



IMPACT OVERVIEW

Developments in quantum area in Europe

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**Quantum ideas
are born in Europe**

The work on the QuantERA impact assessment was carried out between July 2021 and September 2022 by the international team of experts. The evaluation focused on QuantERA I for the period between 2016 and 2021.

The developments of the currently on-going QuantERA II, such as implementation of a topic for applied research in the 2021 call or reinforcement of activities aimed at promoting gender balance and spreading research excellence, were also taken into account, in order to provide an holistic overview.

Since the Programme is in process, the indicated impacts are to be strengthened upon continually performed activities within QuantERA II. The final view of the impacts achieved will be set forth at the end of the QuantERA II programming period.



Mobilisation of efforts and resources

Closer coordination, greater mobilisation and pooling of resources between regional, national and European research programmes

Alignment of national initiatives

Increased awareness of national and regional research and innovation interests followed by establishment and alignment of plans and initiatives

Enhancement of transnational collaboration

Increased transnational collaboration, especially on topics that are complementary to the European work programmes

QuantERA Impacts

on developments
in quantum area

Indication of future developments

Identification of promising directions and drawing outlines for future research programming

Development of industry connections

Incentive for setting up various forms of collaborations with industry

Boost of research capacity

Expansion of European quantum research capacity and inducement of scientific developments

Spread of excellence

Inclusiveness of Widening countries in the Programme's activities and quantum research

Impact overview



77
transnational projects

carried out by



400
national research teams

434

submitted applications

3

calls

QuantERA Consortium Partners' view

97%

of partners expressed satisfaction
with participation in QuantERA

75%

of partners find QuantERA important
for alignment of national research
policies in QT in Europe

63%

of partners appreciate QuantERA in
identifying common call topics in QT



39

Research Funding
Organisations (RFOs) from



31
countries

2016

6

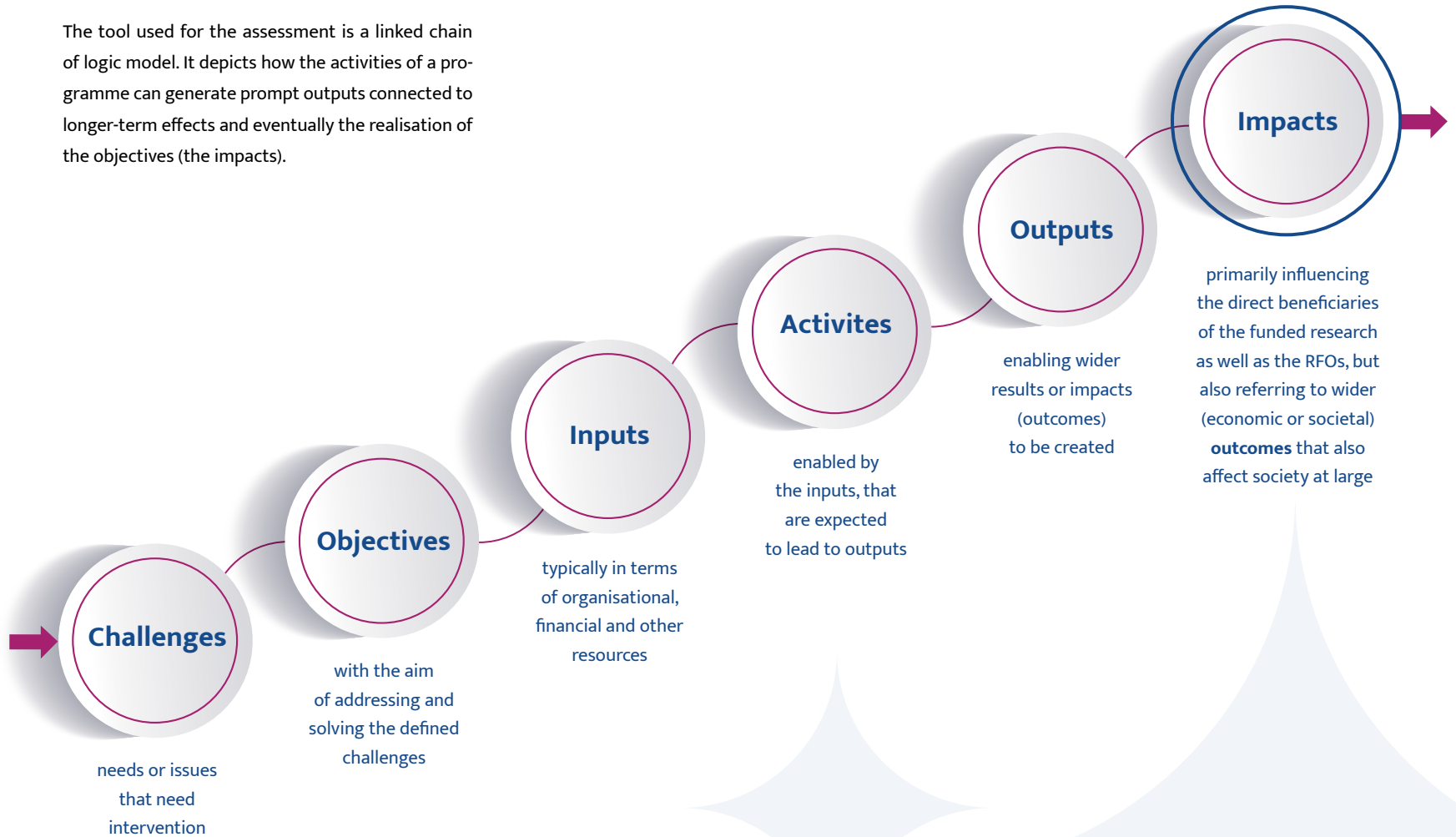
2022

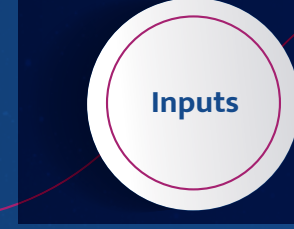
years of
implementation

Methodology

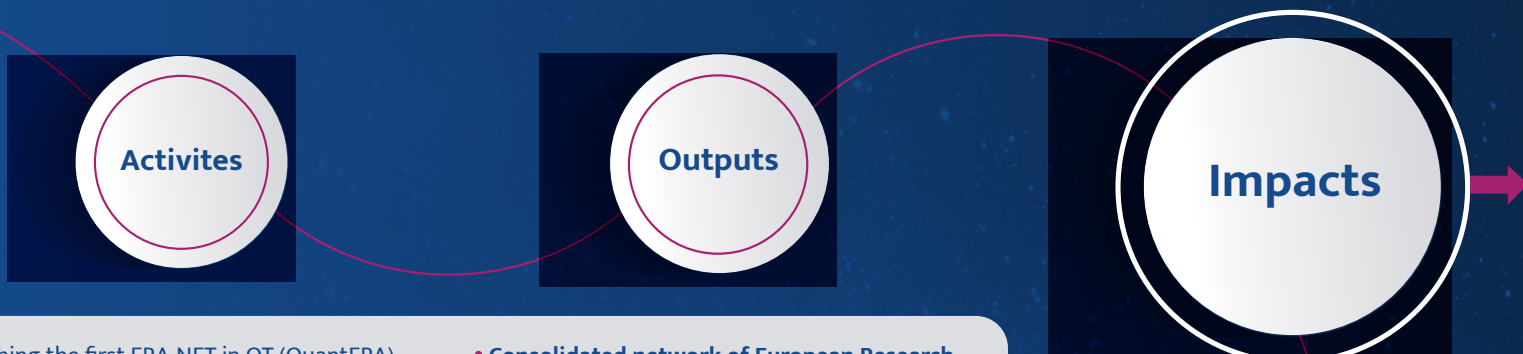
Methodology – logic model

The tool used for the assessment is a linked chain of logic model. It depicts how the activities of a programme can generate prompt outputs connected to longer-term effects and eventually the realisation of the objectives (the impacts).





<ul style="list-style-type: none"> Disparities in Quantum Technologies (QT) Research & Innovation (R&I) in Europe 	<ul style="list-style-type: none"> Building the largest European network of research funders (RFOs) Coordinating a long-term strategic development vision within Quantum Flagship 	<ul style="list-style-type: none"> Networking among research funders, researchers and wider community Consolidating efforts through joint programming
<ul style="list-style-type: none"> Lack of common R&I funding scheme in QT in Europe 	<ul style="list-style-type: none"> Providing joint funding opportunities 	<ul style="list-style-type: none"> Substantial funds mobilised for collaborative research
<ul style="list-style-type: none"> Insufficient participation of Widening countries in QT 	<ul style="list-style-type: none"> Promoting and spreading research excellence 	<ul style="list-style-type: none"> Gathered data on participation of Widening countries and implemented pro-widening mechanisms
<ul style="list-style-type: none"> Insufficient coherency between European funding schemes and various programmes in QT 	<ul style="list-style-type: none"> Increased awareness of decisionmakers regarding public policies in other countries 	<ul style="list-style-type: none"> Gathered knowledge on public policies
<ul style="list-style-type: none"> Weak links between academia & industry in QT 	<ul style="list-style-type: none"> Enhancing cooperation between academia & industry 	<ul style="list-style-type: none"> Sharing of skills, experience and good practices regarding academia-industry collaboration
<ul style="list-style-type: none"> Low awareness regarding Responsible Research and Innovation (RRI) in QT 	<ul style="list-style-type: none"> Raising awareness on RRI 	<ul style="list-style-type: none"> Sharing of skills, experience and good practices regarding RRI



- Launching the first ERA-NET in QT (QuantERA) and expanding network capacity (QuantERA II)
- Aligning QuantERA activities with the broader European agenda

- Organising joint calls for proposals
- Monitoring and assessment of the funded projects

- Adopting network structure and call procedures promoting Widening countries

- Monitoring and mapping public policies

- Involving various stakeholders, including industry

- Raising awareness of potential RRI issues
- Promoting open data exchange practice
- Acting towards more gender-balanced research in QT

- **Consolidated network of European Research Funders in QT**
- **Links in wide community of stakeholders in QT** including cooperation with Quantum Flagship

- **Funded Projects**
www.quantera.eu/quantera-funded-projects/
- **Monitoring and evaluation system and reports of funded projects**

- **Organisations from Widening countries active in the network and in the funded research projects**

- **Report on mapping public policies in QT**
www.quantera.eu/mapping-of-publicpolicies/

- **Links with pro-commercialisation and industry stakeholders in QT**
- **Guidance on cooperation with industry in QT**
www.quantera.eu/industry-qt/

- **Guidelines on RRI in QT**
www.quantera.eu/guidelines-in-rri-in-qt/


Impacts

Dissemination

www.quantera.eu

 @QuantERACoFund

 @QuantERA

 @QuantERA_EU

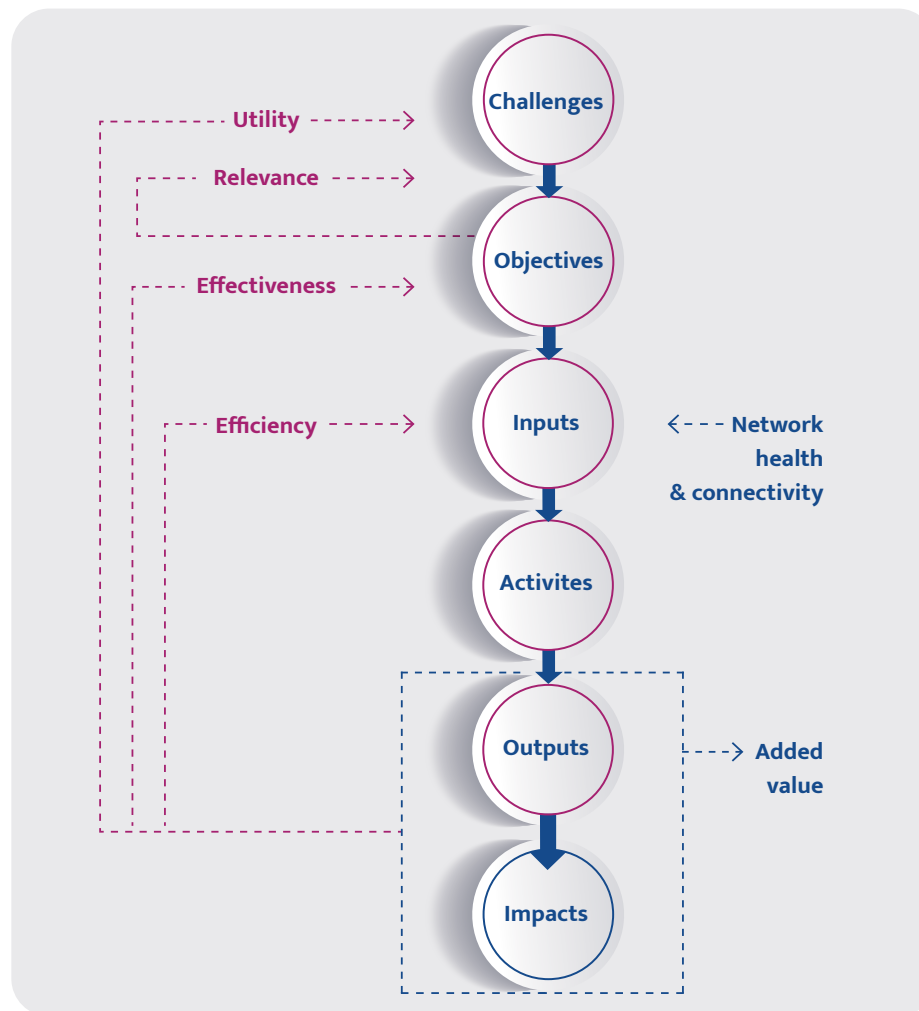
Methodology – evaluation criteria

The relationships between the QuantERA model elements have been examined and addressed by the following evaluation criteria: **effectiveness, efficiency, relevance, utility, added value** and **network health & connectivity**.

The evaluation criteria correspond to the Programme in the following way:

- » **Relevance** relates to the extent to which the QuantERA objectives are pertinent to the needs and problems of the European scientific communities in the QT domain.
- » **Effectiveness** shows how well the Programme manages to reach its objectives through the activities undertaken.
- » **Efficiency** and use of resources refers to the extent to which the desired impacts have been achieved at a reasonable cost.
- » **Utility** refers to the extent to which the impacts of the Programme correspond to the challenges – needs, problems and issues.
- » **Network health & connectivity** refers to examining the extent to which partners are involved in the Programme and maintain formation.
- » The **Added Value** study focuses on discovering the Programme's additional value achieved in comparison to what would have been achieved by the Consortium members alone, without involvement in QuantERA.

The assessment also included **coherence and synergy** studies, which show the extent to which the Programme logic is compatible or in synergy with other initiatives directed at similar objectives.

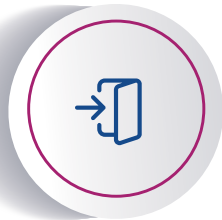


Methodology – data sourcing

Data acquisition was organised through **versatile techniques**:



desk research on
the QuantERA
Programme's
framework, its
objectives and
activities



studying the
Programme's reports
and publications



screening external
sources for references
and reflections of
QuantERA



designing
and conducting
structured in-depth
interviews with
the key QuantERA
actors



executing an
impact assessment
survey to collect
input from the
entire QuantERA
network

Among all the above-mentioned, **the principal contribution to the report was provided by the survey, conducted in November/December 2021 among representatives of RFOs forming the QuantERA network.**

Impacts in details

Assessment results

Mobilisation of efforts and resources

Mutual efforts

QuantERA is the first partnership acting towards supporting research and innovation in QT with such a wide European coverage. The network consists of 39 research funders from 31 countries that work together to support QT.

QuantERA has become the European tool for concentration of resources and addressing key challenges in QT, which confirms **utility** of the Programme.

Calls for proposals

High interest in the QuantERA calls for proposal and tangible success visible in the awarded projects proves the **effectiveness** of the Programme in regard to resources mobilisation to provide funding opportunities in QT. According to almost 94% of the survey respondents, QuantERA is a strong mechanism of transnational research funding in QT.

QuantERA has established solid structures for transnational research funding in QT.



“QuantERA managed to overcome national interests, administrative hurdles, local and international procedures, policies and misalignments, etc.

Together, as a team of funding agencies, we created an effective tool for reinforcement of QT in Europe.



Sylwia Kostka
QuantERA Programme Coordinator
NCN, Poland

The mobilisation of a critical mass of research funding from across Europe is considered among the core benefits brought out by the Programme. It proves not only the **effectiveness** of QuantERA but it also demonstrates the great **added value** provided by the initiative. Thanks to QuantERA there exist funding opportunities brought to researchers and all stakeholders in such an interdisciplinary domain, which is beyond the abilities of a single country.

The Programme's transnational effect has been also **recognised by the wider research community**. In the "[ERA-LEARN Annual Report on Public-Public Partnerships 2020](#)", published in June 2021 QuantERA was highlighted as the best practice of designing research and innovation initiatives at the transnational level, which can be regarded as further proof of the Programme's **relevance** for EU work programming.

Well-designed programme structure and efficient coordination

QuantERA is praised for delivering smooth coordination and effective design of its elements. A majority of the partner organisations found participation in QuantERA a positive experience. 78% of the respondents declared they had not experienced any major difficulties in implementing the Programme, which shows QuantERA has been well structured.

European Union's support

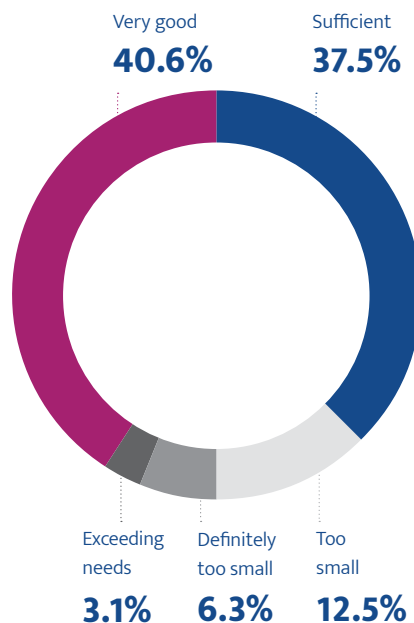


QuantERA is cofunded and strongly supported by the European Commission. The fruitful cooperation is based on constant information exchange, efforts

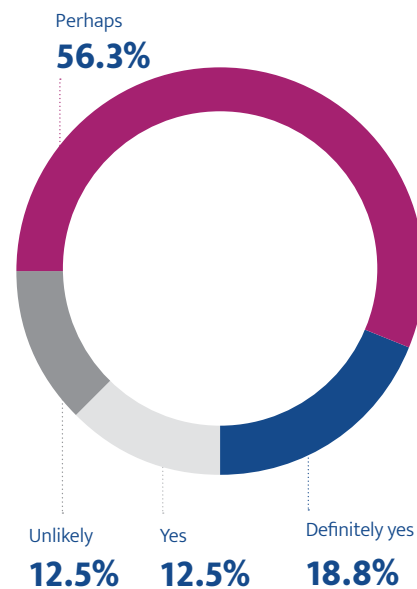
directed towards future joint endeavors, and quantum area development.

QuantERA is well-cared for by the European Commission due to strong engagement of the Project Officer who supports and coordinates activities performed by the Consortium.

The funding from the European Commission (top-up) is:



If there were no further funding from the EC, would your organisation continue your participation in QuantERA?



The financial support of the European Commission has also a meaningful part in the QuantERA Programme's activities. **The majority of the partnering RFOs in QuantERA find the top-up funding support from the European Union sufficient to very good.** In fact, over 81% of the network organisations define the support as exceeding needs (3.1%), very good (40.6%) or sufficient (37.5%).

Also, only 12.5% of respondents stated that their organisation would be unlikely to continue participating in QuantERA without further funding from the EU. Such results demonstrate **efficiency** of the Programme. They also allow for the conclusion that there are other strong sources of RFOs' satisfaction causing their willingness to remain part of the network, notwithstanding the European top-up.

Synergy with QT initiatives in Europe



QuantERA plays a significant role in all the most prominent initiatives on quantum technologies in Europe. Instances include cooperation with the **European Commission**, the **Quantum Flagship programme**, **Quantum Community Network (QCN)**, quantum research community and other stakeholders in Europe.

The Programme paved the way for the **Quantum Flagship**, which, as an incubator of new ideas, guides Europe towards leadership on the world stage.

The liaison between QuantERA and other entities of the European QT landscape confirms the **relevance** of the Programme and demonstrates its **coherence and synergy** with the initiatives similar to QuantERA's objectives that are pursued.

Coherence and synergy between QuantERA and other QT initiatives have been highlighted in the **Midterm Report of the Quantum Technologies Flagship** which speaks up loudly for the positive impact of the Programme, especially at the **research projects level**.

“ I am strongly confident that in the future QuantERA will still be a very important element of the Quantum Flagship.



Pascal Maillot
Acting Head of Unit
High Performance
Computing & Quantum
Technologies
European Commission

“ Quantum Flagship may have a much bigger budget than QuantERA, however, it would probably not exist without QuantERA.



Tommaso Calarco
Chairman of Quantum
Community Network
Quantum Flagship
QuantERA Strategic
Advisory Board

Alignment of national initiatives

Mapping of public policies

In 2020 QuantERA actions were enriched by mapping the development of funding strategies in Europe and describing the existing national public policies in QT. Each QuantERA Partner considered the state of affairs within their respective country and provided the relevant information. **The Report on Mapping the Development of Public Policies in QT** was featured as a good practice within the ERA-NET **Annual Report on Public-Public Partnerships, 2020**. The Report constitutes the instrument enabling QuantERA to enhance its **relevance** and **utility**. An updated report will be published in 2023.

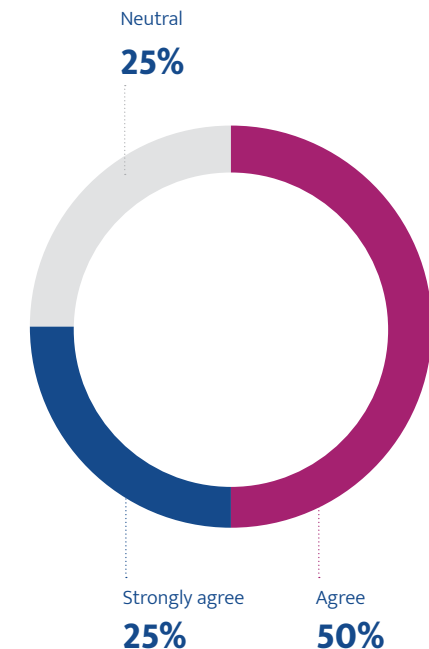


Mapping of public policies in the field of QT is the first such initiative introduced on an European scale by an ERA-NET.

Alignment of national research policies

The vast majority (75%) of the partners state that QuantERA is important for alignment of national research policies/priorities in QT in Europe, which proves its **relevance**. The Programme relates strongly to countries' individual efforts to establish effective research funding mechanisms. In some countries, such as France and Romania, the QT topics defined in QuantERA were adopted in the national instruments, which additionally proves QuantERA's contribution to **coherence** in the scientific scope of QT research in Europe.

The QuantERA Programme is important for alignment of national research policies/priorities in QT in Europe.



Enhancement of transnational collaboration

The evolution of partners' participation

By the time QuantERA was established, back in 2016, only 6 of the 26 countries participating at that point ran support programmes for quantum technologies. This means that for 73% of the countries joining QuantERA, the Programme was their first structured undertaking to provide backup for QT research.

QuantERA acts as the **most important instrument to promote international collaboration in the domain.**

QuantERA Network consists of 39 organisations from 31 countries that work together to support QT.

QuantERA integrates almost the whole Europe in the unified ambition oriented around QT development in Europe and beyond, achieving complementarities in international efforts in this field, and in consequence, the endeavour's **utility**.



“ We are happy to observe such a great evolution of the quantum landscape both at the national and at the European level.

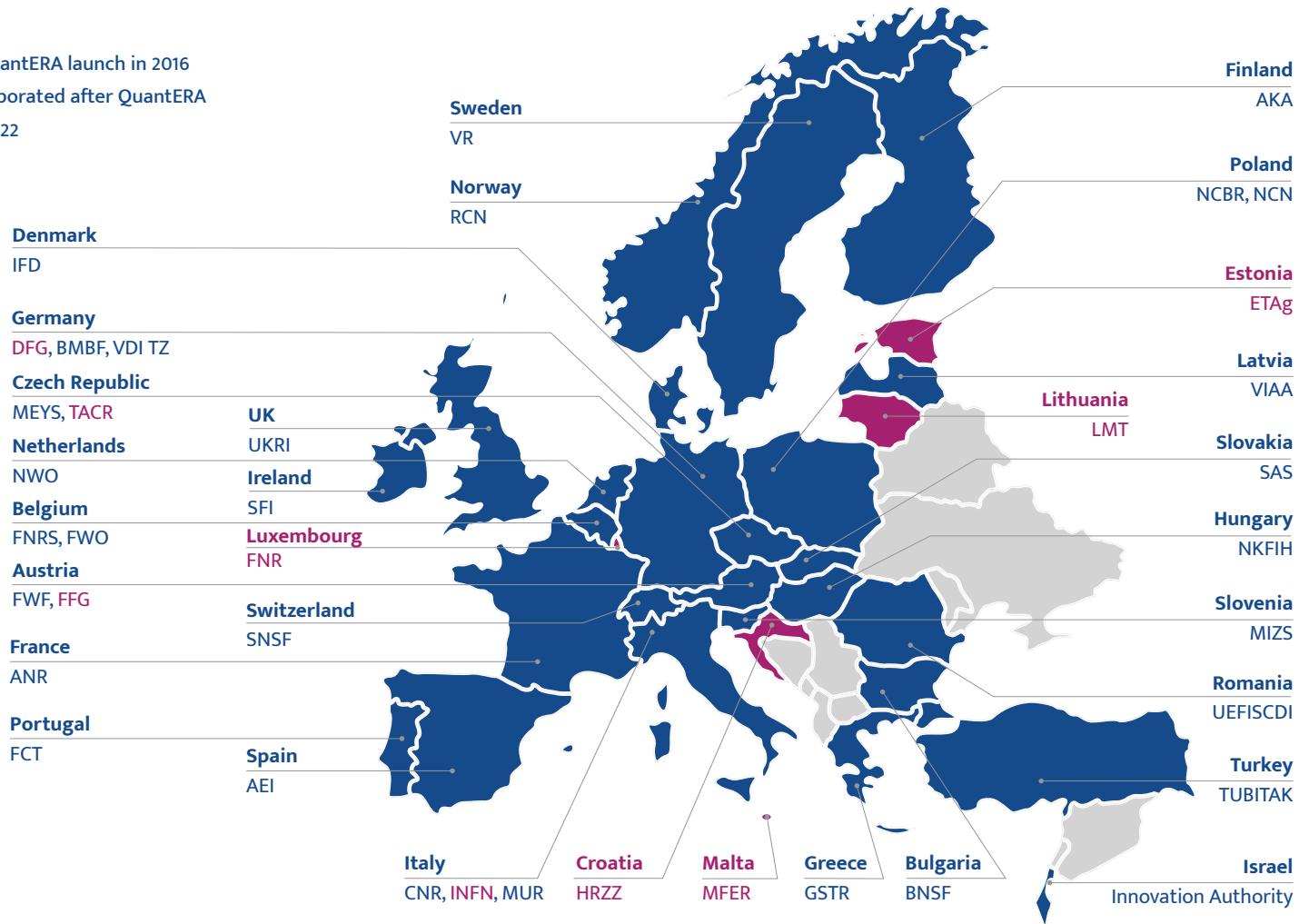
At the beginning the most active partners were those with the most developed QT research communities. But nowadays we are witnessing progress in other countries too, including Widening countries.



Sergueï Fedortchenko
ANR, France

Composition of the Consortium

- Partners at QuantERA launch in 2016
- Partners incorporated after QuantERA launch until 2022



New RFO collaborations

While boosting cooperation between RFOs, QuantERA also enabled its partners to set up new collaborations. The majority of the RFOs developed cooperation with new partners thanks to QuantERA, which proves the **effectiveness** of the Programme in respect of fostering networking effect.

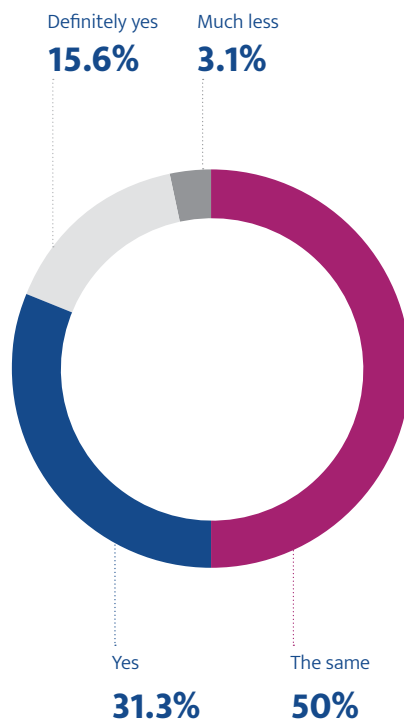
The Programme also demonstrated significant **relevance** in the process of stimulating the development of the QT eco-system by triggering RFOs to collaborate with institutions with a wider range of profiles than before (e.g. RFOs, ministries etc.). Almost half of the partners (47%) claimed such an effect of their participation.

Network – participants' satisfaction

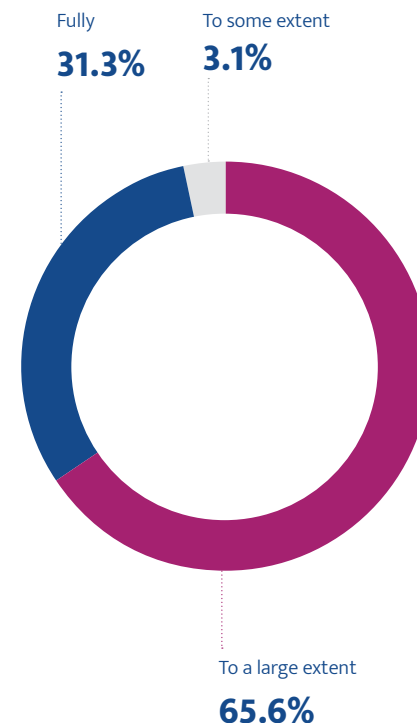
QuantERA reveals **effectiveness** in terms of the extent to which the Programme fulfilled the expectations of the partners. The RFOs, with almost a full majority, expressed that QuantERA had met fully (31%) or to a large extent (66%) their expectations from participation.

The motives for a positive assessment of QuantERA come from the mutual understanding that this Programme addresses certain challenges that can be dealt with better at the international rather than at the national level, bringing an **added value** to its participants.

Within the QuantERA, has your organization collaborated with institutions with a wider range of profiles than before (e.g. RFOs, ministries etc.)?



To what extent have your expectations towards QuantERA been met?



The majority of RFOs claimed **the Programme's effects were positive** (63%). Among responses concerning this aspect we can enumerate a few significant ones:

“Given the rather small size of Czech QT community, it was very pleasant to see the high success rate of Czech applicants and quality of the proposals”

“Large number of countries involved – almost all Member States!”

“The critical mass of research it has generated”

“The level of projects and their outputs is outstanding. And the bundling of European efforts is positive to the geopolitical profile of Europe”

“We are surprised by the large number of proposals, which underlines the strength of the community. Furthermore, QuantERA is also a very good nucleus for other European activities”

“It helped to support a common recognition of a European QT community among National Funding Bodies”

“It helped structure the Quantum community”

“I was surprised how many researchers applied for the call in Slovenia”

“The robustness of the partnership in QuantERA is something that should be shared and replicated, as QuantERA not only managed to develop an efficient ‘know-how’ throughout the past years, but also developed a trust among its partners that allows for the smooth running of the Programme.



Sergueï Fedortchenko
ANR, France

Interest in the calls: strong and rising

Within QuantERA I, the Consortium of Research Funding Organisations jointly implemented two calls for proposals: in 2017 and in 2019. Both of the calls attracted significant interest within the scientific community.

The 2017 call attracted 1087 applicants forming 221 international research teams. Albeit the 2019 call was launched without the EU Cofund, nonetheless the call attracted 85 international research consortia consisting of 423 research teams.

The strong interest in QuantERA has recently been reconfirmed through the results of the first QuantERA II call launched in 2021. From the vast number of 128 proposals (614 applicants), the QuantERA network selected 39 projects, which shows that the Programme is continually **effective. This is the highest number of full-proposals recommended for funding ever achieved in the QuantERA Programme and demonstrates the tangible success of the undertaking.**

The net of collaborations became more distract, which has the effect of enhancing diversity in consortia composition.

Stimulating the building of European consortia

QuantERA demonstrates clear results through **effectiveness** in networking the research organisations engaged.

Programme brings support for projects that had hitherto been lacking sufficient grant support until QuantERA, which is a great **added value** of the undertaking.

Enhancing diversity of research collaborations

QuantERA evolved with respect to the relationships between research teams. While there were only a few very active countries in call 2017 in terms of establishing relationships between research partners, in 2019 the networking map changed and new links started to stand out.

“ Transnational cooperation is one of the fundamental strengths of European R&I efforts in the area of quantum technologies. Ground-breaking ideas and concepts that emerge in Europe can be incubated thanks to the calls organised on a regular basis by the QuantERA Consortium formed by the research-funding organisations.

The results of QuantERA-funded projects provide an important feed into the downstream activities of the EU Quantum Flagship and other European initiatives.



Konrad Banaszek
QuantERA Scientific Coordinator
NCN, Poland

Encouraging new research collaborations

The Programme contributes to the European Research Area (ERA) through attracting new transnational research collaborations. Accounting the call 2017, 19% of the supported consortia had never collaborated before, 66% were formed by a mixture of existing and new collaborators, and 15% were composed solely of existing collaborators.

The majority of the consortia declare involvement in other QT-related projects, which enriches the overall knowledge base and partner network of the beneficiaries. Also, all consortia dedicate significant infrastructure available at partners' premises, necessary in the execution of the planned research.



“ We see that maintaining support for the topic brings predictability to the research community which positively influences its pro-activeness and initiatives. Such support enables sustainable collaborations to be planned and formed. As a result, it improves the quality of research (projects), makes stronger networks and – hopefully – more local projects qualifying for support.



Nicoleta Dumitrache
UEFISCDI, Romania

Boost of research capacity

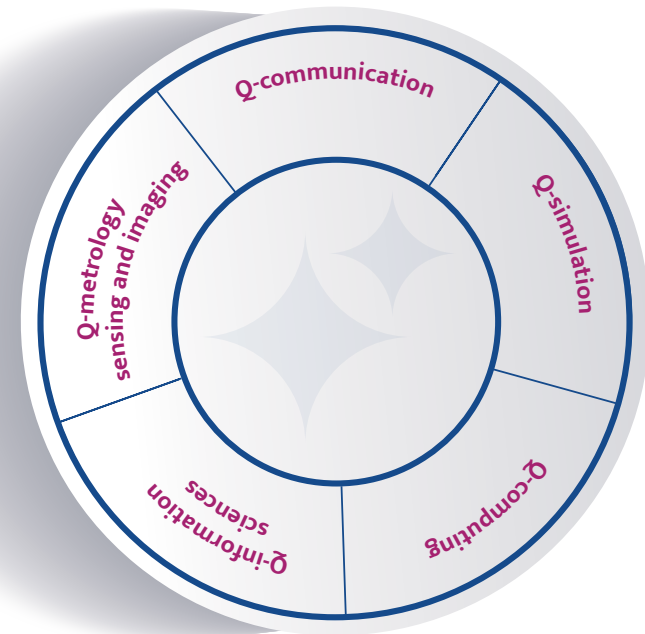
QuantERA's interdisciplinarity

The Programme's proper format is directly connected to the excellent results demonstrated.

The scientific scope of QuantERA has been well cared for with the establishment of the Strategic Advisory Board (SAB) – the Programme's advisory body consisting of prominent researchers from the fields of QT and representatives of industry. The SAB ensures that the QuantERA action has the capability to offer a broad range of perspectives on state-of-the-art advances in the QT field and its further strategic developments. Such approach confirms the Programme's **relevance** and **utility** in the whole QT context.

The scope of developments in the field of quantum technologies can be identified by five main pillars, which have been incorporated into QuantERA as project research areas:

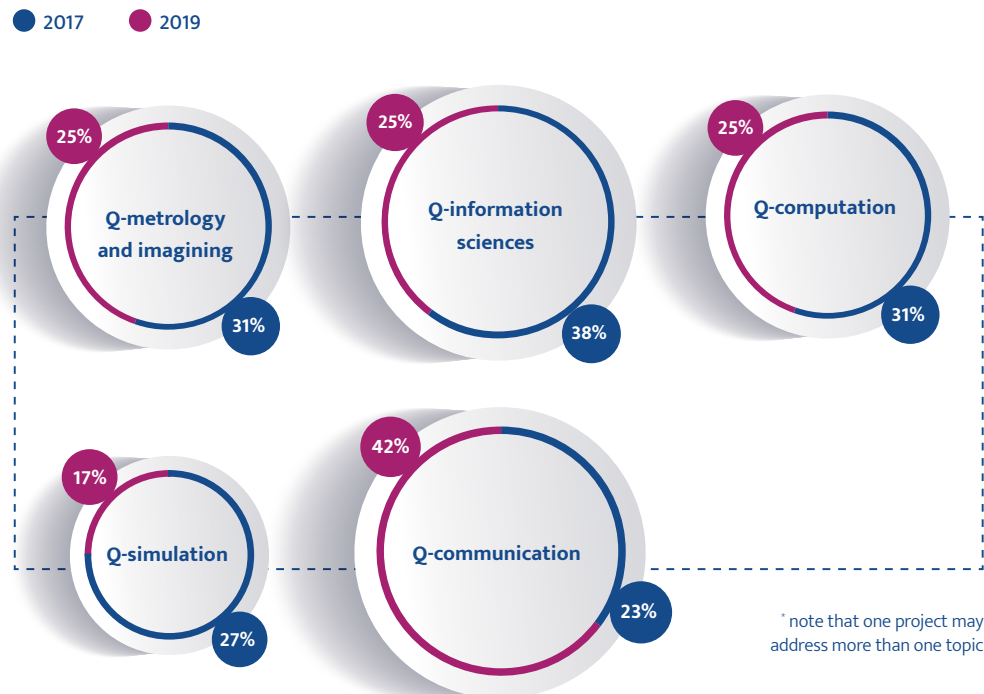
- **Quantum communication**
- **Quantum computing**
- **Quantum simulation**
- **Quantum information sciences**
- **Quantum metrology sensing and imaging**



Each area of research attracts significant interest from QuantERA international research teams, enabling topic-related theories and experiments to be pushed beyond the current conceptual and technological limitations.

The figures below depict interest in the QuantERA areas of research within the call of 2017 and 2019.

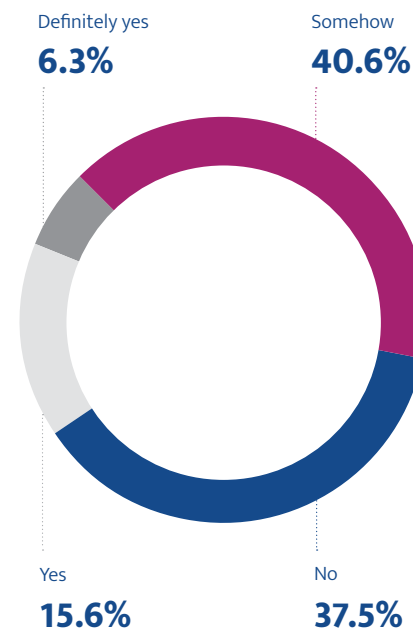
Distribution of project research topics



Respondents stated in the open questions that their participation in the QuantERA Programme definitely contributed towards building research capacity for all the European countries in QT and to empowering their potential for successful participation in transnational research processes.

According to 63% of respondents, QuantERA had a positive impact when it came to identifying common call topics (which could be novel ones to partners) suitable for development within the QuantERA Programme:

Did the participation of your organisation in QuantERA help to identify common call topics between you and other Consortium partners?

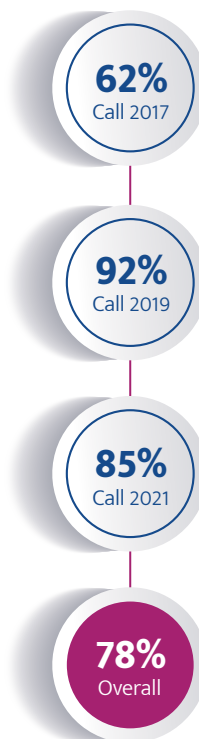


Spread of excellence

Involving Widening countries

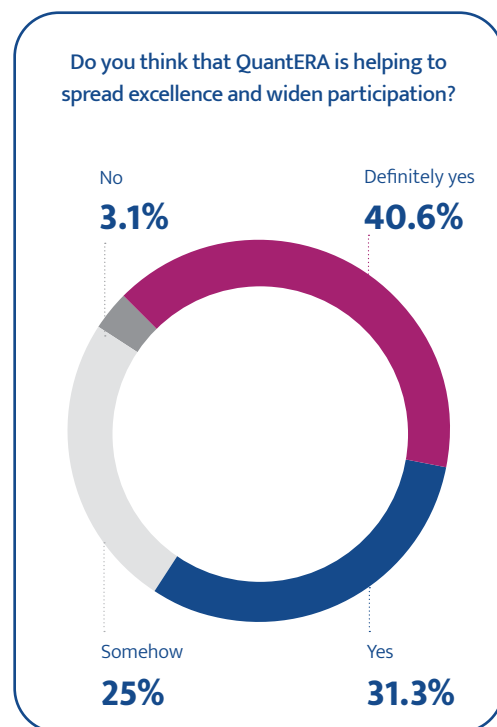
The network **introduces successful mechanisms supporting inclusiveness** and greater participation of the less-represented countries within the framework programmes. All of the QuantERA calls encouraged geographically balanced consortia embracing the diversity of scientific communities across Europe.

Research teams from so-called “Widening countries” are involved in almost 78% of the total number of QuantERA funded projects (16 out of 26 in call 2017, 11 out of 12 in call 2019 and 33 out of 39 in call 2021). This confirms the continuation of the positive trend.



The achievements of the Programme in terms of spreading excellence across the entire European R&I community have been noticed and described in the ERA-LEARN publication: [Inclusiveness in European R&I Partnership Programme](#), where QuantERA serves as an example of best practice in this field.

The QuantERA efforts in the field of spreading excellence have been **effective and relevant**.



Almost all respondents of the conducted survey (96%) clearly stated that QuantERA influenced spreading excellence and Widening participation. Even more noteworthy, 72% of them recognised this impact as explicit.

Gender balance

QuantERA makes special efforts to promote gender balance throughout the supported projects, and within the network itself. Gender balance was laid out in the evaluation criteria of all QuantERA calls. And although the ratio of women's participation is still below the desired values, the positive impact of this strategy is already visible in the 2019 call compared to the 2017 call where we see a slight increase in women's participation in the selected projects both in the Project Investigator¹ role and the Coordinator² role.

QuantERA's struggles towards gender balance in QT research have been strengthened in the continuation of the Programme. The 2021 call addressed gender equality through encouraging a fair representation of female researchers in consortia, considering gender balance in the evaluation panels' structure and setting-up gender equality as one of the tie-breaking criteria.

Currently, such activities are empowered through conducting a series of [interviews with QuantERA project coordinators](#).

The interviews aim to:

- highlight the presence of women researchers among the coordinators of the QuantERA projects;
- encourage the QuantERA project consortia to target the gender equality objectives defined for QT;
- explore the optimal work-life balance and gender equality measures for QuantERA activities;
- promote STEM vocations free from gender bias among women students.

The Programme follows the [Commission's Gender Equality Strategy 2020-2025](#) which presents policy objectives and actions to make significant progress by 2025 towards a gender-equal Europe. The network demonstrates **relevance** for this approach by emphasising the importance of its objectives and striving to apply them in the network's activities whenever possible.

¹ The Project Investigator is the leader of a research team consisting of scientists from one project partner institution

² The Coordinator is the leader of a project consortium consisting of research teams

Development of industry connections

QuantERA aims at stimulating and intensifying industry interests in QT and, while boosting scientific excellence, induces researchers to find their way towards commercial applications. Via cooperation with QT Flagship, the Programme bridges academic research with engineering endeavours in QT applications. Mutual efforts are directed towards speeding up knowledge and technology transfers to put QT

into everyday use. The network developed **Guidance on industry engagement for the public sector** with recommendations that are expected to accelerate the translation of science into real products and thus to create business growth.

Partners share the opinion that one of the crucial mechanisms introduced in QuantERA in terms of col-

laborations with industry was the setting out of the “**Quantum Phenomena and Resources**” (QPR) and “**Applied Quantum Science**” (AQS) topics of support, which are a particular advancement when comparing QuantERA I to QuantERA II. The modification was introduced since the first two QuantERA calls showed that there was an interest from the private sector and from public applicants performing applied research.

Hence, the novelty of creating a topic for applied research in call 2021 of QuantERA II found appreciation among applicants performing applied research. 18 out of 39 consortia whose projects have been selected for funding within this call chose the AQS topic for their research.

Such an approach demonstrates the Programme’s **relevance** and **utility** in European efforts concerning commercialisation of QT, as well as its **effectiveness** in introducing appropriate instruments enabling market-oriented research. This reflects not only the progress of the Programme from edition to edition, but also proves the Programme’s ability to react to the environment’s changes and needs.



Indication of future developments

QuantERA looks beyond and draws outlines for future developments. The following highlights appear to represent the RFOs' collective view over the future direction of the Programme:

Playing a pathfinder role in the break-through research in Europe

Evolution of the QuantERA instruments and unique value proposition

Bringing QT closer to practical applications and industry

The future of QuantERA – the broader picture

Since the QuantERA Programme, realised presently as QuantERA II, ends in 2025, the network has already started mobilising its efforts to find a mechanism which will enable it to continue fulfilling its goals within the existing Horizon Europe Framework Programme – the successor to the Horizon 2020 Programme. Mutual engagement of RFOs, EC, the QT scientific community and other parties involved in this process allow us to conclude that the vision of QuantERA's future is highly optimistic.

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