⟨EQUAL|TY⟩

Efficient QUantum ALgorithms for IndusTrY

WP7 Project management

D7.2 Quality plan and Monitoring

Version: 3.3

Submission date: 27/10/2025

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Document control

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[1]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: 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.

[2]PU – 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

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Version control

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2.5	Kirill Shiianov, David David, Hendrik Meer	9.10.2024	Corrections to the document
2.8	Equality Consortium	16.10.2024	Consortium review
3.0	Hendrik Meer	25.10.2024	Document released by Technical Project Lead
3.1	Hendrik Meer	07.10.2025	Draft of Year-Three update to quality plan and monitoring
3.2	Equality Consortium	20.10.2025	Consortium review
3.3	Hendrik Meer	24.10.2025	Document released by Technical Project Lead

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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 ensure 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.

Current deliverable is an update to the Deliverable 7.2, aimed to include all the progress made by the EQUALITY consortium up to the month 36.

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List of abbreviations

Abbreviation	Description
CA	Consortium Agreement
GA	Grant Agreement
MS	Milestone
WP	Work package

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1. INTRODUCTION

Purpose

The EQUALITY Quality Plan and Monitoring document tracks and reports the acceptance of all milestones and deliverables ensuring excellent quality and progress of the work. This report will be delivered on three occasions: project months 12, 24, and 36 (this report).

Structure of the Deliverable

This deliverable will act as a guide for reporting the progress finding information that is already agreed upon in the CA and GA. This document covers deliverables status, deliverables description, and Milestones Status. The items included in this report comprise:

Milestones and Deliverables addressed during the 36 months of the project:

- M1 Use-case definition and technology roadmap
- M2 Version 1.0 of algorithmic primitives
- M3 Version 1.0 of low-level implementations
- M4 Top-down stack integration
- M5 Version 2.0 of algorithmic primitives
- M6 Use-case implementation (medium complexity)
- D1.1 Technical report on (S)DE solvers
- D1.2 Technical report on chemical simulators
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- D6.1 Project website (including project repository)
- D6.2 Dissemination & communication plan
- D6.3 Dissemination & communication reports
- D6.5 Market analysis, business model and upscaling
- D7.1 Project management handbook and yearly management reports
- D7.2 Quality plan and monitoring
- D7.3 Data management plan

Milestones and Deliverables due on month 36 of the project:

- D4.3 Performance report (energy storage) v-2.0
- D5.3 Performance report (aerospace) v-2.0

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- D6.4 Innovation exploitation plan including IPR
- D6.3 Dissemination & communication reports - M36
- D6.6 Roadmap towards quantum advantage
- D7.1 Project management handbook and yearly management reports - M36 update
- D7.2 Quality plan and monitoring - update on M36
- D7.4 Data management report

2. QUALITY ASSURANCE

In EQUALITY, the approach to quality is based on the milestones and deliverables in each work package. The project coordinator addresses the quality acceptance in the consortium meetings and any non-acceptance is addressed by the respective responsible consortium partner (Table 1). The work package leader will be responsible to ensure the quality and monitoring of the milestones within the respective work package and reporting back the status to be documented in reports such as this one.

Consortium Partners

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) – terminated from 30.06.2025	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

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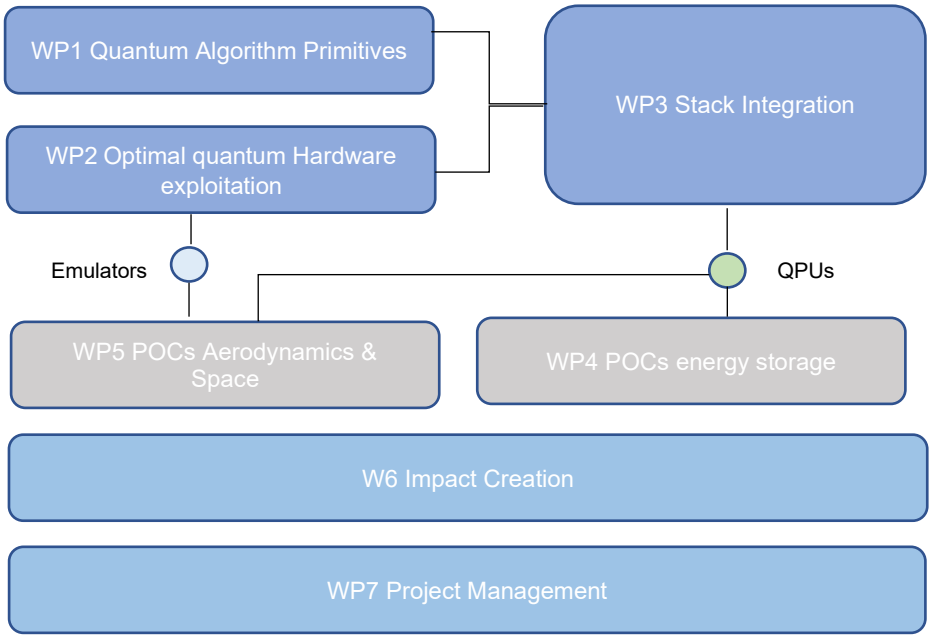
Work Packages Structure

This 36-month-long project is divided into seven work packages and seven milestones. The simplified diagram (Figure 1) displays the main dependencies between the work packages.

Figure 1: EQUALITY project work packages.



The seven work packages are elaborated and controlled in critical tasks, and the 26 key deliverables drive the performance measurement. This document reports the status of the milestones and the deliverables.

3. DELIVERABLES

Deliverables Validation

The submitted deliverables listed below have been reviewed by the consortium members and with mutual agreement delivered to the online Grant Management System of the European Commission on behalf of the EQUALITY project. The project coordinator owned the inclusion of all consortium members in the review procedure of all the deliverables. This will also apply to the ongoing deliverables and to the ones that have not started yet.

The work package leader or consortium member representative monitored the work packages, milestones, and deliverables. In case of any deviation, the project coordinator informed at the earliest. The project coordinator ensured that all stakeholders were informed and helped work package leaders in case of impediments.

The Equality Consortium designed an in-house systematic process for validating the quality and completeness of each project deliverable:

- Align with the consortium member representative in charge of the deliverable.
- Create the deliverable document by gathering all the technical information needed from collaborator researchers across different working groups.

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- Evaluate the deliverable outcome against the stated objectives by performing an assessment of the status.
- Perform a verification of all the documents and results to be reported in the deliverable.
- Follow the agreed quality standards and formats for reporting the work done.
- Engage an internal team of technical experts to perform a peer-review of the intermediate document.
- Check references, dates, content and adhere to agreed layout by using the in-house template.
- Address the issues identified as well as the feedback collected.
- Finalise the intermediate document and submit it to a reviewer.
- Implement comments from the reviewer.
- Submit the deliverable to the platform provided by the funding body.

Deliverables Description and Status

The description of the deliverables mentioned in this report is shown in Table 2, while their status is annotated in Table 3.

Table 2: List of deliverables discussed in this report and their description.

Deliverable name	Description
D6.1 Project website (including project repository)	This deliverable will serve as the main communication and dissemination platform to allow stakeholders, policymakers, and media access to the project development and results launched and developed. It will also host all the public dissemination deliverables and promote relevant content. It will be continuously updated per the project progress. News, editorials, videos, infographics, events, etc. for the key stakeholder groups, engaging them in the content and objectives of the project. The website will also serve as a content generation tool where partners are welcome to contribute content and provide feedback on its development to help increase the visibility of the project and maximise its impact.
D6.2 Dissemination & communication plan	This deliverable will serve as a reference when conducting dissemination and communication activities, illustrating the key objectives for communicating and disseminating the EQUALITY project and the means through which stakeholders will be targeted and engaged to maximise opportunities and impact.
D4.1 Problem specification sheets (energy storage)	This deliverable will define clearly articulated problem statements for each of the four trials (Predictive models for battery design and fuel cells. Simulations of solid oxide fuel cells. Materials discovery for battery design. Atomistic models for fuel cell simulation.) including detailed descriptions of the problem scenario, the chosen methods, its implications, and its impact on the different stakeholders. New: This deliverable will define clearly articulated problem statements for each of the four trials (Predictive models for battery design and fuel cells. Simulations of solid oxide fuel cells. Materials discovery for battery design. Atomistic models for fuel cell simulation.).
D5.1 Problem specification sheets (aerospace)	This deliverable defined clearly articulated problem statements for each of the four trials (Aerodynamics simulations. Space mission optimisation. Space data analysis and processing. Multidisciplinary design optimisation) including detailed descriptions of the problem scenario, the chosen methods, its implications, and its impact on the different stakeholders.

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D6.5 Market analysis, business model and upscaling	This deliverable will present a thorough market assessment (market dynamics, volume, value, growth, segmentation, competitor analysis) and a solution-based business model, considering the upscaling to other countries.
D7.1 Project management handbook and yearly management reports	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.
D7.3 Data management plan	This deliverable will describe the strategies and measures of data management; how the data will be managed, analysed, described, and stored, what standards you will use, how the metadata will be handled, and how the data will be protected.
D3.1 Specifications on quantum hardware and low-level implementations	This deliverable will demonstrate the implementation of the developed algorithm primitives on specific hardware types per the measurement of the exploitation strategies' performance. It will include the process documentation as well.
D6.3 Dissemination & communication reports	This deliverable will report on the progress of the dissemination and communication activities and will track and measure the impact of specific communication metrics and key performance indicators. It will be updated on an annual basis throughout the project (M12, M24, M36)
D7.2 Quality plan and monitoring	This deliverable will report on the continuous quality assurance of the project results including the assessment of the project activities and outcomes, risk analysis, mitigation strategies, and lessons learned to refine results. It will be delivered on three occasions: M12,24,36.
D3.2 Middleware and API specifications	This deliverable will demonstrate the developed framework connecting the algorithms and the identified methods & strategies per the performance measurement. It will include the process documentation as well.
D3.3 Performance report on integrated stack	This deliverable will report on the performance of the integrated stack against different test problems, including a comparison with ideal emulators and emulators with noise.
D4.2 Performance report (energy storage) v-1.0	This deliverable will illustrate the results of the simulations of the four trials (Predictive models for battery design and fuel cells. Simulations of solid oxide fuel cells. Materials discovery for battery design. Atomistic models for fuel cell simulation.) including cross-platform performance assessment, the practical impact of the chosen strategies, and comparison with the classical methods.
D5.2 Performance report (aerospace) v-1.0	This deliverable will illustrate the results of the simulations of the four trials (Aerodynamics simulations. Space mission optimisation. Space data analysis and processing. Multidisciplinary design optimisation) including cross-platform performance assessment, the practical impact of the chosen strategies, and comparison with the classical methods.
D6.3 Dissemination & communication reports - M24	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.
D7.1 Project management handbook and yearly management reports - M24 update	This deliverable will report on the continuous quality assurance of the project results including the assessment of the project activities and outcomes, risk analysis, mitigation strategies, and lessons learned to refine results. It will be delivered on three occasions: M12,24,36.
D7.2 Quality plan and monitoring - update on M24	This deliverable will report in detail on the development process of the (S)DE solvers, how it progressed throughout the project, and will illustrate the achieved results, including recommendations on its integration into various industry-specific workflows.
D1.1 Technical report on (S)DE solvers	This deliverable will report in detail on the development process of the chemical simulators, how it progressed throughout the project. It will illustrate the achieved results, including recommendations on its integration into various industry-specific workflows.
D1.2 Technical report on chemical simulators	This deliverable will report in detail on the development process of the quantum optimisers, how it progressed throughout the project. It will

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	illustrate the achieved results, including recommendations on its integration into various industry-specific workflows.
D1.3 Technical report on quantum optimisers	This deliverable will report in detail on the development process of the QML methods and/or methods to run existing QML on limited hardware, how it progressed throughout the project, and will illustrate the achieved results, including recommendations on its integration into various industry-specific workflows.
D1.4 Technical report on QML methods	This deliverable will report in detail on the exploitation efforts and process of the circuit reduction and optimisation, how it progressed throughout the project and will illustrate the achieved results, including its impact on boosting the performance of the developed algorithms, especially in light of limited quantum devices.
D2.1 Technical report on circuit reduction and optimisation	This deliverable will report in detail on the exploitation efforts and process of the noise estimation, how it progressed throughout the project. It will illustrate the achieved results, including its impact on boosting the performance of the developed algorithms.
D2.2 Technical report on noise estimation	This deliverable will detail the efforts to reduce the resources in qubit routing and the improvements during the project. It will illustrate how the achieved results boost the performance of the developed algorithms.
D2.3 Technical report on qubit routing	This deliverable will serve as an update for the “Performance report (energy storage) v-1.0” per the development of the different models and algorithms.
D4.3 Performance report (energy storage) v-2.0	This deliverable will serve as an update for the “Performance report (aerospace) v-1.0” per the development of the different models and algorithms.
D5.3 Performance report (aerospace) v-2.0	This deliverable will illustrate the developed exploitation strategy and plan of the project results including business development strategy, individual exploitation plans, and IPR management.
D6.4 Innovation exploitation plan including IPR	This deliverable will present full business cases (CAPEX, OPEX, IRR and NPV) for each demonstrator including financial impacts and socio-economic impact.
D6.6 Roadmap towards quantum advantage	This deliverable will report on the progress and application of the data management plan, considering the aspects of data management and analysis, validation workflows, metadata generation, and data preservation.
D7.4 Data management report	This deliverable will report on the progress of the dissemination and communication activities and will track and measure the impact of specific communication metrics and key performance indicators. It will be updated on an annual basis throughout the project (M12, M24, M36)
D6.3 Dissemination & communication reports - M36	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.
D7.1 Project management handbook and yearly management reports - M36 update	This deliverable will report on the continuous quality assurance of the project results including the assessment of the project activities and outcomes, risk analysis, mitigation strategies, and lessons learned to refine results. It will be delivered on three occasions: M12,24,36.
D7.2 Quality plan and monitoring - update on M36	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.

Table 3: List of deliverables due by month 24, and their status.

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Del. No.[3]	Deliverable name	WP	Lead	Type [4]	Dissem. level[5]	Due date (in Month)	Status
D6.1	Project website (including project repository)	6	DVL	R	PU	3	Submitted
D6.2	Dissemination & communication plan	6	DVL	R	PU	3	Submitted
D4.1	Problem specification sheets (energy storage)	4	DLR	DEM	PU	6	Submitted
D5.1	Problem specification sheets (aerospace)	5	Airbus	DEM	PU	6	Submitted
D6.5	Market analysis, business model and upscaling	6	CAP	R	PU	6	Submitted
D7.1	Project management handbook and yearly management reports	7	CAP	R	PU	6, 12, 24	Submitted, updated
D7.3	Data management plan	7	DLR	DMP	PU	6	Submitted
D3.1	Specifications on quantum hardware and low-level implementations	3	QC	DEM	PU	12	Submitted
D6.3	Dissemination & communication reports	6	DVL	R	PU	12, 24, 36	Submitted, updated
D7.2	Quality plan and monitoring	7	CAP	R	PU	12, 24, 36	Submitted, updated
D3.2	Middleware and API specifications	3	QC	DEM	PU	18	Submitted
D3.3	Performance report on integrated stack	3	QC	R	S	18	Submitted
D4.2	Performance report (energy storage) v-1.0	4	DLR	R	S	18	Submitted
D5.2	Performance report (aerospace) v-1.0	5	Airbus	R	S	18	Submitted
D1.1	Technical report on (S)DE solvers	1	Qu&Co	R	S	30	Submitted
D1.2	Technical report on chemical simulators	1	Qu&Co	R	S	30	Submitted

[3] Deliverable numbers in order of delivery dates. Please use the numbering convention. For example, deliverable 6.1 would be the first deliverable 1 of work package 6.

[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.

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D1.3	Technical report on quantum optimisers	1	INRIA	R	S	30	Submitted
D1.4	Technical report on QML methods	1	ULEI	R	S	30	Submitted
D2.1	Technical report on circuit reduction and optimisation	2	ULEI	R	S	30	Submitted
D2.2	Technical report on noise estimation	2	INRIA	R	S	30	Submitted
D2.3	Technical report on qubit routing	2	DLR	R	S	30	Submitted
D4.3	Performance report (energy storage) v-2.0	4	DLR	R	S	36	Submitted
D5.3	Performance report (aerospace) v-2.0	5	Airbus	R	S	36	Submitted
D6.4	Innovation exploitation plan including IPR	6	CAP	R	S	36	Submitted
D6.6	Roadmap towards quantum advantage	6	CAP	R	PU	36	Submitted
D7.4	Data management report	7	DLR	R	PU	36	Submitted

4. MILESTONES

The key milestones to measure the timely project success are listed below on Table 4. Each consortium member representative oversees the monitoring of the work package, comprising milestones and deliverables.

Table 4: List of milestones and their status

#	Milestone name	WP	Due day in Month	Means of verification	Status
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.	Achieved, see D4.1 and D5.1
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.	Achieved, see D3.1
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.	Achieved, see D3.2 ch.4 and publication [10]

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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.	Achieved, see D3.2
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.	Achieved, see D3.3
6	Use-case implementation (mid complexity)	4,5	24	We consider the mid-complexity versions of the use cases. We compare the results on an emulator with noise and topology factors included against simulation on the integrated stack. We identify faults across the stack and make the necessary adjustments before increasing the problem's complexity.	Achieved, see internal MS6-Document
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.	Achieved, see D4.3 and D5.3

5. CONCLUSION

5.1 Work Packages

During the 36 months of EQUALITY, the consortium has successfully collaborated and delivered the results for the work packages 1 (Quantum algorithm primitives), 2 (Optimal quantum hardware exploitation), 3 (Stack Integration), 4 (PoC trials/energy storage), 5 (PoC trials/ aerodynamics and space), 6 (Impact creation) and 7 (Project management).

5.2 Deliverables & Milestones

During the 36 months of EQUALITY, the consortium has provided all deliverables and Milestones on time without impediments.

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