QLectives – Socially Intelligent Systems for Quality
Project no. 231200

Instrument: Large-scale integrating project (IP)
Programme: FP7-ICT
Deliverable D6.3

[Project periodic report]

Submission date: 20.03.2012

Start date of project: 2009-03-01 **Duration: 48 months**

Organisation name of lead contractor for this deliverable: University of Surrey

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	**x**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1.3 Document history

Version	Date	Change
V0.1	09.01.2012	Starting version, template
V0.2	26.01.2012	Content and Management report finished
V0.3	06.02.2012	Submitted to Deliverables Committee
V0.4	16.03.2012	Financial report finished
V1.0	20.03.2012	Approved version submitted to EU
Amended version		Amended version submitted to EU

1.4 Document data

Keywords	Report, progress, management
Editor address data	Maria Xenitidou Centre for Research in Social Simulation University of Surrey Guildford, GU2 7XH United Kingdom

1.5 Distribution list

Date	Issue	E-mail
30.04.2012	Consortium members	QLECTIVES@LIST.SURREY.AC.UK
30.04.2012	Project officer Jose Fernandez-Villacanas	Jose.FERNANDEZ-VILLACANAS@ec.europa.eu
30.04.2012	EC archive	INFSO-ICT-231200@ec.europa.eu

QLectives Consortium

This document is part of a research project funded by the ICT Programme of the Commission of the European Communities as grant number ICT-2009-231200.

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Project periodic report

Grant Agreement number: 231200

Project acronym: QLectives

Project title: QLectives – Socially Intelligent Systems for Quality

Funding Scheme: Future and Emerging Technologies programme FP7-COSI-ICT

Date of latest version of Annex I against which the assessment will be made: 13th October 2008

Periodic report: 1st □ 2nd □ 3rd **X** 4th □

Period covered: from 1st March 2011 to 29th February 2012

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Declaration by the scientific representative of the project coordinator

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;

The project (tick as appropriate):

☐ has fully achieved its objectives and technical goals for the period;

☑ has achieved most of its objectives and technical goals for the period with relatively minor deviations;

☐ has failed to achieve critical objectives and/or is not at all on schedule.

The public website, if applicable

☑ is up to date

☐ is not up to date

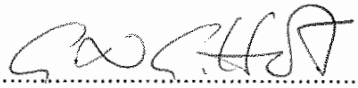
To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.

All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: **Prof. Nigel Gilbert**

Date: .....20..../....03...../.....2012...

Signature of the scientific representative of the Coordinator



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1 Publishable Summary

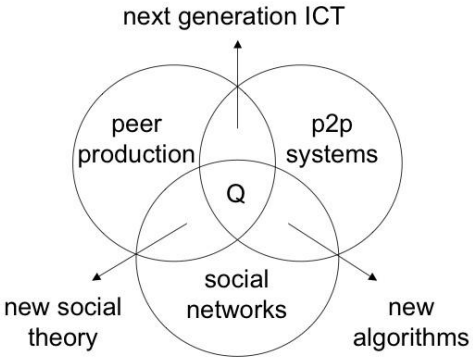
Introduction

QLectives – Socially Intelligent Systems for Quality – is a multidisciplinary research project funded from FP7-COSI-ICT (Project number 231200). Using a complexity perspective, QLectives will understand, experiment with, design and build cooperative socially intelligent ICT systems composed of self-organising peers, that will enable and support emergent "quality collectives" to enhance, for instance, scientific innovation and decentralised media distribution. The QLectives website can be found at www.qlectives.eu.

Objectives

The QLectives project brings together top social modellers, peer-to-peer engineers and physicists to design and deploy next generation self-organising socially intelligent information systems. The project aims to combine three recent trends within information systems:

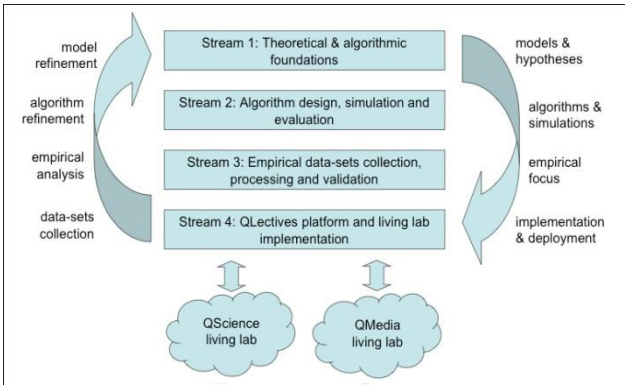
- **Social networks** - in which people link to others over the Internet to gain value and facilitate collaboration
- **Peer production** - in which people collectively produce informational products and experiences without traditional hierarchies or market incentives
- **Peer-to-Peer systems** - in which software clients running on user machines distribute media and other information without a central server or administrative control



QLectives aims to bring these together to form Quality Collectives, i.e. functional decentralised communities that self-organise and self-maintain for the benefit of the people who comprise them. We aim to generate theory at the social level, design algorithms and deploy prototypes targeted towards two application domains:

- **QMedia** - an interactive peer-to-peer media distribution system (including live streaming), providing fully distributed social filtering and recommendation for quality
- **QScience** - a distributed platform for scientists allowing them to locate or form new communities and use transparent reviewing mechanisms to promote quality

The two applications will be based on two existing user communities comprising several thousand people - so-called "Living labs": the media sharing community tribler.org; and the scientific collaboration forum EconoPhysics.



Work performed in Year 3 and significant results

The QLectives project design is based on a constant interaction of empirical data and theoretical models. The project comprises four streams focussing on theoretical and algorithmic foundations; algorithm design, simulation and evaluation; empirical data collection and analysis; and implementation of findings in the QLectives platform and two living labs. These different research steps are cyclically repeated and refined over the four year duration of the project.

Stream 1: Theoretical and algorithmic foundations of quality collectives

The work in Stream 1 during this period concentrated on design creation and implementations.

In WP1.1 work continued to focus on the development of different modelling approaches to better understand complex techno-social collectives.

In WP1.2 most efforts concentrated on: the development and implementation of a model of quality, trust, and reputation (QTR model); the development of a model on the influence of conflict on trust applying dynamic social impact theory; further analysis and lab experiment on the emergence of cooperation.

While Work for WP 1.3 was completed in Month 24, during year 3 scientific outputs and empirical contributions to the loop (see for example QTR model above) were delivered.

The work in WP1.4 during this period aimed at integrating the analysis and modelling efforts on the dynamics of quality collectives.

Stream 2: Algorithm design, simulation and evaluation

Efforts in Stream 2 focused on the implementation of successful ideas developed in Stream 1 into effective algorithms which are ready to be deployed in real environments (living labs).

In WP2.1, work concentrated on Bit Torrent implementations.

In WP2.2, work progressed on the mechanisms of social recommendation (with emphasis on the use of social recommendation in scientific contexts) and on scholar social networks in general.

In WP2.3, work on the protocols in living lab environments and their future deployment was completed.

Stream 3: Empirical datasets collection, processing and validation

The work in Stream 3 focused on the management of the empirical data on the "living archive", web experiments as well as external datasets.

In WP3.1 apart from managing datasets in the Living Archive, web experiments on the influence of anonymity and power balance in bargaining situations were conducted and analysed.

In WP3.2 an effort was made to summarise and characterise the datasets in order to discover and record patters.

In WP3.3 the formation of scientific and online collectives was explored through exploring dynamic community (and citation) patterns, the dynamics of directed networks, and the social effects of quantitative rating systems.

Stream 4: QLectives platform and living lab implementation

In Stream 4 the third versions of the QLectives Platform, QScience, QMedia were delivered.

WP4.1 delivered version 3.0 of the QLectives Platform. The work has centered on improving the major component (that implements most of the core features needed for the decentralized collectives envisioned in QLectives) developed in year 2: the Distributed Permission System (Dispersy).

WP4.2 delivered version 3.0 of the QScience living lab, the EconoPhysics Forum (http://www.unifr.ch/econophysics). Version 3.0 mainly consisted of implementing the QScience living lab in Drupal, adding and creating relevant modules where required.

WP 4.3 delivered version 3.0 of the QMedia platform, introducing the Open2Edit concept, which provides users with a platform to create virtual communities in a completely decentralized setting.

The HQ metadata solution developed in WP4.4 has been integrated into QMedia version 3.0. In addition, new mechanisms for quality prediction from stream 1 and 2 have been identified and analysed for features extraction.

Expected final results and their potential impact and use

The QLectives project has a significant impact on the research into collaboration and P2P activities. Potential future long-term impacts are expected in the following areas:

- *Techno-social inclusion:* QMedia currently allows the creation of virtual communities in a completely decentralized setting where users themselves have to maintain order in the community. This user-controlled inclusion constitutes an appealing alternative for currently prevalent Web-based media-sharing communities.
- *Techno-social operating system:* The current version of the QLectives Platform provides the functionalities for simple-to-use platforms prioritizing built-in self-organizing and information-exchanging and providing improved scalability, message-handling and permission-altering mechanisms. These features are potential major enablers for the popularization of decentralized techno-social systems among system designers, developers and communities of users.
- *Scientific collaboration:* The work currently developed in QScience aims to contribute to the wider community of users. The implementation of the *Patterns* module – allowing for automatic configuration of Drupal web sites and, as regards QLectives, the creation and customization of QScience instances in 'one click' – is expected to attract attention by the community of users in recognition of the contribution of the QLectives project to the development of Drupal. This could lead to our involvement in Drupal events as well as to potential contributions, by other Drupal developers, to modules necessary for QScience. The plan is to launch a test QScience web site in the next few months. Upon successful testing, QScience will be ready to be offered to groups outside the QLectives project, in particular to those that have already indicated an interest in the concept.

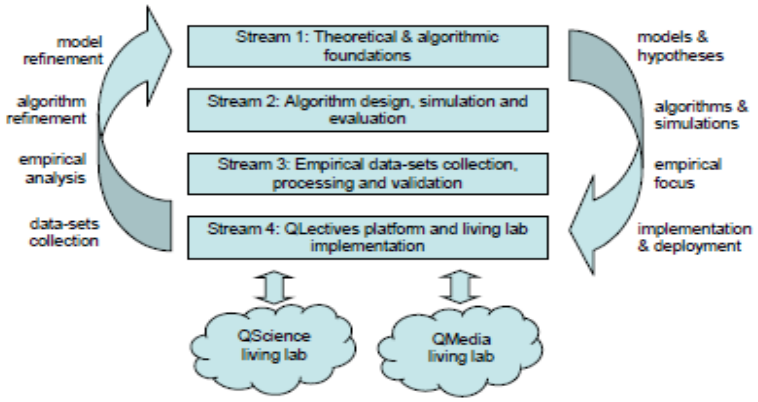
- *Group evolution*: The QLectives platform will allow user-centered group configuration and group evolution.

2 Project objectives for the period

According to the QLectives Work plan, the following objectives should be addressed during Year 3 of the QLectives project. The associated Milestones to be achieved during Year 3 are listed under the relevant objectives.

- Understand, experiment with, design and build cooperative socially intelligent ICT systems composed of self-organising peers, that will enable and support emergent "quality collectives" (QLectives). Milestones: M6.2, M7.
- Develop theoretical foundations informed by complex system science, to understand the emergence of cooperation and beneficial social structures from interacting peers as the basis of QLectives models. Milestone: M9.
- Simulate models to show that they are robust in the face of diverse human behaviour and technological failure. Milestone: M9.
- Study simplified models to derive analytically a theory of the macro-level behaviour of such systems. Milestone: M9.
- Develop methods for the translation of the models into deployable algorithms that are effective at large scales and that have predictable macro properties. Milestone: M9.
- Deploy two living lab ICT social application platforms (QScience and QMedia). Milestones: M6.2, M7.
- Collect massive data-sets from the QScience and QMedia living labs (and elsewhere), tracing system behaviour and dynamics. Milestones: M7, M8, M9.
- Apply a scientific approach through rigorous empirical validation, exploration and analysis of data-sets, refining and reformulating models and theories. Revise living lab implementations in light of findings. Repeat this cycle throughout the lifetime of the project. Milestones: M7, M8, M9.
- Maintain an open web-based living archive, of data-sets collected, freely available to other researchers. Milestone: M7.
- Promote an active technology sharing policy by making most of the code available as Open Source.

In order to address the above objectives, the QLectives project is structured into four research streams – characterising it as an integrated project. Each comprises a set of related Work Packages reflecting a particular research approach. The streams support each other but also operate in parallel. The following figure shows a graphical representation of the streams and how they relate to each other.



3 Work progress and achievements during the period

Following the work plan, most work packages started in Month 1 with the exception of:

- WPs 2.1 and 2.3 which started in Month 6 (and were completed by Month 36);
- WPs 2.2 and 3.2 which started in Month 6;
- WP 3.3 which started in Month 8.

WPs 1.2 and 1.3 were completed in Month 30 and Month 24 respectively. All remaining WPs are due for completion in Month 48 with the exception of WPs 1.1, 1.4 and 3.1 which are due in Month 42.

The duration of each work package is presented in the following chart.

The month 36 review meeting with the European Commission will take place on 30th March 2012.

Stream 1: Theoretical and algorithmic foundations

Stream 1 produces models, theories, and simulation algorithms based on existing and novel complexity approaches that capture both human agent behaviour, and social and collective structures. Specifically it focuses on the emergence of trust and cooperative behaviour and the emergent social structures that incentivise such behaviour. This task is being developed in two phases. First, a class of models and simulations are produced, related to the common functions required in the living lab applications (QScience and QMedia): community evaluation and recommendations for assessing information content quality. Second, hypotheses from our models are elaborated to be empirically tested against our living lab and other collected datasets. Models will be adapted to meet the empirical evidence.

In the third year of QLectives Stream 1 activities included:

- Analysis of citation dynamics at both at the level of author and paper. An extension of this work is the analysis of citation activity among geospatial research areas.
- Analysis and lab experiment(s) on the emergence of cooperation.

Overall, Stream 1 activities have focused on integrating empirical data, model and algorithm development and testing modelling approaches, thus bringing together the work and research conducted among partners. Significant concrete results have already been achieved which feed in to Stream 4: QLectives platform and living lab implementation (WPs 4.1-4.3 in particular).

WP1.1 Theory of complex techno-social collectives

Contributing partners

UniS, ETH Zurich, UniFr, UWAR, CNRS

Objectives for WP 1.1

- Develop analytically tractable agent-based models to study the influence of typical characteristics of complex social systems on phenomena such as the emergence, evolution, and decay of social communities
- Extend agent-based models to represent the essential features of complex techno-social systems.
- Derive implications for the improvement of efficiency, stability and resilience of techno-social collectives

Progress towards objectives

- While there was no deliverable due during the third year of the project, the QLectives partners have continued to work on the development of different modelling approaches to better understand complex techno-social collectives.

Significant results

In the previous year the theoretical implications of using hypergraphs in network analysis were explored, trying to understanding how the use of hypergraphs is likely to affect observed and observable patterns, mostly through using random hypergraph models. Following on from that, part of the work in year 3 focused on preparing a manuscript as a methodological preliminary for the study of random hypergraphs, specifically in order to show that several patterns typical of traditional social networks may actually be explained by simple underlying hypergraphic processes.

Secondly, a new model for the growth of information networks was developed and validated on citation data provided by the American Physical Society. A new model was introduced for the growth of information networks in general where decaying relevance of nodes and heterogeneity of the relevance values are combined. This model produces various degree distributions, including those that are observed in important real systems such as the scientific citation data or the World Wide Web. This work was published in Physical Review Letters and provides an important direction for future research (also affects work in WP1.4).

In terms of insights from analysing citation dynamics (see also WP1.4), analysis was conducted at the author and paper levels. At the author level the work concentrated on determining quantitatively how the impact of a landmark paper can influence the attention received by the previous literature of its authors and, eventually, can boost their careers. At the paper level the work concentrated on a) characterizing them as having a single or multiple 'lives' (a feature that can be linked to their quality or relevance and is not properly captured by existing indices); and b) studying correlations between citation counts and different aspects like, for instance, the 'age profile' of the reference list. In addition, a description of universal features of local dynamic citation patterns was developed (Roth et al, 2012), which may be potentially useful for future citation prediction. Citations as a quality metrics seem to reward normal science (recent, field-focused) and punish potential pioneering papers (rediscovered classics).

Finally, in the previous year an evolutionary game-theoretical approach had been adopted to study social norms and social phenomena involving cooperation or conflict. In year 3, after distilling theoretical studies on the emergence of cooperation, work concentrated on the parameters of (i) information and (ii) structure-behaviour co-evolution. In the first case, it was found that cooperation is not such a strong social dilemma; cooperative behaviour emerges and becomes stable over a fairly large range of model parameters and implementation details, such as differing network topology, migration range, or reproduction speed. In the second case, the results provided strong empirical evidence of the positive influence on cooperation of group choice, which is a form of structure-behaviour co-evolution.

Publications

Gill, A. J., Xenitidou, M., and Gilbert, N. (2011) *Quality in Online Science: Concepts and Recommendations for the Future.* A Decade in Internet Time Symposium on the Dynamics of the Internet and Society, Oxford University Internet Institute, September 2011. Available at SSRN: http://ssrn.com/abstract=1916615

Gualdi, S., Medo, M. and Zhang, Y.-C. (2011) Influence, originality and similarity in directed acyclic graphs, *EPL 96*, 18004.

Medo, M., Cimini G. and Gualdi, S. (2011) Temporal effects in the growth of networks, *Physical Review Letters* 107, 238701.

Roth, C., Wu, J. and Lozano, S. (2012) Assessing impact and quality from local dynamics of citation networks. *Journal of Informetrics* 6(1), pp. 111-120

Tabourier, L., Roth, C. and Cointet, J.-P. (to appear) Generating constrained random graphs using multiple edge switches. To appear in *ACM JEA Journal of Experimental Algorithmics*.

Wu, J., Lozano, S. and Helbing, D. (2011) Empirical Study of the Growth Dynamics in Real Career H-index Sequences. *Journal of Informetrics* 5(4), pp. 489-497

WP1.2 Complexity models of trust networks

Contributing partners

UniS, ETH Zurich, UniFr, UWAR

Objectives for WP1.2

- Review, compare and identify shortcomings of existing complexity models of agency for techno-social systems
- Develop algorithmically specified novel agency models tuned for techno-social communities
- Develop "informational division of labour" interaction scenarios and games
- Apply and tune psychologically plausible "dynamic social impact theory" for techno-social communities

Progress towards objectives

Work towards these objectives was developed through: the development and implementation of a model of quality, trust, and reputation (QTR model); the development of a model on the influence of conflict on trust applying dynamic social impact theory; further analysis and lab experiment on the emergence of cooperation.

Significant results

Apart from D1.2.1 *per se*, the most significant results are:

- The QTR model built upon insights from the empirical work on quality conducted in the previous two years of the project as well as the relevant literatures associated with each area. The model has been partly implemented (translated into algorithms) and tested (validated) using agent based modelling. Full implementation is expected to provide further insights into the ways of tuning with techno-social communities.
- Preparing the project, 'Networks, Social Change, and Dynamical Systems Theory', which aims at: investigating the ways in which various social and psychological processes may be determined by synchronization; exemplifying how synchronization applies to major social transitions; and solving seemingly insurmountable social problems.
- The work on influence of conflict on trust was continued:
    - A qualitative study based on interviews: 'The properties of social networks that support profound, peaceful transitions: The case of Solidarity, the Polish underground movement'. The study is completed, pending publication in a journal aimed at peace-building and conflict resolution.
- A quantitative research project exploring the properties of social networks supporting profound, peaceful social transitions. The questionnaire has been developed and distributed among Solidarity underground leaders; as a comparative cohort a group of university students was identified, and the questionnaire was adapted to social networks supporting the subjects' social involvement.
- Following on from the previous year, the research on the 'Game of Trust' was continued. A survey was conducted to explore the relation between the choice situations and the

perception of risk. The obtained results were not conclusive and a subsequent survey is planned in the next few months. Additional lab studies have been conducted exploring various kinds of manipulation of the original procedure.

Publications

Gill, A. J. and Nokkala, T. (2011) *Web 2.0 tools in the Science 2.0 Workplace: The changing face of scientific work.* Proceedings of the 24th Annual CHER Conference, Reykjavik, Iceland, June 2011.

Praszkier, R. and Nowak, A. (2011) *Social Entrepreneurship: Theory and Practice*. New York: Cambridge University Press.

Roca, C. P. and Helbing, D. (2011) Emergence of social cohesion in a model society of greedy, mobile individuals. *PNAS* 108 (28): 11370-11374.

Roca, C.P, Efferson, C., Vogt, S. and Helbing, D. (2011) Group choice with limited information allows cooperation to persist (submitted to *Science*)

D1.2.1 Novel models of agency and social structure for trust and cooperation

WP1.3 Theory of quality emergence in complex systems

Contributing partners

UniS, ETH Zurich, UniFr, UWAR

Objectives of WP 1.3

- Developing agent-based models for self-consistent estimates of quality
- Proposing and investigating effective approaches to quality signaling
- Deriving implications for quality signaling in real applications

Progress towards objectives

Work for WP 1.3 was completed in Month 24 and led to scientific outputs and empirical contributions to the loop (see for example QTR model above).

Significant result(s)

- Development of model of group communication dynamics cross-checking empirical data.

Publications

Gill, A. J., Iacobelli, F. and Gilbert, G. (2011) *The projection of quality and reputation in scholarly journals.* Proceedings of the 21th Annual Meeting of the Society for Text and Discourse, Poitiers, France, July, 2011.

Gill, A. J. and Gilbert, N. (2011) *Quality in Science: Perspectives from the QLectives Project*. Written evidence submitted to the United Kingdom Parliament Science and Technology Select Committee for the report: Peer Review in Scientific Publishing, (PR 75).

Gill, A. J., Xenitidou, M. and Gilbert, N. (2011) *Quality in Online Science: Concepts and Recommendations for the Future.* A Decade in Internet Time Symposium on the Dynamics of the Internet and Society, Oxford University Internet Institute, September 2011. Available at SSRN: http://ssrn.com/abstract=1916615

Xenitidou, M. (2011) *Understanding Quality in Science in Scientists' Talk*. Paper presented at the 10th Conference of the European Sociological Association, ESA 2011. Geneva, 7-10 September, 2011.

WP1.4 Modelling the dynamics of quality collectives

Contributing partners

UniS, ETH Zurich, UWAR, CNRS

Objectives of WP1.4

- Understand the dynamics of quality collectives using agent-based models: how they emerge, consolidate and decline
- Create an abstract model of the dynamics of quality collectives
- Apply this model to understanding the dynamics of quality collectives observed in the QScience and QMedia living labs

Progress towards objectives

During this period the analysis and modelling efforts focused on the dynamics of quality collectives were continued and a project was set up to integrate these efforts.

Significant results

Apart from D1.4.1 *per se*, the most significant results influencing work in W1.4 are:

- By studying the time patterns in the American Physical Society Data (APS) citation data, it was identified that the classical preferential attachment rule is insufficient to model the citation network. A new model was introduced for the growth of information networks in general where the decaying relevance of nodes and the heterogeneity of the relevance values are combined. This model produces various degree distributions, including those that are observed in important real systems such as the scientific citation data or the World Wide Web.
- Analysis of citation dynamics at the author level to determine quantitatively how the impact of a landmark paper can influence the attention received by the previous literature of its authors and, eventually, can boost their careers.
- Analysis of citation dynamics at the paper level to a) characterize them as having a single or multiple 'lives' (a feature that can be linked to their quality or relevance and is not properly captured by existing indices); and b) study correlations between citation counts and different aspects like, for instance, the 'age profile' of the reference list.
- Integrating an agent-based model which models peer-to-peer dynamics with a model of Bit Torrent which aims at building a framework for testing seeding incentives.
- Finally, the project "Techno-social simulation of Bit Torrent networks" was initiated. This project aims at the integration of different modelling efforts corresponding to Streams 1 and 2. The project attempts to use empirical data (Stream 3) to inform model parameters of a simulation framework. Finally, the goal is to compare model predictions with observed changes in QMedia (e.g. after introducing Bartercast, a reputation system).

Publications

Genoud, S. (2011) *Techno-social simulation of Bit Torrent networks*. 6th October 2011, QLectives Project Meeting, Warsaw

Mazloumian, A., Helbing, D., Eom, Y.-H., Lozano, S. and Fortunato, S. (2011) How citation boosts promote scientific paradigm shifts and Nobel prizes. *PLoS ONE 6*(5): e18975

Roth, C., Wu, J. and Lozano, S. (2012) Assessing impact and quality from local dynamics of citation networks. *Journal of Informetrics* 6(1), pp. 111-120

D1.4.1 Modelling the dynamics of quality collectives

Stream 2: Algorithm design, simulation and evaluation

Based on the high-level models, theories, and simulations developed in Stream 1, Stream 2 translates these to algorithm designs that can be implemented and deployed in our living labs. The resulting deployable algorithms need to factor in practical aspects such as the efficient storage/recall of data and other engineering constraints. This stream focuses on two distinct ways of importing insights from Stream 1 models into algorithms. Firstly, by using the models of human agent motivations it is possible to test (in simulation) the effectiveness of the proposed QLectives platform algorithms. Secondly, by identifying desirable emergent properties, it is possible to base algorithms and protocols directly on complex systems models, even when these may have been designed to model human systems.

In the third year, Stream 2 has continued to implement successful ideas developed in Stream 1 into effective algorithms which are ready to be deployed in real environments (living labs).

WP2.1 Algorithms for the emergence of cooperation

Contributing partners

TUD, ETH Zurich, USZ, UniFr

Objectives for WP2.1

- Translate novel theoretical models of cooperation formation into algorithms for ICT
- Simulate the performance of these algorithms under realistic assumptions based on target applications
- Incorporate human agent behaviour models
- Propose algorithms for implementation and deployment in Stream 4

Progress towards objectives

Following up on the work conducted in year 2, year 3 concentrated on Bit Torrent implementations.

Significant results

The main achievements during this period are summarised below:

- Modified Bit Torrent and analyzed protocols discovered using the Design Space Analysis (DSA) with experiments on a computer cluster. They yield higher system performance and robustness as compared to the reference implementation, thus demonstrating the effectiveness of DSA. The results were published at the ACM SIGCOMM 2011 conference, which is considered as the leading venue in data communication and networking.
- Developed mechanisms to handle the negative consequences of oversupply, which is clearly presented in Bit Torrent communities. These two undesired negative effects are: a) Peers are forced to seed for long times, even though their seeding efforts are often not very productive (in terms of low upload capacity utilization); and b) sharing ratio enforcement (SRE) discriminates against peers with low bandwidth capacities and forces them to seed for longer durations than peers with high capacities. To alleviate these problems, four different strategies for SRE, inspired by ideas in social sciences and economics were proposed and evaluated through simulations. The results were published at the IEEE P2P11 conference.

- Developed an analysis of present methods of resource allocation in multimedia communities. An investigation into whether currently prevalent inter-swarm resource allocation mechanisms perform acceptably or call for improvements was conducted. Data from two Bit Torrent communities were used and results from trace-based simulations were presented. Theoretical efficiency bounds for inter-swarm resource allocation were devised, mapping the resource allocation problem to a graph-theoretical flow network problem. The results were published at the IEEE P2P11 conference.
- Developed a scheme for reducing the amount of history maintained in decentralized interaction-based reputation systems based on elements such as the age of nodes, and explored its effect on the computed reputations showing its effectiveness in both synthetic and real-world graphs. The results were submitted for publication to the IFIP Networking 2012 conference.

Publications

Capota, M., Andrade, N., Vinkó, T., Santos, F. R., Pouwelse, J. and Epema, D. (2011) *Inter-swarm resource allocation in Bit Torrent communities*. In Proceedings of the 11th IEEE International Conference on Peer-to-Peer Computing (P2P11). IEEE. pp.303-309.

Halkes, G. and Pouwelse, J. A. (2011). *UDP NAT and Firewall Puncturing in the Wild*. In the Proceedings of the 10th International Conferences on Networking (IFIP'11). Springer-Verlag, Lecture Notes in Computer Science (LNCS).

Jia, A. L., Rahman, R., Vinkó, T., Pouwelse, J. and Epema, D. (2011). *Fast Download but Eternal Seeding: The Reward and Punishment of Sharing Ratio Enforcement*. In Proceedings of the 11th IEEE International Conference on Peer-to-Peer Computing (P2P11). IEEE. pp. 280-289

Jia, A. L., D'Acunto, L., Meulpolder, M., Pouwelse, J. and Epema, D.H.J. (2011) Bit Torrent's Dilemma: Enhancing Reciprocity or Reducing Inequity. IEEE Consumer Communications and Networking Conference (CCNC '11), pp. 705-709.

Jia, A. L., D'Acunto, L., Meulpolder, M. and Pouwelse, J. (2011) *Modelling and analysis of sharing ratio enforcement in private Bit Torrent communities.* In Proceedings of the International Conference on Communications (IEEE ICC '11), Kyoto, Japan.

Rahman, R., Vinkó, T., Hales, D. Pouwelse, J. and Sips, H. (2011) *Design Space Analysis for Modelling Incentives in Distributed Systems*. In Proceedings of ACM SIGCOMM 2011. ACM. pp. 182-193.

D2.1.3 Empirically informed algorithm design for cooperation - experiments and results

WP2.2 Algorithms for the emergence of collectives

Contributing partners

UniS, TUD, ETH Zurich, USZ, UniFr, IRT

Objectives for WP2.2

- Develop algorithms for detection and reinforcement of collectives
- Test the performance of the proposed algorithms by simulations
- Provide a basis for efficiently distributed implementation of the proposed algorithms

Progress towards objectives

While the only deliverable of this WP is due only in month 48, in year three substantial work was produced on mechanisms of social recommendation (with emphasis on the use of social recommendation in scientific contexts) and on scholar social networks in general.

Significant results

The study on the news recommendation model Newsbag continued. With respect to effects of user heterogeneity, it was shown that it results in a broad distribution of user popularity and that one can improve the model's performance by reflecting this heterogeneity in user reputation which consequently influences the news recommendation process. Various possibilities for simplifying the Newsbag's computational complexity were tested, thus bringing the model closer to its real implementation. This real implementation and collection of user experience (other than scientists) remain important research challenges for the future.

Publications

Cimini, G., Medo, M., Zhou, T., Wei, D. and Zhang, Y.-C. (2011) Heterogeneity, quality and reputation in an adaptive recommendation model. *EPJ B* 80, pp. 201-208.

Wei, D., Zhou, T., Cimini, G., Wu, P., Liu, W. and Zhang, Y.-C. (2011) Effective Mechanism for Social Recommendation of News. *Physica A,* Volume 390/11, pp. 2117-2126.

WP2.3 Algorithms for trusted and quality rankings

Contributing partners

TUD, ETH Zurich, USZ, UniFr, CNRS, IRT

Objectives for WP2.3

- Design algorithms for exploiting partial trust and rating information
- Design fully distributed robust implementations of these algorithms
- Help integrating designed algorithms into the living lab platforms

Progress towards objectives

Progress in this WP in year 3 was made in various directions. The iterative-filtering algorithms previously studied were refined into a novel idea of gossip learning. Secondly, a large part of the research effort in year 3 continued to be the analysis and modelling of the citation data provided by the American Physical Society (APS).

Significant results

Gossip learning: this involved the original idea, and its subsequent refinements, that eventually generalized it into a framework that can support a wide range of algorithms including spam filtering, vandalism detection in the metadata domain, and recommendations. This work builds on previous efforts to develop distributed P2P machine learning algorithms, and on the experience with techniques that did work and that did not work. As such, it can be considered as a second iteration or a second attempt on the same problem originally encountered, but this time offering a more elegant and generic solution. The results are covered by deliverable D2.3.1.

APS data: this data spans over more than hundred years and contains all citations among papers published by the APS. This exceptional scale of the data set allowed extensive analysis of trends and patterns in the data, leading to a novel method for obtaining a tree-like backbone of the citation network in year 2 (random-walk-based framework that can be used to measure mutual influence of nodes and discovering seminal papers in a citation network). In year 3, by studying the time patterns in the citation data, it was shown that the classical preferential attachment rule is clearly insufficient to model the citation network. A new model was introduced for the growth of information networks in general where decaying relevance of nodes and heterogeneity of the relevance values are combined. This model produces various degree distributions, including those that are observed in important real systems such as the scientific citation data or the World Wide Web.

Publications

Medo, M., Cimini, G. and Gualdi, S. (2011) Temporal effects in the growth of networks, *Physical Review Letters 107*, 238701.

Ormándi, R. Hegedűs, I. and Jelasity, M. (2011) Asynchronous peer-to-peer data mining with stochastic gradient descent. In E. Jeannot, R. Namyst, and J. Roman, (Eds) *Euro-Par 2011*, volume 6852 of *Lecture Notes in Computer Science*, pp. 528–540. Springer-Verlag, 2011. Available from doi:10.1007/978-3-642-23400-2_49

D2.3.1 Report on the deployment of protocols in living lab environments

Stream 3: Empirical datasets collection, processing and validation

The task of Stream 3 is to gather datasets from the QLectives living labs (Stream 4) in order to test models and validate algorithms (based on insights from Stream 1 and Stream 2). First, theoretical models are contrasted with the real behaviour of systems, which allows identifying limitations as well as possible strategies for improvement of theoretical models. Second, guidelines for implementation derived from the study of models are provided. Stream 3 contributes to the understanding of social mechanisms which will lead to robust quality-emergence in P2P and Web2.0 systems.

The third year of Stream 3 was devoted to the management of the empirical data on the "living archive", web experiments as well as external datasets.

WP3.1 Data collection and experimentation

Contributing partners

UniS, TUD, ETH Zurich, UWAR, CNRS

Objectives for WP3.1

- collecting massive empirical datasets obtained from the two living labs, peer-to-peer systems, social media websites and/or academic paper archives, social rating and bookmarking sites
- creating an open "living archive" of empirical data for researchers to use
- collecting data from specially designed web experiments

Progress towards objectives

Apart from managing datasets in the Living Archive, web experiments on the influence of anonymity and power balance in bargaining situations were conducted and analysed. Over 4000 invitations were sent out, a total of 246 subjects (6,15%) accessed the experiment website during one of the sessions. Among them, 196 got through the whole experiment.

Significant results

The most important finding is a tendency towards an equal distribution of tasks, which suggests that there might exist a more general inequality aversion among participants. Furthermore, respondents did behave in contrast to game theoretical predictions. One explanation could be that respondents may punish proposers of unfair offers.

Publications

D3.1.2 Web experiments and initial results

WP3.2 Data processing and knowledge extraction

Contributing partners

UniS, TUD, ETH Zurich, UWAR, CNRS, IRT

Objectives for WP3.2

- Summarise and extract measures and statistics from the datasets gathered in WP3.1 in a way that will be relevant and convenient for the work of WP3.3
- Characterise the datasets in order to discover previously unexpected patters, using data-mining and other techniques
- Produce a detailed listing of failures or inefficiencies on existing peer production websites

Progress towards objectives

The following datasets have been used within the project in 2011.

Data (previously) collected from the Living Labs:
QMedia: Anonymised data about user behaviour crawled in Tribler's network from January 1 to July 1, 2010.
QScience: Anonymised dataset about user behaviour in EconophysicsForum from July 5 to November 11, 2010.

Other datasets:
Interviews with Scientists: The dataset contains transcripts (N=18) from interviews (N=19) conducted with scientists in the natural sciences talking about quality in science. The data was collected between October and December 2010 and they are anonymised.

GoodReads rating data: This dataset contains (i) the ratings for 10 000 books from the Goodreads community book-sharing service: http://www.goodreads.com/and some user metrics (e.g. number of books, number of friends, demographics) and (ii) a sub-network of the Goodreads social network. The dataset has not been used and was replaced with Anobii dataset.

In addition, as part of the completion of Milestone 8 – "Completion of data processing and analysis (Batch 2)", a datasets guide and manual based on descriptions, research and results obtained on datasets external to QLectives had been prepared.

Significant results

Data from living labs has been found to be unsuitable for validating models and algorithms developed in streams 1 and 2,[1] partly due to the discrepancy between the living labs platforms and the assumed system structures underlying the models and algorithms, and partly due to the low volume of active users. This has been addressed by validating with external datasets collected from more well-established platforms.

Publications

Iacobelli, I., Gill, A. J., Nowson, S. and Oberlander, J. (2011) *Large scale personality classification of*

[1] See more detailed report: http://qlectives.eu/wiki/images/6/6f/IssuesWithLivingLabsValidation.pdf

bloggers. Lecture Notes in Computer Science (Proceedings of the International Workshop on Machine Learning for Affective Computing; MLAC2011), 6975, 568-577.

Whalen, J., Pexman, P., Gill, A. J. and Nowson, S. (to appear) *Nonliteral Language Use in Personal Blogs*. Manuscript accepted for publication in the *Journal of Behaviour and Information Technology*.

D3.2.1 Datasets guide and manual - external datasets

WP3.3 Model and algorithm validation and prediction

Contributing partners

UniS, ETH Zurich, CNRS

Objectives for WP3.3

- Use data collected and processed in WP 3.1 and WP3.2 to test hypotheses drawn from the theories developed in WP1.1 and the model and algorithms developed in WP2.2 and WP2.3.
- Use data in conjunction with validated models to make predictions about the structure and dynamics of quality collectives

Progress towards objectives

The formation of scientific and online collectives was explored through exploring dynamic community (and citation) patterns, the dynamics of directed networks, and the social effects of quantitative rating systems.

Significant results

The results of this progress were:

- The detection of dynamic community patterns based on recurrent inter-temporal interactions (rather than detection of longitudinal communities through static snapshots); this technique seemed particularly adapted to collective detection and has been applied on scientific citation networks.
- The dynamics of directed networks: this approach is able to exhibit the hierarchical and dominance structure and evolution of citation networks. It shows for instance the “spinning top” dynamics at work in specific scientific communities, where most-cited/citing actors are constantly being replaced, following a movement similar to convection.
- The detection of universal features of local dynamic citation patterns, potentially useful for future citation prediction; this also shows that citations as – a quality metric – essentially reward normal science (recent, field-focused) and punish potential pioneering papers (rediscovered classics).
- The identification of the existence of a dynamic pattern linking citation success to increased co-authorship activity.
- The examination of social effects of quantitative (five-star) rating systems, also including a modelling component on the diffusion of items according to estimated taste similarity among agents.

The work in WP3.3 has been presented in invited seminars, workshops and seminars (see Publications below).

It should be noted that as regards validation using data from the living labs, it has been identified

that data are unsuitable for validating models and algorithms developed in streams 1 and 2,[2] partly due to the discrepancy between the living labs platforms and the assumed system structures underlying the models and algorithms, and partly due to the low volume of active users. This has been addressed by validating with external datasets collected from more well-established platforms (see Section 5.8).

Publications

Chen, C.-C. (2011) Emergence of quality in socio-techno networks. COST workshop on Socialization and technology as co-evolutionary processes, Tarragona, 12-14 April, 2011.

Chen, C.-C. (2011) Group-based measures for online communities. ASSYST workshop "Hypernetworks, network dynamics, influence on networks: current tendency in social research", Warsaw, Poland, Dec 14-15, 2011.

Chen, C.-C. and Roth, C. (2011) The role of (non-)conformism in rating platforms, IEEE SocialCom, Boston MA, USA, Oct 9-11, 2011.

Menezes, T. (2011) Evolutionary modelling of a blog network. IEEE CEC 2011, New Orleans, USA, 2011.

Menezes, T. (2011) A process for mapping large directed networks to 2D images and its applications. Poster presentation at the European Conference on Complex Systems 2011, University of Vienna, Austria, 2011.

Menezes, T. (2011) Evolving social graph models. ASSYST workshop "Hypernetworks, network dynamics, influence on networks: current tendency in social research", Warsaw, Poland, Dec 14-15, 2011.

Mitra, B., Tabourier, L. and Roth, C. (to appear) Intrinsically Dynamic Network Communities. To appear in *Computer Networks*.

Quattrociocchi, W., Amblard, F. and Galeota, E. (2011) Selection in scientific networks. *Social Network Analysis and Mining*, OnlineFirst.

Roth, C., Wu, J. and Lozano, S. (2012) Assessing impact and quality from local dynamics of citation networks. *Journal of Informetrics*, 6(1), pp. 111-120.

[2] See more detailed report: http://qlectives.eu/wiki/images/6/6f/IssuesWithLivingLabsValidation.pdf

Stream 4: QLectives platform and living lab implementation

The aim of this stream is to produce a deployed Web and Peer-to-Peer infrastructure platform with generic functions for supporting QLectives communities. More precisely, it aims to develop components that are deployable over the infrastructure to provide the specific functions required by the two application domains of QScience and QMedia. In each case mechanisms are applied that promote and facilitate the growth of quality communities (putting the right users together) and the quality of disseminated informational items within the communities (passing the right information to the right people). QScience is currently based on a deployed Web2.0 infrastructure and QMedia is based on a deployed P2P infrastructure.

A detailed description of the achievements for each work package in year 3 is presented below.

WP4.1 Peer-to-peer platform - P2P-Qual

Contributing partners

TUD, USZ, IRT

Objectives for WP4.1

- Produce a re-usable Peer-to-Peer (P2P) platform infrastructure which facilitates peer-production
- Craft a zero-server architecture with unbounded scalability, fault tolerance, and high availability
- Provide generic functions and services required by the QScience and QMedia living lab
- Implement the world's first zero-server social network system
- Implement complexity-science inspired techno-social networking fabric primitives:
  - QFlow: augment P2P transfers of information with audit trial of quality indicators
  - BWCurrency: Transform P2P bandwidth into a transferable currency
  - P2PWidgets: run-time deployable code units which extend the platform
- Provide algorithm deployment for Stream 2 and implement collection functions for Stream 3

Progress towards objectives

This work package delivered version 3.0 of the QLectives platform. The aim of the QLectives Platform is to combine social networking, facilitation of quality and scalable peer-to-peer (P2P) technology into a next generation peer-production platform. Producing a re-usable P2P platform infrastructure that facilitates peer-production – the QLectives Platform – this year consisted significant incremental evolution based on three extensive tests (the QLectives platform functionality was expanded, the software was deployed and several bugs and unforeseen missing functionality were identified). Thus, in the third version of the QLectives Platform, the work has centered on improving the major component (that implements alone most of the core features needed for the decentralized collectives envisioned in QLectives) developed in year 2: the Distributed Permission System (Dispersy).

Significant results

The incremental improvement of Dispersy concentrated on: expanded functionality, deployment

and extensive testing to identify several bugs and unforeseen missing functionality.
Major new functionality includes:

- random walker of the self-organizing overlay which is NAT-resilient,
- robust algorithms for efficient gossip and exchange of information using Bloom filters,
- improved scalability of communities using subjective sets,
- performance analysis and emulation framework, utilizing our DAS4 supercomputer,
- message bundling for performance improvement,
- message priority mechanism,
- dynamic permission policies which can be used to alter community rules and regulations at any time.

Finally, progress relevant to this WP also includes the design of P2P algorithms for various areas including recommendation and metadata filtering algorithms and the modelling of P2P systems, which is necessary for the algorithm design.

Publications

Halkes, G. and Pouwelse, J. A. (2011) *UDP NAT and Firewall Puncturing in the Wild*. In the Proceedings of the 10th International Conferences on Networking (IFIP'11). Springer-Verlag, Lecture Notes in Computer Science (LNCS).

Rahman, R., Vinkó, T., Hales, D., Pouwelse, J. and Sips, H. (2011) *Design Space Analysis for Modelling Incentives in Distributed Systems*. In Proceedings of ACM SIGCOMM 2011. ACM. pp. 182-193.

D.4.1.3 QLectives Platform v3

WP4.2 Scientific innovation living lab – QScience

Contributing partners

UniS, TUD, ETH Zurich, USZ, UniFr, IRT

Objectives for WP4.2

- Create a platform to support scientific quality and creativity through proactively linking scientists with shared interests and quality assessments
- Support rapid formation of new scientific communities with rapid consensus on quality and significance of publications and other scientific resources
- Grow social capital through reliable reputation and trust mechanisms and thus improve scientific productivity - share tasks, reduce re-invention
- Collect data from the system for analysis in Stream 3

Progress towards objectives

This Work Package delivered version 3.0 of the QScience platform. In the third year of QLectives, the emphasis was on implementing QScience in Drupal, implementing the evolutionary approach with regards to instances and on enhancing the functionalities offered.

Significant results

While year 3 has seen rapid progress in the implementation of QScience in Drupal, the majority of work has been done on the required basic infrastructure. For example, since our idea of QScience puts emphasis on replication and adaptation of QScience instances, QScience developers had to devote a lot of their effort to developing of a Drupal module Patterns that allows for automatic configuration of Drupal web sites. Once Patterns is finished, it will be used to create and customize QScience instances in “one click”. Work on Patterns is of benefit not only for our project but also for the whole Drupal community. We believe that once we succeed in implementing and maintaining such a demanding module, the community will recognize it and appreciate the contribution of QLectives to the development of Drupal. This in turn might lead to our involvement in Drupal events and in turn also in potential contribution of other Drupal developers to modules necessary for QScience. The plan is to launch a test QScience web site in the next few months. Upon successful testing, QScience will be ready to be offered to groups outside from the QLectives project, in particular for those that have already shown their interest in the concept.

In addition to this, custom Drupal modules have been developed aimed at achieving: Text-based configuration of the whole website (patterns); Secure communication among QScience instances; Social features; Skype integration; Advanced information search and retrieval user interface.

Apart from implementations on Drupal and the evolutionary approach employed, the implementation of the QTR model and functionalities are under way. While for the former specifications are being developed, use cases and functionalities have been identified for consideration and implementation in the QScience platform.

Finally, progress relevant to this WP also includes the design of P2P algorithms for various areas

including recommendation and metadata filtering algorithms and the modelling of P2P systems, which is necessary for the algorithm design.

Publications

D4.2.3 QScience living lab v3 (P2P)

WP4.3 Media distribution living lab - QMedia

Contributing partners

TUD, USZ, IRT

Objectives for WP4.3

- Create an experimental next-generation user centric and social media distribution platform (QMedia)
- Build upon the P2P-Qual platform and offer seamless download and streaming of open media content
- Provide social networking functionality allowing users to freely share media with friends and contacts
- Self-organise, through detection of taste similarity and user rating systems, groups of similar peers
- Implement social tools allowing users to create a shared viewing experience
- Promote the discovery of high quality open content by integrating the WP4.4 quality meta-data system
- This work package deals with the development of the QLectives Platform

Progress towards objectives

This work package delivered version 3.0 of the QMedia platform. Version 3.0 integrated the WP4.4 quality meta-data system and introduced the Open2Edit concept.

Significant results

Open2Edit concept: by implementing the means to help users monitor each other, as is done in Wikipedia, they themselves have to maintain order in the community. Implemented without any centralized system restricting a peer from remaining in control, we aim to get the same level of quality and activity as Wikipedia. QMedia version 3.0, using the newest version of QPlatform, has been released in early December 2011.

In addition, the HQ metadata solution developed in WP4.4 has been integrated into QMedia v3 (see WP4.4).

Publications

Zeilemaker, N., Capota, M., Bakker, A. and Pouwelse, J. (2011) *Tribler: P2P media search and sharing.* Poster presented at ACM Multimedia, Scottsdale, Arizona, US, Nov 28-Dec 1, 2011

D4.3.3 QMedia v3

WP4.4 Quality search and discovery

Contributing partners

TUD, USZ, IRT

Objectives for WP4.4

- Bring public service broadcasting quality commitment to the YouTube and Bit Torrent generation of media distribution
- Explore ways for sharing quality meta-data from, and with, public broadcasters
- Give users the ability to rate, moderate, annotate and recommend contents themselves
- Allow for easy "injection" of existing open meta-data sources (i.e. inter-operate with open standards)
- Increase quality by reducing spam, incorrect or malicious meta-data via application of novel mechanisms from Stream 1 and 2.
- Hence create a global distributed self-organising high quality Electronic Programme Guide (EPG)

Progress towards objectives

While there were no deliverables in WP4.4 due in year 3, work has been ongoing as follows:

Based on the work performed in WP4.4 and documented in deliverables due in years 1 and 2 (D4.4.1, D4.4.2 and D4.4.3) the presented HQ metadata solution needed to be integrated into the P2P QMedia platform. This implementation task has been performed within WP4.3 (corresponding deliverable is "D4.3.3 "QMedia v3 + HQ-MD"). In the next step – dependent on the implemented features of the learning layer (see also D2.3.1) – the principal work item in WP4.4 is to develop appropriate test procedures, to perform tests in the living lab and to report obtained test results from the living lab QMedia implementation in D4.4.4 "Test report on HQ-MD implementation", due in year 4.

Firstly, initial ideas related to testing procedures were collected, in other words, how to perform the tests in "real life" in the living lab in year 4. For example, further clarification will be required as to whether to carry out and evaluate tests by a group of testing people deploying QMedia-clients (as part of the living lab) or by collecting results (implicit and/or explicit feedback) with a central tracking unit. The design of the testing procedures for the HQ metadata implementation tests are on-going, and will be described in D4.4.4. In the meantime, testable features of the QMedia implementation are being discussed and it is planned to have identified and detailed a first set of testing procedure drafts in April 2012.

Apart from the development of testing procedures, there is an ongoing effort in identifying potential features from Stream 1 and 2 as candidates for novel mechanism for quality prediction by the HQ Metadata system. Several work packages involving relevant tasks have been tagged, for example, "free rank" might be a good "feature candidate" (D1.3.2). The process of identifying additional features that can be added to the self-learning metadata quality prediction system is on-going and will be continued in year 4.
Finally, IRT finalised the web service implementation for QL rich metadata, and added support for

both, the DublinCore metadata format, as well as RSS signalling mechanisms (wrappers). This was done in order to allow QMedia to integrate rich metadata support from the IRT metadata aggregation tool, since rich metadata provided by RSS and DublinCore formats have been lately added to the QMedia implementation.

Significant results

Apart from the integration of the HQ metadata solution developed in WP4.4 into QMedia v3, new mechanisms for quality prediction from streams 1 and 2 have been identified and analysed for features extraction. These include algorithms for quality metadata and possibly a recommender algorithm as well. Additionally, initial ideas for testing procedures for the evaluation of the implementation of the HQ metadata solution have been collected.

Publications

No research publications relevant or deliverables due during year 3.

4 Deliverable and milestone tables

The following table lists the deliverables which have been delivered during the third twelve months of the project.

Del. No.	Deliverable name	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I	Delivered (yes/no)	Actual delivery date (month)
D1.2.1	Novel models of agency and social structure for trust and cooperation	UWAR	R	PU	30	Yes	30
D1.4.1	Modelling the dynamics of quality collectives	ETHZ	R	PU	36	Yes	36
D2.1.3	Empirically informed algorithm design for cooperation - experiments and results	TUD	R	PU	36	Yes	36
D2.3.1	Report on the deployment of protocols in living lab environments	USZ	R	PU	36	Yes	36
D3.1.2	Web experiments and initial results	ETHZ	R	PU	28	Yes	28
D3.2.1	Datasets guide and manual -- external datasets	UWAR	R	PU	36	Yes	36
D4.1.3	QLectives platform v3	TUD	P	PU	36	Yes	36
D4.2.3	QScience v3 (P2P)	UF	P	PU	36	Yes	36
D4.3.3	QMedia v3 + HQ-MD	TUD	P	PU	36	Yes	36
D5.5	Report on dissemination activities	UniS	R	PU	36	Yes	36
D6.4	Annual report	UniS	R	PU	36	Yes	36

Table 1: Deliverables

The following table lists the milestones which have been achieved during the third twelve months of the project.

Milestone	Milestone name	WP number	Lead beneficiary	Delivery date from Annex 1	Achieved (Yes/No)	Actual achievement date
M6.2	Based on trial of P2P QScience alpha version decide if to progress to P2P beta version to replace QScience Web2.0 at v3	WP4.2	TUD	M26	Yes	15/04/2011
M7	Completion of data collection (batch 2)	WP3.1, WP4.2, WP4.3	TUD	M30	Yes	07/03/2011
M8	Completion of data processing and analysis (batch 2)	WP3.2, WP3.3	UWAR	M33	Yes	30/11/2011
M9	Theory and algorithm reformulation (batch 2)	All WP's in Stream 1 and 2	UniS	M36	Yes	20/04/2011

Table 2: Milestones