DAG	Directed Acyclic Graph
DNN	Deep Neural Network
DL	Deep Learning
DEC	Dissemination, Exploitation and Communication
ER	Exploitable Result
FLOP/s	Floating Point Operations per second (EFLOP/s = 10^{18} operations per second, PFLOP/s = 10^{15} operations per second
FMLE	FastML Engine
FP	Floating Point
FPGA	Field Programmable Gate Array
GA	Grant Agreement
HPC	High-Performance Computing
HPL	Portable implementation of the High-Performance LINPACK benchmark
HW	Hardware
LES	Large Eddy Simulation
LPT	Low Pressure Turbine
ML	Machine Learning
RACE	Reach, Act, Convert, Engage
KPI	Key Performance Indicator
PB	Petabyte (10^{15} bytes)
POS	Public Outreach Strategy
HPC	High Performance Computing
SME	Small Medium Enterprise
HPDA	High Performance Data Analytics
EPI	European Processor Initiative
BDVA	Big Data Value Association
GPU	Graphic Processor Unit
SW	Software
VPU	Vector Processing Unit
POS	Public Outreach Strategy

WP	Work Package

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Executive Summary

The **ACROSS** (HPC BIG D**A**TA ARTIFI**C**IAL INTELLIGENCE CROSS STACK PLATFO**R**M T**O**WARD**S** EXA**S**CALE) project will build **an Exascale-ready, HPC and data-driven execution platform**, supporting modern **complex workflows mixing High-Performance (HPC), Big Data (BD) and Artificial Intelligence (AI) high-level tasks**, by leveraging on an **innovative software environment** running upon advanced **heterogeneous infrastructural compute resources** (including GPUs, FPGAs and neuromorphic processors), as well as innovative smart resource allocation policies and job scheduling algorithms, up to the management of tasks inside jobs (e.g., pipelines, DAGs).

Position of the deliverable in the whole project context

The deliverable D8.5 is linked to WP8 — *Enabling Integrated Validation and Value Creation Adoption*. This deliverable is a first report on activities initially planned in D8.4 — *Dissemination, Exploitation and Communication (DEC) plan* that was submitted in M6. The final update of D8.5 is due in M36.
As depicted in Figure 1, WP8 is dedicated to analysing the impact of the ACROSS project on an ongoing basis to ensure the success and relevance of the final system. Each WP is contributing to the WP8 in order to maximise the impact of the project.

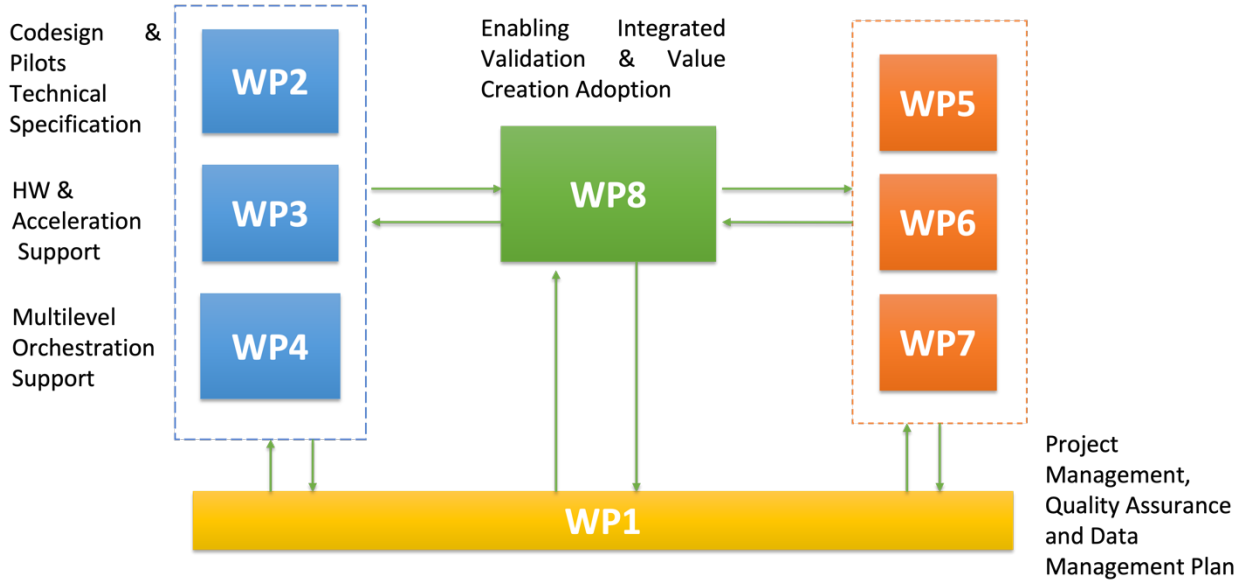

Figure 1 - Relationship between WP8 and the other WPs in ACROSS

Description of the deliverable

This document is an outcome of Task 8.3 — *Dissemination, Exploitation and Communication* from M1 to M18. It provides a dynamic progress report on the communication, exploitation and dissemination activities carried out in accordance with the prevision defined in D8.4.
The document will also give an evaluation based on quantitative and qualitative measures that were defined to track and monitor planned dissemination, exploitation and communication results. This will help to assess the effectiveness of the planned activities, in order to take corrective actions if needed.
All partners are expected to contribute to dissemination, exploitation and communication activities in order to create the impact of the project.

1 Introduction

1.1 Scope and objectives of the deliverable

The aim of this document is to provide a first progress report on *Dissemination, Exploitation and Communication* (DEC) activities carried out in the time frame M1 - M18 of the ACROSS project. Said this, the document aims at including an updated view over the DEC plan activities, with the description of the action plan intended to allow the project to achieve proper project results and goals. Thus, the document is focused on providing a report and evaluation of the following aspects:

- Dissemination Activities
- Exploitation Activities
- Communication Activities
- KPIs Achievements

The deliverable is organised in the following way:

- Section 1 provides a short introduction of the main content of the deliverable, along with the context from which we started to structuring it. This section also contains a short reminder of the adopted methodology used to ensure the execution of the DEC plan activities.
- Section 2 provides a short reminder of the Dissemination and Communication strategies, while it focuses on providing an updated view of the dissemination and communication activities carried out till M18. Concerning the communication part, this section describes the selected tools and means along with achieved KPIs.
- Section 3 is mainly devoted to discussing the project's exploitable results. To this end, the section provides a short reminder of the Exploitation strategy along with the exploitable models. The section goes in detail with the description of the selected exploitable results of the project. The section also goes in the direction of providing information related to the market analysis and business models, describing the related planned activities.
- Section 4 summarizes the content of the deliverable and concludes it.

1.1.1 Context

ACROSS has the obligation to both exploit and disseminate the results of the project. According to "Article 28.1 Obligation to exploit the results" of the Grant Agreement [RD.1]: *Each beneficiary must — up to four years after the period set out in Article 3 — take measures aiming to ensure 'exploitation' of its results (either directly or indirectly, in particular through transfer or licensing; see Article 30) by:*

- *using them in further research activities (outside the action);*
- *developing, creating or marketing a product or process;*
- *creating and providing a service, or*
- *using them in standardisation activities.*

According to "Article 29.1 Obligation to disseminate results" of the Grant Agreement [RD.1]: *Unless it goes against their legitimate interests, each beneficiary must — as soon as possible — 'disseminate' its results by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in scientific publications (in any medium).*

1.2 Methodology reminder

As agreed in D8.4, the devised methodology ensuring the definition and execution of the ACROSS DEC plan covers the following activities:

- WP8 audio calls on a regular (weekly) basis
- Tools' creation to collect and to pilot the dissemination and communication events
- creation of exploitable results' table for involving all the partners to provide the project exploitable results
- Exploitation of business model canvas and other tools.

1.3 Related documents

ID	Title	Reference	Version	Date
[RD.1]	Grant Agreement No. 955648	GA	–	–
[RD.2]	Consortium Agreement	CA	4	15/09/2021
[RD.3]	Dissemination, Exploitation and Communication (DEC) plan	D8.4	0.6	31/08/2021
[RD.4]	ACROSS societal and industrial impact maximization report	D8.6	0.5	31/08/2022

2 ACROSS Dissemination and Communication Activities

Dissemination and communication activities are of primary importance for guaranteeing the success of the project all along its life cycle. Dissemination concerns the public disclosure of the project outcomes in any medium. Although it may mostly appear as passive, it is a fundamental activity for attracting the stakeholders. From this perspective, the dissemination action aims at promoting and raising awareness since the starting phase of the project, by making research results and development outcomes known to various groups including research peers, industry, policy-makers and other commercial actors.
In addition, this activity aims at enabling such actors to use and exploit project results in their own research activities and projects. On the other hand, communication means taking strategic and targeted measures for promoting the action itself and the related results to a variety of audiences. As such, communication also aims to reach out to society, here seen as a whole, by demonstrating how the EU funding contributes to tackling societal challenges. This deliverable is an output result of Task 8.3 which aims at creating the Dissemination, Exploitation and Communication (DEC) in order to define its goals, the strategy to achieve them, and translate them into a detailed implementation plan. The Task 8.3 is also in charge of the reporting on these activities. Outputs of Task 8.3 are used by Task 8.4 mainly focused on "Value creation adoption" that identifies the relevant audiences from multiple industrial and societal domains, specific key messages, KPIs and the appropriate channels for reaching each one of them. So, the Task 8.3 is more focused on technical dissemination activities while the Task 8.4 broadcasts project innovations and outcomes to a wider public including citizens and domain-oriented end-users.

2.1 Reminder on Dissemination and Communication strategy

The following subsections detail the ACROSS dissemination and communication activities, describing the public outreach strategy (POS), the specific dissemination and communication planned actions and the targeted audiences.
The ACROSS public outreach strategy is the crucial first step into building the ACROSS community. Relevant influencers are approached in order to create meaningful connections and build credible, third-party endorsement. At the time of writing this document, the consortium updated the list of influencers, which now includes a broader set of subjects orbiting around the HPC, BD and AI domains. Among the others, we can mention HPCwire[1], InsideHPC[2], The Register[3], The NextPlatform[4], the news section of the TOP500 Supercomputers website[5], Women in High-Performance Computing[6], the news section of the Scientific Computing World website[7], the blog dedicated to the HPC topic from Amazon Web Services[8], etc.
The purpose of this dissemination and communication strategy is to serve as an instructional plan towards the activities relating to raising awareness, informing stakeholders, and disseminating the results of the ACROSS project. The purpose of POS is to introduce guidelines for the partners and involved stakeholders (including the general public) on how the ACROSS community will be created and managed during and after the project lifespan.
The dissemination strategy and dissemination activities follow principles and best practices successfully tested by the partners and in line with the EC Guidelines for successful dissemination. ACROSS dissemination and communication strategy is based on a 4-step methodology which describes *why*, *what*, to *who* and *how* to communicate and disseminate. The *why* step is covered in the section 2.1.1 (dissemination) and in the section 2.1.3 (communication), where we highlight the main aims of disseminating and communicating project activities and outcomes. The *what* step is clearly given by the dissemination and communication activities carried out

[1] https://www.hpcwire.com/
[2] https://insidehpc.com/
[3] https://www.theregister.com/on_prem/hpc/
[4] https://www.nextplatform.com/
[5] https://www.top500.org/news/
[6] https://womeninhpc.org/
[7] https://www.scientific-computing.com/news
[8] https://aws.amazon.com/blogs/hpc/

by the project partners, and it can be found in the sections 2.1.1 and its subsections (dissemination) and 2.1.4 and its subsections (communication). Interestingly, this sections also cover the how step, as tools used to communicate and venues where to disseminate project outcomes and activities are described in detail. The coverage of the last step (to *who*) is also spread in the following sections, as targeted audience is reported.
Dissemination means sharing research results with potential users and stakeholders, and more specifically to promote and facilitate the adoption of the project outcomes. ACROSS dissemination strategy refers to particular target audience that can uptake and potentially use the ACROSS results in their own work. Leveraging in particular on the universities and research centres within the ACROSS consortium, the dissemination will target main international conferences, scientific journals and events, including training sessions. Moreover, ACROSS actively cooperates with European initiatives.

2.1.1 Dissemination Activities

Dissemination activities are aimed at maximizing the impact of the innovation and scientific developments carried out in the project, also providing a solid foundation for a successful exploitation phase.
Table 1 reports the dissemination activities carried out as envisioned in the dissemination plan. As the reader can see, ACROSS consortium targeted to attend very-high level events and to publish on well-reputed journals, conferences and workshops, in order to maximize the chance of intercepting the largest group of stakeholders. Some of these events are set on regular basis (e.g., HiPEAC conference and associated workshops, International Conference for High Performance, Networking, Storage and Analysis (SC), ISC High Performance, etc.), and they represent well established 'historical' events proved to be rewarding in terms of visibility and opportunity to catch relevant stakeholders.
Worth to note here, ACROSS partners continuously work to improve the quality of the dissemination actions and enlarge the basis of events to attend. As such, at the time of writing this report, the proposal for a workshop entitled *CONCERTO - Workshop on projects cross-synergy in advancing exascale platforms and quantum computing* (co-organized with Barcelona Supercomputing Center) and for a Birds-of-a-Feather (BoF) session entitled *Workflows Community: An Update on the Community Roadmap for HPC and AI Scientific Workflows Research and Development* (co-organized with Barcelona Supercomputing Center) have been accepted. The workshop will be held during the HiPEAC'23 conference, while the BoF will be held during the International Conference on High Performance Computing, Networking, Storage and Analysis (SC'22).
In the following, the description of the ACROSS participation to most relevant dissemination events is provided. The full list of dissemination events covering the reporting period (M1 - M18) is provided in Table 1 (important to note that for some of the reported items, the ACROSS partners planned to participate to the associated events but the organizers of the events cancelled them).

ACM Computing Frontiers (CF — Online), 11 - 13 May 2021. This event is marked as a high-quality conference in the computer science domain. As such, it gathers many researchers worldwide coming from industries and academia, well representing a good basin of potential stakeholders. Given that, ACROSS consortium targeted to attend the event; as such, CINI both attended the event (due to the Covid-19 pandemic it was held virtually) and got the chance to present a paper where the ACROSS project, along with other EuroHPC projects, is described in terms of goals and pilot applications that will benefit from the ongoing technical developments.

HPC-IODC, 2 July 2021. This workshop has been organized within the context of the ISC 2021 conference; the workshop aimed at discussing the innovations and technological advancements that are demanded for keeping the pace of improving performance of HPC datacentres. Specifically, the workshop was focused on storage and I/O technologies; as such, ACROSS project was invited to participate to a panel where future directions and the perspective of ACROSS in terms of I/O and storage technologies were presented.

ISC High Performance (Online), 2 July 2021. ISC High Performance represents one of the main conferences in Europe covering all the aspects related to the HPC domain. The event orbited around technical sessions, panels, workshops and tutorial, as well as it was accompanied by a virtual exhibition space. Although the 2021

edition was organized as an online event due to Covid-19 pandemic, attending the event was, for ACROSS, the occasion to meet stakeholders and spread information about project goals and achievements.

19th Workshop on high performance computing in meteorology, 20-24 September 2021. ECMWF held a biennial event on the use of high-performance computing in meteorology from 20 to 24 September 2021, bringing together experts from national weather centres, academia and industry. With the main topic of the workshop set to "Towards Exascale Computing in Numerical Weather Prediction", ECMWF had the chance to describe all the innovations under development in the context of the ACROSS project.

SC - The International conference on High Performance Computing, Networking, Storage and Analysis, 15-18 November 2021. The biggest high-performance computing event of the year, Supercomputing Conference 2021, provided an opportunity for scientists, supercomputing centres, companies, and HPC enthusiasts to meet in hybrid mode. The international conference took place online and in St. Louis, USA. IT4Innovations was on site among the exhibitors and promoted activities of the ACROSS project via the booth of the Czech National Supercomputing Center**.** The conference gathered in total more than 6,550 high-performance computing professionals and it helped us to communicate the activities of the project, meet the partners and set up new collaborations.

EuroHPC Summit Week, 22-24 March 2022. EuroHPC Summit Week is a large event in Europe, seeing the participation of all the major stakeholders, from technology suppliers to HPC infrastructures to HPC users. During the event, technical sessions were organized, as well as a poster session devoted to present EuroHPC funded projects. ACROSS presented a poster and leveraged on the large number of people attending in person to meet stakeholders and disseminate the project goals and achievements.

J on the Beach, 27-29 April 2022. CINI partner attended this event to illustrate technological solutions used in the ACROSS project (mainly focusing on technological solutions developed in the context of WP4 activities). J on the Beach is an international technical conference focused on Big Data aspects, and thus allowed us to intercept an important niche of potential adopters of the ACROSS solutions, including a large number of developers.

High Performance Computing in Science and Engineering 2022 conference (HPCSE), 16-19 May 2022. HPCSE is an international conference with the goal to bring together international specialists in high performance computing, applied mathematics, numerical analysis, high performance data analytics, machine/deep learning, and advanced visualization, to exchange experience and ideas, and initiate new research collaborations. ACROSS presented a poster entitled *Exascale-Ready Cross-Domain Workflows Execution: The ACROSS Approach*. There was advertised the ACROSS platform to an international audience, discussed the pilots and project objectives in terms of the AI/accelerator related aspects.

ISC High Performance, 29 May - 2 June 2022. As for the 2021 edition, this event represented one of the main events in Europe related to the HPC domain, seeing the organisation of technical sessions, workshops and tutorial. This event was a physical event and was accompanied by a large exhibition space. ACROSS got the chance to design and implement a dedicated both. Very positive feedbacks for this event are proved by the high number of contacted people (stakeholders) and other EuroHPC projects. The chance of physically meeting people eased the creation of collaborative paths.

Machine Learning for Astrophysics (ML4ASTRO), 30 May - 1 June 2022. CINI partner was invited for a talk at this international conference on astrophysics. The event was an important occasion to intercept a large scientific community that, generally speaking, is representative of one of the largest scientific domains making use of HPC resources and technologies for enabling scientific discoveries. The talk was focused on presenting the State-of-the-Art in the convergence between HPC and cloud for supporting machine learning applications, including the perspective of the ACROSS project.

ASME Turbo Expo, 13-17 June 2022. ASME Turbo Expo is the largest worldwide conference on turbomachinery with more than 2000 participants, seeing stakeholders from industry and academia attending the event. ACROSS presented two contributions related to HPDA analysis and the first combustor test case. As such, ACROSS had the chance to expose first scientific results achieved through the adoption of the ACROSS co-designed technological solutions. The event allowed ACROSS also to leverage the large number of attendees to illustrate the project objectives.

HiPEAC conference, Budapest, 20-22 June 2022. HiPEAC represents one of the major venues where the ACROSS partners can disseminate project outcomes, as well as to intercept stakeholders. HiPEAC is a network of excellence gathering one of the largest community of researchers in the academia and industry. To this end, the event orbited around technical sessions, workshops, and tutorials. Given the large number of people attending the event, there has been positive feedback for ACROSS, by being able to contact many stakeholders and other EuroHPC projects.

Workshop on Heterogeneous and Low-Power Data Center technologies (HeLP-DC), Budapest, 20 June 2022. Within the HiPEAC conference, ACROSS project organized a workshop dedicated to the creation of a collaborative and synergistic path among projects funded under the EuroHPC and H2020 programmes. HEROES, eFlows4HPC, MICROCARD, REGALE, B-CRATOS projects was invited, providing one general and one technical presentation each. The aim of the workshop was to provide both general perspective and objectives on the attending projects, as well as to present technical achievements. The workshop was based on the positive experience acquired by partner LINKS in organizing it in the past 4 editions of the HiPEAC conference. The positive results of the workshop are well represented by the collaborations set up with some of the attending projects (i.e., HEROES, eFlows4HPC). The cross-dissemination between projects in term of activities are linked also to the Task 8.2 dedicated on “strategic integration boosting synergies with EuroHPC projects”. Future planned deliverables related to Task 8.2 will provide more details on the cross-dissemination activities.

DoK Talks 141 (Online), 14 July 2022. CINI partner attended this virtual event organised by the DoK (Data on Kubernetes) community, to present new technological solutions, mainly related to the activities ongoing in WP4.

Table 1 - Dissemination activities report (underlined partner name carried out the activity).

Conferences/ Events/ Journals	Type	Year	Topic	Partners	Status
18th ACM International Conference on Computing Frontiers (CF’21)	Conference	2021	High-Performance Computing	CINI	DONE (11-13 May)
Teratec	Conference	2021	High-Performance Computing	ATOS, IT4I, ECMWF, INRIA	DONE (23 June)
HPC-IODC	Workshop	2021	HPC and Cloud convergence and the influence on HPC workflow and dataset management	LINKS	DONE (2 July)
ISC High Performance	Conference	2021	High-Performance Computing	LINKS, IT4I, MPI-M	DONE (2 July)
19th Workshop on high performance	Workshop	2021	High-Performance Computing, numerical simulations	ECMWF	DONE (20-24 September)

computing in meteorology					
SC - The International conference on High Performance Computing, Networking, Storage and Analysis	Conference	2021	High-Performance Computing	IT4I, CINECA, LINKS	DONE (15-18 November)
International CAE Conference and Exhibition	Conference	2021	Engineering simulations	CINECA, AVIO, MORFO	Cancelled by organizers
EuroHPC Summit Week	Conference	2022	High-Performance Computing	ATOS, LINKS	DONE (22-24 March)
J on the Beach	Conference	2022	Software development, Big Data	CINI	DONE (27-29 April)
High Performance Computing in Science and Engineering 2022 conference(HPCSE)	Conference	2022	High-Performance Computing	LINKS, IT4I	DONE (16-19 May)
ISC High Performance	Conference	2022	High-Performance Computing	LINKS, IT4I, MPI-M	DONE (29 May - 2 June)
Machine Learning for Astrophysics (ML4ASTRO)	Keynote	2022	High-Performance Computing	CINI	DONE (30 May - 1 June)
ASME Turbo Expo	Conference	2022	Turbomachinery	AVIO, CINI, MORFO	DONE (13-17 June)
Teratec	Conference	2022	High-Performance Computing	ATOS, IT4I, ECMWF, INRIA	DONE (14-15 June)
HiPEAC (main conference)	Conference	2022	High-Performance Computing, Artificial Intelligence, Cloud technologies	LINKS	DONE (20-22 June)
Workshop on Heterogeneous and Low-Power Data Center technologies (HeLP-DC)	Workshop	2022	High-Performance Computing	LINKS	DONE (20 June)
DoK Talks 141 Virtual event	Invited talk	2022	High-Performance Computing and software development	CINI	DONE (14 July)

2.1.1.1 Training Sessions

Within the planned activities for disseminating and communicating the main project goals and achievements, as well as creating awareness of the project outside the consortium, training sessions were planned as one way to achieve this objective. Nevertheless, ACROSS partners considered training sessions also as a mean for transferring the technical knowledge internally to the consortium. As such, LINKS, along with the collaboration of CINI (specifically the University of Torino) organized an internal training session during the ACROSS Progress Meeting (M13 — March 8th, 2022). This internal training was organized as a technical session between WP4 and Pilots (WP5, WP6 and WP7) to start presenting the StreamFlow technology and concretely the way to describe workflows. With a small set of examples, Pilots were guided through the main steps of creating a CWL-based description of their applications. The positive outcome of this first technical

training session has been demonstrated by the initial implementation of a CWL-based basic application using OPM Flow derived from the WP7 workflows.
Given the positive feedbacks of the first training session, ACROSS partners intend to invest more effort in organizing further training sessions in the second half of the project, as the implementation and integration the outcomes related to the technical activities will provide a more mature ACROSS system. As such, partners aim to target training sessions opened to external stakeholders to show the potentiality of the ACROSS platform and the benefit deriving from the adoption of the full stack of ACROSS technologies (including innovative hardware accelerators). To pursue this objective, ACROSS will target to organize at least 2 events between M18 and M36.

2.1.1.2 Peer-reviewed publications in journals, conferences, and workshops

One of the principal dissemination activities is represented by publishing technical/scientific results on high quality venues. ACROSS project is built around a large set of innovative technologies and technical solutions, both on the software side and hardware side; their integration within a coherent execution platform allows project partners to show the highly innovative path followed by the ACROSS co-design.

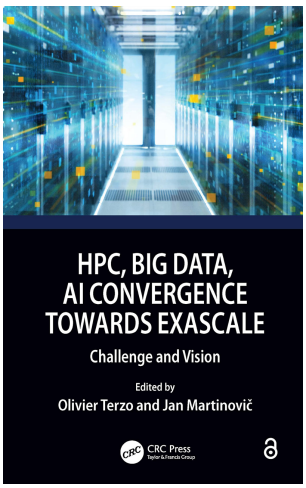

Figure 2 - Edited book with the contribution of ACROSS partners.

In the first half of the project, the work carried out to co-design the whole ACROSS execution platform (with a focus on the way to orchestrate large scale heterogeneous HPC systems and the execution of workflows mixing numerical simulations, deep/machine learning (DL/ML) and HPDA operations) allowed the consortium to reach a high number of publications on highly reputed scientific journals and conferences.
More specifically, ACROSS published 1 book chapter, 2 journal papers and 4 conference papers; beside this, other results of the dissemination activity can be found in the presentation of 2 posters. ACROSS also invested large effort in supporting other dissemination activities not directly linked to publishing. Specifically, the participation to several workshops and exhibition (also supported by a dedicated booth) allowed the ACROSS partners to present the (specific) project activities and goals through invited talks and presentations. Furthermore, the link with the ETP4HPC and HiPEAC entities, gave ACROSS the chance to actively contribute to the ETP4HPC *Strategic Research Agenda 5* (SRA5), as well as to be included in the ETP4HPC project handbook 2022 and HiPEAC Info magazine (issue number 66).
Worth to mention here, is the continuous effort of the ACROSS partners to publish technical/scientific results on high-quality peer-reviewed journals. Following this approach, ACROSS partners submitted 2 papers respectively on Elsevier Future Generation Computer Systems (FGCS) and IEEE Transaction on Parallel and Distributed Systems (TPDS). Also, ACROSS partners LINKS and IT4I are editors of the book (see Figure 2) containing the mentioned chapter, which covers the main aspect of the convergence between HPC, Big Data and AI technologies. The book was born in the context of a collaborative activity between ACROSS, and other H2020 projects. Details about these further activities are as follows:

- *Submitted Journal* — C. Vercellino, A. Scionti, G. Varavallo, P. Viviani, G. Vitali, O. Terzo, "A Machine Learning approach for an HPC use case: the jobs queuing time prediction". *Elsevier Future Generation Computer Systems (FGCS).*
- *Submitted Journal* — N. Manubens, T. Quintino, S. D. Smart, E. Danovaro, A. Jackson, "DAOS as HPC Storage, a view from Numerical Weather Prediction". *IEEE Transactions on Parallel and Distributed Systems (TPDS).*
- *Edited Book* — O. Terzo, J. Martinovič, "HPC, Big Data, and AI Convergence Towards Exascale — Challenge and Vision", Taylor & Francis group (CRC Press), 2022.

In the following we provide the full list of 9 (peer-reviewed) publications:

- *Journal* — Beránek J., Böhm S. and Cima V., "Analysis of workflow schedulers in simulated distributed environments". *Journal of Supercomputing (2022)*. https://doi.org/10.1007/s11227-022-04438-y
- *Journal* — Colonnelli I. et al., "Distributed workflows with Jupyter." *Future Generation Computer Systems* 128 (2022): 282-298.
- *Book chapter* — Scionti A. et al., "Enabling the HPC and Artificial Intelligence Cross-Stack Convergence at the Exascale Level." *HPC, Big Data, and AI Convergence Towards Exascale*. CRC Press, 2022. 37-58.
- *Conference* — Aldinucci M. et al., "The Italian research on HPC key technologies across EuroHPC." *Proceedings of the 18th ACM International Conference on Computing Frontiers*, 2021.
- *Conference* — Viviani P. et al., "Taming Multi-node Accelerated Analytics: An Experience in Porting MATLAB to Scale with Python." *Computational Intelligence in Security for Information Systems Conference*. Springer, Cham, 2022.
- *Poster* — A. Scionti, et al., "Exascale-Ready Cross-Domain Workflows Execution: The Across Approach". *EuroHPC Summit Week 2022*.
- *Poster* — G. Zitzlsberger, "Exascale-Ready Cross-Domain Workflows Execution: The ACROSS Approach", *High Performance Computing in Science and Engineering* (HPCSE), 2022.
- *Conference* — A. Amerini, S. Paccati, L. Mazzei and A. Andreini, "Assessment Of A Conjugate Heat Transfer Method On An Effusion Cooled Combustor Operated With A Swirl Stabilized Partially Premixed Flame", Paper no. GT2022-81345, *ASME Turbo Expo 2022* (under publication).
- *Conference* — D. Lengani et al. "Investigation on Strain and Stress Principal Axes in Unsteady DNS Turbine Data". Paper no. GT2022-83197, *ASME Turbo Expo 2022* (under publication).

2.1.2 Evaluation: Key performance indicators

The key performance indicators (KPIs) and their evaluation have been defined in D8.4. Table 2 reports their evaluation at M18.

Table 2 - Dissemination Key Performance Indicators.

Dissemination channel	KPIs and means of verification	Status	Comments
Peer-reviewed publications in journals, conferences and workshops.	>15 (Partners' regular reporting)	In progress	2 Journal papers 4 Conference papers 1 Book chapter 2 Posters
Training Sessions	>6 in person/online training sessions	Started	1 internal training session

2.1.3 Communication Objectives and Outcomes

The overall objective of the communication activities is to ensure a systemic promotion of the project's activities among all the stakeholders. The specific objectives are:

- Undertaking actions that will pave the way to broad dissemination and communication of the project scope, activities and results
- Setting up and maintaining a project website for public communication, dissemination and information
- Creating the good conditions (following the public outreach strategy which dictates communicating the right messages, to the right audiences through the right channels at the right timing) in order to facilitate the interactions with the stakeholders
- Identify, reach, and engage with stakeholders
- Improve fruitful synergies and internal communication between the work packages (WPs)
- Drive and support innovation in the HPC adoption
- Make the produced knowledge more accessible, inclusive, and actionable
- Facilitate interaction and feedback/input on our work
- Improve press & media relations

2.1.4 Communication Report

Communication activities aim at maximizing the visibility of the ACROSS project to a very wide range of subjects who may benefit from discovering the technological solutions developed in the project, as well as the currently targeted pilot applications. Said this, the proper communication of different aspects regarding the project life (i.e., objectives, achievements, attended events, scientific production, etc.) requires setting up adequate communication actions, which in turn require the use of proper tools and strategies. To this end, the ACROSS consortium analysed the main requirements for an effective project communication and selected a set of different communication channels and tools, including online, off-line, and interactive (face-to-face) means, for better supporting the partners in achieving the communication objectives (e.g., reaching a wide range of subjects, quick promotion of the whole project' aspects, etc.). The first tool the ACROSS partners set up is the project website: this presents the main entry point for discovering updated information of the project, being informed on activities, progresses and planned events. Details on the way the website has been structured are reported in section 2.1.4.1. Through the website, it is possible to get access to the social media channels linked to the ACROSS project. In particular, LinkedIn, Twitter and Facebook buttons are provided across the website sections for a quick access to them. Communication passes also through the creation of specific project accounts on the mentioned social media (LinkedIn, Twitter, and Facebook) as visible in Figure 3 (right).

Communication also requires to well structuring documents (including, among the others, reports, presentations, deliverables, and milestones) with a common use of colour palette and styles, as well as a proper document organization (i.e., organizing reports, deliverables, presentations, agendas, milestones, etc. with a set of required sections). To this purpose, ACROSS partners created a set of standardized templates, as detailed in the section 2.1.4.2.

Project leaflets have been created to facilitate the communication of all the main relevant aspects of the project in a quick and easily understandable manner. Project leaflets allows to quickly reach out a broad range of users during attended events. Details on the created communication project leaflets are given in the section 2.1.4.3.

Finally, to facilitate the collaboration among the partners and easily sharing all important documents and information, a project private area has been envisaged since the beginning of the project. This specific communication tool supporting partners' activities have been implemented and made accessible to the ACROSS consortium. Details on the project private area are given in the section 2.1.4.4.

2.1.4.1 ACROSS website

ACROSS website is one of the main project communication tools. To ensure the maximum visibility for the ACROSS objectives and results, a project website registered in the *eu* domain and with the URL: www.acrossproject.eu has been set up. The website contains links to the project's social media accounts.

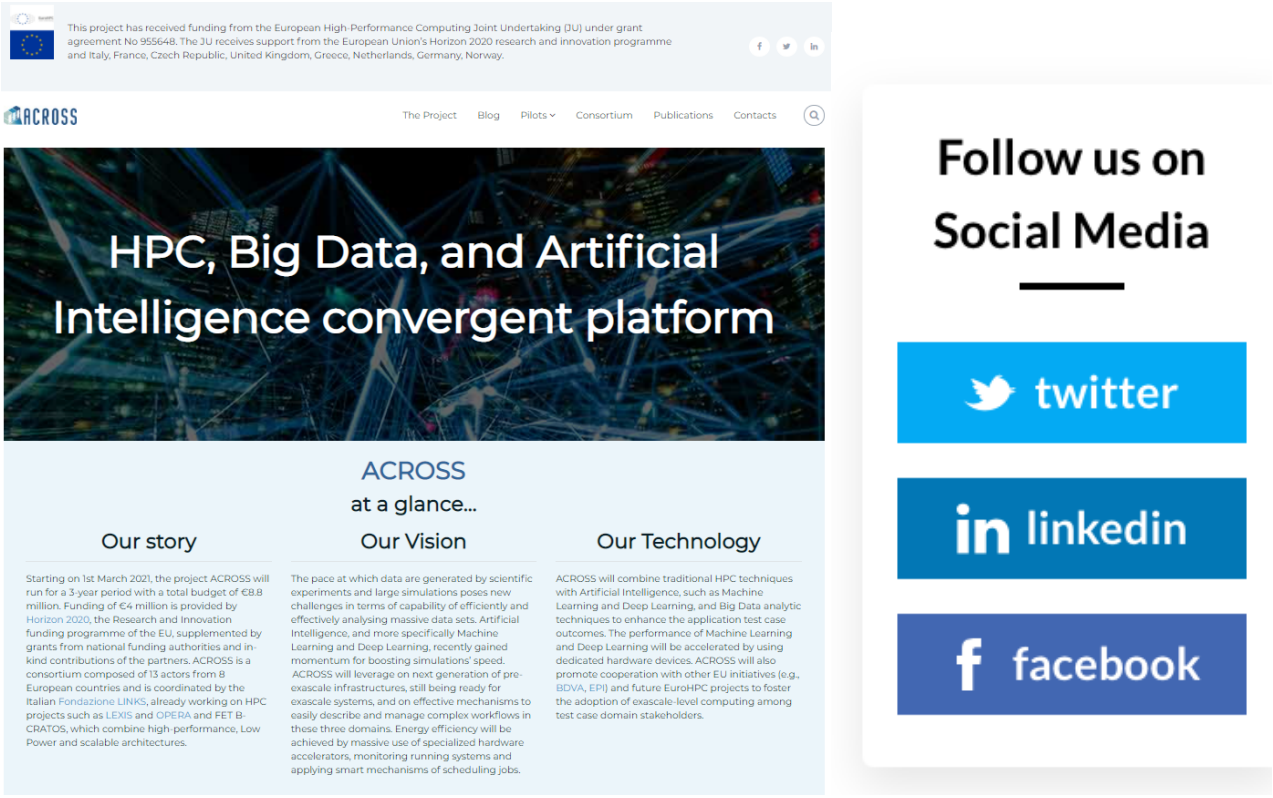

Figure 3 - ACROSS website (left) and the bar containing the buttons to the social media project accounts (right).

The website is used to:

- Provide general information about the project including pilots and partners.
- Enable the download of project documents, including reports, public deliverables, and presentations.

The website includes an active blog session: the blog objective is to publicize both the news and the activities carried out during the project. This information will be regularly updated over the project lifetime. Likewise, each blog post is cross promoted to the ACROSS social media channels. To allow readers to easily find content on topics following the project's target sectors (i.e., sectors such as weather, climate, hydrological and farming, oil and gas, seismic, aeronautics and more), the blog is segmented into a variety of topics. Figure 4 provides the full list of created blog posts, which counts at the time of writing this document a total of 21 thematic posts. A range of inbound marketing tactics such as SEO techniques and email marketing are used to ensure that our content reaches the intended audience at appropriate times and based on their intent.

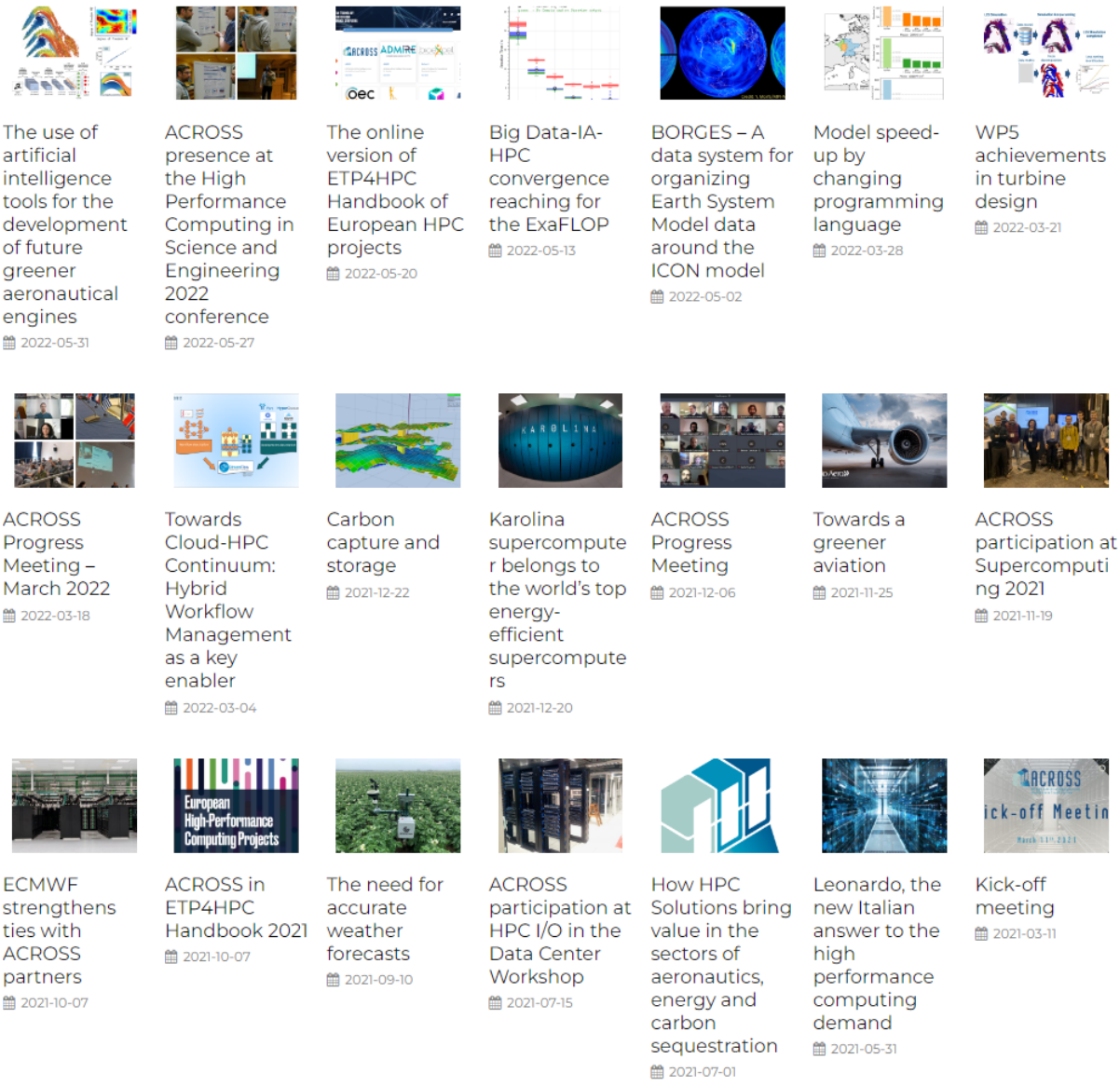

Figure 4 - The list of published 21 blog posts.

Apart from the *home* page, that contains general information and links to the most recent blog posts, the website is structured as per the following navigation tree:

1) The Project
   a) Consortium (contains the list and description of the partners)
   b) Networking (contains a list of related projects and links to their websites)
2) Blog
3) Pilots
   a) Greener aero-engine modules optimization (contains a description of the first pilot)
   b) Weather, Climate, Hydrological and Farming (contains a description of the second pilot)
   c) Energy and Carbon Sequestration (contains a description of the third pilot)
4) Publications
   a) Scientific (contains the list of published scientific papers together with download links)

b) Newsletter (contains the archive of published newsletters)
c) Deliverables (contains a list of all planned deliverables)

5) Contacts

A form was added to the website to allow subscribing to the newsletter (Figure 5). A “call to action” button is also always present in the website header to entice visitors into subscribing. In addition, blog posts can be easily shared with the provided buttons.

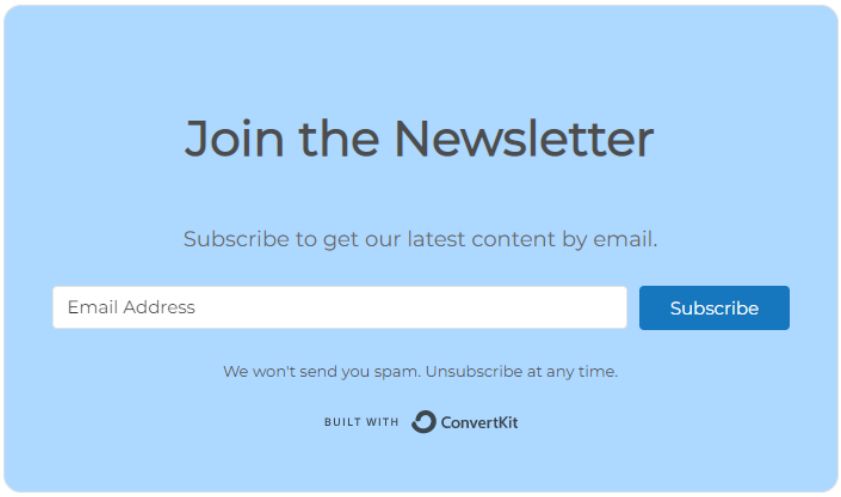

Figure 5 - ‘Join the Newsletter’ subscription form.

According to data from Google Analytics, since April 2021, on the website were recorded (for a more comprehensive discussion on analytic tools, see also section 2.1.4.5):

- 1946 unique users
- 3080 sessions
- 6655 page views
- 13% returning visitors and 87% new visitors
- The busiest week has been March 27th, 2022 - April 2nd, 2022, with 116 visitors (see Figure 6)

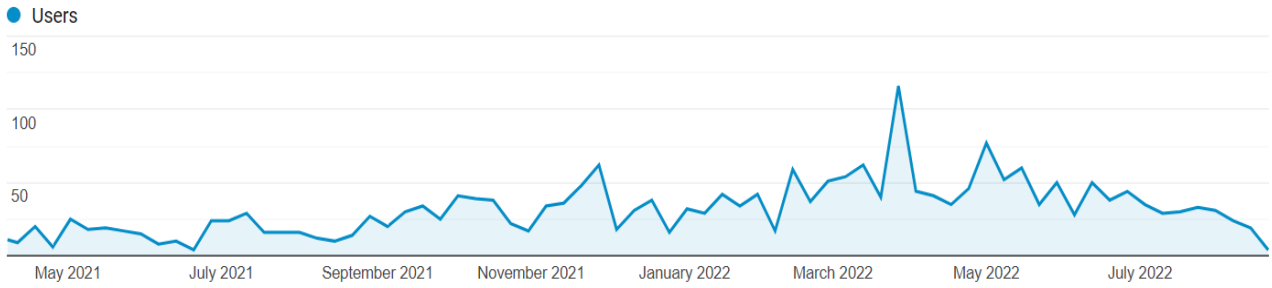

Figure 6 - Weekly distribution of users according to Google Analytics.

English is the most common language with 56% of visitors, Italian is the second one (covering 11%) and Chinese the third (covering 3%). Italy is the country with most visitors (the percentage is 18%), the United States the second (covering 12%) and Germany the third (covering 8%). A more detailed view of the distribution of visitors’ languages and countries is graphically depicted in Figure 7.
The breakdown of the device types used to connect and visit the ACROSS website is as follows:

- 78% of visits are from desktop
- 22% are from mobile

It was however noticed that not all traffic is tracked by the Google Analytics tool, probably due to non-acceptance of web cookies and browser settings that block tracking. An internal analytic tool was then deployed to have another means of comparison. According to this tool, visitors (equivalent of users) were **3170** with a total of **5860** visits (equivalent of sessions). These values are significantly greater than those registered by Google Analytics. Google is the top referring website with 794 visitors, LinkedIn the second with 137 and Twitter the third with 46.

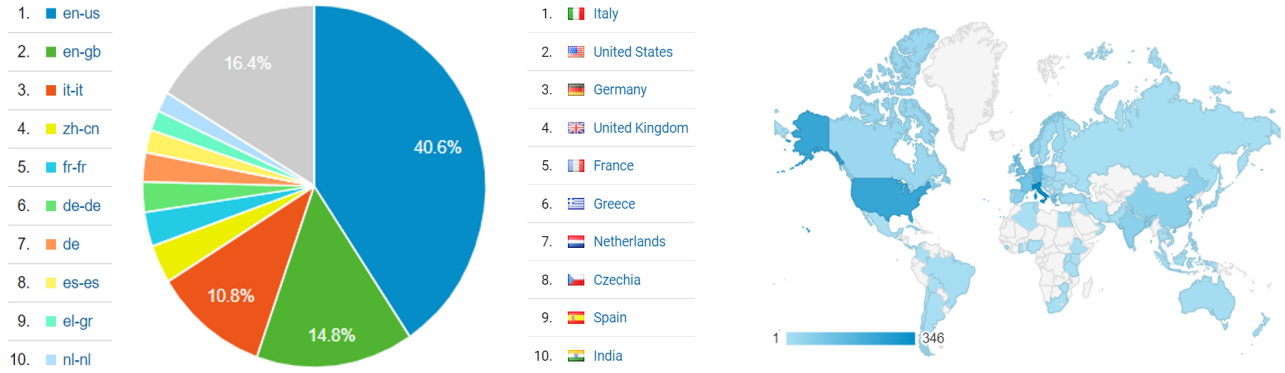

Figure 7 - Top 10 visitors' languages and countries.

2.1.4.2 Templates

Templates for the main documentation (including templates for the meeting agendas, milestones, newsletters, partner periodic reports and work package periodic reports) and presentations have been created since the beginning of the project and shared with the ACROSS consortium through the NextCloud online sharing area (see also Section 2.1.4.4). Since M6, periodic updates aimed at improving the readability and the overall quality of the project material have been done. Whenever a new template version is ready, it is made available on the NexCloud shared folder.
Specifically, at the time of writing this deliverable, the following templates are available (see Figure 8 for a visual overview of the mentioned documents):

- *ACROSS Agenda*: it includes a cover page with main information related to the associated event, and the tables reporting the agenda for the days of the meeting/event.
- *ACROSS Deliverable*: it includes a cover page reporting the main information describing the document, a table tracking the version of the document, table of content, a glossary and the list of figures and tables reported in the document. A fixed chapter containing the Executive Summary, the positioning of the deliverable with regards to the whole project context and a short and precise description of the content is also provided. The remainder of the template contains examples of chapters, sections and subsections, tables, and figures. The deliverable is ended with the list of references.
- *ACROSS Milestone Assessment*: it contains a cover page reporting the main information regarding the milestone to be approved. It follows a table with the main questions to answer for assessing the status of the milestone.
- *ACROSS Minutes WP single TelCo*: a template for keeping track of the TelCos has been prepared and made available to the partners. It includes a cover page for reporting the information of the TelCo; then, the list of partners attending the meeting and the agenda is provided. A third chapter describes

the action points to be checked and tracked over time, along with the upcoming activities foreseen. The last chapter is devoted to report the meeting minutes.

- *ACROSS Newsletter*: the template for the newsletters of the project has been prepared. It has the same graphical structuring in common with the ACROSS leaflets (e.g., the same colour palette and style). The template is structures in different sections organized in columns. An example of a possible content has been provided to help partners in preparing the newsletters.
- *ACROSS Participants*: a simple document collecting the main information of the event/meeting and the list of participants has been created. For each participant, partner information is collected besides the name, surname, and signature.
- *ACROSS Partner Periodic Report*: this template refers to the preparation of the progress report on the activities carried out by each partner. The report is intended to track the status of activities twice per year. As such, it contains a cover page reporting the information of the partner and that of the reporting period of reference. Apart the initial table of content, the partners have a first chapter where to describe the activities carried out in each work package. A second chapter allows to report any important result achieved, including milestone approved and deliverable submitted. A following table allows to report any risk and issue identified; while a fourth chapter reports the list of patents, publication, travels, and visits done. The template is concluded by the list of exploitable results.
- *ACROSS Presentation*: a complete slide deck has been made available to the partners, providing the correct styles for the text, icon set, etc.
- *ACROSS WP Periodic Report*: it contains the cover page reporting the information related to the specific work package involved and the table of content.

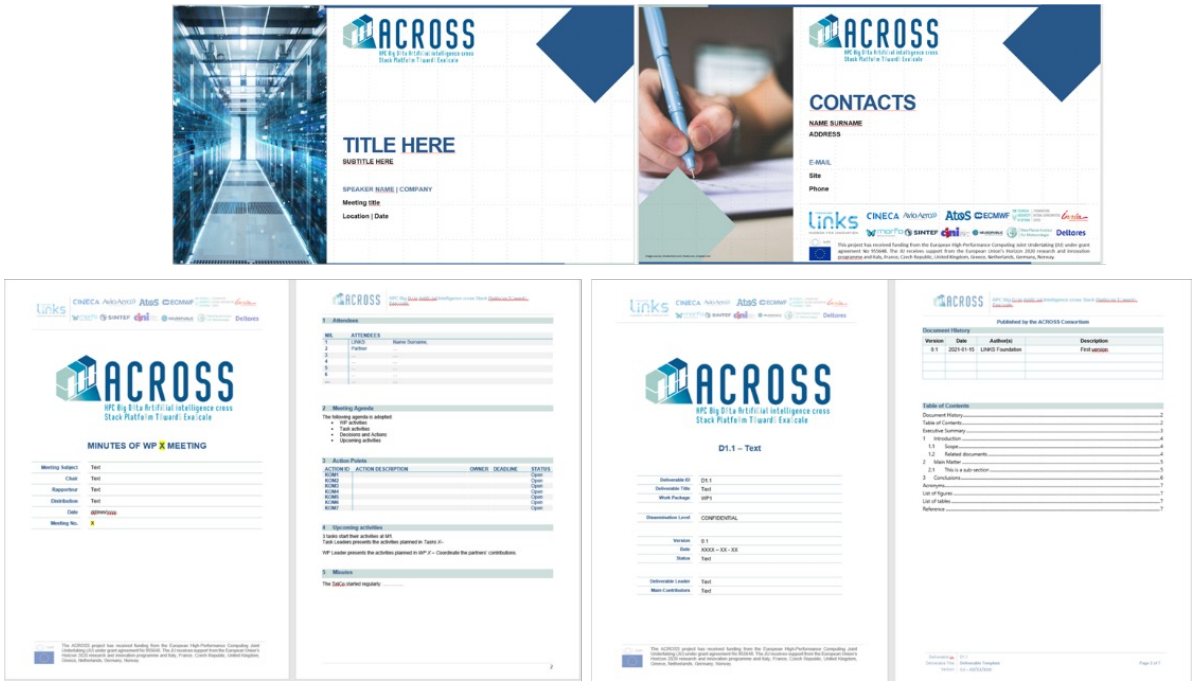

Figure 8 - ACROSS templates.

The document is organized as follows: a first chapter is devoted to report the activities carried out in the specific reporting period; it is followed by a second chapter where the activities per task are reported. A third chapter allows to describe the activities planned in the next period. The fourth chapter is devoted to report the status of planned deliverables and milestones; while chapter five provides the

room for reporting any risk and issue identified. Chapter six allows to report any deviation from the planned activities and plans, while the last chapter keeps track of the KPIs.

2.1.4.3 Project Leaflet

Leaflets are an important communication mean for the project, allowing to spread very quickly all the important information related to the project. As such, an official ACROSS leaflet has been prepared including a short presentation of the project for communication via website and on paper (see Figure 9). It will be available at conferences, workshops, seminars etc. that are organised and/or attended by the partners. ACROSS consortium continuously monitor the status and progress of the project to eventually update the leaflet content, so that the most updated and fresh information about the project can be delivered outside the project consortium.

Figure 9 - The ACROSS project leaflet.

2.1.4.4 Project's Private Area

ACROSS has a private area based on NextCloud (private cloud solution). The private area is accessible for all the users (partners) authorized.

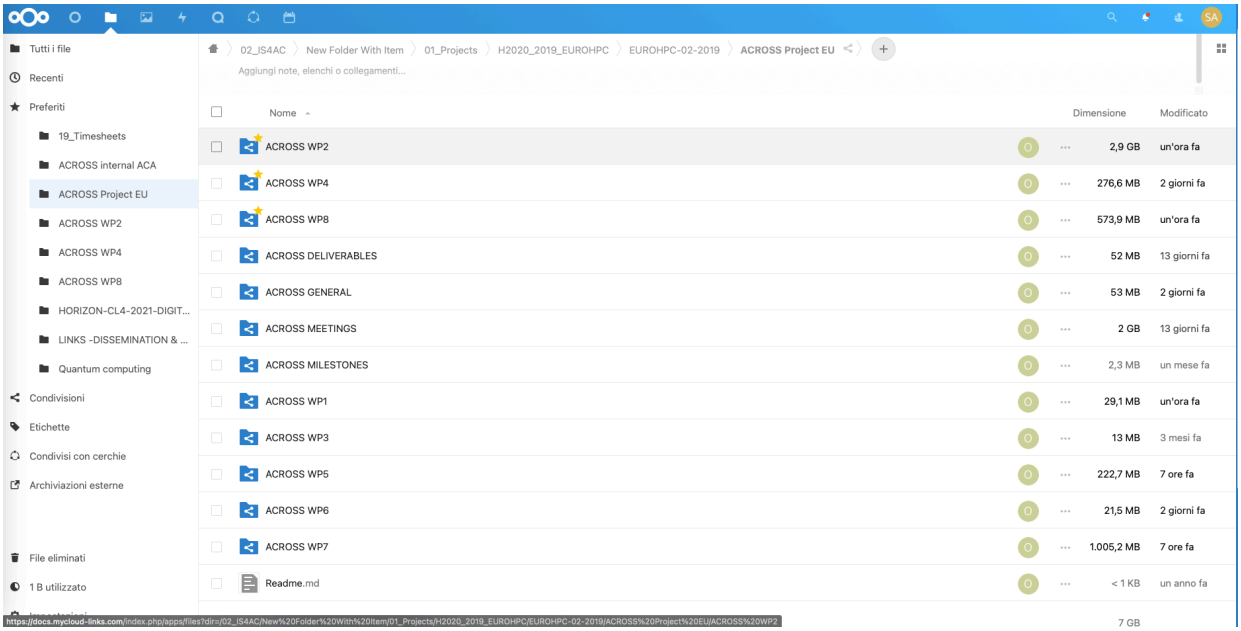

Figure 10 - The NextCloud dashboard.

Figure 10 provides a screenshot of the NextCloud dashboard, where the main project folder structure is depicted, along with the left side navigation tree, folder/document information and toolbar (top-left of the figure).

Once entered in the system, the private area is organized as a group of folders. The access to each folder can be restricted to specific users, so that it will be possible to keep documentation and material that must be visible to only specific partners separated from those accessible by all the partners. The area is organized with folders (and subfolders) related to each work package (WP). Each WP, in turn, is organized in tasks. Also, a folder for collecting all the deliverables related to that WP as well as other documentation is available. In the main project folder, a space dedicated to collect all the submitted deliverables is present. Similarly, there is a dedicated folder to collect all the milestones approved or planned.
A folder named 'General' collects all the general documentation of the project, including subfolders for the templates and the logos. Finally, a folder allows to store all the material related to the organized meetings.
NextCloud is a powerful tool that allows a fast and efficient communication between the partners, as well as to manage the creation of documents (i.e., text files, presentations, spreadsheets, etc.) in a collaborative manner (through the integration of the OnlyOffice suite), other than providing the features for managing the online storage space. Another important tool made available through the NexCloud tool is the chat room system. A dedicated chat room for each WP, as well as other chats dedicated to the interaction between WPs, have been created to ease the communication between partners and the exchange of important information.

2.1.4.5 Communication report summary

The overall objective of the communication activities is to ensure a systemic promotion of the project's activities among all the stakeholders. The consortium has planned to set-up different communication tools to ensure a successful communication during the project. The reporting for each of these tools is detailed in the Table 3.

Table 3 - Communication activities report.

	Type	Status	Comments
Website	Communication	DONE	www.acrossproject.eu
Twitter	Communication	DONE	https://twitter.com/across_project Created on March 2021, 170 followers
Facebook	Communication	DONE	https://www.facebook.com/acrossprojecteu Created on March 2021, 29 followers
LinkedIn	Communication	DONE	https://www.linkedin.com/company/acrossproject/ 165 followers
WFLOW GitHub page	Development	DONE	https://github.com/ACROSS-Project
Newsletter 1 (MS1- Awarness of project Objectives and Requirements)	Communication	DONE	By LINKS https://www.acrossproject.eu/newsletter/
Newsletter 2 (MS2 - ACROSS Key Technologies and platforms specifications)	Communication	DONE	By IT4I https://www.acrossproject.eu/newsletter/
Newsletter 3 (MS3 - Alpha Version ACROSS platform and technologies)	Communication	ONGOING	By ATOS
Project Logo	Identity	DONE	6 different versions
Documents templates	Presentation	DONE	PowerPoint, Deliverable, Business Card
Project Leaflet		DONE	
Internal repository	Share	DONE	https://docs.mycloud-links.com/ NextCloud (private cloud)

Press Release	Communication	ONGOING	No official Press Release. See action plan for the second half of the project lifetime in the section 2.1.5.1 below
Across Gadgets	Communication	DONE	Used in HiPEAC, ISC workshops and at SC conference

Analytics tools have been used to continuously monitoring the effect of the communication actions on the social media channels and the ACROSS web site, as reported in the following charts (see Figure 11 - Figure 16) and Table 4. Worth to observe, is a good general trend in the number of visitors and impressions on all the three social media channels, with notable peaks that are mostly correlated to external organizations (re)posted news/tweets linked to the ACROSS activities (e.g., HiPEAC in several cases reposted tweets from ACROSS).

LinkedIn Analytics. From M7 to M18, the LinkedIn page obtained 674 page views from 284 unique visitors, equally distributed between desktop and mobile devices. Only the last year is reported as LinkedIn does not show data older than 365 days (see Figure 11).

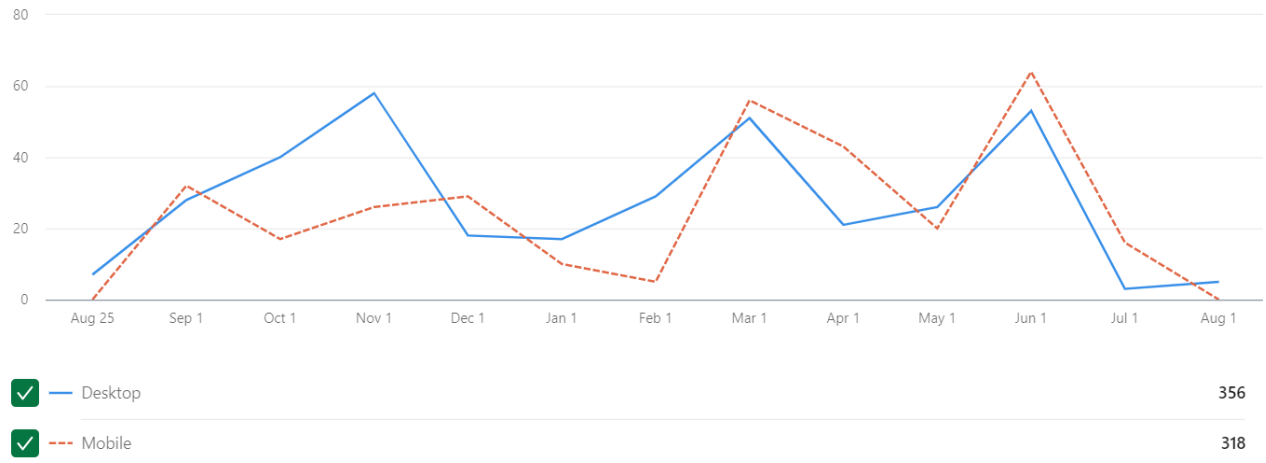

Figure 11 - LinkedIn Analytics: trends of visitors in the last year.

In the same 12-months period the LinkedIn page reached more than 17000 organic impressions (Figure 12).

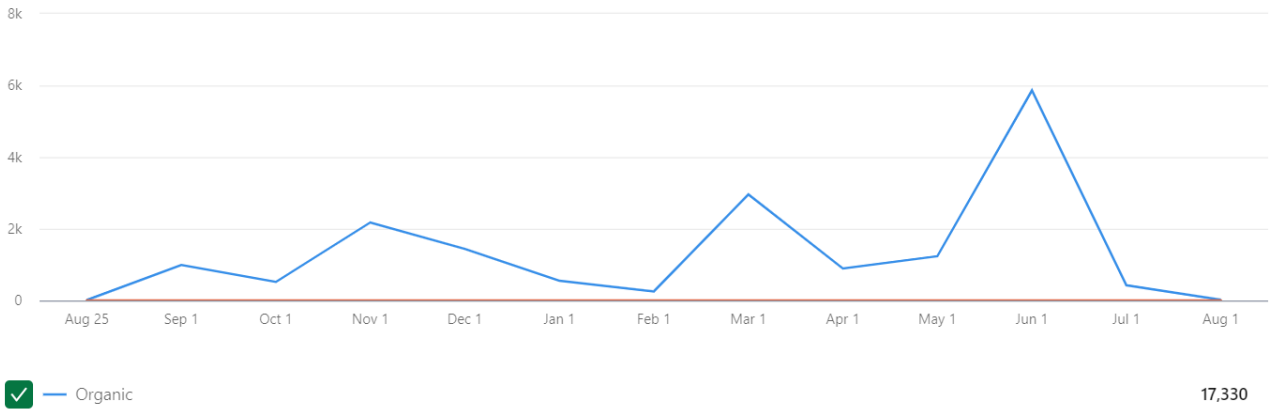

Figure 12 - LinkedIn impressions.

The visitor demographics shows that most visitors work in research (31%), followed by engineering (13%) and on a smaller scale business development, communication, IT and more (Figure 13).

Figure 13 - LinkedIn visitor demographics.

Twitter analytics. Tweets from ACROSS account reached more than 18000 organic impressions over the considered period. The general trend is considered positive, while notably there are peaks related to external organizations (e.g., HiPEAC conference organizers) reposting tweets (Figure 14). Similarly, a positive trend is found in the Twitter engagements (Figure 15).

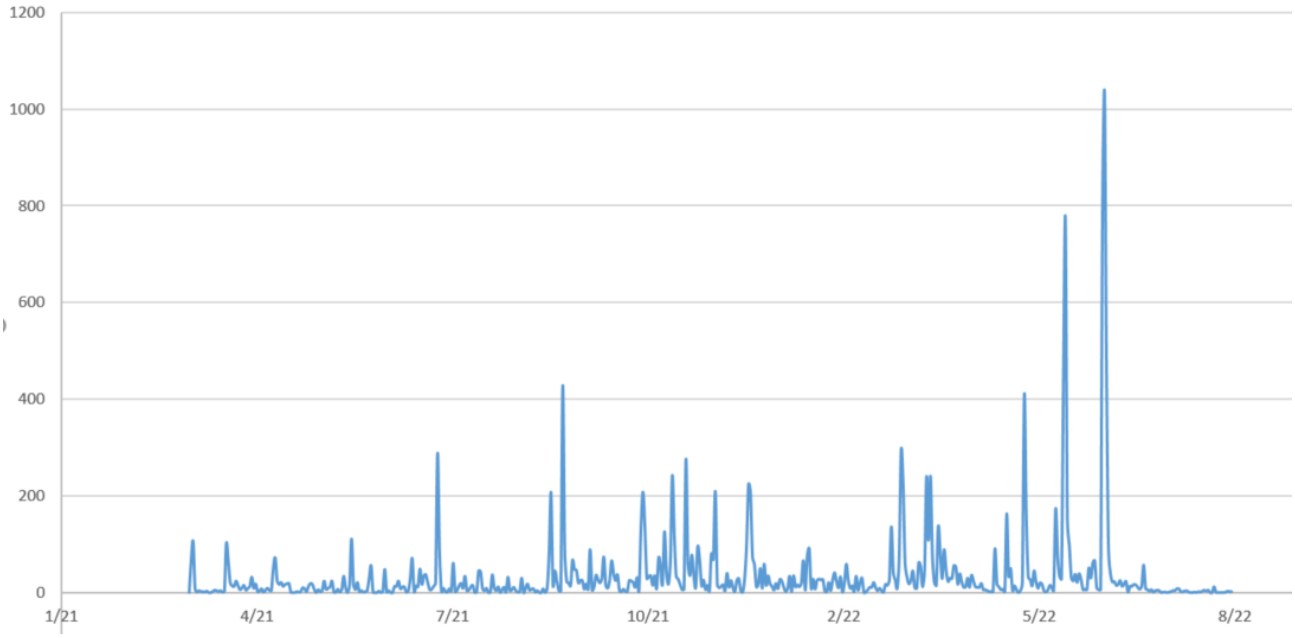

Figure 14 - Twitter impressions.

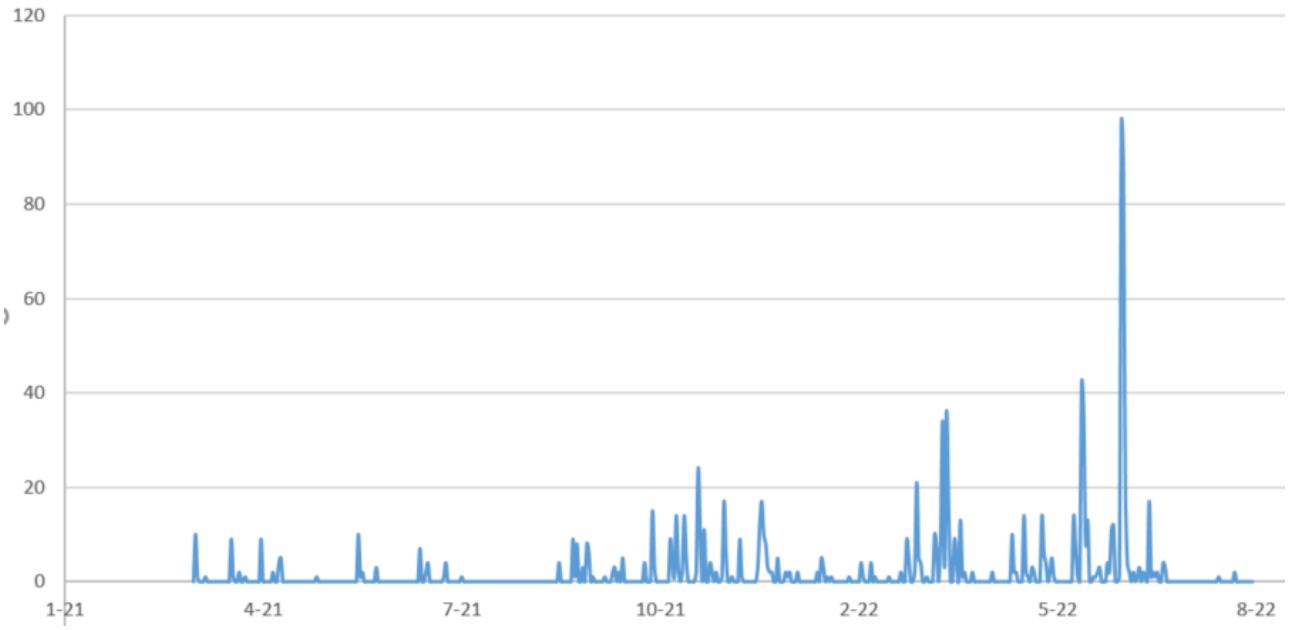

Figure 15 - Twitter engagements.

Facebook analytics. The Facebook page reached more than 1700 impressions, with a peak of more than 530 views on the 21 June 2022 (see Figure 16). Similarly to the trend observed for the Twitter channel, peaks are more related to other external entities and organizations reposting project posts.

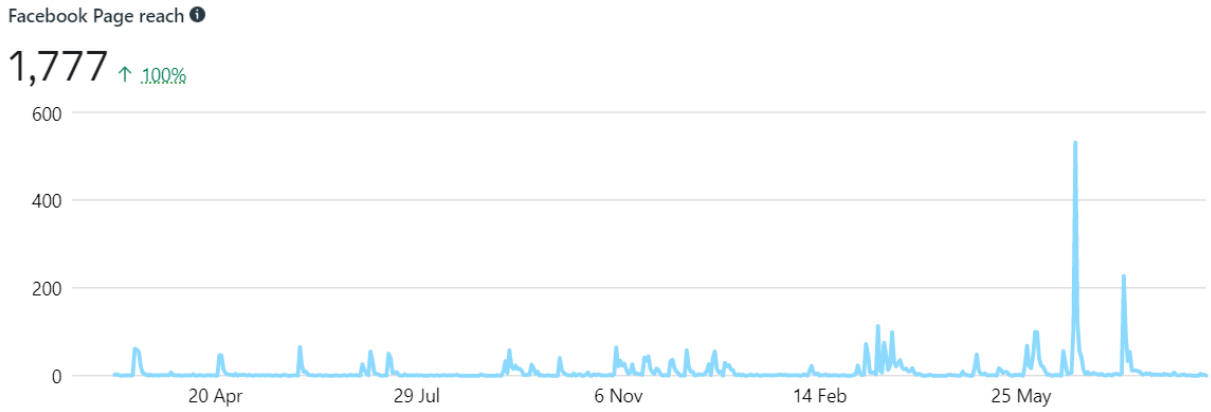

Figure 16 - The Facebook posts impressions.

2.1.5 Evaluation: key performance indicators (KPIs) and measurements

In the Table 4 are represented the ACROSS communication KPIs updated at M18 of the project.

Table 4 - The ACROSS communication key performance indicators (KPIs).

Communication Tools and Channels	KPIs and means of verification	Status	Comments
Project website	>10K visitors (Google Analytics)	ONGOING (32%)	>3100 visitors
Social Media channels	>1K visitors social media followers (accounts data)	ONGOING (36%)	>360

Newsletters	7 newsletters (Partners' regular reporting)	ONGOING (2)	The 3rd newsletter (originally due at M16) has been postponed to M21 (end of November 2022)
Press releases and articles published in regional, national and European online media	~30 articles (Partners' regular reporting)	ONGOING (4)	CORDIS[9] INSA Rennes[10] BOOK:HPC, BIGA DATA, AI CONVERGENCE[11] ACROSS SIMILAR WEBSITES[12]
Online events (e.g. webinars, demo)	~10 events (Partners' regular reporting)	ONGOING (1)	HPC, Big Data e Intelligenza Artificiale: la sfida della convergenza (5/3/2022)
European Industry and target-sector oriented events (Industry verticals)	>15 events (Partners' regular reporting)	DONE (11)	
Specialized blog posts	34 (ACROSS posts within its website)	DONE (14)	
Printed material (leaflet, brochures, posters, and banners)	~1K distributed material	ONGOING (502)	Printed 500 leaflets and 2 project posters

2.1.5.1 Plan for the second half of the project

Achieving the communication KPIs as reported in Table 4 requires setting up an action plan to improve the ACROSS awareness and reach out a broader group of stakeholders. The action plan reported in Table 5 proposes specific actions for achieving each KPI, along with the main partners involved and a due date.

Table 5 - The action plan foreseen for the second half of the project life-cycle to achieve communication KPIs.

KPIs and means of verification	Action Plan	Partners	Due date
Press releases and articles published in national/regional/European online media ~30 articles	- Need for a Wikipedia Page - Each partner could publish a press release on the company's website - Add a press release section on the official website	All	2022
Online events (e.g.webinars, demos) ~10 events (Partners' regular reporting)	ACROSS should organize at least one event (webinar or demo, e.g. Webinar on Big Data and Analytics)	All	2022 -2023
European Industry and target-sector oriented events (Industry verticals	Each Pillar must participate to at least one event related to its target-sector (aero-engine	LINKS, NP, CINI, AVIO AERO,	2022-2023

[9] https://cordis.europa.eu/project/id/955648

[10] https://www.insa-rennes.fr/en/research/ongoing-european-projects/h2020-projects/insa-rennes-as-third-party.html

[11] https://www.taylorfrancis.com/books/edit/10.1201/9781003176664/hpc-big-data-ai-convergence-towards-exascale-olivier-terzo-jan-martinovič?context=ubx&refId=eaefe2e2-1977-4581-922a-89ed1cef0cb7

[12] https://www.sitesimilar.net/acrossproject.eu

>15 events (Partners' regular reporting)	modules optimization, weather, climate, hydrological and farming, energy and carbon sequestration)	MORFO, ATOS, IT4I, CINECA	
~1K distributed material	Print and at least 500 materials to be distributed during events	LINKS	2022

3 ACROSS Exploitation

3.1 Reminder of Exploitation Strategy

The ACROSS exploitation strategy comprises the following exploitation activities:

1. Identification of the innovative exploitable results and the detailed description of all possible non-commercial and commercial exploitation models.
2. Definition and evaluation of the sustainability and viability of possible business models and alternative solutions that may be followed for the provision of the project solutions and services to the identified stakeholders.
3. IPR management strategy based on the principles outlined in the project CA which will guide the joint and individual exploitation capabilities of the project partners.
4. Establishment of tactical alliances with other industrial or research organizations that hold the potential of promoting ACROSS results.

Involvement of external (not project participants) stakeholders which can benefit from project results (commercial and non-commercial).

3.2 Exploitation models

Three main exploitation models or categories of the project results are defined in ACROSS:

1. *Commercial exploitation model*, which incorporates strategies, actions, tools and methodologies in order to: *i*) exploit the bulk of the commercial project outputs and *ii*) reinforce and advance the existing commercial prospects of industrial partners.
2. *Research exploitation model*, which implies the re-utilization of the research know-how acquired in future (research) and non-research activities.
3. *Technological exploitation model*, which implies the re-utilization of the technological know-how acquired for the development of innovative products and services.

As a consequence, the ACROSS Exploitable Results will be classified in these three categories: *commercial*, *research* and *technological*. Analysis on different categories of ERs are made in the exploitation reports in order to provide insight on the balancing of ER categories.

3.3 Exploitation Activities

3.3.1 ACROSS Exploitation Report

As a result of WP8 activities, 19 Exploitable Results (ERs) have been defined. On D8.4 Exploitation Plan was defined in four distinct types:

- Exploitable results in HPC facilities
- Exploitable results in ACROSS SW/HW complex workflows
- Exploitable results in ACROSS marketplace (industry vertical solutions)
- Exploitable results in Research/Scientific

For each ER, whose status is reported in the following sections and related subsections, a classification based on 6 representative categories (graphically depicted in the Figure 17) have been done. Worth to highlight, in the following, an updated view of the list of selected Exploitable Results (ERs) as reported in D8.4 is given. The updated list includes all the previously selected ERs (see D8.4) plus 3 additional ERs (i.e., ER17, ER18 and ER19).

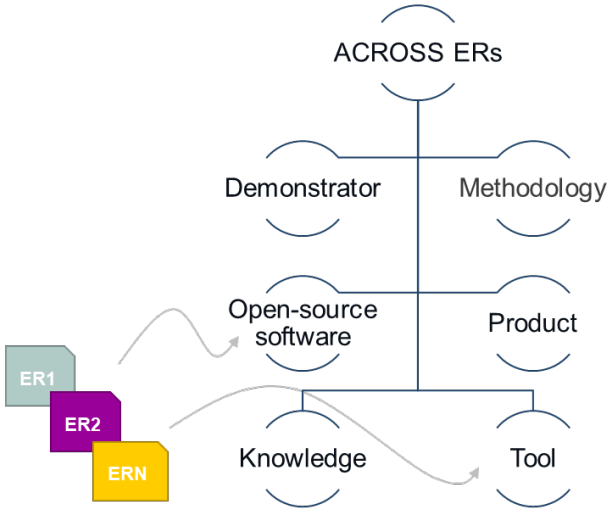

Figure 17 - The 6 categories used to classify the project ERs.

3.3.1.1 Exploitation of Results in HPC facilities

Supercomputing partners will financially exploit the ACROSS solutions by integrating the technologies at their existing infrastructure (e.g., extension of IT4I's HPCaaS platform, integration with CINECA's pre-Exascale Leonardo supercomputing environment) for serving EU users including industries, public administrations, and SMEs.

CINECA is, at present, installing the EuroHPC pre-Exascale Leonardo supercomputer within the new datacentre located in the Tecnopolo of Bologna, that will be operational at the end of 2022, to become the main infrastructure for delivering services to all CINECA stakeholders and customers. It is based on ATOS BullSequana XH2000 technology and features nearly 14,000 NVIDIA Ampere architecture-based GPUs and NVIDIA Mellanox HDR InfiniBand. It will deliver 10 EFLOP/s of FP16 AI performance and will be capable of an aggregated HPL performance of 250 PFLOP/s and equipped with over 100 PB of State-of-the-Art storage capacity.

The strong collaboration between CINECA and ATOS in the Leonardo project will foster the porting, testing and evaluation on the new system of the ERs developed by ATOS in ACROSS in the second half of the project, in view of a joint exploitation of them in either internal research activities, funded projects and commercial activities towards industries.

Furthermore, CINECA is developing a collaboration partnership with ECMWF in the framework of the Digital Earth initiative. In the context of this partnership, CINECA will evaluate the porting on the Leonardo supercomputer and the potential exploitation of the tools for efficient data handling and in-situ processing developed in WP6 and described in the deliverable D6.1.

IT4I has been operating since August 2021 the EuroHPC Petascale supercomputer Karolina which is the key infrastructure for delivering services to all IT4I stakeholders and customers. Karolina is based on AMD EPYC™ architecture processors and features nearly 576 NVIDIA Ampere architecture-based GPUs and NVIDIA Mellanox HDR InfiniBand. The Karolina cluster consists of 829 compute nodes, totalling 106,752 compute cores with 313 TB RAM, giving over 15.7 PFLOP/s theoretical peak performance.

The strong collaboration between IT4I and ACROSS project partners will foster the porting, testing and evaluation of the ERs developed by the ACROSS consortium also at the Karolina supercomputer. The important part of the IT4I activities is the evaluation and integration of the ACROSS technologies with the LEXIS Platform[13] and HEAppE[14] (IT4I in-house HPC-as-a-Service solution). Furthermore, this collaboration

[13] https://lexis-project.eu/web/

[14] https://heappe.eu/web/

can lead to joint exploitation of the ERs developed by ACROSS in either internal research activities, funded projects, or commercial activities towards industries.

Status. The Table 6 below summarizes the report on ERs classified as HPC facilities from M6 to M18.

Table 6 - Report on Exploitation of Results in HPC facilities.

ER#	Type of Exploitable Result	Exploitable Result name	Exploitable Result Description	TRL	Partner	Proof of realisation	Target Classification
ER1	Product	FastML	FastML is a component of the ATOS CODEX AI Suite product. Its goal is to facilitate the ML/DL operation (ML operations), by managing AI models (e.g., training, etc.) and hiding infrastructure and deployment concerns to the user. It will be used, adapted and integrated to other components of the ACROSS software stack, to handle ML/DL workflows.	8	ATOS	FastML enhancements resulting from its ACROSS usage will be available in the ATOS product.	Commercial
ER7	Methodology	AI Acceleration	Hw/Sw extension of HPC architecture to accelerate AI-based applications	5	ATOS	Exploitation by project pilots and/or external applications.	Commercial

3.3.1.1.1 ER1 – FastML

FastML is a component of the ATOS CODEX AI Suite product. Its goal is to facilitate the ML/DL operation (machine/deep learning operations), by managing AI models (i.e., training phase, etc.) and hiding infrastructure and deployment concerns to the user. It will be used, adapted, and integrated to other components of the ACROSS software stack, to handle ML/DL operations involved in the workflows.
In February 2022 (M12), ATOS has released a new version of the FMLE (FastML Engine) with the following new features:

- Tools to manage data object migration to PostgreSQL database
- Database provider for training/subtraining objects (i.e., implementation, interface, etc.)
- FMLE database provider for various objects (Jupiter, datasets, fairing, etc.)
- Tools to manage objects installation and upgrade
- Change FMLE internal database to allow performance scaling
- Implement database providers for all FMLE objects
- Provide a tool to automate object migration to PostgreSQL database
- Allow custom paths for FMLE components at installation time

3.3.1.1.2 ER7 – AI Acceleration

HW/SW extension to be integrated in the HPC architecture to accelerate AI-based applications. To pursue this, ATOS has implemented a prototype solution (with adaptation of install script and a few code modifications plus configuration changes) to install all FMLE components on a VM outside of the HPC cluster (with

prerequisites such as access to HPC users, access to the shared filesystem, access to slurmctld). The so far prototype allowed the achievements of the following targets:

- Validation of the installation
- Basic tests (functional and performance tests)

The work on the acceleration of AI in an HPC environment has focused on 2 axes:

- HW/SW acceleration of classical ANN/DNN using general purpose technologies (GPU/FPGA) but also dedicated technologies (VPU). In conjunction with hardware, multiple layers of software are required to interface with existing standard frameworks
- Investigation of Neuromorphic Computing, from concept to implementation (including modelling, simulation/emulation)

The first of these two approaches are the most advanced and therefore it would be possible, for a near future, to move towards the industrialization of the developed solutions.

3.3.1.2 Exploitable Results in ACROSS SW/HW complex workflows

Prototypes developed in the ACROSS project will be subjected to an industrial evaluation and validation in order to transform into products and services (e.g., enhancing ATOS CODEX AI products suite, LINKS's orchestration tools, extending INRIA's Damaris middleware, improving CINI's HPC4AI centre services).

Status. The Table 7 below gives the report of ERs for SW/HW complex workflows.

Table 7 - Report on SW/HW complex workflows.

ER#	Type of Exploitable Result	Exploitable Result name	Exploitable Result Description	TRL	Partner	Proof of realisation	Target Classification
ER3	Product	YSTIA YORC Orchestrator	YORC is a TOSCA based orchestrator available under open-source licence. It manages deployment and execution of software application & workflow on any infrastructure. It will be extended according to ACROSS requirements.	7	ATOS	YSTIA/YORC orchestrator is available as open source, it is used within ATOS products like ATOS CODEX AI Suite, by some external users, and within other collaborative projects. New versions will benefit from the ACROSS related enhancements.	commercial
ER4	Open-source SW	OPM Flow for carbon sequestration	The OPM Flow software can be used by stakeholders in industry, academia and public sector to perform assessments and studies of large-scale carbon sequestration scenarios and strategies, and drive decisions on such.	7	SINTEF	Deliverable D7.7. New improved capabilities merged into OPM Flow main branch, accessible by stakeholders outside the ACROSS consortium.	technology

ER6	Tool	HyperTools tool chain extension by Pilots requirements	HyperTools is an acronym for a set of software for different users orchestration requirements. We will extend the selected one by the ACROSS requirements. All these software are currently under open source license.	7	IT4I	Pilots and external third party - integration the ACROSS extensions into the other SW solutions developed by IT4I for orchestration. The sustainability of this result is key for IT4I for its users.	technology
ER9	Open-source SW	WARP	WARP (Workflow-aware Advanced Resource Planner) will be the component responsible to provisioning HPC compute resources aiming at providing more deterministic workflow execution and reducing the makespan execution time. The module will work synergically with the batch schedulers.	7	LINKS	A proof of concept will be created and tested within the ACROSS project. The software will be made available on a public repository.	research
ER10	Methodology	Design System 1	Foster extensive use of state-of-art HPC solutions to sustain and support AVIO Aero products excellence that means, specifically for Across project, aeronautical combustor and turbine design systems. Aim is to develop advanced modelling and, at the same time, reduce the required computational efforts and time.	7	AVIO	50% time reduction in computing time for turbine advanced design workflow and better accuracy for the combustor case to improve metal temperature prediction, product durability and life cycle cost	commercial
ER11	Open-source SW	Parallellized open-source software version	The multi-threated and parrallized version of the wflow_sbm Julia software developed on a GitHub branch, once tested and evaluated becomes merged with the main branch to become publically available.	9	DELTA	Updated and tested code added to main branch on GitHub page	Technology
ER13	Methodology	Queue timing prediction	We will integrate our methodology for analysing and predicting queue waiting time of jobs into the middle-level orchestration layer of the ACROSS orchestration system	2 to 3	LINKS	Analysis of the devised methodology have been conducted on a dataset collected on a real cluster. Results of the analysis will be reported on a scientific paper.	research

ER14	Methodology	Design System 2	Innovative Design approach CFD based leveraging on AI/HPC. The Pilot in the ACROSS project will provide an example of the potential innovation of such an approach. This methodology will be adopted as a very powerfull approach for facing complex design phases, when multidisciplinary aspects are involved, and multi-fidelity analysis are available. The methodology behind the new Design System developed in ACROSS will open important possibilities in several other fields of application in which CAE and AI tools can be combined and exploited leveraging on HPC resources.	8	MORFO	Multi-fidelity CFD Database creation of Optimal Geometries and Aero-engine Turbine aerodynamic design pilot Demo	commercial
ER15	Methodology	License Agreement	Internalisation and implementation of the U-THERM3D procedure in Avio Aero practices for the design of aeronautical combustors. The optimised tool within the ACROSS project will allow a much faster design of combustors without loss of quality due to steady simulations or where certain effects are neglected for the calculation of thermal loads (standard practice in the early stages of design).	8	CINI - UNIFI	Standardisation of the optimized U-THERM3d tool for implementation in Avio Aero's internal combustor design procedure	research
ER16	Demonstrator	CDO-FDB-Connector	To allow the climate model ICON to directly write to the DB fdb the central MPI-M I/O library libcdl is extended to copy data via the climate data operators (CDO) application to an fdb DB instance	6	MPI-M	Optimized Obect Store, handling of all data sets of the pilot, support of complex WFs using semantic queries	commercial

ER17	Knowledge	STARCCM+ performance on HPC	The commercial code STARCCM+ is tested on different HPC clusters for a LES calculation on LPT blades. Scalability results will be exploited to estimate computational costs for future activities as well as for proving the code capability to leverage HPC resources. This information is relevant when competing for high-fidelity calculations. They will also adopt to prove the feasibility of the High-Fidelity calculations leveraging on HPC resources, thus enabling this analysis in an industrial context.	8	MORFO	Results on a dedicated test case are collected in terms of computational time on different HPC clusters. Charts highlighting these results have been shared in a dedicated technical meeting between WP5 and WP2	strategic knowledge
ER18	Methodology	Data Analytics for High-Fidelity turbomachinery simulations	Implementation of a series of routines for the reduction of high-fidelity simulations of turbomachinery components. The methodologies and tools developed within ACROSS will allow an "on the-fly" reduction of very large data set to relevant information for turbomachinery industrial designers.		CINI – UNIGE	HPC implementation of post-processing routines for online analysis of high-fidelity simulations	technology
ER19	Open-source SW	StreamFlow Workflow Management System	The StreamFlow framework is an open source container-native Workflow Management System (WMS) based on the Common Workflow Language (CWL) standard. So far, StreamFlow is the first WMS implementing the CWL Loop proposal[15], which has been designed in the context of the ACROSS project to satisfy the needs of pilot workflows.		CINI-UNITO	StreamFlow is available as an Open-Source software.	technology

3.3.1.2.1 ER3 – YSTIA YORC Orchestrator

YORC is a TOSCA based orchestrator available under open-source licence. It manages the deployment and the execution of software applications and their related execution steps on any infrastructure. It will be

[15] https://github.com/common-workflow-language/common-workflow-language/issues/495

extended according to ACROSS requirements. So far, a new release of YORC has been delivered on March 2022 (M13) with the following new features:

- Ability to authenticate against OpenStack with token or application credentials
- Allow to replay application execution steps even if they are not in an error state
- Execution steps replays on error

3.3.1.2.2 ER4 – OPM Flow for carbon sequestration by Pilots requirements

The OPM Flow software can be used by stakeholders in industry, academia, and public sector to perform assessments and studies of large-scale carbon sequestration scenarios and strategies, and drive decisions on such.
The suitability for OPM Flow for simulation of large-scale carbon sequestration has been improved in terms of capability and performance. Significant further improvements are expected over the course of the project.

3.3.1.2.3 ER6 – HyperTools tool chain extension by Pilots requirements

HyperTools is an acronym for a set of software for different users' orchestration requirements. We will extend the selected one by the ACROSS requirements. These software are currently under open-source license.
Based on the ACROSS pilot use-case requirements, HyperQueue has been chosen as the solution that accommodates the need for fine-granular distribution of the workflows' tasks. Initial HyperQueue development originated in EuroHPC-JU project LIGATE[16] and ACROSS drives its further extension focusing on multi-node task support required for example by MPI-based applications. ACROSS also aims to extend other tools to use HyperQueue as a supported backend system (e.g., ERT connects to the HyperQueue queue system).

3.3.1.2.4 ER9 – Dynamic Resource Allocator

Based on the ACROSS pilot use-case requirements and the observation that current State-of-the-Art batch schedulers (although they can be configured in a very sophisticated manner) visibility on the entire workflow to execute is limited, LINKS started the development of a solution for managing the allocation of compute resources and scheduling workflows on them, which is aimed at providing a more deterministic execution.
More specifically, during the first half of the project, the characteristics of the SotA batch schedulers available in the HPC infrastructures used for the project purposes have been learnt; generally, the configuration of the batch scheduler is set at the beginning by system administrators and may not match the changes that arise over the time on the system conditions. Furthermore, the execution of workflow's jobs is non-deterministic since they must enter queues whose dynamic greatly changes over the time.
To better support the execution of pilot workflows, the WARP module (being part of the ACROSS orchestrator) has been devised. The main idea behind it is that of allowing the provisioning of HPC resources in a deterministic way, which in turns translates into a deterministic execution of the workflow. The module aims to reduce the makespan time also in those cases where the maximum clock wall time set for the jobs exceeds that of any queues in the system. Given that, a more efficient use of the compute resources can be achieved. WARP is under developing at the time of writing this deliverable and will be released as an open-source software through a public repository. Although being born in the ACROSS context, there will be further potential achievable results: if combined with a logic that is able to predict the types of jobs that will be scheduled by the batch scheduler at certain point in time, more possibility of optimizing the process of resource reservation will arise.

3.3.1.2.5 ER11 – Parallelized open-source software version

Updated and tested code added to main branch on GitHub page.

[16] https://www.ligateproject.eu/

3.3.1.2.6 ER13 - Queue timing prediction

The optimization of workflow execution passes through a proper management of the jobs, and specifically through the optimization of the jobs' submission time. Indeed, where compute resource reservation cannot be used, jobs enter the HPC execution system passing through the traditional queuing system, where they are subject to the variability of the queuing time. LINKS started to investigate how to approach the problem of predicting the queuing time expected for a submitted job given the specific features of the submission queue. The devised methodology largely leverages on ML/DL techniques to learn from historical data. This methodology has been investigated during the first half of the project lifetime; thus, a clearer view of its maturity degree will be available in the second half of the project.

3.3.1.2.7 ER10 - Design System 1

Foster extensive use of State-of-the-Art HPC solutions to sustain and support AVIO Aero products excellence that means, specifically for ACROSS project, aeronautical combustor and turbine design systems. The aim is to develop advanced modelling and, at the same time, reduce the required computational efforts and time.

3.3.1.2.8 ER14 – Design System 2

Innovative design approach for CFD based leveraging on AI/HPC. The aeronautics pilot (WP5) in the ACROSS project will provide an example of the potential innovation of such an approach. This methodology will be adopted as a very powerful approach for facing complex design phases, when multidisciplinary aspects are involved, and multi-fidelity analysis are available. The methodology behind the new Design System developed in ACROSS will open important possibilities in several other fields of application in which CAE and AI tools can be combined and exploited leveraging on HPC resources.
The achievement of ER14 is ongoing and it is expected to be completed at M30. In the first half of ACROSS, a big effort has been done to develop the tools (e.g., automation of URANS optimization campaign, AI tools, LES pre/post-processing) involved in the complex turbine workflow, and to validate and implement them on the Galileo100 HPC infrastructure (CINECA). As reported and discussed in detail within the Deliverable D5.1, a first step in the Design System development has been done by the creation of first database at M18. This database has been used to perform a first application to blade design and start to consolidate all the tools that will be adopted within ACROSS for all the optimization campaigns need to build the turbine Design System.

3.3.1.2.9 ER15 – License Agreement

Internalisation and implementation of the U-THERM3D procedure in Avio Aero practices for the design of aeronautical combustors. The optimised tool, which is an outcome of the activities carried out in the ACROSS project, will allow a much faster design of combustors without loss of quality due to steady simulations or where certain effects are neglected for the calculation of thermal loads (standard practice in the early stages of design).
In the first 18 months of the project, the new and optimised workflow of the U-THERM3D procedure was defined. The previous data management based on I/O operations was partially revised and replaced. The new interaction between convection and conduction heat transfer mechanisms is solved in a single session of the ANSYS Fluent solver, eliminating I/O time for updating boundary conditions on coupled surfaces. This new procedure was first developed on a simplified test case and then validated on an academic, but challenging, combustor design: the TECFLAM burner. The new data management is much more efficient, requires much less configuration and reduces the time needed to prepare the calculation domain, which is mandatory before a CFD simulation can be carried out. All these aspects, although they do not directly affect calculation time, are fundamental to the internalisation of the tool within a standardised procedure for the aeroengine combustors cooling systems design.
At the same time, the first management was revised to take into account the effect of radiative heat transfer. For this phenomenon, it was decided not to vary the logic and management of the data to be exchanged between the coupled simulations but to act on the coupling frequency between the two domains. In recent months, studies have been carried out on a simplified test case for the definition of the optimised coupling

frequency. An estimate of the savings in terms of calculation time has not yet been carried out in a rigorous manner, given the extreme simplicity of the test case considered, but it should result in a calculation time saving of around 10%. The new procedure will be applied on another academic combustor, the FIRST burner, on which validation will take place and a rigorous estimate of the calculation time saving will be made.

3.3.1.2.10 ER16 - CDO-FDB-Connector

To allow the climate model ICON to directly write to the FDB database, the central MPI-M I/O library *libcdl* is extended to copy data via the climate data operators (CDO) application to an FDB database instance.

3.3.1.2.11 ER17 – STARCCM+ performance on HPC

The commercial code STARCCM+ is tested on different HPC clusters for a LES calculation on LPT blades. Scalability results will be exploited to estimate computational costs for future activities as well as for proving the code capability to leverage HPC resources. This information is relevant when competing for high-fidelity calculations.
They will be also adopted to prove the feasibility of the High-Fidelity calculations leveraging on HPC resources, thus enabling this analysis in an industrial context.
The ER17 has been reached during the first half of ACROSS. First results concerning commercial code STARCCM+ scalability for LES calculations on LPT blades, obtained in the new Galileo100 (G100) cluster at CINECA, have been already discussed in Deliverable D2.2: computational domain of about 42M cells and number of nodes up to 14. New tests have been repeated considering a larger domain (110M cells) and a higher number of nodes (up to 40 nodes) per calculation. The results of this second test campaign are reported within the Deliverable D5.1. Both the test has put in light that STARCCM+ features an excellent scalability enabling an effective exploitation of the HPC infrastructures, in term of relative time and speed up. All these results are significant for large LES calculations, that are really demanding in terms of both computational resources as well as time to solution and put the basis to enabling this analysis in an industrial context.

3.3.1.2.12 ER18 - Data Analytics for High-Fidelity turbomachinery simulations

Implementation of a series of routines for the reduction of high-fidelity simulations of turbomachinery components. The methodologies and tools developed within ACROSS will allow an “on-the-fly” reduction of very large data set to relevant information for turbomachinery industrial designers.
During the first half of ACROSS, the best strategy for the data reduction of large high-fidelity simulations of turbomachinery components has been identified and implemented through MATLB, while it has been moved on Python (HPC environment) in a subsequent stage. The procedure is fully implemented on MATLAB and consolidated at the M18 of ACROSS, it is now being ported to Python in order to better exploit multi-core execution and future implementation of almost real time data analytics of turbomachinery high-fidelity simulations.

3.3.1.2.13 ER19 - StreamFlow Workflow Management System

The StreamFlow framework is an open-source container-native Workflow Management System (WMS) based on the Common Workflow Language (CWL) standard. It allows the execution of tasks in multi-container environments and hybrid workflow executions on top of multi-cloud or hybrid cloud/HPC infrastructures. It will be enhanced according to ACROSS requirements. So far, StreamFlow is the first WMS implementing the CWL Loop proposal[17], which has been designed in the context of the ACROSS project to satisfy the needs of pilot workflows. In addition, the persistence layer has been improved to better support provenance and fault-tolerance in workflow executions.

[17] https://github.com/common-workflow-language/common-workflow-language/issues/495

3.3.1.3 *Exploitable Results in ACROSS Marketplace (industry vertical solutions)*

The aim of this plan is twofold: *i*) find effective ways to commercially exploit the advanced vertical solutions that stem out of the project, and *ii*) make the marketplace sustainable after the end of the project.
Prototypes developed in the ACROSS project will be subjected to an industrial target sector-specific evaluation and validation (Task 8.1) in order to transform into products and services; the partners working on industry vertical solutions can exploit the following ideas:

- Direct financial profit based on licensing and IPR (e.g., ECMWF weather products and data portfolio, NP's smart farming "gaiasense" services for supporting farmers in Greece, CINI's U-THERM3D tool for AVIO Aero, MORFO's design system –relying on data-centric environment, driven by AI and capable of exploiting advanced HPDA techniques– for turbine applications to be used for AVIO Aero) or other industrial applications wherever aerodynamics plays a key role, like Energy, Renewables, Automotive and Sports.
- Utilisation of the AI/HPC technologies and generated innovation and knowledge to advance research and future products, such as: AVIO Aero's next generation greener and safer aeronautical engines for Boeing and Airbus in 2025+ Technology roadmap, allowing reduced fuel consumption, low emissions, extended durability, DELTA's faster and improved version of the WFLOW model for future operational hydrological forecasting systems within Delft-FEWS to provide improved warnings and support many countries and agencies both in Europe and globally.
- Providing entities for carbon sequestration and utilisation: assessment, validation, planning and optimization. Offer services to industry entities of any size for development in reservoir simulation (main exploitation mechanism for SINTEF). Take advantage of the open-source price advantage to gain entry to market for small and medium enterprises, offer customization.

The partners working on WP5 (greener aero-engine modules optimization pilot), WP6 (weather, climate, hydrological and farming pilot), WP7 (energy and carbon sequestration pilot) will be involved in this plan to work on this activity while target sector pilots' partners, industrial partners, research partners will be main stakeholders of this plan.

Status. The Table 8 below gives the report on ERs for Marketplace (industry vertical solutions).

Table 8 - Report on ERs for Marketplace (industry vertical solutions).

ER#	Type of Exploitable Result	Exploitable Result name	Exploitable Result Description	TRL	Partner	Proof of realisation	Target Classification
ER2	Product	Parallellized wflow_sbm adopted for operation forecasting	Reach the point where the tested speed-up version of the wflow_sbm model will be passed on to the Dutch operational water autorities to be tested within operational setting and ultimately incorporated as part of the national hydrological forecasting suite for flood and drought forecasting and monitoring within the Netherlands	7	DELTA	Updated model delivered to operational authorities where will be evaluated and considered for operations	Demonstrator

ER8	Demonstrator	IFS global NWP model working at 5km	We will demonstrate the IFS global NWP model working at 5km resolution and adopted as input model for downstream applications (hydrological simulation and mesoscale downscaling)	8	ECMWF	Exploitation by downstream application in WP6 workflows and/or external applications. Output data archived and available on MARS or CDS archive.	Demonstrator of pre-exscale scalability
ER12	Demonstrator	Mesoscale weather simulations & forecasts	Downscaled weather simulations & forecasts will be conducted over Greek Peninsula in the context of smart farming applications	7	NP	Deliverable D6.4. Public demonstration in relevant environment (smart farming applications)	Pilot Demonstrator, pipelines & methodologies

3.3.1.3.1 ER2 - Parallelized wflow_sbm adopted for operation forecasting

Reach the point where the tested speed-up version of the wflow_sbm model will be passed on to the Dutch operational water authorities to be tested within operational setting and ultimately incorporated as part of the national hydrological forecasting suite for flood and drought forecasting and monitoring within the Netherlands.

3.3.1.3.2 ER8 - IFS global NWP model working at 5km

We will demonstrate the IFS global NWP model working at 5km resolution and adopt as input model for downstream applications (hydrological simulation and mesoscale downscaling).

3.3.1.3.3 ER12 - Mesoscale weather simulations & forecasts

The following progress has been made so far in respect to ER12 (also documented in D6.4 submitted on M16):

- The WRF version 4.3 has been installed and configured on the “Galileo 100 (G100)” supercomputer of CINECA. WRF is set up in 3 domains: one parent and two nested. The parent domain (namely D01) consists of 600x600 grid points and covers the whole Europe, the Mediterranean, the North Africa, and the Saudi Arabia Peninsula with a resolution of 12x12 km. The remaining two nested domains cover the biggest part of the Mediterranean and Greek peninsula (namely D02 and D03 respectively). D02 consists of 691x511 grid points with a resolution of 3x3 km, while D03 consists of 901x901 grid points with a very fine resolution of 1x1 km.
- Preliminary simulations have been executed in order to test the performance/speed of WRF on G100. The aim is to produce 84h of forecasts in less than 4h. Various numbers of nodes and CPUs are used. The best performance is achieved by using 48 nodes and 48 CPU cores per node as a 84h forecast is completed in approximately 3.5h. The use of 32 nodes with 48 CPU cores per node gives inferior results (5.5h for 84h of forecast) while 64 nodes (also with 48 CPU cores per node) perform approximately the same as 48 nodes.

3.3.1.4 Report on Exploitation results in Research/Scientific

The activities in this plan will be oriented to leverage the achieved project results (i.e., developed technological solutions, methodologies, etc.) for advancing and enriching research and education agendas and relevant material. This also implies the participation in international conferences and research events/fora/panel discussions, as well as the active contribution to thematic working groups. Also, the activities include establishing strong connection with the European HPC community including EuroHPC projects.
At the moment of writing this deliverable, the ACROSS consortium leveraged the so far achieved results to pushing out actions aimed at steering agendas and relevant material promoted by decision maker bodies. As such, ACROSS established a connection with some of the most relevant bodies in the context of HPC domain in Europe, specifically the HiPEAC network of excellence and the ETP4HPC initiative. In particular, with

regards to this latter, ACROSS contributed actively to the definition of their next Strategic Research Agenda (SRA5) by emphasising how some of the research activities carried out in the WP4 need attention by the whole HPC community and will become more relevant in the design of future HPC systems. Besides this, ACROSS also established a strong connection with other EuroHPC projects, and with some of them it drawn a collaboration path. Specifically, ACROSS has seen large room for cross-synergistic activities in the context of workflow orchestration, where the devised solutions are well suited as complementary to what other projects are developing.
Exploitation of research/scientific results is also pursued by considering the integration of the developed technological solutions and methodologies within platforms and infrastructures developed in the context of other funded projects.

Status. The Table 9 below gives the report on ERs for research/scientific.

Table 9 - Report on ERs in Research/Scientific.

ER#	Type of Exploitable Result	Exploitable Result name	Exploitable Result Description	TRL	Partner	Proof of realisation	Target Classification
ER5	Open-source SW	Damaris Analytics Plugin	Damaris in-situ/in-transit plug-in to enable analytics of streaming data being received from one or more simulations.	8	INRIA	Public release of plug-in enabled Damaris software (https://gitlab.inria.fr/Damaris/damaris)	Open-source software

3.3.1.4.1 ER5 - Damaris Analytics Plugin

The design, development, and preliminary testing of a new capability of the Damaris library has been enabled through work within WP7 (Task 7.3). The new capability has enabled the use of the Python based scripting on the Damaris server-side processing (i.e., a new plugin). The integration of Python brings with it the large open-source software ecosystem of Python, from which the Dask library for distributed processing has been chosen to be further integrated with Damaris. The Dask library is a fully featured distributed processing library that couples nicely with the distributed data accessible from a simulation through the Damaris library. This integration has been shown to enable new workflows, where streaming data can be received from one or more simulations and basic statistical measures (mean and variance) on a per-element basis of an array computed. Example of this has been run on the Grid5000 research computing grid and on the CINECA Galileo100 supercomputer. Work by LINKS is currently enabling the same workflow, which is being integrated with the ACROSS StreamFlow workflow management tool as a first example of a complex workflow using the new Damaris capability.

3.3.2 Market analysis and Business Modelling

This section reports on market trends, opportunities, and value proposition aspects within the framework of the ACROSS project. It is intended to measure the market size and competition as well as market indicators. Activities performed for the market analysis include research and the resulting use of tools

3.3.2.1 Planning of activities

For the market analysis and business modelling the ACROSS partners initiated a set of dedicated exercises in the form of workshops, in order to better map the key market aspects per project domain (aeronautics, weather and climate, energy and carbon sequestration). The following (Table 10) activities were planned and their progress is documented in the next sections.

Table 10 - Planned activities and their progress.

ID	Name	Period	Description & Methodology
Workshop 1	ACROSS Strategic Planning	February 2022	**Goal:** Defining the internal and external factors that might affect the ACROSS project **Activities involved:** 1. Explain PESTLE and SWOT strategic planning frameworks, 2. Conduct PESTLE analysis (analysis of external macro-environmental factors affecting ACROSS), 3. Use the PESTLE analysis to formulate opportunities and threats for a SWOT analysis, 4. Finalize SWOT analysis (sections for strengths and weaknesses, constituting the internal organizational factors that affect ACROSS), 5. Fill PESTLE and SWOT templates. **Expected results:** 1. PESTLE and SWOT analysis conducted for each pilot. 2. Extract insights and lessons learnt. **Methodology & Partners involved:** NP would lead and organize this task. One separate meeting per pilot (3 in total). At least 1 representative from core partner involved in pilots need to be present at the separate meetings. Representatives with market/business experience could be valuable assets. Expected duration: ~2 hours per meeting. • Workshop 1 - Mtg 1: Deep dive into aero-engine modules optimization pilot. Mandatory Participants: CINI, AVIO AERO, MORFO. Optional Participants: LINKS, ATOS, IT4I, CINECA. • Workshop 1 - Mtg 2: Deep dive into weather, climate, hydrological and farming pilot. Mandatory Participants: NP, ECMWF, MPI-M, DELTA. Optional Participants: LINKS, IT4I, CINECA. Workshop 1 - Mtg 3: Deep dive into energy and carbon sequestration pilot. Mandatory Participants: INRIA, SINTEF Optional Participants: LINKS, ATOS, IT4I, CINECA.
Workshop 2	ACROSS Value Proposition	July 2022 (This workshop will be rescheduled in the second half of the project lifetime, i.e., M19-M36)	**Goal:** Defining the ACROSS target personas and the value proposition offered to them. Target personas are extremely important for the ACROSS market segmentation. Worth to note that, with regards to the original schedule —July 2022, the activity related to the identification of target personas took more time than was initially planned. However, given the strategic value that this activity brings for the proper market

			segmentation, the consortium agreed on reschedule the workshops in the second half of the project lifetime. **Activities involved:** 1. Explain the target personas identification methodology and the value proposition canvas, how the last is linked with business model canvas. 2. Identify target personas and their characteristics. 3. Fill value proposition canvas. **Expected results:** 1. Target personas identified. 2. Value proposition canvas filled for each pilot. 3. Extract insights and lessons learnt. **Methodology & Partners involved:** LINKS/CINI would lead and organize this task. One separate meeting per pilot (3 in total). At least 1 representative from core partner involved in pilots need to be present at the separate meetings. Representatives with market/business experience could be valuable assets. Expected duration: ~2 hours per meeting. • Workshop 2 - Mtg 1: Deep dive into aero-engine modules optimization pilot. Mandatory Participants: CINI, AVIO AERO, MORFO. Optional Participants: LINKS, ATOS, IT4I, CINECA. • Workshop 2 - Mtg 2: Deep dive into weather, climate, hydrological and farming pilot. Mandatory Participants: NP, ECMWF, MPI-M, DELTA. Optional Participants: LINKS, IT4I, CINECA. Workshop 2 - Mtg 3: Deep dive into energy and carbon sequestration pilot. Mandatory Participants: INRIA, SINTEF Optional Participants: LINKS, ATOS, IT4I, CINECA.
Offline Exercise 1	Market & Competition Analysis	September 2022	**Goal:** Document key figures about the target market and associated competition. **Activities involved:** 1. Based on the target personas, perform a market segmentation, and extract key figures, i.e., market size, growth rate, etc. 2. Identify and map direct and indirect competitors, including key characteristics. 3. Fill templates for presenting the aforementioned information. **Expected results:** 1. Target market figures extracted and documented. 2. Competition mapping finalized and documented. 3. Extract insights and lessons learnt. **Methodology & Partners involved:** ATOS would lead and organize this task. One separate exercise per pilot (3 in total). Pilot leaders would lead the exercise within the scope of their pilot. Representatives with market/business experience could be valuable assets.

Workshop 3	Finalizing the ACROSS Business Model	Early 2023	**Goal:** Deep dive into the BMC aspects not yet elaborated with special focus on financial viability sections. Provide an updated version of the BMC. **Activities involved:** 1. Present the Business Model Canvas. 2. Identify the costs associated with the commercialization of the ACROSS tools. 3. Identify the revenue streams associated with the commercialization of the ACROSS tools. **Expected results:** 1. Business model canvas updated. 2. Extract insights and lessons learnt. **Methodology & Partners involved:** AVIO AERO would lead and organize this task. One separate meeting per pilot (3 in total). At least 1 representative from core partner involved in pilots need to be present at the separate meetings. Representatives with market/business experience could be valuable assets. Expected duration: ~2 hours per meeting. • Workshop 3 - Mtg 1: Deep dive into aero-engine modules optimization pilot. Mandatory Participants: CINI, AVIO AERO, MORFO. Optional Participants: LINKS, ATOS, IT4I, CINECA. • Workshop 3 - Mtg 2: Deep dive into weather, climate, hydrological and farming pilot. Mandatory Participants: NP, ECMWF, MPI-M, DELTA. Optional Participants: LINKS, IT4I, CINECA. Workshop 3 - Mtg 3: Deep dive into energy and carbon sequestration pilot. Mandatory Participants: INRIA, SINTEF Optional Participants: LINKS, ATOS, IT4I, CINECA.

3.3.2.2 ACROSS strategic planning

ACROSS strategic planning workshops were led by NP. 3 dedicated meetings were conducted with WP5, WP6 and WP7 partners, to collect domain specific information and then explore the possibility for aggregations. The aforementioned meetings were conducted online on 2/3/2022 during the morning and noon (for WP5 and WP6 partners respectively) and 29/3/2022 (for WP7 partners). Consortium partners were instructed to bring representatives from their organisations with business/market expertise to facilitate the execution of the exercise. In order to collect answers from the participants a dedicated Google form was created and shared during the meetings, with the ambition to capture responses and subsequently fill the PESTLE and SWOT templates. SWOT and PESTLE are analytical tools that help identify the key external and internal factors that should be taken into account in order to achieve success in a project or initiative. They are usually used together and are applied in a group setting to support effective strategic planning, decision-making and action planning.

As PESTLE analysis captures external factors affecting the project, its outputs can provide the first inputs into SWOT analysis (in opportunities and threats sections). This is a common approach found in the literature and was decided to be followed within the ACROSS strategic planning workshops as well.

The participants were advised to allocate specific amount of time ~4 minutes per question, so as to brainstorm and answer. Guidelines/advices for answering the questions were offered by NP.

The Google forms included the following set of questions:

General Section:

- Which ACROSS consortium partner do you represent?

- Which use case do you represent?

PESTLE analysis section:

- What Political factors are affecting the project (either for or against)?
- What Economic factors are affecting the project (either for or against)?
- What Social factors are affecting the project (either for or against)?
- What Technological factors are affecting the project (either for or against)?
- What Legal factors are affecting the project (either for or against)?
- What Environmental factors are affecting the project (either for or against)?

SWOT analysis section:

- What are the Strengths of the project team in respect to the use case you represent?
- What are the Weaknesses of the project team in respect to the use case you represent?

After the 3 dedicated meetings, 14 answers were collected in total by the participants and the following results were obtained —see Figure 18 and Figure 19.

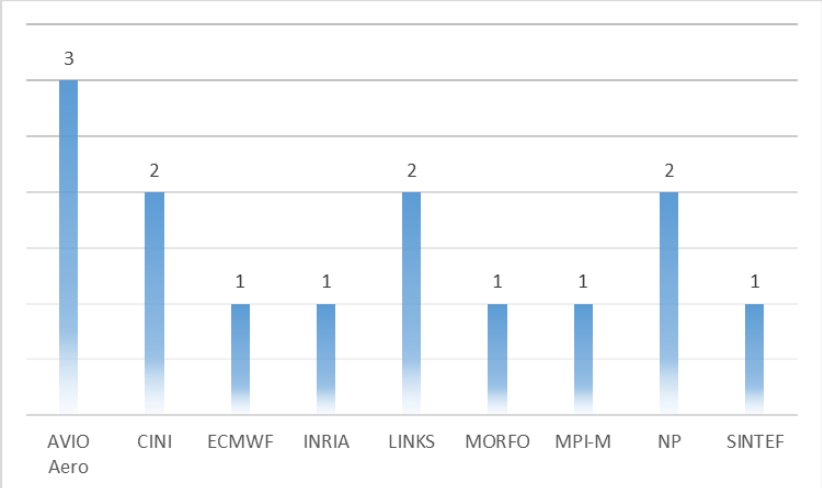

Figure 18 - Representation of ACROSS partners in ACROSS strategic planning workshops.

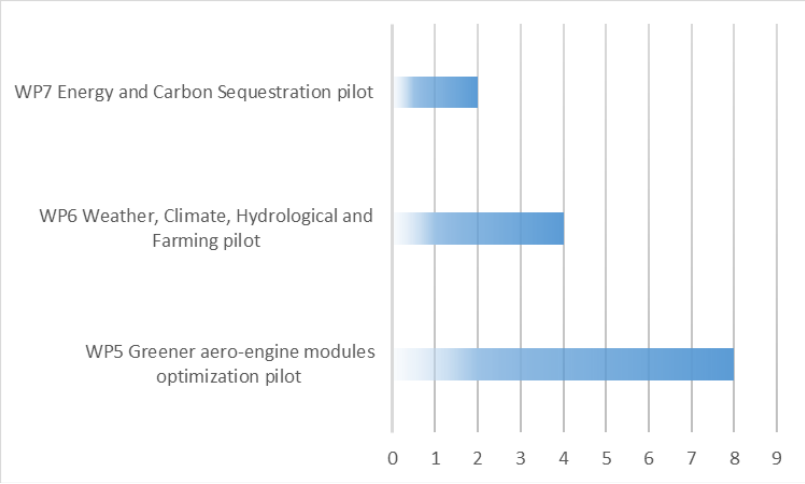

Figure 19 - Representation of WPs in ACROSS strategic planning workshops.

Following the instructions provided, the following PESTLE analysis results have been obtained for WP5, WP6 and WP7.

WP5 PESTLE ANALYSIS	
Political	Economic
• Temporary lack of work because of social and business tensions due to the war in Ukraine. • Expected direction of future policy prospect. • Government resource allocations: HPC development in Europe (and beyond) largely depends on public funding. The ecosystem is strongly dependent on the amount of resources that politics allocates at any time. • The lack of worldwide political balance can affect the project in a negative way. • Armed conflict in Ukraine can induce higher cost and more difficult acquisition of materials needed for HPC developments as planned in ACROSS project. • Government resources allocation to aviation and research (basic research) may affect positively the project in case more resources are allocated. In case of public universities this may translate in the capability of enrolling more people working on the topic. • With regards to the government resource allocations, it is expected it will follow the direction of future political change.	• Temporary lack of work because of: a) aeronautical market contraction caused by travel restriction measures due to new Covid-19 waves, b) labour cost cutting due to the increasing energy/gas prices. • Expected direction of economic change: prevailing economic trends, trade and market cycles. • Economic interventions by governments and their consequences; other relevant economic trends. • Availability of private sector resources relevant for the project/initiative: this is key for bringing results from research to market. In Europe there is less push from the private sector for development of HPC hardware and software. • Changes in economic policies that may lead to changes in the fuels used for aircraft propulsion and thus may affect modeling issues. • Pandemic has impacted negatively to aeronautical business, with research budget being limited very much. Hence, the availability of private sector resources have been reduced. In addition workers could suffer some important lay-off periods, that may reduce working time dedicated to the project. • National investments on infrastructures can reduce the negative impact of Covid-19 pandemic on the project work; for instance, larger investment on communication infrastructures (internet) allowed organizations to (partially) operate remotely. • Economic situation and prospects of aeronautical industries.
Social	Technological
• Temporary lack of work because of social tensions due to the war in Ukraine. • Access to essential services. • HPC is a key enabler for socially impactful innovation: drug discovery, renewable energy, greener aviation, etc. This should be underlined and advertised. • Management style, staff attitudes, organizational culture in AvioAero is always more and more sensible to research topic. Attitude in our company is very positive and open to take this opportunity for improving connection to other partners, network and technology investigation. • Our scope is basic research development, the project itself may have a very positive impact on our University lectures, as well as presentation of the work at conferences may shed light on the	• Delays in releasing newly purchased or very specialized HPC systems due to the global chip shortage. • Technologies and related infrastructures / manufacturing / importing requirements for an initiative to succeed. • EU still depends on foreign technology for HPC hardware. On the other hand, very skilled personnel is available. • ACROSS is intercepting the trend towards more complexity and heterogeneity in HPC applications: interest in workflows is heating up, bearing both competition and opportunities. • Generally, people and also AA is convinced about potential of new digital technologies. This attitude is highly positive. From a company perspective, there is great attention to IP topics

project. Otherwise, social factors may hardly affect our research. • Expected direction of increasing social interest and pressure towards a "greener aviation".	that can limit disclosure of some research results and its sharing. • Within the project we are exploring particular areas of the current aero-engine design space. New technology development (i.e., looking for different design space of future aero-engine) may require the definition of new design space points and hence the project may move towards the new trends. This may impact positively on the project, in case new technology trends are envisioned, moving our basic research toward the future development. Other technology step on the technical (HPC software/hardware) partners may further help the improvement of the project. • Technology transfer from data science to industrial applications, new technologies such as accelerators that could promote the daily use of high-fidelity computation.
Legal	Environmental
• New legislation having an impact on environmental factors (such as further reduction of CO_2 emissions) may make even more challenging the long-term business targets included in the presented aeronautical use cases. • Existing legislation having an impact on any relevant factors (economic, social, technological, environmental or other factors relevant to the issue), or affecting population groups relevant to the issue, or impacting the work of the organization or its partnerships. • Legal aspects of patents and licenses. • Attention should be paid to preserve and keep the control of key technology aspects that can be important from a competitive point of view in the global market. • Basic research on fluid machinery components does not imply any ethical issue that may affect the project. Any benefit from the project may impact positively on CO_2 and pollution reduction thus helping industry and nations to fulfil requirements on pollution reduction. • Increasing of legislation constraints on pollution limits for aeronautical engine.	• Temporary lack of work because of labour cost cutting due to the increasing energy/gas prices. • Trends or expected future developments in the environment. • ACROSS includes activities to improve the energy efficiency of applications running on supercomputers. • Climate change has a big impact on aviation so it is on the basis of the new engine emission limits that research is being done. This is the most impactful aspect out of all the ones introduced above and regarding WP5 activities on the ACROSS project. • A potential risk linked to climate change leading to disasters thus limiting transport, electricity availability, damages to infrastructure. • Because of Covid-19 there was a strong reduction of flights and hence the aero-engine industry was strongly affected. This didn't stop the basic research, but it may have an impact (negative) at the industrial level. • Relevant environmental regulations pushing towards the development of greener engines.

WP6 PESTLE ANALYSIS	
Political	Economic
• Sensitive data - Political cost might be also a negative factor, as it may put the pressure on governments to use new data + HPC infrastructures to take prompt measures (e.g., for civil protection authority). • WP6 processes and outcomes are heavily data-driven. One key aspect is thus data availability. Data providers are mainly national/international organizations that are not keen to distribute their earth observation data openly.	• Still HPC resources is not accessible to everyone (e.g., only for research activities and for limited time to process the data) as high cost accompanies this type of infrastructures. • Weather forecasts are extremely relevant in water management, precision farming, investing on the energy market, etc. Thus, it is expected a growing interest for WP6-related activities in the upcoming years. • One can also expect a growing interest for WP6-related activities from the private sector, while

• Government policies: national, state/provincial, local, other / government resource allocations / stakeholder needs or demands / armed conflicts. • EU Commission's ambition to promote the agenda of HPC affects positively. • Prioritization seems to change easily due to external factors (climate change, war in Ukraine, energy/refugee crisis, etc.).	initially it was only funded by governmental organizations. • Economic situation: local, national, regional, global. • High cost of using HPC infrastructures for real-life applications. Prioritization in terms of investments might change.
Social	Technological
• Climate change and extreme weather events are happening more frequent than ever before. Thus, a huge social factor is the protection of human life and the way we can better forecast and downscale the information to specific areas, in order to increase citizens' awareness through the use (from civil protection authorities) of such vital information. • No major societal factors affecting WP6 have been found, while the successful completion of WP6-related activities may provide relevant resources for the society (i.e., farming advisory services). • Education levels are improving, this is in favour of technologies like HPC.	• There are many technological factors affecting the WP6, e.g., limited time of accessing HPC infrastructures, the connection, integration and automation of HPC systems with other systems (production environments). • There is a positive opportunity for technological transfer from a research/innovation environment to operational services. On the other direction, ACROSS project effort may provide relevant insight on the capabilities of the new HPC technologies and validate the effectiveness of the new pre-Exascale systems. • Technologies and related infrastructures: supercomputer performance is crucial for the WP6's product quality. • Technological progress is important in order to disrupt the status quo in real-life applications.
Legal	Environmental
• Some legal factors may prevent the use of data due to limitation of having access to them due to bureaucratic processes or conflict of interests from one organization to the other • While ACROSS is moving towards an Open-Data approach, data availability is widely affected by the legislation. Moreover, the outcome of numerical models may be used for legally-binding aspects (e.g., alerts issued by civil protection). • International treaties/agreements, either existing or in preparation. • Green Deal, Paris Agreements and other "green" legislations/agreements for a greener future is in favour of project's like ACROSS which promotes innovation in relevant fields/domains.	• HPC are costly and for maintaining such infrastructures may increase the environmental footprint of the service, thus there is need to balance this with the positive impacts on other domains (e.g., saving lives). • While there is not a direct way to affect the environment, ACROSS activities help to mitigate the effect of extreme events, as well as project outcomes can also guide towards a more sustainable development. • Contextually relevant environmental issues: global (e.g., climate change), regional (e.g., flooding, droughts, etc.) or local (e.g., contamination of water supplies), climate, seasonality, potential impacts of weather. • As for the legal aspects, Green Deal, Paris Agreements and other "green" initiatives are push factors for promoting innovation uptake in relevant fields/domains.

WP7 PESTLE ANALYSIS	
Political	Economic
• EU and Norway positive decisions on CCS can be helpful. Similarly, negative decisions may hinder exploitation. • Policies on energy storage. • Allocation of resources to HPC. European push for HPC/EPI may increase resources. • Funding for CCS-related research and piloting is necessary. • ACROSS consortium do not expect national policies on the area (energy storage, involvement in European projects) to strongly change, nor government allocations to have strong impact on the work planned in WP7. Obviously armed conflicts could impact the realisation and exploitation of the results, but that could impact the whole economy in Europe.	• Increased demand for European gas may increase demand for simulations. • High petroleum prices increase available funding for relevant research and development from petroleum companies. • There is national consensus in France, joining a general European trend to support actions to mitigate climate change. The WP7 target application goes this direction. Not only a political, but also an economic push factor.
Social	Technological
• Public perception of carbon capture and storage (CCS) can be controversial. • There is a potential for knowledge exchange increasing. • Increasing interest in CCS in academia, industry, politics and general population. • Public perception may impact national and European policies that can affect the exploitation of the project results, positively or negatively.	• Acceleration technologies (e.g., GPUs, FPGAs, etc.) are becoming more important. • AI techniques (deep-/machine learning) presented as alternative to physics-based simulation, but can also complement simulations. • Open source is a key aspect to consider. • The development of accelerator technologies (GPUS, FPGAs, etc.) along with the development of (pre-)Exascale HPC infrastructures, pushed by national and European policies will favour the exploitation of the outcomes resulting from WP7 activities.
Legal	Environmental
• Paris agreement and similar may create a market for CCS. • Open source: some companies (lawyers) are negative to open source. • Regulation may limit storage operations. • Licensing issues: open-source policies can favour the exploitation of the results. Conversely, limitations to knowledge/technologies transfer would be limiting factors.	• Climate change mitigation. • Carbon storage under land has extra risks compared to undersea storage. • The very purpose of the application area in WP7 is to help mitigate the climate change. The applicability of carbon sequestration can depend on geography (storage under land has higher risks than storage under sea) and on national regulations, which can limit the use of such techniques.

Similarly to PESTLE analysis, a SWOT analysis was also implemented for WP5, WP6 and WP7. It should be noted that the macro-environmental sections of the SWOT analysis —i.e., the opportunities and threats sections— derived from aggregations and filtering from the PESLTE analysis.

WP5 SWOT ANALYSIS	
Strengths	Weaknesses
• Very solid skills of project management and high-level technical skills and expertise in the aeronautical engineering domain. • Comparative advantages (with regards to other actors in the same context) in systems, processes. • Operational efficiency, flexibility, quality standards, other areas. • Team heterogeneity and large network/influence. • The involvement of research centres gives a strong credibility to the scientific areas covered in the project, the union of these with large industrial realities channel the scientific activities of researchers in developing solutions for the increasingly high-performance industrial design activities. • Skills, experience, knowledge (including academic or theoretical, and know-how, i.e., practical or applied knowledge) of the participants to the project. • In addition, a good control and management of the project itself • In the case of a subject like a university that performs basic research on turbomachinery and Big-Data analysis, the exploitation of HPC technologies at research level may strongly increase the competitiveness against other universities, improving skills, experience, and knowledge on these two important topics (Turbomachinery and Big-Data analytics). Leveraging on this, new courses can be created; for instance, a course on Big-Data analytics on fluid machinery. Because of ACROSS, partners started and increased the collaboration with leading universities on fluid machinery computation such as University of Melbourne and KTH (Sweden). • Competence heterogeneity: academic or theoretical knowledge from research center and industrial know-how, presence of partners with a long-lasting experience in HPC sector and engine design, presence of leaders in the field of HPC provider and aeronautical engine	• Temporary lack of Digital Technology people caused by resignation due the present labour market in DT (currently very active). • Delays in releasing newly purchased HPC systems due to the global chip shortage. • Temporary lack of work because of: a) aeronautical market contraction caused by travel restriction measures due to new Covid-19 waves, b) labour cost cutting due to the increasing energy/gas prices, c) social and business tensions due to the war in Ukraine. • Other competing priorities (which may be core activities), pressures and internally imposed timelines that detract from available capacity. • Focus of project is quite broad. • Many components with competing constraints should be integrated. This implies the use of existing components can improve adoption but can bear more technical/integration difficulties with respect to building something from scratch. • The high specialization of the team members does not allow a high comparison with other WP, both for the different technical aspects treated and from a project management point of view. • Other competing priorities (which may regard core activities of AVIO Aero), pressures and internally imposed timelines that could detract time to ACROSS participants from available capacity. Another weakness which could take effect in the future is a change or departure of key staff members. • Weakness will may take effect at the end of the project if we will not have the possibility to use HPC computational resources that are actually employed within the project. The tools developed now are scalable and well suited just for HPC infrastructures and it will link future research plan to the availability of the computational resources. Weakness will arise in case this opportunity (availability of HPC resources to the universities) will not take place in the future. • Weak link between HPC and use case experts.
Opportunities	Threats
• HPC creates new opportunities for socially impactful innovation: drug discovery, renewable energy, greener aviation, etc. • There is an increasing social interest and pressure towards "greener aviation".	• Temporary lack of work because of social and business tensions due to the war in Ukraine. • Expected direction of future policy prospect. • HPC is still largely dependent in government resource allocations. Private funding allocation is still limited.

• ACROSS is intercepting the trend towards more complexity and heterogeneity in HPC applications: interest in workflows is heating up, • New legislations but also environmental concerns (climate change) are pushing towards less CO_2 emissions, greener engines, etc. • Very skilled personnel is available in EU.	• Aviation industry was severely affected by Covid-19. As such innovations in the field are in risk. • EU still depends on foreign technology for HPC hardware. A major threat comes from the delays in manufacturing newly purchased or very specialized HPC systems due to the global chip shortage

WP6 SWOT ANALYSIS	
Strengths	Weaknesses
• Multidisciplinary expertise (Meteo, ICT and Big-Data) are working together (team up) to achieve the needed objective/goals and develop the needed services that could be of great value. • Provision of the needed funds/resources. • The reputation of the partners, the scope (weather, climate, hydro and impact), the availability of very strong technological partners providing. • Skills, experience, knowledge, scientific novelty due to advanced performances and methodologies. • Strong domain capacity and technological specializations are exhibited from WP6 partners. • Influential organisations which are leaders in their domains.	• Long and slow processes to provide access to both the needed data and HPC capacities. • Limitation on using HPC capacities. • Each organization has different research priorities. • While the key partners of WP6 are more than capable to develop the planned innovations, there is a need to increase the cooperation to maximise the outcome of the project. • Minor delays due to infrastructure technical issues (those problems will be solved in the future). • Constant connection with the market and the needs of end-users will affect positively the project.
Opportunities	Threats
• EU Commission's agenda to promote the applied usage of HPC environments. • Private sector interest is growing. • Climate change and extreme weather events are push factors for innovations towards their mitigation. • Education levels are improving and there is room for knowledge transfer among organisations of different nature. • Various policies like (Green Deal, Paris Agreements and other "green" initiatives) are fostering innovation uptake in relevant fields/domains.	• Data availability is key. As data providers are mainly national/international organizations that are not keen to distribute data openly. Also legislation might affect data availability. • Prioritization of funding, investments and resource allocation. • High cost of using HPC infrastructures for real-life applications. • Some legal factors may prevent the use of data due to access limitations or conflicts of interest.

WP7 SWOT ANALYSIS	
Strengths	Weaknesses
• Access to strong HPC resources. • Good reputation of the groups involved. • At leading edge of relevant computational method research. • Strong industry backing. • We think the consortium includes solid partners with relevant industrial and academic partnerships outside the consortium, which will favour the exploitation of the results.	• Groups have not worked together before. • Behind on parallel scaling. • No direct industry participation. • The limited number of relevant, competent human resources can lead to slow progress (slower than we might hope).
Opportunities	Threats

• Policies on energy storage and HPC at national and EU level. • Increase on research funding due to increased gas demands and petroleum prices. • Mitigation of climate change (political & economic/industrial push factor). • Increasing interest in academia, industry, politics and general population.	• Public perception of carbon capture and storage can be controversial. This might hinder the uptake (and funding) of the technology. • Still the risks are high when it comes to carbon storage under land. • Open source is not positively perceived by some lobbies.

3.3.2.3 Value proposition

Value proposition is an important aspect in the process of supporting the creation of a set of technical solutions aimed at supporting the needs of ACROSS stakeholders and to understand how to better exploit results and outcomes of the technical project activities. This said, the ACROSS consortium agreed in setting up specific activities that are of help in defining the benefits that ACROSS platform will be able to deliver to different stakeholders. As such, the activities started to be organized around the "Value Proposition Canvas" model (see Figure 20) which provide a useful mean, on the one hand, for analysing the needs of the specific targeted category of end user (see the right side of the model in Figure 20) and, on the other side, to provide specific link to the solutions provided by the ACROSS project (see the left side of the model in Figure 20).

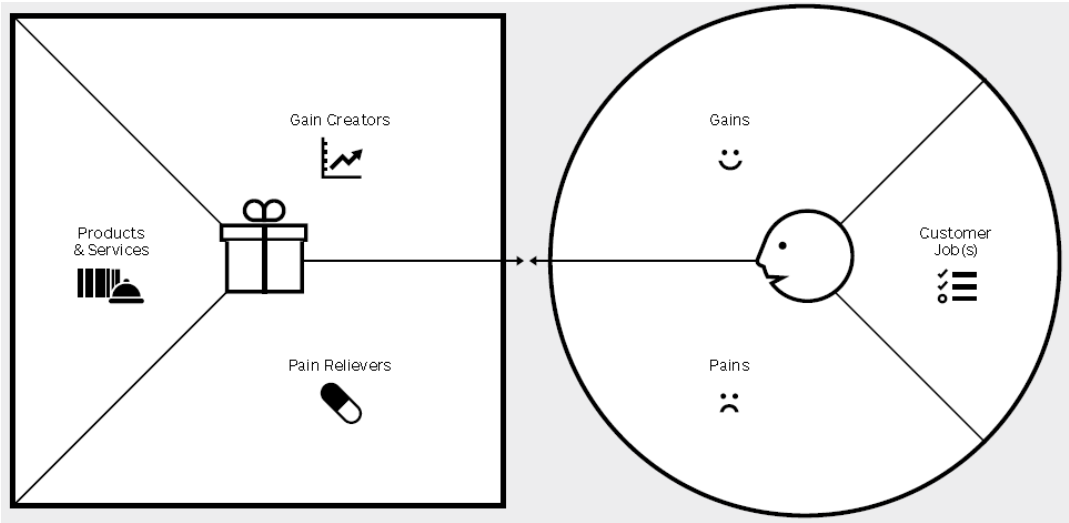

Figure 20 - Value Proposition Canvas model.

In order to support such activity, specific technical workshops have been planned. These workshops aim at clearly identifying the "needs" end users have in carrying out their research/development activities (represented by the 'pain' labelled slice in the right part of the model) and what should be the benefit brought by adopting the ACROSS platform solutions (represented by the 'gain' labelled slice in the right part of the model). All this passes through the identification of key target personas that will be representative of important segments/domains for the ACROSS project; as such, we decided to split the workshops by pilots, and identifying specific partners that will help in the definition of the profiles of such target personas. As a supporting tool, an online (Google) web-form has been created with a list of few open questions that identified partners will help to answer. For instance, the web-form has been organized in such a way to gather the following information from the attending partners of the workshops:

- Short description of the partner role in the project

- Identification of the main characteristics defining the profile of the key persona representing a certain domain/sector of interest for the ACROSS project
- Identification of the needs (technological needs, infrastructural needs, etc.) that also motivated the partner to be part of the ACROSS consortium and that are representative of the key persona needs
- Description of the expected solutions covering the provided needs

The workshops will be co-organized and scheduled as online event along with the pilots starting from M19. Section 3.3.3.1 also provide some additional information concerning the structuring of the workshops.

3.3.2.4 ACROSS business model

Taking into account feedback provided by EAB members, but also insights from the strategic planning workshops, an updated version of the business model of the project was created, using the Business Model Canvas (BMC) —see Figure 21.

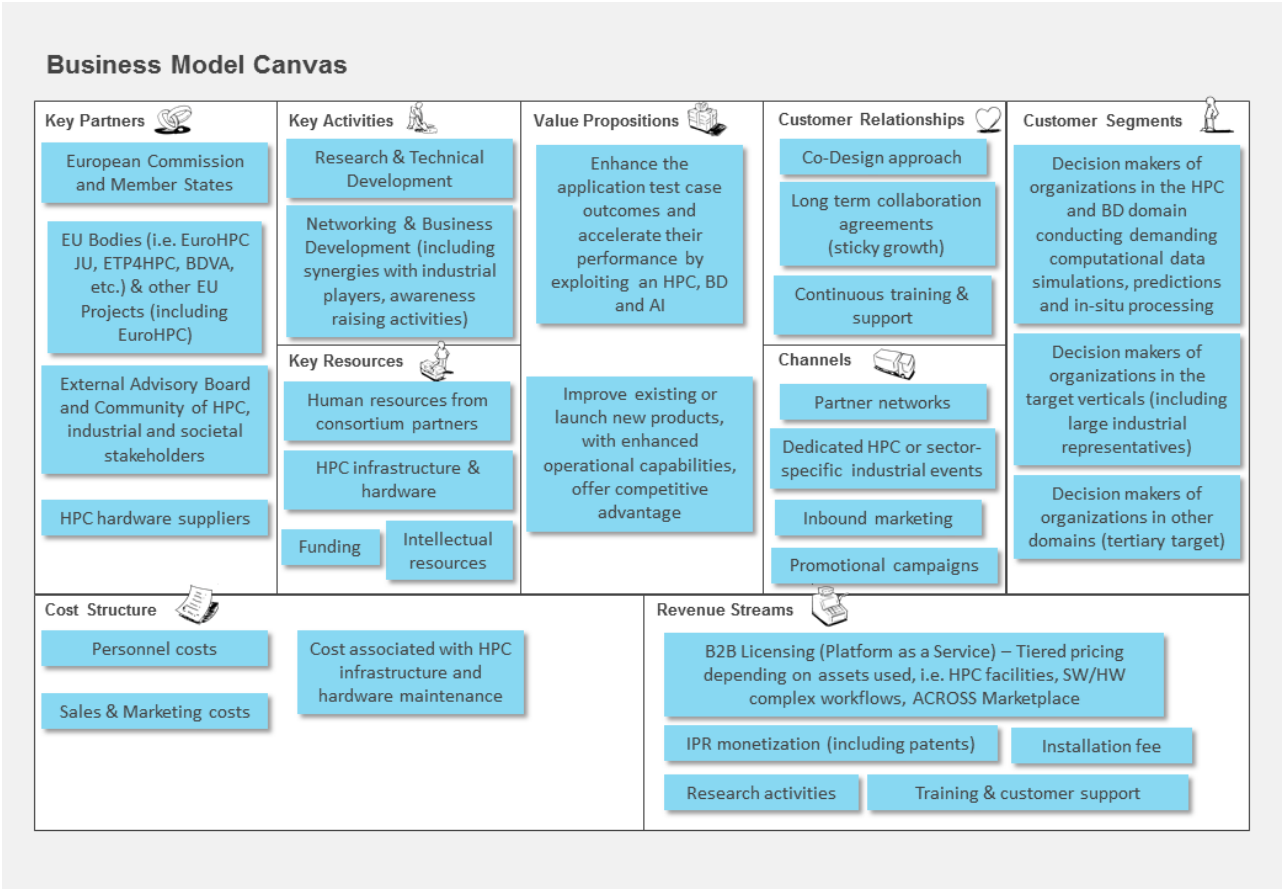

Figure 21 - Updated business model of the ACROSS project.

The BMC is a great tool to help you understand a business model in a straightforward, structured way. The updates from the initial business model, offered within the DEC plan, refer to:

- Focusing more on large industrial players as potential customers,
- Offering trainings as a revenue stream and customer support/engagement mechanism,
- Highlight the importance of awareness raising activities, especially for aspects that can be considered ambiguous (i.e., environmental impact, energy and carbon storage, cost-benefit for the society),
- Put emphasis from a cost perspective on HPC hardware and its availability,
- Financial resources (external EU or national funding is very important for the continuation of such activities, like ACROSS),

- Alternative revenue streams dedicated both on tools and services (installation fees, training, and customer support fee).

An updated version of the business plan is expected as part of the D8.9 (M36) along with more elaborated descriptions of its main building blocks (i.e., value propositions, revenue streams, channels, etc.). This will come naturally, as a result of the "Finalizing the ACROSS Business Model" workshop which is expected to be conducted by consortium partners during early 2023.

3.3.3 IPR management

Throughout the duration of the project, the partners report any project-generated methodologies and technology components to the BIM and Project management. Partners should also report to the BIM manager and Project Management any Third-Party components used by the ACROSS Project. The topic of Third-Party property rights is described in detail in the Consortium Agreement – CA [RD.2] (see in particular Attachment 3) and the GA [RD.1].

3.3.3.1 Patents management report

ACROSS is unlikely to produce patents as its core deliverables are not patentable. However, new innovative products resulting from the project can potentially lead to patents which would certainly be very interesting for the industrial partners participating in this project.

Status. No patents so far.

3.4 Evaluation: KPIs

The exploitable results are expected to be exploited by products, services, trainings, etc., anything out of ACROSS. It is therefore hardly to predict how many and when the planned ERs will be exploited and so to define the KPIs.
ACROSS project will however be willing to provide the evaluation of exploitable results' effectiveness by analysing and assessing the content in the Exploitable Results (ER) —see Section 3.3.1 and subsequent (which also contain summary tables)— to elect the top 5 according to the criteria explained below.

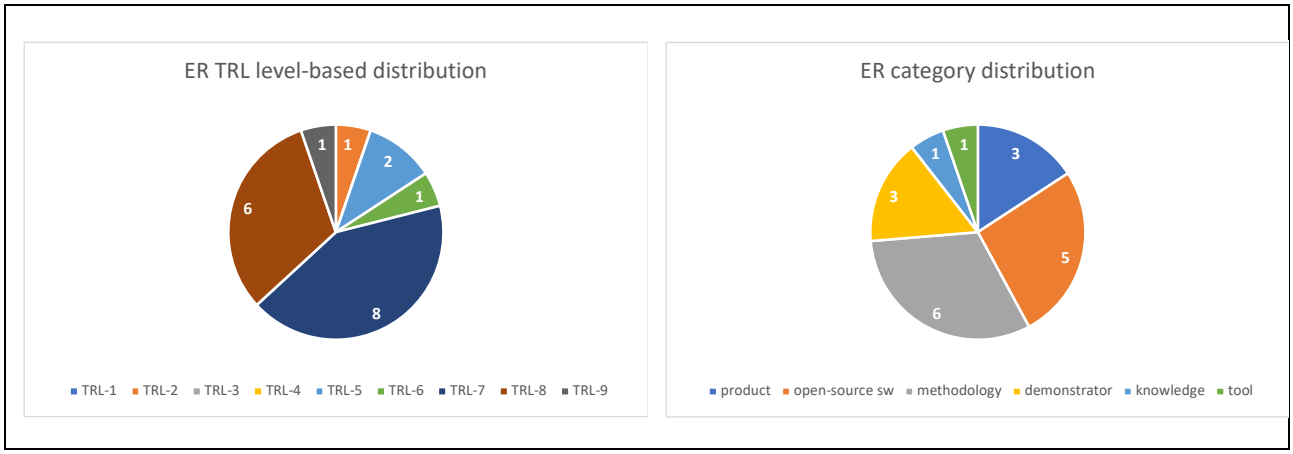

Figure 22 - Distribution of categories and TRL level-based for ERs.

The ER tables are live objects, and each partner shall propose at least one ER. Each technical WP (from WP2 to WP7) shall propose at least one ER. The ER table will be refined and reworked during the entire lifetime of the project.
The industrial partners of ACROSS project would envision to exploit their ERs in their products or services for either enriching the existing ones or creating new ones. The ultimate expectation would integrate the ERs in industrial partners' respective portfolios.

The methodology to select and prioritize ERs is based on ERs' high potential to be exploited - meaning to make use and derive benefits downstream the value chain of a project, process or solution, or act as an important input to policy, further research, or education.
Finally, a set of top 5 ERs has been elected in the first report (D8.5). The final list of ERs, along with the final list of top 5 ERs, will be elected in the last report in D8.9. The following criteria to select the top 5 ERs will be applied:

- degree of innovation
- exploitability
- impact

Concerning the selection of the top 5 ERs, we ordered the ERs based on their maturity level (TRL) and then we applied the 3 above mentioned criteria (see also Figure 22 for the distribution of ER categories and their TRL level). This resulted in ER11 (TRL equals to 9), ER1, ER5, ER8 and ER15 (all with a TRL equals to 8). Other ERs have been marked with a TRL 8 but resulted weaker upon the applications of the 3 mentioned criteria.

4 Conclusion

This deliverable gives a status point on the achievements of the plan of the project dissemination, communication, and exploitation.
The ACROSS project has been disseminated on numerous occasions at both expert events and events open to the public. However, the consortium is on working progress for dissemination activities related to target domains of project pillars. Regarding the Exploitation Results, activities around the initial plan have started. Thanks to dedicated workshops, the consortium is clarifying aspects related to the value proposition, the SWOT analysis, the market, and competition analysis in order to enforce the involvement of partners.
So far, the communication activities take place according to the initial plan. The project has effective tools for communication with a wide external audience.
In view of the above, it can be stated that the project will meet its dissemination and exploitation commitments.

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