



Contract Number 015789

ERA-Pilot QIST

Structuring the European Research Area within
Quantum Information Science and Technology

Instrument: Coordination Action
Integrating and strengthening the European Research Area

Final Activity Report

Period covered: whole duration of the project Date of preparation: February 2008

Start date of project: February 1, 2005

Duration: 35 months

Project coordinator name: Dr. Christian Monyk
Project coordinator organisation name:
Austrian Research Centers GmbH - ARC

Table of Contents

1 – Publishable Executive Summary.....	3
List of Participants.....	5
2 – Project Objectives and major achievements.....	6
Overview of general project objectives, project’s current relation to the state-of-the-art.....	6
Objectives, work performed, contractors involved and main achievements.....	7
Most important problems and corrective actions undertaken.....	11
3 – Workpackage progress	13
Deliverables list	31
Milestone list	35
4 – Consortium Management.....	36
Annex – Plan for Using and Disseminating the Knowledge.....	39

1. Publishable executive summary

The project ERA-Pilot QIST (Structuring the European Research Area within Quantum Information Science and Technology) is a project within the ERA-Net Scheme of the European Commission. It started on February 1, 2005 under coordination of the Austrian Research Centers GmbH - ARC (Austria).

The main objective of the project is to structure the rather young scientific area of Quantum Information that occurred recently. Up to now most research activities within this field depended on local or national strategies and on the scientific orientation of individual research groups. Only the European Commission made a first attempt to achieve collaborative development. When starting the 5th Framework Programme for Research and Development the topic was included in “Future Emerging Technologies”, the targeted basic research fund of the IST-programme. In FP6 the EC continued its activities and set up a proactive initiative QIPC (Quantum Information Processing and Communication). ERA-Pilot QIST was started in order to accompany this process, to generate a complete picture of European expertise, to give a survey about local and national funding situation, and to compare the European situation to other research areas. A second important objective of this project was to go beyond the current situation. Within the project a roadmap for future development within the area of QIST was elaborated and recommendations for improvement and to harmonization of funding and research strategies were given.

The first part of the project aimed at elaborating a survey of the scientific QIST situation in Europe and at structuring this area. For this purpose the first step was to come to a common understanding of the different topics covered by QIST. During the last decade a large variety of different scientific achievements lead to many different research projects all over the world. Even for participating scientists it was difficult to differ between the different topics. ERA-Pilot QIST for the first time elaborated a classification scheme for QIST that was quickly adopted by the community. This work was done mainly during the first project year but continued till the end of the project. Based on this classification scheme the project drew a map of the European QIST-community by analyzing the different research groups in almost all European countries and by creating a large online database containing information about all these groups. In parallel a map of European QIST activities was drawn that gives an overview of nationally and European funded QIST projects, of regional and national structures and funding programmes, and of the governance structure concerning QIST within European countries. All information was included in the online database that can be accessed by all interest groups – both scientific and political – all over Europe.

Another important objective was to look beyond Europe. Roadmaps for targeted research and development within QIST already exist in several research areas. These roadmaps were analyzed and the applicability of such roadmaps to the European situation was investigated. All this work led to the elaboration of a European “QIST guideline”. With this guideline an early dialogue between science, policy, and industry will be initiated in order to develop a common vision of the future of QIST research and development within Europe. Most relevant scientific groups

within Europe contributed to this guideline, it was drafted before the start of the project and updated several times during the lifetime of ERA-Pilot QIST. This document will be handed over to the coordination action QUROPE that will continue to update it regularly. The long term perspective is to create a living document reflecting the situation of QIST in Europe and a common vision for further activities, both for scientific groups and for funding agencies for elaboration of their funding programmes.

A second objective of the project was to analyze the situation outside Europe. Data regarding both scientific activities and funding strategies in different research areas world wide were gathered. The findings of this part of the project will allow a comparison of European to other structures and will contribute to improve the situation in Europe.

Moreover ERA-Pilot QIST took over responsibility of the QIST community in Europe. During FP5 the project QUIPROCONE started to structure the community and another project, the coordination action QUROPE starting in late 2006 will continue to support the community. ERA-Pilot QIST bridged the gap between these two projects and supported the QIST community. In October 2006 it organized a scientific conference at the Royal Society in London, it hosted web pages for distribution of information, and brought together scientific groups to contribute collectively to the elaboration of the QIST guidelines.

Finally the work done within the project contributed to the development of the future European strategy regarding supporting and funding research and development of QIST that is reflected by the workprogramme of FP7.

List of Participants

Nr.**)	Participant Name	Country
1	Austrian Research Centers GmbH – ARC *)	A
2	Bundesministerium für Verkehr, Innovation und Technologie	A
3	Österreichische Akademie der Wissenschaften	A
4	The Engineering and Physical Sciences Research Council	UK
5	Chancellor, Masters and Scholars of the University of Oxford	UK
6	Slovak Academy of Sciences – Institute of Physics	SK
7	Agentúra na podporu vedy a techniky	SK
8	Centre National de la Recherche Scientifique	F
9	National University of Ireland, Maynooth	IR
10	Instituto Nazionale per la Fisica della Materia	I
12	University of Copenhagen	DK
13	Science Foundation Ireland	IR
14	Max Planck Gesellschaft zur Förderung der wissenschaftlichen Forschung E.V.	D
15	Stichting voor fundamenteel Onderzoek der Materie	NL
16	Fonds National de la Recherche Scientifique	B

*) till 13/11/2006 Seibersdorf Research GmbH which merged to Austrian Research Centers GmbH – ARC

***) partner number 13 Science Foundation Ireland left the consortium voluntarily because of organizational changes on 01/02/2006

Contact:

Dr. Christian Monyk
Austrian Research Centers GmbH - ARC
Tech Gate Vienna
Donaucitystrasse 1
1220 Vienna
Tel: +43-50550-4152
Fax: +43-50550-4190
Mail: christian.monyk@arcs.ac.at
Web: www.qist-europe.net

2. Project objectives and major achievements

Overview of general project objectives, project's current relation to the state-of-the-art

The general objective of the project is to structure the rather young scientific area of "Quantum Information Science and Technology" within Europe. This term describes a range of scientific techniques that have been developed over the last ten years. As QIST emerged almost simultaneously at universities all over the world early funding for QIST-research has been taken from national basic research funds according to the national strengths and experiences of the respective research groups. At the beginning there has been limited consideration about how to structure QIST-related funding.

When starting the 5th Framework Programme for Research and Development the European Commission took into consideration novel scientific approaches; QIST-topics have been taken into "Future Emerging Technologies", the targeted basic research fund of the IST-programme. Thus early structuring attempts have been made by bringing together European researchers from the same scientific area within common research projects. This strategy has been continued in FP6 where a proactive initiative QIPC (Quantum Information Processing and Communication) has been established.

Despite those early structuring attempts some of the major problems are not yet solved at the starting point of the project. The major goal of the project have been to find solutions for some of these problems by the following measures:

- Development of a generally accepted QIST classification
- Investigation and analysis of the existing situation of QIST in Europe
- Contribution to the structuring of the European QIST-community
- Survey of the European potential for co-operation and proposals for local and thematic Centers of Excellence
- Establishing a dialogue between science, policy, and industry
- Development of a common European QIST-vision
- Support platform for funding organisations, policy, and European Commission
- Suggestions for future measures in order to design a QIST-strategy in a sustainable way

During the lifetime of the project the following goals have been achieved:

- A common European QIST-vision was developed (through the so-called "European QIPC roadmap")
- A generally accepted QIST classification was developed (the so-called Quantum Information Classification Scheme that was adopted by the "European Physics Journal D")
- A new approach for the evaluation of scientific projects was developed which may be used by different funding agencies

- The project was involved actively in the planning and structuring of the coordination action QUROPE that will update and improve many of the project's tasks and results thus ensuring continuity
- The documents elaborated during the first project year should be updated continuously and finalized
- Funding agencies and patterns of QIST in Europe and abroad (and in the latter case their applicability to the ERA) should be investigated and analysed
- A support platform for funding organizations, policy, and European Commission (e.g. elaboration of a list of evaluators) should be established.

In general all objectives were achieved during the lifetime of the project.

**Objectives of the project, work performed, contractors involved
and main achievements**

Each workpackage has had its individual objectives to be reached. The key features regarding these objectives are listed below:

Work-Package	Objectives	Work performed	Contractors involved	Main achievements
WP 1	Elaboration of a structure for the scientific area of QIST	<ul style="list-style-type: none"> The structure has been elaborated 	P3, P8, P9, P10, P12, P16	<ul style="list-style-type: none"> The structure has been published online on 10/09/2005 The structure has been adopted by EPJ D
	Updating of the QIPC-Roadmap in regular intervals	<ul style="list-style-type: none"> The updating has been organised 	P3, P8, P9, P10, P12, P16	<ul style="list-style-type: none"> There have been two updates so far
	Contribution to the EC-publication "QIPC in Europe"	<ul style="list-style-type: none"> The contributions of several scientists have been coordinated, the publication has been edited 	P3, P8, P9, P10, P12, P16	<ul style="list-style-type: none"> The EC-publication has been finished and published
	Elaborating a QIST overview	<ul style="list-style-type: none"> A publication giving an overview of the main QIST-topics has been written 	P3, P8, P9, P10, P12, P16	<ul style="list-style-type: none"> The publication has been published in Eur. Phys. J. D 36, 203-228 (2005)
	Analysis of QIST-roadmaps	<ul style="list-style-type: none"> QIST-related roadmaps within U.S. and Europe have been analysed and compared 	P3	<ul style="list-style-type: none"> A first draft of an analysis has been written
	Complete survey of QIST-related activities in Europe	<ul style="list-style-type: none"> Active investigation and online registration for 	P3, P8, P9, P10, P12, P16	<ul style="list-style-type: none"> Online database available

		actors		
	Developing of a database of QIST actors	<ul style="list-style-type: none"> Active investigation and online registration for actors 	P3	<ul style="list-style-type: none"> Online database available
	Elaboration of guidelines for future funding of research and development within the area of QIST in Europe	<ul style="list-style-type: none"> Initial paper was revised several times, input collected from various groups 	P3	<ul style="list-style-type: none"> “Stratigic Report” available
WP 2	Elaborating an overview of QIST-groups outside Europe	<ul style="list-style-type: none"> Information has been gathered and structured 	P6	<ul style="list-style-type: none"> A first draft of the overview has been written
	Collecting and structuring of data on research and funding of QIPC activities outside Europe	<ul style="list-style-type: none"> QIPC groups outside the EU were investigated 	P3	<ul style="list-style-type: none"> A database has been generated that contains information about scientific groups and funding institutions
	Establishing of Quantiki as an international resource for the QIST community	<ul style="list-style-type: none"> The Wiki was set up 	P5	<ul style="list-style-type: none"> Quantiki-webpage: www.quantiki.org
WP 3	Elaborating an overview of European funding structures regarding QIST	<ul style="list-style-type: none"> Information has been gathered, based on internet and on questionnaires 	P1, P2, P4, P5, P7, P8, P14, P15	<ul style="list-style-type: none"> A first draft of the overview has been elaborated
	Carrying out a feasibility study about Real Science Reseach Options	<ul style="list-style-type: none"> Methods elaborated for the assessment of new technologies 	P5	<ul style="list-style-type: none"> The feasibility study has been finished

		have been transferred to QIST		
	International Networking	<ul style="list-style-type: none"> • A contact to the umbrella-project CISTRANA has been established 	P1	<ul style="list-style-type: none"> • First contacts for further networking have been made
	Creation of a picture of QIPC funding in Europe	<ul style="list-style-type: none"> • Information has been gathered, based on internet and on questionnaires 	P3	<ul style="list-style-type: none"> • Online database of funging agencies available
	Identification of funding patterns of QIPC	<ul style="list-style-type: none"> • Questionnaires and personal communication with funding agencies and scientific groups 	P3	<ul style="list-style-type: none"> • Report on funding patterns submitted
WP4	Organization of the 7 th European QIPC workshop	<ul style="list-style-type: none"> • All preparatory work was carried out 	P1	<ul style="list-style-type: none"> • The workshop was held on Oct. 13-14, 2006 at the Royal Society in London
	Administration of the general budget	<ul style="list-style-type: none"> • Collection of receipts 	P1	<ul style="list-style-type: none"> • All costs of third parties were remunerated
WP 5	Management support for the project	<ul style="list-style-type: none"> • Development of a communication tool, • Set up of a web site • Communication within the project • Transfer of funding • Amendments of the 	P1	<ul style="list-style-type: none"> • The work performed within the project runs satisfying

		contract • Communication within the project		
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Most important problems and corrective actions undertaken

During the lifetime of the project the following problems occurred:

- The project started in February 2005 without a signed contract and before the funding has been transferred. It took till September 2005 till the money has been received by the co-ordinator and has been forwarded to the project partners. This delay caused some problems as the required additional personnel could not be hired by some partners. Therefore delays in some workpackages have been caused (partly in WP 3 but most seriously in WP 2).
→ corrective actions undertaken:
Some of the delay could be made up, nevertheless the consortium decided to ask for an extension of the project duration to be sure that the overall goals of the project will be achieved.
- Partner Nr. 13 (Science Foundation Ireland - SFI) decided to leave the consortium as the person that has been responsible for QIST-topics within SFI left the agency.
→ corrective actions undertaken:
As SFI has no important responsibility within the project the loss of this partner will not cause major problems. An amendment of the contract will be applied for.
- During the preparatory work for the benchmarking task of WP 2 it has turned out that a majority of the QIPC-community is not willing to support this task but opposes the activities related to benchmarking. There are two reasons for such an attitude: Firstly, most of the researchers in the QIPC community argue that it is still early to perform benchmarking of different approaches to the quantum information processing and to reliably compare presently available techniques. Secondly, some of the groups (represented by e.g. Prof. I. Bloch, Prof. J.M. Raimond, Prof. D. Meschede, etc.) expressed worries that any benchmarking can be inappropriately used by people who are not qualified enough to understand subtleties of the QIP. Unfortunately, in this situation it is unwise to put the ERA-Pilot-leading groups into a very difficult position that might harm their future professional work. In particular the workpackage leader (Partner 6, Slovak Academy of Sciences) is not in a position to resolve the problem that concerns the whole community. Therefore, the ERA-Pilot steering committee has decided that it will not be possible to continue the task of benchmarking as it has been planned.
→ corrective actions undertaken:
Partner 6 will fulfill task 2.1 (Best Practice) of WP 2 but will not continue the benchmarking activities. Parts of the funding dedicated to this Partner will be withdrawn and the co-ordinator will look for another project partner that is not directly involved in the community (no scientific partner). The co-ordinator will try to negotiate a continuation of the benchmarking task with this partner that will receive additional funding taken from Partner 6. In case it will not be possible to find an appropriate partner the co-ordinator will try to achieve an amendment of the "Description of Work" in order to amend the objectives of WP 2 or even to abandon the benchmarking task.
- The review after the first project year required a partially redesign of the project. Parts of the Description of Work had to be rewritten and approved by the

reviewers. This process took about half a year.

→ corrective actions undertaken:

The tasks within the project, especially WP 2 and WP 3 were reallocated and the consortium applied for an extension of the project duration.

- Because the project consortium consumed less than 70% of the first year's prefinancing the consortium did not receive additional prefinancing for the rest of the project duration. Especially Partner 5 (University of Oxford) could not hire additional personnel to fulfill its tasks.

→ corrective actions undertaken:

Parts of the funding already transferred to partners as prefinancing for the first project year was transferred back to the co-ordinator and reallocated so that the partners that took over additional tasks could hire additional personnel to fulfil these tasks. Deliverable 2.9 (Creation of an encyclopaedia kernel consisting of the hundred most important articles) was downsized to a lower number of articles due to the budget restrictions.

3. Workpackage Progress

Workpackage Progress Report

“Drawing a European Guideline for QIST”

Workpackage number	WP 1	Start date or starting event:	t0
Activity Type	Coordination activity		
Participant id	3	10	8, 9, 12, 16
Person-months per participant:	46	2	0,25

Objectives

This WP aims at carrying out a complete survey of QIST-related activities in Europe, at developing a database for further purposes and at elaborating a guideline for future funding of research and development within the area of QIST in Europe. A common strategy shall be developed that is based on the participation of scientists, of funding agencies and policy organizations.

Progress

One major task of this workpackage – Elaborating a QIST-guideline (roadmap) – is a continuation of the QIPC-roadmapping that has been done before the start of the project. In order to carry out this task the responsible partner (Participant 3: Österreichische Akademie der Wissenschaften) developed a web-site independently of the official project web-site. The development of this web-page has been done to continue the “roadmapping” as fast as possible. It can be reached via <http://iqoqi003.uibk.ac.at/qist> or <http://qist.ect.it> It is situated on a server of Participant 3 where the current status of the roadmap can be downloaded by European scientists that have registered previously. The web-site has been published on 08/04/2005, the first call for QIPC groups to subscribe to the site has been issued on 11/04/2004.

The draft version of the roadmap has been revised, edited, and formatted and last changes have been collected before it has been put on the web-page. On 22/04/2005 version 1.0 of the document “Quantum Information Processing and Communication: strategic report on current status, visions and goals for research in Europe” (the roadmap) has been published on-line (Deliverable D 1.2). On 20/07/2005 the “QIPC Strategic Report” has been put online. This version is the one that WP 1 decided to deliver to FET for desktop publication as an official EC Document. In addition the participants of WP 1 elaborated a “European Journal of Physics D” version of the document “QIPC Strategic Report”. The call for the second update of the position paper “QIPC Strategic Report” has been launched on 20/10/2005.

During a meeting in Vienna (26/05/2006) with the project co-ordinator the strategy regarding the common workspace for scientific groups participating in the editing of the roadmap has been discussed. It has been decided that WP 1 will set up a database of actors and the data shall be kept at server within the responsibility of WP 1 where the common work on the roadmap will be done. This database and the roadmap documents can be accessed via <http://qist.ect.it>. To be able to combine the data of persons and groups that register on the WP 1 website and those that register on the general project website a common structure of the database has been defined. Moreover a common strategy how the data shall be collected – especially the data regarding national and international funding agencies – has been developed. In November 2005 an online tool for the consultation of the database including a search engine has been developed.

For editing the roadmap and any additional position document that will be produced within WP 1 commonly a web based tool named Q-Share has been established. The work on this new tool has started in June 2005 and has been published online together with the relative documentation in July 2005.

The work regarding the online-publication of a collection of articles “QIPC in Europe” has been finished in May, on 10/05/2005 this collection has been published and is available at <http://www.cordis.lu/ist/fet/qipc-eu.htm> (Deliverable D 1.1).

In May representatives of WP1 participated in the QUPON conference in Vienna (24th to 27th of May). A presentation of the current status of WP 1 has been prepared and has been presented by Tommaso Calarco there. Moreover Peter Zoller presented the current status of the roadmapping project.

It has been decided to combine the deliverables D 1.4 (draft version of the publication “QIST-overview” describing the most relevant QIST topics) and D 1.9 (publication “QIST-overview”) to the “QIPC Strategic Report” as the work on this task has been faster than planned. The EPJ D version of this report has been published online in September 2005.

A first draft of a Quantum Information Classification Scheme – QICS (deliverable D 1.3, “Description of the QIST structure”) has been put online on 30/09/2005. It has been the basis for a search engine for the QICS. The code for this search engine has been elaborated in September 2005. In October journals have been contacted for running a test of the search engine. The European Physics Journal D has agreed and run a test.

The code for the cartography of European QIPC groups and European funding institutions (deliverables D 1.5 and D 1.6) has been developed and the application has been put online in November 2005.

The work on deliverable D 1.7 (Draft version of an analysis of QIST-related guidelines and roadmaps outside the ERA) has been finished in November 2005 as well.

In November 2005 the ERA-Quantiki project has been designed, developed and launched. Quantiki is a free-content www-resource (<http://www.quantiki.org>) in quantum information science that anyone can edit hosted at Cambridge. WP 1 has set up freely editable versions of the QIPC Strategic Report and QICS, together with some of the available databases (EU QIPC group list, funding agencies, etc.) Roadmap and QICS Quantiki versions are constantly monitored and approved contributions will appear in following releases of the documents.

In December the collection of data regarding the list of potential evaluators for QIST projects (deliverable D 1.10) has been started. The development of a code for managing the database including an automatic unsubscribe form has been done simultaneously. The list has been published in February 2006.

Different sets of data have been combined to create a general list of QIST-actors containing QIPC-scientist, funding agencies, industry, policy, journalists. This list will be updated regularly and will act as a basis for the distribution of QIPC-related information. It has been published in February 2006. (deliverable D 1.11)

The final version of a database of (possibly) all European QIPC groups that have been registering during the lifetime of the project in two successive calls (Deliverables D1.5 and D1.13) was elaborated. The database comprises now 174 QIPC groups for which all relevant information is available (such as group leader, contact, website, interests, QICS, collaborations, etc.), it is fully searchable and features also an interactive map showing the geographical distribution of the groups. When possible, data have been made static by attaching to each entry in the database a time-stamp indicating when the information was lastly updated.

The final version of a database of (possibly) all European funding agencies that have been contacted by WP3 during the lifetime of the project was built up. The database comprises now 44 European funding institutions for which all relevant information is available (such as the institution website, contact, type, mission, focus, strategy, etc.), it is fully searchable and features also an interactive map showing the geographical distribution of the agencies. The WP3 questionnaire, when present, can be also downloaded. When possible, data have been made static by attaching to each entry in the database a time-stamp indicating when the information was gathered. This task is largely based on deliverables D1.6 and D1.14 of the first reporting period.

The final version of the set of the databases of QIPC groups (D 1.17), funding agencies (D 1.18), list of potential evaluators for QIST-projects (D 1.10) supplemented with a list of addresses of specialized press (provided by WP5)¹ was organized. In this way it will comprise all the European QIST actors making possible

¹ This WP5 deliverable has not been accepted during the review of the first year of the project due to the fact that it was biased towards German speaking journalists. The referee suggested that we should contact DG INFSO C4 that should have a much more detailed list. After contacting them, they have replied that they do not disclose nor circulate their list for privacy reasons (not even internally to other DG INFSO Units.) Therefore we revised the list and resubmit Deliverable D 5.7.

to reach all the main player in the field of QIST (scientists, funding agencies, and public relations). This database can be completed with the database of European industries related to QIPC collected by the QUROPE WP7

(see http://www.qurope.net/Q_WP7/industries.php?type=wp7&trig_id=4).

This activity is related to deliverables D1.11 and D1.15 of the first reporting period.

The first version of the report regarding the analysis of roadmaps has been delivered in December 2005 (v-1.0, Deliverable D1.7) featuring a detailed comparison between the US (v-2.0) and EU (v-1.1) roadmaps.

The current version (December 2007) features an analysis of EU guidelines in QIPC with the ones of the main public QIPC investors, i.e., the US and Japan, as well as an updated version of the roadmap comparison (the EU roadmap compared is v-1.4, Deliverable D1.21).

The first version of the QIST-guideline has been delivered in April 2005 and updated in July 2005 (v-1.1, Deliverable D1.2). This latter version is the one delivered to FET for desktop publication (ISBN 92-894-8924-3), and has been published in [1] (Deliverables D1.4 and D1.9).

There have been several major updates of the QIPC Strategic Report: February 2006 (v-1.2, Deliverable D1.8), March 2007 (v-1.3, Deliverable D1.16) and one in October 2007 (v-1.4, Deliverable D1.21).

The latest one has been of particular relevance, for it introduces the new concept of Quantum Information Technologies (QITs). These are technologies designed to control and manipulate entanglement, and can be split into two main categories, being either technologies which represent genuine applications of QIPC (quantum information enabled technologies), or technologies which are needed for further advancing the field of QIPC (quantum information enabling technologies). Thus, QITs accomplish the task of broadening the QIPC area to all subfields of physics and information science that have entanglement and quantum correlations either as a goal, or as a tool of their research, and are to be regarded as a mean of enlarging and evolving the QIPC proactive initiative as a whole. This version has been used to provide input to the Commission for the preparation of the FP7 Call 4 (2009).

For completeness, we report in the Table 1 the complete changelog of the different QIPC Strategic Report versions.

Since its origin, the QIPC Strategic Report is a 'living document' and the community feedback has been constantly monitored and addressed. In particular several sections of the ERA-Pilot WP1 website have been designed to collect input from the QIPC community. This effort is continued now by the WP2 of the Coordination Action QUROPE – QIPC in Europe (see "Complementary activities" in this report).

Finally, between February 1st and September 15th 2006, the WP1 website has hosted a consultation forum for the QIPC area in parallel (and independently) with the one organized by the "Beyond The Horizon (B-T-H)" coordination action for the six thematic areas of pervasive computing and communications, nano-electronics and nano-technology, security, dependability and trust, bio-ICT synergies, cognition and intelligence, software intensive systems. The QIPC Strategic Report was subject to discussion and there were a total of 84 comments submitted, which can still be browsed at <http://qist.ect.it/CForum/cforum.htm>.

[1] P. Zoller et al., "Quantum information processing and communication: Strategic report on current status visions and goals for research in Europe", Eur. Phys. J. D 36, 203 (2005)

SR version	Delivery date	Changelog
v-1.4	10.07	Appendix rewritten for introducing the concept of Quantum Information Technologies (QITs). Accordingly, Section 5 ("Prospects for Applications and Commercial Exploitation") has been removed, due to the large overlap with the new Appendix. State-of-the-art updated
v-1.3	03.07	Executive summary completely rewritten QIPC research in Europe updated: Up-to-date description of the QIPC Proactive Initiative More detailed (but still work in progress) description of the QIPC funding at the EU regional level (WP3) Incomplete/obsolete data on International funding programs tagged: will be updated by WP2 in the final version of the document Section on "Atoms and Cavity QED" broadened to "Neutral Atoms, Molecules and Cavity QED" Updated short- and long-term goals for semiconductor quantum dots and for impurity spins

		Some changes/addenda in the theory section (most notably in the following subsections: Quantum Algorithms and Complexity, Geometric and topological methods for fault tolerant quantum computing, Noisy communication channels, Spin-off to other fields) Format changing of the document to the QUROPE styles State-of-the-art updated
v-1.2	02.06	Quantum computing with trapped electrons has been included in Section 4.2.1 ("Quantum computing with trapped ions") Single molecular magnets have been added to section 4.2.6 ("Impurity spins in solids", which is now titled "Impurity spins in solids and molecular spin cluster") In the theory section, a new section has been added (4.3.4 "Geometric and topological methods for quantum computing"), and decoherence free subspaces have been included in section 4.3.6 ("Quantum error corrections & purification") State-of-the-art updated
v-1.1	07.05	Mainly typographical changes, with few additions among which paragraph highlights for Sections 1, 2, 3 and 5, and finally some typos corrections

Table 1: Changelog for the different versions of the QIPC Strategic Report document

Complementary activities carried out in WP1

1. WP1 website

For the purpose of providing an efficient feedback channel for the community WP1 has established since the beginning of the project a website (<http://qist.ect.it>) independent from the official one (<http://www.qist-europe.net>). This website hosts the entire set of databases collected during the project lifetime as well as (custom developed) tools for shared documents editing; it has moreover been used to disseminate within the community the WP1 results and especially the different versions of the QIPC Strategic Report and QICS documents.

2. Quantum Information Classification Scheme (QICS)

QICS represents by now a classification scheme of QIST related topics widely accepted by the research community. This classification scheme is arranged hierarchically, by subdivision of the whole spectrum of subject matter in the QIST areas into segments and then repeating the process of subdivision down to four levels: Categories (5), Topics (25), Fields (203), and Sub-fields (52). Thus, similar subjects will be found grouped closely together, with browsing up and down near any entry revealing closely related entries. At the ERA-Pilot QIST WP1 website (<http://qist.ect.it/QICS/qics.htm>) a search engine for QICS is available together with different file formats of the QICS document (html and pdf).

Following the publication of the QICS classification scheme in [2], WP1 has contacted the Physics and Astronomy Classification Scheme (PACS) committee for suggesting a revision of their codes based on the scheme developed. The suggestion was accepted and in September 2007 the American Physical Society has released a major update of their codes. The QICS based changes are reported in the Table 2.

As it is already the case for the QIPC Strategic Report, QICS has been developed as a 'living document' and the community feedback has been constantly monitored and addressed. This effort is continued now by the WP2 of the Coordination Action QUROPE – QIPC in Europe (see next bullet point).

[2] D. Binosi, T. Calarco, R. Fazio and P. Zoller, "Quantum Information Classification Scheme", Eur. Phys. J. D 38, 237 (2006)

3. Other publications

The ERA-Pilot WP1 has assisted the European Commission in the preparation of the publication "Quantum Information Processing and Communication – FET Proactive Initiative in the IST Research Program 1999-2006" (ISBN 92-79-02531-7) which describes all the projects, events actions publications reports and activities that have taken place within the QIPC Community during FP5 and (part of) FP6.

Moreover an interview to the ERA-Pilot WP1 member Dr Daniele Binosi has appeared in the ICT-Results website [3]. The ICT-Results service gives on-line news and analysis on the emerging results from the IST research, reporting on prototype products and services ready for commercialization, as well as work in progress and interim results with significant potential for exploitation.

Finally the ERA-Pilot WP1 leader Prof. Tommaso Calarco has been acting as a rapporteur for the QIPC Cluster Review, which assesses the FP5 QIPC proactive initiative as a whole.

[3] "Pointing the direction of future EU quantum information research", ICT Results, see <http://cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/82882>

4. QUROPE Coordination Action

Since the project start, the ERA-Pilot WP1 has been proactively looking for ways to preserve and update both the position documents it was editing as well as the wealth of information it was retrieving. This has resulted in the heavily involvement of D. Binosi and T. Calarco in the writing of the proposal for the coordination action QUROPE, which was eventually funded with 1M€. In particular, the QUROPE WP2 has been especially conceived to complement and gradually (as it ends) take over from the ERA-Pilot QIST project the task of regularly updating the existing ERA-Pilot 'living' documents: the 'QIPC Strategic Report' and the 'Quantum Information Classification Scheme' (QICS). On top of ensuring a smooth transition between the two Coordination Actions, this fact has allowed (due to the extension of the lifetime of the ERA-Pilot QIST until the 31.12.07) to carry out the work of the QUROPE WP2 on the resources already allocated under the ERA-Pilot budget, and therefore at no cost for QUROPE.

Old Codes	2008 Codes	(N): New (M): Modified (S): Split
03.65.-w Quantum Mechanics	(M) 03.65.-w	Quantum Mechanics [see also 03.67.-a Quantum information; 05.30.-d Quantum statistical mechanics; 31.30.J- Relativistic and quantum electrodynamics (QED) effects in atoms, molecules, and ions in atomic physics]
03.65.Ud Entanglement and quantum nonlocality (e.g. EPR paradox, Bell's inequalities, GHZ states, etc.)	(M) 03.65.Ud	Entanglement and quantum nonlocality (e.g. EPR paradox, Bell's inequalities, GHZ states, etc.) [for entanglement production and manipulation, see 03.67.Bg; for entanglement measures, witnesses etc., see 03.67.Mn; for entanglement in Bose-Einstein condensates, see 03.75.Gg]
03.67.-a Quantum information	(M) 03.67.-a	Quantum information [see also 42.50.Dv Quantum state engineering and measurements; 42.50.Ex Optical implementations of quantum information processing and transfer in quantum optics]
	(N) 03.67.Ac	Quantum algorithms, protocols, and simulations
	(N) 03.67.Bg	Entanglement production and manipulation
03.67.Dd Quantum cryptography	(M) 03.67.Dd	Quantum cryptography and communication security
03.67.Lx Quantum computation	(M) 03.67.Lx	Quantum computation architectures and implementations
03.67.Mn Entanglement production, characterization, and manipulation	(M) 03.67.Mn	Entanglement measures, witnesses, and other characterizations [see also 03.65.Ud Entanglement and quantum nonlocality; 42.50.Dv Quantum state engineering and measurements in quantum optics]
89.70.+c Information theory and communication theory [for telecommunications, see 84.40.Ua; for optical communications, see 42.79.Sz]	(S) 89.70.-a	Information and communication theory [for telecommunications, see 84.40.Ua; for optical communications, see 42.79.Sz; for quantum information, see 03.67.-a; for applications to

	neuroscience, see 87.19.io]
	(N) 89.70.Eg Computational complexity
	(N) 89.70.Hj Communication complexity
	(N) 89.70.Hj Channel capacity and error-correcting codes
	(N) 89.70.Cf Entropy and other measures of information

Table 2: PACS changes triggered by QICS codes

5. Synergies with the QUROPE Coordination Action

The QUROPE CA started in September 2007. Since then the ERA-Pilot WP1 activities have been carried out in strict contact with several QUROPE WPs including WP2 (Vision and strategy), WP3 (Dissemination Activities) and WP4 (Electronic Exchange Infrastructure).

In particular:

- With QUROPE WP2 we have organized 3 special meetings
 - A special session at the “Gordon Conference on Quantum Information Science” held in Lucca (April 15-20, 2007) in which the strategy for the coming FP7 was discussed and the idea for Quantum Information Technologies was first proposed;
 - A special brainstorming session at the “QIPC Cluster Review” (February 28 – March 2, 2007) where the QIPC community was invited to provide ideas for quantum information technologies. The discussion was then continued on a dedicate QUROPE Forum [4];
 - A special session in the QUROPE Conference “QIPC 2007” held in Barcelona (October 15-19, 2007) titled “Strategy Planning of the FET QIPC Proactive” where the QIPC Strategic Report Appendix on “Quantum Information Technologies” was presented to the community.
- With QUROPE WP2, the ERA-Pilot WP1 has been involved in the preparation of policy and positions documents for several high profile meetings that have taken place in Brussels:
 - A meeting between the QIPC community representatives and the new FET Proactive Head of Unit Mr. Wolfgang Boch, held in Brussels on the 9th of July;
 - The Consultation Meeting “Shaping Future FET Proactive Initiatives” which has taken place on September 20 – 21 in Brussels [5], where the Quantum Information Technologies concept was presented to the participants;
 - The Consultation Workshop on “QIPC & Entanglement-enabled Quantum Technologies” [6] held in Brussels on the 6th of December.
- With QUROPE WP2 and WP3, the ERA-Pilot WP1 has been drafting and coordinating documents appearing in several high profile magazines [7], [8], [9] and [10]
- With QUROPE WP4, the ERA-Pilot WP1 has developed the needed infrastructure to ensure a smooth porting of all the knowledge collected by the ERA-Pilot project [11].

[4] See http://www.guorope.net/Q_Feedback/Q_Forum/list.php?6

[5] See also the meeting report available at ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/fet-proactive/shapefetip-sept07-01_en.pdf

[6] See also the meeting report available at ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/fet-proactive/qipcqt-01_en.pdf

[7] “Quantum Information Processing and Communication in Europe”, The Parliament Magazine, Nov. 13, 2006

[8] “Potential revolution world-wide”, The Public Service Review: European Union, issue 13, p.54 (2007)

[9] “The second quantum revolution”, The Public Service Review: European Union, issue 14, p.182 (2007)

[10] “A quantum leap in computing power”, The Public Service Review: European Union, issue 15 to appear

[11] See the QUROPE website <http://www.guorope.net>

Deviations from the project work programme, corrective actions

none

Workpackage Progress Report

“Benchmarking and Best Practice in QIST”

Workpackage number	WP 2	Start date or starting event:		t0
Activity Type	Coordination Activity			
Participant id	3	6	5	4, 7, 8, 12, 14
Person-months per participant:	15	23,5	5	0,25

Objectives

WP 2 investigates QIST outside the European Research Area and will analyse existing QIST-structures. It aims at identifying examples for excellent research-structures.

WP2 analysis activities within QIST all over the world and will draw some general recommendations which topics should be investigated more intensively within Europe to gain and/or to keep a leading role.

Progress

The WP 2 team work started in August 2006 with a delay of about half a year after the funding has been received and two additional persons (Peter Stelmachovic PhD and Mario Ziman PhD) had been hired by the Slovak Academy of Sciences (Partner 6). The work started with the collection of data about research groups outside Europe. In a first round all possible data that are available through Internet and several publicly available documents have been collected. Based on these data an initial version of the document “document giving an overview of QIST groups and initiatives outside Europe” (deliverables D 2.1, D 2.2, D 2.3, and D2.5) with a list of these groups has been created. In a second step a simple questionnaire has been elaborated that has been sent via email the groups. The purpose of the questionnaire is to collect more sensitive data about the structure of the corresponding groups and their funding. The collection of data out of the replies to the questionnaire is an ongoing process and has not been completed.

In parallel the preparation of the benchmarking process has been started. Due to the fact that this is a rather sensitive issue the process has to be prepared very carefully for the input from the research groups will be required. In December 2005 a local meeting has been organized where the goals of the benchmarking have been identified and a general strategy how these goals can be achieved has been formed. Before the actual execution of the benchmarking this strategy will be further questioned by a group of international experts.

After the first project year partner 6 withdraw from the benchmarking activities. Additionally the reviewers recommended to restructure the WP completely. After the restructuring Partner 3 took over and the Tasks were reformulated.

Task 2.1: Field Overview Investigation

Funding of research in the field of QIPC outside Europe is investigated. Both, the absolute amount of money invested in academic research as well as the funding sources and the organisational structure have been studied. It is obvious that financial funding is a sensible topic for both sides, the funding source and the funding target. Therefore, nearly no official data is available and the numbers in question need to be estimated. These estimates are dependent on the method used and should not be taken for granted. The collected raw data has been pooled together in a database.

Method

The total funding has been estimated by summing up salaries, equipment and overhead costs of each individual research group. In the following salaries and experimental equipment are referred to as direct costs, anything else is referred to as overhead costs. For those groups where real numbers were available these have been used in the study. However, this was possible only for less than 5% of the groups investigated. The data has mainly been obtained by estimations made upon the data which was freely available and by the answers of the survey.

The salaries could be estimated through an analysis of the number of people and their professional function

in every group, applying mean salaries for the respective countries taken from recent World Bank statistics. The costs for experimental equipment have been estimated through the filling of jobs in every group and have been applied only to groups doing experimental research. The costs for experimental equipment are therefore bound to the total salaries including theoretical researchers and represent 36% of the direct costs on average. The overhead costs could be deduced from the direct costs applying an overhead percentage that is customary in the place.

An intensive inquiry on the activities of all research groups that were identified to do research in the field of QIPC has been done. The inquiry started from a list that has been obtained already earlier and covered the research group's web pages, publications and references. The persons working in each research group as well as their function were deduced from the author lists of the group's publications, which was possible for nearly all groups investigated. In some cases, the people involved were published on the group's website.

As a second step, surveys among the QIPC researchers were realised. Surveys are typically answered by less than 50% due to lack of interest. Asking questions on confidential facts such as salaries or industrial funding reduces the percentage of answers even more. Therefore, no relevant data could be collected in the first survey that was run in 2005/2006, where researchers were asked about numbers concerning their funding. The second survey, which was started in September 2007, has been designed in order to get information that helps to state the estimations taken from free information more precisely rather than asking for numbers. During the time where the first survey was running, it has been recognized that no information was collected on whether the groups work experimentally or theoretically. Therefore the survey was stopped and the task was handed over to a professional sociologist. It has turned out that the design of the first survey was not sophisticated enough to derive relevant information. The survey has been redesigned completely and was launched in the period from December 2007 to February 2008.

Timescale: Month 13 – 35 of the project

D2.3: Overview of QIPC groups and initiatives outside Europe, together with an estimation of their funding

Task 2.2: Survey on research interest and corresponding funding

Public funding agencies, identified to be active in QIPC have been addressed in order to get precise numbers on their total funding of QIPC research. Unfortunately, this information was kept confidential by the most interesting funding agencies. Furthermore, the research fields are not categorized similarly in all the countries investigated. Therefore, no relevant information could be deduced. However, analyzing the data available, an important interest in QIPC by National Defence Agencies like NSA in the US is registered.

Results

In total 205 research groups have been investigated. The total funding by these groups according to the calculation method mentioned above including experimental equipment and overhead is 299.9 Million USD. More than three quarters of all research groups that have been identified to work in the field of QIPC are found in the United States, covering a total sum of 149 Million USD. Other important nations are Canada (31.6 M\$), Japan (20.0 M\$), Australia (19.1 M\$), Brazil (15.2 M\$) and China (14.2 M\$). It is interesting to note that most of the costs are spent within the large research centres and large research networks such as Caltech, Yale University or Los Alamos National Laboratory.

There have been found less theoretical research groups than experimental groups. In addition, experimental groups are found to be significantly larger than theory groups. In the United States 42 experimental groups (516 people) and 30 Theory groups (260 people) have been identified. The mean size of an experimental group is 12.3 members. The mean size of a theory group is 8.7 members. Taking into account the expenses for experimental equipment, experimental research requires 75% of the total funding.

An important part of the QIPC research is done within the framework of large physically existing research centres like in the Los Alamos National Laboratory or Caltech. Some research is done within strong networks, also often referred to as "centres" like the Centre for Quantum Computer Technology in Australia. The structures of these centres have been analyzed separately in order to properly handle the redundant data.

The lion's share of the funding originates from National Science Foundations like the NSF in the USA, JSF in Japan or SNSF in Switzerland. From the information available, most notably from acknowledgements within publications and on web sites, additional funding sources could be deduced for 20% of the groups. Also this

additional funding originates from public funding agencies like DARPA, NSA and ARDA in the USA or the Defence Science Organization in Singapore. A growing industrial interest in the field has been detected. Whereas most of the research investigated is mainly of academic interest, it has to be taken into account that confidential collaborations between industry and academia do exist as it has been identified in QUROPE WP 7.

Significance of the Results

The list of research groups that has been taken as a source for the estimation might be incomplete. It was impossible to calculate the number of unreported cases. Therefore the numbers presented in the report are to be considered as a lower barrier.

A few research groups have been found where detailed data was not available. Skipping these groups completely would lead to a systematic error giving rise to too small absolute numbers. Therefore, estimations have been made for these research groups. As a generic research group, the mean population has been taken from the known groups, which is one full professor, one assistant professor, one post-doctoral researcher, two PhD students and an administrative co-worker. Since only few groups had to be estimated, the maximum error due to the uncertainty of the involved people is below 5 %.

Recommendations

Since industrial funding seems to be still quite low, research topics that might be relevant for industrial applications on a time scale of less than 5 years might be identified.

In spite of the big efforts taken in the US, the European research funding agencies should reconsider the relevance of QIPC for Europe. The possibility of technical applications and their role on an international market should be taken into account when thinking about whether the European Union needs to be able to compete with the United States.

Timescale: Month 13 – 35 of the project

D 2.4 Report on research activities within the field of QIPC outside Europe together with the data on their funding and an overview of scientific outcome

D 2.7 Survey and analysis of research within the field of QIPC, Report on structures outside the European Union and on their Funding strategies, Recommendations for better collaboration and world-wide integration.

Task 2.3: Informal EU/US bilateral meeting

A workshop was organized from Jan. 6 to 8, 2008 at the University of Basel in close co-operation with the University of Harvard (US). The title of the workshop was: “2008 Frontiers in Nanoscale Science and Technology Workshop” (a workshop on Nanoelectronics and Nanophotonics Quantum Information Processing). The workshop’s webpage is <http://nsec.harvard.edu/fnst/index.htm>

Timescale: Month 35 of the project

D 2.5 Informal EU/US bilateral meeting organization

Task 2.4 Establishing Quantiki as an international resource for the QIST community

The improved website has a stable number of approximately 100 visitors per day (source: Google analytics), and we are particularly happy that we have an international audience. For example, during January the top ten visiting countries were: United States, Poland, United Kingdom, Spain , Germany, India, Italy, Canada, France, Hong Kong. 4% of our visitors are from Africa, 10% from Central/South America, and 10% from Asia.

The number of active contributors (people who changed/added content) has increased by a rate of roughly 10 people over the last two months (in addition to the employees below), which is a good number considering the small field of QI. We have set up an international team of 6 researchers, all of which expressed their wish to remain at the project as volunteers. Thus Quantiki is established as a fundamentally international collaborative resource.

Ongoing synergistic effects which are worth mentioning include a possible contribution to support from the QIP-IRC (currently in discussion) together with server support from the new Centre for Quantum Technology in Singapore.

Due to an unforeseen initial delay in employing international students via Oxford most of the work was done in the last quarter of 2007. Fortunately the employees were able to focus their efforts intensively within this relatively short space of time, so that the facilities described in this report could be implemented.

In the latter half of the project period, it became clear that there was a desire for a facility to support scholarly debate about recent QIST papers and preprints. The demands of such a facility are significantly different from the core quantiki philosophy (for example, one must anticipate that many debates will involve contributors advocating conflicting views rather than implicitly assuming a cooperative attitude). Therefore, it was decided to create a second site, separate from Quantiki.org but closely aligned and integrated with it. This second site is Quantalk.org (from quantum talk) and is now on-line. It is described further below. The decision to implement Quantalk.org as a sister site also meant that a second team of developers could work on it, in parallel to ongoing development of Quantiki. In this way a fully functioning system was created in a short period of time.

Sub-Task 2.4.1: Implementation of a content management system

We employed Piotr Gawron and Jarosław Mischczak (both PhD students working in the field of Quantum Information) from the Instytut Informatyki Teoretycznej i Stosowanej in Gliwice, Poland for the technical development and support of the Quantiki website. The amount of hours that they have worked for Quantiki is 140h each, which we paid at 20€ per hour nett. With additional 60% overhead for social and income tax and 40% overhead for the Gliwice Institute this amounts to 12544€.

The main achievement of Piotr and Jarek is to adopt the open source content management system „drupal“ (www.drupal.org) to Quantiki (www.quantiki.org). The most important task was to integrate the user management system of the wiki part of Quantiki (www.quantiki.org/wiki) with the new content management system and to harmonise the layout. Once this was achieved, they largely improved the following features of Quantiki: search functionality, news section, list of groups working in the field including world map (http://www.quantiki.org/groups_table), list of conferences (http://www.quantiki.org/events_calendar), list of jobs (http://www.quantiki.org/recent_jobs). As new features they have implemented blogs (<http://www.quantiki.org/blog>); a forum for discussions of Quantum Information with the possibility to include latex equations (<http://www.quantiki.org/forum>); polls; RSS feeds; and the automated fetching of recent scientific papers from PRA, PRL, quant-ph, the virtual journal of Quantum Information. Finally they have migrated the web page to its new server, resolved bugs and technical problems occurring during the work of the rest of the team, and created regular backups.

Timescale: Months 30 – 32 of the project

D 2.8 Choice and implementation of a content management system. Maintenance of the system and implementation of new features if requested by the community

Sub-Task 2.4.2: High quality content and promotion

For the creation of content we have employed the following PhD students/ postdocs working in the field for the following hours:

Oleg Gittsovich (University Innsbruck, Austria): 80h
Man-Hong Yung (University of Illinois at Urbana-Champaign): 100h
Anna Kubasiak (Institute of Photonic Sciences, Spain): 30h
Alexandra Liguori (University Trieste, Italy): 40h

With additional 25% overhead for income tax and 40% overhead for the Gliwice Institute this amounts to 8750€. During the two months that we were able to employ them they have written a kernel of 31 articles.

As stated under Task 2.4, an appreciable part of the total Quantiki resource allocation was used to implement a dedicated system for scholarly debate focusing on recent research papers. This system, implemented on the site Quantalk.org, has now been up and running for over a month and is currently attracting contributions from the QIST community, including roughly three full review articles per week. These articles (about 12 in total at time of writing) have been of a high standard and were obtained at relatively low cost by the novel mechanism of making an open offer of 100 euros to post docs (or other qualified people) in the community. In fact this mechanism has been so successful that support will continue in coming months, from the Royal Society and (possibly) the QIP IRC.

The Quantalk system was implemented by UK-based post doctoral researchers John Morton (Oxford) and Matthew Webb (Bristol), working intensively in the last quarter of 2007. They were remunerated at a rate of 15 UKP/hour and total costs including overheads, domain registration and server requirements amounted to 12394.31GBP. The system went on-line to the public in December 2007. It is worth noting that the QIST group in the American Physical Society will be publishing a substantial article about Quantalk.org the March edition of „Quantum Times“.

This part was continued on a voluntary basis by Daniel Burgarth. The main progress to report here is that the EU funding has given us a stronger position and more continuity, which enabled us to improve our collaboration with www.qubit.org and to start a discussion on merging with qwiki.stanford.edu. As the next step we are planning to provide „plug-in“ content to the community so that groups working in the field can easily include Quantiki content on their websites. The list of groups http://www.quantiki.org/groups_table and conferences http://www.quantiki.org/events_calendar was maintained by Daniel Burgarth. As any content on Quantiki, it can be edited by anyone, and researchers from the field have already started submitting their own content. On the long term these lists will become self-maintaining.

Timescale: Month 30 – 35 of the project

D 2.9 Creation of an encyclopaedia kernel consisting of the hundred most important articles. Maintenance of the encyclopaedia structure. Updating the news section

D 2.10 Promotion and evaluation of Quantiki. Keeping contact with groups and other web resources. Maintaining lists of events and open positions.

Sub-Task 2.4.3: International endorsement

Having now implemented the basic technical improvements to the core Quantiki project, we are planning to have a workshop on future improvements to Quantiki and a call for suggestions in the third quarter of 2008.

As noted in Task 2.4 and D 2.9 above, a significant extension to the original Quantiki project has been created to answer the QIST community's need for a central on-line facility for scholarly debate. The idea for this facility was put forward by Tommaso Calarco (among others) and it was rapidly implemented using a portion of the Quantiki funding.

In order to secure the long-term support of the Quantiki server we needed to migrate the website from the former machine at the University of Cambridge to a dedicated commercial server. The National University of Singapore has agreed to rent such a server at www.hetzner.de over the next three years for us which has made the website faster and more reliable. We have also received requests from NUS Singapore and University of KwaZulu-Natal, Durban to set up mirror sites there. This will reinforce the international nature of the Quantiki project and make the site faster.

Timescale: Month 30 – 35 of the project

D 2.6 Call for suggestions on the improvement of Quantiki and granting of support for the best ideas

D 2.11 Long-term support and hardware/server needs

Deviations from the project work programme, corrective actions

Because of the delay during the starting phase of the project the project's progress has not been in plan.

As partner 5 did not receive any additional prefinancing most of the work could only be started after the prefinancing of period 1 was re-allocated. Therefore the tasks fulfilled by partner 5 started too late and the duration was too short. As results of this delay the related deliverables were delivered at a later point of time and the collection of articles was reduced from 100 to 31..

Workpackage Progress Report

“Elaboration of Co-ordination Measures”

Workpackage number	WP 3	Start date or starting event:	t0		
Activity Type		Coordination Activity			
Participant id	3	1	5	4	2, 7, 8, 15
Person-months per participant:	16	19	3	0,75	0,25

Objectives

The aim of WP3 is to create an accurate, complete and in-depth picture of QIPC funding in Europe. As a basic step, a comprehensive catalog of all funding agencies involved in QIPC will be compiled. From this collection of funding agencies, the funding patterns of QIPC will be identified by again collecting trustful, quantitative and complete data that can be compared to give an ensemble view. A last step, more qualitative, will allow understanding the mechanism of funding.

It needs to be emphasized that much of the information is sensitive; it that might prove difficult to acquire, especially from the research group’s side.

Progress

The work within WP 3 started with some delay as additional personnel had to be hired at Participant 1 that was responsible for this workpackage during the first project year. In mid of March Partner 1 began to collect data of European QIST-groups. On 24/06/2005 a first draft of the “Document about the analysis of European QIST-structures” (deliverable D 3.2) has been issued and sent to the participants of WP 3 to be discussed on the first WP 3 Workshop. On 16/08/2005 a questionnaire has been sent to European funding institutions that has been pretested by the funding institutions that participate in the project. On 2/11/2005 a second draft of the document has been distributed to the participants of WP 3.

The first WP 3-workshop has been organised at the University of Oxford and has taken place on 01/07/2006. On this workshop several topics have been discussed:

- Presentation of the intermediate status of the “Document about the analysis of European QIST-structures”: Several suggestions for improvements have been made. It has been decided that the European funding institutions shall be addressed by a questionnaire. The questionnaire has been elaborated during the following weeks and has been pretested together with the funding institutions that participate in the project.
- Presentation of the current status of the work on the feasibility study regarding “Real Science Research Options”: The real work on this part of WP 3 shall start in July 2006 but a few basic considerations of the design of the study have been presented and discussed.
- Market study on Quantum Information Processing: Independently from our project the SAID Business School (Oxford) is about to start a market research regarding future business opportunities for technologies emerging from Quantum Information Processing. A first draft of the design of this study has been presented and the participants agreed to support the authors of the study.

After this workshop Partner 5 (University of Oxford) has started work on the feasibility study mentioned above. It has been finished in January 2006 (deliverable D 3.3).

The second WP 3-workshop has been held on 11/11/2005 in Bratislava where the discussions on the topics mentioned above has been continued and where a first draft of the feasibility study has been presented.

On 15/02/2005 the first concertation meeting of the project CISTRANA has been held in Brussels where a representative of the project co-ordinator participated

At the beginning of the second reporting period Partner 1 (ARC) continued to carry out the work within this WP according to the original Description of Work. It continued the gathering of information regarding European funding agencies and organized a workpackage meeting in Paris on May 23, 2006. Immediately after the review report has been transferred to the co-ordinator (June 12, 2006) Partner 1 stopped its activities within WP3. After the Description of Work has been restructured Partner 1 handed over its documents to Partner 3 that took over responsibility for WP3 from September 2006 on.

The elaboration of a list of funding agencies needed to be done carefully and thoroughly. This is why a long period is devoted to its fulfillment and the prolongation of the project for another half year. The requirements were manifold. This directory needed to be:

- Complete: The whole point is to take into account all funding mechanisms for QIPC. This information can only come from the groups themselves. In order to avoid this request be overlooked by the groups leaders, it had to be both diplomatic and limited in its scope. We have had to ask a limited amount of information from the groups at that stage, in order to get as many replies as possible. Nonetheless, we tried to obtain information not only about current funding agencies, but also about past or possible funding agencies in the future.
- Classified: The funding agencies needed to be categorized by type (state, private, industrial, possibly foreign) and by size (local, regional, national, European or even international).
- Accessible: This information could and should be made available, for instance on the ERA website which already contains a matrix that may be used (database, plus interrogation form). This database could be completed while the other sub_WP are done. However, in order to collect information from the groups, it should be made clear to them that sensitive data will be treated confidentially, i.e. there will be no such thing as "how much each group receive" at any stage of this WP available online.
- This database is to be kept "alive" both during and after the project has finished. This could be a valuable tool for the whole QIPC community.

Whereas research groups hesitated to give away sensitive information about how much they received, funding agencies should in general - except perhaps from industry or sensitive agencies such as defense-related - be willing to communicate on the amount they spend on QIPC. By contacting the different funding agencies, we tried to obtain the following information:

- The total amount they spent on QIPC. We tried to obtain absolute and relative numbers (for instance the percentage of QIPC in the total funding or in the total budget of the organization).
- The total number of groups funded: the total and relative amount spent per category of the QICS (deliverable D 1.3).
- Funding trends: trend from 2004 to 2006 for example.

Two main challenges in this work package:

- Completeness: It cannot be ruled out that some funding agency may simply refuse to communicate in part or in totality some information. Any missing or incomplete information will weaken the accuracy of the survey.
- Coherence: we obtained much data from several sources. This data is aggregated and compared, so the data format need be consistent, which was one of the conclusions of the review report n°1. QIPC is a rapidly growing field, and funding varies strongly from year to year. Funding is usually granted for several years (2 to 5 typically). Getting a snapshot of the funding situation in, for instance 2006, might prove difficult.

In order to obtain exploitable data, a methodology and a questionnaire were defined prior to contacting the funding agencies. In case we did not receive a reply, the data was extracted on the basis of their annual reports and other publicly available information.

Completeness and coherence of the collected data was the target of WP3. However we had to take into account even before the start of the project that this aim would probably not be totally fulfilled, at least not for all the information we want to gather. We therefore tried to extract the maximum from the data and gave qualitative patterns and trends.

When we analyzed the funding patterns we tried to understand and analyze the mechanisms of funding, by consulting both the groups and the funding agencies. The information we gathered from both sides are as following:

Design of the study

From the research groups:

- The name, telephone number, the contact person, the group leader of the research group, the website of the research group in order to check the relevant information. This was useful for checking the scientific publication of the groups and finding out specific projects and funding agencies names in the acknowledgement of the publication (when the information was missing).
- The main subject of the research area of the specific group and the relation with the QIST research direction.

- The names of the funding agencies.
- The overall structure of the funding process (*international; EU fund; national; regional; home institution; private foundations*)
- The relative funding of each agency from the total funding of the group.
- The name of the projects funded on the national and European level.
- Advantages/disadvantages of each funding agency (too much paperwork requested, ease of use).
- Proposals for better interaction between the groups and the funding agencies and better integration at the European level.

From the funding agencies:

- The contact information of the funding agency: name of the contact person, telephones numbers, emails, website.
- Details about **organization**
 - a) Type – description how the organization belonged to which public body and what was its legal form.
 - b) Mission– What was the purpose of the institution and what were their main tasks.
 - c) Link to the national research strategy-If a national research strategy existed, how the funding organization was linked to this research strategy.
 - d) Strategic/focus concentration concerning QIST – Qualification of a strategic focus or concentration concerning QIST in the mission of the funding institution.
 - e) Support (writing proposals and duration of the projects) – Which support offered the funding organization at the start and during the funding process. How did they see their role in the light of new challenges in research and innovation funding (timescale, referring process....)
- Details about the **funding programs**. The description of funding programs showed whether the instruments they had were more complex interventions like involving networks and industry-academic linkage and how the QIST topics fitted within.
 - a) Description of the types of programs.
 - b) An “umbrella topic” to which the QIST belonged.
- Details about the **budget**. The budget showed the impact of the funding institution and the effect on the QIST R&D.
 - a) Total budget and
 - b) percentage going to QIPC projects.
- Details about **funded projects**. The description of the project gave an overview of the overall funded projects and in relation to the QIST projects.
 - a) Number of projects and groups: total and
 - b) percentage for QIPC projects/groups.
- Links to other **actors**: Illustration of existing network/clusters/collaborations. Did they have the analytic and strategic capacity to be a platform for the scientific community, policy and industry in a country?
- What would they want from the group (more feedback, more results, patents etc.)
- Funding objectives, reasons for funding QIPC, what could make them willing to spend more?
- Proposals for better interaction between them and the groups or integration at the European level.

This study required interaction with participants. It was done in form of a survey sent to the research groups and the funding agencies, extensive personal interviews and phone calls.

During a meeting with the project officer (Dr. Antonella Karlson) held on June 7, 2007 in Brussels the criteria for the analysis of Funding Institutions were decided that influenced the final report.

First procedure

- From the questionnaire of the research groups (sent in June 2006), data about the funding agencies were extracted.
- All this activity resulted in a list of the relevant funding agencies, this time all relevant for funding in QIPC.
- A first questionnaire was sent to all the contacts in the list (September 2006). It contained information about the funding agency, the QIPC related activities, funding in figures, etc.
- A second questionnaire to the same list of the funding agencies was released (May 2007). It aimed at gathering information's about the process of granting of funds. For example, the requirements regarding the application process, the referring process, the evaluation process, the time scales,

evaluation of the results, the number of funded projects, as well as quantitative information (number of projects, amount of grants, importance of QIPC). The goal was to understand the entire funding process. It is important to note that some of the responses were compiled on a regional level.

- In some small countries the OAW contacted personally key people (either researchers or funding agencies) to obtain a general overview of the situation.

Second Procedure

- A summary of the data from the all questionnaires was made and grouped by country.
- At the end we needed to obtain two summaries (research groups and funding agencies) per country. They contained all the meaningful and reliable information from the initial data base, 3 questionnaires and if applicable personal contacts.
- We determined one or two people per country (top level researchers with some management positions) that were our local contacts for the confirmation of the final steps. We sent them the summary for their respective country and asked them to refer it, by giving an estimate of its reliability, complete the information where possible, and give an overview.
- If was necessary, we contacted these people by phone.
- In this report we will give the general structure of a report and agree on it.

We summarized the data per country and made conclusions on a general level.

Deviations from the project work programme, corrective actions

After the first project year and after the first review the workprogramme was restructured completely, Partner 3 (OAW) took over the data already collected and started according to the new Description of Work that was accepted by the reviewers. In June 2007 it was dicussed how the data shall be analysed in order to achieve appropriate results. During the last phase of the project the work was continued according to the decision that was agreed with the Project Officer.

Workpackage Progress Report

“Organisation”

Workpackage number	WP 4	Start date or starting event:				t0
Activity Type	Coordination Activity					
Participant id	1	2				
Person-months per participant:	6	5				

Objectives

WP 4 will organize the QIST-symposia and some QIPC-events to support the EC and will administer the general budget dedicated for reimbursement of cost for not directly funded partners. WP 4 will organize the 7th European QIPC Workshop.

Progress

The participant that was mainly responsible for this workpackage – Participant 2: Bundesministerium für Verkehr, Innovation und Technologie – started its work not before October 2005 because the signature of contracts with the subcontracting organisation and the hiring of qualified personnel subsequently could not be done as long as the funding has not been received.

The project has been presented at the QIPC cluster-review 2005 on 15/02/2005 in Innsbruck.

During a meeting with the FET-IP-leaders within the frame of the QUPON-conference in Vienna (24th to 27th of May) it has been decided to start the preparatory work for a conference in Venice in autumn 2006. After this meeting a first contact has been established to the administration of San Servolo, a small island near Venice where this conference shall be organized and the meeting rooms have been reserved. In autumn 2005 the co-ordinators of the FET-QIPC-IPs have been contacted as well as the future co-ordinator of the Coordination Action QUROPE in order to harmonize the planning of the event. It turned out that because of some misunderstandings the required accommodation in San Servolo will not be available. A meeting between the participating IPs, QUROPE, ERA-Pilot QIST and the EC has been organized within the framework of the QIPC-cluster review that was held mid of February in Paris to discuss the organization of the conference.

During this meeting the organization of the Workshop was discussed and a scientific committee, chaired by Artur Ekert, was installed. The meeting facilities at the Royal Society in London were reserved by Artur Ekert, the detailed organisation (booking of meeting rooms, organisation of food and refreshments, organisation of the conference dinner) was carried out by Partner 1 (ARC). A webpage was prepared for the presentation of the programme, for online registration and for payment via credit card (www.qist-europe.net/QIPC-Workshop).

The workshop was held from October 13 to 14, 2006.

Partner 1 (ARC) that held the general budget reimbursed the travel costs for participants to the Workshops of WP3, for partners that take part in the review meeting, and for invited speakers at the 7th QIPC Workshop. Parts of the general budget were used to finance the organization of the 7th QIPC Workshop itself (payment for meeting rooms and refreshment).

A press release for announcement of the 7th QIPC Workshop was prepared, the webpage was organized and the presentations given at the workshop were put as downloads to the webpage after the workshop. Moreover the official project webpage was updated several times.

The online databases relevant for QIPC – both supplied by third parties and by the other workpackages of the project – were tested. Therefore the submission of the regarding deliverable was postponed till all relevant databases were available.

Deviations from the project work programme, corrective actions

none

Workpackage Progress Report

“QIST-Management”

Workpackage number	WP 5	Start date or starting event:	t0
Activity Type	RTD/Innovation		
Participant id	1		
Person-months per participant:	6,5		

Objectives

WP 5 will carry out all administrative tasks within the project, it will take over the EC's funding and transfer it to the project partners.

Progress

This workpackage organised the kick-off-meeting in Innsbruck on 15/02/2005 within the frame of the QIPC cluster-review where most project partners participated. Immediately after the project kick-off a press release has been issued on 16/02/2005 in order to inform the public about the project's goals.

A lot of effort has been invested to set up the infrastructure for the co-ordination of the project. For this purpose an internet based tool for communication, document management and data-exchange has been installed (Deliverable D 5.1). It is based on a Microsoft Sharepoint Portal Server that is installed within the secure IT-environment of the co-ordinator. It can be accessed by all partners that have received been registered and that have received a password via the URL <https://qist.arcs.ac.at>.

In parallel to the web-site set up by WP1 the official project homepage has been developed. It can be accessed via the URL <http://www.qist-europe.net>.

On 24/06/2005 the Contract has been received from the EC. Subsequently the co-ordinator took all required steps to finish the contractual procedure. The document and all its annexes have been sent to the project partners and the required Form A (Accession to the contract) together with the cover letter have been collected and forwarded to the Project Officer.

During the QUPON conference (24th to 27th of May) a meeting with the leaders of WP 1 has been organized to discuss the internet based working tool. It has been decided that for the fulfilment of the tasks of WP 1 it will be best to keep an internet based communication tool, a WP 1 web site and some databases within the range of the WP 1 co-ordinator in parallel. Nevertheless measures have been taken to secure that the data kept at two different locations can be exchanges without additional effort.

On 06/09/2005 the co-ordinator received the funding for the first project period. Subsequently the money has been transferred to the funded partners. Copies of the signed contract have been forwarded to all partners.

In November 2005 a mailing list of relevant scientific journalists has been elaborated and this mailing list has been used for the first time to distribute a press release on the occasion of the official publishing of some QIPC-publications.

After the 1st review a complete restructuring of the “Description of Work” turned out to be necessary. The co-ordinator negotiated the new structure with the other project partners and the EC. The new DoW was submitted and agreed by the reviewers. The duration of the project was extended and some amendments to the contract were negotiated. The co-ordinator fulfilled the administrative requirements for those tasks. A reallocation of funding was required following the new allocation of tasks to the project partners.

Deviations from the project work programme, corrective actions

None

Deliverables list

Deliverable No²	Deliverable title	WP no.	Due date³	Actual delivery date	Estimated indicative person-months	Lead Participant
D 4.1	Presentation of the project at the QIPC cluster-review 2005	WP 4	1	Feb. 15, 2005	0,25	1 ARC
D 5.1	Internetbased tool for communication, document management and data-exchange	WP 5	3	April 20, 2005	0,5	1 ARC
D 5.2	ERA-Pilot QIST homepage	WP 5	3	April 5, 2005	0,5	1 ARC
D 5.3	1 st quarterly progress report to the EC	WP 5	3	May 14, 2005	0,25	1 ARC
D 1.1	Reviewed version of "QIPC in Europe"	WP 1	4	May 10, 2005	1,5	3 OAW
D 1.2	1 st update of the QIPC-roadmap	WP 1	4	July 20, 2005	3	3 OAW
D 1.3	Description of QIST structure	WP 1	6	September 2005	3	3 OAW
D 2.1	1 st draft of a document giving an overview of QIST groups and initiatives outside Europe	WP 2	6	not delivered ⁴	4	6 BRA
D 3.1	Analysis of network structures for future collaboration	WP 3	6	not delivered ⁵	0,5	1 ARC
D 4.2	QIPC-workshop 2005	WP 4	6	May 25, 2005	0,25	1 ARC
D 5.4	2 nd quarterly progress report to the EC	WP 5	6	Aug. 21. 2005	0,25	1 ARC
D 5.5	Structure for internal quality control and risk management	WP 5	6	Nov. 4, 2005	0,5	1 ARC

² Deliverable numbers in order of delivery dates: D1 – Dn

³ Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

⁴ D 2.1 has not been delivered as an individual document, it has been combined with D 2.2

⁵ D 3.1 depends on information provided by WP 2. The delays in the start of WP 2 caused significant delay in D 3.1 as well. After the restructuring of the project it was deleted.

D 1.4	Draft version of the publication "QIST-overview" describing the most relevant QIST topics	WP 1	9	Aug. 12, 2005 ⁶	2	3 OAW
D 1.5	1 st draft version of "Map and cartography of excellence"	WP 1	9	January 2006	3	3 OAW
D 1.6	Draft version of a map of European activities	WP 1	9	January 2006	2	3 OAW
D 1.7	Draft version of an analysis of QIST-related guidelines and roadmaps outside the ERA	WP 1	9	Dezember 2005	1	3 OAW
D 2.2	2 nd draft of a document giving an overview of QIST groups and initiatives outside Europe	WP 2	9	March 1, 2006 ⁷	5	6 BRA
D 5.6	3 rd quarterly progress report to the EC	WP 5	9	Nov. 17, 2005	0,25	1 ARC
D 1.8	2 nd update of the QIPC-roadmap	WP 1	10	February 2006	3	3 OAW
D 1.9	Publications "QIST-overview"	WP 1	12	Aug. 12, 2005 ⁸	2	3 OAW
D 1.10	Publication of a list of potential evaluators for QIST-projects	WP 1	12	January 2006	0,5	3 OAW
D 1.11	1 st draft version of a database of QIST-actors	WP 1	12	January 2006	2	3 OAW
D 3.2	Document about the analysis of European QIST-structures	WP 3	12	Feb. 25, 2006	8	1 ARC
D 3.3	Feasibility Study for Real Science Research Options	WP 3	12	March 1, 2005	3	1 ARC
D 3.4	Document about possible synergies between European funding instruments as input for the preparation of FP7	WP 3	12	not delivered ⁹	2,5	1 ARC
D 4.3	1 st QIST-Symposium	WP 4	12	not delivered ¹⁰	1	2 BMVIT

⁶ D 1.4 has been combined with WP 1.9

⁷ D 2.2 has been combined with D 2.1

⁸ D 1.9 has been combined with WP 1.4

⁹ D 3.4 depends on information provided by WP 2. The delays in the start of WP 2 caused significant delay in D 3.4 as well. After the restructuring of the project it was deleted.

¹⁰ It has been decided that the symposium shall be held in autumn 2006.

D 5.7	Mailing list of relevant scientific journalists	WP 5	12	February 2006	0,5	1 ARC
D 5.8	1 st yearly report about the progress of the project	WP 5	12	March 15, 2006	1	1 ARC
D 4.7	7 th QIPC Workshop	WP4	21	October 2006	2	1 ARC
D 5.11	7 th quarterly progress report to the EC	WP5	21	November 2006	0,5	1 ARC
D 2.3	Overview of QIPC groups and initiatives outside Europe, together with an estimation upon their funding	WP2	23	January 2008 ¹¹	3	5 OXF
D 3.5	Online database of funding agencies	WP3	24	January 2008	6	3 OAW
D 4.8	2 nd report about the use of the general budget	WP4	24	February 2008	0,25	1 ARC
D 4.11	Report on testing of the online project database	WP4	24	January 2008	2	2 BMVIT
D 5.12	2 nd report about the progress of the project	WP5	24	not delivered ¹²		1 ARC
D 2.4	Report on research activities within the field of QIPC outside Europe together with the data on their funding and an overview of the scientific outcome	WP2	25	January 2008 ¹³	3	5 OXV
D 2.5	Informal EU/US bilateral meeting organization	WP2	27	January 2008	1	5 OXF
D 3.6	Progress report regarding funding patterns	WP3	27	January 2008	3	3 OAW
D 2.6	Call for suggestions on the improvement of Quantiki and granting of support for the best ideas	WP2	30	September 2007	1	3 OAW
D 1.17	final version of "Map and cartography of QIPC groups"	WP1	35	January 2008	3	3 OAW
D 1.18	final version of a map of European activities	WP1	35	January 2008	3	3 OAW

¹¹ D 2.3 was merged with D 2.7

¹² After the second project year it was decided that only one additional review will be held at the end of the project's duration

¹³ D 2.4 was merged with D 2.7

D 1.19	final version of a database of QIST-actors	WP1	35	January 2008	3	3 OAW
D 1.20	Analysis of QIST-related guidelines and roadmaps outside the ERA	WP1	35	January 2008	3	3 OAW
D 1.21	Strategic report with detailed technical assessment and outlook per sub-area	WP1	35	January 2008	6	3 OAW
D 2.7	Survey and analysis of research within the field of QIPC, Report on structures outside the European Union and on their Funding strategies. Recommendations for better collaboration and world-wide integration.	WP2	35	January 2007	2	5 OXF
D 2.8	Choice and implementation of a content management system. Maintenance of the system and implementation of new features if requested by the community	WP2	35	October 2007	2	5 OXF
D 2.9	Creation of an encyclopaedia kernel consisting of the hundred most important articles. Maintenance of the encyclopedias structure. Updating the news section	WP2	35	December 2008	3	5 OXF
D 2.10	Promotion and evaluation of Quantiki. Keeping contact with groups and other web resources. Maintaining lists of events and open positions.	WP2	35	December 2008	2	5 OXF
D 2.11	Long-term support and hardware/server needs	WP2	35	December 2008	0,5	5 OXF
D 3.7	Survey and analysis of QIPC funding in EC. Recommendations for better European integration	WP3	35	January 2008	3	3 OAW
D 4.12	3 rd report about the use of the general budget	WP4	35	February 2008	0,5	1 ARC
D 5.13	final report about the progress of the project	WP5	35	February 2008	1	1 ARC

Milestone list

Milestone No¹⁴	Milestone title	WP no.	Due date¹⁵	Actual delivery date¹⁶	Lead Contractor
M 1.1	Draft version of European QIST-maps	WP 1	12	12	2 OAW
M 1.2	Map of European activities, common vision of the future of QIST in Europe	1	35	35	3 OAW
M 2.1	Survey and analysis of research within the field of QIPC. Report on structures outside the European Union and on their Funding strategies. Recommendations for better collaboration and world-wide integration	2	35	35	3 OAW
M 2.2	Establishment of the Quantiki page as an international resource for the QIST community	2	35	35	3 OAW
M 3.1	Recommendation for coordinaton of funding at the EC level	3	35	35	3 OAW
M 5.1	End of ERA-Pilot QIST	5	35	35	1 ARC

¹⁴ Milestone numbers in order of achievement dates: M1 – Mn

¹⁵ Month in which the milestone will be achieved. Month 0 marking the start of the project, and all dates being relative to this start date.

¹⁶ Month in which the milestone will be achieved. Month 0 marking the start of the project, and all dates being relative to this start date.

4. Consortium Management

This activity report concerning the Management of the ERA-Pilot QIST-Consortium will cover four major areas:

- Communication
- ERA-Pilot QIST Management Bodies
- Networking
- Administration

1. Communication

Communication within the project is the responsibility of the co-ordinator, although all other partners are obliged to contribute. Nevertheless the co-ordinator has to supply the consortium with the necessary infrastructure and has to steer the flow of information. Within this chapter both the internal project communication and the external communication according the project will be described.

For internal communication a protected web-based information and communication system has been established. We choose a Microsoft "Sharepoint Portal Server" to organise communication and electronic collaboration. This system allows access only to project partners, the platform can be structured according the internal structure of the project. There the participants can share information, can discuss relevant topics, can store and work collectively on documents, and can generate mailing-lists. It can be accessed via <https://qist.arcs.ac.at>. WP 1 set up in parallel a similar structure mainly for collective work on the QIPC-roadmap.

For external information about the project the project homepage has been developed. On www.qist-europe.net the public will achieve information about the project, its goals, the participants, and the like. The co-ordinator actively aspired contact to the relevant press as well. On the occasion of the start of the project a press release has been written communicated to relevant media.

Together with the FET-unit we prepared a press release for announcement of the 7th QIPC Workshop.

2. ERA-Pilot QIST Management Bodies

The project is structured very simple. There are the four workpackage leaders forming the Steering Group that communicate regularly either electronically via e-mail, on telephone, or personally at QIPC-related events. The workpackage leaders communicate to their workpackage participants and workpackage related workshops are organized according to the planning within the workpackages. On February 2005 a kick-off meeting has been organized in Innsbruck where this structure has been presented.

3. Networking

The goals of the project ERA-Pilot QIST address two different communities: the scientific community of QIPC (Quantum Information Processing and Communication) and the funding institutions that are active within the field of QIST. Therefore networking activities can be divided into two sections:

Scientific networking:

The project supported the FET-unit in several ways. WP 1 continued the QIPC-roadmapping that has been initiated by the EC prior to the start of the project and it contributed to some QIPC-publications. Permanent contact to all relevant groups within Europe has been kept in order to get the information required to fulfill the the tasks within this workpackage. All major QIPC events have been used as a platform for the project participants to share the idea of the project and to ask the community to participate in the project.

Political networking:

The project looked for contact to all European funding institutions in order to achieve the information that will be required to develop a common funding strategy for QIST. By this the project idea has been communicated to all relevant institutions. On a more formal way the project entered a network structure organized by the umbrella project CISTRANA that aims at harmonize the work within different ERA-Net Projects.

4. Administration

The co-ordinator received the funding from the EC as a whole and distributed it to the individual partners according to the project shares that have been laid down in Annex I. Additionally the co-ordinator reimbursed the travel costs of not directly funded partners. The management team of ARCS met regularly in order to monitor the progress of the project.

During the first project year two amendments to the contract have been required. The Science Foundation of Ireland wants to leave the consortium and the Istituto Nazionale per la Fisica della Materia changed its legal situation so that officially the participating organization has changed.

At the beginning of 2005 the management team started with the preparatory work for the reporting of the first project year. The review meeting that was held in Brussels on April 28, 2006. Later on the co-ordinator's company was merged with other Austrian research institutions and formed a new legal entity. This merger required an amendment of the contract as well.

After the first project review the project had to be restructured completele. The coordination of the restructuring of the project according to the recommendations of the reviewers was part of the management section of the project. This task included a reallocation of tasks and budget. The partner originally responsible for WP2 (Slovak Academy of Sciences) could no longer fulfill its tasks, therefore it was shifted to partner 3 (Austrian Academy of Sciences) and partly to partner 5 (University of Oxford). The Description of Work (Annex I) had to be rewritten completely and

approved by the reviewers. Additionally the consortium requested an extension of the project's duration.

During the second reporting period the consortium did not receive additional prefinancing. The funding already received had to be reallocated.

Reporting: It was decided to hold no review after the second project year but to hold only one additional review after the end of the project. The co-ordinator prepared all reports.

Annex – Plan for Using and Disseminating the Knowledge

The Plan for Using and Disseminating the Knowledge is an evolving document which will be annually updated to give a cumulative overview of the project's undertaken and planned activities, and submitted at the end of each reporting period.

Section 1 - Exploitable knowledge and its Use

This section will only present exploitable results, defined as knowledge having a potential for industrial or commercial application in research activities or for developing, creating or marketing a product or process or for creating or providing a service.

There is no such knowledge that has been created within the project

Section 2 – Dissemination of knowledge

<i>Planned / actual date</i>	<i>Type</i>	<i>Type of audience</i>	<i>Countries addressed</i>	<i>Size of the audience</i>	<i>Partner responsible / involved</i>
<i>Feb. 15, 2005</i>	<i>Presentation</i>	<i>QIPC-community</i>	<i>EC</i>	<i>100</i>	<i>ARC, ÖAW</i>
<i>Feb. 16, 2005</i>	<i>Press Release</i>	<i>international press</i>	<i>worldwide</i>	<i>about 100 journalists</i>	<i>ARC</i>
<i>March 2005</i>	<i>Project Web Site</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ARC</i>
<i>April 8, 2005</i>	<i>WP1 Web Site</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>April 22, 2005</i>	<i>Online Publication (Strategic Report, Version 1)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>May 10, 2005</i>	<i>Online Publication (QIPC in Europe)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>May 25, 2005</i>	<i>QUPON-Conference</i>	<i>QIPC-community</i>	<i>EC</i>	<i>200</i>	<i>ARC, ÖAW</i>
<i>July 20, 2005</i>	<i>Online Publication (Strategic Report, Version 2)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>September 2005</i>	<i>Scientific Publication (EPJ D, QIPC Strategic Report)</i>	<i>scientific community</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>Sept. 9, 2005</i>	<i>Online Publication (Quantum Information Classification Scheme, Draft)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>Feb. 14, 2006</i>	<i>Presentation</i>	<i>QIPC-community</i>	<i>EC</i>	<i>100</i>	<i>ARC, ÖAW, BRA</i>

<i>February 2006</i>	<i>Online Publication (Map of Excellence)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>February 2006</i>	<i>Online Publication (Map of Activities)</i>	<i>Internet User</i>	<i>worldwide</i>	<i>not specified</i>	<i>ÖAW</i>
<i>October 2006</i>	<i>Conference</i>	<i>QIPC-community</i>	<i>EC</i>	<i>150</i>	<i>ARC, ÖAW</i>
<i>June 7-10, 2007</i>	<i>Conference (Vienna Symposium on the Foundations of Modern Physics)</i>	<i>QIPC-community</i>	<i>International</i>	<i>160</i>	<i>ÖAW</i>
<i>October 5-7, 2007</i>	<i>Workshop (ESF exploratory workshop: Coherence, decoherence & entanglement)</i>	<i>Quantum Physics Community</i>	<i>International</i>	<i>35</i>	<i>ÖAW</i>
<i>August 17-31, 2007</i>	<i>Conference (European Young Scientists Conference on Quantum Information)</i>	<i>QIPC-community, young researchers</i>	<i>International</i>	<i>120</i>	<i>ÖAW</i>
<i>October 15-19, 2007</i>	<i>Conference (QIPC 2007 International Conference on Quantum Information Processing and Communication)</i>	<i>QIPC-community</i>	<i>International</i>	<i>270</i>	<i>ÖAW</i>
<i>February 28 – March 2, 2008</i>	<i>Conference (Annual Cluster Review and Conference of the Quantum Information Processing and Communication (QIPC) FET proactive initiative)</i>	<i>QIPC-community</i>	<i>International</i>	<i>100</i>	<i>ÖAW</i>