3rd Annual Report

VO-TECH

The European Virtual Observatory - VO Technology Centre

A DESIGN STUDY

implemented as

SPECIFIC SUPPORT ACTION

Contract Number : 011892

Project Co-ordinator : Professor A.Lawrence, University of Edinburgh

Project website : http://www.eurovotech.org/

Reporting Period : from 01/01/2007 to 31/12/2007

A. ACTIVITY REPORT

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1. Progress Report

1.1 Summary of the activities and major achievements

The third year of the VOTECH project has been a significant success : four out of six of the the key planned technical reports were delivered during this reporting period, and the status of the project was formally assessed by an external reviewer, with very positive results. Meanwhile there has been continued steady progress against objectives and milestones; the project is well on track to achieving the overall objectiveness of technological readiness for Euro-VO. In addition, a major strength has been the clear demonstration of European added value through the process of partner co-operation. Our full consortium project planning meetings have developed into a twice yearly Technical Forum which attracts additional attendance, both from the European Space Agency and from international collaborators, and has allowed us to plan coherently our approach to the key international standards body, the International Virtual Observatory Alliance (IVOA).

Some highlight achievements include the following :

- very positive report from the formal mid-term review
- four out of six of the key technical reports delivered
- dissemination of technology to a workshop for European data centres
- prototype software delivered by all substantive study areas
- widepsread international adoption of the PLASTIC protocol
- several tools created or updated - e.g. ViRGO, Yafit, a Theory Portal, VisiVo, VONeural
- new tools for automated name detection in astronomical literature
- key contributions to IVOA standards development
- cemented the concept of the bi-annual Technical Forum

1.2 Consortium management activities (DS1)

Consortium management activities followed the same pattern as the previous year. All partners participate in consortium management activities at the level of policy development and decision making. This is done through a **Consortium Board** which is composed of the named investigators from each partner, supplemented by an administrative member if and when necessary. The purpose of the Consortium Board is oversight of the project - its setup, financial monitoring, resolution of issues between partners, and overall scientific and technical policy. The full Consortium Board had two formal meetings during this period (2007 April 4th and November 8th), both in conjunction with the Technical Advisory Panel.

The administration of consortium activities is undertaken purely by partner number 1, Edinburgh. The goals are (1) To oversee the project on behalf of all partners; (2) To co-ordinate financial and administrative matters; (3) To deliver an external presence. This work is undertaken by the **Consortium Administrator** (Peredur Williams, 0.2FTE on the project) and the **Consortium Web Developer** (Mark Holliman, 0.6 FTE on the project). (Staff effort in DS1 is detailed in section 1.3.1)

In addition during this year DS1 took lead responsibility for organising the **mid-term review**. This was held in Edinburgh on October 8th in the presence of an external reviewer and EC contract officer and was attended by almost all staff associated with the project. Thorough reviews of project progress were given both overall and for each work package - the presentations are available at the link given in the table below. Following the review, the external reviewer completed a report, which was extremely positive on all counts. (The reviewer's comments are reproduced in Annex-1).

Project Meetings. Below we tabulate formal meetings that were held involving all partners and considered to be organised under this activity.

Date	Title/Subject of Meeting	Locn	No. of attendees	Website address
2007 Mar 12-15	Stage 05 DS review and Planning Meeting	ESO	30	http://wiki.eurovotech.org/twiki/bin/view/VOTech/StageFivePlanningMeetings
2007 Apr 04	Board/Tech Advisory Panel	Telecon	12	http://wiki.eurovotech.org/twiki/bin/view/VOTech/BoardMeet20070404
2007 Oct 8	Mid term Review	Edinburgh	35	http://wiki.eurovotech.org/twiki/bin/view/VOTech/FormalReviewMaterials
2007 Oct 9-11	Stage 06 DS review and Planning Meeting	Edinburgh	35	http://wiki.eurovotech.org/twiki/bin/view/VOTech/StageSixPlanningMeetings
2007 Nov 08	Board/Tech Advisory Panel	Telecon	12	http://wiki.eurovotech.org/twiki/bin/view/VOTech/BoardMeet20071108
Project Meetings				

Deliverables. The complete set of deliverables and their target dates is set out in the Project Plan. Revised target dates were agreed during the first year of the project, but have not been formally altered yet. Here and in Annex-3 we tabulate those deliverables that either had a target date during this third reporting period, or were actually achieved during this period.

Deliv. No.	Deliverable name	Lead	Target Date	Achieved
DS2-03	Science Framework Document	UCAM	2006 Jun	2007 Oct
DS2-04b	Baseline software release 2	LU	2007 Mar	2007 Mar
DS3-01	Infrastructure Study Report	LU	2006 Jun	2007 Jan
DS3-02	DS3 prototype releases to DS2	LU	2007 Mar	2007 Mar
DS4-01	Tools Study Report	ESO	2007 Jun	2007 Jun
DS4-02	DS4 prototype releases to DS2	ESO	2007 Sep	2007 Oct
DS5-01	Resource Discovery Study Report	CNRS	2007 Sep	----
DS5-02	DS5 prototype releases to DS2	CNRS	2007 Sep	2007 Oct
DS6-01	Data Exploration Study Report	EDIN	2006 Dec	2007 Feb
DS6-02	DS6 prototype releases to DS2	EDIN	2007 Mar	2007 Mar
Deliverables				

Other milestones. The project Plan sets out additional milestones along with the deliverables. Below we tabulate those that either had a target date during this third reporting period, or were actually achieved during this period.

Milestone	Target Date	Achieved	Comment
Cycle-5 plan	2007 Mar	2007 Mar	
TAP-5	2007 Mar	2007 Apr	combined with Board-4
Board-3	2007 Feb	2006 Dec	
Board-4	2007 Mar	2007 Apr	
Demo Event	2007 Apr	2007 Jun	VOSAC meeting ESTEC
Cycle-6 plan	2007 Sep	2007 Sep	
TAP-6	2007 Sep	2007 Nov	combined with Board-5
Board-5	2007 Sep	2007 Nov	
Other Milestones			

1.3 Other specific activities

The project is divided into six "Design Study" tasks, DS1 to DS6. DS4-6 are substantive design studies which proceed in parallel. A **DS Leader** is chosen for each DS task. DS2 integrates the results from the other tasks. DS1 is simply the consortium management activities. This division into major parallel tasks plus an integration task continues to work effectively.

1.3.1 Task-1 : DS1 - Management of the Design Study

This is another name for the consortium management activities described at section 1.2.

Staff Effort in DS1. Below is the staff effort expended in this task. Funded staff effort is exact; partner contributed staff months are approximate.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months - funded	9.6						9.6
Person-months - contributed	1			1	2		4.0
Person-months - TOTAL	10.6			1	2		13.6

Deliverables. DS1 is responsible for top-level oversight of deliverables. However no DS1 specific deliverables were due in this period.

1.3.2 Task-2 : DS2 - Technical Project Management

This task provides technical and scientific leadership, planning, and integration. The four substantive tasks DS3-6 produce their deliverables to DS2, which is responsible for external technical deliverables. This task also aims at technical co-ordination amongst the partners, including an informal software repository. Finally, it also provides scientific leadership and co-ordination.

Technical Management.

Our work planning cycle continues to function well. All work carried out is in the context of the long term Project Plan, including revisions agreed during the second year of the project. This can be found at http://wiki.eurovotech.org/bin/view/VOTech/ProjectPlan . Within this long term context, we produce detailed plans in six month cycles, known as "Stages", which cover work in April-September and October-March. Shortly before each Stage, we hold a DS Review and Planning (DSRP) meeting, which is essentially a full open project meeting. During this period, we have held two such meetings, for Stage05 and Stage06 planning. The Stage06 planning meeting was immediately preceded by the formal project mid-term review.

At these meetings we review results of the previous stage, exchange experiences, and debate plans for the next stage. Detailed plans are written on the project web site by the DS Leads, and these are reviewed at a meeting of the Technical Advisory Panel (TAP). This is a smaller body with partner representatives and key technical staff. They agree the final plan and the contributions of each partner. As in the second year, we amalgamated TAP and Board meetings for reasons of efficiency. Once the plans are agreed, the various DS tasks proceed more or less separately until the next planning cycle debate. This debate and planning process is quite expensive in travel and staff time, but has been key to the success of the project.

Technical Co-ordination.

As well as oversight and planning, DS2 aims at technical co-ordination. Partly this is achieved by the sequence of meetings described above, but also by a wiki based project document system (http://wiki.eurovotech.org). This is an internal web site, where information, documents, reports and debates are all stored. Any project staff member can upload and edit information in this communal documentation system. We are working towards common standards for coding, versioning and software repository, but these are not enforced. However, all partners have some kind of CVS-like system, and we have been able to exchange software with little trouble. Public software sharing uses a central download site :

http://wiki.eurovotech.org/bin/view/VOTech/SoftwareDownload

Science Activities.

The scientific direction of VOTECH has been carried out under the leadership of the Project Scientist in conjunction with the VOTC Science team. This team, chaired by the PS, has consisted of a lead scientist from each Design Study with a scientist from ESA as an observer. The current composition of the VOTC science team (as 07/08/2007) is:

• Nicholas Walton VOTC Project Scientist (UK: AstroGrid)

• Eduardo Gonzalez Solares DS2 (UK:AstroGrid)

• Anita Richards DS3 (UK:AstroGrid)

• Evanthia Hatziminiaoglou DS4 (ESO)

• Mark Allen DS5 (F:CDS)

• Guiseppe Longo DS6 (I:INAF)

• Deborah Baines (ESA)

Science drivers have played an important role in defining the technical development programme of VOTECH. These have been input at each of the VOTECH stage planning meetings, with a focus on both listing high science priority features for study, and returning scientific analysis of the designs and implementations developed during the preceding stage. The major achievement during the third year of science activity was completion of the Science Framework Document, which in turn has been factored into each of the DS area reports. This was originally planned for delivery much earlier in the project, but was deliberately delayed to allow co-ordination with the rest of the Euro-VO structure.

Building on the exemplar science cases which were defined in Year 1, a number of these have been implemented utilising VO systems and capabilities determined in the context of the VOTECH project. These exemplar cases have resulted in preliminary scientific exploitation, the outcomes of which are will be published in the scientific literature. Lessons learned from the implementation of these cases were fed back to the VOTECH development streams, allowing for improvements to be made.

VOTECH science advice is coordinated with other Euro-VO strands through the combined Euro-VO science advisory committee (VO-SAC), which the VOTECH PS attends. This group is developing a user driven science agenda for the Euro-VO as a whole. At the meetings during the third project year, a key focus of the VO-SAC was been on encouraging user take up of Virtual Observatory tools. For VOTECH, this has meant an increased focus on developing software systems that are simple to deploy for those publishing data, and simple to use for those astronomers using the VO. The science team have played a key role in assessing the usability of the software, balancing ease of use with functionality.

During 2007 the partner Euro-VO project, the Data Centre Alliance (DCA: funded through the FP6 IST programme of the EU), continued operations. The DCA is tasked with informing the wider European astronomy resource providers as to how to implement the Euro-VO technical infrastructure, being defined and created through the Euro-VO VOTECH project, such that the widest possible set of European astronomy data, application and compute resources are published through the Euro-VO to the astronomy science end user community. In order to ensure fullest scientific coordination between the VOTC and DCA, Richards from the VOTC Science Team participates on the Project Coordination Team of the DCA. Allen is Project Scientist of the DCA.

A number of the VOTC science team have given talks or participated in lecture courses focused on the Virtual Observatory and have contributed to a wide range of workshops organised by the partners constituting the VOTECH project. At these, the opportunity has been taken to demonstrate VO capabilities developed by VOTECH to a wide range of European astronomers.

Walton is co-Chair of the Open Grid Forum Astronomy Applications Research Group. This group provides an interface between the Virtual Observatory and the wider Grid community. Regular meetings are held at the OGF conferences, with a major one day workshop at OGF20 in Manchester (May 2007).

The VOTECH science pages can be found on-line at:

http://wiki.eurovotech.org/bin/view/VOTech/ScienceTeam

The released version v1.0 of the VOTECH Science Framework Document is available at :

http://wiki.eurovotech.org/twiki/bin/view/VOTech/VotcSFD

Meetings. Staff working in DS2 attended the Review and Planning meeting as listed in section 1.2. There were other informal meetings and telecons within the DS that are not listed.

Deliverables. DS2 completed two major deliverables during this reporting period. The first is DS2-03, the Science Framework Document (SFD). This is significantly delayed compared to the original project plan, but this delay was necessary in order to co-ordinate with the formation of the overall Euro-VO science advisory structure. Since its completion, the SFD has had a significant influence on technical developments. The second major DS2 deliverable was DS2-04b, the second baseline software release, which was delivered on time. As described above, this was achieved through a co-ordinated software download page.

DS2 Effort expended. Staff effort expended in DS2 is summarised below.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months – funded							0
Person-months – contributed			6	3			9
Person-months – TOTAL			6	3			9

1.3.3 Task-3 : DS3 - New Infrastructure

This task aims at producing final designs of mature components, as well as assessments, designs, and trials of new components that don't fit into the major categories of DS4-6 below. In addition it has a responsibility for considering interoperability, integration and testing within the context of the overall Euro-VO architecture. Building upon the work of previous years, steady but significant progress has been made, particularly in consolidating design and standards with our colleagues in the IVOA.

Areas of particular note are:

- Completion of the Infrastructure Study Report
- Improvements in the VO API
- Authentication and Authorisation
- Making tools and data VO-capable
- Client-side application interoperability
- Distributed storage
- Adoption of new technology (esp. REST)

DS3 is also charged with considering interoperability, integration and testing within the context of the overall EuroVO architecture and hence liaising with the VOFC. On one level this requires International standards that define exactly how services interact and on another, ensure deployed services comply with those standards. To this end much of our work during this reporting period has been to consolidate our research and conclusions with that of our International colleagues to ensure we have the means to both define and verify our services in a truly International distributed environment. This has involved much work in many areas including: VOSpace, Single Sign-On, UWS, CEA, ADQL, DAL TAP/QL, STAP, SLAP and IVOA WS Basic Profile. We are now starting to define the Data Access Layer V2 protocol suite which builds upon experience gained from using the V1.x standards and enhances them allowing more functionally rich clients and servers to be developed.

Keeping pace with these progressions would be an almost impossible task for client application writers were it not for the parallel evolution of the VO API. For VOTECH, this capability is provided by the Astro-Runtime (AR) component. By abstracting away the complexities of interfacing with the various VO services, application writers can concentrate their efforts on the science utility of their applications safe in the knowledge that the VO services are readily accessible. To provide the same level of abstraction to server side application writers, investigations into a headless, multi-user version of the AR are being undertaken. This has the advantage that it will support Web 2.0 style interfaces as they become more popular.

Related to the above is the concept of "Workflow" and much effort has been invested in ensuring suitable workflow systems are available. These include JLOW and Taverna.

Similar efforts have been made to develop work started in previous Stages especially in data and application access, client side application interoperability, security and distributed storage. Taking these in turn, the IVOA UWS standard has been significantly influenced by the CEA pattern, implemented by several VOTECH partners and proved in practice. Similarly, work on ADQL querying (DSA/TAP), SIA and SSA by various partners has informed the development of the core IVOA DAL standards. PLASTIC (application message bus) has largely been adopted as the IVOA SAMP standard allowing ever more applications to become VO friendly without disproportionate effort. Work on Single Sign On and the security façade has progressed significantly: this is a key element in a truly distributed system as control over resources (access and use) becomes increasingly important as the numbers of users, applications and data volumes within the VO increase. For distributed storage, great strides have been taken developing the VOSpace components and interfaces.

Technology continually evolves and new opportunities arise all the time. One of the more obvious opportunities is the increasing adoption of the REST pattern of web service access as opposed to SOAP. DS3 research into and prototyping of REST interfaces has proved that this is the correct way forward for the VO. New versions of IVOA standards will embrace a RESTful style.

Finally, DS3 undertakes Studies and Prototyping into new services or collaboration opportunities including developing trial plug-ins for VirGO, collaboration with The san Diego Supercomputer Center and their iRODS product integration as DSA and DMMapper services etc.

Meetings. Staff working in DS3 attended the Review and Planning meetings as listed in section 1.2. There were other informal meetings and telecons within the DS that are not listed.

Deliverables. The key formal achievement during this reporting period was the delivery of the Infrastructure Study Report (DS3-01), although this mostly reflects work done during the second reporting period. It is planned that an additional "Final Infrastructure Study Report" will be published towards the end of the project. The second deliverable during this reporting period (DS3-02) was a sequence of prototype software releases to DS2, reflecting the developments described above.

Other milestones. DS3 is expected to make contributions the general project milestones listed in section 1.2, especially the six-monthly review and design planning. This is done (a) by attending the meetings and making presentations on progress, and (b) placing reports and internal DS plans on the project wiki-based documentation system. As in previous stages, these contributions have been successfully accomplished.

DS3 Effort expended. Staff effort expended in DS3 is summarised below.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months - funded	1	9.2		6	16.5		32.7
Person-months - contributed	0		20	30			50
Person-months - TOTAL	1	9.2	20	36	16.5		82.7

1.3.4 Task-4 : DS4 - New User Tools

The intention of this study is to create designs and prototypes for new VO-compliant end-user tools. Substantial progress towards the DS4 goals are detailed in the DS4 Study Report (http://wiki.eurovotech.org/twiki/bin/view/VOTech/DS4StudyReport) and the first prototype release to DS2 (http://wiki.eurovotech.org/twiki/bin/view/VOTech/DS4ReleaseOne). Below is a summary of depicted highlights for the reporting period.

Footprint overlay. Most archive browsers and proposal preparation tools provide means to graphically overlay instrumental footprint information onto some celestial background image registered with a given world coordinate system. The exact description of detector characteristics and the observation context can be truly

complex. Therefore, it is extremely helpful to provide a quicklook capability which mimics a human observer glancing at the sky and drawing a pattern of the aerial coverage as one would see it when peeking through various oculars. The IVOA Note "Footprint Overlay Specification using current VO Standards" was written up to serve this purpose and as a guideline for data service providers and client tools developers. Through the help of DS4 team this convention is now supported by several services and tools such as Aladin (CDS), VirGO (ESO) and HST-APT (STScI).

SED construction. The asssembly of the spectral energy distributions (SED) of a given celestial object and across measurements from different telescopes is a workflow encompassing several stages. The first one is a data access stage and a lot of progress was made in recent years on seamless access across electronic archives. Once catalogues of objects are available a cross matcher needs to cross identify objects in individual wavelength regimes. The individual values need to be put on a common scale with a given physical unit. In the optical domain this can often be achieved by converting Vega or AB magnitudes into physical fluxes. Such a magnitude to flux converter has been set up for several ESO instruments (http://archive.eso.org/apps/mag2flux/), and on top of it also provides a (limited) service for general unit conversions. Progress on cross matching facilities was made, both in DS5 and DS4 as described in the next paragraph.

Cross matching. This crucial component merges multi-wavelength information. The cross-match tool available in Aladin, initially developed in the FP5 RTD project Astrophysical Virtual Observatory (contract HPRI-CT-2001-50), has been improved to take into account error ellipses, i.e. uncertainty on positions. There is also a new cross match service for asynchronous batch processing of large(r) catalogues. Also, the creation of a positional index across several thousand VizieR catalogues has started and an initial implementation is available from the VizieR catalogue server (vizier.u-strasbg.fr). Once cross identified the resulting data sets can be fed to a classification tool such as a fitting utility...

Best fitting tool. A prototype best fitting tool called Yafit has been developed. It is capable of comparing model and observational data to identify the best fits, suitable for interactive or batch use. Typically Yafit compares a list of observed photometric points with a list of library model spectra and plots them against each other for visual inspection of the goodness of fit. Fitting tools are nothing new, but the strength of Yafit is its extensive I/O framework supporting a number of observational and model data formats and their online access. Currently supported model formats are Galaxev, Starburst99, SVO-format VOTable archives and user-prepared VOTables. Observational data is supplied as a table (VOTable or other) plus an additional key file. Support for additional formats, including ones related to the IVOA Spectral Data Model, can be added in future. This leads to another big challenge and topical area which is linking theoretical and observational Astronomy...

Theory VO web portal. Linking theoretical and observational Astronomy is the aim of three combined activities. Firstly, the definition of a data model specifying terms for interaction between the two domains. Secondly, the definition of the Simple Numerical Access Protocol (SNAP) to access the theoretical data and also making a different cutout of the snapshot boxes. These two activities happen in close collaboration with the IVOA Semantics and Theory working groups. Thirdly, the implementation of a prototype Theory Virtual Observatory TVO for a selected scenario: A tool to create on-the fly maps and profiles of some quantities for the simulated galaxy cluster with the possibility to load simulated data via Aladin. These activities allow to validate standards, protocols and data models defined within the IVOA collaboration. The tools built for the different implementation shall became of general use for the access and manipulation of theoretical data. Tool demonstrators were already deployed in Triest http://wwwas.oats.inaf.it/IA2/ and Catania http://www.astrocomp.it/itvo. Those sites feature web interfaces for the creation of quantity profiles and SNAP services. These activities are performed in coordination with the Framework Programme 6 EURO-VO DCA project (RI031675).

The latest ESO **Scisoft Release V7** includes also a set of VO tools. Scisoft is a project within ESO to provide a collection of astronomical software utilities in a uniform way at all four ESO sites and to make them available to the outside world (http://www.eso.org/scisoft/). Relationships of the DS4 team with VO partners in China and India greatly simplified the setup of mirror sites in those countries who's Astronomy community is sometimes lacking international network links with sufficiently high bandwidth.

Meetings.

Staff working in DS4 attended the bi-annual Review and Planning meetings as listed in section 1.2, and there were further informal meetings and telecons within the DS.

Deliverables.

The main deliverable for DS4, due within the reporting period, was the User Tool Study Report (DS4-01). Complementary to the written report the DS4 team delivered the first software release to DS2 (DS4-02). The VOTECH Board may decide to request an update of the report close to the end of the project similar to the DS3 and DS6 preliminary reports which were due already in the previous reporting period.

Other milestones.

DS4 is expected to make contributions the general project milestones listed in section 1.2, especially the six-monthly review and design planning. This is done (a) by attending the meetings and making presentations on progress, and (b) placing reports and internal DS plans on the project wiki-based documentation system. As in previous stages, these contributions have been successfully accomplished.

Effort expended.

Staff effort expended in DS4 is summarised below.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months – funded		18		6	1.6	5	30.6
Person-months - contributed						13	13
Person-months – TOTAL		18		6	1.6	18	43.6

1.3.5 Task-5 : DS5 - Intelligent Resource Discovery

This task aims at undertaking a feasibility study for developing components based on emergent technologies in the areas of the semantic web and ontologies. On the assumption that these studies are successful, the project will proceed to trial implementations, and standards development. In the third year of the project, the development and usage of ontologies was sustained. The different topics that were addressed can be grouped by their proximity to general working groups of the Virtual Observatory community. One can mention in particular:

Registry-related experiments

Development of an ontology for VO access control, applying ontological reasoning (with the SPARQL reasoner) to digital certificates for access control to VO resources :
(http://wiki.eurovotech.org/twiki/bin/view/VOTech/AccessControlUseCases)

Development of a registry metadata ontology, describing VO resources into an ontology in order to apply ontological reasoning and SPARQL queries to browse VO registries
VO Resources describe the various components (datasets, services, organisations) of the astronomical Virtual Observatory. The access to some of the resources might be controlled by digital certificates. Access-control use cases have been elaborated in collaboration with AstroGrid people, using Security Assertion Markup Language (SAML) and proxy certificates. The registry ontology was updated to take into account the version 1.0 of the Registry standard, and several usage patterns were developed (with ACR, Quaestor).

VOEvent-related

VOEvent is the VO packet message exchange format for transient phenomena. An ontology for VOEvent was earlier developed :
(http://wiki.eurovotech.org/twiki/bin/view/VOTech/VoEventOntology).

Several science cases have been tested. For solar events, the remote packets have been stored in an rdfstore, accessible with SPARQL queries. A VOEvent search tab has been added to the VOExplorer tool. For more general events, an ontology of the Characterization data model has been used in combination with the VOEvent ontology to find macthing events by querying a remote store of events. This has been applied to OGLE VOEvents located in the same sky region as a set of 2MASS images (cross-DS issue with DS6).

Semantics-related

Describing the various astronomical object types in SIMBAD (follow-up of previous work)
http://wiki.eurovotech.org/twiki/bin/view/VOTech/OntologyOfObjectTypes

The ontology of astronomical object types has become quite mature, with the development of specific domains (AGN, YSO) in collaboration with domain experts. Discussion has been opened within IVOA on its contents. The contents have been improved, by adding more links to the vocabulary, and taking into account measurements for restrictions on concepts.
A user-friendly user interface has been developed to explore and search the ontology. And a use-case was developed atop the SIMBAD4 database, allowing to check consistency of multiple object types assigned to a single SIMBAD object, using the ontology and a reasoner.

Thanks to experience accumulated in DS5, the SKUA project (Semantics Knowledge Underpinning Astronomy - http://myskua.org/) was accepted for start in 2008 (JISC, e-Infrastructure programme).

Some other DS5 tasks are not directly related to ontologies, but explore other areas of resource discovery:

The registry query tool and homogenized data retrieval tools have been upgraded to take into account UCD1+, they can connect to several registries, including those with the new 1.0 schema. They can use the PLASTIC protocol to interact with each other, and other VO tools. These tools were included in the First Prototype release (see deliverables). The implementation of the characterization data model has also been improved, and a dedicated library has been developed (CAMEA, see DS6).

The MEx FITS keyword mapping utility, used to automatically extract keywords from a set of FITS files into a database was improved (http://wiki.eurovotech.org/twiki/bin/view/VOTech/DpSubmitKWmappingDoc). Better support for unit conversion, better mapping builder, and user friendly interface have been provided. Mex was also part of the prototype release.

The software for automated Detection in Journals of Identifiers and Names (DJIN) was also released. It has been validated by experts, and is now used by all the people extracting astronomical object names from journals for populating the SIMBAD bibliographic data. An interesting feature is the ability to weigh the importance of an object in a paper (based on the number of times an object is cited, and the context where the name appears: title, abstract, table, plain text...).

A new task started in late 2007 to design a common interface to the CDS services (SIMBAD, VizieR, Aladin), trying to offer advanced data discovery to the astronomers.

Meetings. Staff working in DS5 attended the Review and Planning meetings as listed in section 1.2. There were other informal meetings and telecons within the DS that are not listed here. They also provided support as advisors in the EURO-VO workshop on how to publish data to the VO (ESAC, Madrid, June 25-29, 2007 - http://cds.u-strasbg.fr/twikiDCA/bin/view/EuroVODCA/DcaMay2007Workshop).

Deliverables. Two deliverables were due during this reporting period. The first major deliverable for DS5 is the first prototype software release (DS5-02:
http://wiki.eurovotech.org/twiki/bin/view/VOTech/ResourceDiscoveryPrototype1).
It contains four different pieces of software that were developed under DS5: Registry Query tool; Data Extraction tool; Object Names Recognition tool; FITS Keyword Mapping (MEx).
The second major deliverable, the "Resource Discovery Study Report" (DS5-01) was delayed to the next stage, in order to take into account the feedback from the “Practical Semantic Astronomy” workshop (http://www.cacr.caltech.edu/semast/), held in Caltech in february 2008, and strongly supported by VOTECH co-workers (3 persons in the Scientific Organizing Commitee).

Other milestones. DS5 is expected to make contributions the general project milestones listed in section 1.2, especially the six-monthly review and design planning. This is done (a) by attending the meetings and making presentations on progress, and (b) placing reports and internal DS plans on the project wiki-based documentation system. As in previous stages, these contributions have been successfully accomplished.

DS5 Effort expended. Staff effort expended in DS5 is summarised below.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months – funded		9.6	10		17.2	19	55.8
Person-months - contributed			1		8.4		9.4
Person-months – TOTAL		9.6	11		25.6	19	65.2

1.3.6 Task-6 : DS6 - Data Exploration

This task assesses data mining and visualisation algorithms and packages, with a view to determining how they can be run as distributed services, how they can be made VObs-compliant, and how they can be extended to extremely large datasets. On the assumption that these studies are successful, the project will proceed to actual component designs, trial implementations and standards development.

Significant progress has been made on all DS6 topics within the reporting period, as summarised below.

Interoperability of desktop tools. DS6 researchers led the development of "PLASTIC", a protocol enabling desktop data exploration tools to be used interoperably. This was adopted with enthusiasm by the developers of astronomical data exploration tools, and the focus of related work within the current reporting period has been harnessing this enthusiastic adoption of the prototype PLASTIC protocol for the production an IVOA standard encapsulating the essential ideas of PLASTIC in a manner which meets related requirements within the wider VO community. The reporting period has seen a lot of discussion over this standard – to be called the Simple Application Messaging Protocol (SAMP) – which should make its appearance within the formal VO standardisation procedure during 2008.

Other IVOA standards work The DS6 team has continued to contribute through the reporting period to the further development of IVOA standards in the Data Modelling (DM) and Data Access Layer (DAL) working groups. Foremost amongst the DM developments has been that of the Data Model for Astronomical DataSet Characterisation which attained IVOA Recommendation status during the reporting period. The Characterisation data model is an abstraction which can be used to derive a structured description of any relevant data and thus to facilitate its discovery and scientific interpretation. The model aims at facilitating the manipulation of heterogeneous data in any VO framework or portal. A VO Characterisation instance can include descriptions of the data axes, the range of coordinates covered by the data, and details of the data sampling and resolution on each axis. The DS6 team has also undertaken a lot of work developing reference implementations for DAL protocols, as well as aiding their adoption, and the generation of requirements for their further extension through revealing where they fail to meet user needs in practice.

VisiVO. The development and adoption of the VisIVO (http://visivo.oact.inaf.it) visualization tool has continued apace during the reporting period. The VisIVO team held a successful first User Tutorial at CINECA (Bologna) in March 2007, which highlighted the use of VisIVO both as a sophisticated standalone tool for visualizating multidimensional datasets and interoperating with other VO tools via PLASTIC. New features continue to be added to VisIVO, which has started to attract significant attention beyond astronomy.

VONeural. The transformation of the MATLAB-based Astroneural data mining toolkit into the VONeural tool, more suitable for use within the VO, made significant progress during the reporting period. As well as making more of the individual algorithm from Astroneural available in VONeural, the INAF team have made great progress in using Grid and cluster hardware to execute computational jobs defined by VONeural. This represents one of the most significant interactions to date between the VO and Grid worlds, and bodes well for the future deployment of very large scale VO data mining tasks onto Grid resources.

Testbed science scenario. A major activity for the UK-based portion of the DS6 team within the reporting period has been the undertaking, using existing VO resources, of a testbed science scenario, which is representative of the kind of large-scale data mining project that users will ultimately wish to perform within the VO. The principal goal of this testbed is to assess how well the current VO infrastructure can support such analyses and to identify whether further work is needed. The chosen scenario focuses on the photometric selection of quasars, following the pioneering work of Richards et al (2004, ApJS,155, 257) using data from the Sloan Digital Sky Survey, but supplementing this with proprietary data from the UK Infrared Deep Sky Survey, accessed via a secure version of the AstroGrid Data Set Access service.

Meetings. Staff working in DS6 attended the Review and Planning meetings as listed in section 1.2. There were other informal meetings and telecons within the DS that are not listed.

Deliverables. The first major deliverable for DS6, the preliminary version of its "Design Study Report", was published at the very start of the reporting period, in February 2007. The majority of the work for this was conducted during 2005 and 2006, and is described in the DS6 report for 2006. Within the current reporting period, the DS6 team contributed software to the Second Baseline Software Release, constituting deliverable DS6-02.

Other milestones. DS6 is expected to make contributions the general project milestones listed in section 1.2, especially the six-monthly review and design planning. This is done (a) by attending the meetings and making presentations on progress, and (b) placing reports and internal DS plans on the project wiki-based documentation system. These contributions have been successfully accomplished.

DS6 Effort expended. Staff effort expended in DS6 is summarised below.

Participant No.	1	2	3	4	5	6	
Participant short name	UEDIN	ESO	LU	UCAM	CNRS	INAF	
Person-months - funded	21				6.3	23	
Person-months - contributed	1				1.8	22.5	
Person-months - TOTAL	22				8.1	45.5	

1.4 Update of the non-confidential Project information

A Design Study is being undertaken aimed at completing all technical preparatory work necessary for the construction of the European Virtual Observatory (Euro-VO). Euro-VO is a specifically European implementation of the Virtual Observatory (VObs) concept, and will produce a world leading infrastructure providing a unified virtual data resource and the ability to perform complex data discovery and manipulation tasks across the whole range of astronomy. Access to data and tools will be equally good across Europe, regardless of location. This will require establishing an alliance of data centres, and a VObs facility centre in support of the community, but crucially requires the construction of an infrastructural glue of software components, in the context of rapidly evolving background developments in IT and the grid. The VOTECH project aims specifically at feasibility studies and design work aimed at integrating such new technologies into the Euro-VO. Key IT advances to build on are in intelligent resource discovery (ontology and the semantic web), data mining, and visualisation capabilities. These will be integrated via global astronomical interoperability standards coupled with the latest distributed grid computing services. Additionally this project covers design and preparatory work to ensure that data from the major European telescopes and facilities (as represented by the Opticon and RadioNet networks) is fully accessible through the Euro-VO.

1.4.2 Project website address : http://www.eurovotech.org

1.4.3 Project Achievements

Early in its third year, VOTECH delivered four of the six key technical reports needed to plan the development of the European Virtual Observatory concept. During the year the project also constructed prototype working software based on these technical studies, and worked with data centres across Europe to deploy the new software, as well as demonstrating new software capabilities to astronomers in several public meetings. Key agreements on technical standards were also reached with international partners. Finally the project continued to strengthen methods for partner co-operation, developing the idea of a bi-annual semi-open technical forum.

1.4.4 List of participants

Participant number (co-ordinator = N°1)	**Participant name** (Organisation, city, country)	**Short name**
1	University of Edinburgh, representing UK AstroGrid Consortium	UEDIN
2	European Southern Observatory, Garching bei München, Germany	ESO
3	University of Leicester, representing UK AstroGrid Consortium	LU
4	University of Cambridge, representing UK AstroGrid Consortium	UCAM
5	Centre National de la Recherche Scientifique, representing French VO	CNRS DR10
6	Istituto Nazionale di Astrofisica, Roma, Italy	INAF

2. List of Deliverables

Deliverables were specified in the Project Plan first released in March 2005, and revised in December 2006. Below is a list of deliverables that were either scheduled for this reporting period according to the revised project plan, or were otherwise delivered during this reporting period, together with their target date, and their current status.

The project plan and copies of the deliverable reports are available at :
http://wiki.eurovotech.org/twiki/bin/view/VOTech/ProjectContract
The software deliverables are available at :
http://wiki.eurovotech.org/bin/view/VOTech/SoftwareDownload

Deliv. No.	Deliverable name	Lead	Target Date	Achieved	Note
DS2-03	Science Framework Document	UCAM	2006 Jun	2007 Oct	(1)
DS2-04b	Baseline software release 2	LU	2007 Mar	2007 Mar	
DS3-01	Infrastructure Study Report	LU	2006 Jun	2007 Jan	(2)
DS3-02	DS3 prototype releases to DS2	LU	2007 Mar	2007 Mar	
DS4-01	Tools Study Report	ESO	2007 Jun	2007 Jun	(2)
DS4-02	DS4 prototype releases to DS2	ESO	2007 Sep	2007 Oct	
DS5-01	Resource Discovery Study Report	CNRS	2007 Sep	----	(3)
DS5-02	DS5 prototype releases to DS2	CNRS	2007 Sep	2007 Oct	
DS6-01	Data Exploration Study Report	EDIN	2006 Dec	2007 Feb	(2)
DS6-02	DS6 prototype releases to DS2	EDIN	2007 Mar	2007 Mar	

Note (1) : The Science Framework Document (SFD) was originally planned for much earlier in the project. However it was decided that it should be merged into the larger plan for overall science planning of Euro-VO through the new VO Science Advisory Committee (VOSAC). Once the VOSAC was fully underway, the SFD was completed.

Note (2) : The study reports on Infrastructure, on Tools, and on Data Exploration are key products of VOTECH. It was originally planned to issue them in a staged manner in order to spread the work of the project; however all the teams concerned felt a pressure to delay because significant new developments continued. We decided thefore to issue "preliminary reports" roughly on schedule, but also to plan later "final reports". In fact the "preliminary reports" are quite thorough, and fully constitute the formal deliverables.

Note (3). Semantics and Resource Discovery is a particularly fast moving field at the moment, and crucial meetings were due to take place shortly after this reporting period. We decided therefore to delay the Resource Discovery Study Report to take account of these developments.

Public dissemination. The public web page (http://www.eurovotech.org) has been available since very early in the project, and is also linked from a more general Euro-VO public web page (http://www.euro-vo.org/pub/).

3. Use and dissemination of knowledge

Euro-VO partners. Progress on VOTECH is reported to the Euro-VO Executive Board, along with progress on other components of Euro-VO - the VO Facility Centre (VOFC), and the Data Centre Alliance (DCA). The VOFC is supported by internal ESO and ESA fundsl the DCA is supported by a mixture of national agency funding and FP6 project funding. A prime aim of the DCA is co-ordinating national efforts to deploy VOTECH software.

European data centres. A key event during this reporting period was a workshop on "How to publish in the VO". This was organised by the VODCA project, but in co-ordination with VOTECH, and showed data centre representatives how to deploy VOTECH software. This was held at ESAC, Madrid in June 2007.

International context. VOTECH is part of an international drive towards the Virtual Observatory. Most project staff are members of one or another IVOA working group and have contributed throughout the year to standards development, attending meetings during 2007 in Beijing (China) and Cambridge (UK). VOTECH staff are active in all technical areas, including Applications, Registry, Grid and Web Services, Semantics, Data Model, and Data Access Layer. Within the VOTECH leaders, Lawrence, Genova, and Linde were all members of the IVOA Executive, and Walton was the IVOA secretary.

Scientific community. The key event was the Joint European National Astronomy Meeting (JENAM) in Armenia in August 2007, where a joint Euro-VO stall was run, and several VOTECH-related talks were given. VOTECH software was demonstrated to the joint Euro-VO Science Advisory Committee at ESTEC in June 2007. In addition, VOTECH staff contributed to a number of national events.

Wider e-science links. All the partners have strong links with other e-science projects at national level, and also within the EGEE project. The VOTECH project scientist (Walton) is co-chair of the Open Grid Forum Astronomy Applications Research Group. A major one day workshop was held in conjunction with OGF20 in May 2007 in Manchester.

Publications

The following publications appeared during calendar year 2007, which resulted wholly or partly from VOTECH activity :

Bonnarel, F., et al, 2007, *Utype list for the Characterisation Data Model*, IVOA Note 25 June 2007

Bonnarel, F., Chilingirian, I., Gassmann, B., and Louys, M., 2007, *Implementations of the Data Model for Astronomical DataSet Characterisation*, IVOA Note 13 August 2007

Cambresy, L., et al, 2007, *Ontology of Astronomical Object Types*, IVOA Working Draft 19 February 2007

Dalla, S., Richards, A., et al, 2007, *Solar System Data Access and Analysis with AstroGrid*, in Astronomical Data Analysis Software and Systems XVI ASP Conference Series, Vol. 376, proceedings of the conference held 15-18 October 2006 in Tucson, Arizona, USA. Edited by Richard A. Shaw, Frank Hill and David J. Bell., p.77

Dalla, S., Fletcher, L., 2007, *Walton, N., Solar active region emergence and flare productivity*, Highlights of Astronomy, Volume 14, p. 614-614

Derriere, S., Richards, A., Preite-Martinez, A., 2007 *VO Registry Queries and Ontologies*, in Astronomical Data Analysis Software and Systems XVI ASP Conference Series, Vol. 376, proceedings of the conference held 15-18 October 2006 in Tucson, Arizona, USA. Edited by Richard A. Shaw, Frank Hill and David J. Bell., p.607

Derriere, S., Richards, A., Preite-Martinez, A., 2007, *An ontology of astronomical object types for the Virtual Observatory*, Highlights of Astronomy, Volume 14, p. 603-603

Dolensky, M., Chereau, F., et al., 2007, *The ESO Science Archive Facility*, Astronomical Data Analysis Software and Systems Conference XVII, ASP Conference Series.

Dolensky, M., 2007, *Status of the New Archive Infrastructure for Spectra at ESO*, Astronomical Spectroscopy and Virtual Observatory Workshop, ESA Conference Series.

Genova, F., 2007, *Summary of Special Session 3*, Highlights of Astronomy, Volume 14, p. 623-624

Graham, M., Harrison, P., Morris, D., Rixon, G., 2007, *VOSpace service specification*, IVOA Proposed Recommendation 07 September 2007

Graham, M., Harrison, P., Morris, D., Rixon, G., 2007, *VOSpace service specification*, IVOA Proposed Recommendation 23 July 2007

Graham, M., Morris, D., Rixon, G., 2007, *VOSpace: a Prototype for Grid 2.0*, in Astronomical Data Analysis Software and Systems XVI ASP Conference Series, Vol. 376, proceedings of the conference held 15-18 October 2006 in Tucson, Arizona, USA. Edited by Richard A. Shaw, Frank Hill and David J. Bell., p.567

Gray, N., *An RDF version of the VO Registry*, IVOA Note 20 September 2007

Gray, N., 2007, *UTypes and URIs*, IVOA Note 02 March 2007

Lesteven, S., Derriere, S., et al , 2007, *Ontologies for Astronomy*, in Library and Information Services in Astronomy V: Common Challenges, Uncommon Solutions. ASP Conference Series, Vol. 377, proceedings of the conference held 18-21 June 2006 in Cambridge, Massachusetts, USA. Edited by Sandra Ricketts, Christina Birdie, and Eva Isaksson., p.193

Louys, M., Richards, A., et al, 2007, *Data Model for Astronomical DataSet Characterisation*, IVOA Recommendation 08 November 2007.

McDowell, J., et al , 2007, *IVOA Spectral Data Model*, IVOA Recommendation, 29 October 2007

Norris, R., et al, 2007, *Astronomical data management*, Highlights of Astronomy, Volume 14, p. 673-682

Padovani, P., 2007, *Towards a VO compliant ESO science archive*, Highlights of Astronomy, Volume 14, p. 585-585

Plante, R., Benson, K., et al 2007, *VOResource: an XML Encoding Schema for Resource Metadata*, IVOA Proposed Recommendation 28 June 2007

Preite-Martinez, A., Lesteven, S., *Astronomical Keywords in the era of the Virtual Observatory*, IVOA Note 25 April 2007

Preite-Martinez, A., et al, 2007, *The UCD1+ controlled vocabulary*, IVOA Recommendation 02 April 2007

Prema, P., Walton, N., McMahon, R., 2007, *Galaxy formation and evolution using multi-wavelength, multi-resolution imaging data in the Virtual Observatory*, Highlights of Astronomy, Volume 14, p. 592-592

Richards, A., et al, 2007, *Using VO tools to investigate distant radio starbursts hosting obscured AGN in the HDF(N) region*, Astronomy and Astrophysics, Volume 472, Issue 3, September IV 2007, pp.805-822

Richards, A., et al, 2007, *Virtual Observatories and Access to Radio Interferometry Data*, in Exploring the Cosmic Frontier: Astrophysical Instruments for the 21st Century. ESO Astrophysics Symposia, European Southern Observatory series. Edited by Andrei P. Lobanov, J. Anton Zensus, Catherine Cesarsky and Phillip J. Diamond. Series editor: Bruno Leibundgut, ESO. ISBN 978-3-540-39755-7. Published by Springer-Verlag, Berlin and Heidelberg, Germany, 2007, p.81

Rixon, G. , 2007, *Introduction to CEA and UWS*, IVOA Note 05 October 2007

Rixon, G., Graham, M., *IVOA Single-Sign-On Profile: Authentication Mechanisms*, IVOA Proposed Recommendation 04 September 2007

Rixon, G., 2007, *UWS recast as a REST protocol*, IVOA Note 26 February 2007

Vollmer, B., Derriere, S., et al 2007, *Determination of radio spectra from catalogues and identification of gigahertz peaked sources using the Virtual Observatory*, Highlights of Astronomy, Volume 14, p. 583-583

Walton, N., 2007, *The AstroGrid Virtual Observatory Service*, in Astronomical Data Analysis Software and Systems XVI ASP Conference Series, Vol. 376, proceedings of the conference held 15-18 October 2006 in Tucson, Arizona, USA. Edited by Richard A. Shaw, Frank Hill and David J. Bell., p.715

Walton, N., et al, 2007, *Mapping Galactic spiral arm structure: the IPHAS survey and Virtual Observatory access*, Highlights of Astronomy, Volume 14, p. 595-595

Walton, N., et al 2007, *AstroGrid Virtual Observatory Access to Large Scale Surveys: The IPHAS Galactic Plane Survey---a Science Driven Example*, in Astronomical Data Analysis Software and Systems XVI ASP Conference Series, Vol. 376, proceedings of the conference held 15-18 October 2006 in Tucson, Arizona, USA. Edited by Richard A. Shaw, Frank Hill and David J. Bell., p.30

Walton, N., Lawrence, A., Williams, R., 2007, *Special Session 3 Poster Abstracts*, Highlights of Astronomy, Volume 14, p. 625-637

Walton, N., Lawrence, A., Williams, R., 2007, *The Virtual Observatory in action: new science, new technology, and next generation facilities*, Highlights of Astronomy, Volume 14, p. 577-578

Wicenec, A., Chereau, F., et al., 2007, *The New Face of the ESO Science Archive Facility*, Astronomical Data Analysis Software and Systems Conference XVII, ASP Conference Series.

Williams, R., Allen, M., et al, 2007, *The IVOA in 2007: Assessment and Future Roadmap*, IVOA Note 18 June 2007

Annexes

Annex 1 - Summaries and main conclusions of the General Meetings *(section 1.2)*

Tabular summary of General Meetings

Date	Title/Subject of Meeting	Locn	No. of attendees	Website address
2007 Mar 12-15	Stage 05 DS review and Planning Meeting	ESO	30	http://wiki.eurovotech.org/twiki/bin/view/VOTech/StageFivePlanningMeetings
2007 Apr 04	Board/Tech Advisory Panel	Telecon	12	http://wiki.eurovotech.org/twiki/bin/view/VOTech/BoardMeet20070404
2007 Oct 8	Mid term Review	Edinburgh	35	http://wiki.eurovotech.org/twiki/bin/view/VOTech/FormalReviewMaterials
2007 Oct 9-11	Stage 06 DS review and Planning Meeting	Edinburgh	35	http://wiki.eurovotech.org/twiki/bin/view/VOTech/StageSixPlanningMeetings
2007 Nov 08	Board/Tech Advisory Panel	Telecon	12	http://wiki.eurovotech.org/twiki/bin/view/VOTech/BoardMeet20071108
Project Meetings				

Stage05 DS Review and Planning Meeting : 2007 Mar 12-15 (ESO) . This was the fifth in our standard cycle of work planning meetings. Colleagues from ESA also attended. Progress in all DS areas was reviewed, and plans debated and drawn for the following six month work cycle. This meeting also re-inforced the idea of a free-form "hackathon" in the middle of the meeting, which was extremely fruitful.

Technical Advisory Panel and Board Meetings : 2007 Apr 04 (Telecon) . The TAP formally reviewed reviewed the progress made at the Stage05 DSRP and the proposed plans. Minor amendments were suggested to the workplans, which were then formally proposed to the Board and agreed. The Board reviewed the financial status of the project, discussed the development of a VOTC charter, and discussed plans for partner involvement in future FP7 proposals.

Mid Term Review : 2007 Oct 8 (Edinburgh) . This was the required formal mid term project review. It was attended by essentially all project staff, along with an external reviewer (Szalay) and our EC contract officer (Carvalho-Dias). Progress reports on all areas were presented, along with forward plans, and an overview of finances. The review was extremely successful, and shortly later the external reviewer provided a very positive report. The reviewers comments are reproduced at the end of this esection.

Stage06 DS Review and Planning Meeting : 2007 Oct 9-11 (Edinburgh) . This was the sixth in our standard cycle of full consortium work planning meetings. Significant technical progress was again reported, and work plans for the next six months produced.

Technical Advisory Panel and Board Meetings : 2007 Nov 8 (Telecon) . The formal TAP meeting following the Stage06 DSRP meeting was somewhat delayed, due to the difficulty of finding an agreed date. DSRP progress and work plans were reviewed, and very minor changes made before formal agreement. The Board discussed financial issues, and reviewed progress on plans for FP7 proposals.

REVIEWERS COMMENTS from MID-TERM REVIEW

Reproduced from official report.

1a : Executive summary

The project has clearly demonstrated an enormous amount of progress. It has fully achieved its objectives technical goals, and has exceeded expectations. The team is well integrated, has a young group of scientists who are collaborating with one another. The management is well-organized and provides an excellent atmosphere for the participants, that motivates and rewards excellence.

1b : Recommendations

The project should continue to pursue its stated goals and should be expected to considerably exceed those by the time of the project's completion.

2a : Have the objectives for the period been achieved?

All objectives have been clearly achieved.

2b : Are the overall objectives (i) still relevant and (ii) still achievable within the time and resources ?

The VOTECH effort has the world's largest concentration of people working on the Virtual Observatory for Astronomy. Their objectives were rather aggressive, and I originally had some doubts whether such an ambitious task can be accomplished in time. They have done all what they promised and more.

2c : Do you recommend changes in objectives in order to keep up with the current state-of-the- art?

The project itself has already made small adaptive steps to accommodate the changing environment. There is no need for an external intervention.

3a : Has the project as a whole been making satisfactory progress in relation to the Description of Work (Annex I to the contract)?

They have built a framework that works. They developed various tools that work. They have built an international team that works together. Their activities are internationally visible. The project had a major impact on the world-wide VO effort and serves as a poster-child for other disciplines

3b : Has each work package (WP) been making satisfactory progress in relation to the Description of Work (Annex I to the contract)?

The presentations during the review process demonstrated that all the work packages are well on track, in fact most of them exceeded expectations.

3c : Have planned milestones and deliverables been achieved for the reporting period?

In all the packages (Infrastructure, Tools, Data exploration, Science Framework) the milestoines have been successful accomplished.

3 d : Have resources been deployed as foreseen in Annex I, overall and for each participant?

Yes, I have not seen anything that would show otherwise. Participants seemed to be satisfied with the resources allocated to them and have made good use of them.

3e : Have costs incurred, i.e., personnel costs and other major cost items, been 1) necessary for the implementation of the project and 2) economic. Note that both aspects 1) and 2) have to be covered in the answer.

The project reaches across several sub-disciplines of astronomy, and the activities are also rather broad, from middleware to visualization and data mining. These required a non-trivial amount of resources. In my opinion, these have been both necessary and well-utilized. The results speak for themselves.

4 : Is the proposed update to the Implementation Plan (IPs) or Joint Programme of Activity (NoEs) for the next 18-month period satisfactory (a) from a scientific/technical point of view?

The remaining the scientific reference cases represent a serious challenge. Their successful execution will validate the VOTECH approach convincingly.

(b) : from a management point of view including use of resources?

I see no problem in the proposed plan of activities.

(c) : concerning non-scientific activities (dissemination, exploitation, training, science-society issues, further integration etc)?

The project has started a wide dissemination effort. This is a crucial part of the acceptance of such a new technology. They might also to consider working closely with a few 'pundits' in the astronomy community in each country, who carry a lot of weight in how a particular community reacts to new efforts. Should they convince those people, the rest of the community will follow.

5a : Has the collaboration between the participants been effective?

I was very impressed how smoothly this worked. I particularly liked the idea of the 'hackathon's, where the young people get together on a regular basis to make critical coding decisions. I have not seen this applied elsewhere – looked like an innovative idea, that works.

5b : Have the partners contributed as planned to the project and tasks assigned to them?

During the review and from the presented materials I did not see any partner falling behind.

5c : Do you identify any conflicts or evidence of underperforming partners, lack of commitment or change of interest of any partners? Do you recommend any changes in responsibilities?

I have no concerns.

6a : Has the scientific/technical management been performed as required?

Very effective.

6b : Has the administrative and financial management been performed as required ((including proper handling of contractual matters, maintenance of the consortium agreement, intellectual property rights, technical collective responsibility, sub-contracting, competitive calls)?

Clean, concise presentation, looks like the external requirement on the reporting is non-trivial, nevertheless they appeared to cope with it extremely well.

6c : Have (electronic) information and communication networks been established as required to support interactive working between the teams involved (if relevant)?

The electronic information was also very useful for the reviewer in preparing for the meeting, and the report. The group is clearly using the electronic repository as their main interaction point. The wiki is well organized, and holds relevant content.

6d : Is the consortium interacting in a satisfactory manner with other related 5th and 6th Framework projects or other R&D national/international programmes (if relevant)?

The project interacts well with the national VO efforts. They are also a key component in the International Virtual Observatory Alliance. There could be somewhat stronger ties with similar efforts in the new member states.

7a : Does the project have significant use potential (if applicable)?

It is relevant not only for astronomy but for other areas of science. In my opinion the VOTECH effort is ahead of similar efforts in other disciplines. Interactions across such boundaries could help in avoiding duplication of efforts.

7b : Is the Plan for the Use and Dissemination of Knowledge developing in a satisfactory manner?

Yes, progress is extremely solid.

7c : Have the contractors disseminated project results and information as foreseen by the contract and the plan for dissemination and use of knowledge (publications, conferences…)?

Yes, they made a considerable effort. They are also very visible world-wide.

7d : Are potential users and other stakeholders (outside the consortium) suitably involved (if applicable)?

Making radically new technologies widely accepted is a VERY DIFFICULT problem. The project has done everything they could, but they cannot perform miracles. The realistic expectation should be that a general acceptance of the V technologies is going to be a slow process, nevertheless it is inevitable.

8a : Have policy-related and/or regulatory issues been properly handled (if applicable)?

There were no major issues that I could see.

8b : Have ethical issues been appropriately handled (if applicable)?

No major issues either.

8c : Have safety issues been properly handled (if applicable)?

Not really applicable.

8d : Has progress on the Gender Action Plan been satisfactory (if applicable for this reporting period)?

Good gender balance as I could see.

Annex 2 - Updated non-confidential Project information *(section 1.4)*

A Design Study is being undertaken aimed at completing all technical preparatory work necessary for the construction of the European Virtual Observatory (Euro-VO). Euro-VO is a specifically European implementation of the Virtual Observatory (VObs) concept, and will produce a world leading infrastructure providing a unified virtual data resource and the ability to perform complex data discovery and manipulation tasks across the whole range of astronomy. Access to data and tools will be equally good across Europe, regardless of location. This will require establishing an alliance of data centres, and a VObs facility centre in support of the community, but crucially requires the construction of an infrastructural glue of software components, in the context of rapidly evolving background developments in IT and the grid. The VOTECH project aims specifically at feasibility studies and design work aimed at integrating such new technologies into the Euro-VO. Key IT advances to build on are in intelligent resource discovery (ontology and the semantic web), data mining, and visualisation capabilities. These will be integrated via global astronomical interoperability standards coupled with the latest distributed grid computing services. Additionally this project covers design and preparatory work to ensure that data from the major European telescopes and facilities (as represented by the Opticon and RadioNet networks) is fully accessible through the Euro-VO.

1.4.2 Project website address : **http://www.eurovotech.org**

1.4.3 Project Achievements

Early in its third year, VOTECH delivered four of the six key technical reports needed to plan the development of the European Virtual Observatory concept. During the year the project also constructed prototype working software based on these technical studies, and worked with data centres across Europe to deploy the new software, as well as demonstrating new software capabilities to astronomers in several public meetings. Key agreements on technical standards were also reached with international partners. Finally the project continued to strengthen methods for partner co-operation, developing the idea of a bi-annual semi-open technical forum.

List of participants

Participant number (co-ordinator = N°1)	**Participant name** (Organisation, city, country)	**Short name**
1	University of Edinburgh, representing UK AstroGrid Consortium	UEDIN
2	European Southern Observatory, Garching bei München, Germany	ESO
3	University of Leicester, representing UK AstroGrid Consortium	LU
4	University of Cambridge, representing UK AstroGrid Consortium	UCAM
5	Centre National de la Recherche Scientifique, representing French VO	CNRS DR10
6	Istituto Nazionale di Astrofisica, Roma, Italy	INAF

Annex 3 - Deliverables during the reporting period *(section 2)*

The third year of the project was very significant, as four out of six of the key planned technical reports were delivered, along with software prototypes from all of DS3, D4, D5, and DS6, released via DS2.

Location of Deliverables. All the deliverables are available on line, linked through a single web page listing the deliverables and milestones :
http://wiki.eurovotech.org/twiki/bin/view/VOTech/ProjectContract

Deliverables which are documents are available at the link above, but are also appended to this report on a CDROM. Software deliverables are available at :
http://wiki.eurovotech.org/bin/view/VOTech/SoftwareDownload

Here, as in section 2, we tabulate those deliverables that were either due during this reporting period according to the revised Project Plan of December 2006, or were otherwise delivered in this reporting period. On the accompanying CDROM we provide a document that summarises the overall status of VOTECH deliverables and milestones to date.

Deliv. No.	Deliverable name	Lead	Target Date	Achieved
DS2-03	Science Framework Document	UCAM	2006 Jun	2007 Oct
DS2-04b	Baseline software release 2	LU	2007 Mar	2007 Mar
DS3-01	Infrastructure Study Report	LU	2006 Jun	2007 Jan
DS3-02	DS3 prototype releases to DS2	LU	2007 Mar	2007 Mar
DS4-01	Tools Study Report	ESO	2007 Jun	2007 Jun
DS4-02	DS4 prototype releases to DS2	ESO	2007 Sep	2007 Oct
DS5-01	Resource Discovery Study Report	CNRS	2007 Sep	----
DS5-02	DS5 prototype releases to DS2	CNRS	2007 Sep	2007 Oct
DS6-01	Data Exploration Study Report	EDIN	2006 Dec	2007 Feb
DS6-02	DS6 prototype releases to DS2	EDIN	2007 Mar	2007 Mar
Deliverables				

Note (1) : The Science Framework Document (SFD) was originally planned for much earlier in the project. However it was decided that it should be merged into the larger plan for overall science planning of Euro-VO through the new VO Science Advisory Committee (VOSAC). Once the VOSAC was fully underway, the SFD was completed.

Note (2) : The study reports on Infrastructure, on Tools, and on Data Exploration are key products of VOTECH. It was originally planned to issue them in a staged manner in order to spread the work of the project; however all the teams concerned felt a pressure to delay because significant new developments continued. We decided thefore to issue "preliminary reports" roughly on schedule, but also to plan later "final reports". In fact the "preliminary reports" are quite thorough, and fully constitute the formal deliverables.

Note (3). Semantics and Resource Discovery is a particularly fast moving field at the moment, and crucial meetings were due to take place shortly after this reporting period. We decided therefore to delay the Resource Discovery Study Report to take account of these developments.