



PhenomUK Briefing Note 001

EMPHASIS Structure and Proposed Services

August 2023

Executive Summary

EMPHASIS is an ESFRI (European Strategy Forum on Research Infrastructures) initiative aimed at the design, implementation and operation of a pan-European research infrastructure supporting the plant, crop and agricultural sciences by providing a range of services in the broad area of plant and crop phenotyping. EMPHASIS is expected to become operational in spring 2025.

The UK, in the form of BBSRC and DSIT (then BEIS), was one of the 4 countries who came together in 2016 to initiate EMPHASIS, and its successful implementation has been a BBSRC and DSIT priority since then. It is believed that EMPHASIS will integrate and strengthen the UK and European phenotyping communities, provide UK scientists with access to high quality phenotyping data and facilities across Europe, and create an income stream supporting UK facilities and services.

It has been agreed by the now 12 partner countries making up the EMPHASIS Interim General Assembly (IGA) that the infrastructure will be formalised as a European Research Infrastructure Consortium (ERIC). An ERIC is a legal entity set up by a decision of the European Commission. In December 2023 the IGA will submit a first stage application to create an EMPHASIS-ERIC to the Commission. The aim of this Briefing Note is to present the UK community with an outline of the current proposal and seek input to guide the UK's formal response and contribution to the ERIC specification.

EMPHASIS is envisaged as a distributed infrastructure comprising phenotyping facilities and service providers spanning the member countries. Service providers in a given country will be contracted, through their respective national infrastructure (National Node), to perform specific tasks or provide access to specific facilities to the EMPHASIS-ERIC, which will link them to consumers across Europe.

It is anticipated that EMPHASIS' services will fall into a small number of distinct categories, e.g., access to phenotyping facilities or data management and analysis. To allow strategic oversight and development of these clusters of related services - any of which may be delivered by providers in multiple countries - EMPHASIS-ERIC is structured around a small number of Functional Units. Management of the Functional Units is overseen by a Directorate, which is advised by and reports to Assemblies of member country and National Node representatives and an expert Advisory Board.

The Briefing Note outlines the services proposed as of August 2023 and invites the UK community to consider:

- Which of these services would be welcomed?
- Which are unlikely to be of benefit to the UK?
- Are there additional services which should be included in EMPHASIS' plans?
- Which services would the UK be able and willing to deliver?

Community response to these questions and comments on the EMPHASIS proposal in general will be sought at the September Town Hall and Conference, but can also be submitted by email to enquiries@phenomuk.org.

EMPHASIS' Mission

EMPHASIS will facilitate European multiscale plant and crop phenotyping to analyse genotype performance and quantify the diversity of crop traits in diverse environments and under varying agricultural management practices.

By integrating the European plant and crop phenotyping infrastructures, EMPHASIS will develop, maintain and enable access to the facilities, data and tools needed to advance basic and applied plant and crop science and address the challenges to food security presented by a growing population, diminishing resources and climate change,

Finally, EMPHASIS will create, evaluate and disseminate knowledge and novel technologies providing opportunities for innovation to academia, industry, institutions and the general public.

EMPHASIS' Objectives

- Bring about a step-change in Europe's ability to address the societal challenges of climate change, food insecurity, reduced biodiversity and the need for sustainable agriculture by increasing access to world-class European research facilities for users from academia and industry.
- Catalyse and advance the development of new phenotyping practices for the whole plant and crop science community.
- Provide a pan-European plant and crop phenotyping information system to bring about FAIR (Findable, Accessible, Interoperable, Reusable) data use across all EMPHASIS member countries.
- Educate the next generation of researchers around plant and crop phenotyping, providing the multi-disciplinary skills and tools needed to address the challenges facing modern phenotyping.
- Work with European partners outside of EMPHASIS including other international research infrastructures to bring a collective, collaborative approach to the grand challenges we are addressing.

The EMPHASIS Infrastructure and EMPHASIS-ERIC

EMPHASIS is envisaged as a distributed infrastructure comprising phenotyping facilities and service providers spanning the member countries. These are linked together first by local National Nodes, then by those National Nodes and relevant Government/national bodies (in the case of the UK, the Department for Science, Innovation and Technology (DSIT) and BBSRC) contributing to the activities and governance of an independent legal entity: the European Research Infrastructure Consortium EMPHASIS-ERIC.

Service providers in a given country will be contracted, through their National Node, to perform specific tasks or provide access to specific facilities to the EMPHASIS-ERIC, which will link them to consumers across Europe. These contracts are known as Service Level

Agreements. Funding to cover services provided will come from a number of sources, as specified in the Service Level Agreements, but is likely to flow through the National Node. It is anticipated that EMPHASIS' services will fall into several categories, e.g.:

- Access to phenotyping facilities
- Data management and analysis
- Education and Training
- Development of new tools and methods (Advancing Phenotyping Practice)

To allow strategic oversight and development of these clusters of related services - any of which may be delivered by providers in multiple countries - EMPHASIS-ERIC is structured around a small number of Functional Units. Each Functional Unit will have a dedicated Manager, working within the ERIC, who will coordinate a coherent sub-group of services across the relevant National Nodes, ensuring they are aligned with the goals and needs of the infrastructure.

Functional Unit managers will report to the Directorate, which will be responsible for the day-to-day running and strategic development of EMPHASIS. The Directorate will take advice from and report to:

- The Assembly of Members, comprising a national and scientific representative of each member country. Until formal creation of the ERIC the role of the Assembly will be performed by the Interim General Assembly (IGA). The UK is represented on the EMPHASIS IGA by BBSRC and PhenomUK in close collaboration with the DSIT
- The Advisory Board, comprising internationally-recognised experts in relevant disciplines
- The National Node Assembly, comprising representatives of each country's national node

Together, these individuals and groups make up the EMPHASIS infrastructure (Figure 1).

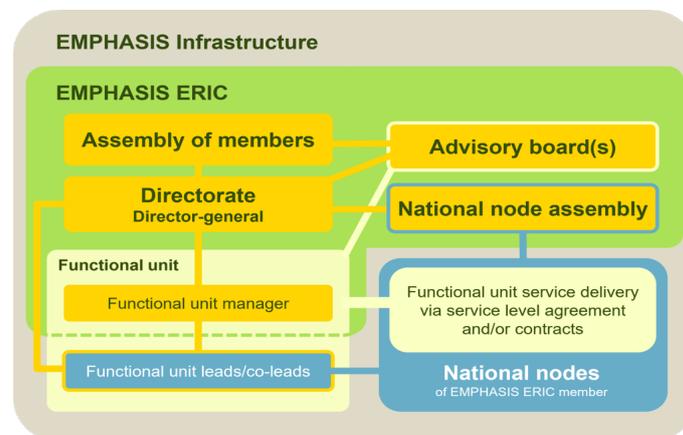


Figure 1. The proposed structure of EMPHASIS

EMPHASIS as a Service Provider

Pan-European Users of EMPHASIS

EMPHASIS aims to develop services at the infrastructure level, which cannot be provided by most individual countries, supporting excellent research in general and four user groups in particular:

- **The European plant and crop phenotyping community**, both academic and industrial, which has invested in and must continually develop plant and crop phenotyping facilities, tools and methods.
- **The European plant and crop science community**, both academic and industrial, which addresses grand challenges to society, in particular the development of resilient crop varieties and crop management practices with low environmental impact.
- **Funders and policy makers**, who require high return on investments in research and up to date evidence when making policy decisions.
- **The public** who needs a secure and stable supply of nutritious food, and confidence that their governments and research communities are responding to current and future global challenges.

Proposed Services

The services described below are those contained in the August 2023 draft of the EMPHASIS Technical and Scientific Description. Feedback is invited from the UK community either at the UK Plant Phenomics 2023 Town Hall and Conference or via email to enquiries@phenomuk.org. Responses received will inform the UK's position at future EMPHASIS IGA meetings.

Directorate

The Directorate develops, monitors, maintains and oversees implementation of the scientific and administrative strategic plans driving EMPHASIS' operational activities. It coordinates all activities of the infrastructure including strategic alignment/interactions with other pan-European initiatives and provides services under three broad categories:

User access

- Facilitation of access to and synthesis of the use of [EMPHASIS installations](#). An installation finder will list information about throughput, types of available measurements and trait extraction for each installation involved in EMPHASIS.
- Provision of a single contact point for users' questions about the most appropriate installations, or possible combinations of installations, given a trait of interest.
- Management of transnational access funded by EMPHASIS and coordination and support of third party- funded access (e.g., INFRASERV) from EMPHASIS-ERIC members.

Communication

- Promotion of the engagement of all relevant stakeholders via a central website, newsletters, social media, fora, and event management, including operation of Annual Town Hall Meetings providing information on EMPHASIS' achievements, collecting users' needs and discussing future developments
- Provision of policy documents, position papers and advice to funders and policy makers and specific stakeholder groups.

Industry engagement

- Implementation of an Industry Forum as a platform for exchange between technology developers, providers, service providers, seed companies, etc.

Advancing phenotyping practices (Functional Unit)

- Horizon scanning: Regular assessment of the state of the art and identification of relevant breakthroughs in related disciplines. Provision of technical reports on i. emerging technologies and ii. current solutions to the community's challenges.
- Support in the selection and encouraging use of common solutions: e.g. provision of a repository of available environmental sensors for field and in-door platforms.
- Tool development for image analysis: (i) Identifying common procedures for calibration of facilities and comparison of results between installations. (ii) Interacting with other RIs for joint development of services. (iii) Facilitating access to and evaluation of public image processing tools. (iv) Supporting the development and deployment of novel deep machine learning-based solutions, e.g. via the curation of training data of annotated images.
- Maintenance of tools developed by the infrastructure: e.g. monitoring and compensating for obsolescence of underlying software components.
- Diffusion of techniques across the phenotyping community: (i) Adapting solutions to different categories of users via node visits and workshops, (ii) making user's problems understandable for developers, fostering novel applications for addressing these needs. iii) (together with FU training): Specific training on the use of tools from the Functional Unit.
- Outreach via events, hackathons and presentations at a level understandable to non-trained plant and crop researchers, who can express their demands for the development of new tools (in collaboration with education and training FU).

Data management (Functional Unit)

- Horizon scanning: Assessing breakthroughs in the data sciences, together with current practices for data management in the various EMPHASIS nodes.
- Development of a consistent network of information systems. These systems will share common functionality according to the FAIR principles. EMPHASIS will

propose suitable information systems to national nodes and support system implementation.

- Development of a 'dataset finder': enabling access for the whole plant and crop science community to the data stored in different information systems in cooperation with other research infrastructures and within the framework of EOSC.
- Maintenance of tools developed by the infrastructure, diffusion of techniques in the phenotyping community and outreach to the plant and crop science communities.

Education and training (Functional Unit)

- Identification of user's needs and strategies for the provision of training. Potential design of bespoke training programmes where gaps are found in the European training offer.
- "Training finder" for practical training and education as well as for online content.
- Offer practical training and learning opportunities for each career step including i) on the job training for early career researchers (e.g. together with IAESTE international) ii) MSc thesis opportunities and iii) PhD exchange opportunities, iv) train the trainers workshops.
- Liaison with training organisations and EU initiatives (e.g. Marie Curie)
- Coordination of online training (MOOCs, Videos etc) on common principles across installations, in collaboration with training in above FUs and those offered across EMPHASIS-ERIC member countries.
- Annual Summer Schools. Coordinate, co-sponsor, and support the organisation of multi-disciplinary summer schools by EMPHASIS national nodes.

Statistical modelling

- Horizon scanning: Assessing and providing access to novel methods for statistical/knowledge-based modelling, together with the current practices in member countries.
- "Model finder" for both statistical and process-based models, including example datasets and training tutorials.
- Design generators applied to novel questions, e.g. multi species plots.
- Development of statistical tools and links between statistical and process-based models, with other RIs for process based modelling (AGMIP) and statistical modelling including genetic information (ELIXIR).
- Maintenance of tools developed by the infrastructure, diffusion of techniques in the phenotyping community and outreach to the plant and crop science communities.

A Role for the UK?

The services outlined above are those included in the August 2023 draft of the EMPHASIS Technical and Scientific Description document. The UK representatives on the IGA will have an opportunity to influence the development of these ideas at the next IGA meeting on October 23-25th 2023.

Questions for the UK community are:

- Which of these services would be welcomed?
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