JISC DEVELOPMENT PROGRAMMES

SAW-GEO: Project Plan

Project

Project Acronym	SAW-GEO	**Project ID**	???
Project Title	Development of **S**emantically-**A**ware **W**orkflow Engines for **Ge**ospatial Web Service **O**rchestration		
Start Date	01 October 2006	**End Date**	30 April 2008
Lead Institution	University of Newcastle upon Tyne		
Project Director	David Fairbairn		
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Partner Institutions	-		
Project Web URL	http://edina.ac.uk/projects/seesaw-geo		
Programme Name (and number)	GRID and OGC Collision		
Programme Manager	James Farnhill		

Document

Document Title	Project Plan		
Author(s) & project role	David Fairbairn (Project Director)		
Date	21 December 2006	**Filename**	
Access	■ Project and JISC internal		☐ General dissemination

Document History

Version	Date	Comments
V1.0	04 Sept 2006	Draft plan for kick-off meeting
V1.1	04 Dec 2006	Revised draft for JISC review
V2.0	21 Dec 2006	Incorporating JF comments

JISC

Overview of Project

1. Background

One of the most challenging aspects of web service orchestration is the matching of the ultimate product of the composite web service to the task the user needs the product for. Grid web services adopt a workflow-based model for matching web services to users' tasks. A workflow is a collation of business process logic and routing rules. The processes are invoked in a runtime execution module referred to as a workflow engine.

The ISO19119 standard relates to geographic data processing, data transmission, data handling, multi-system connectivity and digital information exchange over a service-oriented architecture (SOA) and it recognises three workflow-based approaches for orchestrating geographic web services:

i) a transparent model where the user manually manages the workflow,
ii) a translucent model where a workflow management system controls the flow and the user is aware of the individual web services and
iii) an opaque model where the user invokes the initial service request but is then unaware of the individual web services that take part in the task.

These are referred to as transparent, translucent and opaque chaining respectively. The Open Geospatial Consortium (OGC) recognises the potential for workflow engines in geospatial data processing, as evidenced by Phase 4 of the OGC Web Services (OWS-4) series which includes calls to address workflow service development and investigate the patterns for building general purpose geo-processing services.

This is therefore an area of significant interest in the further development of geographic web services: in the enhancement of data dissemination through the application of workflow engines, but also in the future work of OGC in addressing service-based processing of geographic information through a Web Processing Service (WPS). The SAW-GEO project has been developed and funded to address the potential of workflow engines in the orchestration of OGC services and to demonstrate the capability of such developed systems in real-world applications.

SAW-GEO builds upon the expertise available at Newcastle University in areas of geospatial data handling and grid services. The School of Civil Engineering and Geosciences includes a team of experienced and technically able researchers which works on projects related to archiving, querying, processing, disseminating and visualising spatial data of all types, using web-based techniques. In addition, middleware development and the investigation of user needs for specific applications are regular activities of this team. The North East Regional e-Science Centre (NEReSC), attached to the School of Computing Science at Newcastle, works alongside the UK Grid community in developing areas such as grid middleware, workflow implementation and grid-database integration for application areas in science and bioinformatics application areas.

2. Aims and Objectives

This research project aims to develop semantically-aware workflow engines for supporting the orchestration of geographic web services. By incorporating a semantic component into the web service infrastructure, it is envisaged that the conceptualisations of the different user groups served by JISC will be represented. The objectives which will help achieve this aim include:

- examining the range of available technologies in geographic and grid web services, with the intention of creating an effective architecture for geographic web services chaining;
- creating a working prototype of the workflow management system suggested and assessing its performance;
- in particular, the creation of a graphical tool for visually orchestrating geographic web services will be undertaken;
- rolling out the developed system with appropriate training and documentation for the user communities.

Included in the aim of the project is collaboration with the SEE-GEO research activity being undertaken at EDINA, University of Edinburgh. The evaluation of the web service orchestration approach developed will involve participation of web services being developed at Newcastle University and at EDINA. SAW-GEO will prepare scenario-testing which will involve consuming EDINA services and encountering the security issues addressed by SEE-GEO. Further collaboration in scenario testing with the MoSeS (Modelling and Simulation in e-Social Science) project run out of the National Centre for e-Social Science will be sought.

3. Overall Approach

The project **strategy** will be to address the work as a series of work packages, addressed in a progressive manner, with deliverables and targets at regular points through the life of the project. Primarily the responsibility of one qualified, full-time research assistant, the strategy will also involve significant technical direction and overall management from a team of experienced researchers.

The major **issues** to be addressed include:

- compatibility with and development of existing standards and approaches
- technical execution of the intended architecture
- understanding of user issues and possible applications areas
- appreciation of and liaison with parallel initiatives in similar projects

In scope: The scope of the work will be applications-oriented, with the objective of producing a working prototype system. This will involve considerable liaison with the SEE-GEO project examining areas of common interest and setting up testing regimes. Input and experiences from other projects and initiatives will be examined and incorporated where appropriate. These include the National Environmental e-Science (NEeS) GIS Grid working group, the OGC Technical Committee meetings and outputs, and other Newcastle projects involving geographical data handling using web and grid services.

Out of scope: We do not intend to develop our own workflow engine, OGC servers, or processing utilities (we are integrating existing Open Source utilities). We will

restrict our development work to a small number of OGC standards (i.e. WMS, WFS, WCS, WPS): we shall not address catalogue, sensor or location-based standards.

The **success** factors will primarily revolve around the deliverables which are reported for each work package. Critically, each deliverable is dependent on a preceding one.

4. Project Outputs

Tangible deliverables:

- a working system which is intended to give user assistance in creating, discovering, invoking workflows for the purpose of geospatial data processing
- user documentation informed by the testing of the system and its evaluation by a variety of user communities
- a training manual indicating how to orchestrate web services using the SAW-GEO workflow platform
- a software development report that includes the design, source code on CD-ROM, summary of implementation issues and the results from the evaluation phase
- web site populated with information and documentation to ensure effective dissemination of the working system and other results of the research project

5. Project Outcomes

The general project outcomes will include enhanced knowledge and experience in a number of areas, which will benefit the research team at Newcastle, and the research community throughout the UK (including the Grid community, JISC programmes addressing geospatial data handling, and academic and commercial organisations using OGC standards). With a mission to present contemporary research by 'trickling-down' to undergraduate modules, the Newcastle team will inform its teaching using the results of this research. The undergraduate academic community makes significant use of the EDINA services, which will be enhanced by example scenarios produced by Newcastle and tested using these EDINA services. The following areas will stimulate teaching and research communities:

- a wider understanding and mastery of developing OGC standards
- awareness and linkage with grid web services initiatives, including national projects directly supported by JISC and/or of significant benefit to the UK scientific community
- deeper understanding of user needs and experiences in web-based geospatial data handling
- experience in incorporating geographic ontologies into workflow engines
- defining a way forward for embracing generic web services standards, such as SOAP, and process execution languages, such as BPEL, within OGC development

6. Stakeholder Analysis

Stakeholder	Interest / stake	Importance
OGC	We will assist in the enhancement of semantic and grid capabilities, being addressed across OGC	High

	We will specifically engage with groups, such as the ad hoc OGC Grid GIS group, under the aegis of the Technical Committee of OGC.	
JISC user community	Notably, geospatial data users, including those consuming JISC-funded resources (e.g. EDINA Data Services)	Medium
Grid community (e.g. NIEeS Grid GIS working group)	1. Workflow issues will be addressed, an area of interest to many specialist Grid communities, and of increasing interest to those accessing processing capabilities (including geospatial processing) over the web 2. The convergence of web services being developed by OGC and mainstream grid services will improve functionality	Medium

Within our own institution there are individuals working on Grid issues and geospatial data handling issues who will be interested in our work. The keenest interest, however, will be felt in the wider community: we intend reporting to formal and informal OGC forums to draw from and inform the geospatial community; our user testing and evaluation will take in a number of user communities (including EDINA data users and the MoSeS community within NCeSS), and will inform them and the more general Grid community also.

7. Risk Analysis

Risk	Probability (1-5)	Severity (1-5)	Score (P x S)	Action to Prevent/Manage Risk
Staffing: loss of key project staff	2	4	8	Loss of key project staff would be difficult to mitigate in a relatively short project, but we do have significant depth of expertise and will be sharing knowledge throughout the project.
Organisational: Project timescale and/or deliverables are not met	3	2	6	Manageable work packages should mitigate against risk of creeping delays. Slippage is less likely with more numerous target dates for individual WPs.
Project specific: WP4 which involves user feedback may experience delay	3	4	12	1. Recruitment of user testers can start before the prototype system is ready. 2.. We have plans in place to ensure effective user testing by highlighting alternative user groups to test.
Project specific: Insufficient time to prepare full professional training materials (WP6)	3	3	9	We may be able to use the system documentation (regarded as an essential final deliverable to ensure sustainability) as a substitute. It is appreciated that this is not an ideal

				solution as system documentation is not prepared specifically for training purposes.
Project specific: Disagreement between SAW-GEO and SEE-GEO regarding the primary middleware	2	2	4	1. Agreement has been reached on grid web service containers (Globus Toolkit v.4) to be used. 2. SAW-GEO will be able to use any OGSA-DAI developments implemented by SEE-GEO within its proxy web service.
Project specific: Scaleability of SAW-GEO and implementation on large distributed systems	3	4	12	Mastery of technical issues related to software such as workflow engines and ontology language specifications is critical. Continuing education and liaison with the computing science community (through the North East Regional e-Science Centre) and data providers (through EDINA) is intended to ensure scaleability.
External suppliers	3	2	6	This is a minor element: We shall liaise with EDINA, collaborating on the design of the security project as proposed by them. However, security considerations are of lower importance to our project examining workflow management systems than to the EDINA project, and it may be that the standard WS-Security systems currently used by grid services (through the Globus toolkit) are sufficient.
Legal	1	4	4	The issues of IPR are addressed below in Section 10. No problems are anticipated as the project relies on open source software and tools.
Management	2	4	8	At both University and School level we are an experienced academic unit, forming a well-resourced in-house team, supported by university HR and research finance sections, and experienced in establishing strong links with partners. Effective project management is intended to mitigate these generic risks.

8. Standards

Name of standard or specification	Version	Notes
Open Geospatial Consortium: WFS v1.1, WMS v1.3, WCS v1.0, (CSW draft), (WPS draft)	As indicated	To match OGC requirements for SAW-GEO Integral to this proposal and the TOR of the call.
Grid services e.g. SOAP (v1.2), UDDI (v3.0), WSDL (v1.1)	As indicated	To ensure web compatibility W3C and OASIS standards
OWL	1.0	To assist in semantic modelling

		W3C standard
BPEL (alternative would be SCUFL, but this has limited support)	BPEL4WS1.1	To assist in web service orchestration New BPEL v2.0 will be an OASIS standard

The inclusion of support for SOAP and WSDL in OGC web services is still an active area of discussion within the OGC. Although at the OGC TC meeting held in Edinburgh (June 2006) the community acknowledged that it would be beneficial to include such support within OGC web services, the technical committee is still yet to decide on which versions of SOAP or WSDL to adopt. Consequently, the SAW-GEO project will base its choice of versions of these standards on the availability of support on the Globus Toolkit 4 and existing BPEL-based workflow engines.

9. Technical Development

It is felt that the detailed schedule of Work Packages will ensure appropriate and progressive technical development and resource usage throughout the project. Our general approach is to follow the Waterfall method of software development which takes a component-based approach to system implementation and testing. Subversion, a code repository providing versioning capability will be used to archive and distribute code within the research community. Other elements of the project, including reviews, usability testing, and documentation development, will also be subject to such software engineering practices. Although we will not formally abide by project management structures such as PRINCE2, we are aware of their implications and recommendations and intend to achieve the resource, skills, ideas and product outcomes which such structures can enable. This will be achieved through a small, focussed, goal-driven team.

10. Intellectual Property Rights

Newcastle University recognises the need to encourage and support the open exchange of research ideas and results and of educational material. However, the University will enforce its rights under the Copyright, Designs and Patents Act 1988 and, by exercising appropriate stewardship, it will meet its general obligation to secure the effective exploitation of innovations generated with the support of public funds. The University will abide by current practice agreed with Research Councils that the University has a 'licence to exploit' the results on behalf of the Councils.

If suitable for commercial exploitation, the outputs will be handled by the University's Technology Transfer Office (TTO) in the normal way, with no implications for the agreed budget. The actual means would depend on the nature of the outcomes. As a University with a research turnover in excess of £60M pa, the TTO is well equipped to exercise such commercial exploitation and is experienced at dealing with complex IP issues. The TTO would also be in a position to decide the most appropriate means for protecting the IP. Patenting is rarely the appropriate choice in these instances, but the University reserves its right to choose whatever protection method is appropriate to protect its IPR.

It may be that the website, resources and documentation will become available to users under a suitable Creative Commons licence, and again the TTO will be able to

advise on the nature of such licensing, the impact on commercial take-up and the extent of the 'user community'.

Most of the development work for SAW-GEO is undertaken using Open Source tools and resources. The research team is well-versed in consuming and contributing to such resources, and has an understanding of the nature of the IPR attached to them.

Project Resources

11. Project Partners

There are no formal project partners outside Newcastle University.

12. Project Management

The manager and directors of this project will meet regularly and take joint responsibility for reporting to JISC at intervals to be advised.
Quarterly meetings with EDINA will ensure liaison and some external input into SAW-GEO for management and technical purposes. Weekly information exchange with EDINA (e.g. by teleconferencing) will form a regular part of working practices also.

Members of the project team (Newcastle):

David Fairbairn	Project Manager
Phil James	Technical Co-director
Paul Watson	Technical Co-director
Gobe Hobona	Software Engineer

Administrative support through staff of the School of Civil Engineering and GeoSciences; research support through Newcastle University's Business Development Directorate (Research Services Support).

(EDINA liaison)

Chris Higgins	Technical Advisor

There is no requirement for the project participants to attend training events or consume training resources.

13. Programme Support

The JISC programme manager may be able to assist in the evaluation stage (WP4) by directing us to sample user communities with whom we can test the prototype system. Advice has been used in the completion of this project plan. In addition, the programme manager can keep the project informed about similar projects being sponsored by JISC, and others, with which beneficial collaboration or information exchange could be effected. Definitive advice on the implications of handling open source components will also be sought.

14. Budget

See Appendix A

Detailed Project Planning

15. Workpackages

See Appendix B

16. Evaluation Plan

The evaluation of the prototype workflow management system is an integral part of this project. By extension, the evaluation of the project relies to a considerable extent on the evaluation of the prototype system, which is its main deliverable. The performance of the system, along with its effectiveness within the user community, will be formally assessed as part of WPs 4 and 5. The development of the training and documentation associated with the system will be closely scrutinised in the light of experiences during the evaluation phase. It should be possible to derive and apply a series of metrics to make a detailed assessment of the working of the system and its use in practice. Such metrics (including response times and usability) will be used to assist in the overall evaluation of the quality and success of the project.

Timing	Factor to Evaluate	Questions to Address	Method(s)	Measure of Success
Nov 07	Response times of system	Is the time from initial query, through data calls, integration and processing acceptable? Are server-side operations effectively carried out?	Measures of timing of sample sessions, including Apache JMeter to simulate web-based systems and BPEL Simulator to validate the system	Specific targets (e.g. x seconds response time) will be proposed, considering variables such as workflow patterns and load on the server. Such testing will be based on experience from previous testing regimes.
Dec 07	User satisfaction	Does the system meet the needs of the user community? To what extent are users willing to handle data and implement processing tasks using the workflow engine developed?	User questionnaires and observation	Qualitative assessment of user responses to questions, observation of sample tests, and noting of online user experiences through sample application developed through EDINA services. Previous experiences in user testing will be used to manage this element of WP4. Success gauged by percentage of respondents satisfied with the system (e.g. >75%), and able to use it without problem (e.g. >75%), along with the number of users of the sample

				online application (e.g. >100 unique sign-ons).
Jan 08	Enhancements of the system	What is the effect of improvements resulting from previous testing?	Internal assessment of improved access times and number of users.	Any decrease in average access time and increase in user numbers would be acceptable for WP5.
Mar 08	Quality of software	Does the software meet appropriate standards?	Use standard ISO metrics to assess functionality, reliability, usability, efficiency, maintainability and portability.	Specific measures associated with ISO/IEC 9126. Further feedback from the user community.

The final intention is to produce good quality software which has been appropriately evaluated. User testing, performance metrics, observations of users, and exposure to working test-bed through EDINA will all yield external evaluation of the prototype system.

17. Quality Plan

Output	**Report summarising available technologies (output from WP1)**				
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools (if applicable)**
31/12/06	Accuracy and relevance of report	Report written by Newcastle team and also disseminated for comments to associated colleagues within NEReSC.	Acceptability by those consulted and effectiveness to inform WP2. Advice from user forums (e.g. for BPEL, Taverna). Developers' response through such forums.	Entire team	User forums

Output	**Design of a possible architecture (deliverable from WP2)**				
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools (if applicable)**
31/03/07	Elegance and fitness for purpose of the proposed system	Error checking; reference to similar platforms in other applications (e.g. certain NEReSC projects); assessment of match to existing and developing specifications.	Error-free operation; matching web and OGC published specifications	Software Engineer	Workflow simulators/ validators (e.g. for ActiveBPEL)

Output	**A working prototype of the workflow management system and its workflow engine (output from WP3)**

Timing	Quality criteria	QA method(s)	Evidence of compliance	Quality responsibilities	Quality tools (if applicable)
31/10/07	Effectiveness of the proposed user interface; working of the prototype system	User and developer testing to ensure compliance with standards alongside good working practice	Matching standards for visual display (e.g. ISO 9241) Matching advice from the Workflow Management Coalition (WfMC) for interface design	Entire team	ISO 9241

Output	A quantitative assessment of system performance (output from WP4)				
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools (if applicable)**
31/12/07	Effectiveness of the system performance	Development and application of metrics for assessing usability, speed, deployment, scalability	Matching standards for assessment of usability tests (e.g. ISO/IEC 25062:2006).	Software Engineer, Project Manager	ISO/IEC 25062:2006

Output	A revised implementation of the workflow management system for web service orchestration (output from WP5)				
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools (if applicable)**
29/02/08	Improvement to system as a result of user testing; meeting need to create a platform for web service orchestration; correction of bugs in initial implementation	Obtaining approval from user community; checking bug list	Exclusively using a number of emerging specific web services standards (e.g. BPEL) based on more generic standards (e.g. XML, WSDL and other WS standards), web service description and communication will adopt OGC schemas for WFS, WMS and WCS. Measured improvements in response times.	Software Engineer, Project Manager	

Output	User training and documentation (output from WP6) A software development report that includes the design, source code on CD-ROM, summary of implementation issues and the results from the evaluation phase plus an exit strategy for future maintenance and sustainability (output from WP7)				
Timing	**Quality criteria**	**QA method(s)**	**Evidence of compliance**	**Quality responsibilities**	**Quality tools**

					(if applicable)
31/03/08	Usable documentation to inform and educate individual users, the user community, stakeholders and possible future developers	Apply existing templates which have been developed for successful and long-running user training (in commercial GIS software use). The system deliverable is primarily middleware so documentation for the expected users need not be overly detailed, but does need to be precise and logical.	Matching documentation to accepted norms (including those specified by the British Computer Society (BCS))	Entire team	BCS norms

18. Dissemination Plan

Timing	Dissemination Activity	Audience	Purpose	Key Message
Oct 06	Liaison with OMII	OMII National Grid Services group	To examine user requirements of Grid community and possible technologies to meet these; to overview a range of current projects	Active BPEL is an effective workflow engine for use in the Grid community
Jan 07	Conference paper submissions	European GIS research community	Show results of WP1	Role of workflow engines in spatial data processing using geographic web services
May 07	Participation in Open Grid Forum meeting	International Grid community	Show potential of geo-data and geo-data handling	Use of open standards to effect convergence of grid and geographic web services is possible
Sep 07	All hands meeting	UK Grid community	Showcase progress in SAW-GEO prototype development	Inform Grid community further about geographic web services
Throughout project	Liaison with OGC	OGC Technical Committee members	Inform and react to the OGC TC	Convergence of grid and geographic web services can be effected through the specification

				of support for SOAP, WSDL and BPEL. Hence formal guidance on support for these standards within OGC web service specifications is necessary.
Mar 08	Demonstrator	User community	Demonstrate potential of system	Awareness raising

19. Exit and Sustainability Plans

Project Outputs	Action for Take-up & Embedding	Action for Exit
Example workflow engine system to assist in meeting OWS-4 standards	Embedding by practical service providers (notably EDINA) Effective documentation	Ensure adherence to current standards
User guidance	Preparation of effective tutorial material	Disseminate tutorial material widely

We believe that the deliverables from this project will be capable of further development. Issues of improvement in workflow integration, adherence to OGC standards, widening participation in geospatial data handling, and increasing relevance of geoprocessing in grid services all mean that there is a wide range of stakeholders who would be interested in continuation of this project. The major potential sources of additional funding will include EU FP7 initiatives dealing with interoperability, digital heritage, and ICT activities. The influence of the internationally successful OGC will also encourage the development and expansion of this project.

The ongoing commitment of the Newcastle team to Grid GIS development (School of CEG) and to e-Science (NEReSC) should ensure that knowledge gained from this project is not dissipated. This is important to ensure that the user community has some response to bug reports, feedback, any patches and further enhancements which may be communicated back.

Continuation is thus regarded as a serious possibility and approaches to range of sponsors, particularly those who are dealing in practical terms with geographic data handling with the Grid, will be actively made. To an extent the development of a self-sustaining community of users is an aim, but it is important to consider the probability of further technological and institutional impacts on the deliverables.

Project Outputs	Why Sustainable	Scenarios for Taking Forward	Issues to Address
Viable workflow management system to allow for visual orchestration of geographic web services	Based on proven and state-of-the-art research Addressing real needs of a range of users	Incorporation into established EDINA services Further development by Newcastle and/or other OGC partners	Continued support and adherence to developing standards

	Incorporating generic and open source tools which can be easily applied to different problems.	Inform wider grid GIS community	

Appendixes

Appendix A. Project Budget

	JISC Contribution Requested			Institution Contribution			Total
	YR1	**YR2**	**YR3**	**YR1**	**YR2**	**YR3**	
Staff *(list all staff with FTEs and salary scale range):* ***includes overhead***	£57,203	£51,483		(£12,641)	(£10,896)		£85,149
Project director / manager [redacted]							
Technical co-director 1 [redacted]							
Technical co-director 2 [redacted]							
Software engineer PDRA [redacted]							
Travel & Subsistence *(include attendance at relevant programme meetings)*	£500	£500					£1000
Equipment *(specify individual items over £10k)*	£4500						£4500
Dissemination activities							
Evaluation activities		£500					£500
Other *(please specify)*							
Liaison with EDINA	£1000	£2000					£3000
Total	£63,203	£54,483		(£12,641)	(£10,986)		**£94,149**

Appendix B. Workpackages

WORKPACKAGES	Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1: Examining existing technologies	Oct06-Dec06																			
2: Architecture design	Jan07-Mar07																			
3: Implementation (inc. initial testing)	Apr07-Oct07																			
4: Evaluation (inc. user testing)	Nov07-Dec07																			
5: Revised implementation	Jan08-Feb08																			
6: User training and dissemination	Mar08																			
7: Reporting	Apr08																			

Project start date: *01-10-2006*

Project completion date: *30-04-2008*

Duration: 19 months

Workpackage and activity	Earliest start date	Latest completion date	**Outputs (clearly indicate deliverables & reports in bold)**	**Milestone**	**Responsibility**
YEAR 1					
WORKPACKAGE 1: EXAMINING EXISTING TECHNOLOGIES **Objective:** Prepare a thorough review of available technologies	01 Oct 06	31 Dec 06	**Report summarising available technologies**		**Newcastle University (GEH)**
1. examine workflow engines					
2. determine how workflow engines have been applied to grid web services					
3. implement geographic data dissemination and processing in Apache Axis and Globus Toolkit web services					
WORKPACKAGE 2: ARCHITECTURE DESIGN **Objective**: Consider a system to assist the user in chaining multiple web services together	01 Jan 07	31 Mar 07	**Design of a possible architecture**		**Newcastle University (GEH, PMJ, PW)**
4. include a semantically-aware aggregate service (cascading service) that probabilistically resolves the process routes to be followed to achieve a given task					
5. ensure that the meanings of operations will be					

obtained from the getCapabilities and WSDL descriptions of geographic and grid web services respectively					
6. incorporate the requirement for the WPS to carry out server-side spatial operations on a PostGIS/PostgreSQL database					
WORKPACKAGE 3: IMPLEMENTATION (INCLUDING INITIAL TESTING) **Objective:** Practical implementation of the architecture	1 Apr 07	31 Oct 07 (into Year 2)	**A working prototype of the workflow management system and its workflow engine**		**Newcastle University (GEH)**
7. creation of a graphical tool for visually orchestrating geographic web services					
8. testing of the initial system					
9. addressing issues of sustainability					
YEAR 2					
WORKPACKAGE 4: EVALUATION (INCLUDING USER TESTING) **Objective:** To undertake an evaluation of the web service orchestration system	1 Nov 07	31 Dec 07	**A quantitative assessment of system performance**		**Newcastle University (GEH, DJF)**
10. Test response times of the system					
11. Undertake usability testing involving users of other JISC services through EDINA					

WORKPACKAGE 5: REVISED IMPLEMENTATION **Objective:** To address issues discovered during the evaluation phase	01 Jan 08	29 Feb 08	**A revised implementation of the workflow management system for web service orchestration**		**Newcastle University (GEH, PMJ, PW)**
12. Re-visit the initial development phase and make necessary enhancements					
WORKPACKAGE 6: USER TRAINING AND DISSEMINATION **Objective:** To effectively ensure that users have knowledge of the service to allow for efficient operation	01 Mar 08	31 Mar 08	**User training and documentation**		**Newcastle University (GEH, DJF, PMJ)**
13. Produce a training manual for users					
14. Create a demonstrator on a geo-portal					
WORKPACKAGE 7: REPORTING **Objective:** To report on the project to stakeholders	01 Apr 08	30 Apr 08	**A software development report that includes the design, source code on CD-ROM, summary of implementation issues and the results from the evaluation phase plus an exit strategy for future maintenance and sustainability**		**Newcastle University (DJF)**
15. Supply a CD-Rom with all source code					
16. Produce a report dealing with implementation, evaluation and exit strategy					

Members of Project Team (prime responsibilities indicated above, but all members will contribute to each WP):
GEH (Gobe Hobona); DJF (Dave Fairbairn); PMJ (Phil James); PW (Paul Watson)