MIRRI - The Microbial Resource Research Infrastructure: managing resources for the bio-economy

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The term Microbial Resource Centre (MRC) has been introduced to describe the traditional public culture collections (CCs) that are managed under a quality system. Europe has a few of these MRCs that complement the landscape of facilities accessing, monitoring and providing microbial resources. They communicate within ECCO (European Culture Collections' Organisation), and several of them have been networking for more than 30 years with respect to research and operational issues.

Public CCs of microbial material are the key providers of resources for a broad spectrum of users: from researchers in academia to those in bio-industry – all depend on the wealth of microorganisms stored in these collections. Unfortunately, this landscape in Europe is fragmented: smaller public CCs and MRCs do not have harmonised strategies for collection focus, delivery of associated information, bio-security or legal aspects. Although access to holdings is available for some larger collections in Europe (see CABRI project[1]) and worldwide the World Data centre for Microorganisms Global Catalogue of Microorganisms[2] holds data on 60 collections in 29 countries, most of the rest are not connected to a common online portal. This leads to under-utilisation of existing resources, which hampers European research in many fields: it isn't just academic research, but also bio-industry that requires access to authentic well-characterised microbial resources. The microbial raw material, and their genetic and metabolic products, are utilised in many areas: production of healthy and functional food; identification of new antagonists against pathogens; fighting agricultural disease; identifying novel energy sources on the basis of microbial biomass; and screening for new active molecules in the bio-based industries – to mention only a few. Owing to the lack of harmonised approaches, there is duplication of effort, not just for users, who have to perform long and time-consuming investigations before the requested microbial material is found in a database, but also for the CCs, which are often not aware of activities in neighbouring collections.

The G8 Science Ministers' Statement[3], made 12 June 2013, highlighted the need to improve transparency, coherence and coordination of the global scientific research enterprise to address global challenges. They focused on anti-microbial drug resistance as a major health-security challenge, and the need to work together to reduce antimicrobial resistance. They stressed that Research Infrastructures are key elements in research and innovation policies.

MIRRI intends to address these global challenges in many ways, by working with multidisciplinary partners, delivering to them the resources, tools and services needed to facilitate the discovery of solutions. The microbes themselves have most of the answers: after all, they are the great pioneers of our planet, surviving the extremes. Examining organisms from before the introduction of antibiotics and comparing them with resistant strains is the obvious route to improving our understanding, and increasing

1 http://www.cabri.org/
2 http://gmc.wfcc.info/
3 https://www.gov.uk/government/news/g8-science-ministers-statement

Table 1: List of MIRRI partners in the preparatory phase.

Acronym	Full Designation	Country
DSMZ (coordinator)	Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH	GE
CABI	CAB International	UK
CSIC-IMEDEA	Agencia Estatal Consejo Superior de Investigaciones Cientificas y University of the Balearic Islands	ES
IAFB-CCIM	Institute of Agricultural and Food Biotechnology , Culture Collection of Industrial Microorganisms	PL
IBPM	All-Russian Collection of Microorganisms, Institute of Biochemistry and Physiology of Microorganisms, Russian Academy of Sciences	RU
INRA-CIRM	Institut National de la Recherche Agronomique - Centre International de Ressources Microbiennes	FR
IP	Institut Pasteur	FR
Jacobs Uni	Jacobs University Bremen	GE
KNAW/CBS	Koninklijke Nederlandse Akademie van Wetenschappen - KNAW	NL
MUT	Mycotheca Universitatis Taurinensis	IT
SPP-PS	Service Public Fédéral de Programmation Politique scientifique	BE
UGENT	Universiteit Gent 8.1 UGent - BCCM/LMG 8.2 UGent - Dept. of Applied Mathematics and Computer Science	BE
UGOT	Culture Collection, University of Goteburg	SE
UMinho-MUM	Micoteca do Universidade do Minho	PT
USMI	IRCCS AOU San Martino IST	IT
UVEG-CECT	Universidad de Valencia, Coleccion Española de Cultivos Tipo	ES

our opportunities to discover new possibilities. By understanding the chemistry, and seeking those organisms with the properties needed, be they taxonomic relatives or organisms from particular ecosystems, the coordinated efforts of Microbial Resource Centres can accelerate the process. Well-described microbial resources will play a key role in underpinning the bio-economy and driving economic growth. To do this, there is a need to better utilise microbiological diversity in biotechnology. This is fundamental to the delivery of the bio-economy, and to accelerate the discovery of natural solutions to today's global challenges.

Having recognised the need for improvement, the European Strategy Forum on Research Infrastructure[4] (ESFRI) placed MIRRI on their roadmap in 2010. Having started its preparatory phase at the end of 2012, MIRRI will focus on strategic goals to assure that facilitated uptake of high-quality resources promotes good science and innovation, whilst breaking down the barriers mentioned above. By establishing a user- and quality-driven centre for resources and information, MIRRI will facilitate access to the right microorganisms for the task in hand. Furthermore, by applying coordinated isolation programs, and closely collaborating with similar programs already on-going in the academic environment, existing gaps in the availability of microbial resources will be resolved. Together, these are the prerequisites for enhancing European competiveness in the knowledge-based bio-economy, which gets more and more important as the non-European markets expand.

MIRRI Objectives

In its *preparatory phase*, the MIRRI consortium consists of 16 European partners (see Table 1), as well as 17 European collaborating parties. Based on a history of successful cooperation between most of the participants (*e.g.*, CABRI[5], EBRCN[6],

4 http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap

5 http://www.cabri.org/

6 http://www.ebrcn.eu

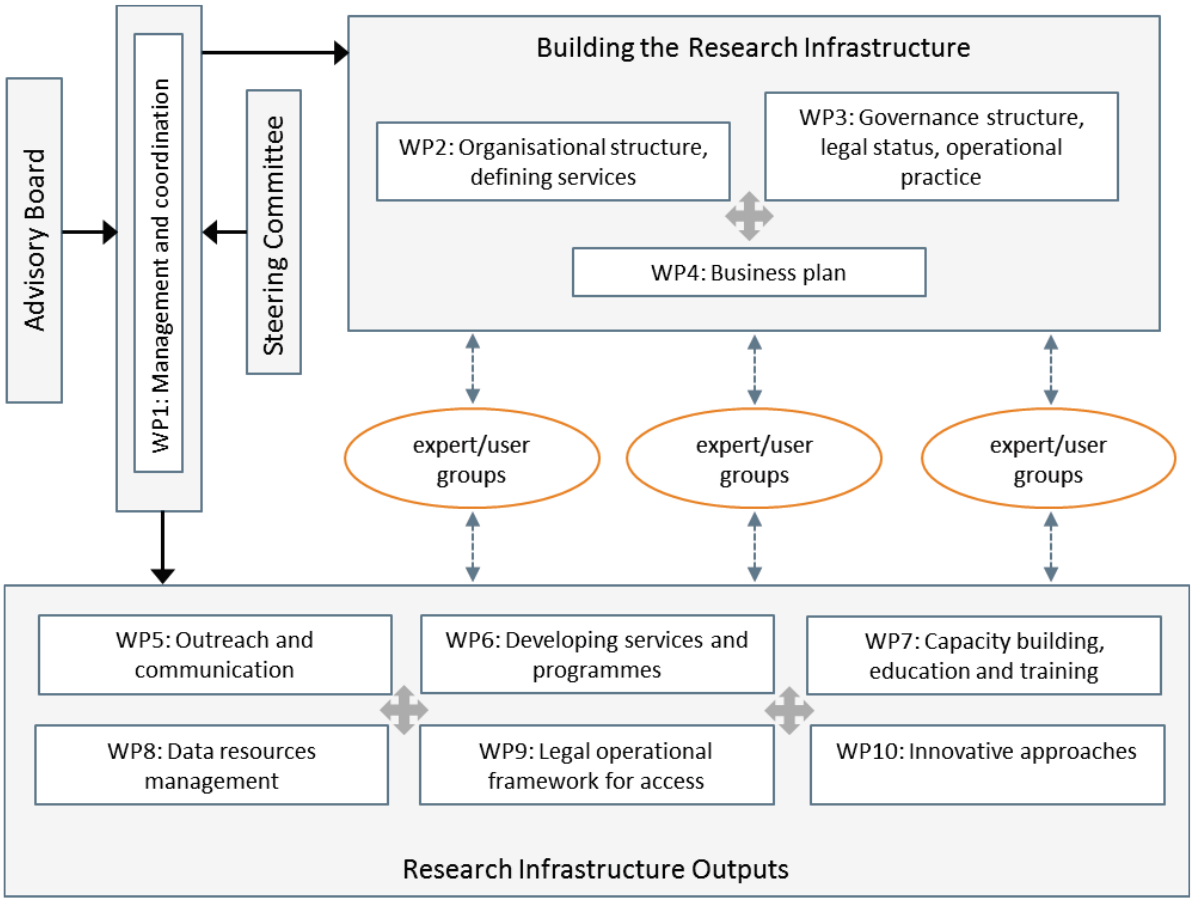

Figure 1. Working scheme of the MIRRI consortium during the preparatory phase.

EMbaRC[7], a well-rehearsed team will address the challenging objectives of the MIRRI project.

The overall objective of MIRRI is to create a quality-driven centre for resources and information to facilitate access to microbial material within Europe. This idea of a European 'onestopshop' to serve users' needs offers not only a significantly broader range of raw material, but also access to their associated data, as well as to expert knowledge in fields of microbiology. A second major goal of MIRRI is to establish a platform for capacity building. This includes both transnational access to facilities and a Masters curriculum for students in microbial systematics and resource management. By offering special training in the field of modern approaches to taxonomy, MIRRI will combat the increasing loss of expertise. Such well-trained, next-generation scientists are necessary to work with bio-industry in Europe, to accelerate discovery processes and innovations.

Strategic Development

During the preparatory phase of MIRRI, strategies will be developed to fulfil the proposed objectives. The workload is distributed across several work packages (see Figure 1), between which close dialogue and cooperation is necessary; more importantly, involvement of different stakeholders is essential (e.g., users/providers of microbial material, bio-industries, policy makers, national authorities) – expert/user groups are a basic requirement for successful strategy development. Several work packages are strongly dependent on stakeholder feedback, especially those dealing with MIRRI's future outputs; they analyse, for example, which resources, expertise and methodological services are requested by users of microbial material (WP6). The field of education and training (WP7) will be strengthened through cooperation with other ESFRI projects, such as

7 http://www.embarc.eu/

ERINHA[8], ELIXIR[9] and EMBRC[10]. Management of data resources (WP8) is one of the most important issues, as access to physical resources is markedly enhanced by the availability of their associated data. This includes the development of tools to extract microbial data from the literature, and development of strategies to allow data interoperability. Bringing together different data-sets will provide an information landscape that will facilitate data-mining and new opportunities for innovation. This leads to open access to an unparalleled wealth of microbial resources within Europe.

MIRRI will create an appropriate legal framework for access and application (bio-risk assessment, as well as bio-security) (WP9) that will ensure user compliance in access and use of biological materials within the plethora of regulations involved. This will include strategies to assure compliance with the Nagoya protocol[11] - *i.e.*, Prior Informed Consent and Access and Benefit Sharing. Further details concerning the work packages can be found on the MIRRI website[12].

The scheduled progress of all work packages is monitored by defined deliverables, to be submitted to the European Commission. Once having entered the *implementation phase* in 2016, the outlined strategies will then be realised.

The proposed future organisational structure of MIRRI is shown in Figure 2. The so-called hub-and-spokes model foresees a central operational hub and several national nodes, each of which is connected to a network of specialised national collections. This model allows a flexible dialogue between hub and spokes. A business plan focusing on a sustainable financing model for the proposed structure is under development, and will be communicated to funders.

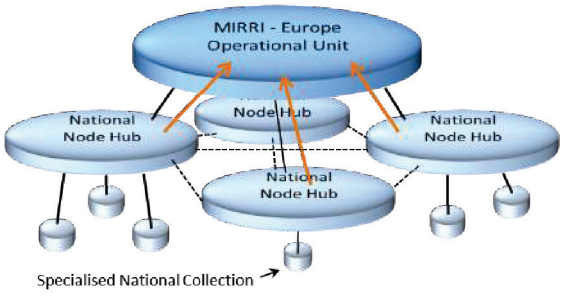

Figure 2. Hub-and-spokes model of the future MIRRI.

On the road towards implementation

Although one of the youngest ESFRI projects, MIRRI has achieved important milestones that will facilitate the step into the *implementation phase*. The management structure chosen for the preparation phase guarantees an open and transparent decision-making process that can be applied to the implementation phase. MIRRI is already well recognised by different stakeholder groups, and their involvement in various aspects of the MIRRI work packages has been achieved. Following the trend of online dissemination, MIRRI established its website and is represented in social media. By using these channels, information can be easily forwarded to all stakeholder groups: young researchers, in particular, will find it easy to communicate with MIRRI via social media. But MIRRI is also using traditional media: the project is presented at conferences and in journals, and, of course, all members have face-to-face meetings with stakeholders. By doing so, the project is moving in the right direction to make an impact on science research and innovation.

As mentioned above, MIRRI's success depends on input and feedback from stakeholders – i.e., users as well as providers of microbial material, bio-industries, policy makers and national authorities. We would like to encourage all of them to contact MIRRI, and to give their valuable insights on their needs and expectations, allowing MIRRI to facilitate discovery for a brighter future.

Acknowledgements

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8 http://www.erinha.eu/
9 http://www.elixir-europe.org/
10 http://www.embrc.eu/
11 http://www.cbd.int/abs/
12 http://www.mirri.org