Design Study

EGI_DS

EGI FUNCTIONS : FIRST DEFINITION

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1. INTRODUCTION

1.1. Purpose

A general pan European e-infrastructure is required to support the research projects in many disciplines enabling them to easily share all sort of national resources: compute, storage, data, instruments, and easing their effort to reach a global dimension

The EGI Design Study (EGI_DS) was partially funded by the EC as a project over 27 months from September 2007 with the aim of bringing about the creation of new European Organizational model, which will be capable of fulfilling this vision of a sustainable European grid infrastructure for research. The foundation for e-Infrastructure sustainability has been identified since the beginning in establishing National Grid Initiatives (NGI), as legal organizations, in general supported by governments, providing a unique representation at European and international level of all the national communities related to a national grid infrastructures: from resources providers to scientific users. Over the last nine months the study has collected and consolidated the requirements of a wide range of research disciplines within a large number of NGIs, and designed the required functionality & modelled the organization that could consolidate, operate, manage and continue to develop a sustainable European e-Infrastructure. The functions that are needed in EGI are at the core of this study and we have worked at them from the beginning. Now EGI_DS has developed the draft EGI Blueprint (deliverable D4.4), which has been released a few days before the present document, as a description of what the sustainable infrastructure would look like.

The purpose of the Blueprint is for NGI and other stakeholders to assess whether it meets their requirements, and if not to inform the design project of changes they would like. We, as EGI_DS preparation team have decided that the Blueprint needed to be a rather lightweight document for easier readability and better evidence of the relevant issues, and the presentation of the EGI functions in the Blueprint has been much condensed. The present document includes the more detailed technical descriptions, the implementations scenarios and other background material that together with the chapter "Functions of the EGI" of the Blueprint give the complete overview of the studies EGI_DS has performed till now for assessing the EGI functions.

The specific purpose of this document is thus to complement the Blueprint overview of the EGI functions for the people interested in understanding them in more technical detail. This document and the Blueprint have been developed together in EGI_DS and describe the same proposal for the sustainable European grid infrastructure of the near future.

The EGI function descriptions in this document are still preliminary and the feedback from the NGI's and from the different actors presently involved in the grid projects, including the users and the VOs is welcome and will be actively searched for. The feedback will be incorporated in a further deliverable "Final EGI Function definition" which will be released in a few months.

1.2. Editorial Responsibilities

Section	Main Providers of material	Responsible editor(s)	Work Package
1		L.Perini	WP3
2		L.Perini	WP3
3	D.Cresti, S.Fantinel, , project coordinators of reported projects	A.Caltroni	WP3
4	J.Kmunicek, F. Karayannis	J.Kmunicek	WP3

5		M.Mazzucato, T.Ferrari	WP3
6		T.Ferrari	WP3
7	M.Mazzucato	L.Perini	WP3
8	D.Cresti	D.Cresti, L.Perini	WP3
9	P.Öster, F. Karayannis	L.Perini	WP3
10	K.Ullmann, L.Matyska	L.Perini	WP3

1.3. Document organisation

Following this introduction and the executive summary in chapter 2, chapter 3 presents on overview of European grid projects, intended to assess the functions they fulfill and to provide some estimation of the effort they deploy.

Chapter 4 contains the handover for the Work Package 2 of EGI_DS that has performed the preliminary work on which the EGI function definition is based: essentially the collection of the use cases (already documented in deliverable D2.1 [11]) their mapping on the function and the results of the poll between NGI's on the relevance of the functions proposed for EGI.

Chapter 5 includes the EGI Business Model, specifying the EGI scope and purposes, the actors considered and the advantages EGI brings to them.

From Chapter 6 on, the main EGI functions are described, and outlines are provided for their time evolution and for the effort they are expected to require:

- Chapter 6 deals with Operations and Security,
- Chapter 7 deals with the Middleware Maintenance Support and Development, which is included here because it is a critical part of the functions needed by EGI, though not included in the EGI funding.
- Chapter 8 deals with the support EGI will provide for the Research Team to run the Application of interest for them on the grid, after becoming grid enabled Virtual Organizations (VO); the shorthand for this activity is Application Support, used everywhere in this document and in the Blueprint
- Chapter 9 deals briefly with the External Liaison Functions, including Dissemination, Industry Take-up, and other issues like the relations with extra-European grids etc.
- Chapter 10 outlines the management function of EGI

The funding and related issues are in general not specifically addressed in this document; the Blueprint deals with these matters, and its full content is assumed valid here.

1.4. Document amendment procedure

Amendments, comments and suggestions should be sent to the authors

1.5. Terminology

This subsection provides the definitions of terms, acronyms, and abbreviations required to properly interpret this document.

Glossary

AAA	Authorisation, Authentication, Accounting
API	Application Programming Interface
ARC	Advanced Resource Connector
CA	Certification Authority
CAO	Chief Administrative Officer
CERN	European Organization for Nuclear Research
COO	Chief Operational Officer
CPU	Central Processing Unit
CSIRT	Computer Security Incident Response Team
CTO	Chief Technical Officer
DANTE	Delivery of Advanced Network Technology to Europe
DEISA	Distributed European Infrastructure for Supercomputing Applications
DESY	Deutsches Elektronen-Synchrotron
EC	European Commission
EDG	European Data Grid
EGEE	Enabling Grids for E-sciencE
EGI	European Grid Initiative
EGI_DS	European Grid Initiative Design Study
eIRG	e-Infrastructure Reflection Group
ENOC	EGEE Network Operation Centre
ERA	European Research Area
ERI	European Research Infrastructure
EU	European Union
EUGridPMA	European Policy Management Authority for Grid Authentication
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GGUS	Global Grid User Support
GNI	Gross National Income
gNOC	National Grid Operating Centre
GNP	Gross National Product

IGTF	International Grid Trust Federation
JRU	Joint Research Unit
JSPG	Joint Security Policy Group
LHC	Large Hadron Collider
M	Million
MoU	Memorandum of Understanding
NGI	National Grid Initiative
NREN	National Research and Education Network
OCC	Operation Coordination Centre
OGF	Open Grid Forum
OMII	Open Middleware Infrastructure Institute for Europe
PB	Policy Board
QA	Quality Assurance
ROC	Regional Operating Centre
SDC	Strategic Discipline Cluster
SLA	Service Level Agreement
UMD	Universal Middleware Distribution
UNICORE	Uniform Interface to Computing Resources
US	United States of America
VDT	Virtual Data Toolkit
VO	Virtual Organisation
W3C	The World Wide Web Consortium
WLCG	Worldwide LHC computing Grid Project
WP	Work package
WS	Workshop

2. EXECUTIVE SUMMARY

In the European Grid Initiative (EGI) Blueprint (D4.4) we have described the proposal developed by the EGI Design Study (EGI_DS) to establish a sustainable grid infrastructure in Europe in place by the end of EGEE-III in spring 2010.

This document includes the more detailed technical descriptions, the implementations scenarios and other background material that together with the chapter "Functions of the EGI" of the Blueprint give the complete overview of the studies EGI_DS has performed till now for assessing the EGI functions. Thus this executive summary is actually very similar to the one included in the Blueprint.

This document and the Blueprint have been developed together in EGI_DS and describe the same proposal for the sustainable European grid infrastructure of the near future.

The EGI function descriptions in this document are still preliminary and the feedback from the NGI's and from the different actors presently involved in the grid projects, including the users and the VOs is being seeked. The feedback will be incorporated in a further deliverable "Final EGI Function definition" which will be released in the following reporting period.

This document, like the Blueprint, is based on the vision of a large pan-European distributed computing and data grid infrastructure providing such services aligned with the EGI Vision Document (available at http://www.eu-egi.eu/vision.pdf) [1].

The EGI functions described here are the ones needed to realise such a vision, with the necessary implications for the implementation, operation, user interaction and management of the corresponding infrastructure.

The main foundations of the EGI are the National Grid Initiatives (NGIs), which operate the grid infrastructures in each country. The EGI will be composed of the NGIs and a central (mostly coordinating) part, called EGI-Organisation (EGI.org).

EGI.org will not directly own any grid infrastructure**.**

Although every effort should be made to ensure continuity for the current users of European infrastructure projects, especially but not limiting to EGEE, the EGI is not a simple continuation of EGEE. It is important to note that EGI is composed of NGIs and EGI.org and the relation between EGI.org and the NGIs is not a hierarchical one. EGI.org is rather seen as the "glue" enabling coherence between the NGIs for the benefit of the users.

EGI.org will link existing NGIs and will actively support the setup and initiation of new NGIs. The relation between EGI.org and the NGIs is governed by the "subsidiarity principle" meaning that tasks that are more effectively performed at the national or regional level should be left there. The EGI.org will ensure pan-European Grid coordination - aiming at standardization wherever reasonable.

EGI.org will provide central functions to address the operation of the infrastructure, user support and application development, middleware interfaces and final certification, and management. Table 1 summarizes the number of FTEs required for each of these functions.

Costs for	EGI.org Costs (in FTE/a)
Operations	17
Middleware interfaces and final certification	8
Application Support and training	12
External functions	4
EGI.org Management and Administration	10
Total	**51**

Table 1: Resources for EGI.org

To run an NGI within the EGI, between 5 and 30 FTEs are necessary to cover the basic tasks as described in blueprint Chapter 4 – the precise requirement depends on the size of the NGI and on the demands of the local user community, as these tasks serve primary the national communities. In countries with an operating grid infrastructure these resources are already existing.

It is necessary that the underlying middleware for the European grid be further developed. This development will continue to take place in the "middleware consortia" and is not part of the EGI funding model. EGI will foster middleware commonality and interoperability wherever possible. A common European middleware distribution (UMD) is strongly supported.

For the successful launch of EGI initial co-funding by the European Commission will be necessary. The major purpose of this co-funding is to bring all the players—NGIs—together, not to substitute for national funding, that is the base of EGI financial stability and sustainability. After the initial period, the EC co-funding role as a glue for operations will decrease. In the highly dynamic environment of distributed computing for science, funding for innovation (including the EC support) has to continue – most logically on a project basis.

3. OVERVIEW OF EUROPEAN PROJECTS

This section provides an overview of current or recently-terminated European Grid projects, projects in the international e-Infrastructure in which European countries are involved, projects aiming at extending the usage of the European Infrastructure to new research communities (e.g. EUMEDGRID, EUChinaGrid, EUIndiaGrid, EELA) and a sample of the ones dealing with middleware, with data, etc.

The objective is to illustrate that many projects implement similar functions that can be identified with the ones described in the following of this document; an EGI infrastructure offering this functions would be useful to all the projects of this kind and could allow synergies that may help in incrementing the efficiency and lowering the costs.

We decided to include a wide number of projects to have a comprehensive overview of the European effort even though for some of them we were not able to collect detailed information. All projects do include at least an estimate of the yearly manpower or annual budget.

The majority of the projects (including the major ones) are presented with complete and comparable information which allows us to provide sound estimates for the future.

For each project we include a description of the project with the results achieved and future plans, a table showing the effort dedicated for the three clusters of functions (excluding management tasks), expressed in FTEs (the latter is calculated by dividing number of person-months by the duration in months of the project) and the project's duration with the annual budget or PMs.

3.1. INFRASTRUCTURE PROJECTS

3.1.1. EGEE

As results of investments from member states into national resources as well as by the European Commission with project such as EGEE (Enabling Grids for E-sciencE), Europe has developed a scientific grid infrastructure in and across many member states, which is being used by many research communities.

More then 250 sites in 48 countries contribute to the EGEE infrastructure which can at the present deliver, 24 hours-a-day, seven days per week, more then 45000 CPU's to communities like Archeology, Astronomy, Astrophysics, Civil Protection, Computational Chemistry, Earth Sciences, Finance, Fusion, Geophysics, High Energy Physics, Life Sciences, Multimedia, Material Sciences, across all Europe; the infrastructure is serving more then 8000 registered users spread across about 90 Virtual Organizations. In the year 2007 was stored about 25PB of data in disk and tape/MSS storage,

Peaks of 3.5 Mjob per month have recently been observed on the EGEE infrastructure, which corresponds to 115 kjobs per day. During last year, 20578 kSI2kyears of CPU's have been used. One third of such computing resources is today used by the "other research" communities, the rest by the high energy physics community. In the near future, it is expected that the HEP community alone will contribute to a factor of 5 increase in the computing resources usage during the next year. Massive data transfers rates up to 1.5 GB/s have been reached.

EGEE III Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA1: Middleware Engineering	Total	52.8

	SA3: Integration, Testing and Certification TNA5.3: Monitor EGEE contributions to standardisation activities	Funded	26.4
Operations	SA1: Grid operations SA2: Networking Support	Total	189.9
		Funded	94.9
User oriented activities	NA3: User Training and Induction NA4: User community support and expansion NA2: Dissemination, Communication and Outreach	Total	121.7
		Funded	60.9
Global Effort		**Total**	**364.4**
		Funded	**182.2**

Project duration: 24 months
Project's home page: http://www.eu-egee.org/

3.1.2. BalticGrid-II

The BalticGrid Second Phase (BalticGrid-II) project is designed to increase the impact, adoption and reach, and to further improve the support of services and users of the recently created e-Infrastructure in the Baltic States.

This will be achieved by an extension of the BalticGrid infrastructure to Belarus; interoperation of the gLite-based infrastructure with UNICORE and ARC based Grid resources in the region; identifying and addressing the specific needs of new scientific communities such as nano-science and engineering sciences; and by establishing new Grid services for linguistic research, Baltic Sea environmental research, data mining tools for communication modelling and bioinformatics.

The e-Infrastructure, based on the successful BalticGrid project, will be fully interoperable with the pan-European e-Infrastructures established by EGEE, EGEE associated projects, and the planned EGI, with the goal of a sustained e-Infrastructure in the Baltic Region.

The e-Infrastructure of 26 clusters built in five countries during the first phase of the BalticGrid is envisaged to grow, both in capacity and capability of its computing resources.

The BG-II consortium is composed of 13 leading institutions in seven countries, with 7 institutions in Estonia, Latvia and Lithuania, 2 in Belarus, 2 in Poland, and one each in Sweden and Switzerland.

The overall vision is to support and stimulate scientists and services used in the Baltic region to conveniently access critical networked resources both within Europe and beyond, and thereby enable the formation of effective research collaborations.

BalticGrid-II Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA1: Enhanced Application Services on Sustainable e-Infrastructure NA4: Policy and Standards Development	Total	4.25
		Funded	4.25

Operations	SA1: Grid Operation SA2: Network Resource Provisioning	Total	16.25
		Funded	16.25
User oriented activities	NA2: Education, Training, Dissemination and Outreach NA3: Application Identification and Collaboration SA3: Application Integration and Support	Total	16.87
		Funded	16.87

Project duration: 24 months
Yearly effort: PM 448; Annual budget: €1,499,000
Project's home page: http://www.balticgrid.org/

3.1.3. SEE-GRID-SCI

The South-East European e-Infrastructure initiatives are committed to ensuring equal participation of the less-resourced countries of the region in European trends. SEEREN initiative has established a regional network and its GÉANT connection and the SEE-GRID initiative the regional Grid.

SEE-GRID-SCI leverages the SEE e-Infrastructure to enable new scientific collaborations among user communities.

SEE-GRID-SCI stimulates widespread e-Infrastructure uptake by new user groups extending over the region, fostering collaboration and providing advanced capabilities to more researchers, with an emphasis on strategic groups in seismology, meteorology and environmental protection. The initiative thus aims to have a catalytic and structuring effect on target user communities that currently do not directly benefit from the available infrastructures.

In parallel, it aims to enlarge the regional e-Infrastructure to cater for demands of the communities by increasing the computing and storage resources and involving new partner countries in the region.

Finally, SEE-GRID-SCI targets to help mature and stabilise the National Grid Initiatives in the region, allowing them to join the new era of longer-term sustainable Grid infrastructure in Europe.

SEE-GRID-SCI Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA1 Development of application-level services	Total	3.6
		Funded	2.7
Operations	SA1 Infrastructure Operations	Total	9.6
		Funded	9.6
User oriented activities	NA4: User communities support NA3: Dissemination and Training	Total	12
		Funded	12

Project duration: 24 months
Yearly effort: PM 302; Annual budget: €1,014,443
Project's home page: http://www.see-grid.eu/

The following table summarizes the effort for the infrastructure projects (EGEE-III, BalticGrid, SEE-GRID-SCI).

All Infrastructure Projects	**Effort in FTEs**	
Middleware	Total	60.65
	Funded	33.35
Operations	Total	215.75
	Funded	120.75
User oriented activities (includes Application support, Training, and Dissemination)	Total	150.57
	Funded	89.77
Global Effort	**Total**	**426.97**
	Funded	**243.87**

3.2. DEVELOPMENT PROJECTS

3.2.1. OMII-Europe

OMII-Europe is an EU-funded project which has been established to source key software components from major Grid middleware platforms and re-engineer them to be interoperable.

Components are selected for their potential in the field of interoperability: similar functionalities, availability and maturity of standards, open nature of the standard, etc.

The focus is on individual components and not on full middleware distributions in the spirit of a service-oriented approach and to prove that interoperability can be achieved even among completely different Grid middleware architectures.

The final objective is to make available the quality-assured re-engineered components in a common repository with the expectation of their re-introduction in their original middleware releases.

The work involves a set of 16 established partners from Europe, the USA and China.

The selected middleware platforms for the initial work are gLite, UNICORE and Globus and the protocols or services to implement include job execution (BES/JSDL), data integration (OGSA-DAI), VO management (VOMS), accounting (RUS) and portal capability (GridSphere).

The first year was dedicated to building the connections among all internal and external partners, organize participation in OGF and other working groups, design and prototyping of the components with the aim of delivering alpha versions by the end of the project year.

The second year saw the beginning of QA tests, ramp-up of training events, continued cooperation with partner projects and participation in standardization events and the bulk of development leading to the delivery of final versions of all components at the end of the project.

OMII-Europe's work is intended to be the beginning of an effort to spread the definition and the implementation of open standards in all fields of Grid computing. The project established the concept that standards are fundamental for the future of Grid middlewares and proved that interoperability can be achieved even between very different architectures.

OMII-Europe Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA1: Re-engineering of services JRA2: Identification of new services JRA3: Infrastructure integration JRA4: Benchmarking	Total	38.2
		Funded	17.3
Operations	SA1: Repository SA2: Quality Assurance SA3: Support	Total	14.9
		Funded	6.2
User oriented activities	NA2: Outreach and inreach NA3: Training	Total	3.4
		Funded	2.2

Project duration: 24 months
Yearly effort: PM 678; Annual budget: €3,174,191
Project's home page: http://www.omii-europe.org

3.2.2. GridCC / DORII

While remote control and data collection was part of the initial Grid concept, most recent Grid developments have been concentrated on the sharing of distributed computational and storage resources. In this scenario applications that need computational power only have to use these Grid elements in order to access an unlimited amount of computational power and disk storage. However scientific and technical facilities both provide concrete use cases where a strong interaction between the instrumentation and the computational Grid is required.

The GRIDCC project, launched in September 2004 by the European Union, provides a well proven technology that can be deployed on top of existing grid middleware, extending the grid e-infrastructure to the control and monitoring of remote instrumentation. EGEE gLite is the natural reference grid middleware for GRIDCC and the EGEE e-infrastructure is the natural framework where to deploy and integrate the instrument grid technology.

The goal of GRIDCC was to build a geographically distributed system that is able to remotely control and monitor complex instrumentation, ranging over a large number of diverse environments, from a set of sensors used by geophysical stations monitoring the state of the earth to a network of small power generators supplying the European power grid. These applications need real-time and highly interactive operation of GRID computing resources. To achieve this goal the project has pursued three main objectives:

- To develop generic Grid middleware, based on existing building blocks (Grid Services), which will enable the remote control and monitoring of distributed instrumentation.

- To incorporate this new middleware into a few significant applications to validate the software both in terms of functionality and quality of service aspects. These applications include, among others, European Power Grid, Meteorology, Remote Operation of an Accelerator Facility, High Energy Physics Experiment.
- To widely disseminate the new software technology and the results of the application evaluations on the test beds, and to encourage a wide range of stakeholders to evaluate and adopt our Grid-oriented approach to real-time control and monitoring of remote instrumentation.

GridCC Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	WP1: System Architecture WP2: Real-time and Interactive web services WP3: Grid-Enabled Instrumentation WP4: Brokering access to existing Grid resources WP5: Cooperative Environment (user-oriented?)	Total	21.7
		Funded	10.8
Operations	N / A	Total	0
		Funded	0
User oriented activities	WP6: Integration and Pilot Applications WP7: Information dissemination and exploitation	Total	15.7
		Funded	7.8

Project duration: 36 months
Yearly effort: PM 449; Annual budget: €1,763,000
Project's home page: http://www.gridcc.org/cms/

3.2.3. Interactive European Grid

The objective of the Interactive European Grid project is the deployment of an advanced Grid empowered infrastructure in the European Research Area specifically oriented to support the execution of interactive demanding applications. The Interactive European Grid, whilst interoperable with EGEE, will focus on interactive use for medicine, environment, physics and other research areas (from robotics to archaeology) that have demanding interactive applications that can benefit from being Grid-enhanced. The initiative exploits the expertise generated by the EU CrossGrid project to provide researchers with an interactive and simultaneous access to large distributed facilities through a friendly interface with powerful visualization.

Project duration: 24 months
Annual budget: €1,318,500
Project's home page: http://www.interactive-grid.eu/

3.3. FIELD-SPECIFIC PROJECTS

3.3.1. BIOINFOGRID

Since the completion of the Genome Project, due to the vast number of sequences available for consultation, the problems associated with the calculation resources needed to process biological data have increased dramatically. Moreover, the amount of data continues to increase at a high speed because new technology of high throughput expression analysis gives to researches a continuous flow of information to be appropriately elaborated and interpreted. In the meantime the study of comparative genomics and genetic variation using modern analysis methods, to identify in details the different set of genes involved in diseases, amplify the computational load problem.

The major result of the BioinfoGRID project is the demonstration that Grid computing can be a reliable solution to face with the appropriate tools the most recent computational problems in Bioinformatics. More specifically the BioinfoGRID project has evaluated applications in the fields of Genomics, Proteomics, Transcriptomics and Molecular Dynamics, showing that a reduction in the time required to reach the final result can be obtained by distributing the calculation on thousands of computers using the Grid infrastructure network created by the EGEE Project (6th Framework Program). By exploiting these resources, challenges that were not possible in a recent past, can now be deployed walking through the sequencing of the Human Genome and working with new perspectives at the study of complex multigenic diseases analysing in parallel thousands of molecular components.

However, the BioinfoGRID project has also shown that the situation is far from being ideal, for example for what concerns the friendliness, completeness, robustness and adherence to standards of the existing tools for the biological data access and management as well for the grid jobs submission, monitoring and bookkeeping. On the other end the BioinfoGRID project has also pointed out that a continue dissemination activity is necessary in order to bring the Grid vision to pervade campuses, departments and laboratories and set up the basis for the sharing of information and of a collaborative work.

BIOINFOGRID Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	N / A	Total	0
		Funded	0
User oriented activities	WP1: Genomics applications in GRID WP2: Proteomics Applications in GRID WP3: Transcriptomics Applications in GRID WP4: Database and Functional Genomics Applications WP5: Molecular Dynamics Applications WP6: Coordination of technical aspects and relation with Grid infrastructure Projects, user training, application support and resources integration WP7: Dissemination and Outreach	Total	12.2
		Funded	9.3

Project duration: 24 months
Yearly effort: PM 146; Annual budget: €527,104
Project's home page: http://www.bioinfogrid.eu/

3.3.2. CYCLOPS

CYCLOPS brings together two important Communities: GMES (Global Monitoring for Environment and Security) and GRID, focusing on the operative sector and needs of European Civil Protection. The main objectives of CYCLOPS are:

1) To disseminate EGEE results to the CP Community, assessing EGEE infrastructure for CP applications. A variety of activities will focus on dissemination and outreach, training, workshops, possibly in close relation with EGEE events and on promoting a close collaboration between the two communities.

2) To provide the EGEE Community with knowledge and requirements that characterise the CP services. These requirements will also be used to assess the possibility for the development of an advanced grid platform enabling Real Time and near-Real Time services and implementing a security infrastructure very close to the defence systems standards.

3) To evaluate the possibility to utilise the present EGEE services for CP applications, developing the research strategies to enhance EGEE platform.

4) To develop the research strategies to enhance EGEE platform, especially for Earth sciences resources.

CYCLOPS will contribute to the EU policy developments establishing liaisons and synergies with other existing projects and initiatives dealing with GMES, GRID and complementary sectors, among them: PREVIEW, Risk EOS, RISK-AWARE, BOSS4GMES, EGEE Networking Activities and Application Support, e-IRG and INSPIRE. In fact, Consortium partners are involved in all these projects and initiatives.

Furthermore, CYCLOPS aims to address the OGF standardization needs as far as the Earth and Space Science Communiy, GMES and gLite are concerned.

In this context, it is contributing to OGC (Open Geospatial Consortium) OGF initiative."

CYCLOPS Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	N / A	Total	0
		Funded	0
User oriented activities	WP2: Coordination with EGEE activities WP3: Civil Protection System analysis WP4: research and Innovation Strategies definition WP5: Dissemination & Exploitation	Total	5.1
		Funded	5.1

Project duration: 24 months

Yearly effort: PM 61; Annual budget: €412,500
Project's home page: http://www.cyclops-project.eu/

3.3.3. e-NMR

e-NMR aims at deploying and unifying the NMR computational infrastructure in system biology, a project funded under the 7th framework programme of the European Union (Contract no. 213010 - e-NMR).

NMR plays an important role in life sciences (biomolecular NMR), and structural biology in particular, at both European and international levels. Our main objective is to optimize and extend the use of the NMR Research Infrastructures of EU-NMR through the implementation of an e-Infrastructure in order to provide the biomolecular NMR user community with a platform integrating and streamlining the computational approaches necessary for NMR data analysis and structural modelling (e-NMR). Access to the e-NMR infrastructure will be provided through a portal integrating commonly NMR software and GRID technology.

e-NMR Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	WP3: Design and development of the e-NMR Grid platform	Total	5.1
		Funded	5.1
Operations	WP2: e-NMR Grid deployment and operation	Total	1.4
		Funded	1.4
User oriented activities	WP1: Monitoring, Standardization and Outreach	Total	1.8
		Funded	1.8

Project duration: 36 months
Yearly effort: PM 100; Annual budget: €922,217
Project's home page: http://www.e-nmr.eu/

3.3.4. Ithanet

Ithanet is a Euromediterranean network of research centres conducting molecular and clinical research of thalassaemia and related haemoglobinopathies. Participants of Ithanet include all major European research institutions active in haemoglobinopathy research and a number of collaborating partner institutions from non-EU Mediterranean and Black Sea countries.

The main objective of Ithanet co-ordination action is to enhance the scientific potential of this research community using infrastructures and tools of European Research Networks. Ithanet aims to harmonize and develop these resources for the coordination of existing research activities as a base for future collaborative projects.

Using eInfrastructure tools to consolidate and strengthen a research community with a specific geographic distribution and research topic, Ithanet strives to create new opportunities for high-impact collaborative research in the European Research Area.

Ithanet Effort Table

	Project Activities	Effort in FTEs	
Middleware	N/A	Total	0.0
		Funded	0.0
Operations	WP2: e-Infrastructure (collaboration tools)	Total	1.05
		Funded	1.05
User oriented activities	WP3: Tools for clinical research WP4: Tools for molecular research WP5: Training and knowledge transfer WP6: Portal WP7: Dissemination	Total	3.3
		Funded	3.3

Project duration: 24 months
Yearly effort: PM 52; Annual budget: €603,650
Project's home page: http://www.ithanet.eu/

3.3.5. DEGREE

A major challenge for DEGREE is to build a bridge linking the ES and GRID communities throughout Europe, and focusing in particular on the EGEE-II Project. An ES applications panel with a range of candidate applications suitable for porting to GRID will make sure key ES requirements for porting and deployment on the GRID middleware are identified, communicated and discussed within the GRID community. At the same time the DEGREE SSA will ensure the ES community is informed and up to date on GRID developments and potential benefits.

The results will provide feedback to the GRID community and dissemination in the ES community will increase awareness of and involvement with GRID developments.

In order to ensure that ES requirements are taken into account in the next Grid generation, DEGREE will initiate different collaborations; at short, medium and long term via EU horizontal collaborations, specific collaboration with Grid projects and participation to the e Infrastructure Reflection Group (e-IRG).

Objectives:

- Disseminate, promote uptake of Grid in wider ES community
- Reduce the gap between ES users and Grid Technology
- Explain and convince ES users of Grid benefits and capability to tackle new and complex problems.

Project duration: 24 months
Annual budget: €670,000
Project's Home page: http://www.eu-degree.eu/

3.3.6. EuroVO-DCA

The concept of a Virtual Observatory is that all the worlds astronomical data should feel like it sits on the astronomers desktop, analysable with a user selected workbench of tools and made available through a standard interface. Euro-VO is the European implementation of this idea that will produce a unified data and service resource (a data and service grid) with the ability to perform complex data discovery and manipulation tasks across the whole range of astronomical research topics. The Euro-VO Data Centre Alliance project will co-ordinate the national and European Agencies Virtual Observatory initiatives, supporting implementation of the Virtual Observatory framework by the European Data Centres to populate the Virtual Observatory with data produced by the European astronomy infrastructures.

Project duration: 28 months

Yearly effort: PM 72.9; Annual budget: €702,857

Project's home page: http://www.euro-vo.org/pub/index.html

3.4. INTERNATIONAL COOPERATION PROJECTS

3.4.1. EUChinaGrid

Co-Funded by the European Commission in the framework of FP6, EUChinaGRID Project officially started on 1st January 2006 with the aim to support the interconnection of the existing European and Chinese Grid Infrastructures and enable their interoperability, thus creating a network of collaboration between Europe and China.

EUChinaGRID provided specific support actions to foster the integration and interoperability of the Grid infrastructures in Europe (EGEE) and China (CNGrid) for the benefit of e-Science applications and worldwide Grid initiatives, in line with the support of the intercontinental extension of the European Research Area (ERA).

The project studied and supported the extension of a pilot intercontinental infrastructure using the EGEE-supported applications and promoted the migration of new applications on the Grid infrastructures in Europe and China; this was done by training new user communities and supporting the adoption of grid tools and services for scientific applications. A set of existing Euro-Chinese collaborations in research, marked by strong requirements in terms of analysis of large quantities of data and needs for wide amounts of computing power, were selected as pilot applications in order to validate the infrastructure.

During the 27 months of duration, the Project achieved several goals.

The pilot infrastructure includes 12 sites 5 of which are in China (4 in Beijing and one in Shandong). All the relevant Grid services were started and are maintained to facilitate the access of users and Virtual Organizations (VO) through the web portal (www.euchinagrid.eu). Some of those core Grid services are hosted in China.

A special stress was posed on designing an e-Infrastructure allowing full interoperability, both horizontally (i.e. between European and Chinese middleware) and vertically (i.e. between Grid middleware and the different versions of the IP protocol). Works towards both objectives lead to interesting results and the EUChinaGRID findings in this field raised interest amongst middleware developers in EGEE and ETICS communities leading to common activities such as a code checker for IPv6 compliance implemented in the ETICS building system.

A Gateway between gLite and GOS has been build and extensively tested and improved. The Gateway allows to exchange jobs between the two infrastructures taking care of the differences related to the Job Description Languages and the Security mechanisms.

Application deployment has also achieved significant impact in several science fields:

- High Energy experiments (ATLAS and CMS) at the CERN Large Hadron Collider (LHC) can run their applications on the pilot infrastructure.
- Astroparticle experiment ARGO-YBJ, a joint collaboration between Chinese and Italian researchers, is currently collecting data on Cosmic Ray showers in the YangBaJing laboratory in Tibet; a complete system has been deployed to perform the data transfer from YangBaJing to IHEP (Beijing) and INFN-CNAF (Bologna) sites, using the EUChinaGRID Grid Infrastructure and the 2.5 Gbps link provided by the ORIENT project.
- EUChinaGRID also supported Biological applications in the field of simulation and discovery of new proteins. The work in this field, carried out in the laboratories of Biology Department of University of Roma Tre (UROM3), Jagiellonian University – Medical College (JU-MC) and Peking University (PKU), led to first ab-initio protein structure prediction processes ever deployed in a Grid environment. The parallel approaches adopted by UROM3 and JU-MC have been compared on a large sample of candidates (2x104), while the predicted protein structures are being experimentally verified by the PKU group.

EUChinaGRID had an intense dissemination activity with two website versions in English and Chinese and more than 300 Chinese researchers, engineers and students took part to the advanced knowledge tutorials held in China. A specific dissemination action was carried out towards the community of middleware developers, to raise their awareness about IPv6 compliance and interoperability issues, and to suggest actions and best practices for overcoming these problems. This included the delivery of focused workshops and tutorials, that involved more than 150 developers, and the publication of a dedicated IPv6 website (http://www.euchinagrid.org/IPv6/index.html), as well as the collaboration with other projects such as 6DISS.

EUChinaGrid Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	WP2: Network planning and interoperability study WP3: Pilot infrastructure operational support	Total	20.08 (10 Non-EU)
		Funded	14.01 (6 Non-EU)
User oriented activities	WP5: Applications WP5: Dissemination	Total	37.64 (13 Non-EU)
		Funded	21.81 (5 Non-EU)

Project duration: 27 months

Yearly effort: PM 693; Annual budget: €577,777

Project's home page: http://www.euchinagrid.org/

3.4.2. EUMEDGRID

Funded by EC within the Sixth Framework Program for Research and Development and Coordinated by INFN, EUMEDGRID aimed to support the development of a Grid e-Infrastructure in the Mediterranean Area and promote the porting of new applications on the Grid platform, thus allowing Mediterranean scientist to collaborate more closely with their European colleagues.

EUMEDGRID has disseminated Grid awareness and competences across the Mediterranean and, in the meanwhile, identifying new research groups to be involved in the project, helped them to exploit Grids' enormous potential to improve their own applications.

The implementation and coordination of a grid infrastructure at a national (or larger) level can be regarded, especially in the beneficiary Countries, as an opportunity to optimize the usage of existing, limited storage and computing resources and to enhance their accessibility for all research groups.

The EUMEDGRID project was conceived in this perspective and has set up a pilot grid infrastructure for Research in the Mediterranean Region, which is interoperable and compatible with EGEE and related initiatives. The EUMEDGRID's vision focused on improving both the technological level and the know-how of networking and computing professionals across the Mediterranean, thus fostering the introduction of an effective Mediterranean Grid infrastructure for the benefits of eScience. Accordingly, the project objectives can be regarded as belonging to two main areas: the first focusing on softer actions, with the overall aim of creating a human network in e-Science across the Mediterranean, and the second one addressing technical issues and intended to support the implementation of a pilot Grid infrastructure and applications in the area.

The Project lasted for 26 months and made a considerable step forward during the second year of the project and a number of achievements give evidence of the success of its activities.

Cooperation among all the participants has been demonstrated by the enthusiastic participation to common workshops and meetings organized during the duration of the project and the great success obtained fostering the creation of National Certification Authorities and National Grid Initiatives. Impressive results were also obtained in the events of knowledge dissemination on Grid Technology and services. A large community including system administrators, researchers, and final users was involved with good results in terms of number of participants (more than 700 people) and feedback obtained through dedicated questionnaires.

The promotion of National Grid Initiatives carried out in all non-EGEE Partner Countries registered a good level of success with programs already operational in Algeria, Egypt, Morocco, Tunisia and Turkey and well advanced plans, with clear commitments, in Cyprus, Jordan, Syria and Palestinian Territories. The project was very active in promoting the creation of national Certification Authorities which will issue digital certificates necessary for allowing secure Grid access to the users. The process is completed in Morocco, the first African Country to become member of EUGridPMA and well advanced in the other countries and, in the meanwhile, a temporary catch-all CA was created in order to fulfil the needs of EUMEDGRID users.

A pilot grid infrastructure, composed to date of 25 sites in 13 countries, was set up during the project's duration.

Several applications have been proposed to run on the EUMEDGRID e-Infrastructure and many were selected to be supported, spanning several fields of interests: High Energy Physics, Biology and Biomedical, Hydrology, Archaeology, Seismology and Vulcanology. New communities and applications of Regional interest were also discovered by means of a survey based on web

questionnaires[1]. The works to port the first applications on the EUMEDGRID eInfrastructure begun in the 1st quarter of 2006 with CODESA and ArchaeoGrid, respectively an hydrological and an Archaeological application which are of interest for the Mediterranean Region.

Another large bunch of applications was deployed during a dedicated event in Cairo: the first "EUMEDGRID School for Application Porting" (EGSAP-1 http://www.EUMEDGRID.org/egsap-1/) on 17-28 April 2007. Conceived as a full immersion experience for selected new communities of regional interest, the school was deemed of paramount importance for the uptake of new applications on the regional pilot infrastructure. EGSAP-1 was accordingly one of the largest dissemination efforts of the whole lifetime of the project, contributing in involving new communities in the project activities, while providing them the knowledge needed to build upon the eInfrastructure and deploying their own application.

All selected applications were ported to the EUMEDGRID e-infrastructure. Moreover these applications have been also ported to the GENIUS web portal.

The interest of the EUMEDGRID experience does not however restrict to scientific issues - although the opportunity to port applications of regional importance, such as the hydro-geological and medical ones, on the pilot infrastructure sounds really exciting. Fostering Grid awareness and the growth of new competences in EU Neighbours' scientific communities is a concrete initiative towards bridging the digital gap and, moreover, to promote a peaceful and effective collaboration among all Partners.

At Social level e-Infrastructures can contribute to mitigate phenomena such as Digital Divide and, possibly, revert Brain Drain to allow brilliant minds in the area to contribute significantly to cutting edge European Scientific activities concretely enlarging the European Research Area (ERA). Research and Education Networks and Grids are fundamental infrastructures that will allow non-EU researcher to make high quality work in their home laboratories without the need to migrate in most advanced countries.

An extended Mediterranean Research Area could thus be seen as a first step towards the suggestion of more politically ambitious plans of open market, open transportation infrastructures, free circulation of citizens, etc.

EUMEDGRID Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	WP3: Pilot infrastructure operational support	Total	22.33 (15.09 Non-EU)
		Funded	12.1 (4.76 Non-EU)
User oriented activities	WP4: Application support WP2: Requirement capture and analysis WP5: Dissemination and Outreach	Total	26.57 (10.56 Non-EU)
		Funded	20.84 (8.36 Non-EU)

Project duration: 26 months

[1] https://secure.um.edu.mt/EUMEDGRID/questionnaire/wp2/, https://secure.um.edu.mt/EUMEDGRID/questionnaire/wp4/

Yearly effort: PM 587; Annual budget: €759,231
Project's home page: http://www.eumedgrid.org/

3.4.3. EUAsiaGrid

The EUAsiaGrid proposal contributes to the aims of the EU Research Infrastructures FP7 Programme by "promoting international interoperation between similar infrastructures with the aim of reinforcing the global relevance and impact of European e-Infrastructures".
The project's main goal is to pave the way towards an Asian e-Science Grid Infrastructure, in synergy with the other European Grid initiatives in Asia, namely EGEE-III via its Asia Federation, and both the EUChinaGRID and EU-IndiaGRID projects and their eventual follow on efforts.
Taking advantage of the existing global Grid technologies, with the specific emphasis on the European experience with the gLite middleware and applications running on top of it, the project plans to encourage federating approaches across scientific disciplines and communities.
EUAsiaGrid acts as a support action, aiming to define and implement a policy to promote the gLite middleware developed within the EU EGEE project across Asian countries.
Its main actions will be to spread dissemination, provide training, support scientific applications and monitor the results. The use of the Grid e-Science infrastructure is not only promoted on a geographical base, but also to new communities which can profit of the resources made available, like Social Sciences, Disaster Mitigation, building on the knowledge of more experienced fileds, like High Energy Physics and Bioinformatics. The project would envision any collaboration with standard bodies and other projects which helps in making the results sustainable over time.

EUAsiaGrid Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	N / A	Total	0
		Funded	0
User oriented activities	WP2: Requirement capture and coordination policy definition WP3: Support of scientific applications WP4: Dissemination WP5: Training	Total	15.0
		Funded	13.1

Project duration: 24 months
Yearly effort: PM 180; Annual budget: €727,075
Project's home page: http://www.euasiagrid.org/

3.4.4. EU-IndiaGrid

EU-IndiaGrid is the European project that has established and currently maintains e-Infrastructure ties with the Indian generalized Grid infrastructure. Among the partners of the project are the Indian

NREN (ERNET) and the Indian NGI (GARUDA). EU-IndiaGrid is formally supported by the Indian Government, as witnessed by a letter sent to Ms Reding (EC) by the Indian Government Principal Scientific Advisor, Dr Chidambaram.

In addition to extensive dissemination and training activities, EU-IndiaGrid has set up a testbed running applications from several scientific communities, and has reported on its interoperation efforts in the context of many collaborative and standardization / interoperability events. The work has produced some specific requirements which would benefit interoperation between the European gLite middleware and the Indian middleware.

The project would envision extending the collaboration with standards bodies and projects such as (a possible continuation of) OMII-Europe by implementing these requirements (either directly or in an effort mediated by EGI), and in general to continue and ideally stabilize the elements which maintain the current EU-India Grid relationship.

EU-IndiaGrid Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	N / A	Total	0
		Funded	0
Operations	WP3: Network Planning Support WP4: Pilot grid infrastructure operational support	Total	4.7
		Funded	3.1
User oriented activities	WP5: Applications WP2: Building an eScience Network Community WP6: Dissemination & Networking Events	Total	8.9
		Funded	6.0

Project duration: 24 months

Yearly effort: PM 163; Annual budget: €640,410

Project's home page: http://www.euindiagrid.org/

3.4.5. EELA-2

EELA-2 aims at building a high capacity, production-quality, scalable Grid Facility, providing round-the-clock, worldwide access to distributed computing, storage and network resources needed by the wide spectrum of Applications from European - Latin American Scientific Collaborations, with special focus on:

- Offering a complete set of versatile services fulfilling Applications requirements;
- Ensuring the long-term sustainability of the e-Infrastructure beyond the term of the project.

Such an ambitious project would not be possible without the prior existence of a consolidated e-Infrastructure, set up with the early intention to build a sustainable Grid platform. This was the objective of the EELA Project (www.eu-eela.org/first-phase.php) that provided its users with a stable, well supported Grid Infrastructure based on 16 Resource Centres (RCs) summing up to over 730 CPU cores and 60 Terabytes of storage space, thus proving that the deployment of an European-Latin American e-Infrastructure was not only viable but is also responding to a real need of a significant part of the Scientific Community.

The EELA-2 vision is two-fold:

- Consolidate and expand the current EELA e-Infrastructure built on the GÉANT2/European and RedCLARA/LA National Research & Education Networks (NREN), to become an e-Infrastructure Facility, providing a full set of enhanced services to all types of Applications from multiple Scientific Areas of European and Latin American Scientific Communities;
- Ascertain the conditions of the durability of the e-Infrastructure, beyond the Project duration.

EELA-2 Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA1: Development of Services for Applications and Infrastructure	Total	7.5
		Funded	5
Operations	SA1: Grid Infrastructure Service Activity SA2: Network Resource Provision	Total	31.5
		Funded	18.3
User oriented activities	NA3: Application Support NA2: Dissemination and Training	Total	17.0
		Funded	8.7

Project duration: 24 months
Yearly effort: PM 672; Annual budget: €1,284,160
Project's home page: http://www.eu-eela.eu/

3.5. DATA MANAGEMENT PROJECTS

3.5.1. D4Science

D4Science is one of the main European e-Infrastructure project, involving 11 participants and co-funded by the European Commission's Seventh Framework Programme for Research and Technological Development. The project started in January 2008 and has a duration of 2 years.

D4Science aims to continue the path that the GÉANT, EGEE, and DILIGENT projects have initiated towards establishing networking, grid-based, and data-centric e-Infrastructures that accelerate multidisciplinary research by eventually overcoming several crucial barriers that stand in the way, primarily those related to heterogeneity, sustainability and scalability.

The main objective of D4Science is laying the foundations for next generation of collaboration and knowledge management environments by realizing an infrastructure that allows members of dynamic Virtual Research Environments (VREs) to create on-demand transient digital libraries based on shared computing, storage, multi-type content and application resources. Knowledge sharing and support of collaboration in a secure, coordinated, dynamic and cost-effective manner are to be the two major facilities offered by the combination of hardware, network, software and content elements that constitute a D4science infrastructure. Whereas this infrastructure is designed to support many different research and industrial applications, two communities are used to demonstrate and validate the project: the Environmental Monitoring and Fisheries and Aquaculture Resources Management communities.

The objectives of the project will be achieved through the synergetic operation of Networking, Service, and Joint Research Activities. The overall objective of the Networking Activities (NA) is to serve the needs of the communities. The experience done with these large communities will facilitate a future extension of the e-Infrastructure capabilities to other scientific communities. This will be done by: disseminating the project outcomes, training of the various players, and exploiting and collecting feedback to the D4Science e-Infrastructure through the implementation of the communities VREs.

The Service Activities (SA) aims at making available and maintaining a stable, reliable and usable e-Infrastructure to these (and possible other) D4Science user communities.

Finally, the Joint Research Activities (JRA) address the technical requirements raised by the Environmental Monitoring and Fisheries and Aquaculture Resources Management communities against the gCube framework.

D4ScienceEffort Table

	Project Activities	**Effort in FTEs**	
Middleware	JRA4: gCube Development	Total	6.1
		Funded	4.6
Operations	SA1: Infrastructure Operation SA2: Community Specific Operations SA3: Software Integration, Testing and Distribution	Total	9.4
		Funded	9.4
User oriented activities	JRA1: Overall Planning and Development Coordination JRA2: Environmental Monitoring Community-specific Software Development JRA3: Fishery Resources Management Community-specific Software Development NA3: Communication and Dissemination NA4: Training NA5 Communities VREs Definition, Validation and Exploitation	Total	15.25
		Funded	10.75

Project duration: 24 months

Yearly effort: PM 200; Annual budget: €1,575,000

3.5.2. DRIVER

DRIVER is building the testbed for a future knowledge infrastructure of the European Research Area. Aimed to be complementary to GN2, the successful infrastructure for computing resources, data storage and data transport, DRIVER will deliver the content resources, i.e. any form of scientific output, including scientific/technical reports, working papers, pre-prints, articles and original research data.

The vision to be accomplished in a second phase is to establish the successful interoperation of both data network and knowledge repositories as integral parts of the e-infrastructure for research and education in Europe.

The knowledge infrastructure testbed, delivered by DRIVER, will be based on nationally organized digital repository infrastructures, similar to GN2 and the NRENs. The successful DARE network in

the Netherlands, recently presented to the public by the project partner SURF, will serve as a model to DRIVER.

DRIVER with its testbed will not build a specific digital repository system with pre-defined services, based on a specific technology and serving dedicated communities.

The testbed will in its inception focus on the infrastructure aspect, i.e., open, clearly defined interfaces to the content network, which allow any qualified service-provider to build services on top of it. Like the data network GÉANT, DRIVERs knowledge infrastructure offers mainly a well structured, reliable and trustworthy basis. DRIVER opens up knowledge to the communities; it does not prescribe how to use the knowledge.

Project duration: 18 months

Yearly effort: PM 244.7

3.6. POLICY AND PUBLIC RELATIONS PROJECTS

3.6.1. Belief

BELIEFs aim is to create a platform where e-Infrastructure stakeholders can collaborate, reach out to new audiences and exchange knowledge, thus helping to ensure that e-Infrastructures are both developed and used effectively worldwide. It will be a one stop shop for information on e-Infrastructure documentation and activities for both research and industry and will thus aid the knowledge transfer between them.

Project duration: 24 months

Annual budget: €604,226.5

Project's home page: http://www.beliefproject.org/

3.6.2. e-IRGSP

The e-IRGSP project provides a number of services to support the work of the e-Infrastructure Reflection Group (e-IRG), such as a secretariat (in The Hague, The Netherlands), a knowledge base and policy and editorial support. e-IRG consists official government delegates from the 25 EU member states, as well as associated countries.

Project duration: 24 months

Yearly effort: PM 22.5; Annual budget: €183,042

Project's home page: http://e-irg.eu/

3.7. OTHER PROJECTS

3.7.1. ICEAGE

At European level, e-Infrastructure has been identified as a key element of the construction of the European Research Area (ERA) so as to stimulate industry, improve the lives of citizens, accelerate

research and gain international competitive advantage. For Europe to realise this expectation, there needs to be a diverse, knowledgeable and creative community to skilfully exploit e-Infrastructure.

With the support of the European Union, the ICEAGE project aimed to encourage and support the incorporation of education in distributed computing in academic courses throughout the ERA. Built on EGEE, ICEAGE has enabled students and educators to obtain and develop Grid Education via sustained, large-scale, multi-purpose e-Infrastructures. ICEAGE differs from EGEE in that its primary goals are educational and therefore embraces a wide variety of approaches to e-Infrastructure.

ICEAGE has catalysed the necessary infrastructure and skills by establishing a worldwide initiative to inspire innovative and effective Grid Education. Grid Education implies the use of education in the Grid, but also the use of the Grid in education. In the context of ICEAGE the term "Grid" is indeed used in a broad sense to include computing and communications technology, working practices, and policies that underpin e-Infrastructure.

ICEAGE Effort Table

	Project Activities	**Effort in FTEs**	
Middleware	t-Infrastructure – development and provision (with several middleware co-existent)	Total	3
		Funded	2
Operations	t-Infrastructure operation (during Grid Schools)	Total	2
		Funded	1
User oriented activities	WP1 - Extend and Advance Grid Education – Grid Education Policy Development WP2 - Advanced Grid Education Support, Outreach, Induction & Training Services WP3 - Educational events and Summer Schools WP4 - t-Infrastructure – development and provision	Total	13
		Funded	9

Project duration: 24 months

Yearly effort: PM 216; Annual budget: €600,000

Project's home page: http://www.iceage-eu.org/

3.7.2. ISSeG

ISSeG aims to contribute to the consolidation of the European Grid infrastructure in the field of computer security, by creating and disseminating practical expertise on the deployment of Integrated Site Security (ISS), as a complementary action to Enabling Grids for E-sciencE (EGEE) projects Grid Security. ISS is a concept where all Site Security components (technical, administrative, educational) are developed in a coordinated fashion. The ISSeG vision is that Grid Security, which focuses on inter-site security, middleware, and authentication, needs to be complemented by a comprehensive ISS strategy at every centre. The ISSeG consortium comprises three large scientific centres, CERN, CCLRC and FZK, all involved in EGEE.

The project objectives will be achieved by the creation and capture of raw expertise through full-scale ISS deployment at CERN and FZK, and by dissemination through the provision of applicable recommendations and methodologies for further ISS deployments.

Project duration: 24 months
Yearly effort: PM 102.5; Annual budget: €655,000
Project's home page: http://www.isseg.eu/

3.7.3. RINGrid

RINGrid provides an architecture which integrates scientific instruments in the e-Infrastructure and promotes a vision towards next-generation Remote Instrumentation Systems. It encompasses the current state-of-the-art and near future technology, delivers a conceptual design of missing architectural pieces to achieve such vision and assumes a Grid environment and high-speed network interconnections.

Project duration: 18 months
Yearly effort: PM 123; Annual budget: €666,110
Project's home page: http://www.ringrid.eu/

3.8. OVERVIEW OF THE EFFORT

The Table 3.1 below summarizes the effort of the projects for which full tables were shown in this chapter: EGEE-III, BalticGrid, SEE-GRID-SCI, OMII-Europe, GridCC, BIOINFOGRID, CYCLOPS, e-NMR, Ithanet, EUChinaGRID, EUMEDGRID, EUAsiaGrid, EU-IndiaGrid, EELA-2, D4Science and ICEAGE.

All projects	**Effort in FTEs**	
Middleware	Total	142.25
	Funded	78.15
Operations	Total	298.02
	Funded	176.55
User oriented activities (includes Application support, Training, and Dissemination)	Total	301.87
	Funded	196.11
Global Effort	**Total**	**742.14**
	Funded	**450.81**

Note that for EUAsiaGrid, EU-IndiaGrid the non-EU effort is not separated, and thus is counted in the above table.

The effort included in the Table 3.1 does not of course account for all the activities in the EU grid projects; only for the projects described in this document, but not accounted for in Table 3.1 the sum of the yearly budget amounts to more than 5 M Euro, which assuming a cost of 80 kEuro per FTE accounts for more than 65 additional FTEs.

The National grid projects are more difficult to treat in an homogeneous way and did not seem to deploy any new specific function in addition to the ones of the European projects, thus they are not treated in this chapter; it should however be noticed that for many countries the effort invested in this projects is considerably higher.

4. HANDOVER FROM WP2

It was agreed during the initial phase of EGI DS project that the most appropriate way to obtain both overall and detailed insight into the end users' and resource providers' expectations was through collecting their views and requirements as a set of Grid utilization use cases. The collected use cases were subsequently analyzed to provide more concise overview of what is requested from the EGI infrastructure and how the infrastructure should fulfill all requested demands.

The mechanism of use cases content analysis was built on two complementary approaches. Firstly, the so-called "bottom-up" approach tries to cluster the use cases into categories based on their relation. This allows us to identify primary areas of interest as present in the collected use cases. Secondly, we applied a complementary "top down" approach in which use cases are mapped to a set of predefined areas of interest. Two different predefined areas have been used for the analysis – a set of proposed EGI functions and set of the current EGEE project activities, i.e. service (SAs), joint research (JRAs) and networking activities (NAs). Direct comparison of results from both approaches (see Table 1) clearly indicates that both types of analyses led to the same results, however top-down approaches yielded also areas that are currently not covered by obtained use cases (e.g. there were no use cases received on legal or policy issues).

Bottom-up	Top-down
Infrastructure access and operations	Operation of a reliable Grid infrastructure
Middleware development/deployment/enhancement	Middleware development and standardization
Application scenarios	Application support
Middleware development/deployment/enhancement	Development and operation of build and test systems
	Legal. organizational, and administrative issues, management
	Policies and strategy
	Industrial take up

Table 1 – Comparison of use cases analysis approaches

To sum up, the obtained use cases results clearly indicate that Grid communities worldwide are willing to provide their day-to-day experience and/or requirements from current Grid infrastructure utilization. During the collection of initial input form various Grid actors we collected and analyzed substantial amount of provided material.

The analyzed and processed content of all use cases were exposed in the EGI DS Knowledge Base and during December 2007 were made publicly available to the first community feedback and from that

time a set of newly arrived use cases has been regularly added to the Knowledge Base content. They serve as the critical input for final definition of EGI functions expected by Grid actors from future upcoming sustainable Grid environment.

Top expected EGI functions
Operation of a reliable Grid infrastructure
Application Support
Coordination of middleware development and standardization
Development and operation of build and test systems

Table 2 – Proposed Critical proposed EGI functions

To conclude, during the first phase of the EGI DS project we collected and analyzed material in the form of current Grid utilization use cases proposed by various Grid communities. This information resulted into a table of requirements (individual use cases) that has been mapped to the expected EGI functions (the whole material is available in the Knowledge Base, http://knowledge.eu-egi.eu/index.php/Main_Page, and a summary of which is presented in Table 2. As one can observe, the focus of attention and related use cases received were in the areas of operations, applications, middleware and related testing systems.

4.1. THE SURVEYS BY WP2

WP2 continued the survey work on sustainability that was led by the EGEE project (NA5 activity on policy and international cooperation). To extend the views arising from the use cases, further information needed to be collected evaluating the importance of the implementation of the planned EGI infrastructure. Moreover, each future EGI service can be either implemented at the EGI.org level, at the NGI level or in a mixed mode. This will provide crucial information on how to distribute the overall EGI functionality and provide an overall picture of the EGI sustainable model. Note that part of this work has been charged to WP3, since it continued after the end of WP2.

To achieve this aim the primary stakeholders (representatives of National Grid Initiatives) of future EGI/NGI model were asked to fill in the survey covering the basic aspects of the derived model. The survey has been implemented in Survey Monkey program and was supposed to answer the question concerning the preferred way of functions implementation. The following set of anticipated functions of the sustainable grid infrastructure was subject of

investigation:

1. Operation of a reliable grid infrastructure
   1.1. Fast addition of new experimental services
2. Accounting, reporting & monitoring
   2.1. Tools implementation
   2.2. Independence of tools
3. Coordination of middleware development and standardization
   3.1. Middleware development
4. Development of build and test systems
5. Operation of build and test systems
6. Selection, validation, integration and deployment of components
7. Mechanisms for resource provisioning to virtual organizations
8. Application support
   8.1. VO interfaces to middleware
   8.2. VO interfaces to operation
   8.3. Community building
9. Help Desk
10. Training
11. Outreach and dissemination
12. Industry take-up
13. Contribution to standardization bodies (OGF, …)
14. Definition of policy, strategy of international cooperation, involvement in e-IRG
15. Representation of European Grid efforts, international cooperation, and ESFRI
16. Network coordination
17. Security
18. Virtual organization management
19. Virtual organization management coordination

Each NGI was asked to rate the importance of each of the following functions/sub-functions and also provide rated views on the importance of each of the sub-functions to the NGI or EGI.org. By summarizing these ratings a good estimation of the views of the NGIs on where each function should be implemented and how distributed should be, was achieved in this way, as can be shown in more detail in the next section.

4.2. FUNCTIONS SURVEY RESULTS

The EGI functions survey has been spread around to all NGI representatives. The NGIs from which at least one response has been obtained are indicated in Figure 1. The results obtained from the EGI/NGI functions survey are summarized in Figure 2. The scheme shows the importance of implementation of a specific function at three different levels (global, at the EGI level and at the NGI level) according to survey participant opinions.

Figure 1 – Map of functions survey respondents

While most of the results are non-surprising, some of the results clearly indicate important aspects. At first, concerning the middleware-related activity – the expected function "Middleware development" has been assigned a crucial global importance while the majority of NGIs declared that this activity is not interesting for them, as a small set of NGIs is currently involved in it. Furthermore, it was deemed also unappealing for central EGI.org organization to be involved in middleware development tasks. On the contrary, the "Coordination of middleware development and standardization" function is perceived as very important at both global and EGI level. It seems therefore appropriate to allocate a substantial human power to be able to deliver this service properly at the EGI level, which is consistent with the proposal included in this document.

The results concerning the "Application support" function show the necessity of handling application support at the NGI level while the importance at the EGI level is considered marginal. These findings well corresponds with the EGI Blueprint recommendation to implement application support at national level while EGI responsibility will be basically in

the NGIs application support coordination. Similar conclusions can be derived for functions "Virtual organization management" and "Virtual organization management coordination". On one hand, VO management should be clearly performed at NGI level while on the other hand the VO coordination effort is expected to be taken care of at the EGI level.

Similarly to EGI functions survey a second survey dealing with legal issues regarding the EGI/NGI model has been also performed among the NGI representatives. The obtained information from this survey is summarized in Figure 3. The results show rather substantial progress towards establishment of NGIs as legal entities, however their interpretation also raises a warning that the situation in Europe is not homogeneous and the EGI will have to be prepared to accommodate several different NGI models—see for example the legal status (Q1), the extent of being an all inclusive body (Q8) or ability to contribute (Q10-12). These differences must be taken into account in during the EGI formal establishment process.

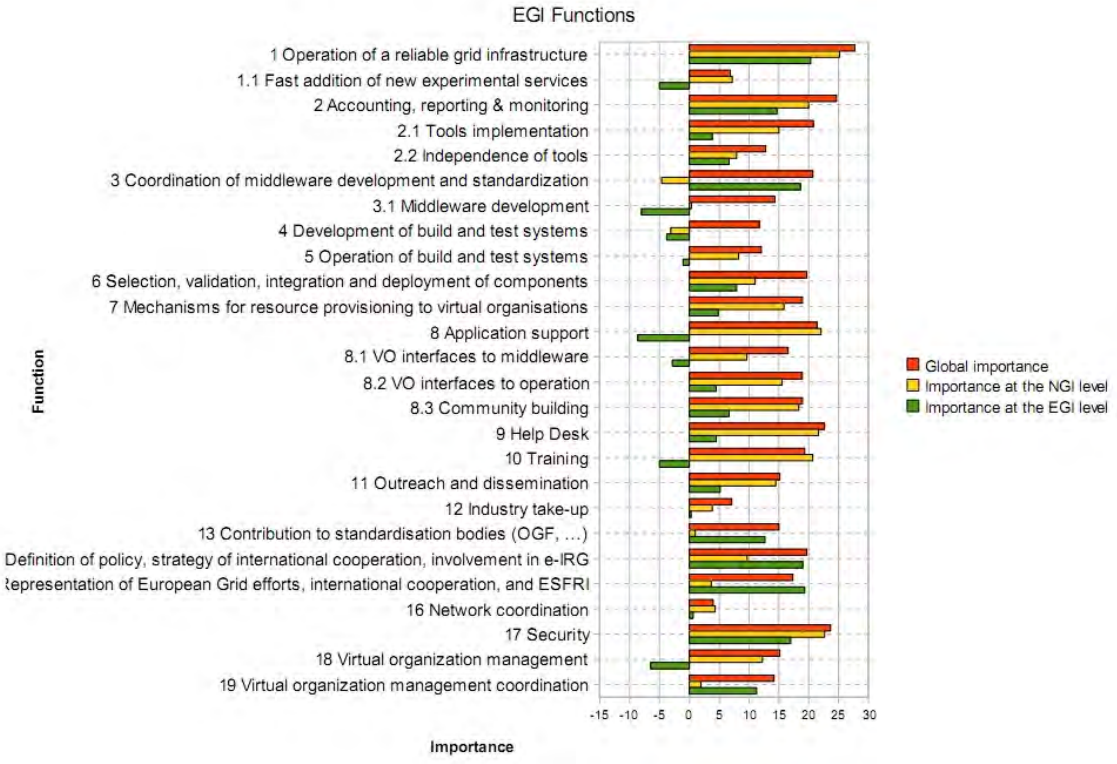
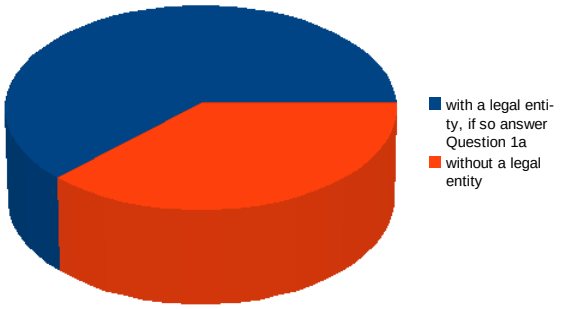
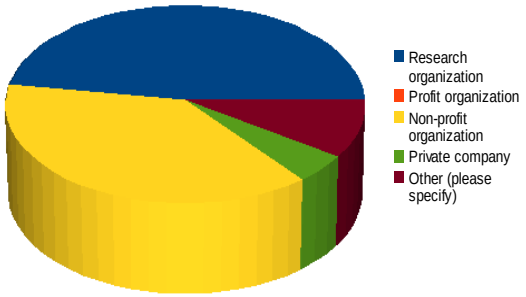


Figure 2 – EGI/NGI functions survey results

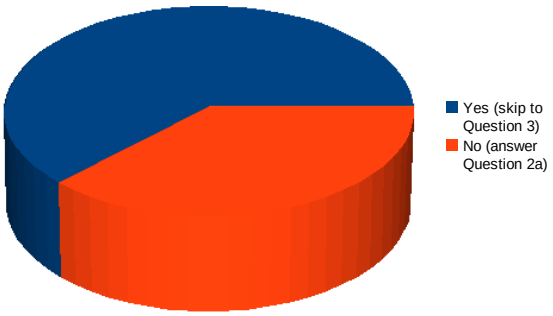
1. In what kind of structure is your organisation organized?



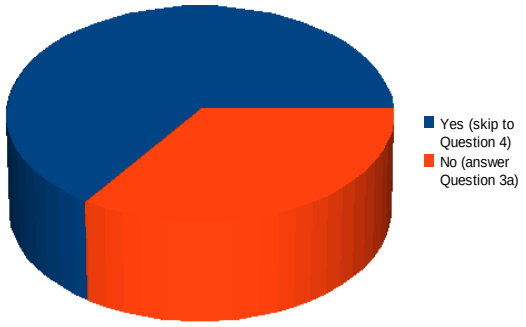
1a. If with a legal entity, is your organisation a ...



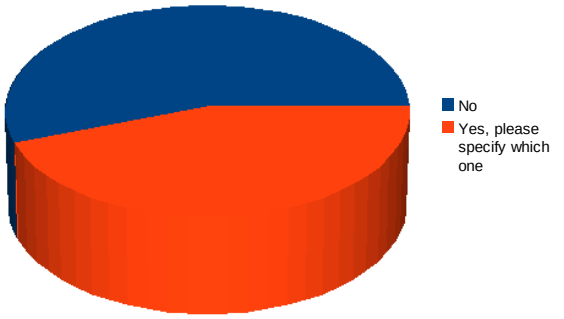
2. Can your organization engage its own legal and financial responsibility?



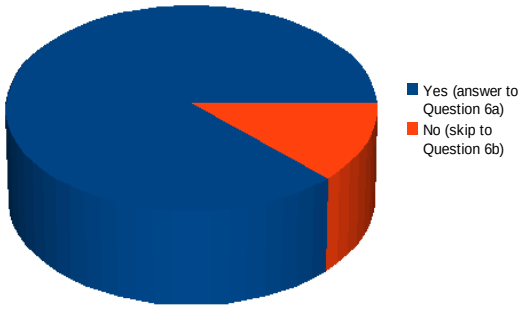
3. Does your organization have its own personnel?

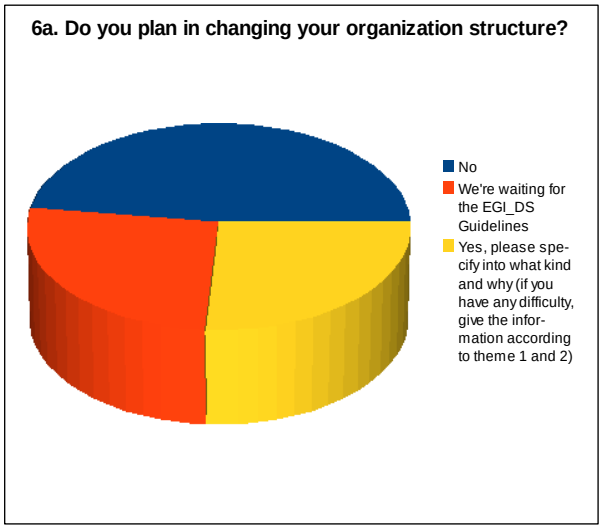


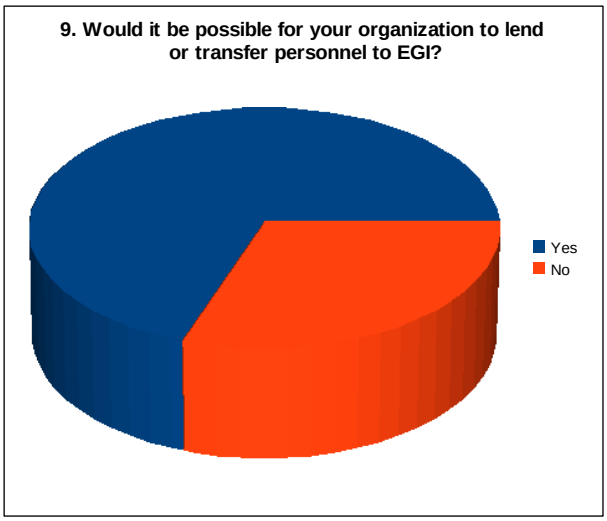
3a. Is your personnel lent by another organization?

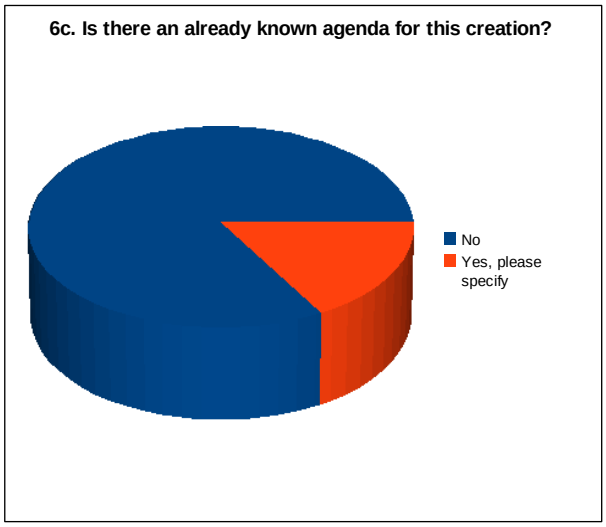


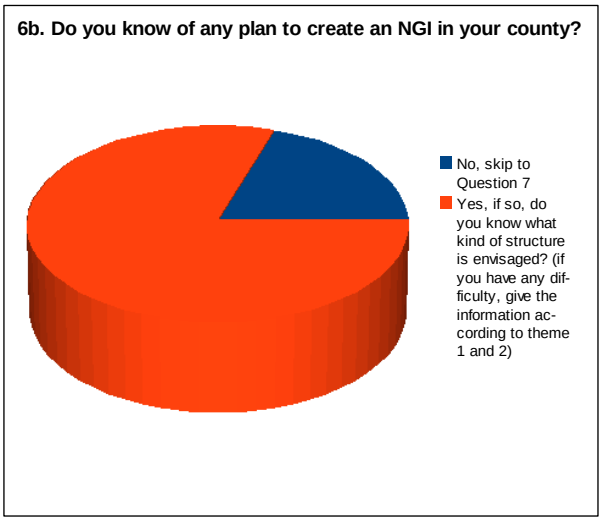
6. Do you have the status of NGI in your country? (i.e. do you represent, coordinate and support the grid community in your country)?

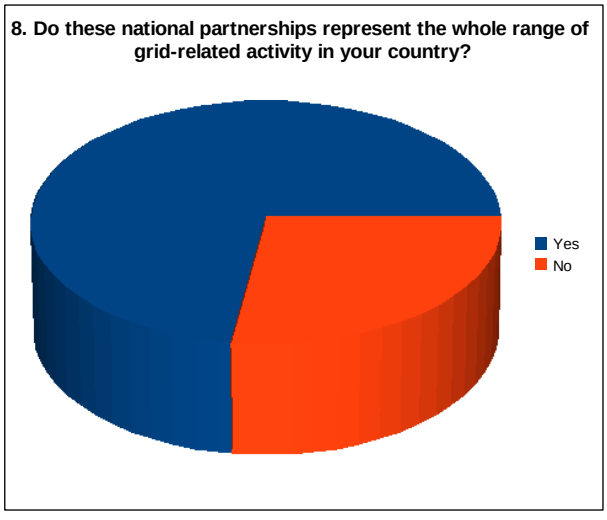


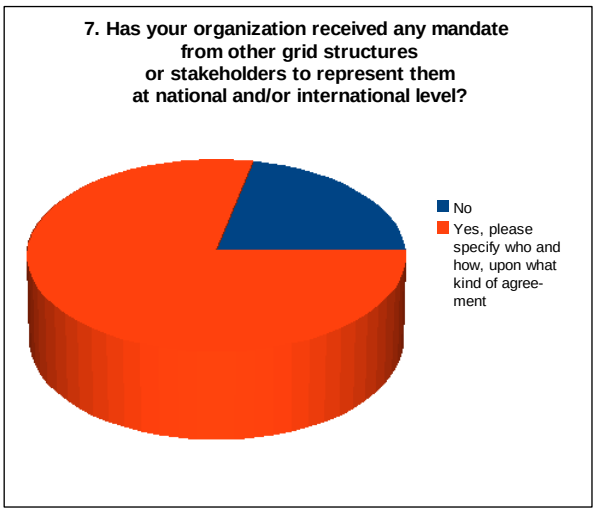

6a. Do you plan in changing your organization structure?
No
We're waiting for the EGI_DS Guidelines
Yes, please specify into what kind and why (if you have any difficulty, give the information according to theme 1 and 2)


9. Would it be possible for your organization to lend or transfer personnel to EGI?
Yes
No


6c. Is there an already known agenda for this creation?
No
Yes, please specify


6b. Do you know of any plan to create an NGI in your county?
No, skip to Question 7
Yes, if so, do you know what kind of structure is envisaged? (if you have any difficulty, give the information according to theme 1 and 2)


8. Do these national partnerships represent the whole range of grid-related activity in your country?
Yes
No


7. Has your organization received any mandate from other grid structures or stakeholders to represent them at national and/or international level?
No
Yes, please specify who and how, upon what kind of agreement

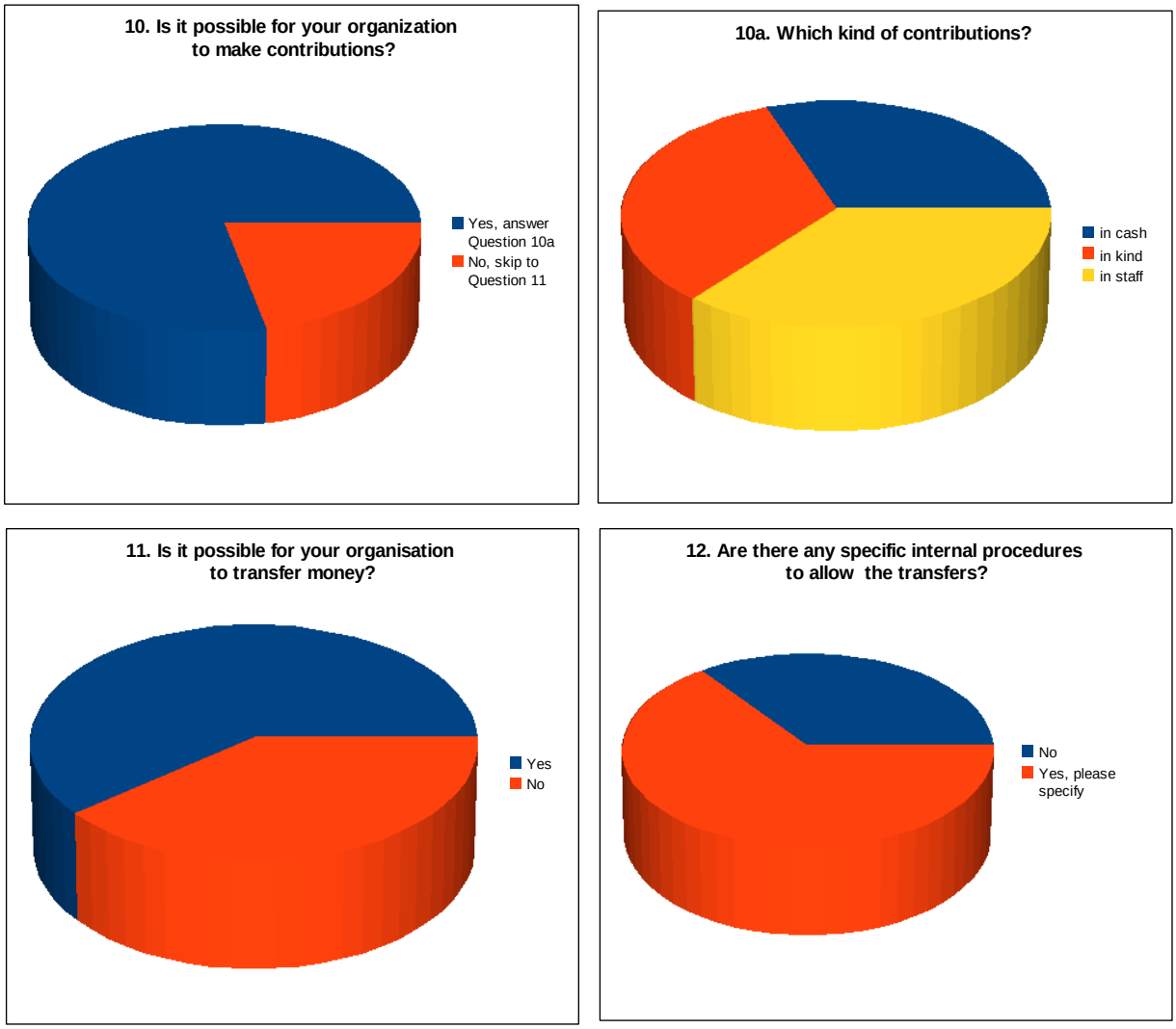


Figure 3 – EGI/NGI legal survey results

5. BUSINESS MODEL

This Chapter defines the European Grid Initiative-EGI Business Model (BM), i.e. the proposed EGI framework to create value. The goal of EGI is to provide services for a standard and easy access to potentially any type of resource from multiple distributed and heterogeneous domains, made available by the respective providers.

The distributed resources to be accessed can be dedicated to the users from a given community (the so-called Virtual Organization – VO), or shareable by users from different VOs. In the former case, EGI supports *intra-VO sharing*, while in the latter *cross-VO sharing* is performed. The primary *mandatory* purpose of EGI is the enabling of intra-VO sharing, i.e. the possibility to get access to the distributed pool of resources allocated to a given VO. In addition to this, EGI *optionally* supports cross-VO sharing (if requested by some of its stakeholders and if technically feasible). Cross-VO sharing is a resource supply model that addresses the needs of users that do not own (neither directly nor indirectly) resources, but that are willing to pay for the best-effort access of distributed resources.

Cross-VO sharing needs to be transparent to its primary users (the amount of resources negotiated with the providers, needs to be available to them at any time when needed) and is technically implemented by the providers. This is currently technically enabled by various mature implementation techniques which allow fair sharing by giving cross-VO access to resources only when resources are left idle by their primary users.

The EGI BM optionally supports full cross-VO sharing (it is an optional service offered by the NGIs) to create added value to the respective Resources Providers and the related Funding Agencies, whose typical main interest is the optimal usage of available funds.

EGI promotes and encourages the maximum of cross-VO sharing because this is a value that EGI can offer to Research Institutions, Funding Agencies and Resource providers (its important stakeholders).

EGI e-Infrastructure: distributed resources from providers, the technical Grid services at the Grid site and NGI level, the NGI operational services (accounting, monitoring, help desk, etc.), the Grid middleware and the testbeds for the its certification and integration, are some of the main elements which constitute the *EGI e-Infrastructure*, which technically enables the access of resources (the EGI mandate as explained above). The EGI services are organised in an NGI-based environment. EGI.org is an instrument for the NGIs to “better” provide these services; “better” meaning either more economical or with enhanced functionality or both.

This Chapter describes aspects of the overall EGI framework and of its BM actors, such as: the purpose, the offerings and strategies, the e-Infrastructure, organizational structures, operational processes and policies, etc.. The BM is informally introduced in Chapter 5.1.4 by detailing a general use case for EGI, and it is formally detailed in Chapter 5.3.

5.1. EGI USE CASE AND REQUIREMENTS

EGI brings together NGIs and EGI.org with Research Teams, Resource Centres/Owners, Middleware providers, to enable global research collaborations on a European scale to more easily accomplish their mission in profiting from common shareable pools of IT resources. The EGI BM comprises a set of partners, stakeholders and customers:

5.1.1. EGI Partners

- **National Grid Initiatives (NGIs):** the NGI is a legal organization. NGIs are the EGI partners responsible for the management of their national Grid e-Infrastructure and for holding

relationships with customers (primarily, the Research Institutes and Research Projects carried out by the VO constituted by research teams), and with a set of national partners, the Resource Providers (e.g. the resource centres) which offer resources to support the needs of customers in the country. The NGI and the Resource Provider form a national "business alliance" to jointly develop and "sell" a specific national marketplace solution.

A national VO itself is in general constituted by research teams from Research Institutions in the country (and not by individual scientists, who have no relation to a research institution). In so far an international VO is a federation of national VOs.

Note that a resource centre chosen by Research Institutions could be a commercial one offering for example, cloud computing and storage services under payments of fees proportional to the usage. In the future, commercial providers may be willing to offer their resources through the EGI e-Infrastructure to Research Institutions or to a wider user domain e.g. other public sectors like health, civil protection etc. In that case the EGI business model would evolve to include such possibilities.

- **EGI.org**: the EGI partner mainly responsible for coordination and provision of common services for the European e-Infrastructure, to be sold in the long term, to NGIs.
- **European Research organizations** like CERN, EBI, ESA…..the ESFRI Research Infrastructures, interested in the availability of a pan-European e-Infrastructure, who can supplement EGI.org or NGIs in providing the services required by their specific sectors. European Research Organisations will in the context of their scientific work make use of the EGI infrastructure but always through NGIs in terms of a "business relation".

5.1.2. Other EGI Stakeholders

- **Middleware Consortia (MC):** these are the EGI partners which provide the middleware needed to implement the European e-infrastructure (e.g. gLite, UNICORE, ARC, and other development teams. in Europe and Globus, Condor etc in US.)) who have so far guaranteed the middleware used in current e-Infrastructures; maintenance and development work will be commissioned for some time to those partners by EGI in order to meet the requirements of the user communities.

5.1.3. EGI Customers

National Research Institutions (RIs): Universities, Research Laboratories, National Research Organizations….); Research Teams (RTs) operating across Europe, create pan-European Virtual Organizations (VOs), whose members represent the consumers of the services offered to RIs.

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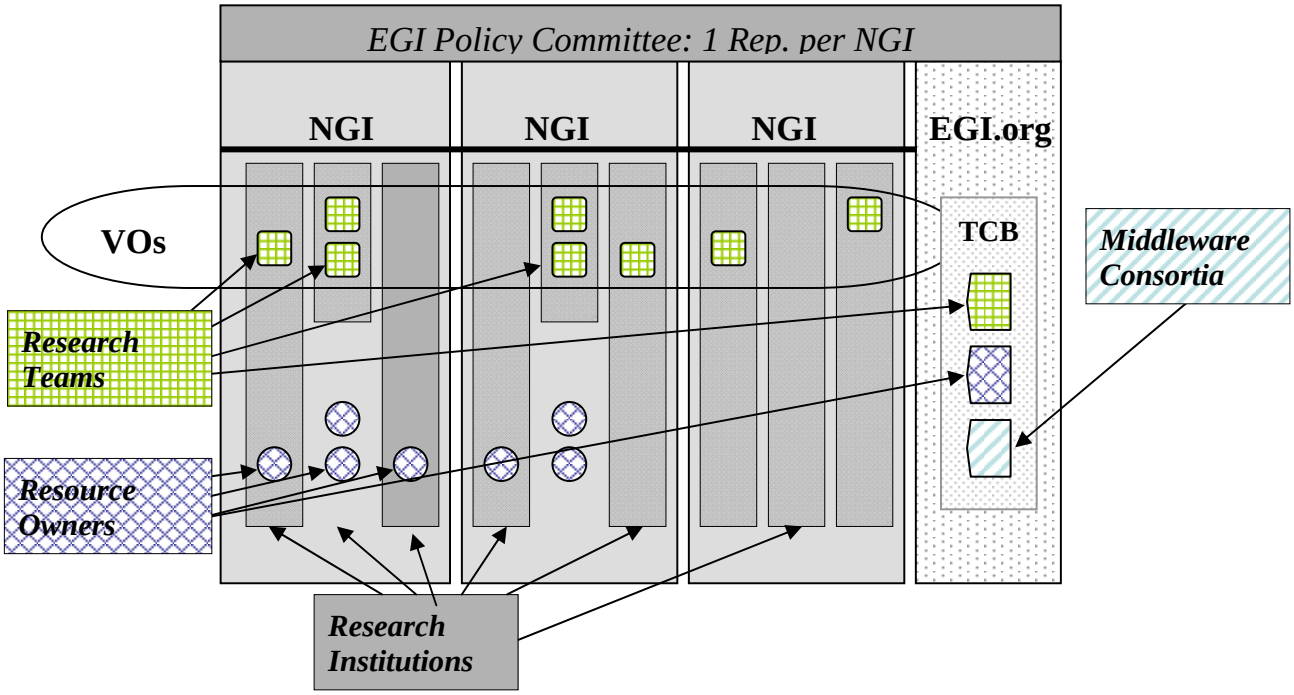


Figure 1: Actors in the EGI Business Model

5.1.4. Use Case

Research Teams (RTs) in general come together for a limited time (at the National, European or International level) within a Virtual Organization (VO), to constitute a project which pursues some research objectives. Such project is normally approved by peer review committees (acting at national and/or European or International level), set up by the involved Research Institutions or funding Agencies, that allocate the necessary funds including those for the IT resources.

VOs have different requirements on the IT resources they need to share, their usage model and the set of baseline services which EGI has to offer to enable this, e.g.: authentication and authorization services, accounting services for NGIs and VOs, services for data sharing at different levels of abstraction, services for compute sharing for different types of resources, monitoring services, etc.

The Research teams belong to different Research Institutions (Universities, Laboratories, Applied Research Institutions…).

Resource consumption may be organised in different ways through VOs. A VO may fulfil its resource requirements through resources from its constituent research institutions, or through resources provided by a resource provider (either by another research institution or by the market) or any other means which fits the VO's needs.

1)

An e-Research project needs to make available to its members a set of *software tools* which enable the *secure sharing* of all the partner Organizations' "local" IT resources and data located in the different administrative domains (**Requirement n.1**).

Such sharing may concern the CPU cycles of the commodity clusters used for the analysis of HEP, BIO, Astro… data, the fast interconnect parallel systems for the MPI applications of Computational Chemists, Earth Observation, Biomed, Weather forecast etc., the files contained in distributed storage systems for image visualization of Astronomers, Medical doctors etc, the metadata located in distributed archives systems related with a large variety of applications, etc.

The sharing occurs through software services (*grid middleware*) which expose to the user a uniform interface hiding the local diversities and allowing a distinct level of authorization according to the member's role and the agreed project policies. In this way a project common pool for all kind of resources is created, allowing the most efficient exploitation by the project partners of all the available distributed resources and data.

The reference Resource Centres/Providers are asked by the VOs to operate the set of services which enable them to reach the above goal. A distributed accounting at the level of Institutions is also required together with tools to monitor the activities and eventually a support to the VOs to enable their legacy user applications to execute in this multi-administrative domain pool.

It should be noticed that many VOs, especially the new ones, tend to consider their sharing requirements always a special case which need the development of integrated special vertical services dedicated to them (see LHC experiments, ESFRI, etc). However the use of a layer of services common to the other VO's, when possible, has the advantage of manpower saving, for the development and even more important for the seamless operation and the maintenance of the more fundamental baseline services enabling the sharing, as well as the advantage of allowing partial sharing with different VO (thus increasing the pool of available resources), see below.

It is economically much more *convenient and efficient* for the funding bodies as the Research Institutions, or in general the national and European funding agencies, to promote, support and fund the procurement and the operation of a common, robust, secure, certified set of baseline grid services which the EGI.org, at European level, and the NGIs, at national level, can offer and operate as part of the general EGI/NGI e-Infrastructure to enable global sharing, rather than a chaotic set of tools that each VO may freely ask to adopt or develop (**Economy argument**).

In this way most of the past investments made at EU or at national level will be continuously reused for the benefit of the new VOs and the high level special services that these may still need to develop will be less expensive and founded on a mature layer with a longer lifetime and wider user spectrum (**Reuse and long-term perspective argument**).

The point of view of a better global return for the money invested by the funding bodies, pushing for the creation of global pools based on a well defined certified set of services, constitutes the important **Requirement n.2** for EGI which could possibly not always be shared by all VOs.

Resource Centres/Providers have obtained so far from external providers (EU projects or Middleware Consortia) the general grid middleware services they need to operate. Obeying to different VO consolidated practices in some cases they are currently supporting more than one middleware solution. To *avoid* to charge the *high costs* of the support of chaotic and very expensive multiple special environments and the real operational challenge of being able to offer a well defined *quality of service* for multiple solutions, they will normally appreciate and support the coordinated action of EGI.org and of their national NGIs in moving towards a *progressively unified solution* for the services they will have to operate in line the funding Research Institutions and Funding Agencies but moved by the need of simplified and easy operations (**Operational argument**). This constitutes the **Requirement n.3** for EGI.

Of course while the above **3 Requirements** provide the foundation of the EGI.org and NGI's Business Model they should not be perceived as limiting by any means the strategies that each NGI could adopt in its reference country. It may well happen that some countries in addition to the common set of supported services obeying the EGI rules and policies decide to continue to support also "islands" based on more private or not certified services.

5.2. TEMPLATE AND RELATED TERMINOLOGY

The template by Osterwalder [2] was adopted to illustrate the EGI business logic. The template is illustrated in Figure 2. Nine building blocks can be identified.

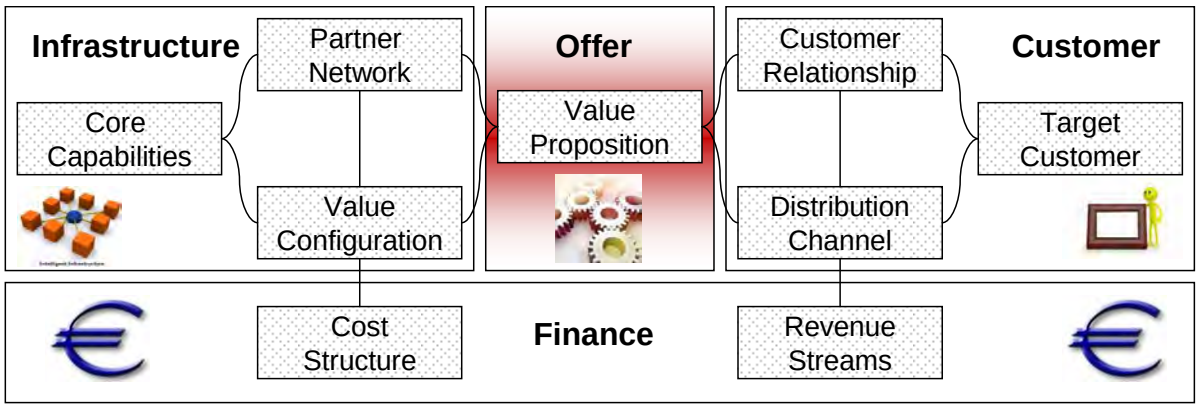


Figure 2: Business model template

- **Offering**, composed of:
  .1. *value proposition*, the products and services a business offers;
- **Infrastructure**, composed of:
  .1. *core capabilities*, the capabilities and competencies necessary to execute a company's business model,
  .2. *partner network*, the business alliances which complement other aspects of the business model,
  .3. *value configuration*, the rationale which makes a business mutually beneficial for a business and its customers;
- **Customers**, composed of:
  .1. *target customer*, the links a company establishes between itself and its different customer segments,
  .2. *distribution channel*, the means by which a company delivers products and services to customers,

[2] The Business Model Ontology - A Proposition In A Design Science Approach, Thesis by Alexander Osterwalder, 2004 (http://en.wikipedia.org/wiki/Business_model)

.3. *customer relationship*, the target audience for a business' products and services;

- **Finances**, composed of:

.1. *cost structure*, the monetary representation of the means employed in the business model,

.2. *revenue streams*, the way a company makes money through a variety of revenue flows.

5.3. EGI BUSINESS MODEL

5.3.1. Offering

- **Service "Secure sharing of distributed IT resources** and data (e.g. CPU cycles available from commodity clusters or fast-interconnect parallel systems supporting MPI applications, storage space, geographically distributed data as files for image visualization, metadata from distributed archives, etc.).

  Many RTs need secure sharing of resources among the geographically distributed Resource Centres that provide them with these resources. In principle these RTs could perform this sharing with their own tools and in a way not coordinated with any other RT; this lack of coordination however entails a significant waste of resources (hardware, software and human) both for the RT and for the Resource Providers and Funding Agencies at large.

  For the resource owner this implies that sharing the contracted resources within *much larger pools* from other resource owners (with the agreement that for a given RT the corresponding share is still made available with top priority), gives the possibility to gain low priority access to other owners' resources. In order to facilitate sharing, access credits to other owners' resources should be proportional to the amount of own resources offered and consumed by Grid Resource Teams. In the long term, the amount of resources made available to other external customers, and the amount of resources received in exchange need to compensate.

  Resource providers in this way *increase their offer* to the respective Research Institutes. In this way, for a defined period of time, they can make available a much larger pool than the one they can offer locally or types of resources not locally available.

- **Service "Middleware"**: *resource* sharing occurs through the EGI e-Infrastructure which exposes to the user a uniform interface, thus hiding the local diversities and allowing a distinct level of authorization according to the member's role and the agreed project policies. EGI collects requirements from the Research Teams and Resource Providers and ensures that the middleware offered (originally provided by the Middleware Consortia), meets those requirements, is certified, interoperates and enable the creation of common pan-European pools for all sort of IT resources and data. Note however that each NGI and Resource Provider is free to adopt any other service implementations to continue to support more private or regional islands. EGI has very little to say about this.

- **Service "Application support and training"**: EGI supports RT applications that need to use the e-Infrastructure and offers specific support in gathering requirements from the RTs and representing them vis à vis the middleware (and other software) providers. This is carried out in part by a small central team plus a set of **extended RT services** (optional services). Activities such as providing support to porting activities and training of the users and administrators is generally delivered through NGIs, either on a national level or via specific agreements with other NGIs in the context of the creation of a cluster of extended RT services referred to as a Specialised Support Centre (see section 8.1.1).

- **Service "Resource brokerage"** (optional service)*:* gathering resources for European and international RTs can be a lengthy and difficult task, especially for smaller RIs who do not own resources. If requested (this is an optional service), EGI can facilitate the process by connecting customers with the resource providers via the relevant NGIs, and by ensuring that the RT has access to shared resources in the e-Infrastructure. The establishment of an SLA and the related contract only involves the RI and the resource provider.
- **Service "Help desk"**: support is provided to resource providers and users in case of problems with the use and the operation of the local and global e-Infrastructure respectively.

5.3.2. Infrastructure

5.3.2.1. Partner network

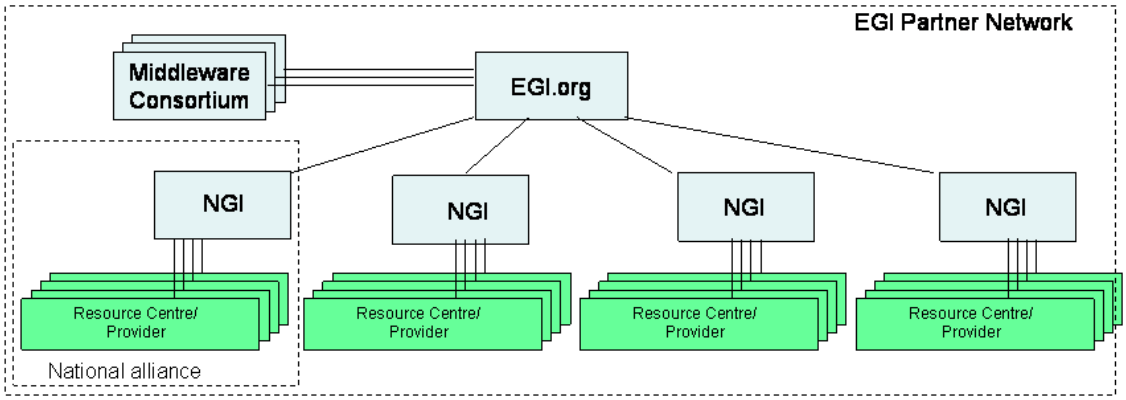


Figure 3: Alliance of EGI partners and NGI partners constituting the EGI Partner Network

NGIs and related Resource Providers (RPs): a given NGI and the national/regional RPs join to form a national partner alliance to jointly offer the services needed to implement a global pan-European shared pool of resources as the most efficient way to satisfy the requirements of the national RTs. Resources from national/regional resource owners, are made available to customers via RPs. One owner is also a provider if it both owns and provides resources to the Grid (RIs which operate their own resource centres which share resources via the Grid, are typically both owners and providers).

The NGI represents the RIs and the Resource Centres/Owners of one country for all matters concerning the national e-Infrastructure towards the other NGIs, the EGI.org and the European Commission.

The existence of a National Grid Initiative and of EGI.org operating the general European e-Infrastructure streamlines the actions required to share resources by reducing the $O(N^2)$ problem of establishing bi-lateral contacts with other providers.

In addition, the NGI can provide help and recommendations to guarantee the "balance" between the national amount of IT funding (which determines the national resource global offer) and the national RI global demand for each individual type of resource. It should be stressed that in the EGI model at the substantive level each country is completely responsible for guaranteeing such balance.

Note that this document only describes activities and offerings by an NGI that are needed to support international RTs and to be seamlessly integrated in the European e-Infrastructure. Any other activity and offering that is specifically targeted to address local needs, are not part of the EGI BM. For these

latter activities the NGI is completely free to adopt a BM of its choice. Similarly the role of RPs described in this document complements the traditional resource provider BM typically based on the offering of IT resources often according to annual flat service fees (needed to cover capital expenditures).

EGI.org: it offers those services that are of common interest to all NGIs, such as the overall coordination framework for the development, operations including security across national borders and user support activities, and

- the hosting of operation/maintenance of operational tools and critical services which are more conveniently performed centrally.
- the overall coordination framework for the development, operations including security across national borders and user support activities.

The main customers of EGI.org are the National Grid Initiatives (NGIs), which operate the Grid infrastructures in each country.

Middleware Consortia: the current environment of EU middleware development consists of multiple teams of experts specialized in the development of one or more of the middleware services. At this time, these teams are organized around Middleware Consortia with additional distributed teams. They normally work in close collaboration with the US teams which provide the solutions for TeraGrid or the Open Science Grid (OSG) like Globus and Condor. In order to leverage the existing clusters of competence it is then advisable to maintain this model based on decentralized teams while introducing with EGI an effective pan-European technical coordination.

Almost all the EU middleware developments have been supported so far by a significant EC co-funding which has allowed especially for gLite, but also for other solutions, the strong interaction between Operation, Application and Middleware activities (included in the same project) and the delivering of the services with the functionalities and quality that user VOs and site administrators needed for their daily work. The same has happened for Globus and Condor in US which have received substantial support by the National Science Foundation (NSF) or the Department of Energy (DOE).

ARC, gLite, and UNICORE represent the today leading edge European reference MWare solutions that have demonstrated the capability to support large and diverse pan-European communities with a great variety pf requirements and huge amounts of computation and data needs. There are some European user communities also relying on the US Globus services, but these Globus based grids are usually much smaller and independent, not creating a truly general shared grid infrastructure.

The Open Source software development and the offering of related maintenance and support services by the middleware Consortia and the additional European teams of experts has a less straightforward economic sustainability model compared to current service activities (e.g. network bandwidth offering by the Dante/NRENs organization). The Consortia cannot expect to immediately gain economic sustainability through standard fee-for-service contracts, as the Open Source software can be freely downloaded and used by skilled communities (e.g Linux is used by the HEP scientific communities without buying extra services).

A possible way to overcome these difficulties and to make profit of the significant progress made so far is the creation of an Open Source Universal Middleware Distribution (UMD) under the steering of EGI which could progressively include all certified interoperable services adopted in the pan European e-Infrastructure.

Specific actions to expand the usage of UMD by less skilled user communities should be undertaken, in order to progressively increase its economic sustainability through this additional income. Sustainability should rely on the generalization of the UMD services to adapt to requirements from a growing user community, including business and government (similarly to the case of Red Hat or the Apache consortium). This process will take time and will require continuity of explicit support of the development efforts leading to general and standard products (the case of pre-competitive services).

The target customers of middleware consortia are EGI.org, NGIs and, indirectly, Resource Centres/Owners and RTs.

The overall partner network is illustrated in Figure 3.

5.3.2.2. Core capabilities: IT Resources

RESOURCE PROVIDERS

- **IT resources** which can be brokered via different channels:
    - RIs have them already internally available via consolidated *centres* which host their own IT resources and data infrastructures. These are made available to the RTs according to well defined amounts and usage policies.
    - RIs *acquire and operate* their own resources only when needed (this is typically applicable when the demand is imited).
    - RIs sign a *long term contract/agreement* with external RPs, which guarantee that the agreed resources are provided, and host the RI data (for example, at the cost of a negotiated flat rate for a given yearly share).
- **Operation of Grid resources to make them shareable.**
- **Operation of Grid technical services** (at the RP and NGI level): these operate the set of services needed by the customers for the sharing of resources. Additional tools need to be operated, for example for the accounting of the RI resource usage and for monitoring.

NGI

- **Cooperation with the partner NGIs and EGI.org** to define common policies, specifications, standards, procedures, etc. for the usage of the resources included in the shareable common pools
- **Operation of Grid core technical services** at the NGI level (workload management services, data management services, catalogues, etc.) following EGI operational requirements and recommendations, and a number of other auxiliary services such as the issuing of certificates, authorization services, etc.

- **Rollout and deployment of Grid middleware to the resource centres:** the NGI ensures that the middleware services adopted by the partner resource centres comply with the international standards and with the set of EGI policies and quality criteria necessary to guarantee the full functionality and interoperability which are at the foundation of general pan-European pools.
- Operation of the central **monitoring and accounting** service of the national e-Infrastructure. Accounting is needed to provide information about the overall resource usage to national RIs or NGIs.
- Technical coordination (if and when needed) of the **customization** of middleware components released by Middleware Consortia.
- **Ticketing system and help desk** (NGI)**:** support to the RTs is needed to facilitate the running of existing user applications on the e-Infrastructure.
- **Training of users and resource centre administrators.**
- **Resource Brokerage** (optional service) towards other NGIs when some required services are not provided by the national Resource Centres/Owners ;
- The NGI ensures global monitoring and accounting at national level for VOs and other NGIs, in order to account for the global resource usage balance between the NGIs.
- Offering and operation (possibly via outsourcing) of the **high level services** required by the national customers.

Note that some of the above-mentioned activities can be considered services which in due time could be offered by the NGI under annual contract fees. There is also a large number of practical possibilities to be chosen by an NGIs to implement such services ranging from delivering them directly to completely outsourcing most of them to one or more Resource Centres/Owners.

EGI.org

- **Coordination** of middleware development, standardization, operation and application support activities carried out by the partner NGIs.
- **Liaison** with international bodies, standardization bodies and other e-Infrastructures.
- **Infrastructure for middleware testing and certification**: to check if middleware released by MC meets the RT requirements and to certify its interoperability.
- **Provisioning of Grid services, support, dissemination and outreach activities** at the pan-European level, complementing and coordinating the NGI ones.
- **Integration, testing, validation and packaging of software** from Grid middleware providers, along with its distribution.
- **Definition of common policies and procedures**.

MIDDLEWARE CONSORTIA and additional teams

- Middleware **development** and **maintenance to satisfy the EGI requirements**
- Active involvement in international **standardization** efforts

5.3.2.3. Value configuration

Value configuration for EGI

- **e-Infrastructure implementation**: creation and support of the European e-Infrastructure that includes the cost-effective procurement, final certification, coordinated release, deployment and seamless operation of Grid middleware.
- **Evolution and excellence:** the capability to ensure the long-term evolution of the e-Infrastructure according to the user needs, and to drive the leading edge of the technology

Value configuration for Research Teams

- **Use of a European e-Infrastructure** which can maximize the RT achievements, such as publications, R&D results, patents, etc.
- **Capability to share resources** within the Team, with only a limited Team investment in the development, maintenance and operation of the tools and infrastructure needed for effective sharing .
- Increased capability to satisfy the RT **workload during peak hours**– thanks to statistical multiplexing – if access is granted to a pool of shared resources (in addition to the minimum share agreed with the RPs of choice).

Value configuration for Resource Providers

- **Efficiency of resource exploitation** – The sharing of heterogeneous distributed resources and distributed data allows a most efficient exploitation by RTs, thus increasing the pool of available resources thanks to statistical multiplexing.
- **Increase the amount of resources** available to customers during peak hours and attract those customers who have large peak demands or need some type of resources not available from the own resource centres.
- Simple set up of the VOs and sharing of the resources and data from the beginning of the VOs' activities with the **quality** required by a production Grid infrastructure. The VOs can then concentrate on developing the additional higher level services that they may need to be able to offer an easy high level access to the e-Infrastructure to their users.
- Access to a **help desk** service operated by their partner NGI for support in case of operational problems and to training activities.
- **OpEx reduction**[3] (reduced cost of Grid infrastructure operation): the use of a layer of Grid technical services common to many RTs, when possible, has the advantage of manpower saving, for the development and even more importantly for the seamless operation and the maintenance of the more fundamental baseline services which enable the sharing, as well as the advantage of allowing partial sharing with different VO (thus increasing the pool of available resources) – see below

Value configuration for NGIs

[3] Operating Expenditure

- Being the **unique national point of contact** for grid computing between the EGI.org and the other NGIs and national Institutions.
- **Return on investment on OpEx** (same as for the RPs, see above)

Value configuration for Middleware Consortia

- **Interoperability and certification:** the partnership with EGI ensures the gathering of novel requirements, and facilitates the convergence to a common standard compliant, interoperable and certified layer of middleware services (UMD) which could receive a wider support.

Value configuration for Funding Agencies

- **CapEx reduction**[4] It is economically much more *convenient and efficient* for the funding bodies as the RIs, or in general the national and European funding agencies, to promote, support and fund the procurement and the operation of a common, robust, secure, certified set of baseline grid services which the EGI.org, at the European level, and the NGIs, at the national level, can offer and operate as part of the general EGI/NGI e-Infrastructure to enable global sharing, rather than a heterogeneous set of incompatible tools that each RT may freely ask to adopt or develop. The coordinated action of EGI.org and of the NGIs in moving towards a *progressively unified solution* is needed to simplify and ease operations (**Operational argument**).
- **Reuse and long-term perspective argument:** a larger user community will benefit from past investments at the EU and national level. Future investments on middleware development are likely to decrease, as application-level specific services will relying on a common middleware layer.

5.3.3. Customer

5.3.3.1. Target customers

- **Research Institutions** (RIs): Universities, Laboratories, Applied Research Institutions, Research facilities, etc. Consumers of these services are the national, European or even international *Research Teams* (RTs) belonging to different RIs who come together for some time within a *Virtual Organization* (VO) to constitute a project which pursues some research objectives. Such project is normally approved by peer review committees (acting at national and/or European or International level), set up by the relevant RIs or funding Agencies, that allocate the necessary funds including those for the IT resources. VOs have different requirements on the IT resources they need to share and usage models. These needs are matched by the baseline services offered by EGI.
- **Public organizations** such as Civil Protection, Hospitals, etc.

5.3.3.2. Distribution channel

The EGI offer is articulated in a set of integrated services offered by EGI.org at the European level, by the National Grid Initiatives (NGIs) and the RPs at the national level.

Resource Provider resources are made available to RTs directly through the relevant RIs, or indirectly through EGI.org and/or the NGIs in accordance with the different scenarios.

[4] Capital Expenditure

EGI.org itself is the channel for centralized services, while the (global) EGI offer is channelled to Research Institutes and Research Teams via the partner NGIs.

5.3.3.3. Customer relationship

As illustrated in Figure 4, Grid services are distributed to the RIs (the customers) via the NGIs.

On the other hand, the procurement of Grid resources for those RIs that do not own resources in the Grid, is based on a negotiation between the RI itself and the Resource Centres/Providers. The NGI can assist an RI in the process of resource brokering, if this service is requested by the RI. In both cases, a Service Level Agreement between the RI and the RP is established as a result of the negotiation process.

For the EGI BM offer a contract is established by NGIs with the national RIs and Service Level Agreements need to be established with RPs to ensure that the Grid services in the resource centres are operated according to an adequate production-level standard.

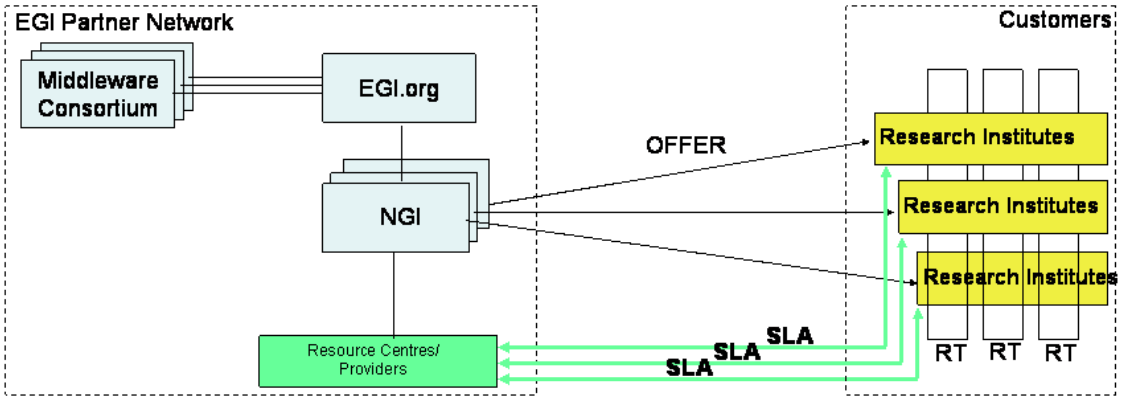


Figure 4: Relationship between the EGI BM partners and the customers

5.3.4. Finance

The financial model of EGI is described in detail in the EGI Blueprint draft [http://web.eu-egi.eu/blueprint]. In what follows we briefly describe the cost structure and the revenue streams.

Note that for what concerns the funding of NGI activities, the NGI has the responsibility of raising the national and the European funding for its international tasks. The NGI acts as the unique national interface for what concerns the e-Infrastructure towards all funding Agencies: National and EC, the other NGIs and EGI.org. In addition, for what concern the costs related to the international NGI tasks and EGI membership fees, the NGI needs to ensure the national co-funding.

The problem of hardware funding needed by Resource centres/owners is out of the scope of the EGI BM.

5.3.4.1. Cost structure

NGI costs: EGI membership fees, middleware consortia fees, co-funding of international NGI tasks, operation of required Grid technical services, application support and training, help desk, fees for EGI.org. services (in the future).

EGI.org costs: operations, management and coordination costs.

5.3.4.2. Revenue streams

NGI: fees and/or funds from partner RIs, EU co-financing, national funding agencies, service charges (in the future). Revenue streams are always related to specific EGI services.

EGI.org: membership fees corresponded by NGIs, EC contributions and service charges (in future)

Middleware Consortia: Fees corresponded by EGI.org and NGIs, EC and national public funding. In future contributions from companies involved in the Consortia

5.4. SUMMARY

The table below summarizes the components of the general EGI business model and the specific components concerning each one of the main actors.

Business Model Component		**Research Institutions/Funding Agencies**
Infrastructure	Core Capabilities	Capabilities to carry out a Research program at best
	Partner Network	EGI.org, NGIs, VOs, Resource Centres/Owners
	Value Configuration	Mutual sharing of computing power/storage can reduce whole costs of IT
Offer	Value Proposition	Giving better research results thanks to European or International scale (also thanks to greater resource pools available through the grid infrastructure)
Customer	Target Customer	National Research Institutions , Research communities,
	Distribution Channel	Research Teams forming Research Virtual Organizations. Publication of R&D results, patents Research facilities. Possibly other public organizations (Civil Protection, Hospitals etc)
	Customer Relationship	Through trans-organizations VOs, Resource Centres/Owners …..
Finance	Cost Structure	Mw Consortia fees, EGI.org and international NGI's tasks, additional Resource Centres/Owners fees
	Revenue Streams	EU & National Research e-Infrastructure funding, service charges (in future..)

Business Model Component		**EGI.org**
Infrastructure	Core Capabilities	Overall central coordination of the European Grid Initiative
	Partner Network	The NGIs and indirectly the full EGI ecosystem
	Value Configuration	Making available a European-wide e-Infrastructure for e-Research
Offer	Value Proposition	Enabling sharing of national IT resources for e-Science. Creating common pools of European dimension. Optimizing usage and reducing costs.
Customer	Target Customer	NGIs and indirectly VOs using the grid infrastructure and resource centers/owners providing the resources

	Distribution Channel	EGI.org itself for centralized services. Through NGIs for national services,
	Customer Relationship	Indirect through NGIs
Finance	Cost Structure	Operations, management & coordination costs
	Revenue Streams	Fees corresponded by NGIs, EC contributions and service charges (in future)

Business Model Component		**Resource Centres/Owners**
Infrastructure	Core Capabilities	Making shareable and operating owned IT resources at best (CPU, Storage, Archives, Network transfer services..) – really the "Grid infrastructure resource providers"
	Partner Network	EGI.org and the NGI
	Value Configuration	The ability to share computing power/storage and other resources enlarges research possibilities of national VOs teams, expand the RCO service offer and reduce the unit costs thanks to optimization of use
Offer	Value Proposition	Offering computing power, storage time-slots & facilities for VOs integrated into greater resource pools available through the grid infrastructure
Customer	Target Customer	VO,s National Research Institutions, Research communities other public organizations: civil protection, hospitals…..
	Distribution Channel	Direct through Research Institutions, or indirect through NGI
	Customer Relationship	Research Institutions or indirect through NGI
Finance	Cost Structure	Mw fees, grid service operation and maintenance fees
	Revenue Streams	Additional revenue from service charges for the additional services enabling resource sharing from National Research Funding Agencies or Research Institutions

Business Model Component		**NGIs**
Infrastructure	Core Capabilities	Rising funds, supporting global collaborations and coordinating/supporting the national grid activities, offering services to VOs and resource centres/owners
	Partner Network	Research Institutions, VOs, EGI.org, NGIs Mw Consortia
	Value Configuration	Being the unique national point of contact for grid computing between the EGI.org and the other NGIs and the National Institutions
Offer	Value Proposition	Giving national access to the European Grid Infrastructure (for RI & VOs). Making e-Infrastructure customers & providers to interact., supporting technically Resource Centres/Owners in the operations of the common pools, ensuring accounting balance
Customer	Target Customer	Research Institutions & Resource Owners
	Distribution Channel	Direct or through Resource Centres/Owners

	Customer Relationship	A contract is needed with RI and Resource Centres/Owners
Finance	Cost Structure	Membership fees, co-funding of internal EGI tasks operations of required services, fees to mw Consortia. For maintenance and support . Fees for EGI.org. services
	Revenue Streams	Fees/funds from partner Research Institutions. EU cofinancing, national funding agencies or governments

Business Model Component		**Middleware Consortia**
Infrastructure	Core Capabilities	Middleware developing & maintenance
	Partner Network	NGIs & EGI.org
	Value Configuration	Only a mature & open source middleware evolving user driven can realize the vision of a mutual & seamless sharing of IT resources
Offer	Value Proposition	Middleware stacks (actually: gLite, UNICORE, ARC) and other products constituting the the Unified Middleware Distribution
Customer	Target Customer	EGI.org & NGIs. Indirectly Resource Centres/Owners ajnd VOs
	Distribution Channel	EGI.org & NGIs
	Customer Relationship	Indirect through NGIs
Finance	Cost Structure	Development, maintenance and support
	Revenue Streams	Fees corresponded by EGI.org and NGIs. EC and national public funding. In future contributions from companies involved in the Consortia

6. FUNCTIONS OF EGI: OPERATIONS AND SECURITY

The operations and security function includes those EGI tasks needed to ensure optimal functionality of the pan-European infrastructure and the overall seamless effective interoperation of national and regional Grids. This Chapter provides a thorough description of activities and the related resource demand. A summary of the Chapter is available in EGI_DS Deliverable 4.4 (the EGI Blueprint).

Operations and security activities are composed of *EGI.org tasks* and of *international NGI tasks*, which are complementary and equally important. The relationship between EGI.org tasks and NGI international tasks is illustrated in Figure 5.

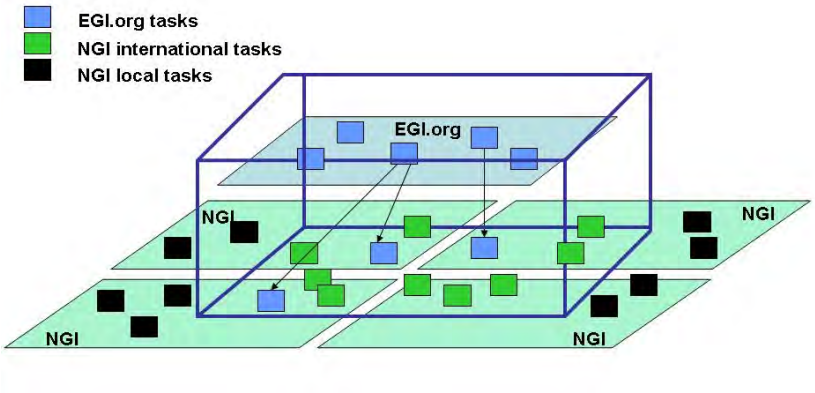


Figure 5 EGI operations and security tasks (blue rectangle) as a sum of NGI international tasks and EGI.org tasks

As detailed in [2], the operation of the pan-European Grid infrastructure relies on a number of principles. These are the foundation of the set of operational and security tasks identified in this Section:

- **Reliability of Grid services and SLAs**: notwithstanding the different and evolving needs of application communities and NGIs, a key component of the EGI vision is the provision of a large-scale, production Grid infrastructure – built on NGIs that interoperate seamlessly at many levels, offering reliable and predictable services to a wide range of applications, ranging from "mission critical" to prototyping and research. It is understood that it will be a long and continuous process to reach this, with additional NGIs and/or application communities joining at different times, with varying needs and different levels of "maturity". In addition, sites of widely varying size, complexity and stage of maturity must be taken into account. The EGI shall negotiate the minimal size and set of functions for an NGI to participate in a wider context, including the associated Service Level Agreements. This includes the agreement and follow-up of the associated certification processes. In some cases, these requirements may be more stringent than those used within a given NGI. That is, only a subset of sites participating within an NGI may satisfy the wider requirements at the EGI level.
- **Multi-level operation model:** highly centralized models – e.g. for monitoring – have been shown to be both intrusive and non-scalable. This suggests a move to a multi-level operations model. Whilst building on the positive experience of today's production Grids, these concerns

must nevertheless be taken into account as part of the EGI/NGI architecture. This includes designing and deploying for low-cost-of entry and ownership, whilst maintaining sufficient flexibility to meet the requirements of the application clusters. The EGI shall foster agreement on the definition of the key operations infrastructure, its establishment and delivery. Such functions are preferably located at one or more NGIs (to offer both resilience and scalability).

- **EGI, NGI and ROC**: The NGIs participation to the operation of the European grid infrastructure requires set of services to be operated in a coherent way. Currently, within EGEE, this is guaranteed by the Regional Operations Centres (ROCs), that either span over several countries (NGIs) or are serving one country only. Continuation of the current ROC services will be guaranteed by NGIs, either at the NGI level or through associating into ROC equivalents..
- **A secure environment:** Security is essential for establishing trust in the Grid infrastructure. It spans a wide range of topics, from low level computer forensics through middleware security to the highest level policies negotiated between networks and institutions. It ranges from immediate incident response to adapting to advances in technology which may be years from deployment. Furthermore, security will be vary between NGIs, and will certainly differ between different types of Grid middleware. The challenge is to build on the security expertise of the NGIs, to foster collaboration, coordination and best practice, to ensure that the whole is not just as strong as the weakest link. The continuing development of international standards, for example in OGF, will be essential for interoperability. EGI.org, the NGIs and the resource centers have responsibilities to ensure a secure operating environment for users, VOs and sites.
- **Planning, coordination and gathering of new requirements:** EGI.org operations represent a "thin layer" mainly responsible for operations planning and coordination of efforts by the various NGIs and other parties. Also, EGI.org operations staff works towards a smooth evolution of tools and operational procedures according to the new requirements gathered.
- **Cooperation:** EGI.org and NGIs cooperate for a sustainable and effective operation of the e-Infrastructure and to tackle problems of common interest such as: implementation rules for robust services, security best practices, middleware security issues, steering of new developments, intervention procedures, incident response, escalation procedures and so forth.
- **Federation, interoperability and data aggregation**: EGI must federate a variety of operational aspects – some of which are implemented by NGIs and/or component sites. Consistency of security procedures, user support, incident tracking, monitoring and accounting must be ensured. EGI ensures interoperability of operational tools/infrastructures for security, monitoring, support, accounting, etc. For scalability reasons, operational data such as monitoring information, availability statistics and accounting records – collected by the NGIs need to be aggregated at the EGI.org level for SLA monitoring in full respect of the relevant national legal constraints.

The operations and security model adopted in EGI is distributed and needs to satisfy various requirements:

- scalability and interoperability: we expect the level of complexity of the EGI Grid infrastructure to gradually increase due the growing number of resource centres involved, of user communities supported and, in the transition phase, to an increasing complexity of the middleware to be deployed and supported. Scalability and interoperability of operations need to be guaranteed under such conditions.
- availability and reliability: operations need to be structured in a way which eases the delivery of a production-quality e-Infrastructure.

- sustainability: responsibility of daily operations and of ensuring high availability of services need to be distributed to NGI's and to the resource centres themselves. This is also achieved through increasing automation, the improvement of Grid operational tools and the establishment of bilateral SLAs.
- autonomy of NGI's: the operational model needs to be sufficiently flexible to allow the NGI to fully conform to EGI policies and procedure and to satisfy specific requirements and activities in the country.

Distribution is one possible approach to both ensure smooth transition and to address the above-mentioned requirements. For example, reporting of usage will need to be collated and trouble tickets may well also traverse several helpdesks.

Interworking relies on common standards and/or specifications for interoperation between NGI's. For example, exchange of information between Grid domains is necessary to support functionalities such as resource discovery and accounting; protocols for this need to follow common guidelines. To this end, collaboration from the NGIs is important to jointly define specifications, policies, best practices, and in general, to share operational responsibilities.

In what follows EGI Operations and security tasks and the related manpower effort are described.

6.1. Tasks and services

Given the operational described above, the main operational and security tasks of EGI.org are the coordination of NGI activities, definition of procedures, policies, specifications and standards for interoperation, and the operation of central data aggregation services and user-support services such as the helpdesk. The added value of the EGI.org tasks is to grant the seamless and efficient integration of the National Grids, providing coordination, procedures, repositories etc. Note that the current EGEE III model is already partially distributing responsibilities to regions and analyzing the operation tools and processes to see where additional distribution can increase efficiency.

EGI.org tasks are defined to be *mandatory* if deemed necessary to ensure interoperation of operational tools and to implement a consistent operational model across countries. We assume mandatory tasks to be already provided in year one of EGI.

The list of tasks for EGI.org and NGI is provided below, while a summary table of EGI.org activities and corresponding effort is provided in Table 2. Tasks are described in general and abstract terms, however they rely on the current operational model developed in the framework of the current and past EGEE projects. Activities are divided into five categories:

1. operation of tools and services;
2. support;
3. other tasks;
4. security;
5. development.

Notation: EGI.org and NGI tasks are numbered according to the following scheme. Prefix O-E identifies operations services provided by EGI.org, whereas O-N identifies those provided by NGIs.

6.1.1. Operation of tools and services

O-E-1 and O-N-1: Operation of the Grid configuration repositories (EGI.org and NGIs) – *mandatory*

> Many aspects of operations rely on the availability of information (as applicable) from NGIs about service nodes, contact details, security contacts, certification status, sites in scheduled downtime, etc. The Grid repository provides all such information. Information input is

devolved to regions and sites. The current central repository (known as GOCDB in EGEE) may need to be adapted to support a two-tier distributed model. This requires the definition and implementation of an exchange protocol between peer NGI repositories, or of other alternative implementation techniques.

O-E-2 and O-N-2: Operation of accounting repositories for global VOs – *mandatory*

The accounting repository is responsible of keeping records about usage of compute, storage, networking and other types of resources as required. It is the responsibility of a NGI to collect accounting data, and to keep a permanent master copy of usage records. Accounting information is needed by Global VOs in order to allow VO managers to know about the amount of IT resources consumed by the VO across different domains of the e-Infrastructure. For this reason, the deployment of standard interfaces between accounting systems in different NGIs, is important to ensure the interoperable exchange of records between different domains. EGI.org is responsible of the gathering and of making publicly available accounting information (as applicable and according to local lows) for each NGIs.

O-E-3 and O-N-3: Operation of the Grid repositories for SLA compliance and performance monitoring – *mandatory*

Availability and performance of Grid services and sites are important elements of information to check the health of the infrastructure and to verify the Quality of Service delivered to VOs and other NGIs. As SLAs can be established between VOs and sites, VOs and NGIs, NGIs and global VOs, tools need to be available to monitor the level of SLA conformance. This requires the maintenance of available tools and of the schema for central publishing of site and service status information. EGI will help VOs, NGIs and resource centres to define their SLAs according to a common format recognized by EGI.org and NGIs. VOs, NGIs and resource centres are free to choose the most suitable SLAs.

Performance information allows the monitoring the Quality of Service delivered by NGIs and the related resource centres, to global VOs. Performance monitoring is also important for network quality assurance/reporting and metrics follow up, to ensure the underlying network infrastructure is working properly, that it is efficiently used by the project, and that network providers are respecting their contractual obligations, when SLAs are in place.

EGI.org tasks are the publication of SLA-compliance statistics, maintenance of tools and schema for central publishing of site and service status information, preparation of reports on performance of NGI's, maintenance of monitoring tools able to generate alarms in case of SLA violations, and of a central dashboard tool.

O-E-4 and O-N-4: Operation of the Grid Operations Portals – *mandatory*

The Grid operations portals provide an entry point for various actors to support their operational needs. Different "views" are necessary according to the role of the customer (Grid operators, VOs, Grid site managers, Region Operations Managers, etc.). Information on display is retrieved from several distributed sources (databases, Grid information systems, etc). It provides static information about sites/VOs, and dynamic information about resources/services status and allocation. The central Operations portal is the aggregation point of regional information also accessible via regional operations portals.

O-E-5 and O-N-5 Grid operation and oversight of the e-Infrastructure – *mandatory*

Oversight activities over the NGI infrastructures are needed for detecting problems, coordinating the diagnosis, and monitoring the problems during the entire lifecycle until resolution. Oversight of the NGI Grid is based on monitoring of status of services operated by sites, opening of tickets and their follow up for problem resolution, 1st line support for operations problems.

This task includes all the work related to operation support including managing and responding to problems reported by the grid operator, running the required grid services at each site as well as services provided by the NGI, and services required by virtual organizations, such as file catalogues, and other VO-specific services.

This is currently done in EGEE in cooperation with the relevant Regional Operations Centres (via rotating shifts) according to a two-level hierarchical model [12]. We foresee the possibility to evolve this model, in such a way that NGIs can autonomously run oversight activities in the region, or to federate in order to share efforts. Regardless of this distributed model, during the transition we foresee the need of performing quality checks of the services provided by NGIs and of taking care of operational problems that can not be successfully distributed to NGIs.

EGI.org supports and actively controls the overall status of Grid services and sites, opening of tickets for requesting problem fixing, and tackling of residual problems not successfully distributed to NGI's.

6.1.2. Support

O-E-6, O-E-7 and O-N-6, O-N-7: central and regional Grid User Support and ticketing system – *mandatory*

User support relies on a central helpdesk, which is a regional support system with central coordination [6]. It gives access to user documentation and support, and to a problem ticketing system. The central system is interfaced to a variety of other ticketing systems in use in the NGIs in order that tickets reported locally can be passed to the central instance or other areas, and that operational problem tickets can be pushed down into local support infrastructures.

Support to network end-to-end problems in the Grid is also important, as connectivity is provided by the pan-European network research backbone and by a large number of National Research and Education Networks, each providing links to sites within countries. A Network Operation Centre provides the operational interface between the Grid and the relevant network players to check the end to end connectivity of Grid sites [4].

The NGIs provide 1st line local/regional support to users and centres, while EGI.org takes care of the Maintenance and Operation of the central ticketing system (GGUS like) and of the Triage of incoming problems.

a. Maintenance and Operation: run a central ticket handling system for Grid and network end-to-end problems. User support relies on a central helpdesk, which is a regional support system with central coordination [6]. It gives access to user documentation and support, and to a problem ticketing system.
b. Triage of tickets entering the central user support system (also known as ticket processing management in EGEE), consists in the monitoring and routing of all active tickets in the Grid user support system by Grid and VO experts, who are responsible of addressing the problems to the appropriate second-line specialized support units.

O-E-8 Gathering of requirements for user support tools and process – *mandatory*

Tools and the process for user support are designed to meet the requirements of customers taking input from NGIs, VOs and resource centres. Additional requirements may arise with the evolution of the middleware stacks in use, and with the support of new user communities. EGI.org is responsible of the coordination of this process.

6.1.3. Other tasks

O-E-9 Middleware roll-out and deployment, middleware pilot and certification testbeds - *mandatory*

It is important to ensure that middleware updates move from certification and into production as quickly as possible, while also assuring that the updates are suitable for deployment in the production Grid. EGI.org coordination will be needed for strategy decision, for example to decide significant changes to processes, and to ensure that resource sites are encouraged to upgrade whenever new critical updates of supported middleware stacks are released. Being still in a phase where middleware is subject to frequent bug fixing cycles, prompt alignment of the Grid services and components to the latest releases, contributes to better functionality and availability of the overall infrastructure.

In addition to this, the operation by NGIs of facilities for testing and certification of middleware are important for the deployment of high-quality middleware by allowing VOs and site managers to test Grid components during the early development and release phase.

O-E-10 Resource allocation and of brokering support for VOs from NGIs - *optional*

Global VOs can specify requirements in terms of resources guaranteed by the overall pan-European Grid infrastructure used. In this case, coordination – as required by VOs – contributes to ensure that a suitable production infrastructure (Grid core services and resources offered) is in place, to meet the global VO SLAs agreed upon. Development is still needed to provide tools for the automation of the management and the negotiation of SLAs. EGI.org is responsible of support and coordination of this process.

O-E-11 Interoperations between NGIs and with other Grids - *mandatory*

Coordination is needed to foster the creation of a seamless operations model across administrative boundaries, in order to pursue pervasiveness and sustainability of the infrastructure. This is of great importance as users who want to cross Grid boundaries need to know that the environments will be similar, and applications must function properly without major changes. Interoperation covers a number of aspects, such as the availability of common tests for monitoring of site status, the interconnection between helpdesks/ticketing systems, etc. “Other Grids” includes Asia-Pacific regional Grids, OSG, Naregi, and related infrastructure projects.

This role owns the definition of the middleware and the models allowing the NGI’s to interoperate. EGI aims at continuing the collaboration established with operations centres outside Europe in order to preserve the current integration of non-European sites into the production infrastructure. EGI.org is responsible of support and coordination.

O-E-12 Network support – *mandatory*

Network operation design, trouble handling, network assessment and improvement, application network requirement assessment, ensure the projects know the state of the network used and that problems raised by the Grid are managed, and that a link is established between Grid operations and network operations.

O-E-13 Definition of best practices, operations procedures, operations requirements - *mandatory*

Interoperation relies on the definition of best practices and of general operational procedures for daily monitoring activity for sites and federations. EGI.org is responsible of the coordination of these activities.

O-E-14 and O-N-8: Operation of the production Grid core services, catch-all services for global VOs, catch-all VO – *mandatory and distributed*

Grid core services are components of the Grid technical infrastructure, are software components that typically run on server machines. With Grid service we refer to a software instance (a Web service in many cases) "that is designed to operate in a Grid environment, and meets the requirements of the Grid(s) in which it participates." [7]

In particular, core Services are those mandatory components on which the overall Grid functionality relies in order to operate. Catch-all instances can be required to support small user communities. It is a responsibility of EGI.org to ensure that user communities are properly supported by the NGIs of reference. Examples of Grid core services are: the VO management service (e.g. VOMS), the File catalogue and transfer services (e.g. LFC and FTS), Job management services (e.g. WMS), Information services (e.g. BDII), Security services, etc.

Authentication is also fundamental to get access to resources in the Grid. This is why a catch-all Certification Authority must be available to any user community in EGI.

6.1.4. Security

The character of the security vulnerabilities and risks presented by Grid infrastructures provides a rationale for coordination among the Grid participants at various levels.

A common authentication trust domain is required to persistently identify all Grid participants. The International Grid Trust Federation [8], and the EUGridPMA [5] in particular, operated in line with the relevant e-IRG recommendations, exist to ensure interoperability at the European as well as the global scale. This must continue in EGI and must also adapt to take advantage of the work currently underway in TERENA and the National Research and Education Networks on developments of large-scale Authentication/Authorisation federations and infrastructures, as well as from the work of the Joint (EGEE/WLCG) Security Policy Group, that has successfully developed common interoperable security policies now in use across a number of international Grids

In a European e-infrastructure some central coordination will be required on policies, vulnerability handling, and operational security. Support and coordination of the work of teams drawn from the NGIs, will be the task of EGI.org

O-E-15 Coordination of security policy development and maintenance - *mandatory*

Security policy development and maintenance are needed to define agreement on best practice and security policies, CA policies (EUgridPMA) etc. A team of security people in NGI's will

take care of ensuring the definition and application of standard security policies. EGI.org is responsible of support and coordination.

O-E-16 Security and incident response - *mandatory*

It is needed to ensure that common policies are followed for coordinated incident response by Grid participants in the region for NGIs and overall for EGI.org. EGI.org is responsible of coordination and support.

O-E-17 Vulnerability – *mandatory*

A team of experts will deal with security vulnerabilities in middleware and its deployment. EGI.org is responsible of its support and coordination.

6.1.5. Development

O-E-18 Development and maintenance of operational tools – *mandatory (EGI.org)*

While the tools for accounting are included in the Middleware, other tools are needed to support operations. Examples are: tools for SLA-compliance monitoring, dashboards and alarm systems, ticketing systems, portals, etc., and new tools to improve automation.

The maintenance of the set of the tools presently in use on the Europe production Grids and the upgrades that will be necessary for keeping in step with the quantitative and qualitative evolution of the Grid, are included in the responsibility of the Operation function of EGI. This includes monitoring tools to measure and report on the quality of networks used by Grid project to ensure the underlying network infrastructure is working properly and is efficiently used, and that SLA constraints with network providers are met.

It is foreseen that EGI.org will only take coordination responsibility (mandatory task) while a set of willing NGI's will take care of the development work, to be co-funded by the EC.

6.2. Resources

Given the detailed description of activities provided above, the following paragraphs summarize the list of activities carried out by EGI.org and NGIs, and indicate the effort needed to support those tasks. For the sake of simplicity, estimations are expressed in Full Time Equivalents.

6.2.1. EGI.org effort

Operation of tools and services

O-E-1. Operation of the Grid configuration repositories. EGI.org FTE: 1

O-E-2. Operation of accounting repositories for global VOs. EGI.org FTE: 1

O-E-3. Operation of the Grid repositories for SLA compliance and performance monitoring. EGI.org FTE: 2

O-E-4. Operation of the Grid Operations Portals, EGI.org FTE: 0.5

O-E-5. Grid operation and oversight of the e-Infrastructure. EGI.og FTE: 1

Support

O-E-6. Maintenance and operation of central ticketing system: EGi.org FTEs: 2.

O-E-7. Triage of incoming problems: assignment of tickets to the 2nd line support units, ticket escalation end ticket follow-up to ensure they get closed, EGI.org FTEs: 2

O-E-8. Gathering of requirements for user support tools and process: EGI.org FTE: 0.5

Other tasks

O-E-9. Coordination of middleware roll-out and deployment, middleware pilot and certification testbeds. EGI.org FTE: 0.5

O-E-10. Coordination of resource allocation and of brokering support for VOs from NGIs, EGI.org FTE: 0.5

O-E-11. Coordination of interoperations between NGIs and with other Grids. EGI.org FTE: 1

O-E-12. Coordination of network support, EGI.org FTE: 0.5

O-E-13. Coordination of definition of best practices, operations procedures, operations requirements – *mandatory*, FTE: 0.5

O-E-14. Operation of production Grid core services, catch-all services for global VOs, catch-all CA: EGI.org FTE: 1

Security

O-E-15. Coordination of security policy development and maintenance; EGI.org FTE: 0.5

O-E-16. Grid security and incident response coordination. EGI.org FTE: 1

O-E-17. Vulnerability. EGI.org FTE: 0.5

Development

O-E-18. Development and maintenance of operational tools. EGI.org FTE: 1

Table 2: overall effort for EGI.org operations and security critical services

ACTIVITIES	FTE
Operation of tools and services	5.5
Support	4.5
Other tasks	4
Security	2
Development	1
TOTAL	17

6.2.2. NGI effort

The list of tasks in this paragraph is not intentionally comprehensive, as it is meant to only contain those *mandatory* tasks that the NGI needs to supply in order to support interoperation with the distributed model of EGI, and to support global VOs. Many of the tasks in this section are performed by the NGIs and coordinated by EGI.org. The mandatory property of many of the tasks below does not prevent an NGI to devolve the operation of the task itself to a third party or to choose the option of purchasing it from EGI.org. Tasks not relevant to the overall EGI operation model, or specific to national VOs, are omitted.

NGIs are free to choose the most suitable supply model for those, for example, it can federate with other NGIs to share effort, it can buy a set of services from other NGIs or other partners, or request

them to EGI.org. In order to facilitate NGIs, especially during the transition phase, we foresee the possibility for EGI.org to supply catch-all operational services – in addition to the central ones – to meet the demand of the NGIs. We believe the number of FTEs needed by EGI.org to run catch-all services remains fairly constant with the number of NGIs requesting it.

O-N-1. Operation of the NGI Grid configuration repository - *mandatory*

O-N-2. Operation of the NGI accounting repository - *mandatory*

O-N-3. Operation of the NGI repository for SLA compliance and performance monitoring – *mandatory*

O-N-4. Operation of the NGI Operations Portal - *mandatory*

O-N-5. NGI Grid oversight (monitoring of status of services operated by sites, opening of tickets and their follow up for problem resolution), 1st line support for operations problems: this task includes all associated effort related to support for the operation including managing and responding to problems reported by the grid operator, running the required grid services at each site as well as services provided by the NGI, and services required by virtual organizations, such as file catalogues, and other VO-specific services. *Mandatory*

O-N-6. Operation of the NGI ticketing system, gathering requirements for user support tools in the region – *mandatory*

O-N-7. Regional helpdesk: user and application support with local/regional helpdesk - *mandatory*

O-N-8. Operation of production Grid core services, catch-all services for global VOs, catch-all CA: running the required Grid services provided by the NGI, and services required by global VOs - *optional* and availability of Certification Authority: to distribute X.509 certificates to users and servers in the region - *mandatory*

O-N-9. Operations Coordination at the NGI level - *mandatory*

- security and incident response coordination in the region
- Roll out of middleware updates in the NGI
- Resource allocation in the NGI
- Interoperation with national and regional Grids

The estimation for the total manpower needed needed at the NGI level depends of course from the size of the NGI, from its model of working, including if it will outsource mandatory tasks or take care of extra tasks on behalf of other NGI's or EGI, etc.

Here tentative estimations are provided separately for three rough categories of NGIs, "small", "medium" and "large"; they are based mainly on the present EGEE experience, assuming that increasing automation and expertise will at least partly make up for the increase of Application variety and Middleware complexity.

2) Small NGI 3-6 FTE
3) Medium NGI 7-10 FTE
4) Large NGI 16-18 FTE

16 FTEs for a large NGI are based on the resource estimation carried out per-ROC during the preparation phase of the EGEE III project for the SA1 activity (Operations). 16 FTEs are distributed

into: 5 for Grid Management, 6.5 for Operations and Support, 3.5 for Support to VOs, Users and Applications, and 1 for Grid Security.

Note that we estimate that in the countries presently involved in EGEE a similar number of people are already working on the Grid with task similar to the ones envisaged here for the NGIs. The amount of FTEs currently involved in operational activities for the EGEE III project alone is 189.9, of which 85.9 are funded by the E, as documented in the Chapter 3 of this deliverable.

We envisage that when all the NGIs that have expressed interest in EGI will have been properly constituted and will have joined EGI, in EGI there will be 6-7 large NGIs, 12-15 medium NGIs and 16-20 small NGIs; however for the very first year the number of NGIs will be probably somewhat smaller.

The Operations and security function is supported by manpower effort and additional hardware resources, that are needed (mainly at the NGI level) to host Grid core technical services, operational tools, testbeds and auxiliary IT services (wiki pages, agenda pages, databases, etc.). Based on the current status, it is estimated that for some large EGEE ROCs about 150 servers are needed for these functions. Hardware resources needed for the realization of the NGI e-Infrastructure are funded via national funding sources (i.e. no EC co-funding is expected).

6.2.3. Evolution

FTE estimates refer specifically to the overall amount of effort needed during the EGI transition phase. Efficiency after a few years might reduce the staff requirement for the initial operational model but we expect this to be partially matched by the requirement for new activities to meet the evolving requirements of new communities. As to development, we foresee a reduction in cost in about 3 or 5 years when operational tools will likely reach maturity. At this point, still a small fraction of funding will be needed for maintenance of existing tools.

In 5 years we foresee the possibility to evolve some Operational and security tasks of EGI.org into services, of which some will be mandatory and sold as a bundle, while others will be optionally subscribed by the NGI. Depending on the type of service, these will be charged through a per-use or flat rate.

6.3. Transition

The proposed EGI operations model is built upon the experience gained and the infrastructure deployed mainly in the EGEE projects. This infrastructure is a leading global Grid, in terms both of the scale of resources provided and the number of user communities supported.

The goals are aimed at ensuring that the EGI Grid infrastructure delivers a production service that focuses on enabling and supporting science, in diverse research communities, through a sustainable infrastructure in Europe and with responsibility distributed to the NGIs and the resource centres themselves.

These goals will be achieved through:

- **Distribution**: Experience in the first two phases of the EGEE project has shown the value of distributed operations teams – at several levels. The concept of Regional Operations Centres (ROCs) as a distributed management team has worked well, providing effort to cover the operational oversight, while also ensuring the dissemination of knowledge and expertise. At a finer-grained level several of the ROCs themselves are also distributed teams, with similar benefits.
- **Automation:** A complete set of grid monitoring and service management tools at the resource centre level will help the resource centre and service managers to provide a robust and reliable

service with the minimum of external intervention. This strategy is important for ensuring resource centre reliability, as well as being necessary for increasing the scale of the infrastructure without the need for additional staff. It is also anticipated that this strategy will eventually allow a reduction in the staffing required at the grid oversight level.

- **Site responsibility**: Pushing responsibility and information to the lowest level of service management – as close to the service itself as possible - will ensure faster response times. This reduces the need for higher level oversight and will allow that role to transition into one of monitoring of service metrics (for example, accounting, resource centre reliability, service reliability, performance, etc.)
- **Cooperation**: The concept of the ROCs has been shown to work well in the EGEE projects. Cooperation can be done in a full cooperation mode (for example, similar to an EGEE ROC), or focused on a specific function (for example, a central operations service run by one or more NGIs on behalf of all NGIs). For small NGIs this may help with the organization and the staffing required.
- **Interoperability and interoperation**: It is vital that EGI work to ensure continued interoperability between the NGIs as well as between the EGI grid infrastructure and that of other international Grids; this is absolutely essential for some application communities (for example WLCG). Interoperations covers many aspects – operational security and policies, problem reporting across Grids, information exchange, etc. EGI will continue to work in this broad forum of infrastructure projects to agree common operational policies and procedures. In addition, operations standard formats and interfaces will be defined and developed further to permit data gathered through a variety of different tools to be exchanged in a coherent and consistent way between NGIs and EGI. Such standards will increase the scope for sharing of tools and avoid duplication of developments and monitoring.

The following paragraph presents a possible overview of the distribution of operations and security activities between EGI and NGIs.

- **Test-beds & Services**
  - Certification test-beds (EGI.org and some NGIs)
  - Production and Pre-production Resource Centres (NGIs)
- **Support Structures**
  - Operations Coordination (EGI.org)
  - Regional Operations Centres (individual or federated NGIs)
  - Global Grid User Support (central service run by 1 or more NGIs on behalf of all of them)
  - Operational Security Coordination (federated NGIs with central coordination)
  - Grid Security Vulnerability Group (federated NGIs with central coordination)
  - Network Operations Centre (central service run by 1 or more NGIs on behalf of all of them)
  - Training activities (individual or federated NGIs)

- **Policy Groups**
  - Joint Security Policy Group (federated NGIs with central coordination)
  - CA management (NGIs)
  - Resource Access Policies (EGI.org)

As to resource needs, FTE estimates in this paper refer specifically to the overall amount of effort needed during the EGI transition phase. Efficiency after a few years might reduce the staff requirement for the initial operational model but we expect this to be matched by the requirement for new services to meet the evolving requirements of new communities.

7. EGI FUNCTIONS: MIDDLEWARE DEVELOPMENT AND SUPPORT

This chapter provides the technical details that complement and complete the Middleware Section (4.2) of the Blueprint. The concepts expressed there will not be repeated here, in general, and the reader is assumed to have preliminary knowledge of the Blueprint.

7.1. MIDDLEWARE TASKS AND SERVICES

The general goal of EGI is to realize a large-scale, production Grid infrastructure for the sharing of IT resources and data – built on National Grids that interoperate seamlessly at many levels, offering reliable services to a wide range of applications, ranging from "mission critical" to prototyping and research" will be reached by distributing very different responsibilities between the various players.

The EGI specific technical objective, to be achieved by a coordinated effort of the EGI.org central organization and the National Grid Initiatives, is to take care, on behalf of all the stakeholders, of the procurement, certification, deployment, and operation of the software services (i.e. of the software infrastructure) and to set up the organizational rules, policies and procedures which will provide the required standard access and sharing mechanisms for all sort of IT resources and data which currently are and will continue to be made available to the researchers by national resource providers. These today are mostly constituted by public or semi-public Resource Centers of very different size and dimensions which will continue to be completely funded at national level.

In the Blueprint we have discussed the need for the establishment of a middleware function in EGI which needs to remain in full control of the software infrastructure which constitutes one of its key services offered to all the stakeholders. The Blueprint proposes to implement such function, at least in the first EGI years, to avoid the risk of disruption of the current services used daily by thousands of researchers, with a limited manpower in EGI.org, and without requiring any further immediate mandatory contribution from the NGI's. The maintenance and support of the Middleware components used in the current e-Infrastructure should continue to be co-funded at a level of 50% from the EC , without excluding contributions from other interested partners and sustained for the remaining part by the Middleware Consortia and other development teams, that have agreed to move toward a Unified Middleware Distribution (UMD), under the steering of EGI. In future, once the EGI e-Infrastructure will be well established, the maintenance and support of the legacy widely adopted services will be progressively covered by the NGIs through the payment of service charges while the necessary innovation and the new developments, as defined by the need of the user communities and operations, will continue to be co-funded by EC through competitive calls.

In this Chapter more details are provided, in separate sub-chapters about:

1. Middleware Components and Middleware Consortia
2. Guidelines for UMD
3. Role of the EGI.org Middleware Unit
4. Components and Services proposed for inclusion in UMD in the first stage of EGI
5. Estimation of the manpower needed for the maintenance and further development (at least for UMD and general standard compliance, and for fitness for operation in full production mode) of the components and services presently supported by the Consortia

7.1.1. Middleware Components and Middleware Consortia

Currently, a variety of Middleware components are deployed in the EU e-Infrastructure. They are the result of several years of European and international competitive efforts aimed at satisfying the needs of a large number of user communities with complementary requirements and dimensions ranging from teams of few individuals to very large international collaborations with thousands of researchers.

They all adhere to a general service oriented approach aimed at compliance with the evolving Web Services and the Open Grid Forum standards.

They are largely part of three more or less complete solutions: gLite , ARC and UNICORE which provide the foundation services for the current EU e-Infrastructure. Other EU middleware projects (GridWay, pGrade, AssesGrid, GRIA...) in Europe, funded by the European Commission and by National funds, have provided high level services which complement the basic services provided by these 3 EU stacks.

The recent efforts in particular by the OMII Europe project have already improved their interoperability. Pragmatically (after 8 years of successful developments) these 3 EU stacks with the mentioned enrichments mainly from other EU initiatives provide a very large fraction of the services in use in the EU e-Infrastructure together with some components from the US-based Globus and VDT.

These 3 European stacks thus constitute the basis for the creation of the open source Unified Middleware Distribution (UMD) that the future European Grid Initiative (EGI) will make available to the national Resource Providers as a key integral part of its offer and business model. The availability of certified grid services that can be easily downloaded from a common UMD repository, together with the set of common procedures, policies and rules that EGI will establish, will make easy for the research teams to access and share all type of IT resource and data made available by their national resource centers and funded at national level.

The EGI Middleware function needs to continue to guarantee the current level of quality of the deployed services to the European scientific user communities during the transition and in the initial years of consolidation of the new EGI organization.

During the transition to the new sustainable European organization embodied by EGI, the middleware currently represented by these stacks and other identified services needs to continue to be supported, maintained and further developed, in particular in view of emerging standards, and, in some parts, completed and hardened from their current stage to fully satisfy the operational quality requirements. The requirements will be established by a new EGI body including representatives of VOs, Operations and Middleware development, called EGI Technical Coordination Board –TCB) which represents a straightforward evolution of current best practices of EGEE, DEISA and other national experiences.

The maintenance, development and evolution towards standards for these 3 EU stacks and related middleware projects is currently funded by national Institutions or Consortia and co-funded by the EU Commission via competitive bids.

The Advanced Resource Connector (ARC) is developed by the NorduGrid collaboration and associated projects since 2001. It features a decentralized architecture, leading to high efficiency, low maintenance costs and robust performance. It is highly portable and is available for all major Linux flavours. This in turn allows a decentralized deployment of ARC in over 60 sites, with over 20.000 cores. In particular, ARC is adopted by the NDGF (Nordic DataGrid Facility) to support the world's only distributed heterogeneous Tier1 center. Currently, the next generation of ARC is under development, which minimizes dependencies on third-party components, improves extensibility, interoperability and allows portability to non-Linux platforms.

gLite services are the result of a truly pan-European development effort made by the EDG-EGEE project series started in 2001 and co-financed by EC via competitive bids. They are currently deployed in about 250 sites distributed in all EU countries and provide a general, unified and robust access service to ~50.000 compute nodes (largely commodity clusters with some HPC systems) and to very

large (>15 PB) distributed storage systems. The gLite middleware consists of an integrated set of components compliant with open standards and covering all the aspects of the Grid infrastructure. It is developed for the Scientific Linux environment, but extensive effort is recently provided to make it operating system independent. The gLite environment is tightly coupled with the ETICS build and test system (also funded by the EC), which provides an automated environment for the integration and validation of new components and their new versions.

UNICORE has a traditional HPC background (since 10 years) and is open source since 2004 (http://www.unicore.eu). It is used in HPC-related infrastructures like DEISA (serving a similar amount of CPUs as in EGEE but concentrated on a few powerful supercomputers) and in the future PRACE (European PetaFlop/s Supercomputers), but also in non-HPC-focused NGIs like D-Grid and some Swiss SwiNG projects. UNICORE is characterized by its open, extensible, lean, and interoperable Web services architecture which supports many open standards, providing a seamless, secure and intuitive access to Grid resources. UNICORE comes with a strong focus on workflow capabilities, security, application support and ease of installation and configuration.

7.1.2. Guidelines for the Unified Middleware Distribution (UMD)

The Consortia have agreed that the middleware components, tools and services, they presently support, have to evolve into a unified distribution: UMD. The support and coexistence of different implementation of the same middleware service is acceptable (and unavoidable) in the short term, but in the longer run may generate unnecessary duplication of effort which has to be avoided through a progressive specialization of the different services.

The following criteria have been agreed for the components which will be included in UMD:

- **Interoperability**: services included in the UMD release should be fully interoperable with all other UMD implementations adopted in the EGI Grid infrastructure.
- **Completeness**: the set of available components and tools included in UMD once adopted by any NGI should allow the national infrastructure to be operated in a fully self-functional and autonomous way and at the same time completely integrated with the rest of the pan-European EGI infrastructure. The Grid services included in UMD should address the needs of all current VOs and a process should be in place to allow them to evolve according to new scientific communities requirements.
- **Scalability**: available services should allow the management of resources and services in an e-Infrastructure which must satisfy scientific user communities ranging in size from a few to thousands of researchers. Different service implementations should be included to take into account both the need of simplicity for small user communities and scalability for the largest ones. In addition the services should be able to face the expected growth in scale (in terms of users, services and sites operated) over a short time period.
- **Simplicity**: UMD should contain tools to download the appropriate services, to provide assistance during their configuration, and to perform as much automatic set up as possible.
- **Extensibility:** UMD must provide interfaces (and “hooks”) that allow independent development (by any interested party) of higher level and additional services that will create a software pool from which further UMD innovation will be drawn. Gateways to the other (EU and non-EU like Globus) grid systems and components will be one example of services built on the extensibility APIs.

7.1.3. Role of the EGI.org middleware Unit

The current environment of EU middleware development consists of distributed multiple teams of experts specialized in one or more services in general organized around the 3 Middleware Consortia with additional teams with complementary expertise belonging to other EU and international initiatives.

In order to leverage the existing clusters of competence it is then advisable to maintain this decentralized model based on decentralized teams while introducing with EGI an effective pan-European technical and financial coordination. The decentralization will also leave open the road for the introduction of other development teams, including eventually for teams who developed components on a commercial basis.

The *Central technical coordination* will be supported by an EGI.org unit having as head a Chief Technical Officer (CTO). The main objective of this unit is to guarantee the availability of the required middleware services at the pan-European level with the assistance of additional technical bodies including the relevant experts appointed by the Consortia. These bodies (in addition to the ETCB, transversal including Consortia with Operations and Applications representative, already discussed in the Blueprint and overall steering of the middleware related activities) will include a Middleware Architect Group and a Middleware Technical Management Group which will be more precisely defined when this general proposal will be ready for implementation to guarantee the availability and evolution of the UMD distribution and repository .

This EGI.org MW Unit and its technical bodies should be the unique place in Europe where the needs concerning the middleware for EGI will be planned and coordinated, in particular with respect to:

- Common baseline architecture
- Full interoperability of existing services through standardization
- Validation/testing of the released services included in UMD;
- Increasing complementarities and specializations of the included services
- Adoption of application and operation requirements;
- Convergence and interoperability through the implementation of standard interfaces with Globus and other non-EU stacks;
- Definition of additional APIs that will allow independent development of higher level services.

Special care needs to be taken to assure that the UMD software components are easily installed and configured. The goal of the UMD is to make it as easy as possible for the NGIs national resource providers to deploy, maintain and use the grid services that need to guarantee to the VOs teams a uniform access to their resources.

Another important objective for the EGI.org MW Unit will be to provide the necessary testing and certification of the services included in UMD to guarantee a seamless operation and interoperation of all the components included in UMD. This will also include provision of test suites for Quality Assurance and to validate standards compliance of considered new or modified already introduced services. To guarantee these functions, we propose the MW Unit should also offer support to a common software configuration, build and test systems.

In addition, the Unit will establish effective collaborations on an equal basis to promote the inclusion with their related support of services coming from outside Europe (like for instance Condor and Globus) compliant to the same set of EGI rules.

7.1.4. Components and Services proposed for inclusion in UMD in the first stage of EGI

Below is reported a table from OMII EU summarizing the main services developed by each stack. These services need to continue to be co-funded in the EGI scenario. See:
http://omii-europe.org/OMII-Europe/docs/DJRA20.pdf

OGSA capability	gLite	UNICORE	ARC
Security.AttributeAuthority	VOMS+SAML	WS-UUDB, SAML-VOMS	VOMS+SAM
Security.Accounting	DGAS, APEL	RUS	SGAS, APEL
Data.Management.Storage	StoRM, DPM	SMS	Smart-SE, dCache
			ARC Gridftp
Data.Management.Transfer	FTS	JMS	FTS, gridftp2
Data.Access.Relational			
Data.Access.FlatFiles	GFAL	TSI	ARC Caching
Information.Model	GLUE	GLUE (future)	GLUE, arcschema
Information.Discovery	OpenLDAP		OpenLDAP
Information.Monitoring	GridICE,	LLview, CIS, RSS	NG-Monitor
	R-GMA		
ExecMan.ExecService	GT2 Gram,	TSS, OGSA-BES	Grid-Manager+AREX (BES), gridftp interface
	CREAM+BES		
ExecMan.JobManager	WMS	XNJS	ARC Client
ExecMan.CandidateSetGen			
ExecMan.ExecPlannService			

7.1.5. The detailed Middleware cost estimates

The cost estimates reported in this section have been performed by the Consortia, refer to the situation of some months ago and may need to be revised for describing accurately the EGI start time needs. Synergies as e.g. for a common security framework could also be possible but have been not evaluated so far.

The costs estimated here include also the developments that have been performed, typically on users or Operations request, and that have been extrapolated also in the near future, accounting approximately to a 30% of the total. The inclusion of these costs explains the difference between the number of FTEs estimated in this section and the one reported in the Blueprint, which are thus fully coherent with this evaluation, and actually based on it.

7.1.5.1. Cost estimate for gLite

Here is an evaluation of the FTE needed for maintenance-support-development of the gLite cluster of components (but the security tools are already common, thus the FTE for security are for everybody, not just gLite

gLite Area	**FTEs**
Security tools (already common, not gLite only)	9 FTE
Information system, monitoring, accounting	6 FTE
Computing (exec) Element/ Services	5 FTE
Data Storage and Management Services (DPM, STORM, GFAL, LFC, FTS, Encrypted storage, AMGA)	6 FTE
Job management services	8 FTE
Total gLite maintenance+support	**34 FTE**

To this personnel it has to be added the one needed for Integration&Packaging and for Pre-Certification&Testing (i.e. the activities currently performed in EGEE-SA3, that will be included in the mw function). The following table provide an evaluation valid for the current situation.

Component	FTEs for Integration & Packaging	FTEs for Pre-Certification & Testing
Security.AttributeAuthority – VOMS + SAML	0.5 FTE	1 FTE
Security.Accounting – DGAS, APEL	1 FTE	1 FTE
Data.Management.Storage – Storm, DPM	0.5 FTE	1 FTE
Data.Management.Transfer –FTS, gridftp	0.5 FTE	1 FTE
Information.Model – BDII	0.5 FTE	1 FTE
ExecMan.ExecService – CE CREAM	1 FTE	2 FTE
ExecMan.JobManager - Workload Management System	1 FTE	2 FTE
Logging & Bookkeeping	1 FTE	1 FTE
Total	6 FTEs	10 FTEs
	Total "SA3-Like" = 16 FTEs	

Note that the Integration&Packaging and the Pre-Certification&Testing will be performed under the control of the mw Consortia, keeping close link with the developers of the relevant components.
The final acceptance test of the components is instead a task for EGI.org

Still to be added the personnel for taking care of the Build and Test system and repository; today it is done via the ETICS Project and the evaluation is 8 FTE. It may be reduced somewhat at EGI start.
Total "ETICS-like" 5 FTE

Here is the final summary table:

gLite Area	FTEs
JRA1	34 FTEs
SA3	16 FTEs
ETICS	5 FTEs
Total gLite	**55 FTEs**

7.1.5.2. Cost Estimate for ARC

NorduGrid candidate components for the European Universal Middleware Distribution (UMD)
In what follows, we give an estimate of 5 NorduGrid ARC-based components. We stress the fact that NorduGrid provides a full end-to-end solution, in which case the total funding would be multiplied by roughly a factor of 1.5.

I) **NorduGrid Computing Element**

A general purpose service (called A-REX) implementing the job execution capability over large variety of computational resources. A-REX interprets standard job descriptions, offers OGF-compliant interface (BES together with community embraced extensions). A-REX offers powerful, transparent and automatic integrated data staging capability. A-REX offers WS-based local information interface (supporting OGF standard Glue model))and can be connected to information backbone and logging services. A-REX can work together with community approved security frameworks.

NorduGrid CE	**FTEs**
maintenance and support (multiplatform including popular Linux flavours, MAC-OS and Windows): 3 FTE	3,0 FTEs
interoperability and integration with other UMD components including certification process: 2 FTE	2,0 FTEs
standard compliance, including the support for community approved best-practices: 2.5 FTE	2,5 FTEs
system hardening and development of new features: 1.5 FTE	1,5 FTEs
ARC SUM 1	**9 FTEs**

II) Grid service hosting and development framework (NorduGrid HED)

The Next generation ARC services are implemented in a general and powerful hosting environment, the HED component. HED offers a convenient service development platform by taking care all the internal details of the underlying security, network communication and local information system layers.NorduGrid HED offers multilanguage support for server-side grid development (java, c/c++, python). The HED runs on Linux, MAC-OS, Windows.

NorduGrid HED	**FTEs**
maintenance and support (multiplatform including popular Linux flavours, MAC-OS and Windows)	1,0 FTE
interoperability and integration with other UMD components including certification process	0,5 FTE
standard compliance, including the support for community approved best-practices	1,5 FTE
system hardening and development of new features	1,5 FTE
ARC SUM 2	**4,5 FTEs**

III) General purpose grid library (ARCLIB) and lightweight intelligent clients

ARCLIB offers a transparent access to grid resources through an intuitive and easy-to-use multilanguage API. The ARCLIB comes loaded with plenty of power features such as job description pre-processing, modular brokering library, job submission module to common middlewares, data library. ARCLIB is targeted for grid developers and advanced application integrators and provides a general toolkit for higher-level client side development.

ARCLIB is the core of the highly successful and powerful, nevertheless lightweight ARC client, grid portals and client-side job managers.

NorduGrid ARCLIB	**FTEs**
maintenance and support (multiplatform including popular Linux flavours, MAC-OS and	1 FTE

Windows)	
interoperability and integration with other UMD components including certification process	1 FTE
standard compliance, including the support for community approved best-practices	1 FTE
system hardening and development of new features	2 FTE
ARC SUM 3	**5 FTEs**

IV) NorduGrid Information System backbone

A highly scalable distributed system of Information Indexing Services connecting the grid-enabled resources and offering a general platform for resource discovery.

NorduGrid Information System backbone	**FTEs**
maintenance and support	1,0 FTE
interoperability and integration with other UMD components including certification process	1,5 FTE
standard compliance, including the support for community approved best-practices	0,5 FTE
system hardening and development of new features	2,5 FTE
ARC SUM 4	**4,5 FTEs**

V) dCache based distributed storage system

A dCache based storage system offering a transparent highly reliable solution for distributed storage facilities (the Nordic Tier-1 runs on a dCache based distributed storage system operated by NDGF).

dCache is to providing a system for storing and retrieving huge amounts of data, distributed among a large number of heterogeneous server nodes, under a single virtual file system tree with a variety of standard access methods. Depending on the Persistency Model, dCache provides methods for exchanging data with backend (tertiary) Storage Systems as well as space management, pool attraction, dataset replication, hot spot determination and recovery from disk or node failures.

Connected to a tertiary storage system, the cache simulates unlimited direct access storage space. Further, dCache offers all the functionality via WAN enabling a geographically widely distributed storage system, with high degrees of redundancy.

This however needs to be clarified with the dCache team NDGF is part of.

NorduGrid dCache	**FTEs**
maintenance and support	2 FTE
interoperability and integration with other UMD components including certification process	2 FTE
standard compliance, including the support for community approved best-practices	1 FTE
system hardening and development of new features	1 FTE
ARC SUM 5	**6 FTEs**

So, in summary:

NorduGrid/ARC Component	**FTEs**

1 NorduGrid CE	9,0 FTE
2 NorduGrid HED	4,5 FTE
3 ARCLIB	5,0 FTE
4 NorduGrid Information System backbone	4,5 FTE
5 dCache	6,0 FTE
Total ARC	**29,5 FTEs**

7.1.5.3. Cost estimate for UNICORE

EGI Middleware Function - Cost Estimates for UNICORE 6

cost per FTE	100.000 €					
Round	-3					
		4,5	5,7	2,3		
	total	54	68	27	149	12,4
		person months per year				
OGSA capability	**UNICORE component**	Maintenance, Support	Integration, Certification	Standard Compliance	PM	PY
Security.AttributeAuthority	WS-UUDB, SAML-VOMS	2,0	3,0	1,0	6,0	0,50
Security.Accounting	OGSA-RUS	2,0	2,0	2,0	6,0	0,50
Data.Management.Storage	SMS	2,0	1,0	0,5	3,5	0,29
Data.Management.Transfer	FTS, UDT, OGSA-ByteIO	2,0	3,0	1,0	6,0	0,50
Data.Access.Relational	OGSA-DAI4UNICORE	2,0	3,0	1,0	6,0	0,50
Data.Access.FlatFiles	TSI	1,0	1,0	0,5	2,5	0,21
Information.Model	GLUE	2,0	2,0	2,0	6,0	0,50
Information.Discovery	CIS-IP, Service Registry	1,0	2,0	0,5	3,5	0,29
Information.Monitoring	LLview, CIS, RSS, SIMON	2,0	4,0	1,0	7,0	0,58
ExecMan.ExecService	TSS, OGSA-BES	2,0	3,0	2,0	7,0	0,58
ExecMan.JobManager	XNJS, TSI	3,0	6,0	3,0	12,0	1,00
ExecMan.CandidateSetGen	ServiceOrchestrator	3,0	4,0	2,0	9,0	0,75
ExecMan.ExecPlannService					0,0	0,00
Additional Components	**UNICORE component**					
Workflow.WorkflowEngine	Workflow Engine	3,0	6,0	1,0	10,0	0,83
Client.RichClient	Eclipse-based rich client	9,0	12,0	3,0	24,0	2,00
Client.ApplicationClient	GPE app client	2,0	2,0	0,5	4,5	0,38
Client.Commandline	UCC, DESHL	2,0	2,0	0,5	4,5	0,38
Client.ProgrammingAPI	GPE API	2,0	2,0	1,5	5,5	0,46
Client.HighLevelAPI	HiLA, DESHL-SAGA	2,0	2,0	1,5	5,5	0,46
Client.ApplicationSpecific	GridBeans	6,0	2,0	0,5	8,5	0,71

Client.Portal	GridSphere4UNICORE	2,0	3,0	0,5	5,5	0,46
Security.Authentication	Gateway	1,0	1,0	0,5	2,5	0,21
Security.Authorization	UNICORE/X	1,0	2,0	1,0	4,0	0,33

TOTAL SUM FOR UNICORE : 12.45 FTEs

7.2. OUTLINE OF TIME EVOLUTION

The description of the Middleware function in EGI provided in this Chapter and in the Blueprint refers to the first few years after the establishment of EGI. In the longer run the middleware components should evolve into services that may be charged to customers and for which the maintenance and support may be more easily outsourced also to commercial partners.

7.3. SUMMARY OF RESOURCES FOR MIDDLEWARE

We summarize here the effort separately estimated for the maintenance, support and development of the three stacks. Note that the development, as typically requested by the VOs and Operations is included in the table, and is estimated to account for approximately 30% of the effort; this kind of development is not included in the Blueprint estimation of about 70 FTEs.

Middleware	**FTEs**
ARC	29,5 FTE
gLite	55,0 FTE
UNICORE	12,5 FTE
Total UMD	**97 FTEs (*)**

(*) *plus additional components to be identified by NGIs.*

8. FUNCTIONS OF THE EGI: APPLICATION SUPPORT AND TRAINING – A.K.A. EXTENDED SUPPORT SERVICES

The overview in Chapter 3 shows that the user community that already makes use of the grid is very large and diverse. This community expects to continue to use the current infrastructure and to drive its evolution. It is also growing quickly and diversifying even further, generating new requirements. As the e-Infrastructure becomes more generalised, the EGI will become a point of reference for international collaborations as envisioned in the ESFRI Roadmap:

> Europe has a long-standing tradition of excellence in research and innovation, and European teams continue to lead progress in many fields of science and technology. However our centres of excellence often fail to reach critical mass in the absence of adequate networking and cooperation. There is therefore a need to bring resources together and build a research and innovation area equivalent to the "common market" for goods and services.[5]

Within this ecosystem, the set of services commonly referred to as application support, training, and (technical) dissemination – and the way they are organised – need to evolve to fit an EGI model which is more inclusive yet more "customisable" than in current models. We will refer to these as **Extended Support Services** (ESS). Effective support services in EGI will be instrumental in ensuring that the European Grid Infrastructure is used by as many scientific communities as possible, thus exploiting in the best possible way the funds that will be made available by the NGIs and the European Commission.

The needs of the scientific communities cannot be assumed *a priori* to be homogeneous and well known. Each community has its specific applications, its specific training needs, and its specific communication venues. Hence the extended support services must be articulated according to well defined sets of requirements by each scientific community. This leads to the concept of **Specialised Support Centres** (SSCs). The role of EGI.org in this context is to provide central coordination and representation to the various communities and VOs via the extended services offered by the SSCs.

This Chapter assumes the description of this function already reported in the Blueprint, and does not repeat everything that is said there; here the description goes into much more details and some of the scenarios proposed are still tentative, representing some of the possible implementation of the model of Application Support and Training described in the Blueprint. We expect to be able to consolidate these scenarios in the deliverable D3.2 "Final Function Description" due in few months, incorporating all the feedback this Chapter will trigger.

In the Blueprint we have described in some detail the tasks of EGI.org and quantified the manpower needed for them, and the effort the NGIs are expected to invest in the direct Application Support and Training. The summary of these tasks and of the effort is reported at the end of this Chapter for completeness, here however we describe in more detail the aspects of the Specialised Support Centres and provide an overview of how the Application Support and Training tasks may be shared between the different actors: NGIs, SSC, EGI.org and the VOs themselves. No evaluation is provided yet for the effort expected to be invested in the system of the SSCs; this effort will come from the NGIs (except the thin layer foreseen in EGI.org) as part of their international tasks, co-funded by EU in EGI.

The total effort the NGIs will devote to the Application Support (direct + contributions to the SSCs of choice) is expected in any case to be smaller than the one presently deployed for this function in the EU grid projects. The participation of the NGI to any specific SSC is always on a voluntary basis: the

[5] European Roadmap on Research Infrastructures (Report 2006). ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri-roadmap-report-26092006_en.pdf

support of the national and international Applications of their Users is an obligation for the NGIs in EGI but each NGI is free to decide how to implement this support. The SSC system as we have started to design it in the Blueprint and in this Chapter is expected to constitute an efficient support structure that exploits the different synergies available, thus we expect the NGIs will invest in it, first helping to finalize its description and effort estimation for D3.2 and then supporting its actual implementation in EGI.

8.1. TASK AND SERVICES

8.1.1. Specialised Support Centres: a first approximation

As mentioned above, a one-size-fits-all model of an SSC cannot be constructed, as each community has its own specific requirements. It is already apparent that different kinds of service will apply to communities whose primary virtual workspace is grid-based as opposed to those who will be served by large research infrastructures (e.g. ESFRI), and for whom EGI is expected to provide a seamless integration with grid services. In what follows, then, we provide guidelines and qualitative estimates that can be of use for the relevant experts in planning a particular SSC.

The kind of effort which may be required to implement an SSC is described below. Note that some services are relevant specifically to grid-centred communities, while others are more general.

- A team to build and maintain a European-level scientific portal and provide varying levels of interfacing with national gateways that share the same purpose. This interfacing could be limited to a link to the national portals, or it could be more involved, depending on agreements with the individual NGIs.
- Front desk services for new communities – see Section 8.1.7
- VO services: representation, creation counseling, support and development of specialised tools, site testing support, SAM test repository; general VO management and interaction (if required) with national VO managers.
- Application porting support; application porting case studies; “help desk” for application developers.
- Direct user services: creation and maintenance of FAQs, use cases, how-tos, specific documentation and mini-tutorials; free demonstrations for new communities; identification of common problems affecting users, notification of relevant people (e.g. operations or middleware developers), and following the problem to resolution.
- Central “interdisciplinary” services:

  Coordination of the interactions between users (usually application developers) and middleware developers. Coordination of the interaction between users and operations; typically related to the provisioning of core VO services or computing resources.

  Application database. Supplying an application database that allows applications to be "registered", permitting people to search for similar applications and contact the authors for guidance.

  Selection of software packages that can help application developers use the grid infrastructure, but are not (at a given time) part of the core Middleware distribution(s). Similar to / an extension of the EGEE RESPECT program. This service in particular will be crucial in driving/assisting the evolution of the UMD, and is further discussed in section 8.1.8.

It is important to note that these services are in any case subject to evolution as the other EGI services (operations, middleware) also evolve. For instance, as services become more stable and user-friendly, it is natural that less effort will be required to support users dealing with help desk issues; as more communities are brought under the umbrella of SSC services, the effort employed in the creation and maintenance of common services (e.g. repositories and databases) will decrease, etc.

The key to the success of an SSC is in fact the stabilisation of services that are currently built in large part on a competitive project basis. While some projects may have a natural finite lifecycle, many are initiated to provide a permanent service to a community (e.g. medical imaging, meteorology, digital repositories, etc.). While the effort to optimise and then maintain these services is expected to stabilise in the long term at levels well below the initial project effort, the lack of continuity among successive incarnations of a project (or successive projects aimed at supporting a certain set of results) often entails a heavy loss in terms of resources and intellectual capital, as repositories risk shutting down, specialised manpower migrates elsewhere, VOs disappear, etc. Recovering from this fractured scenario requires extra effort in training new personnel, reactivating services or building new ones, etc.

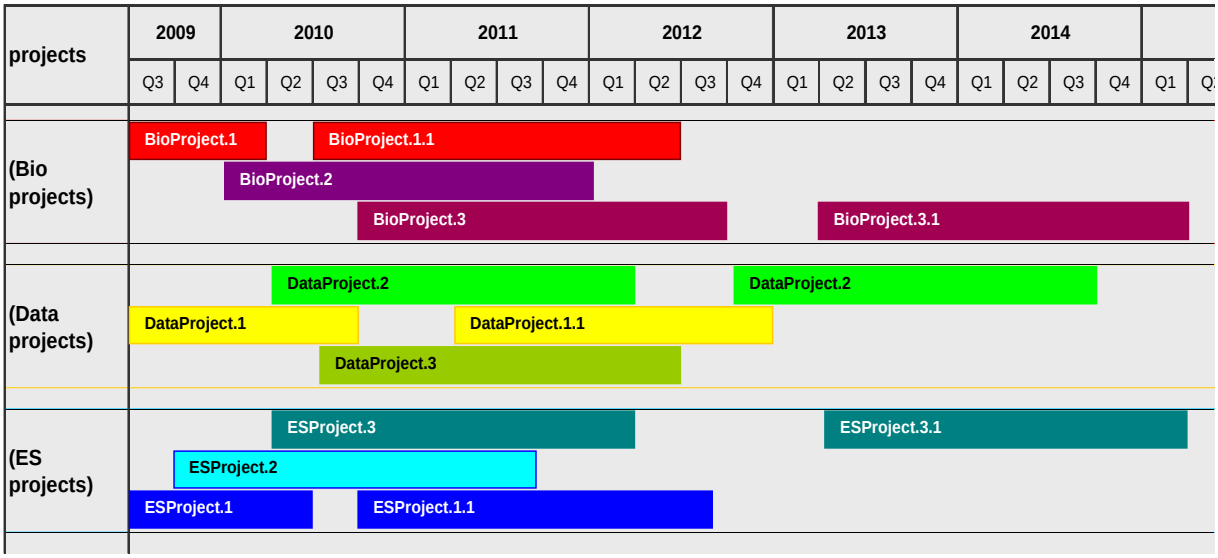


Figure 6: A project-based landscape.

From an EGI perspective, it is immediately apparent that the "landscape" in Figure 6 lacks durability: once a given project is finished there is no apparent way to "reinvest" its results.

In the complex EGI scenario, and in an ecosystem which involves a few dozen nation-states and international VOs, it makes more sense to encourage collaborative efforts among projects throughout Europe. An SSC should provide the effort necessary to stabilise the relevant set of services for their scientific communities, in a process like that depicted below:

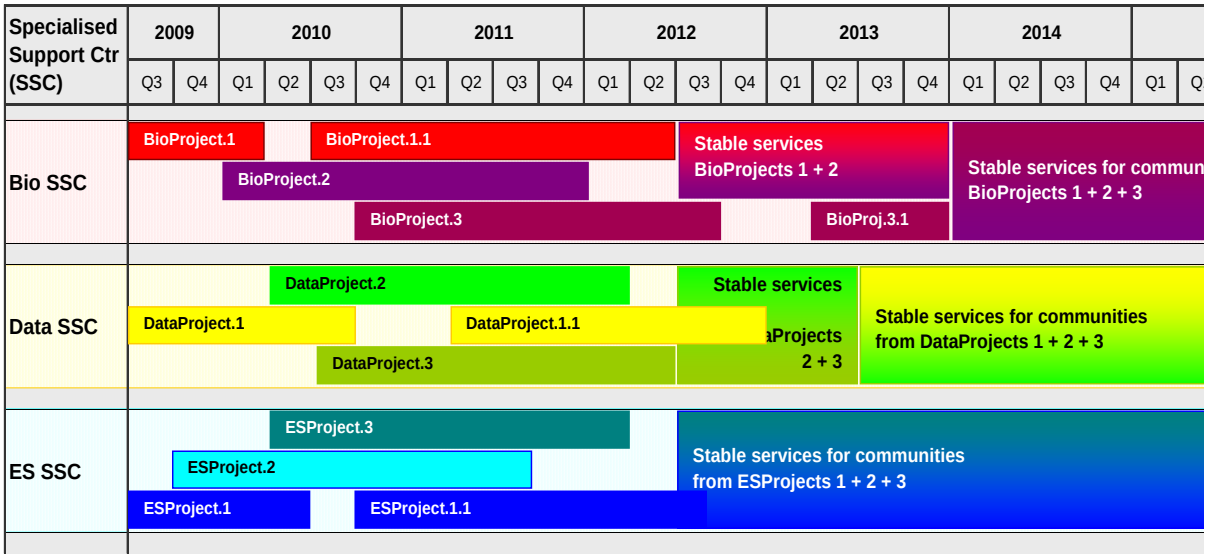


Figure 7: Evolution and stabilisation of SSC services.

NB: the height of horizontal bars represents community coverage, not manpower.

As the infrastructure becomes more generalised, the number of SSCs may be expected to increase. These centres, however, should make their best effort to be inclusive and offer reliable common services to new projects, rather than expecting that each project will create its own SSC; in this latter case, there is a risk of missing out on the benefits that a collaborative environment can offer, failing to learn from earlier experience, complicating the evolutionary process of the services offered by the infrastructure, multiplying project management effort, and so on.

A specific case is currently being studied which involves the Life Sciences community. The initial hypothesis for this case is to establish a specific SSC to (a) support the transition from EGEE III to EGI for the EGEE Life Sciences cluster plus several collaborating projects, and (b) initiate a collaborative effort with one (or two) ESFRI projects to plan the EGI integration with these infrastructures. This is of course a very early hypothesis, which will require extensive further study and adjustment as all parties involved refine their thinking on these issues; for this case study, one could very well imagine that some Research Infrastructures will have their own SSC if they extensively use EGI as their computing infrastructure. The Life Sciences SSC could host the Research Infrastructure services for some time and then help it to run a separate dedicated SSC. A more detailed sketch of the Life Sciences case is given in Appendix m.

8.1.2. SSC "Blueprint"

What does it mean in an EGI environment (i.e. based on NGIs + EGI.org) to have Specialised Support Centres?

It is assumed that SSCs will arise primarily as required by the international user communities and VOs, although the model can be extended if there is an interest. These centres will thus have a European-level commitment and will work in tight collaboration with EGI.org, via a central team as initially sketched in the EGI_DS Blueprint. The details and motivations for this central team are given in section 8.1.9 , along with the description of the tasks fulfilled by the extended support teams in the global EGI environment.

The SSCs fulfill a set of **extended** support services in the sense that they are endorsed **electively** by a subset of NGIs, and have a specific relationship with EGI.org. The characteristics of this relationship are still under study, but some guidelines are given below (see also the EGI Blueprint). On a practical level, the individual SSCs can be viewed as "satellites" of EGI.org:

Figure 8: The EGI Extended Support Services

In Figure 8 above, the abbreviation "ESSC" refers to the team coordinating the extended support services (application support, training) and representing these in the TCB within EGI.org.

As mentioned, the SSCs will be jointly supported by groups or federations of NGIs, EGI.org "project" funding, and other EC funding, in proportions to be determined (options: peer review, EGI PB, EGI technical boards, existing MoWs,…). An NGI can choose whether it wants to be a "member" of a particular SSC or not:

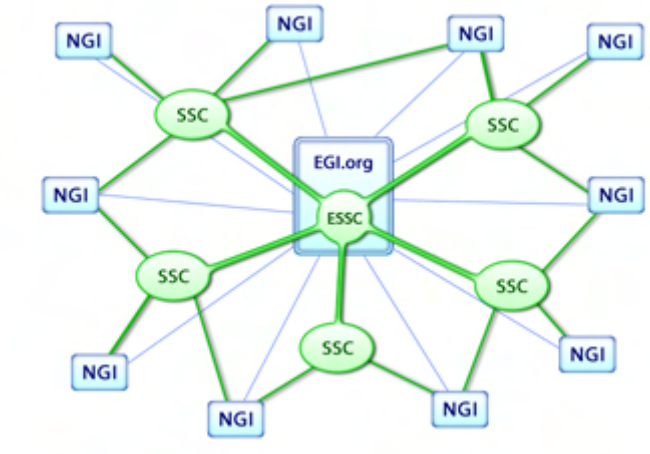


Figure 9: Relationship between SSCs and NGIs and between SSCs and EGI.org. Thin blue lines represent the independent relationship between NGIs and EGI.org.

Note that the SSCs do not affect the general relationship between EGI.org and the NGIs. It is expected that an NGI will provide a means to support its users, either directly or via an SSC, which is the typical choice for international VOs that have "pre-SSC" structures in place. These should evolve into actual SSCs which would have the following characteristics:

The articulation in SSCs will provide flexibility to the EGI ecosystem, minimising the load on the central EGI.org (hence the NGIs' "membership fee"), and allowing the NGIs to support the parts of the system that are closest to their interests and would benefit most from federation of resources.

An SSC can be hosted by an NGI that has (or can host) the appropriate resources and European-level commitment, under a specific agreement with the other member NGIs and EGI.org.

There is no obligation for an NGI to be part of any SSC. An SSC can (and should) have a mechanism to allow new members to join at a later date, or – if appropriate – to allow a community within an NGI to make "partial" use of its services, which would be properly acknowledged by the relevant NGI.

The formation of SSCs will be carried out under assessment by the EGI governing bodies of proposals submitted by federations of NGIs and the relevant VOs. These plans should include timetables for the evolution of the SSC and resource estimates, for which we give some guidelines below.

An SSC can be formed for a particular scientific area (Biomed, Astro, Archaeology, …) but it may also be formed for specific user needs. Examples of SSCs can be drawn from the characteristics of the projects in figure 6. – e.g. there could be a Training SSC or an SSC for interoperation with massively parallel applications (in collaboration with DEISA/PRACE), etc.

As mentioned above, the manpower for the SSCs will be provided by the interested NGIs with EC co-funding; from this point of view, the tasks fulfilled under the SSC umbrella can be classified as NGI International Tasks, as depicted in Section 6 (Operations and Security). A more detailed description of possible SSC tasks is given in section 8.1.9

The **coordinator** – or coordinating body – of an SSC should be an appropriate team proposed by the SSC and provided by an NGI, an institution within/associated with an NGI, or a team appointed (or selected) by EGI.org (which may reside in a member NGI).

The ESSC team within EGI.org is obviously not a candidate for this role, since this team has an already heavy coordinating role and is not partial to any of the various specialisations. Furthermore, enlarging this team would require a larger workforce in EGI.org, which would affect the NGIs' member fees.

EGI.org however should specify general rules for the governance of SSCs, including mechanisms for ensuring that an SSC coordination body can guarantee the appropriate European-level commitment, beyond the specific availabilities of members of this body.

8.1.3. SSCs and VOs

With respect to the current practical (as opposed to legal) notion of a VO, the general principle governing the relationship between these actors is that **an SSC provides services to one or more VOs**. In other words, a given SSC may offer services s_1, s_2, … s_n (see also ESS tasks below) to its "customer" VOs, of which a relevant subset (typically involving communication, user support, etc.) are exposed through the SSC Gateway.

Below we give a tentative characterisation of four types of VOs and their practical relationship within the general EGI scenario:

Type of VO	NGI role	SSC role	EGI.org role
Large Scientific VO requesting SSC	Member of federation supporting the provision of SSC services or if desired, link with a subset of SSC features	Provider of requested services	Liaison; central representation and (limited) coordination as described in Blueprint
Large Scientific VO not requesting SSC	as determined by NGI	none	
Institutional, University or National VO	Main service provider (or coordinator thereof)	none unless requested in the context of a functional SSC	
Functional VO requesting SSC	Same as for the first item, but on a functional basis (e.g. training, interoperation, etc.)		

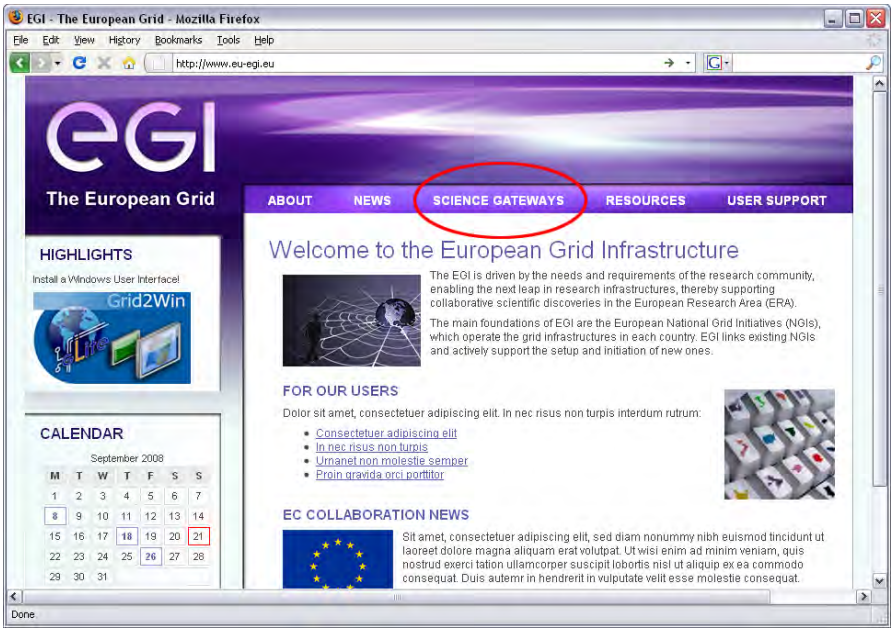
8.1.4. Evolution of SSCs

As a consequence of the business model proposed, the EGI technical system is an access infrastructure to resources – i.e., the infrastructure is constituted by a set of services organised in an NGI based environment. EGI.org, together with the extended support services provided by the SSCs, is an instrument for the NGIs to "better" provide these services; "better" meaning either more economical or with enhanced functionality or both.

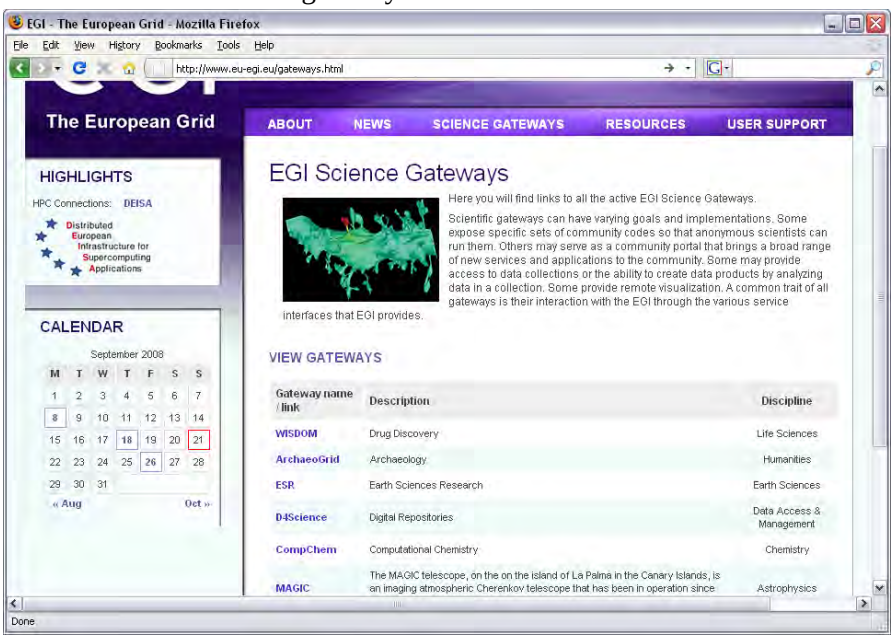
8.1.5. EGI gateways

From the point of view of the user, the EGI (EGI.org + NGIs) should present itself as set of easy-to-find services, organised as thematic gateways that users can access by navigating directly to their area of interest and quickly begin their work. In other words, EGI should allow users to be just a few clicks away from their virtual workspace. Many SSCs are expected to expose their services – in particular those related to communication, user support, overview of related applications, etc., by means of a scientific gateway accessible in a transparent manner from the EGI website.

A user friendly model of this "gateway" system is one where these areas are immediately evident in the main EGI web page:



It takes only one click to see the list of gateways…



…and one more click to access the gateway of choice:

For these gateways, it is recommended that SSCs have a specific content management task overseen by a "specialised user" – a person who can identify with typical potential users from the community, and "catch" possible barriers for these communities, such as information portals unnecessarily hidden from users not bearing personal certificates.

8.1.6. SSCs and Large Scientific Infrastructures

Beyond the concept of EGI gateways, there is an expectation that EGI will offer services to large infrastructures that have their own gateways and who expect a seamless integration of grid services into their own infrastructure.

The prototypical case is the ESFRI projects. The scale and diversity of these projects immediately suggests that EGI should provide specialised services for them on a case-to-case basis, providing an EGI point of contact for each project and structuring an SSC in response to each specific case. For these kinds of SSCs, the ideal coordinator would be a team appointed directly by EGI.org in consultation with the relevant experts in the EGI ecosystem. The SSC coordinator can then take the leadership in setting up a dialogue with the relevant ESFRI counterpart to model the expected integration between EGI and the ESFRI project and provide a liaison with EGI grid planning and management.

The ESFRI communities will also require an organised effort to understand and represent user requirements and should be integrated in the process of responding to these requirements, as described in part in the next section.

8.1.7. The New Applications Front Desk and the related integration process

The European Grid Infrastructure should have specific points of entry and well organised processes for welcoming new scientific communities. EGI.org in particular should have a central point of contact where groups/communities developing new applications can bring their case for evaluation and subsequent deployment on EGI. In the first phase of EGEE a task of this kind was carried out, in a limited fashion, by the EGEE Generic Applications Advisory Panel (EGAAP). In EGI, there must be specific points of access for new communities, along the lines of (a more inclusive and well articulated version of) the EGAAP. Without a well organised service of this kind, it is more difficult for researchers to know who to contact in the countries to create a new dedicated VO and access resources.

This gives rise to what we will refer to as the new applications **Front Desk**, a service provided by EGI.org as well as the appropriate SSCs, which will be responsible for gathering requests from new applications and will put the relevant communities in contact with the NGIs of the country/ies involved. The NGIs themselves may also offer front desk services; what we describe here of course is more oriented towards international communities.

The process of acquiring new communities involves several actors:

A. The **human network** of teams in EGI.org, the SSCs and the NGIs that organise events (via user fora, dissemination/PR activities, OGF-like events, etc.)

B. The **Front Desk** proper – a subtask of the set of tasks called "Services for New Communities". We assume that EGI.org will have a front desk facility; NGIs may have one as well – indeed, it is strongly recommended for those NGIs who opt out of SSC participation and who have an interest in serving new communities.

C. **Grid Planning** teams, in consultation with relevant management entities (strategy committees, technical board, policy board, etc.)

D. Relevant **SSC**s or and/or SSC **Brokering teams** appointed according to the needs of a new community.

E. The **Resource Providers** associated with the relevant NGIs

F. The **new communities** themselves, including relevant institutions, application developers, and owners of resources which come with the new community.

The diagram below is modeled for EGI.org, but similar schemas could be used (even in simplified form) directly by SSCs or NGIs, perhaps with some minimal necessary interactions with the central services. This schema represents one possible implementation of the process of acquiring new large international communities.

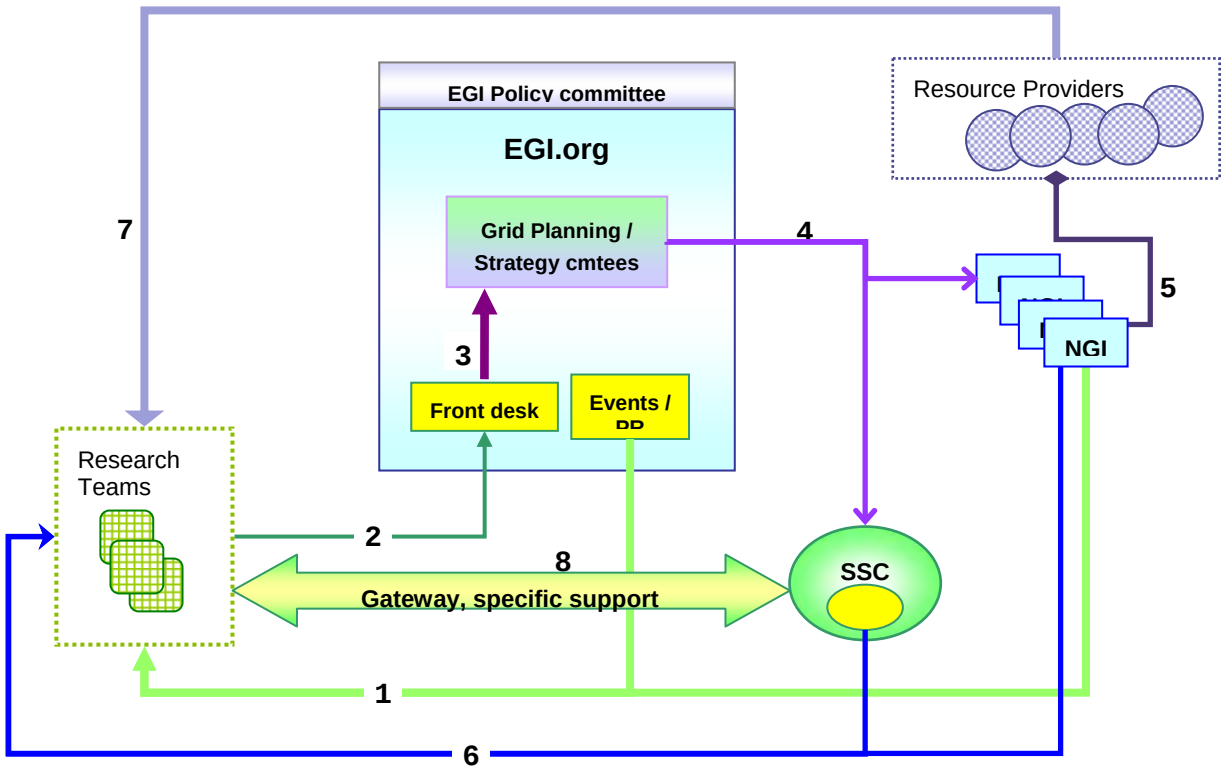


Figure 10: Process for the acquisition of some new communities

The general process depicted in Figure 10 consists of the following steps:

1. Research Teams (RTs) become aware of the European grid services via event organisation and dissemination services (Public Relations) by actors in (**A**)

2. RTs contact the EGI.org Front Desk (**B**) and submit their "case"

3. EGI.org front desk evaluates impacts over other EGI functions, estimates the efforts and the costs for hardware, application porting support, human resources (possibly based on a questionnaire – see e.g. examples from EELA 2). Front desk team produces a **User Requirements document** (**UR**) to be used in the next steps by the Grid Planning team(s).

4. EGI Grid Planning receives the UR, contacts the relevant NGIs, and enlists the SSC liaison team ("SSC interfacing") to identify possible existing SSCs that could have common interests with the new community. If there is an SSC that can be further involved in this process, its planning team(s) is brought in. Actors in (**C**) and (**F**) are involved in various ways throughout this process.

◆ If it is determined that a new SSC is needed, the involved parties also manage the creation of a project-specific SSC by appointing an **SSC brokering** team composed of the appropriate experts – some contributed by the new community itself (**F**).

4.1 This step requires further articulation. The work sketched here involves at least the actors in (**D**) and (**F**), with good communication during this process with actors in (**C**) and (**E**). The SSC or the brokering team take the UR, with the task to translating it into a seamless and transparent

community portal. The NGIs involved in this partnership contribute to the creation of proper procedures, and VO(s) if nedeed. Relevant teams in the NGIs collect information about the application environment and use cases. The SSC/brokering team produces the application release, to be managed and published by NGIs. The team also creates test protocols (SAM), first line support, FAQs and tutorials with the assistance of the relevant training teams.

5. The NGIs establish contact with their (associated) **Resource Providers** (RPs), both within the EGI eocsystem and the entering ones – to prepare and setup the hardware, integrate the needed services, etc. For incoming RPs there must be flexible admin training from the national ops centers or national training ctr or similar.

6. The resource providers associated with the NGIs and the existing or new SSC deploy the application, create local documentation and deliver the final solution to the RTs.

7. The RPs activate or release resources to the RTs, in accordance with SLAs established between RPs and RTs.

8. The RTs will refer to the SSC for application support issues, help desk, maintenance and review of documentation (in collaboration with the EGI.org ESS team), to be used by NGI for training purposes, developing case studies for new application upgrades, or porting. Development issues to be managed by SSC, technical overview and use-case by NGI or SSC as per agreed protocols..

8.1.8. User Requirements and the UMD

A particularly important aspect of the user oriented functions is an effective representation of user needs in the interaction with operations and software / middleware providers.

In Appendix B we provide a detailed overview of current requirements generated by some large and well organised user communities. It is evident from this schema that a European-level effort in analysing (and synthesising) these requirements provides an enormous benefit in driving the evolution of a variety of grid services. These requirements often arise in the context of forward-looking collaborative activities in various disciplines, such as:

Security of data. An early requirement from the medical imaging sector, which is of interest to many other user communities. EGEE teams have developed the MDM (gLite Medical Data Manager), a highly secure service for medical imaging, while at the same time working in close collaboration with their US counterparts in the GLOBUS MEDICUS team. The community hopes that these tools will continue to be supported and developed, opening the door to a more widely used grid infrastructure for medical data management.

The DEGREE (Dissemination and Exploitation of Grids in Earth Science) project has been working with DEISA and EGEE as well as the European Space Agency and others, and has provided the initial impetus for the organised set of user requirements given in Appendix B.

The D4Science project (successor of the DILIGENT project) offers digital library management services which allow dynamic creation and deployment of digital libraries. Operationally it brings together resource centres that offer computing and storage facilities through gLite, the DILIGENT gCube software, and “community” centres providing data sources and community specific services through web services and the like. D4Science and DILIGENT have partnered with large international organizations, such as the European Space Agency, the Food and Agriculture Organization of the United Nations and the WorldFish Center, supported by the Consultative Group on International Agriculture Research

Some user requirements are specific to a certain community and can be handled by a relevant SSC; others are quite general – or can be predicted to extend beyond the scope of a certain community, in which case the ESS teams, together with EGI Technical management, should take the responsiblity of either commissioning new features or improvements on current EGI core middleware, or identify an "external" product to integrate in its service package.

The adoption or integration of UMD-external software can follow a process similar to that being developed by the EGEE RESPECT (Recommended External Software Packages for EGEE Communities) program (http://technical.eu-egee.org/index.php?id=290). In a nutshell, the current requirements for a package to appear in the RESPECT "recommended" list is as follows:[6]

> The software package must be used by an application running on the EGEE infrastructure,
>
> The software developers must provide user and system administrator documentation,
>
> The software developers must provide user and system administrator support, and
>
> The software developers must provide binary package compatible with the production release of gLite and the operating systems supported by gLite.
>
> If the software is open source, we recommend that the software be built, packaged, and distributed with the ETICS system. If the software is commercial, it must be available for all supported operating systems, have a grid-friendly license, and be approved by the EGEE project and technical directors.

In EGI, some or all of the items currently on the EGEE RESPECT list may be expected to be part of the UMD, either directly or within the scope of an existing consortium.

Figure 11: Some "external" software packages, most of which are already in RESPECT.

[6] Excerpt from https://edms.cern.ch/document/818362/1

8.1.9. Summary of tasks

Here we list the basic "ingredients" that we believe are part of a successful interaction with the user community, from which we derive tasks, and who is typically responsible for each task – NGI, SSC, EGI.org.

Some tasks where collaboration seems particularly useful especially in the transition period are marked with '■' both in the SSC column and the EGI.org column. It is expected that such tasks would be jointly fulfilled by EGI.org (ESS teams and Policy Board) and the SSCs, to provide the needed organisational structure to effectively represent and respond to the user communities. In the EGI.org column there are several subtasks marked with '(■)'; this indicates that the EGI.org ESS teams have a coordinating or tracking role with respect to the task in question. When the '(■)' symbol appears in an NGI or SSC column, this indicates that the task is already recognised to be of interest to some, but not all, NGIs or SSCs.

It is not expected that all NGIs will support all tasks. It is however expected that NGIs will ensure that their user communities get appropriate support.

N.B.: Please note that these tasks are not quantified globally in this context, as the EGI ecosystem is expected to evolve based on real needs. For completeness, we have included tasks that may be considered "hybrid" in the sense that in current projects these may be carried out in collaboration or complementarity with other functions – in particular application support vs. operations and application support vs. training.

Additionally, we have not (yet) provided a distinction between "EGI support" and pure VO tasks. In principle, a mature VO may not require a number of these services, being able to perform them itself. This kind of decision should be made by the VO itself.

T-ESS-1. Direct User Support

This set of activities is often carried out in collaboration with Operations staff. An organised collaborative effort on these tasks also results in the emergence of common issues which generate specific requests to the Middleware providers.

T-ESS-1 Subtask	Actor		
	NGI	SSC	EGI.org
Collecting information regarding the take-up and use of grid technology by application area within a country.	■		
Providing first line support regarding the use of the infrastructure and use of the more formal support services. Also (where applicable) coordination between local support teams and "global" support teams.	■	■	
Creating FAQs/Use Cases. Writing short papers focused on particular problems identified with the infrastructure (and relevant work-arounds) or "mini-tutorials" on common tasks for techniques.	■	■	
Use Case repository. Furnishing a database of use cases, essentially mini-tutorials documenting common tasks.		■	(■)
"Help desk" support for usage of grid infrastructure. This involves the routing and handling of GGUS tickets that deal with the usage of the grid infrastructure as distinct from the treatment of operational problems.	■	■	(■)

Identification of common problems affecting users, notification of relevant people (e.g. operations or middleware developers), and following the problem to resolution.		■	■

In EGI.org, the effort indicated above is part of the "Coordination of SSC interfacing activities" task.

T-ESS-2. VO Support

This set of tasks is expected to be carried out at any level (NGI, SSC, EGI.org), depending on the VO.

T-ESS-2 Subtask	**Actor**		
	NGI	**SSC**	**EGI.org**
VO creation counseling. Discussions with those starting new VOs to understand if a new VO is really necessary and to help them with the required minimum documents for a VO.	■	■	■
VO tools support and development. Answering questions related to the web-based registration. Development of additional tools to help VOs manage their users and facilitate communication between them.	(■)	■	(■)
VO advocacy. To discuss with VO managers (and "directors") problems that the VO is having and acting as an ombudsman to resolve those problems. This may include problems with policies, procedures, resource allocation, and the like.	■	■	(■)
The operation and management of a VO, including managing the membership, responding to security issues, etc.	■	■	
Site testing support. Work to create standard, application-level tests to better filter "acceptable" sites for a particular VO or application. This includes a SAM test repository and interaction with FCR tool.		■	(■)
SAM test repository. Supplying a database of SAM tests appropriate for application level tests. This includes such things as the availability of compilers.		■	■

The first subtask – VO creation counseling – is assumed to be triggered at any level and in many cases will require close collaboration between the NGIs, the SSCs and EGI.org. For the latter this activity is managed by the "Grid Planning" task, presumably after an initial assessment carried out by the "Services for new communities" task.

T-ESS-3. Documentation and Training

The overall goal of these activities to is increase usage of the e-Infrastructures by providing users with the skills needed to access the services, increasing attractiveness of the services by encouraging the provision of applications by providing developers with the skills need to create them, and supporting usability of the infrastructure by disseminating good operations practice. Added values for infrastructures are support to several middleware, as well as the possibility to clone the infrastructure for training or eductional purposes.

Middleware developers should provide documentation for their services. It is, however, a well known fact that extracting knowledge from developers to produce useful documentation is in general a challenging task.[7] The EGI.org, in collaboration with the relevant stakeholders, must provide effort to review the documentation provided by the middleware developers and ensure that such documentation provides information on 1) the purpose of a service, 2) how users can interact with the service (via a command line and/or API), and 3) how the service is installed and configured.

For all of the documentation and training materials, EGI should coordinate periodic reviews of the materials by the target audience and ensure that comments are fed back to the writers to ensure that the materials continue to improve.

Additionally, high level documentation that treats the grid infrastructure as a coherent system must be written and maintained. As this type of documentation is really above any particular service, middleware developers cannot really be asked to provide it. Instead, EGI.org – perhaps with the assistance of a dedicated SSC, must employ technical writers to create this documentation and to keep it up to date. Support for multiple middleware stacks will complicate this task and will probably require dedicated manpower for each of the supported stacks.

Related to the high level documentation is the creation of training courses geared to 1) new users, 2) application developers, and 3) system administrators. Training is required by operations centres for system operators, by application developers who are developing programs to use the system and by users to allow them to access the services. Training is also required for trainers and educators regionally to support them in disseminating experience of changes in the system which they must then pass on to their communities (local and in different user communities / VOs).

The experience gathered during EGEE and ICEAGE shows that production infrastructures don't fully match needs of education trainers and students, starting from the strict identification procedures that often discourages students and beginners through their learning process, or even the difficulties for trainers on finding suitable resources to effectively run events. Therefore an infrastructure specialized for training (a t-Infrastructure) is required, in order to match requirements of this kind

The current scenario is that the majority of training provision occurs at the NGI level, gradually moving towards education being taken over by universities in their normal duties. In this respect, the e-IRG Education and Training Task Force (ETTF) has produced a report outlining the main issues to be addressed in this area and proposing a strategy to support and make progress in grid and e-Science education and training.[8]

However, the expectation is that, especially initially, coordination and facilitation of sharing of resources and expertise will be required. Under an alternative scenario of no coordination and support, it would be expected that Europe will be unable to retain its lead in this area as other regions will be able to duplicate the process using their existing training and education infrastructures.

T-ESS-3 Subtask	**Actor**		
	NGI	**SSC**	**EGI.org**
Technical information gathering, indexing of documentation. This includes the documentation available through the Middleware providers as well as that provided by national grid infrastructure or institutes.	■	(■)	■

[7] References to this fact are plentiful, e.g. http://www.codinghorror.com/blog/archives/000668.html

[8] e-IRG ETTF Report:
http://www.e-irg.eu/images/stories/publ/task_force_reports/ettf_long_report_final_july08.pdf

Review and maintenance of documentation; the systematic review of all documentation to provide feedback to authors for improvement. Content and material creation for central services.		(■)	■
Indexing of local documentation. Maintaining a census of documentation available within the region, especially localized documentation.	■		
Localization of global documentation. Translation of key documents to regional language.	■		
Review of local documentation. Review and improvement of documentation available within a region.	■		
Creation of training materials, live or broadcast training events and provision of web based materials.	■	(■)	(■)
Maintenance of local repositories and online teaching environments.	■	(■)	■
Support of central services such as material repository and online resources		(■)	
Operations in each site part of the regional t-Infrastructure	■		
Coordination and interoperation of regional t-Infrastructure resources. For EGI.org: support of t-Infrastructure interoperation and management of grid central services.	■	(■)	(■)

In EGI.org, the effort indicated above is assigned in large part to the Training tasks, and to some extent to the middleware interfacing tasks.

T-ESS-4. Application Porting Support

T-ESS-4 Subtask	**Actor**		
	NGI	**SSC**	**EGI.org**
Application porting "case studies". Development of case studies that document how particular applications were ported to the e-Infrastructure. These typically include an application overview, selected grid services, and external services.	■	■	(■)
Development of porting plans. The creation of porting plans based on the needs of a particular application and constraints of the production infrastructure.	■	■	
"Help Desk" for application developers. Providing application porting expertise for application developers on the grid. This is remote help (email, phone) for short well-identified issues.	■	■	(■)
Identification of common issues or techniques and interaction with training and user support teams to ensure this information is available to the full user community.	(■)	■	■

T-ESS-5. Specialised Services

T-ESS-5 Subtask	Actor		
	NGI	SSC	EGI.org
Specific scientific discipline support. Examples are the porting of common software for the discipline, developing techniques for access to common data stores, etc.	(■)	■	(■)
Application-level testing. These include tests for functionality, scalability, and performance.	(■)	■	
Development of shared "services". Examples of past generic packages are GANGA/Diane, AMGA, and Hydra.		■	■
Scientific discipline meetings. The planning and running of meetings focused on the use of grid technology within a particular scientific discipline.		■	(■)

T-ESS-6. Extended Support Services Management

T-ESS-6 Subtask	Actor		
	NGI	SSC	EGI.org
Topical meetings. The planning and running of meetings focused on particular technologies or techniques required by several disciplines. Examples are MPI access, low-latency scheduling, etc.		■	■
User Forums. The planning and running of meetings focused on the scientific and industrial exploitation of grid technology. These should be pluridisciplinary meetings used to bring people from different communities together.	(■)	■	■
Coordination of the interactions between users (usually application developers) and middleware developers.	(■)	■	■
Coordination of the interaction between users and operations. Typically related to the provisioning of core VO services or computing resources.	(■)	■	■
Application database. Supplying an application database that allows applications to be "registered", permitting people to search for similar applications and contact the authors for guidance.	(■)	■	■
External and UMD Candidate Software Review Selection of software packages that can help application developers use the grid infrastructure, but are not part of the core Middleware distribution(s). Similar to / an extension of the EGEE RESPECT program.	(■)	■	■
Contributing to the description and evaluation of operational issues that can be of interest for scientific research.		■	■

Facilitating and supporting the effort towards publication of grid behavioral data, and fostering collaborations with relevant EU projects and national scientific networks. ■ ■

8.2. OUTLINE OF TIME EVOLUTION

This chapter describes in some detail the principles on which EGI will base its function Application Support and sketches some possible implementation scenarios. The time addressed is the first years of EGI. Specifically for this function is not easy to outline an evolution in a quantitative way, as much depends on the ability of EGI to attract new communities and offer to them the means for setting up a structure fitting their needs as grid users. As shown also by the survey reported in Chapter 3 there is a vast potential for useful expansion of the application sector served by EGI.

8.3. SUMMARY OF RESOURCES

The Table summarizes the manpower estimation for the Application Support function in EGI.org.

The estimation for the total manpower needed from the NGI's is depending on the number and kind of Applications EGI will support, and thus from the number and size of the SSC's that will be established.. In addition to the manpower an NGI devotes to the SSC's of its interest, there are other Application Support activities an NGI will take care of, including the services for purely national VO's, the organization of the national events, the help to new national communities for getting started on the grid.

ACTIVITIES	FTE
Support to SSC's and link to Operation and MW	2
Event organization	2
Services for new communities	2
Grid Planning	2
Training	4
TOTAL	12

Table 3:Overall effort for EGI.org Application Support and Training

For a reliable estimation of the manpower needed in the SSC's system more work and more contacts with the Applications are still required. At the moment we can however estimate it will be no smaller than the one presently supporting the Strategic Discipline Clusters in EGEE, also taking into account new Application and redistribution of resources for the current ones. Actually, taking into account the survey reported in Chapter 3, we expect it should soon became consistently bigger than that.

The estimation of the manpower needed for Application Support and Training in addition to the one devoted to the SSC's system, needs to be done separately for "small", "medium" and "large" NGI's with a model similar to the one used for the Operations (see 5.1.4)

- Small NGI : Application Support 1-3 FTEs ; Training 1-2 FTEs

- Medium NGI: Application Support 2-4FTEs ; Training 2-3 FTEs
- Large NGI: Application Support 3-6 FTEs; Training 3-5 FTE's

The exploitation of the synergies between Application Support and Training and the federation between NGI's may allow some consistent reduction of the manpower estimated above for the NGI's.

Note that we estimate that at least in the countries presently involved in EGEE a similar number of people are already working on the grid with task similar to the ones envisaged here for the NGI's.

9. FUNCTION OF EGI: EXTERNAL LIAISON FUNCTIONS

9.1. TASK AND SERVICES

9.1.1. Dissemination

A small team within this function will execute the dissemination activities of the EGI.org. The team will focus on content production and coordinating activities. Technical and specific services will preferably be bought from third party.

The objectives of the dissemination activities of EGI.org are

- to ensure the visibility and inform about EGI among decision makers, funding bodies, research communities, industry partners and other grid initiatives in Europe and worldwide
- to inform the user communities and NGIs
- to arrange activities in collaboration with the NGIs
- to create and maintain excellent PR/media relations
- to coordinate publishing of activity and management reports
- to organise events such as EGI conferences and user forums

The dissemination activities need to be effective and well targeted. For EGI the dissemination activities at large must be executed both by EGI.org and the NGIs with a clear division of responsibilities. The EGI.org will typically be in charge of tasks requiring coordination between NGIs. In general terms, the EGI.org will deal with the common actions of the EGI while the NGIs are responsible for the EGI dissemination in their local and regional areas. It is important to note that in order to achieve good results the dissemination team needs to act in close collaboration with the user-oriented, grid operational and technical activities of EGI.

The dissemination team of the EGI.org will serve as a horizontal link between the stakeholders (NGIs) and existing user communities, and has therefore a central role in maintaining the information flow to these parties. A dynamic and up to date website is a key element in maximizing the visibility, providing support to users and stakeholders and informing about the EGI. It is therefore a clear need for a professional and dedicated web editor.

The dissemination team of the EGI.org will support and coordinate the publication work of the EGI. Press releases and Newsletters of the work and key achievements will be published and widely distributed in order to increase the visibility of the EGI. NGIs have to contribute by providing material to paper and electronic publications. The EGI.org will also be in charge of organisation of annual events and conferences, similar to e.g. EGEE User Forum and DEISA Symposium. These events not only increase the visibility and inform existing users but also aim to enlarge the user community. Also presence in other major events in Europe and outside will be coordinated and organised by the dissemination team of EGI.org, whereas NGIs are responsible of the EGI presence in local and regional events. The presence can be for example, a presentation, where the dissemination team would support in finding the right experts. Further in practical arrangements, such as drafting of abstracts, or planning for an exhibition booth.

The core EGI.org dissemination team will be small at the beginning, but can be augmented by a rotation of 1-2 colleagues from the NGIs. The NGIs will further be requested to provide a contact person for the dissemination activities within their organisations.

9.1.2. Industry take up

It has been identified that sustainability of EGI would benefit from a persistent activity aimed at increasing participation of the private sector in the European Grid Infrastructure, bringing additional competences and financial resources to the initiative.

As a publicly funded infrastructure aimed for research, the usage policies will be determined not only by EU policies but primarily by national law and policies. The usage policies can be expected to be comparable to those of other similar research infrastructures, such as the GÉANT network and thus dedicated to research usage. Business usage is then limited, and primarily in form of research collaborations with European and national research institutes, universities and other educational institutions. The EGI.org management must develop a business model for the grid infrastructure although it by essential qualities will be limited in its commercial potential.

The general interest and potential use by industry can be very different. The most likely forms are;

- use of the EGI infrastructure in R&D (collaboration with the publicly funded research community).
- the EGI infrastructure as “state-of the-art”/”best practice” for industry.
- industry use of the EGI infrastructure for testing and learning.
- industrial projects with occasional exceptional requirements (critical computing on demand)

Preferably EGI.org would initiate a work together with the stakeholders, to elaborate on policies for access for industrial research projects in the pre-competitive domain and industrial production projects accessing innovative technologies or deploying innovative strategies. The NGIs are expected to work along similar lines on a national level.

Following the recommendations of the e-Infrastructure Reflection Group (e-IRG) Task Force on Sustainable e-Infrastructures, industry has to be seen as both a potential user and a service provider. Today it is possible to identify an emerging business based on the major European grid technologies. EGI.org should act positively towards such initiatives and establish policies allowing emerging companies and other initiatives a fair competition in providing services for the EGI.

9.1.3. Other External Relations

External relations are defined as relations with organisations and initiatives outside of the EGI and of direct relevance for the EGI in terms of collaboration or interoperation. Examples of such organisations and initiatives are:

- Grids outside Europe
- Commercial grids (e.g. cloud computing efforts)
- Large-scale international research collaborations (e.g. the EIROForum organisations and WLCG)
- Networking organisations (e.g. NRENs, DANTE, TERENA)
- Policy and standard shaping bodies (e.g. e-IRG, ESFRI, OGF)

The EGI.org management and specifically the Director should be in charge of External Relations. This responsibility should primarily be focused on

- establishment of formal relations when necessary
- promotion of common understanding on policies in scope of grid interoperation
- influence on policy and Standards shaping activities
- networking and enlargement of the EGI “sphere of influence”

The operational aspects in interoperation with other grids are handled by the EGI.org Grid Operations function..

The activity is not actively pursuing standardisation work but handles the relations of EGI.org with organisations such as OGF, e-IRG and OASIS. EGI.org should consider membership in organisations like OGF and OASIS if it is found beneficial for EGI. The work could include coordination and reporting of participation in different Standards working groups and interfacing with the technical teams doing the actual standardisation. To maximise the outcome of the external relations activity the EGI.org management should encourage bridging to external organisations and initiatives through the NGIs.

9.2. OUTLINE OF TIME EVOLUTION

The description provided in this chapter refers as usual to the first year of EGI. These kind of activities however are expected to be rather constant in time, with the very important exception of Industry Take-up, which will start very small, as a kind of feasibility study, but that hopefully will much grow, and may in future also require some change in the EGI structure, for better accommodating profit partners.

9.3. RESOURCES

Dissemination:

FTEs estimation: 3 (or 2) FTEs for EGI.org and 0,5 for each NGI

According to the above analysis the following expertise is proposed:

- A dissemination manager – 1 FTE for EGI.org
- A dissemination support person – 1 FTE for EGI.org (this can be combined with the one of the admin person at the EGI.org management function).
- A web editor – 1 FTE for EGI.org
- NGI dissemination interface for EGI – 0,5 FTE for each participating NGI. As said above 1-2 of the NGI interfaces can also further staff the EGI dissemination team.

Industry Take-up:

FTEs estimation : no additional manpower

It is proposed that the EGI.org director and the management team cover these activities, in the first years of EGI. The effort could increase substantially in the subsequent years when effective way of collaborating with the business world.

Other:

FTEs estimation: 2 FTEs for EGI.org.

According to the above analysis the following expertise is proposed:

5) A policy and external liaison manager – 1 FTE for EGI.org
6) A standardisation liaison manager – 1 FTE for EGI.org

10. FUNCTIONS OF EGI: MANAGEMENT

One of the obviously necessary functions for EGI is the management of EGI.org. The following description contains a rough sketch of the management levels and (within text-boxes) assumptions how the functions should be funded.

10.1. ASSUMPTIONS ABOUT EGI.ORG'S FINANCING STRUCTURE

The first assumption is on the general budgetary structure:

(a) Central management,

(b) Projects,

(c) Service provisioning

are accounted in separate cost centres. Cost centres are an efficient way of presenting activities of EGI.org in a transparent way to the EGI Council. The most important formal characteristic is that only the EGI Council is able to transfer resources from one cost centre into another one.

The second assumption is on the budget sources. The income is provided by three different streams:

6. membership fees from NGIs according to an EGI-Key, which is decided by the EGI Council,
7. income from project grants
8. . service charges to be paid by those NGIs who get specific services from EGI

For more details on financing see Chapter 5 in the Blueprint.

10.2. EGI COUNCIL

The top level management layer in EGI.org is the EGI Council. The NGIs own EGI.org and voice their views on all EGI matters through the EGI Council. The EGI Council may install committees, which elaborate recommendations to the EGI Council for specific topics. It may furthermore elect an Executive; details will be determined later.

The EGI.org Management has to provide legwork services to the EGI Council and its committees.

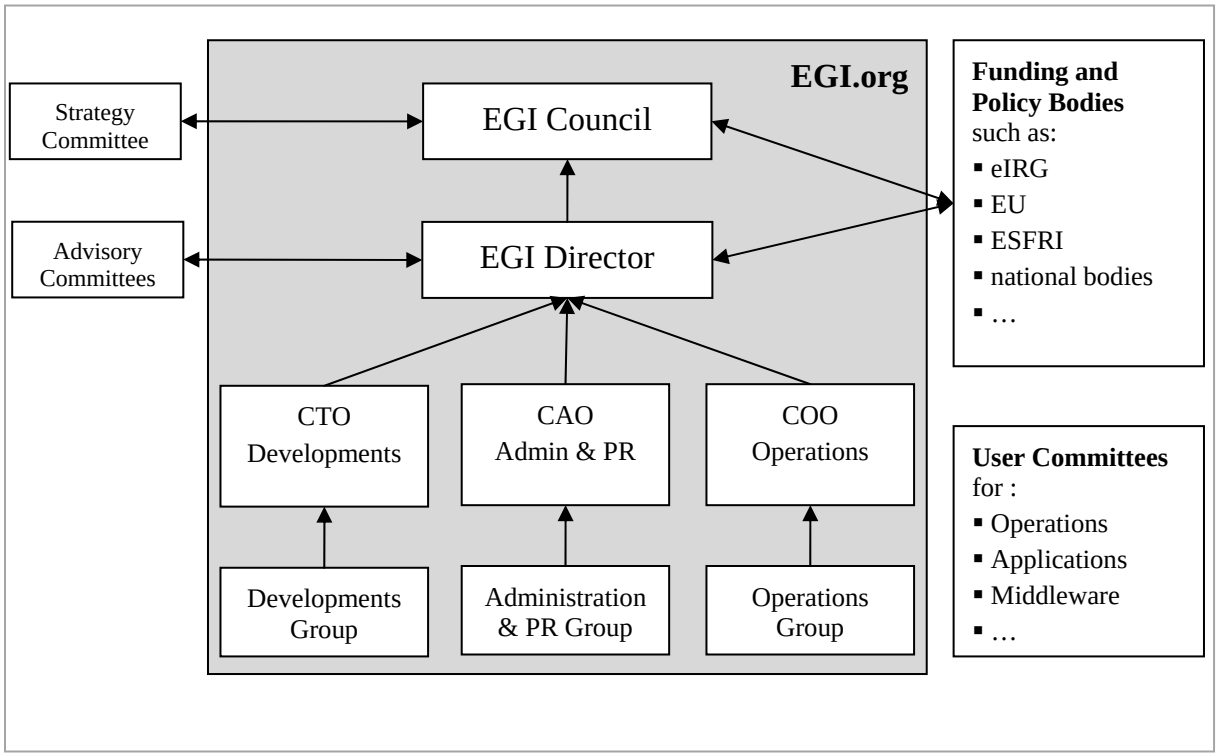
10.3. EGI.ORG DIRECTOR AND HEADS OF UNITS

The EGI.org Director, who works full time, provides the organizational interface to the EGI Council, to political bodies (EU etc.) and to several EGI committees on one side and to the Heads of the EGI.org Units on the other side. The EGI Director has to direct the group of unit heads. For all internal and external activities the EGI.org Director has one person who will assist him with handling his work. Within the unit heads the functions of a Central Technical Officer (CTO), a Central Operational Officer (COO) and a Central Administration Officer (CAO) are implemented. The administration also covers efforts for the public relations and contains positions in the administrative and legal services. The EGI.org Director needs a secretariat and must have some staff which prepares policy developments, the representation on European level and the legwork function for the EGI Council.

EGI.org should be positioned in a flexible way as far as EGI.org units are concerned. It seems that only three units should have a permanent basis: the Operational Unit, the Development Unit and the Administration Unit with the COO, the CTO and the CAO as head of the respective unit.

Projects may, based on EGI.org's findings, be embedded in these units or they may be organized as a separate project oriented unit within EGI.org, but always embedded in the organization's structure.

The following graph summarizes the features of the EGI.org management structure:



Summary EGI.org Funding and Management Structure

The following table summarizes the financial implications of the items mentioned above:

Position	**FTE/a**	**Funding source**
Director Assistant to the Director Secretaries	1 1 2	membership fees from NGIs
CTO	1	Project grants, if available otherwise NGIs contribution
COO	1	Service Charges or project grants
Administration + PR: CAO Admin. Staff Legal expert	 1 2 1	membership fees from NGIs
Total (positions paid by membership fees)	**8**	
Total (position not paid by membership fee)	**2**	

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APPENDIX A: A PILOT CASE FOR AN SSC: LIFE SCIENCES

DESCRIPTION OF THE USER COMMUNITY

Users of the EGI resources in the field of life sciences can be classified in three categories:

- Research Teams coming together for a limited time (at the National, European or International level) to constitute a project which pursues some research objectives. This use case is very well discussed in the documents. These users are keen to have their own VO for the duration of their project and therefore their own scientific gateway as well.
- Research teams having a continuous scientific activity that requires regular access to limited resources (equivalent to 1-2 CPU years) and from time to time, access to important resources (equivalent to 10-20 CPU years). These people are the customers of the biomed VO that they join once for all. The biomed VO should have its own scientific gateway.
- The ESFRI infrastructures will structure communities with well defined long tern scientific topics and therefore specific requirements. Each ESFRI should have its own international VO, its own scientific gateways and be managed from the ESFRI collaboration board.

The role of the SSC is therefore quite complex to coordinate between these categories of users.

Activities of the life science SCC

Most of the SCC activities are documented in the EGI Application Support and Training document. We will list here additional tasks.

- ***Comment to T-ESS-1 "Direct User Support"***

Coordination of user support

The SSC should supervise the selection of experts for GGUS and the distribution of work.

- ***Comment on T-ESS-2 "VO Support"***

Administration of international VOs

The multiplication of Virtual Organizations on a grid infrastructure is difficult to avoid but there is a need for one catch-all VO in the life sciences area. This VO should be under the responsibility of the life sciences SSC which can negotiate resources with the different nodes within NGIs.

- ***Additional task to T-ESS-3 (Documentation and training)***

SSC should be in charge of organizing tutorials and international grid summer schools for their communities. For instance, the Life Sciences community has now its own yearly grid summer school in Italy at spring and the Life Sciences SSC should pursue the organization of this event.

- ***Comment to T-ESS-5 "Specialised services"***

Coordination of development of science gateways

Development of international gateways should be the effort of the research communities which aim at using it. However, it is necessary to share some tools (workflow engines) and technologies (web services, semantic annotation).

The SSC should coordinate the development of the science gateways to guarantee their interoperability and their integration.

SSC should be in charge of the science gateway to the biomed VO which should be used as a template for the other gateways. Its development should be started very early in the project to be able to distribute it to the communities.

Development and support to high level community specific middleware services

The adoption of e-infrastructures by the biomedical sciences is still in its infancy. There are many reasons to this, including the lack of awareness of the biomedical sciences research communities for the grid technology and the stringent requirements of this community. A major cause for the limited adoption of the e-infrastructures is the lack of proper secured data management tools. Availability of these tools is slowly improving but the data management services developed in the middleware activities are still not integrated at a comparable rate with the job management services. Another limiting factor for the adoption of e-infrastructures is the lack of proper web service interfaces to grid services which is a key to the adoption of e-infrastructures as back end to increasingly popular e-science environments such as MyGrid, VL-e and workflow managers such as Taverna.

As a consequence, although very relevant services have been developed, their availability is quite limited as well as the resources for their maintenance and development, and they need to be properly interfaced using web services technology.

- ***Additional tasks to T-ESS-6 "Extended Support Services management"***

EGI Interface to the user communities

Individual users are expected to access to the grid resources through NGIs. However, international projects or initiatives will most naturally look for the SSC as an official interface to EGI. This is particularly important for ESFRI infrastructures are currently at the same stage as EGI, namely defining their internal structure and organization. As a consequence their interface to other infrastructures projects like EGI is not at all clear although their interest is obvious. The life science SSC should follow up on the different ESFRI design studies to understand their requirements on EGI.

Information

The SSC is the entry point to all life sciences activities on EGI. Its web site should provide all the information relevant to the life sciences activities on EGI. This includes a number of tasks:

- Keep an updated list and provide links to all the life sciences sectors of NGIs
- Keep an updated list and provide links to the projects in the field
- Keep an updated list and provide links to the science gateways in the field

Relationship to NGIs

The different NGIs are expected to have activities in the field of life sciences at a national level. The organization of these activities will depend on the NGI so the life sciences SSC should act as a support for the national life sciences activities and a broker for users looking for contacts at a national level.

APPENDIX B: COLLECTED USER REQUIREMENTS FROM SOME LARGE COMMUNITIES

REQUIREMENTS PROVIDED BY THE EARTH SCIENCES COMMUNITY via DEGREE project

The requirements with highest priorities are needed for any middleware, the second set of requirements were the ones typical for ES.

Highest priority requirements

Five requirements have the highest priority for any middleware:

1. Reliable grid middleware; Quality of Service, especially when submitting a huge number of jobs;
2. Easy access to data and databases; easy to use, standardized API and fine grained access policies possible;
3. Advance reservation or the information when your job will be scheduled: monitoring of jobs, estimate of queue delay, near- real time reservation;
4. Common ways of authentication and authorization: Standardized Authentication and authorization mechanisms for usage in portals as well as in direct Grid access. A globally accepted, trustworthy Grid user identity or 'Passport' with an infrastructure providing it is part of this.
5. A support to international VOs which are in many NGIs each with its own preference for grid services

These ES requirements are not unique; they are also valid for other science domains.

OTHER REQUIREMENTS

The requirements specific of the ES community are grouped in the following paragraphs according to different middleware aspects.

Administration and Operating

Common Authentication process across all Services

Powerful Authorization with VO/group support (multiple groups per user)

Shared Credentials (same certificate for all Services and Groups)

Central place to create user and credentials for the whole Grid

Secure Communication and Transfer (e.g. TLS)

Uniform configuration across all Grid components

Standard mechanisms for deploying application environments to CEs

Ability to deploy and operate different versions of same software

Interoperability through standard-compliance (e.g. OGSA)

Standard mechanisms to fault tolerance, error handling, service recovery, outages and maintenance scheduling for all Grid components

Testing and Monitoring of Grid Components with automatic Alerts

Reliable adherence to quotas and Quality of Service requests

Common standard for documentation, consistent documentation model, supported tools and formats across all middleware packages

Fast, easy site installation and verification procedures for new sites joining the grid

Infrastructural Services

Support for very data and metadata intensive applications, including fast access to metadata and reliable transfer of massive amounts of data.

Level of fragmentation and distribution into subjobs as well as the selection of computational sites should be influenced by proximity of data and bandwidth capabilities to ensure efficiency of the workflow. If this is ignored, data transfer might take much more time than the actual computation. If needed, local copies of files, so called replicas, should be created to aid the user. Existing replicas should be discovered automatically.

Ad-hoc integration of arbitrary data sources that lie outside the Grid, e.g. archives of sensor data that get updated regularly. The aggregation should not be a rarely synched local copy, but the up-to-date original data. Possible data sources are web service queries, databases (oracle, mysql, postgresql, firebird, mssql, db2), (S)FTP, HTTP(S), RTP (real-time).

Access to and integration with auxiliary software libraries for:

- Data format conversion for types typically used in ES, e.g. OGCs GML and KML, but also HDF, HDF-EOS, netCDF, ADDE, GeoTIFF, IDL, binary formats like BUFR, custom formats with transformation languages like XSLT.
- Services for common pre-processing / preconditioning steps (filtering, data reduction, data search, extraction based on time space constraints, subsetting)
- Data transformation (coordinate transformation, mapping, mesh/geometry generation, parameter retrieval, different interpolation techniques)
- Data postprocessing (statistical / numerical analysis, validation, grid registration, storage)

Application Development and Porting

Consistent API for all middleware components

Standardized error codes and error handling procedures

Framework to easily use Authentication, Authorization and secure communication

Client APIs for most prominent programming languages (Java, C++, Perl, Python, Fortran)

Consistent Command Line Interface to support shell scripting or unsupported languages

Ability to use MPI-standard (across domain boundaries)

Automatic Utilization of file replicas and mirrored databases without application side interaction

Unique identifier for files and all associated metadata

Support and interoperability of different query languages, e.g. SQL, LDAP, TMQL, XQuery, SPARQL, DMX

API to retrieve parameters specified in job description file

API for service and resource discovery features

Utilisation and Usability

Visualization of intermediate data during computation and of completed results

Discovery of services and data by arbitrary properties and metadata.

Potential modification of parameters during computation by interpretation of specific indicators or manually (application / simulation steering)

Description of entities by the use of custom or standardised ontologies

Support for wide range of metadata schemas (ISO 19115/19139) providing means to discover data, describe data objects, etc.

Non-intrusive easy to handle authentication

Reliable real-time and instantaneous job submission for high priority jobs for e.g. risk management

Intelligent assistant interface to facilitate scientific workflows and domain applications.

Workflow must provide knowledge representation and reasoning tools connected to metadata repositories

Workflow management must be able to handle workflow templates

Description of workflows in standard workflow description languages

Possibility to explicitly specify QoS requests

Support for Service Level Agreements and monitoring of their compliance

Standard framework for response messages. Unambiguous, clear and meaningful error messages. Rationalization of request handling processing and result codes (i.e. analogous to the HTTP error processing and execution codes)

30 June 2008

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DEGREE : http://www.eu-degree.eu

Ongoing:

REQUIREMENTS PROVIDED BY THE LIFE SCIENCES COMMUNITY

This community shares all the requirements listed by the ES community.

In addition, an important requirement for the Life Sciences is encryption / protection of data on grid storage elements.

See also following user survey https://edms.cern.ch/document/878801/1