1 - ERIC Objectives and Strategy

The mission of AnaEE ERIC (hereafter simply referred to as "AnaEE") is to provide the tools and services needed to obtain the knowledge necessary to tackle the complex global environmental challenges facing human societies. Its core task is to provide open, coordinated access to state-of-the-art experimental facilities and high quality data on ecosystem properties and functions to a wide range of users. AnaEE will offer a range of added-value technological transfer and R&D services. AnaEE will thus derive a major impact on public policies and the development of a sustainable bio-economy, within Europe and globally.

1.1 The AnaEE vision

The key to anticipating and predicting the consequences of already known but also unprecedented anthropogenic changes to our Earth system lies not only in a better understanding of the complexity of ecosystems processes and their drivers, but also in acquiring the necessary knowledge to better plan for a changing future. AnaEE strives to become Europe's central research infrastructure for experimental manipulation of managed and unmanaged terrestrial and aquatic ecosystems to critically improve our understanding of the interdependencies between ecosystems and the environment. Without such knowledge, Europe will remain unable to fully assess the impacts of anthropogenic change, mitigate the risks and plan accordingly. To achieve that aim, AnaEE will bring together highly equipped research platforms from countries across the European Union and beyond, to support scientists in analyzing, assessing and forecasting the impact of global changes on ecosystem services.

Providing such services at the EU-level requires a broader approach than what individual national facilities can provide. AnaEE will contribute to facilitate, produce, process and understand information and data on changes in agriculture, forest and water resources, thereby addressing their profound economic direct and indirect impacts on communities. While each country currently relies on its observations and measures, the added value of AnaEE will be to undertake studies and experiments to be tested in different zones, with common standards and certified procedures, in order to formulate more robust and comprehensive conclusions. This would lead to testing scientific solutions for e.g. greenhouse gas mitigation and climate adaptation.

A unique feature of AnaEE will be to offer an integrated access to both models and data. This benefits model developers and experimental scientists alike. AnaEE will generate new opportunities in developing new insights from the data and will support users in using science-based models to better design experiments or derive greater commercial and policy impact from their research.

Partnerships with the private sector will be sought to improve facilities for ecosystem experimentation directed towards their ecosystem service needs, to improve ecosystems-related instrumentation, engage into new ecosystems engineering activities and incorporate predictive ecosystems services in business models.

AnaEE will then become the key European research infrastructure to provide experimental knowledge to better understand ecosystem functioning, in order to anticipate and respond to the consequences of climate and land use changes on ecosystem services, and to secure food provision across the European continent and around the world. Knowledge generated by AnaEE will be synthesized and shared with policy-makers and the general public. AnaEE will

support the training and capacity-building of actors in charge of land management and the provision of ecosystem services, to nurture anticipation and innovation.

1.2 The landscape

AnaEE is one of the eight projects on the ESFRI Roadmap for the Health & Food domain, which also regroups six already established landmark RIs1. Since AnaEE aims at a better understanding of the biological, physical and chemical processes at play in terrestrial and aquatic ecosystems, it stands at a crossroads between life sciences and environmental sciences. AnaEE is noticeably expected to interact with EMPHASIS (European Multi-Environment Plant Phenotyping and Simulation Infrastructure) a project coordinated by Germany and integrated to the ESFRI Health & Food roadmap in 2016.

The ESFRI roadmap includes five projects and five landmark RIs[1] in the environmental domain. AnaEE already exhibits strong complementarities with ICOS which provides scientific data on carbon cycle and greenhouse gas emissions, and with LifeWatch which provides access to biodiversity and ecosystem science data and data processing tools. Some proposed AnaEE platforms are already collocated with ICOS sites. AnaEE is also expected to develop synergies with ACTRIS (Aerosols, Clouds and Trace Gases, coordinated by Finland) and DANUBIUS-TI (river-sea ecosystems, estuaries, coordinated by Romania), two projects newly admitted to the 2016 ESFRI roadmap, and with eLTER which is an emerging RI in the roadmap. AnaEE will make a significant stride in the broader effort to organize the European research landscape; thanks to its participation to the ENVRIplus[2] cluster which has mapped twenty-two research infrastructures so far, including eleven already on the European roadmap (Fig. 1.1).

Fig. 1.1: The landscape of pan-European environmental research infrastructures included in the ENVRIplus cluster – see ESFRI projects in central circle.

It is essential for these infrastructures to capitalize on their joint potential, to ensure the European scientific community derives full value from these large-scale environmental projects and European scientists remain at the forefront of global research, as they tackle the scientific challenges ahead. ENVRIplus aims to homogenize environmental data infrastructures, so as to highlight best practices and provide technical tools to help researchers fulfill their scientific remit. AnaEE has played an active role in building this cluster to better share work and resources (ENVRIplus). Collaborations within ENVRIplus will enable a multidisciplinary

[1] http://www.esfri.eu/esfri_roadmap2016/roadmap-2016.php

[2] An Horizon2020 project bringing together Environmental and Earth System Research Infrastructures, http://www.envriplus.eu/

approach across all science fields traditionally associated to the Earth System. Cooperation will also minimize risks in fragmentation or duplication of efforts, making RI products and solutions easier to share, improving their innovation potential and the cost/benefit ratio of the RI operations.

While specific research infrastructures already provide data and services towards answering environmental challenges and societal needs, the 2030 vision for environmental research infrastructures is that of a holistic understanding of all interactions and processes within the Earth System, connecting and sharing data, models, instruments, algorithms and discoveries. In other words, a systemic scientific approach will generate flexible services, answering environmental challenges and providing key products for societal needs.

Linking AnaEE results with data from observational sites across Europe (ICOS, LTER) will allow models to be rigorously tested and scaled to larger geographical areas. AnaEE will also complement and add value to emerging research infrastructures in the agrifood, forestry, bioenergy and aquaculture sectors, as well as other infrastructures in existence or under development, particularly in the areas of technological development, data exchange (e.g. ELIXIR), interoperability of models and the synthesis of summary results on spatial and temporal scales.

AnaEE has already established strong links with similar initiatives worldwide, such as NEON in the USA (http://www.neonscience.org/) and TERN in Australia (http://www.tern.org.au/). The connection with the COOP+ (previously COOPEUS) project aims at building a framework for information exchanges between the US and EU environmental research infrastructures. The EUDAT provides research data services, expertise and technology solutions for all European RIs, so that AnaEE might mobilize the EUDAT Knowledge Hub to develop its own data and metadata structures. AnaEE was also included in the strategic research agenda of the FACCE Joint Programming Initiative and maintains links with the Group on Earth Observation (GEO). Likewise, AnaEE facilities and services to scientists and policy-makers may benefit international research initiatives the likes of:

- AgMip[3] (a comparative approach to agriculture models);
- MACSUR[4] (a modeling of agriculture under climate change);
- TempAg[5] (a collaborative research network on temperate agriculture set up by the OECD's Global Science Forum).

As a result, AnaEE holds a unique position within the ESFRI roadmap and is at the heart of several major international initiatives for ecosystem science and agriculture.

1.3 Challenges

1.3.1 Scientific challenges

An unsustainable exploitation and pressures on ecosystems since the industrial revolution of the XIXth century has resulted in a series of anthropogenic environmental changes which now present a threat to the welfare of human societies everywhere [1]. The scientific community is now called upon to address such challenges as:

[3] www.agmip.org
[4] http://macsur.eu
[5] (http://www.oecd.org/sti/sci-tech/tempag.htm

- Climate change;
- The disruption of biogeochemical cycles (carbon, nitrogen, phosphorous) with consequences on pollution, nutrient losses and soil quality;
- The disruption of the water cycle and eutrophication;
- The disruption of natural habitats;
- Biodiversity loss.

Threatened ecosystem services include the provision of food, fresh water, wood and fiber, fuel, the regulation of climate, floods and disease, as well as the delivery of cultural (aesthetic, spiritual, educational and recreational) elements. Generating strategies for the preservation of ecosystems service and sustainable exploitation of natural resources demands further collaboration between researchers, industry, politicians and citizens [2, 3] which the AnaEE will support (Tab. 1.1).

Our understanding of ecosystems' structures and functions has dramatically increased in the past few decades, thanks to the introduction of new approaches, such as satellite imagery applied to the remote sensing of the Earth's structure and dynamics [4]. These technological developments have been at the heart of many previous experimental programs (e.g. FACE experiments) with some of them integrated across continents, which allowed to upscaling the observations on continental ecosystems, thanks to modelling and geographic information systems. Despite these new approaches, ecosystem science is still relatively new and faces drastic challenges.

Many threats to ecosystem functions manifest themselves in a non-uniform and non-linear manner, so that solutions may vary from one region to another. Traditional reductionist approaches are still needed to better understand and predict basic ecosystems' processes and functions such as the mechanisms controlling the emissions of greenhouse gases, or the long-term storage of carbon in the soil, in order to suggest mitigation measures, much in the same way as understanding the biological mechanisms of plant survival might pave the way for better forest management. We generally lack the capacity to test interactions between multiple global change drivers since it is unlikely that all response strategies are additive [5]. We also lack the experimental designs necessary to understand species and ecosystems' responses to extreme conditions (i.e. sources of environmental stress ranging beyond the historical or predicted ranges [6]), as well as comprehensive longitudinal studies addressing long-term ecological responses to global changes.

Many processes at play in global changes characteristically develop over time scales much longer than the duration of most experiments: a coordinated approach is therefore necessary to combine long-term, large-scale global change experiments with process studies and modelling. Moreover, cross-scale interactions – that is, from one spatial or temporal scale to another – require a more extensive and integrated approach. They may result in nonlinear dynamics and can either amplify or attenuate system response to broad-scale drivers [7].

ecosystem type	threats	services affected	AnaEE research fields leading to adaptation and mitigation strategies
agricultural systems 	climate change land use change air and soil pollution soil erosion flooding soil fertility pests	food production food quality nutrient cycling carbon storage GHG emissions buffering stream water quantity and quality renewable natural resources biodiversity maintenance	agronomy agroecology soil sciences hydrology plant biology microbiology biogeochemistry
forests 	climate change land use change air pollution biodiversity loss invasions	timber and wood production timber and wood quality carbon storage water cycle biodiversity maintenance habitat quality leisure & tourism	ecology hydrology tree biology biogeochemistry
wetlands 	climate change management practices soil pollution flooding invasions	water quality habitat biodiversity GHG emissions	hydrology ecology biology of aquatic species microbiology management alternatives
grasslands, shrublands 	climate change land use change air and soil pollution biodiversity loss soil erosion invasions	fodder production grazing quality and quantity nutrient cycling GHG emissions buffering renewable natural resources	agroecology plant biology biogeochemistry microbiology management alternatives

Tab 1.1: Key threats to different ecosystems and AnaEE' corresponding fields of experimental research

A guiding principle and core strength of AnaEE is the effective integration of experimental and modelling activities for the overall progress of ecosystem science, particularly with regards to expanding Earth system models [8]. AnaEE infrastructures will address a key challenge in predicting how ecosystems function under the complex combination of diverse environmental pressures, also taking into account biotic and abiotic factors.

1.3.2 Societal challenges

Societies depend on the continuous provision of critical ecosystem services such as food, energy and raw materials. Thus, the maintenance of ecosystem services – in particular the mitigation of anthropogenic activities' negative impacts – is a major challenge to our future. AnaEE will contribute to tackle those challenges by enabling a better understanding of ecosystems' responses to anthropogenic pressures.

At present, many European ecosystems are in jeopardy which necessitates common and coordinated responses to help mitigate the negative effects of climate change, land use change and pollution. It is difficult to predict these impacts, both on ecosystems and society,

since they interact on a multi-regional scale. Phenomena such as deforestation, desertification, but also river floods, droughts, increased temperature and precipitation records affect all regions of the European Union, with adverse effects on agriculture, biodiversity as well as land and water resources.

Impacts of climate change on agriculture

Agricultural land covers 47% of the EU territory and over 95 % of the EU-28's 12.2 million farms are classified as family units. Family farms are particularly vulnerable to the adverse effects of climate change, implying that unless a coordinated action plan is developed at a regional, national and European level, most of the farmers will face drastic income losses. Adverse societal impacts on agriculture would amount to yearly losses in the billions. Indeed, a 5% reduction in agricultural production would result in a €8 billion income loss for the EU as a whole.

Climate change, including extreme weather events, will likely influence delicate equilibria such as the populations of insects and the spreading of diseases to animals and weeds. Water significantly limits plant productivity in large parts of the world. Even in relatively moist climates such as England, droughts lower the crop yields by an average of 10 to 15 % each year. Farming in the Southern and South-Eastern regions of the EU will be most affected [9] (Fig. 1.2) and corollary migration flows in the Mediterranean basin will noticeably increase pressures on European resources.

Impacts of climate change on forests

33% of the EU territory totalling 215 million hectares (ha), is classified as forestry, of which 150 million ha constitute its wood supply [10]. Forests are currently under threat from climate change, with 3.7 million ha already impacted including the 0.5 million ha of forests been damaged by fire. Moreover, it has been estimated that a tree pest affecting 5% of the wood stocks could cause losses over €10 billion if not properly confined and cured. Wood-based industries employed 3.4 million people across the EU-28 in 2012, or 11.3% of the manufacturing sector's gross labour force, thereby highlighting climate change's significant adverse societal impacts for the many communities relying upon forests for their livelihood.

Forest products are noticeably used for substituting fossil fuels and as building materials while forested land retains a great carbon sequestration and biodiversity conservation potential. European forests currently constitute a sink for 450 million tons of CO_2 per year, which is roughly 10% of the EU total annual emissions. 5 million tons of carbon are furthermore stored in woody biomass and 30 million tons in forest soils [11]. Maintaining this storage capacity will be crucial in the mitigation of climate change globally.

It is not self-evident forests will maintain such functions under multiple stresses and sustainable forest management options will need to be carefully evaluated. Adaptation measures for forestry need to be planned well in advance in order for the forests regenerated today to cope with future climate conditions over the course of several decades, if not the next century. The level of vulnerability varies from one region of the EU to another, as illustrated by a 2007 report [12].

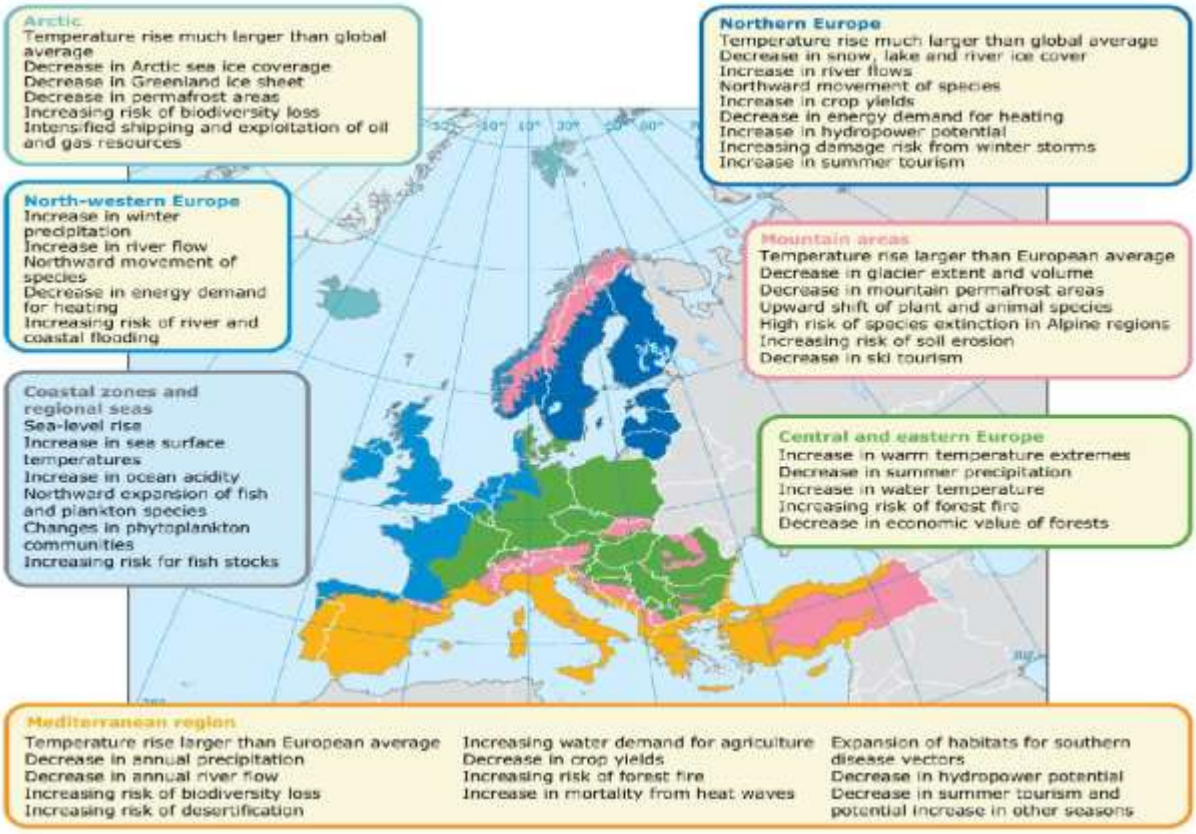

Fig. 1.2: Key observed and projected climate change–related impacts in Europe's main regions.
Source: Climate change, impacts and vulnerability in Europe 2012, an indicator-based report, European Environment Agency.

Considering the current uncertainty as to the extent and speed of such changes, conclusive targeted research results on adaptation options will vary between regions, making the European-wide AnaEE platform combination uniquely poised in testing different options, starting with small scale experiments in an effort to advise the wider community of forest managers and decision-makers.

Threats to aquatic ecosystems

There are several million kilometres of streams and rivers and more than a million lakes across the European territory. Therefore "fresh water" provides for a multitude of ecosystems, which play a crucial role in European economy and culture.

Besides recreation and tourism, ecosystem services provided by lakes include climate change mitigation, sediment and nutrient retention and processing, hydrological regulation and fisheries. Mitigation efforts conversely rely on carbon sequestration and hydrological buffering. For instance, lake sediments in Northern Europe offer larger carbon storage capacity than above-ground forest vegetation. Besides carbon, lakes and reservoirs also retain phosphorus and nitrogen: such nutrients as well as carbon may be mineralized through a biogeochemical process, resulting in the production of atmospheric methane, amongst others. A major nitrogen sink lies in sediment N_2 gas production by means of a denitrification process.

Twenty-two of the European Union's Member States have commercial inland fisheries with an associated fleet of 14 000 boats, 17 000 fishermen (in addition to numerous recreational and

subsistence fishermen) grossing a total annual catch of 35 000 tons. Freshwater ecosystems are also used for aquaculture purposes. While biodiversity is a key ecosystem service provided by aquatic ecosystems, it is especially challenging to tackle in adverse impacts on lakes where the cause for photosynthesis are microscopic eukaryotic unicellular algae and prokaryotic cyanobacteria, which are still difficult to identify.

While many freshwater areas are sparsely populated with lakes' catchments consisting of forests and peatlands, key man-generated impacts mostly affect peatland drainage and forest management, while agriculture and urbanization are at the root of the most severe lake pollutions. Conversely, such human activities have gravely affected riverine ecosystems in Central and Southern Europe. In Europe in general, the main threats to freshwater ecosystems are climate change, eutrophication (i.e. nutrient enrichment, often manifesting in harmful algal blooms) and emerging pollutants. Besides, a large part of European freshwaters are heavily hydrologically modified and altered, through channeling, damming, flood control regulations, agricultural purposes, urbanization and energy production. Only a fraction can be regarded as pristine and while water bodies are much cleaner than in 1980's, only 50% can be said to be in good or optimal ecological condition.

In chapter 2, the potential services of AnaEE to address these threats are presented, together with a market analysis of the main sectors affected, in an effort to list costs and benefits associated with a better management of European ecosystems.

1.4 Education and training

AnaEE will contribute education materials, with goals and tools adapted to all academic backgrounds, from the primary school to the PhD levels. It is of the utmost importance to decision-makers and to the general public, that they better understand ecosystems basics, as well as interrelated issues such as biodiversity, nutrient cycles, soil and water quality, which are key factors in food production and environmental health. Wider familiarity with such concepts will facilitate the incorporation of the scientific knowledge generated by the AnaEE infrastructure into policy design and decision processes.

AnaEE partially addressed this issue in its Preparatory Phase in developing an educational website (learn.anaee.com). This website presents scientific contents, based on research projects and experimental data acquired from manipulation, measurements, modelling and translate them into general knowledge and suggestions for climate change mitigation strategies and the basic preservation of ecosystems. The website's content policy follows an inquiry or problem-based educational methodology which stems from a general interrogation, problem or scenario, rather than simply presenting established facts or portraying a linear path towards knowledge acquisition (Fig. 1.3).

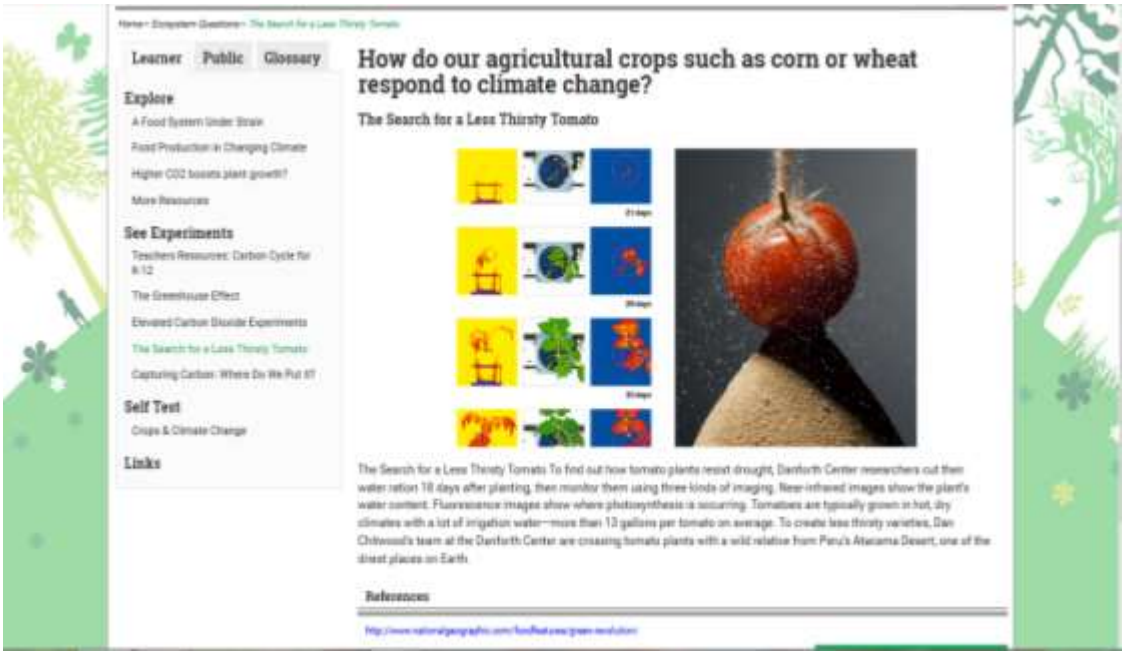

Fig. 1.3: An excerpt from the AnaEE interactive website.

AnaEE will manage educational/outreach components through its Central Hub (or Synthesis Centre) and conduct a set of activities that will:

- **Analyse national curricula** in primary and secondary education systems in order to define new approaches to improve basic understanding of the concepts associated to ecosystems preservation;
- **Launch a web-based platform** (separate from one mentioned above and, if possible, available in different languages) to facilitate exchanges between ecosystems scientists and educators interested in developing new teaching materials based on AnaEE research;
- **Encourage secondary-level students** to choose environmental academic careers at a university level, possibly by means of internship programs.
- **Provide e-learning (MOOC) teaching materials either developed in-house or in partnership with related** infrastructures and involving leading European scientists and professors.

With regards to the scientific community, AnaEE plans to support specialized higher education and training activities to attract promising young researchers and promote sustained interactions between academics and future economic leaders, smart companies or emerging agro- and eco-friendly businesses.

AnaEE's higher education programme will consist of a unique series of **winter and summer schools** open to graduate students, early career researchers and professionals across Europe. AnaEE summer-winter schools will use an experiential learning philosophy to teach research and technology, thanks to the advanced technologies, data and models made available by AnaEE sites and partners. Bearing in mind interdisciplinarity is the most pressing challenge for higher education in ecology and environmental sciences today, summer-winter schools will promote practical learning modules and make reference all environmental, life and earth sciences involved in AnaEE. Focusing on climate change, food security and generally how ecosystems function, standard, week-long summer/winter school sessions for academics will take advantage of AnaEE European infrastructures in order to be hosted in different venues.

Once a year, an additional **week-long business and innovation programme** will be organized for experienced professionals and young academics to develop innovative and ecological engineering solutions to face global changes. In addition to delivering knowledge and skills, the programme will also focus on connecting people and ideas, especially academics and professionals. This will strengthen AnaEE community and prove essential in achieving this research infrastructure's optimal economic impact.

Finally, AnaEE will partner with European training networks so that AnaEE facilities may deliver high-quality trainings in the experimental manipulation of ecosystems. In addition, training activities will be organized for all AnaEE staff, as described in chapter 4.

1.5 Relevant European policies and priorities

As a result of its commitment to preserve its environmental resources, the European Union has adopted a set of comprehensive policy measures since 1991. Some of those policies relate to topics which will very likely be the focus of AnaEE environmental-targeted activities, as for example the Common Agricultural Policy (CAP), the European Climate Change Programme (ECCP), the EU Biodiversity Strategy and the Water Framework Directive (WFD). [16]

The CAP has shaped the last decades of EU agriculture. It consists of two pillars, the first of which establishes a system of direct payments to farmers and a price support scheme, amongst other interventions in support of the market for agricultural products. The second pillar aims at improving rural development while reducing the environmental impact of farming. As part of post-2013 CAP proposal (EC, 2011c), a series of 'green payments' were introduced to support crop diversification, permanent grassland and ecological focus areas, such as buffer strips. Rural Development measures further encourage the preservation of natural habitats and biodiversity as further stated, e.g. in the Birds and Habitats Directives. Specific community programs financing the promotion, conservation, characterization, collection and use of genetic resources in agriculture are also described in the CAP [14]. Thus, integrating biodiversity and genetic resources into the management of agro-ecosystems is a CAP objective to be considered by AnaEE.
The EU Biodiversity Strategy[6] aims at halting the loss of biodiversity and improving the state of Europe´s species, habitats and ecosystems. The six objectives of the Biodiversity Strategy are:

1) Enhance implementation of nature legislation
2) Restore ecosystems, establish Green infrastructure
3) Sustainable agriculture and forestry
4) Sustainable fisheries
5) Combat alien invasive species
6) Contribute to averting global biodiversity loss

Cost-effectiveness demands for the identification of key priority regional areas to plan intervention and achieve the objectives beyond 2020.
A European Commission Package also includes revised legislative proposals regarding waste and Europe's ultimate **transition towards a circular economy**, in an effort to boost global competitiveness, foster sustainable economic growth and create new jobs [17]. The Circular Economy Package establishes a concrete and ambitious programme of action, with measures covering the whole cycle, from production and consumption to waste management and the

[6] http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

market for secondary raw materials. AnaEE will support research projects on the management of ecosystems in the view of moving towards a circular economy.

The **WFD** of the EU pinpoints the following objectives, which serve to direct AnaEE activities in the water management market:

- Expanding water protection schemes to include surface and ground waters;
- Achieving "good quality status" for all waters by a set deadline;
- Basing water management strategies on river basins;
- Adopting a "combined approach" to emission limits and quality standards;
- Furthering citizen engagement.

The ECCP was initiated in the wake of the EU ratification of the Kyoto Protocol and encourages the development of integrated measures to limit the loss of ecosystem services and curb negative climate change-related impacts. The ECCP package includes a number of binding regulations to ensure the EU meets its climate and energy targets by 2020:

- A 20% cut in greenhouse gas emissions from 1990 levels;
- A 20% portion of EU energy derived from renewable resources;
- A 20% improvement in energy efficiency.

The Paris Climate Conference (COP21) in December 2015 led 195 countries to adopt the first-ever universal, legally binding global climate deal. The agreement, to be enforced by 2020, confirmed the global momentum to mitigate climate change and limit global warming to 2°C or lower. The EU led international efforts towards reaching a global climate agreement. Following limited participation in the Kyoto Protocol and the lack of an agreement at the 2009 Copenhagen conference, the EU committed to building an ambitious coalition and shape a successful outcome of the Paris conference.

AnaEE will be an effective tool for the Member States to gather knowledge and implement actions towards the fulfilment of the objectives of the European policies. For example, AnaEE can be used as an asset to implement the Monitoring, Reporting and Evaluation (MRE) component of the ECCP and provide consulting services to policy-makers [15]. European countries with MRE systems in place aim at monitoring and reporting on their progress in the implementation of actions and policies included in their national adaptation strategies or plans. AnaEE can further serve MRE implementation by e.g. generating informative prediction models, facilitating the interpretation of interdisciplinary data, and enabling synergies between natural and social sciences.

1.6 Infrastructure description

The AnaEE Research Infrastructure (AnaEE-RI) operates on two distinct layers:

1) The **ERIC** will be the central legal entity that will coordinate, service and integrate the whole RI. It will be composed of one Central Hub and three Service Centres (Section 1.11). While the four bodies of the ERIC will likely be hosted in different countries, they will be centrally coordinated. The Management Board (MB) will gather the Director General and the heads of the three Service Centres. The executive body of the ERIC is composed of the Director General and the central Hub team (Section 1.11.1). The Director General reports to the Assembly of Members (AoM) which benefits from the advice of an external Scientific and Ethical Advisory Board (SAB), as described in the AnaEE governance scheme (Section 3.4).

2) The National Platforms constitute experimental facilities. The platforms located in AnaEE partnering countries will retain their legal and financial independence. Member States will submit applications of their platforms to AnaEE and the AoM will carry out platform selection upon an internal check based on specified criteria. Annual memberships are paid by relevant national authorities, following the decision of the AnaEE Assembly of Members. Platforms will in turn derive a variety of benefits from AnaEE, ranging from global recognition to training in quality assurance.

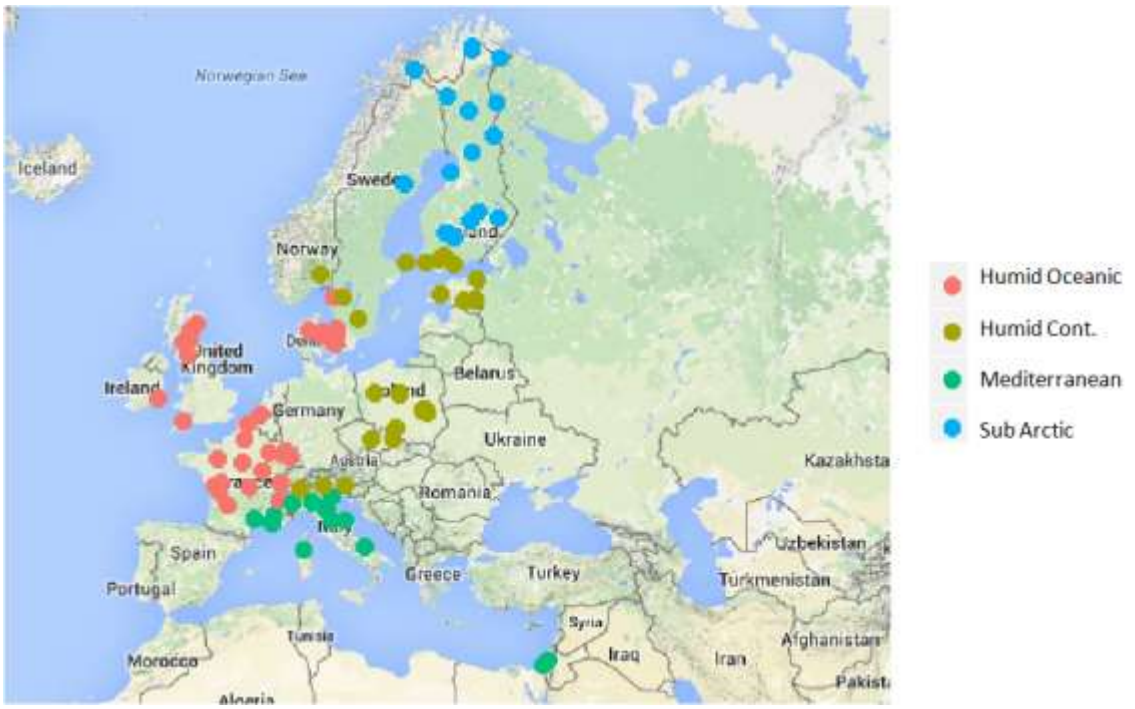

Fig. 1.4: AnaEE pan-European coverage of open-air and enclosed ecosystem platforms (as of April 2016)

AnaEE National Platforms are spread across four climate zones (humid oceanic, humid continental, subarctic and Mediterranean -- see Fig. 1.5). Within these climate zones, AnaEE projects cover seven different types of ecosystems: agricultural lands, forests, grasslands, shrublands, wetlands, rivers and lakes.

National Platforms study the influence of a wide variety of environmental pressures on ecosystems with a view to develop mitigation, adaptation and management measures for the optimization and/or preservation of ecosystems' services in the face of global change. They are classified in 4 different groups:

- **Open-air ecosystem platforms (also referred to as '*in natura*'):** permanent or semi-permanent facilities dedicated to the manipulation and measurement of the main processes in terrestrial and freshwater aquatic ecosystems. They also provide laboratories for basic sample analysis and storage. These platforms are distributed across Europe's Arctic, Mediterranean, Oceanic and Continental environmental gradients and agricultural lands, forests, shrublands, wetlands, grasslands, and rivers and lakes. AnaEE call for interest received 165 submissions from *in natura* platforms.

- **Enclosed ecosystem platforms (or '*in vitro*'**): controlled environments dedicated to the analysis of processes involved in natural ecosystems or sub-systems within a research facility, for greater control over environmental variables and facilitated

measurements. They possess in-built measurement systems for a wide array of processes (e.g. water, carbon, nitrogen, phosphorus) and enable efficient hypothesis testing and quantitative analysis of natural ecosystem functions. The AnaEE call for interest received 44 submissions from *in vitro* platforms.

- **Analytical platforms:** laboratories and workshops providing technically demanding and/or expensive analyses (e.g. high-throughput genomic, mass spectrometry, advanced microscopy) in support of manipulation experiments. They provide research tools and expertise usually unavailable to individual research groups. The AnaEE call for interest received 44 submissions from analytical platforms.

- **Modelling platforms:** facilities specialized in developing models to support projects run by AnaEE. They streamline model development by providing the necessary hardware and software, as well as the access to expertise, datasets and modelling libraries. The AnaEE call for interest received 9 submissions from modelling platforms. Further analysis led to distinguish 5 modelling solution platforms from 4 distinct model factories.

The AnaEE call for interest was circulated to national focal points in 16 European countries, being either a partner of AnaEE Preparatory Phase or not. The call generated a total of 241 responses, including tropical open-air sites managed from Europe. Of 209 open-air and enclosed experimental platforms submissions, 125 were considered to be eligible for AnaEE. Each platform demonstrated its commitment to ecosystems science and capacity to host new projects. The key eligibility criteria were as follows: the possibility to manipulate at least two environmental factors with a sufficient number of replicates, as well as instrumentation quality, data handling know-how and the capacity to interact with modellers. The ability to manipulate climate parameters was particularly encouraged but not mandatory. This analysis indeed highlighted strengths and gaps of interest to countries in planning their national research strategy. The grand sum of eligible modelling, analytical, open-air and enclosed experimental platforms reached 152.

AnaEE will maintain an open call for candidacies and monitor upgrades planned by all eligible platforms. Each country joining AnaEE will have to confirm and commit to the long-term support of its platforms entering AnaEE.

1.7 The lead up to ERIC

The AnaEE initiative started with an "AnaEE Design Study" phase (2007-2009), the objectives of which were as follows:

- To demonstrate the added value of its innovative concept of a new experimental infrastructure aimed at tackling major challenges including climate change, food security and environmental sustainability;
- To share this concept with the wider scientific community at the European scale;
- To identify financial, administrative and legal aspects and obstacles in building such an infrastructure; and
- To convince national research institutions and stakeholders to support such an infrastructure.

During the "AnaEE Design Study" phase (Fig. 1.5), significant progress structured the ecosystems scientific communities into an infrastructure of sufficient maturity to launch an ESFRI preparatory phase.

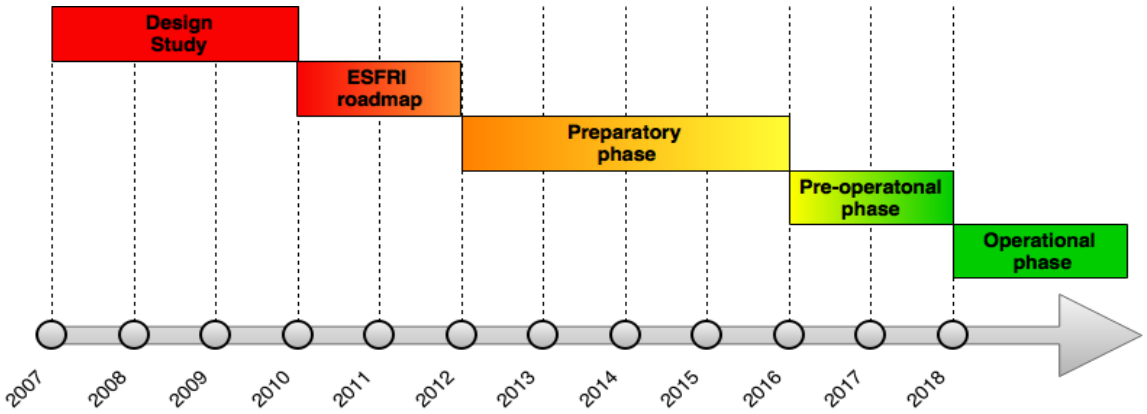

Fig. 1.5: development process

Taking advantage of the momentum of the Design phase and to expand on the community thus gathered, the achievement of the I3 project 'ExpeER'[7] paved the way to initiate the AnaEE project, by structuring a large number of existing and well established *in natura* and *in vitro* experimental sites as well as monitoring sites belonging to the LTER Europe network. Work carried out as part of ExpeER enabled the ecosystem community to identify potentially relevant sites for AnaEE, as well as current gaps to be filled by the upgrading or opening of new sites in order to establish AnaEE at the European level.

The AnaEE Preparatory Phase was successfully submitted to the EU Commission and launched in 2012, thanks to the contribution of 10 countries and 12 research institutions. This phase provided content for the present Business Plan as well as the fundamental basis for implementing AnaEE as a Pan-European research infrastructure. The successful call for platforms underlined the need for a sustainable coordination, hereby justifying presenting an ERIC application for AnaEE.

While the lifespan of such an ERIC is expected to be several decades, the types of platforms and the infrastructure's core activities may evolve in time, depending on the state of knowledge and the needs of AnaEE Members.

1.8 ERIC Objectives

AnaEE will be established as an ERIC in order to fulfill the need of a pan-European infrastructure. AnaEE will then be in a prime position to secure long-term funding for the RI's operations and integrate all National Platforms research efforts. It will bring together countries and expertise, and ensure the exploitation of synergies between the different Member States. A wide geographical distribution of the infrastructure will permit to tackle global research questions. The ERIC will improve the quality of the National platforms (e.g. improved methodologies, training of the staff, guidelines for quality management) and the return on national investments (more and better research projects).

AnaEE will coordinate environmental manipulation studies across major European climatic zones and landforms. Permanent and semi-permanent facilities, providing continuous data

[7] http://expeeronline.eu/

streams over the long-term manipulation and observation of environmental variables, will highlight associations and causalities overlooked so far. Moreover, long-term studies will better encapsulate the effects of episodic events, such as extreme weather or pollution episodes. Studies coordinated by AnaEE would therefore aim to face to complex, multivariate environmental issues with a considerable spatial and temporal reach. The complexity of the research hypotheses processed will, in addition, foster the development of innovative approaches.

AnaEE will also harmonize all the data obtained under the AnaEE-RI, develop a federated data infrastructure for improved data access and facilitate the building of globally applicable models. The research output from the ERIC will be shared with scientific communities, policy-makers, and the general public. The research findings will be presented in global arenas by an AnaEE unified voice with a view to increase the visibility of European scientific excellence. Finally, AnaEE will provide fundamental contributions to the United Nations' post-2015 development agenda on topics such as food security, water resources and biodiversity preservation as well as energy.

1.9 The AnaEE Business Model

The AnaEE business model is summarized under the following canvas, which serves to presents its nine characteristic components [18] (Fig. 1.7).

<table>
<tr>
<td rowspan="2">Key Partners
CH
-

European Commission

National administrations

International research Infrastructures (FACCE, GOE, NEON, TERN)</td>
<td>Key activities
CH
-
- 6

Coordination
Project/Data management
Communication/Dissemination
Certification/Standardization
Quality Control
Capacity Building
Fundraising</td>
<td rowspan="2">Value Proposition
CH

Links National Platforms and users

Enables pan-European research cooperation

Coordinates complex multidisciplinary projects

Certifies and increases competitiveness

Increases visibility</td>
<td>Customer Relationship
CH

National Focal Points

Expression of Interest

Calls for proposal

Calls for pilots

Direct promotion</td>
<td rowspan="2">Customer Segments
CH

National Platforms

Research Community

Policy Makers

Industry

Educators

Civil Society</td>
</tr>
<tr>
<td>Key Resources
CH
-
-</td>
<td>Customer Relationship
CH

Web portal

Liaising by representatives of the Centres</td>
</tr>
<tr>
<td colspan="2">Key Resources
CH

Direct personnel costs (salaries)
Other direct costs (e.g. travel, durable equipment, consumables, materials
Indirect costs (i.e. overheads)
Subcontracting costs (e.g. legal, accounting, auditing services)</td>
<td colspan="3">Key Resources
CH

Memberships and host contributions
EU structural funds (e.g. Horizion 2020 calls for International Development Projects)
Access fees
Consultancy services
Licensing and sponsoring</td>
</tr>
</table>

Fig 1.7: The AnaEE business model canvas with references to all business plan chapters.

1. **Key Partners**: considers *other organizations and partners whose recruitment is essential to the ERIC, or whose interactions are a key component of the ERIC strategy.* AnaEE activities will be coordinated with National Platforms, which are ultimately the operational entities translating research programs into practice. Local administrations are consulted to approve research projects.

2. **Key Activities:** *devises tasks the ERIC must perform to carry out its value proposition*. The tasks devoted to the AnaEE are project planning, coordination and management, communication, certification, standardization, education, capacity building, data management, technical development, consultancy, fundraising and dissemination. These tasks are detailed further in section 1.13.

3. **Key Resources:** *describes supply chains (e.g. hardware suppliers), staff, commodities and natural resources essential to ERIC operations.* Aside from providing hardware equipment, National Platforms are key resources for AnaEE, as their research output justifies AnaEE's existence and their raw data feed AnaEE key activities.

4. **Value Proposition**: *illustrates proposed products and services, their features and benefits and the relevant market opportunity*. AnaEE facilitates the interaction between National Platforms and their users. While it does not perform experimental services directly, it supports and coordinates access to the platforms and enables the realization of complex, multi-partner and multidisciplinary research projects. In addition, AnaEE certification and branding increases the competitive advantage of research centers, services and technology providers.

5. **Customer Relationships**: *illustrates how the ERIC relates, communicates and interacts with all customer segments.* AnaEE interacts with National Platforms through National Nodes; platforms will have the possibility to cooperate with AnaEE via service agreemenst, following their response to a call for interest. In addition, AnaEE actively promotes platform services to their users, mainly through the web portal.

6. **Channels**: *describes how products and services are distributed to the customer segments*. The main access point to AnaEE is through its web portal and national platforms will benefit from the ERIC support and coordination services by means of direct contacts with Centers representatives.

7. **Customer Segments**: *examines potential customers and their respective needs as addressed by the value proposition (or benefits as seen from the customer perspective)*. National Platforms are stakeholders in AnaEE, as their membership increases their research potential and visibility. National Platforms users are indirectly customers of the AnaEE, as they might require services from the Service Centers.

8. **Cost Structure:** *evaluates investment and operational costs required by ERIC operations.* Costs generated by AnaEE will chiefly correspond to personnel, premises, travel, services and outreach expenditures.

9. **Revenue Streams:** *lists revenue sources and ventures figures to estimate costs and profits.* During the Pre-operational phase, costs related to the setup of AnaEE will be covered Host Countries. In the first stage of the Operational phase (year 1 to 3) at least 50% of the costs will be covered by Host premium (cash or in-kind) contributions, while the remainder will be derived from memberships contributions (median of

€50,000/year/member). In its second stage (4 to 7 years), the AnaEE will also apply for targeted H2020 funding. AnaEE is eligible for the EU Structural Funds for research infrastructures and technologies and can participate in the programmes as sole beneficiary or in consortium with other legal entities. In its third stage (beyond 7 years), the ERIC will obtain part of its revenue from the sale of services and technologies established at platform level.

1.10 Benefits for Member States

AnaEE Member States will gain access to a transnational research network of experimental and supporting research facilities. AnaEE will enhance the rate of innovation and dissemination of technologies within partnering States and give visibility to local companies and research centers in the eyes of international funding agencies. The research output will benefit from greater credibility thanks to ERIC Quality Control and Standardization processes, so as to be globally disseminated. Member States may in addition use ERIC facilities to carry out programmes complying with the European and national environmental policy. Participation to AnaEE will bring renown to environmental research programs at partner level and attract international talent as well as investors. AnaEE will improve the status of environmental research in Europe, provide new solutions for data collection and access and provide a wide services portfolio to its stakeholders (Table 1.2).

	Current infrastructures	**With AnaEE in operation**
Infrastructure	National facilities across Europe though not on a sustained basis; Individual activities funded by projects and research consortia.	Distributed research infrastructure of multiple strategic integrated nodes, collecting data simultaneously and on a sustained basis in different critical areas identified by the science community.
	Few permanent multidisciplinary environmental manipulation platforms.	Permanent platforms for multidisciplinary environmental manipulation projects across different eco-climatological zones.
	Standardization effort planned through isolated and sporadically implemented EC-funded projects.	Long-term planning for equipment and data standardization and implementation, also involving industries in the process.
Costs	Lack of a coordinated procurement policy for the construction and extension of nodes.	Reduced capital expenditure costs through procurement activities coordination.
	Individual platforms come at very high operating costs.	Cost reduction through better planning and shared resources.
Data collection	Existing platforms collect data for a limited amount of time only, to be stored in in-house repositories.	Capacity for long-term longitudinal studies and combined data repositories and databases.
	No real-time data collection.	Real-time data collection, allowing for the development of early-warning systems
	Poor data integration.	Data integration and interoperability for a diverse user community.
Data and infrastructure access	Dispersed access points for data and information.	A single access point facilitating coordinated data access
	Restricted access to Information	Open access data portal.
	No systematic access to infrastructure. Transnational access (TNA) available sporadically.	Consistent application processes and a single point of contact encourage multi-site access; Permanent TNA enabled.
Service	Lack of a structured offer for data	Prominent and structured services rendered

provision	products and other services.	to a variety of stakeholders include multidisciplinary science, equipment testing, data products, materials testing in extreme conditions, R&D services, etc.
Innovation and industrial liaison	Lack of active, knowledge-driven generation of innovation and technology transfer projects.	Proactive liaison with industries and knowledge management, to offer innovative products and technology transfer.

Tab. 1.2: AnaEE's added value as an integrated research infrastructure.

Documenting, forecasting and testing the evolving changes of agricultural lands, forests and aquatic ecosystems will help countries and regions design the appropriate adjustment policies, manage new strategies and anticipate the impacts and pace of these changes. In particular, AnaEE could develop, calibrate and monitor regionally relevant ecosystem indicators, standards and certification procedures to support academic, institutional and private users. This would be decisive for instance in designing alert and early warning instruments or even tools to mitigate the potential outbreaks of agricultural or forest pests or other major climate change-related impacts on ecosystems. By conducting experiments in controlled conditions, potential adaptation measures may be tested and recommended for adoption by AnaEE experts, who may also offer costs and benefits estimates for these new procedures.

1.11 AnaEE Future Operations

AnaEE is the central legal entity that coordinates and integrates the whole RI. The bodies constituting AnaEE (the Central Hub and the three Service Centres) will each be in charge of a portion the future operations.

1.11.1 Central Hub

The Central Hub is at the heart of AnaEE RI. Its main activities are listed below.

The strategic development and implementation of the AnaEE vision: The AnaEE's Director General (DG) main task will consist in elaborating strategic plans to be submitted to the AoM and ensuring they are implemented. The DG will be assisted in this task by the heads of the three Service Centres and advised by the SAB. The DG also supervises Service Centres activities and ensures they are aligned with the AnaEE strategy. In concertation with the heads of the Service Centres, the representatives of the National Platforms and the National Nodes coordinators, the DG makes proposals to develop new platforms, in order to address emerging research needs. He/she will additionally oversee the optimal performance of National Platforms. The acceptance or removal of National Platforms will however require AoM ratification.

The DG also represents AnaEE with regards to governing bodies and nurtures relationships with international infrastructures (e.g. other ERICs and ESFRI roadmap partners) relevant to the AnaEE action plan. He/she will be assisted in this function by the Hub manager as well as the Heads of the Service Centres. The Hub manager is responsible for the implementation of a system engineering management plan. This plan defines processes, identifies team members and describes system development activities. The plan is designed according to other operational activities (budget, schedule, communication and scientific activity), with the support of a third-party advisor.

Communications: The Central Hub runs the general web portal of the AnaEE-RI, which serves as access point to AnaEE services (on an open access basis). The web portal provides a description of all National Platforms, specifies access policy and conditions and presents projects both

completed and ongoing, in addition to granting access to AnaEE services, databases, inventory and collections. The portal will also post job openings and calls for proposal and implement topical discussion forums.

Moreover, the Central Hub manages the automated submission of research projects to National Platforms. Should projects overlap in different National Platforms, the Hub Manager will guide the selection process. Selection processes will follow an open and transparent access policy, to be prepared during the Pre-operational Phase and decided upon with AnaEE members.

The Central Hub regularly **assesses National Platforms performance** by means of annual anonymous user surveys and ensures optimal operation. Moreover, it is in charge of quality control on AnaEE output. Finally, the Central Hub will devise a AnaEE dissemination and marketing strategy, entertain relations with media outlets and organize meetings (including the preparation and circulation of associated documents) for AnaeEE bodies, boards and committees (Assembly of Members, AnaEE annual conference, Scientific and Ethical Advisory Board, as well as any other committee appointed by the AoM.

Quality management: The Central Hub will develop a set of policies and procedures to ensure correct Quality Control (QC) opening onto ISO 9001 certification. It will provide appropriate management tools and set standard working practices, all the while producing the necessary documentation and organizing periodic training sessions. As the ISO 9001 standard does not specify product characteristics, a product-specific QC system will be developed by the Technology Centre. National Platforms carry out QC in collaboration with internal personnel and according to the policies established by the Central Hub.

Daily operations: The Central Hub manages all AnaEE administrative, procurement and financial affairs, including the collection of membership contributions and the resource allocation to all Service Centres.

1.11.2 The Technology Centre

The Technology Centre will coordinate innovation services, standardize procedures across platforms, promote technological development, organize testbed services for industries and ensure appropriate technology distribution and knowledge transfer. The Technology Centre's core activities include:

Harmonizing instruments and procedures: the Technology Centre will setup Technology Specialist Groups (TSGs) in charge of the development and harmonization of experimental procedures and measurements, in order to achieve comparable data across National Platforms as well as push for and adopt new developments. The TSGs gather internationally renowned specialists under the coordination of the Head of the Technology Centre, and the counsel of third-party technology providers where necessary. The Technology Centre will also ensure that AnaEE procedures are aligned with other international infrastructures (e.g. ICOS, NEON, TERN) standards. This will include experimental designs, instrumentation, sampling, measurement procedures and calibrations. The Technology Centre will provide references for cross comparison calibrations.

Organizing technology foresight workshops: Technology foresight workshops will bring together TSGs, relevant industries and specialists upstream of the instrumentation used in AnaEE platforms (physics, chemistry, ITC) or other disciplines where such instrumentation is further developed (medicine, high energy physics, space science). Together, they will determine which new technology to develop or adapt to the needs of ecosystems science.

Developing innovative technology: the Technology Centre pursues both demand-driven innovation (in identifying solutions to specific technical needs) and supply-driven innovation (by identifying potential users). The development of new instruments will either be carried out by national platforms or in the labs (physics, chemistry, computer sciences) where the fundamental technology is mastered and/or jointly with specialized private companies. Conversely, AnaEE will provide a European-wide testbed for external innovations. The technology centre will help implement all required technological developments by establishing contacts between relevant scientists, laboratories and industries and will assist AnaEE platforms in supporting innovative local SMEs and start-ups. The Centre will also take part in negotiating consulting agreements as part of public-private partnerships between facilities and local industries.

Training: the Technology Centre will organize training sessions through its TSGs. Those include theoretical and practical workshops, seminars, classes and intensive courses (e.g. winter/summer schools). Trainings primarily target AnaEE platform personnel. Once a year, platform managers will be trained in industry policy, with particular emphasis on Intellectual Property Rights policy. The Centre Manager will be responsible for all relevant coordination and logistics.

The Technology Centre will f**eed the technology section of the AnaEE portal** with the following:

- An updated list of the Technology Specialists Groups and their respective activities;
- AnaEE standards and recommended protocols, calibration procedures, cross-calibrations and reference sensors information;
- An inventory of instruments available to AnaEE partners and recommended specifications;
- An innovation access point, including technology development information;
- An agenda of upcoming training sessions and training documents. The Technology Centre will also manage an interactive technical forum via the portal, to harbor exchanges between platform personnel so that partner companies and scientists may compare demand and the availability of technical solutions.

1.11.3 The Data and Modelling Centre

The AnaEE platforms will deliver various sets of data that need to be harmonized and organized in an efficient manner to facilitate their subsequent use in various purposes, including modelling. The overarching common objective of DMC is to create and enable a suitable environment for scientific data to be Findable, Accessible, Interoperable and Reusable (i.e. being 'FAIR'). Core activities of DMC include:

Harmonizing metadata and data from national platforms: An AnaEE Experts' Group will analyze ongoing international efforts and will participate in (or organize) international data/metadata standardization workshops to develop vocabularies, metadata and ontologies for ecosystem science. With the assistance of the Centre Manager, the Expert Group will provide national platforms with guidelines and operational tools (thesaurus, ontologies, etc.) to implement metadata and data standardization. Data management plans will be developed for new projects and platforms. A DMC engineer will assist platform owners in their implementation.

Data quality improvement and data analysis: Automated procedures for data quality checks and post-acquisition treatments will be developed. Data quality will be improved by analyses over larger datasets through National Platforms synergies or comparing model predictions with new data. The DMC will develop visualization, statistical and data analysis tools and act as a resource center for open-source data analysis toolkits. Training workshops/tutorials will be provided for

platform managers to implement metadata and data standards, conduct quality check procedures and use data analysis tools. Training materials thus developed will also be made available to all AnaEE users.

Ensuring visibility and access to AnaEE data: a key objective is the full interoperability of experimental datasets collected on AnaEE platforms. Access to data will consequently be centralized and benefit from a user-friendly, single querying tool in the data portal hosted on the master AnaEE portal. Projects and national platforms will be expected to develop Data Management Plans and manage their own data. Workflows for data publication and minting of DOIs will be created.

Facilitating access to a range of ecosystems modelling solutions and to models factories: Models are necessary to develop and test our understanding of the complex quantitative relationships between processes within ecosystems, the interactions with their environments as well as their functioning and behavior under various pressures. Models are also needed to generalize from specific ecosystem studies and to upscale results to the scale of interest. The DMC will facilitate access to the following two types of national AnaEE Modelling Platforms:

- A Modelling Solution Platform (around a well-established and supported model)
- A Model Factory Platforms (an advanced facility offering access to models, model development tools and integrated simulation facilities to its users).

The DMC will grant access to recognized process-oriented and other models corresponding to key aspects of ecosystems complexities. The DMC will work with developers to provide scientific and technical documentation and implement continuous improvement and version control strategies. In collaboration with modelling solution platforms, it will contact additional model developers to progressively expand on the range of models made accessible through the AnaEE portal. Resources available in model factories are specific models and their relevant components, development tools, data analysis and visualization methods and integrated simulation facilities. Model factories will provide tools to enable the composition of new models through linking model components in such a way as to not require software programming skills. Similarly, model factories will offer tools to help link models at different scales.

Improving model interoperability: The DMC will rely on software engineers working for AnaEE modelling platforms and modellers interested in AnaEE projects to define and implement a range of software interface standards (Application Programmer Interfaces) to facilitate the interoperation of individual models and across components within modelling factories.

The DMC will also facilitate **the use of models** by non-model developers by:

- Ensuring that quality tutorials are available for running the available models;
- Organizing training workshops on resorting to models to conceive an experiment or interpret experimental datasets;
- Compiling user stories describing how users from different backgrounds are leveraging DMC models and model factories.

Feeding the Data and Modelling section of the AnaEE portal: The DMC will organize and update with the appropriate metadata a specific section of the AnaEE portal, including the following:

- AnaEE datasets available through the querying interface;
- Ecosystems models;
- Models factories functionalities;

- Other DMC services (tutorials, training sessions…) and
- Publications incorporating modelling activities using DMC tools.

1.11.4 The Interface and Synthesis Centre

The Interface and Synthesis Centre will promote foresight and knowledge transfer activities and deliver scientific outputs tailored to stakeholders. It will establish a strong stakeholder dialogue as well as links to scientists upstream of experimental activities, in order to identify future challenges to ecosystems sciences and examine their potential for fundable research programs. The Interface and Synthesis Centre core activities include:

Scientific and Societal prospective studies and new research programs lobbying – Foresight conferences or workshops will be organized where societal challenges have been identified by policy-makers, representatives of ecosystems-related industries and will welcome inputs from social scientists. Major gaps in ecosystems sciences and mobilization of AnaEE platforms will be identified by leading scientists and representatives of international expert panels, such as the IPCC and IPBES. Lobbying towards research funding agencies will be led by the AnaEE DG together with the head of the Interface and Synthesis Centre, with the assistance of leading scientists involved in prospective workshops.

Project building capacity setup – The European project engineer will assist scientist consortia in writing proposals and will administer successful proposals.

Outreach material production – The Communication engineer will be responsible for the elaboration of outreach materials on AnaEE results intended for policy-makers and citizens. She/he will also produce learning modules for e-learning initiatives and establish an interface with ecosystems accounting communities (e.g. SEEA, TEEB, SASB).

Organizing worldwide ecosystems sciences syntheses – The Interface and Synthesis Centre will organize data/knowledge syntheses on specific aspects of ecosystems sciences, based on data generated by AnaEE or published worldwide. Finally and at the request of the relevant stakeholders, AnaEE will contribute recommendations and perspectives on potential solutions to critical scientific and societal issues addressed in its platforms.

Identifying societal scenarios and innovation needs – Scenario building and associated innovations require workshops to be organized with policy-makers, relevant professionals and industries. These would be held every 3-4 years or whenever results of major societal significance are made available. Opinion/recommendation papers could be outputs of these meetings. The Centre will provide the AnaEE portal with:

- Conferences and workshops information (planning, agendas and results);
- Information on its services for the elaboration of European projects;
- Papers published by AnaEE national platforms or following AnaEE conferences and workshops;
- Outreach materials for stakeholders, teachers and citizens.