



Efficient QUantum ALgorithms for IndusTrY

WP7 Project management

D7.1 Project Management Handbook and yearly management reports

Version: 2.0

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AIRBUS

Capgemini



Fraunhofer
ENAS

DLR
Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

Inria

 **Universiteit
Leiden**
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¹R: Document, report (excluding the periodic and final reports); DEM: Demonstrator, pilot, prototype, plan designs; DEC: Websites, patents filing, press & media actions, videos, etc.; DATA: Data sets, microdata, etc.; DMP: Data management plan; ETHICS: Deliverables related to ethics issues.; SECURITY: Deliverables related to security issues; OTHER: Software, technical diagram, algorithms, models, etc.

²PU – Public, fully open, e.g., web (Deliverables flagged as public will be automatically published in CORDIS project's page); SEN – Sensitive, limited under the conditions of the Grant Agreement; Classified R-UE/EU-R – EU RESTRICTED under the Commission Decision No2015/444; Classified C-UE/EU-C – EU CONFIDENTIAL under the Commission Decision No2015/444; Classified S-UE/EU-S – EU SECRET under the Commission Decision No2015/444

Document description

This deliverable will report on the general technical and administrative management information, organised around the project lifecycle of initiating, planning, controlling, and closing. It will be delivered on four occasions: M6,12,24,36.

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Abstract

A quantum revolution is unfolding, and European scientists are in the lead. It is time to take decisive action and transform our scientific potential into a competitive advantage. Achieving this goal will be critical to ensuring Europe's technological sovereignty in the coming decades. EQUALITY brings together scientists, innovators, and prominent industrial players with the mission of developing cutting-edge quantum algorithms to solve strategic industrial problems. The consortium will develop a set of algorithmic primitives applicable to various industry-specific workflows. These primitives include differential-equation solvers, material-simulation algorithms, quantum optimisers, and quantum machine learning. To focus our efforts, we target eight paradigmatic industrial problems. These problems will likely yield early quantum advantage and pertain to the aerospace and energy-storage industries. They include aerodynamics simulation, battery- and fuel-cell design and optimisation, battery material discovery, space-mission optimisation, and space data analysis.

We aim to develop quantum algorithms for industrial problems using real quantum hardware. This requires grappling with the limitations of present-day quantum hardware. Thus, we will devote much of our efforts to developing strategies for optimal hardware exploitation. These low-level implementations will account for the effects of noise and topology and will optimise algorithms to run on limited hardware. EQUALITY will build synergies with Quantum-Flagship projects and Europe's thriving ecosystem of quantum start-ups. Use cases will be tested on quantum hardware from three of Europe's leading vendors and two HPC centres. The applications targeted have the potential to create billions of euros for end-users and technology providers over the coming decades. With EQUALITY, we aim to play a role in unlocking this value and placing Europe at the centre of this development. The project gathers nine partners and has a budget of €6M over three years.

Consortium

The EQUALITY consortium members are listed below.

Legal Name on Grant Agreement	Short name	Country
CAPGEMINI DEUTSCHLAND GMBH	CAP	DE
PASQAL (former QU & CO AI BV)	QC	FR
AIRBUS OPERATIONS GMBH	AOG	DE
DEUTSCHES ZENTRUM FÜR LUFT – UND RAUMFAHRT EV (DLR)	DLR	DE
FRAUNHOFER GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG EV (FHG)	ENAS	DE
INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE (INRIA)	INRIA	FR
UNIVERSITEIT LEIDEN (ULEI)	ULEI	NL
DA VINCI LABS	DVL	FR

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List of abbreviations

Abbreviation	Description
WP	Work Package
CA	Consortium Agreement
GA	Grant Agreement

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1. INTRODUCTION

1.1. Purpose

The EQUALITY Project Management Handbook aims to give a quick overview of the project's most relevant managerial aspects, setting the partners' rules and responsibilities to ensure excellent quality and progress of the work.

This deliverable will report on the general technical and administrative management information organised around the project lifecycle of initiating, planning, controlling, and closing. It will be delivered on four occasions: M6,12,24,36.

This handbook is alive and can be modified according to the project's needs. This document will be updated, when necessary, throughout the lifecycle of the EQUALITY project extending the information given, including relevant issues and changes in the project or procedures. The work-package WP7 (management) and the task T7.1 coordinator maintain and keep this document current. It will be available in the Project SharePoint shared with all partners.

1.2. Structure of the deliverable

This deliverable will act as a guide for finding information that is already agreed upon in the CA and GA. This deliverable covers the following:

- 1) Consortium Partners and their Description;
- 2) Project Structure: Work Packages, Deliverables and Milestones;
- 3) Consortium Governance Overview.

1.3. Contractual Documentation

1.3.1 Grant Agreement (GA)

Grant Agreement with the EC: Grant Agreement No. 1010801142. This is the contractual document signed by all the project partnerships, which defines the rights and obligations of the Consortium regarding the EC. For reference, a copy of the Grant Agreement can be found on Project SharePoint.

1.3.2 Consortium Agreement (CA)

The Consortium Agreement is the internal contract of the consortium partners, which is signed and accepted by all partners. It defines the Consortium's internal rules for project management and the Consortium organisation and decision-making mechanisms. In case of discrepancy, the Grant Agreement overrules the Consortium Agreement. The project Consortium Agreement will also be available for all partners at the Project SharePoint.

2. CONSORTIUM & PARTNER DESCRIPTIONS

The consortium partners are listed in the following table:

Table 1: Consortium Partners.

	Organisation name	Short Name	Country
1	Capgemini Deutschland GmbH	CAP	DE
2	PASQAL (former Qu&Co AI BV)	QC	FR
3	Airbus Operations GmbH	AOG	DE
4	Deutsches Zentrum für Luft- und Raumfahrt e.V.	DLR	DE
5	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	ENAS	DE
6	Institut National De Recherche En Informatique Et En Automatique	INRIA	FR
7	Universiteit Leiden	ULEI	NL
8	Da Vinci Labs SAS	DVL	FR

2.1. Partners description

EQUALITY consortium consists of eight highly qualified industrial and research institutions that have joined forces to address the challenges defined in the project.



Capgemini Engineering combines its broad industry knowledge and cutting-edge technologies in digital and software to support the convergence of the physical and digital worlds. Coupled with the rest of the Group's capabilities, it helps clients accelerate their journey towards Intelligent Industry. Capgemini Engineering has more than 55,000 people team in over 30 countries in sectors including Aeronautics, Space, Defence, Naval, Automotive, Rail, Infrastructure & Transportation, Energy, Utilities & Chemicals, Life Sciences, Communications, Semiconductor & Electronics, Industrial & Consumer, Software & Internet.



PASQAL builds quantum computers from ordered neutral atoms in 2D and 3D arrays to bring a practical quantum advantage to its customers and address real-world problems. PASQAL was founded in 2019, out of the Institut d'Optique, by Georges-Olivier Reymond, Christophe Jurczak, Professor Dr Alain Aspect, Nobel Prize Laureate Physics, 2022, Dr Antoine Browaeys, and Dr Thierry Lahaye. PASQAL has secured more than €140 million in financing to date.

AIRBUS

Airbus is an international pioneer in the aerospace industry and a leader in designing, manufacturing, and delivering aerospace products, services, and solutions to customers on a global scale. We believe it is not just what we make but how we make it that counts; promoting responsible, sustainable, and inclusive business practices and acting with integrity. Our people work with passion and determination to make the world a more connected, safer, and smarter place, on the ground, in the sky and space.



DLR is the Federal Republic of Germany's research centre for aeronautics and space. They conduct research and development activities in aeronautics, space, energy, transport, security, and digitalisation. The German Space Agency at DLR plans and implements the national space programme on behalf of the federal government. Two DLR project management agencies oversee funding programmes and support knowledge transfer. Climate, mobility, and technology are changing globally. DLR uses the expertise of its 55 research institutes and facilities to develop solutions to these challenges.



The Fraunhofer Institute for Electronic Nano Systems ENAS is the specialist and development partner in Smart Systems and their integration for various applications. Fraunhofer ENAS has specialised in combining micro and nanosensors, actuators and electronic components with interfaces for communication and a self-sufficient energy supply to form intelligent systems, thus supporting the Internet of Things and the ongoing digitalisation. Fraunhofer ENAS develops single components, manufacturing technologies and system concepts, and system integration technologies and actively supports the technology transfer for and with its customers. For EQUALITY, Fraunhofer ENAS brings in its long-term expertise in the atomistic simulation of advanced materials using quantum chemistry and the electronic structure theory of periodic materials.



As a technology institute, Inria supports the development of numerous software products, sometimes making a global impact via the open-source model. Because technology start-ups are potent channels for research outcomes, Inria also supports entrepreneurial risk-taking and

start-up creation (Deeptech). Firmly established on major university campuses and in industrial ecosystems, the Institute is at the heart of the digital revolution.



Leiden University was founded in 1575 and is one of Europe's leading international research universities. The University has seven faculties and a campus in Leiden and The Hague. The university motto is Praesidium Libertatis – Bastion of Freedom. And there are five broad clusters of science areas distinguished (fundamentals of science; health and wellbeing; languages, cultures, and societies; law, politics, and administration; life sciences) and one overarching research theme (artificial intelligence).



Da Vinci Labs is a research and incubation structure inspired by Leonardo da Vinci. Its interdisciplinary and humanistic approach aims to respond in a competitive way to the ecological challenges of tomorrow and to bring out the future champions of deep tech in the field of quantum technologies, artificial intelligence, and synthetic biology. To do this, Da Vinci Labs participates in European collaborative research projects and builds a technological infrastructure in Touraine, which will be available to researchers and entrepreneurs ready to tackle our significant societal challenges.



Figure 1: EQUALITY Consortium.

3. PROJECT STRUCTURE

This Chapter will overview how the project is organised and where the details can be found in the Grant Agreement (GA) and the Consortium Agreement (CA) of the EQUALITY.

3.1. Work Packages

This 36-month-long project is divided into seven work packages and seven milestones.

The simplified diagram (Figure 2) displays the main dependencies between the work packages.

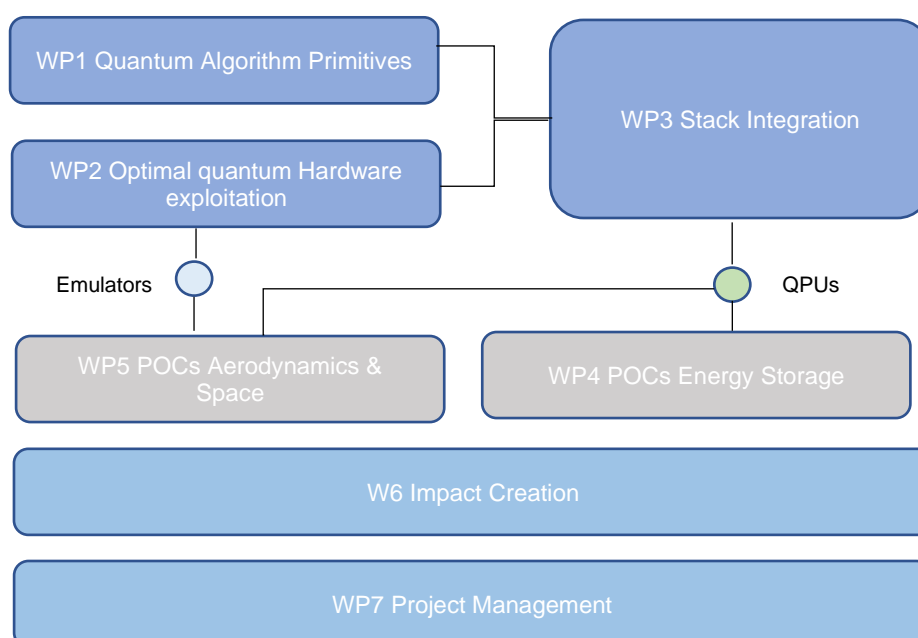


Figure 2: EQUALITY Project Work Packages.

The seven work packages are elaborated & controlled in 32 critical tasks, and the 26 key deliverables drive the performance measurement.

3.2. Milestones

The key milestones to measure the timely project success are listed as under.

Table 2: List of Milestones.

#	Milestone name	WP	Month	Means of verification
1	Use-case definition and technology roadmap	4,5	6	This consists of a set of well-defined computational problems and a set of specifications on how to implement them on quantum hardware. Also, a

				roadmap identifying different levels of complexity and desired targets will be prepared.
2	Version 1.0 of algorithmic primitives	1	12	Primitives will be tested on small-scale paradigmatic problems using noiseless emulators, e.g., small molecules, 1D differential equations, etc. Flaws on the algorithms will be identified and corrected before moving on to the next stage.
3	Version 1.0 of low-level implementations	2	12	Low-level implementations will be tested on small emulators. Noise and topology will be considered when pertinent. Overheads from qubit routing, noise mapping, etc. will be measured numerically. Flaws on the algorithms will be identified and corrected before moving on to the next stage.
4	Top-down stack integration	3	18	We will run the first algorithms on a fully integrated stack on real quantum hardware. We will test performance using standard well-studied algorithms through an API to verify robust operation. A detailed report will be produced.
5	Version 2.0 of algorithmic primitives	1	18	Primitives tested on small-scale paradigmatic problems using emulators e.g., small molecules, 1D differential equations, etc. This time including the effects of layout topology and noise. Areas of improvement will be identified and corrected before moving on to the next stage.
6	Use-case implementation (mid complexity)	4,5	24	We will consider the mid-complexity versions of the use cases. We will compare the results on an emulator with noise and topology factors included against simulation on the integrated stack. We will identify faults across the stack and make the necessary adjustments before increasing the problem's complexity.
7	Use-case implementation (high complexity)	4,5	36	We will consider the high-complexity version of the use cases. We will compare the results on an emulator with noise and topology factors included against simulation on the integrated stack. We will identify faults across the stack and make the necessary adjustments. We will conclude with a roadmap towards quantum advantage.

3.3. Deliverables

Each WP has specific critical deliverables associated, and to do rigorous tracking throughout the EQUALITY project, all deliverables are listed below. The deliverables are listed in chronological order to facilitate the submission date of each deliverable. Submission.

Suppose a deliverable comprises several versions to be submitted on different dates during the project. In that, the deliverables are shown as many times as it is to be submitted, indicating

the release month (M#). Partners responsible for these deliverables must be cautious with the submission of these deliverables.

Table 3: List of Deliverables.

Del. No. ³	Deliverable name	WP	Lead	Type ⁴	Dissem. Level ⁵	Due Date
D6.1	Project website (including project repository)	6	DVL	R	PU	M3
D6.2	Dissemination & communication plan	6	DVL	R	PU	M3
D6.4	Innovation exploitation plan including IPR	6	CAP	R	SEN	M4
D6.5	Market analysis, business model and upscaling	6	CAP	R	PU	M4
D4.1	Problem specification sheets (energy storage)	4	DLR	DEM	PU	M6
D5.1	Problem specification sheets (aerospace)	5	AOG	DEM	PU	M6
D7.1	Project management handbook and yearly management reports	7	CAP	R	PU	M6
D7.3	Data management plan	7	DLR	DMP	PU	M6
D3.1	Specifications on quantum hardware and low-level implementations	3	QC	DEM	PU	M12
D6.3	Dissemination & communication reports	6	DVL	R	PU	M12
D7.1	Project management handbook and yearly management reports	7	CAP	R	PU	M12
D7.2	Quality plan and monitoring	7	CAP	R	PU	M12
D3.2	Middleware and API specifications	3	QC	DEM	PU	M18
D3.3	Performance report on integrated stack	3	QC	R	SEN	M18
D4.2	Performance report (energy storage) v-1.0	4	DLR	R	SEN	M18
D5.2	Performance report (aerospace) v-1.0	5	AOG	R	SEN	M18
D6.3	Dissemination & communication reports	6	DVL	R	PU	M24
D7.1	Project management handbook and yearly management reports	7	CAP	R	PU	M24
D7.2	Quality plan and monitoring	7	CAP	R	PU	M24
D1.1	Technical report on (S)DE solvers	1	QC	R	SEN	M30
D1.2	Technical report on chemical simulators	1	QC	R	SEN	M30
D1.3	Technical report on quantum optimisers	1	INRIA	R	SEN	M30
D1.4	Technical report on QML methods	1	ULEI	R	SEN	M30
D2.1	Technical report on circuit reduction and optimisation	2	ULEI	R	SEN	M30
D2.2	Technical report on noise estimation	2	INRIA	R	SEN	M30
D2.3	Technical report on qubit routing	2	DLR	R	SEN	M30

³ Deliverable numbers in order of delivery dates. Please use the numbering convention. For example, deliverable 7.1 would be the first deliverable of work package 4.

⁴ Indicates the nature of the deliverable using one of the following codes: R: Document, report (excluding the periodic and final reports), DEM: Demonstrator, pilot, prototype, plan designs, DEC: Websites, patents filing, press & media actions, videos, etc. DATA: Datasets, microdata, etc. DMP: Data management plan ETHICS: Deliverables related to ethics issues. SECURITY: Deliverables related to security issues OTHER: Software, technical diagram, algorithms, models, etc.

⁵ Indicates the dissemination level using one of the following codes: PU – Public, fully open, e.g., web (Deliverables flagged as the public will be automatically published on the CORDIS project's page), SEN – Sensitive, limited under the conditions of the Grant Agreement.

D4.3	Performance report (energy storage) v-2.0	4	DLR	R	SEN	M36
D5.3	Performance report (aerospace) v-2.0	5	AOG	R	SEN	M36
D6.3	Dissemination & communication reports	6	DVL	R	PU	M36
D6.6	Roadmap towards quantum advantage	6	CAP	R	PU	M36
D7.1	Project management handbook and yearly management reports	7	CAP	R	PU	M36
D7.2	Quality plan and monitoring	7	CAP	R	PU	M36
D7.4	Data management report	7	DLR	R	PU	M36

Submission of deliverables:

As the project progresses, the identified deliverables will be submitted to the EU per the timelines defined in the deliverables list. All publicly rated deliverables will be shared via the project website.

The deliverables will be verified in the review meeting led by the Project Coordinator. Once validated, the Deliverable will be released.

Any impediments and delay in submitting the deliverables should be immediately reported to Project Coordinator, and the Project Coordinator will coordinate with the EU to negotiate the best course of action ahead.

After submission, a copy of the deliverable will be kept on SharePoint for future reference.

4. GOVERNANCE & MANAGEMENT

There are few key management bodies and roles in the project management structure for end-to-end collaboration and successful delivery.

4.1. Project Management

4.1.1. Project Coordinator

The Project Coordinator is the legal entity acting as the intermediary between the Parties and the Granting Authority. The coordinator shall perform the assigned tasks described in the Grant Agreement and this Consortium Agreement.

Some of the key responsibilities, but not limited to, are:

- Monitoring compliance by the Parties with their obligations under this Consortium Agreement and the Grant Agreement.
- Keeping the address list of Members and other contact persons updated and available.
- Collecting, reviewing to verify consistency, and submitting reports, other deliverables (including financial statements and related certification) and specifically requested documents to the Granting Authority.
- Preparing the meetings, proposing decisions, preparing the agenda of General Assembly meetings, chairing the meetings, preparing the minutes of the meetings, and monitoring the implementation of decisions taken at meetings.
- Transmitting documents and information connected with the Project promptly to any other Party concerned.
- Administering the financial contribution of the Granting Authority and fulfilling the financial tasks described in Section 7.2 of the CA.
- Providing, upon request, the Parties with official copies or originals of documents that are in the sole possession of the coordinator when such copies or originals are necessary for the Parties to present claims.

4.1.2. General Assembly

A General Assembly consists of a representative from each Consortium member and is the steering management committee. One main aim is to advise and collaborate on operational and management issues. This board will be responsible for all decisions of general nature within the frame of the Grant Agreement and the Consortium Agreement. The General Assembly is responsible for all decisions and will be convened once every six months. The detailed functioning of the General assembly is elaborated in Section 6.2 of the CA.

4.1.3. Consortium Lead Responsible

The lead responsible from each Consortium member will ensure the timely execution of tasks included in each Work Package, stimulating the interaction between the partners involved. They are also responsible for consolidating the specification reports and execution of the functions that integrate each WP. For smooth functional collaboration, the below list of leaders or representatives will constantly be updated.

Table 4: Consortium Representatives.

	Consortium Member	Lead Responsible
1	Capgemini Deutschland GmbH	Hendrik Meer
2	PASQAL (former Qu&Co AI BV)	Vaishnavi Duraisamy
3	Airbus Operations GmbH	Gerd Büttner
4	Deutsches Zentrum für Luft- und Raumfahrt e.V.	Birger Horstmann
5	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	Jörg Schuster
6	Institut National De Recherche En Informatique Et En Automatique	Harold Olivier
7	Universiteit Leiden	Alfons Laarman
8	Da Vinci Labs SAS	Renan Picoreti

4.2. Project Procedures

The General Assembly drives the leading governance at the project level. The detailed procedures of the General Assembly can be found in Section 6.3 of the CA.

4.2.1 Convening Meetings & Representation

The chairperson shall convene ordinary meetings of the General Assembly at least once every six months and call extraordinary meetings at any time upon written request of any Member.

The coordinator shall chair all General Assembly meetings unless the General Assembly decides otherwise.

Consortium members must be present or represented at every General Assembly meeting.

The chairperson/coordinator shall give written notice along with the meeting agenda to each Member as soon as possible and by 14 calendar days preceding an ordinary meeting and seven calendar days preceding an extraordinary meeting.

The chairperson shall produce minutes of each meeting which shall be the formal record of all decisions. They shall send draft minutes to all Members within ten calendar days of the meeting.

4.2.2 Decisions taking Mechanism

The General Assembly shall be free to act on its initiative to formulate proposals and take decisions following the set procedures.

Decisions must always be taken at the right decision level. In this sense, the roles and responsibilities of each Consortium member are defined in the project Consortium Agreement. Each Consortium Body shall not deliberate and decide validly unless a quorum of two-thirds (2/3) of its members are present or represented.

If the quorum is not reached, the chairperson of the General Assembly shall convene another ordinary meeting within 15 calendar days. Suppose in this meeting, the quorum is not reached once more. In that case, the chairperson shall convene an extraordinary meeting which shall be entitled to decide even if less than the quorum of Members is present or represented.

The list of critical decisions the General Assembly should take can be found in Section 6.3.7 of the CA.

5. REPORTING

5.1. GANTT Chart

The complete “Equality Board” can be referred to for the detailed project status at Project SharePoint. The detailed status of various tasks under each work package can be reviewed by all stakeholders in the “Equality Board”.

The glimpse of the GANTT for the work packages where the tasks are being performed is as under:

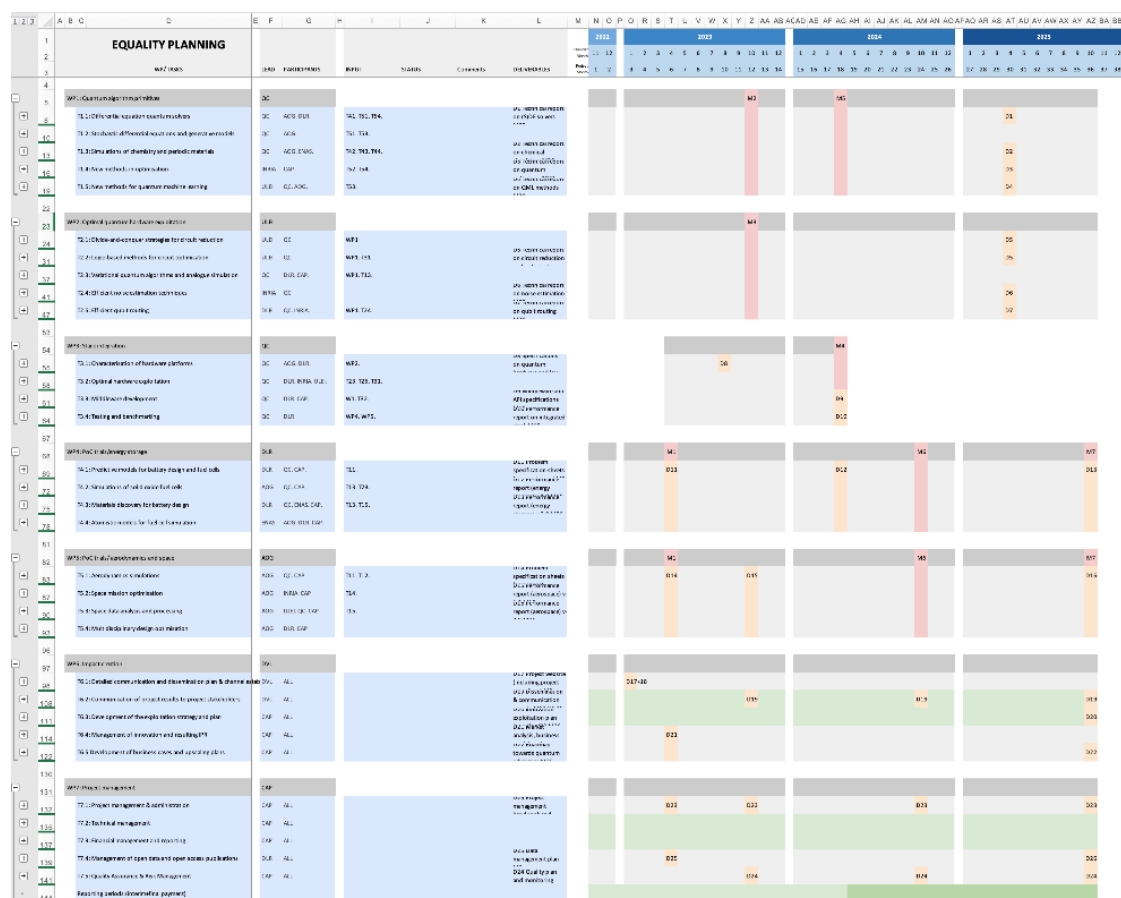


Figure 3: GANTT Chart.

6. DISSEMINATION

Dissemination is strictly governed by all the clauses mentioned in section-8 of the CA. The responsible partners must adhere to the timeline of deliverable “**D6.3 Dissemination & communication reports**” and ensure the yearly delivery of this deliverable.

All parties must ensure that during the Project and for a period of 1 year after the end of the Project, the dissemination of their Results by one or several Parties, including but not restricted to publications and presentations, shall be governed by the procedure of Article 17.4 of the Grant Agreement and its Annex 5, Section Dissemination, subject to the following provisions. Prior notice of any planned publication shall be given to the other Parties at least 21 calendar

days before the publication. The Grant Agreement shall make any objection to the planned publication by written notice to the Coordinator and the Party or Parties proposing the dissemination within 14 calendar days after receipt of the information. The publication is permitted if no objection is made within the stated time limit.

7. NON-DISCLOSURE & DATA PROTECTION

All parties should abide by the non-disclosure clauses mentioned in Section 10 of the CA.

Where necessary, the Parties shall cooperate to enable one another to fulfil legal obligations arising under applicable data protection laws (the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons about the processing of personal data and on the free movement of such data and relevant national data protection law applicable to said Party) within the scope of the performance and administration of the Project and of this Consortium Agreement. In particular, the Parties shall, where necessary, conclude a separate data processing, data sharing and/or joint controller agreement before any data processing or sharing occurs.

8. YEAR-ONE MANAGEMENT SUMMARY

There were no managerial changes to this document at the end of Year 1.

9. YEAR-TWO MANAGEMENT SUMMARY

- Individual lead responsible have been updated.
- For upcoming milestones without an associated deliverable an internal milestone document will be created to document their achievement. Thus, an internal document has been created for the documentation of milestone 6 completion (MS6).
- Task Amendments
 - ENAS to manage T4.4: Atomistic models for fuel cell simulation.
 - DLR to manage T2.5: Efficient qubit routing, and T4.3: Materials discovery for battery usage.
- Budget Amendment
 - ENAS and DLR budget amended due to changes in task distribution.
- Interim reporting has been completed.