

Deliverable D1.2 Survey of business models

Project Title (Grant agreement no.):	ELIXIR-CONVERGE: Connect and align ELIXIR Nodes to deliver sustainable FAIR life-science data management services (871075)		
Project Acronym (EC Call):	ELIXIR-CONVERGE (H2020-INFRADEV-2018-2020)		
WP No & Title:	WP1 Expert Network		
WP leader(s):	Bengt Persson (UU), Jiří Vondrášek (UOCHB), Silvio Tosatto (CNR)		
Deliverable Lead Beneficiary:	20 - CNR		
Contractual delivery date:	31/01/2022	Actual delivery date:	10/03/2022
Delayed:	Yes		
Partner(s) contributing to this deliverable:	CNR,UOCHB,UU,VIB, UiB, DTL PROJECTS, ATHENA RC, CSC, INESC ID, UNILU, ELIXIR-Hub, ELIXIR-UK, ELIXIR-DE, ELIXIR-EE, ELIXIR-IL, ELIXIR-FE, ELIXIR-LU		
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Reviewers:	ELIXIR-CONVERGE Management Board (MB) members.		

Log of changes

DATE	Mvm	Who	Description
05/08/2021	0v1	Marco Carraro (CNR)	Initial version
10/08/2021	0v2	Marco Carraro (CNR)	Draft for business models landscape analysis section
7/11/2021	0v3	Marco Carraro (CNR)	Draft for business models comprehensive analysis section
17/12/2021	0v4	Marco Carraro (CNR), Niclas Jareborg (UU), Karel Berka (UOCHB)	Draft for results from business models landscape and comprehensive analysis section
03/02/2022	0v5	Marco Carraro (CNR)	Added business models fact sheets

21/02/2022	0v6	Marco Carraro (CNR), Niclas Jareborg (UU), Karel Berka (UOCHB), Natália Pižemová UOCHB), Jiří Vondrášek UOCHB)	Internal WP1 review
01/03/2022	0v6	Nikki Coutts (ELIXIR Hub)	Version circulated to WPLs for review
10/03/2022	1v0	Nikki Coutts (ELIXIR Hub)	Final version to be uploaded into EC Portal

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1. Executive summary

Growth of omics disciplines has significantly increased the researchers' demand for support in the field of data management. It follows that long term sustainability of existing data management services and platforms is of critical importance to the research community.

The ELIXIR-CONVERGE Task 1.3-Business model aims at investigating long-term sustainability strategies for supporting the provision of said data management/data stewardship services. In order to achieve this goal, the authors reviewed existing business models that were currently implemented by the ELIXIR Nodes.

Data collection was performed by means of on-line surveys and interviews, investigating how DM/DS services are delivered and how they are financially supported.

The current investigation was performed at different time points along the implementation of the ELIXIR-CONVERGE action, allowing the authors to sketch an analysis of the delivered services, and their financial sustainability in a two years time frame.

The investigation revealed how in almost all the Nodes, the delivery of data management services depends on public subsidies, usually by means of a mix of institutional, national and European Union/European Commission funded projects.

Likewise, the current work highlighted how Nodes are exploring new sustainability strategies and models where part of the costs are recovered from final users.

Considering the gradient of public subsidisation and user/customer contribution, the authors of the current report characterised the implemented sustainability strategies under three (plus one) business models: Free, Freemium, Pay per use (Pay per use +).

Although a growing number of Nodes are moving towards exploring and implementing sustainable business models, our investigation highlights how in most cases the resulting strategies can be considered only experimental. In several instances transactions are only virtual and cost recovery often never happens in full.

The main outcome of the effort presented in the current document is the definition of a portfolio of fact sheets describing all the alternative funding strategies other than the full public subsidisation implemented by the Nodes: the Business Model Catalog.



2. Contribution toward project objectives

With this deliverable, the project has reached or the deliverable has contributed to the following objectives/key results:

Objective no. / Key Result no. Description	Contributed to:
Objective 1: Develop a sustainable and scalable operating model for transnational life-science data management support by leveraging national capabilities (WP1, WP5)	
Key Result 1.1: Established European expert network of data stewards that connect national data centres and similar infrastructures and drive the development of interoperable solutions following international best practice, including national interpretations of the General Data Protection Regulation (GDPR)	No
Key Result 1.2: Development of joint guidelines and common toolkit that are adopted into funder recommendations, with support available nationally and in local languages	No
Key Result 1.3: The catalogue of successful national business models incorporated into national strategies	Yes
Key Result 1.4: The developed “sustainable and scalable operating model for transnational life-science data management support” is adopted into national ELIXIR Node	Yes
Objective 2: Strengthen Europe’s data management capacity through a comprehensive training programme delivered throughout the European Research Area (WP2, WP6)	
Key Result 2.1: A comprehensive ELIXIR Training and Capacity building programme in Data Management, directed at both data managers and ELIXIR users, and connected to the national training programmes in Data Management in the ELIXIR Nodes and prospective ELIXIR Member countries.	No
Key Result 2.2: Development of a collective group of trainers that support scalable deployment of Data Management training across ELIXIR Nodes.	No
Key Result 2.3: A substantial cohort of data managers, Node coordinators and researchers with specific data management skills, business planning and knowledge of transnational operations across the ELIXIR Nodes	No
Objective 3: Align national data management standards and services through a sustainable, scalable and cost-effective data management toolkit (WP2, WP3, WP5)	
Key Result 3.1: Assemble a full-stack harmonised common toolkit comprising	No



all aspects of data management: from data capture, annotation, and sharing; to integration with analysis platforms and making the data publicly available according to international standards.	
Key Result 3.2: Provide exemplar toolkit configurations for prioritised demonstrators to serve as templates for future use.	No
Key Result 3.3: Establish national capacity in using as well as updating, extending and sustaining the toolkit across the ERA.	No
Key Result 3.4: Enable 'FAIR at source' practice for data generation, and analytical process pipeline implementation by flexible deployment of the toolkit in national operations	No
Objective 4: Align national investments to drive local impact and global influence of ELIXIR (WP4,WP6)	
Key Result 4.1: Development of a Node Impact Assessment Toolkit based on RI-PATHS methodology.	No
Key Result 4.2: Adoption of Impact assessment in ELIXIR Nodes, supported by Node coordinators network and feedback on applicability from dialogues with national funders.	No
Key Result 4.3: Creation of national public-private partnerships and industry outreach where open life-science data and services stimulate local bioeconomy	No
Key Result 4.4: Growth in reach, impact and engagement of stakeholder communication assessed by established ELIXIR Communications metrics	No
Key Result 4.5: Initiating and advancing discussions on Membership (EU and international) or strategic partnerships (international countries) following ELIXIR-CONVERGE workshops.	No

3. List of acronyms

BM	- Business Model
BU	- Billing Unit
DM	- Data Management
DMP	- Data Management Plan
DPO	- Data Protection Officer
DPIA	- Data Protection Impact Assessment
DTL	- Dutch Techcentre for Life Sciences
DS	- Data Stewardship
EU	- European Union/European Commission
FAIR	- Findable Accessible Interoperable Reusable



- FTE - Full-Time Equivalent
- GPU - Graphics Processing Unit
- GDPR - General Data Protection Regulation
- HPC - High Performance Computing
- IT/ICT - Information and Communications Technology
- LCSB - Luxembourg Centre for Systems Biomedicine
- MESR - Ministry of Higher Education and Research
- Mx - Project Month, EG: M1 project month 1
- NWO - The Dutch Research Council
- WP - Work package

4. Introduction

Availability of cost-effective high-throughput molecular platforms has rapidly increased in the last decade, generating an unceasing data deluge. This pattern has reflections in almost all the fields of knowledge but it's in the life-sciences where, more than in others, it is expected to keep growing in the near future, still following an exponential pattern.

The urge for shaping more effective data management practices has resulted in the definition of the FAIR principles and the growth of plenty of national and international efforts and tools supporting researchers in making their data available to the community.

The need to keep supporting the delivery and further development of such services, at least for the next decade, is somehow taken for granted in the research community. Conversely, almost all the initiatives supporting a more effective data management rely on public subsidisation, usually provided via specific grants. Although grants supporting the creation of tools, the set-up of dedicated infrastructures or for financing training and capacity building programs, are producing clear advancements in the field of DM, all these initiatives are based on weak foundations, being grants that are temporary by definition.

In such a context, the development of long-term sustainability strategies is needed more than ever. The ELIXIR-CONVERGE Task 1.3-Business model will provide a contribution in addressing this matter by reviewing existing business models implemented by ELIXIR Nodes in order to improve sustainability of delivered DM/DS service. Preliminary information highlights how Nodes are moving towards funding schemes where users are asked to provide a contribution for accessing DM consulting services and infrastructures. Although these attempts are more and more common within the ELIXIR member States, almost every Node is implementing such business models in its own peculiar way, reflecting the national research environment and funding schemes.

With the current document we will sketch a picture of how DM/DS services delivery are currently supported financially, and map how the different business models are implemented at the national level.

Data collection was performed by means of on-line surveys and interviews, investigating how DM/DS services are delivered and how they are financially supported.

The current investigation was performed by means of three main actions:



- Landscape analysis of DM/DS services provision and BMs implementation (M1)
- Landscape analysis of DM/DS services provision and BMs implementation (M18)
- Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)

Thanks to the first two steps of investigation, an overview of the capacity and the level of services provided by the ELIXIR Nodes in the context of DM/DS, all along the implementation of the ELIXIR-CONVERGE action, was compiled. A specific focus was set on financial support and sustainability for the services.

Deeper analysis was allowed by the third step of investigation, specifically focused on business models implementations. Outcome of this last step of analysis is the set up of the so called Business Models Catalog: a portfolio of fact sheets for all the Nodes exploring alternative strategies for the financial support of the delivered DM/DM services other than full public subsidisation.

The work presented in the current document will shine the light on the current financial sustainability of the delivered DM/DM services and suggest possible complementary strategies by a portfolio of existing approaches.

Expected outcome of this effort is to provide support for the development of long-term sustainability models by sharing best practices gathered from the experience of the ELIXIR Nodes currently exploring alternative funding strategies.

The current document reflects the efforts of the WP1 *impact assessment and business models* working group members. Effective contributions for shaping the investigations composing the present deliverable came from members of WP3 and WP4. Useful insights for approaching the topic of business models implementations for the delivery of public services were provided by the ELIXIR-CONVERGE project management team.

5. Description of work accomplished

Work under ELIXIR-CONVERGE Task 1.3 -Business model was performed by means of three main investigations:

- Landscape analysis of DM/DS services provision and BMs implementation (M1)
- Landscape analysis of DM/DS services provision and BMs implementation (M18)



- Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)

5.1 Landscape analysis of DM/DS services provision and BMs implementation (M1)

The first landscape analysis of DM/DS implementations was carried out at the beginning of the CONVERGE action (M1).

Details about the investigation are presented below.

Aim

The purpose of the investigation was to compile an overview of the capacity and level of services provided by the ELIXIR Nodes in the context of DM/DS, at the beginning of the action.

Conducting such analysis was crucial for the kick-off of the project, identifying strengths, weaknesses and resources developed by the Nodes and allowing WP leaders to better plan the implementation of project tasks.

The analysis has been performed in the context of WP1, but was designed on the basis of the inputs received from multiple WPs. In order to meet the needs / expectations raised by the other WPs, the scope of the document significantly broadened and the number of topics investigated slightly escalated in time.

Timing

Data collection started a few months before the official beginning of the project, with most of the Nodes providing information during the 2019 WP1 meeting (Noordwijkerhout, Netherlands, 14-15 October 2019), and concluded in February 2021.

In light of this, it has to be noted that (M1) has to be considered as an average timing for this analysis.

Methodology

The investigation was performed by means of an online, shared, spreadsheet document.

The document was drafted as a collaborative effort during the October 2019 WP1 meeting.

As a consequence of brainstorming, both the definition of the investigated topics and the data collection have been performed almost simultaneously.

The main sheet focused on the investigation of DM/DS capabilities for the different Nodes, generating a landscape overview of the capacities for the different partners of the action. An extensive range of DM/DS related topics were investigated like (among others) the provision of DM support, DMP support, DM training, DS policies, and DS infrastructure. More interesting for the current document, the implementation of DM business models was also investigated. This sheet is mainly constituted by multiple choice questions, with the list of possible answers to be selected from a drop-down menu.

Important considerations

Some important considerations have to be taken into account when analysing the results collected by this investigation.



The purpose of the analysis, as already anticipated, was very broad and a relevant number of information collected does not fall within the scope of the current document and will not be further detailed.

The document was drafted in the context of a brainstorming event, generating some intrinsic weaknesses in the analysis:

- the document was conceived dynamically as the output of an on-going discussion and, at first, not all the topics of the investigation were added in the document.
- some Nodes were not represented at the event.
 - Some Nodes filled out the survey remotely without taking part in the discussion, adding a certain degree of freedom to the interpretation of the different fields.
 - Some other Nodes never provided feedback to the investigation.

As a consequence, some parts of the document resulted in being filled out only partially.

An additional degree of freedom for the current analysis has to be taken into account as at the time of the document generation it was clear there was no agreement on the definitions for some terms/roles.

Of particular interest for the current document is the fact that, at that time, what a business model implementation for the provision of DM/DS services was in practice was not a clear concept for all the participants at the event, nor to the ones who filled out the document remotely.

5.2 Landscape analysis of DM/DS services provision and BMs implementation (M18)

The second landscape analysis of DM/DS implementations was realised almost halfway through the project (M18).

Details about the investigation are presented below.

Aim

The second round of investigation was conceived trying to fulfil two main aims.

- The first one was to compile an updated overview of the level of services provided by the ELIXIR Nodes halfway through the project with the purpose of detecting any new services/tools implementation and/or improvement since the first survey collection, possibly put in place as an output of the action.
- The second aim was to drive the definition of a more extensive analysis with a deep focus on the implementation of business models for the provision of DM/DS services. The results of this second part of the investigation were used to define the topics and the structure of interviews underlying the task: *Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)* (see dedicated paragraph).

The analysis has been performed in the context of WP1 with inputs and suggestions from members of WP3 and WP4.

Timing



The first draft of the investigation has been presented during the CONVERGE general assembly (virtual event, 2021-06-10), incorporating feedback mainly from WP1 and WP4 members.

The final version of the investigation was agreed in the following weeks in the context of WP1, incorporating new, additional feedback from WP3 and WP4 members.

Unlike the *Landscape analysis of DM/DS services provision and BMs implementation (M1)*, in this case, the definition of the topics to be investigated and data collection have been performed on separate occasions.

Data collection started at (M18) with most of the Nodes providing information within a month after survey distribution.

Methodology

The investigation has been performed by means of an online surveys (Google Forms).

The survey recipients are: the ELIXIR head of Nodes, the Node Coordinators and the data management coordinators (WP1).

The survey was intentionally kept as short as possible, composed of four main questions with two other additional questions to collect basic information about the submitters and their affiliation.

Out of the four main questions, two were about the provision of DM/DS services, while the remaining two were about business models implementation and the financial sustainability of the services provided. Despite being all multiple choice questions, each question contemplated the possibility to add free text in case none of the options provided would fit the case.

Questions dedicated to the investigation of the provision of DM/DS services:

- *Is your node currently offering DM/DS support services?*
Aim of this question was to allow Nodes with no services implemented to quickly conclude the survey.
- *Specify the service/s provided*
Aim of this question was to investigate which kind of services were provided to the community.
Pre-set list of answers comes from the analysis of the previous investigation and is based on the experience collected under the activities of WP1.

Questions dedicated to the investigation of business models implementations and the financial sustainability of the provided services:

- *How do you cover the costs related to providing the service?*
Aim of this question was to investigate how the provision of services is financially supported.
Pre-set list of answers comes from experience collected under the activities of WP1.
- *Do you think that the provided service will be financially sustainable in the long-term?*
Aim of this question was to investigate if the current implementation of the financial support for the provision of DM/DS services could sustain such activities in the long run or, conversely, if the services are funded by dedicated grants lasting for a few years only.

The two other additional questions aimed at collecting information about the submitters:

- *Name and Surname*

This question was performed in order to identify a reference person in case of possible misunderstanding.

- *ELIXIR Node ID*

Important considerations

Some important considerations have to be taken into account before moving to the analysis of the results collected by this investigation.

The survey was intentionally kept as short as possible in order to maximise the probability of feedback submission from the highest number of Nodes. As a consequence, only two broad topics were included in the investigation (provision of DM/DS services and financial sustainability). In addition, only a coarse analysis was performed for both the topics. Despite the second investigated topic being the analysis of business models implementations and financial sustainability, the word “business model” was not mentioned in the survey. This choice was, again, intentional. It reflects the outcomes of the discussion behind the generation of the survey where it was agreed that the use of the word “business model” can possibly make it difficult for recipients to address the question, as in most cases it would be hard to tell if a business model is in place or not.

In light of this fact, it was decided to slightly move the investigation towards how Nodes cover costs related with the provision of DM/DS services. Raising this issue had a strong influence on the definition of the following step of investigation: the *Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)*, where the analysis was shaped towards the investigation of what makes a business model and it articulates questions on that.

Pre-set lists of answers were provided for most of the questions. The overlap with options provided in the *Landscape analysis of DM/DS services provision and BMs implementation (M1)*, is only partial. The option to provide the same lists of answers was considered in order to facilitate the comparison between the two investigations, but finally was discarded as in the first iteration of the investigation too few options were provided and some were barely fitting the purpose of this second step of the investigation potentially making difficult for the submitters to provide the most appropriate answer. As a consequence of this partial mismatch, a little interpretation was performed by the authors in order to map answers from one survey to the other.

The last survey question aimed at the investigation of the financial sustainability of the provided services in their current implementation. As it was expected that Nodes would not have detailed financial strategy behind the provision of DM/DS services, it was asked to just select the statement that most suits their thoughts about the financial sustainability of the services, without providing precise financial details in order to maximise feedback from the submitters.



As introduced in the Methodology section, survey recipients were: the ELIXIR head of Nodes, the Node Coordinators and the data management coordinators from WP1. Again, this decision was taken in order to maximise the probability to receive feedback from the Nodes. As a possible consequence of this choice, some of the Nodes provided multiple submissions of the survey. Namely Portugal, Luxemburg, and Germany submitted feedback twice.

In order to sort this double answers issue, it has been agreed to merge answers received from the same Node. In order to do so, a conservative policy has been adopted. For most of the questions, double submissions were almost overlapping while for a minority of cases the feedback has been merged considering the answers provided in both the submissions.

5.3 Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)

The *comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)* was realised a few months after collecting feedback from the landscape analysis of DM/DS implementations (M18) and results from such analysis were used to guide and shape the investigation presented below.

Aim

The final comprehensive round of analysis was conducted with the main aim of performing a deep investigation of how DM/DS services are currently financially supported and to understand the different sustainability strategies implemented by the Nodes.

Thanks to this last step of investigation, we generated the main tangible outcome of CONVERGE action Task 1.3: the definition of the so-called “Business Models Catalog”, an inventory of strategies (business models), implemented by the ELIXIR Nodes in order to ensure the financial sustainability of the delivered DM/DS services.

Timing

The first draft of the investigation was sketched on the basis of feedback collected during the CONVERGE general assembly (virtual event, 2021-06-10), shaped while collecting answers from the *Landscape analysis of DM/DS services provision and BMs implementation (M18)*, and finalised in July and August 2021, incorporating feedback from WP1 members.

The final version of the investigation was shared with all the WP1 representatives at the September monthly call (2021-09-27).

Data collection was performed in October and November 2021 (M21-22) while data analysis, and definition of fact-sheets for the Business Models Catalog were performed in the following months, till the submission of the current deliverable, in February 2022 (M25).

Methodology

Data Collection

The investigation was performed by means of on-line, live interviews.

Invitations were sent to contact persons filling out the *Landscape analysis of DM/DS services provision and BMs implementation (M18)* survey.



The interviews follow a template, covering the main aspects and components of business models, applied to the field of data management. The template was provided by means of Google Documents to interviewed Node representatives, one month before the scheduled day of the interview on average, asking to start checking the investigation topics and sketching answers, before the actual interviews. This procedure was agreed in order to provide interviewees enough time to collect data for the broad range of topics covered by the investigation.

Business model is, by definition, a multifaceted concept. In the private sector, it tends to refer to the outline of how a company plans to make money, generate revenue with its products, and provide a return for owners and shareholders. Although the concept of business model clearly emerged from the business environment, all organisations that are offering goods and services, including the public sector, to some extent share the business model's core components.

Even though the definition of business model might not be applicable as is to public services, business models can be taken as inspiration for public organisations providing services with the aim of improving service quality and ensuring sustainability for the future.

For the sake of the current investigation, we shaped the interviews around four main broad topics, that by definition are at the core of each business model (Fig.1):

- What service/product the Node is providing/selling.
- How the Node is providing/marketing the service/product.
- Which kind of expenses the Node is facing in order to support the service/product delivery.
- How the Node expects to make the service sustainable/turn out a profit from the service delivery.

The first two topics aimed at investigating how the services are currently delivered by the Nodes. The latter two topics focus on financial aspects of service delivery, investigating budget details, financial figures, and sustainability plans.

With the aim of performing a comprehensive investigation, the four overarching topics were further dissected, following the outline presented in the figure below.

In order to clarify the several investigated topics, all questions were provided with suggestions and examples of possible answers, allowing interviewees to better focus on the specific topic and facilitating a comparison between the different business model implementations.

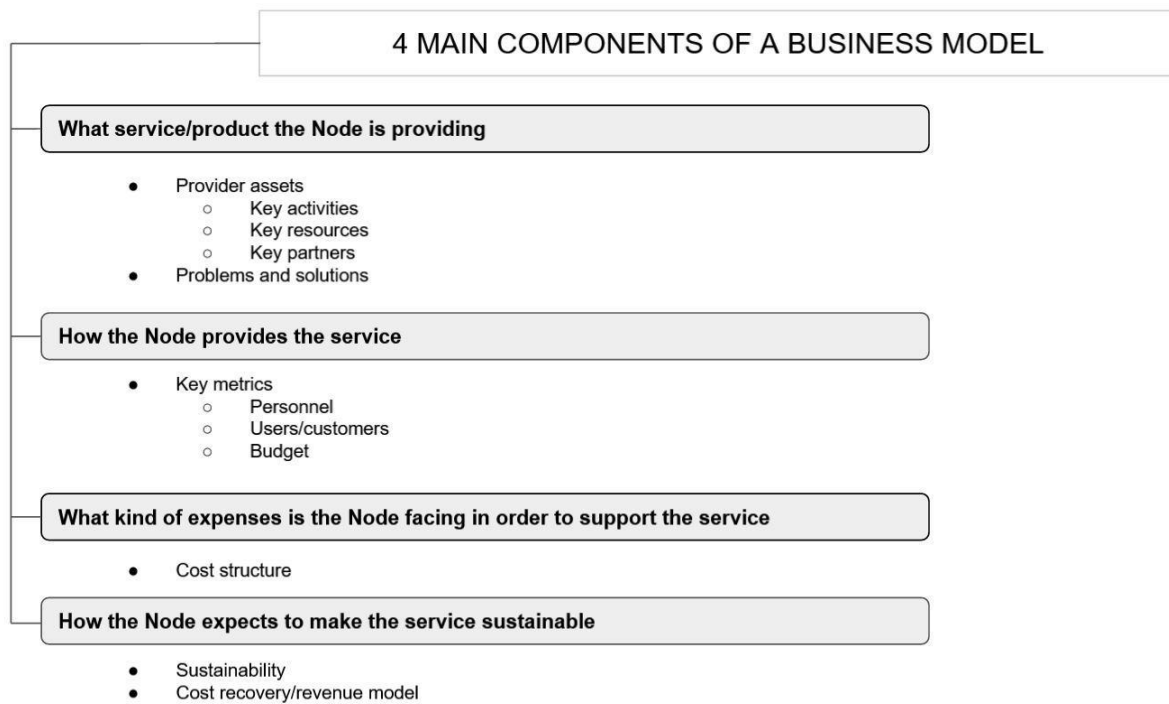


FIG.1 Main topics covered by the interview template.

Full list of topics/questions can be found in the [template interview document](#)¹ provided to the interviewees ahead of the live calls.

Interviews lasted 1 hour each on average, were performed on the ZOOM platform, and were all recorded.

Recording consent was requested to interviewees before the beginning of the session, with the sole aim of allowing WP1 members to re-analyse the content of the interviews within the purposes of the CONVERGE action.

A Google Sheets spreadsheet with time index for the different topics covered along the interviews was generated in order to facilitate the re-analysis of the recorded sessions.

Considering the results of the investigation being released by means of the current deliverable and as a consequence of the consent limitations, recordings and interview templates will not be released to the public.

Video recordings, all interview templates filled out by the Nodes and the time index document are archived in the [CONVERGE WP1 shared folder](#)² (Google Drive), with access limited to members of the action.

An additional copy of all the files is archived off-line in the local cluster of the Task 1.3 lead (UNIPD BiocomputingUP laboratory).

¹ <https://drive.google.com/drive/u/2/folders/1zf-ysXEXcnW7I0QEKY5N6xQZ9iqf0T2Y>

² <https://drive.google.com/drive/u/2/folders/1zf-ysXEXcnW7I0QEKY5N6xQZ9iqf0T2Y>

Business Models Catalog generation

Business Models Catalog factsheets were generated by the staff of Task 1.3 lead (UNIPD), based on information collected during the interviews and from information and comments provided in the template documents.

The factsheets generation was performed during December 2021 and January 2022 (M23-24).

Final versions of the documents were reviewed by the Nodes in January and February 2022 (M24-25).

Important considerations

Some important considerations have to be taken into account before moving to the analysis of the results collected by this part of the investigation.

Not all the topics listed in the interview template document were included in the final version of the factsheets composing Business Models Catalog.

Here we briefly present some of the main reasons underlying this decision:

- several topics were introduced in the investigation in order to understand how the different Nodes are structuring and delivering data management services. This was required background information for a comprehension of the sustainability strategies adopted at national levels but it does not really fit the main scope of the current investigation about sustainability strategies *per se*.

This consideration mainly applies to topics investigated under the first subject addressed in the interviews (What service/product the Node is providing/selling).

As a consequence, most of the information collected under this topic (e.g. key activities, key resources, key partners) were summarised as a single paragraph at the beginning of each factsheet.

- some data turned out to be very challenging to collect. This consideration mainly applies to topics where quantitative data were requested (e.g. table for users/customers accessing the services, questions where financial figures were requested). Very few Nodes were able to provide precise estimates for these topics making a comparison between different Nodes almost impractical.
- as introduced above in this chapter, interview topics were mutated from definitions typical of the business environment. In order to adapt the investigation, some topics were rephrased with a wording that better applies to the delivery of public services. Contrary to our expectations, some topics come out to be barely applicable to the delivery of data management services.

With the exploration of alternative financial strategies for the provision of DM/DS services being the aim of the current investigation, all the Nodes where the services were fully subsidised by public funding and Nodes just about kick-starting DM/DS service delivery, hence not having a structured sustainability plan in place, were excluded from the Catalog.

As a consequence, only 8 fact sheets, out of the 14 Nodes that underwent the interviews of the *Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)*, were included in the final version of the Business Models Catalog.

6. Results

Results of the analysis carried out in the context of CONVERGE Task 1.3 - Business model, are here presented in two main parts:

- in the first we will provide an overview of the DM/DS services delivered by the Nodes and how they are currently financially supported
- the second will present examples of sustainability strategies applied to the delivery of DM/DS services via a portfolio of fact sheets: the Business Models Catalog



Useful considerations for the understanding of the following chapters are presented as “Important considerations” in the above section of the current document.

6.1 Overview of DM/DS services delivery and financial support

In this section we provide an overview of results gathered via *Landscape analysis of DM/DS services provision and BMs implementation (M18)*.

The Chapter will revolve around four main topics:

- DM/DS services provision
- funding support
- business models
- service sustainability

Wherever possible, a comparison with the results from the *Landscape analysis of DM/DS services provision and BMs implementation (M1)* will be described, highlighting how the landscape around the delivery of DM/DS services has changed during the initial close to two years of the CONVERGE action.

A brief overview of the current part of the investigation has earlier also been presented as a paragraph of the CONVERGE milestone [M1.2 Draft description of pan-European model for coordinated data management in LS](#).³

In the following paragraphs we will present some trends for the provision of DM/DS services gathered from the results of our investigation.

³https://docs.google.com/presentation/d/1EFNYr2N9ZiMwxCLeCu3g51FRZifoxc5YVJdih-HXaMg/edit#slide=id.g75cc253543_3_33



6.1.1 DM/DS services provision

Nodes delivering DM/DS services

After almost 2 years of the CONVERGE action, the 88,2% of the Nodes (15/17 responding Nodes) are offering some sort of DM support, with another Node in the process of setting up, for a total of 94,1%. At the beginning of the project, a similar but somewhat lower number of Nodes were providing DM support (83% - 15/18 responding Nodes).

Interpolation of data collected at M1 and at M18 allowed us to identify 2 additional Nodes, not filling out the survey at M18, already providing services at M1. In light of this finding we considered it fair to add those nodes (ELIXIR-ES,CH) to the count at month M18. We in fact considered it very plausible that they are still delivering, at least, the same services described at M1 or better.

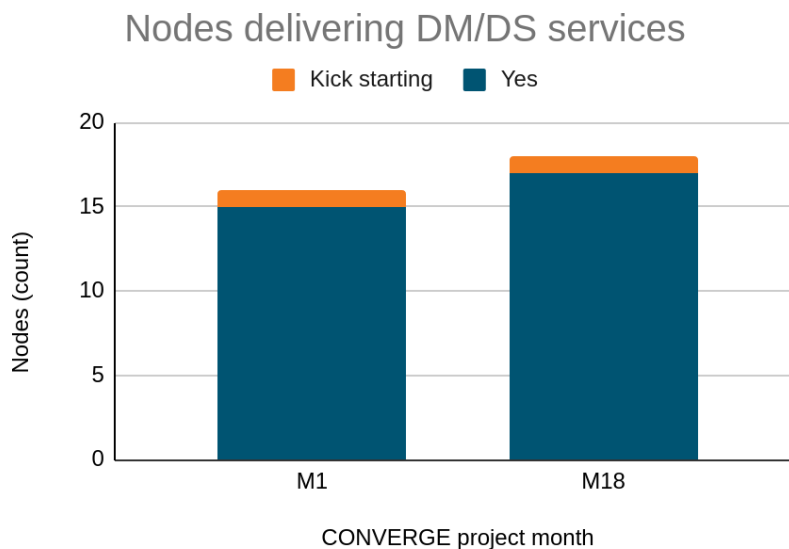


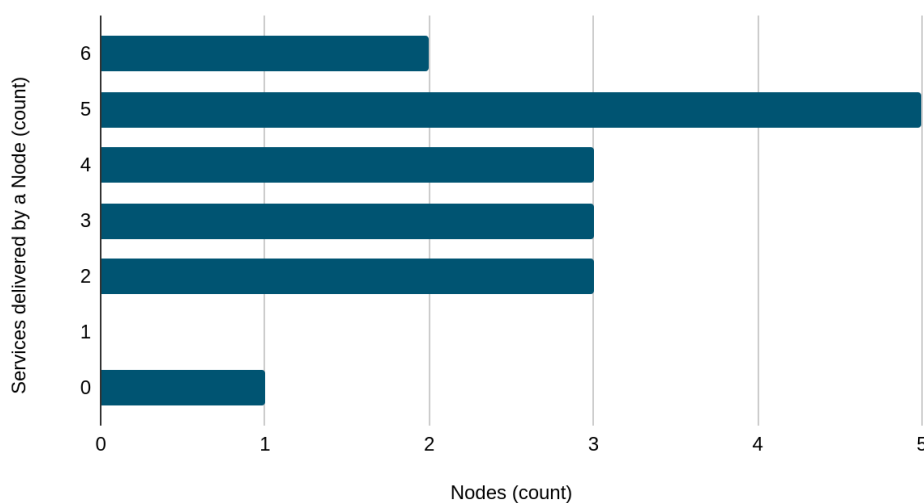
FIG.2 Count of Nodes delivering DM/DS services at M1 and M18.

In light of this consideration, we can conclude 94,7% (18/19) of the Nodes are delivering some service in the field of DM/DS at M18 (Fig.2).

DM/DS services delivered

At M18, most of the Nodes are providing DM/DS services to the research community through a broad range of activities addressing most common needs in terms of data management and stewardship.

DM/DS services delivered (M18)


FIG.3 Count of DM/DS service categories delivered by the Nodes.

In most of the cases (10/17Nodes), 4 or more categories of services are provided, with a distribution clearly skewed towards Nodes providing a wide range of DM/DS activities (Fig.3).

These findings might suggest national communities are progressively reaching an advanced maturity stage in the field of data management, for most of the Nodes.

Below follows a list of the main services offered(Fig.4):

- **Consultancy services** to guide users facing the implementation of FAIR/Open data principles for the first time (14/17 Nodes). Additional advanced consultancy services are provided to users already sensitised on FAIR/Open data principles and looking for a more proficient implementation of their DM/DS practises in order to improve the impact of their work.
- **Training**, often delivered through courses covering the different aspects of FAIR/Open data principles implementation (14/17 Nodes).
- **DM/DS best practice guidelines**, usually addressed in dedicated websites (11/17 Nodes).
- **Dedicated IT infrastructure** (10/17 Nodes). The implementation of these services usually includes the possibility of accessing IT resources such as data storage, HPC resources and computational pipelines. In some advanced implementations, IT resources are offered to users in the form of tool assemblies (12/17 Nodes) which provide instruments to cover several steps of the research data lifecycle concatenating different resources in a single platform.

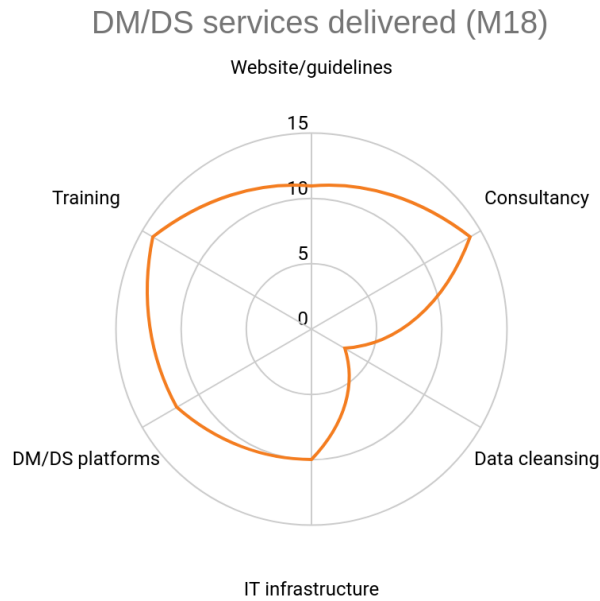


FIG.4 Count of DM/DS service categories delivered by the Nodes.

A comparison with service categories delivered at M1 was possible only for 3 broad topics:

- **Data management support** (14/18 Nodes at M1)
- **Data management training** (14/18 Nodes at M1)
- **Data management infrastructure** (4/18 Nodes at M1)

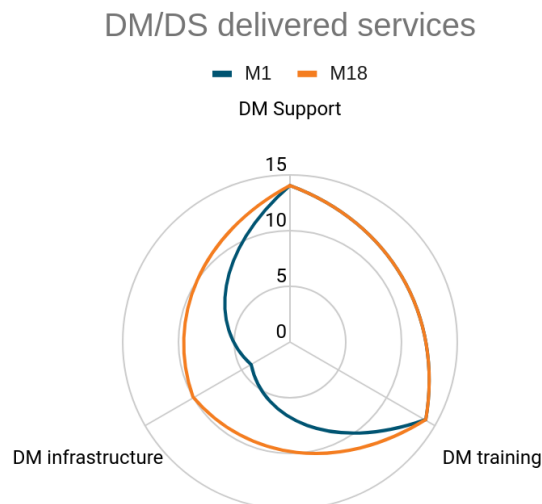


FIG.5 Count of DM/DS service categories delivered by the Nodes at M1 and M18.

This comparison allows us to identify that while the provision of data management support/consultancy and training was very common already at the beginning of the CONVERGE project, the set-up of an IT infrastructure for DM/DS purposes was very rare (Fig.5). After 2 years, Nodes with a dedicated IT infrastructure have more than doubled, rising from 4 to 10 at M18, again suggesting a maturity boost in the provision of DM/DS services by several Nodes.

6.1.2 Funding support

Funds supporting the provision of DM/DS services usually come from different sources. Considering the investigation at M18, 3 major sources of funding can be identified (Fig.6):

- **national grants.** In almost all the Nodes (14/17) the current DM/DS services are supported by national grants
- **EU grants.** A relevant number of DM/DS services are supported as part of EU funded projects (9/17 Nodes)
- **institution's budget.** In a still relevant number of cases, costs generated by the provision of DM/DS services are covered by institution's own budget (6/17 Nodes)

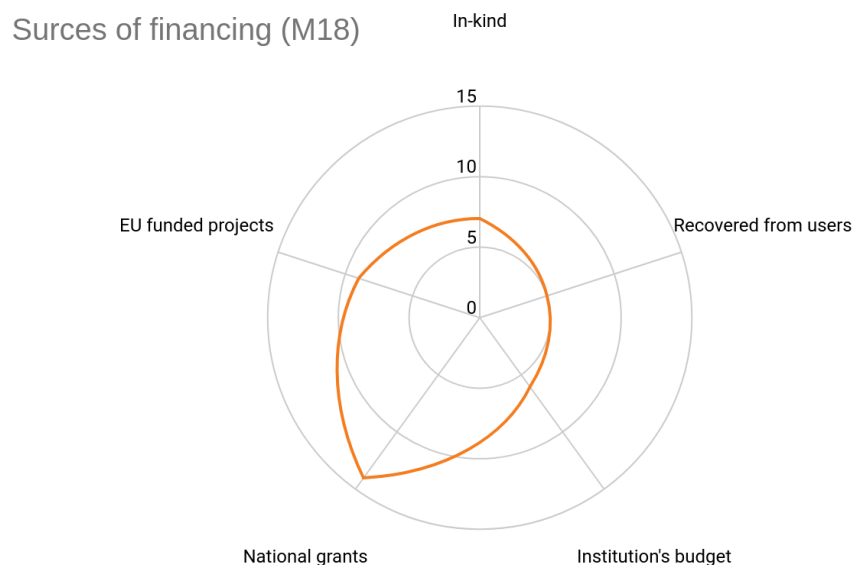


FIG.6 Funding sources supporting DM/DS services provision.

In the vast majority of cases, the service provision is not supported by a single source of financing only, but rather by a combination of the 3 sources listed above (Fig.7). A possible reason for having multiple sources of funding, supporting DM/DS related activities could be that in most cases Nodes provide a plethora of DM/DS activities, with relevant underlying costs like personnel and hardware above all, as outlined in the previous paragraph. As possible additional proof of the aforementioned hypothesis, our investigation revealed that in almost half of the cases (7/17 Nodes) part of the costs incurred in order to provide DM/DS services are not recovered in any way, and the activities are provided partially or totally in-kind (Fig.6). Many of the nodes thus seem to have acted on the need for DM/DS services before governments and national infrastructure funders have decided on strategies for how to support these needs. The extreme case in this

distribution seems to be ELIXIR-GR where most of the DM services are provided with no direct source of financing.

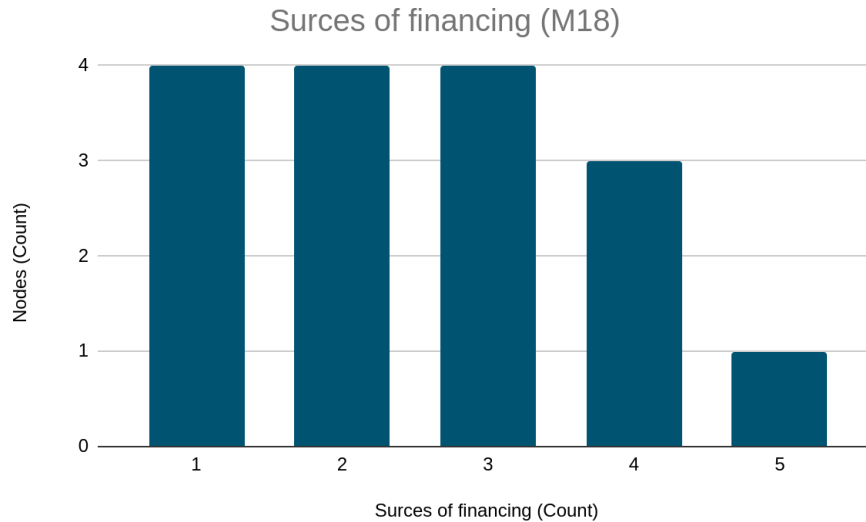


FIG.7 Count of funding sources supporting DM/DS services provision, for every Node.

6.1.3 Business models

In almost one third of cases (5/17), Nodes are moving towards models where at least part of the costs are recovered from to the final users (Fig.6).

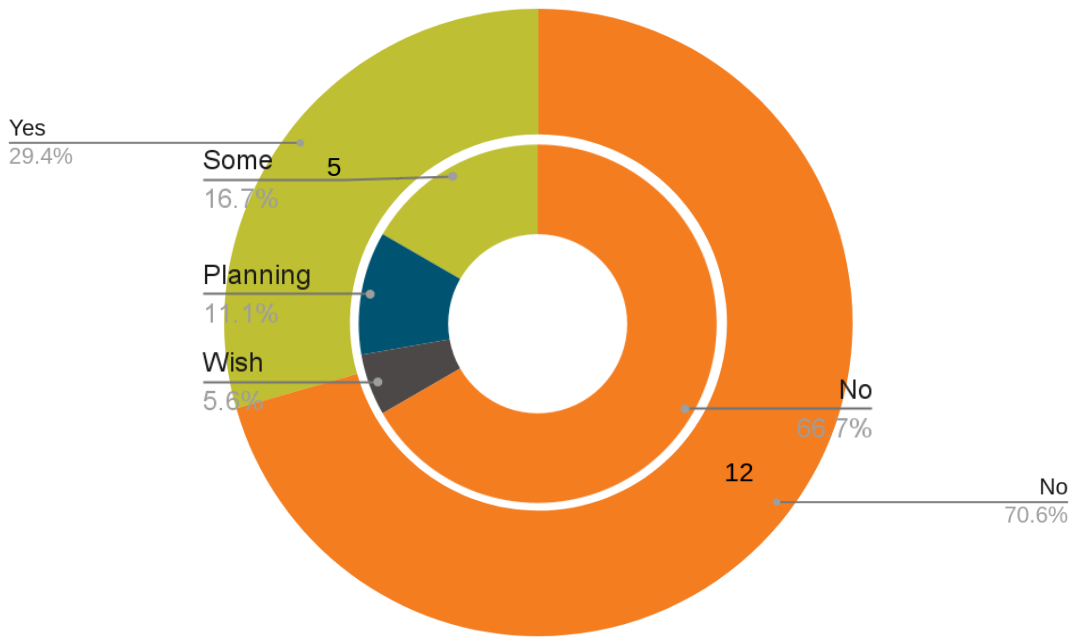
Comparison with the analysis performed at M1 allows us to identify as even fewer Nodes (3/18) had some sort of business model in place, supporting their data management activities (Fig.8). At the same time, 3 other Nodes were expressing the will of exploring this option (“Wish”/“Planning”).

Despite being small numbers, data show the phenomenon has grown within an 18 months time-frame, in parallel with DM/DS services provision among ELIXIR Nodes increasing in complexity and hence needing basic budgeting and more sustainable funding strategies.

Conversely, it has to be highlighted that, still at M18, most of the Nodes (12/17) do not have any business model in place (Fig.6, Fig.8) and no Node has it in place in full.

Only exception is ELIXIR-DK where the only source of financing seems to be a cost recovery strategy. Unfortunately no additional information can be detailed as the Node did not take part in the following step of the investigation.

Further details on how the Nodes are exploring sources of financing other than from public grants will be explored in the following chapter of the current investigation.



**FIG.8L Nodes implementing business models supporting the provision of DM/DS services.
Inner circle: M1, outer circle: M18.**

6.1.4 Service sustainability

In the vast majority of cases, the DM/DS services, in their current implementation, are foreseen to be “*Likely to be sustainable*” (12/17 Nodes) for the foreseeable future time frame (Fig.9). It has to be highlighted how this forecast is based just on the Nodes' thoughts about the financial sustainability of the service, and not on a precise financial analysis of the current costs and revenues.

Financial sustainability (M18)

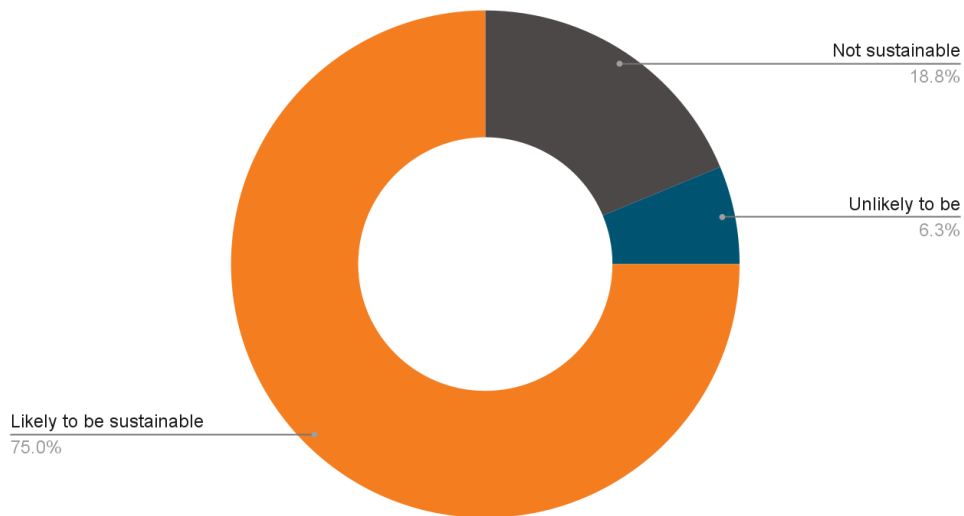


FIG.9 Financial sustainability of DM/DS services provision.

Furthermore, it can be highlighted how these considerations about the long term sustainability of DM/DS services provision seem to be in contrast with DM/DS services being supported mainly by institutional, national or EU grants, which by definition are constrained to specific time-frames and thus not suited for long-term services support.

In three cases only, services are considered to be “not sustainable” in the long run. Interestingly these cases involve a Node with a long history and experience in DM/DS services provision, that currently is moving towards a model where costs are recovered from the final users (ELIXIR-NO).

Despite the optimistic view on the financial sustainability of DM/DS services gathered from the survey, the next step of investigation allowed us to understand how the sustainability landscape seems to be much more unstable than what could be expected from the outcome of this part of the investigation.

6.2 Business Models Catalog

In this section, results gathered from the *Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)* are presented.

Our investigation highlighted how the ELIXIR Nodes are differently structured, being shaped by the research environments, regulations and funding schemes of the different Countries. Nodes’ peculiarities are mirrored on how the DM/DM services are delivered and reflected on the sustainability plans behind the provision of such services.

As introduced in the previous section, in almost all the Nodes, DM/DS service delivery is only possible thanks to the provision of public support, specifically delivered via institutional/national/EC grants (Fig.6).

Accepting public subsidisation is the main source of financing for DM/DS services, alternative sustainability strategies or business models are emerging in several Nodes (Fig.6, Fig.8).

The main feature of these business model implementations is the fact that end-users of the services are requested to provide a financial contribution for benefitting from the support, allowing the service provider to recover all, or at least part of the costs.

Considering the information gathered from our investigation, for the sole aim of the present document, the following classification is proposed in order to label business models currently implemented by the Nodes (FIG.10).

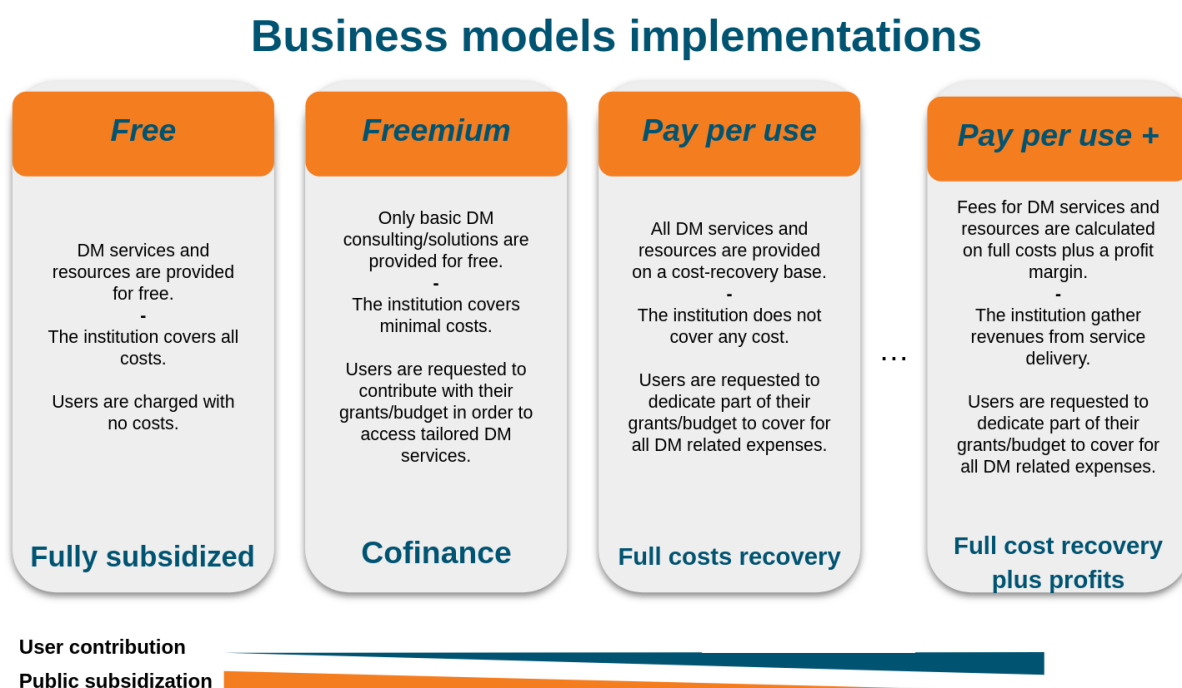


FIG.10 Business models classification proposed for describing the alternative funding strategies currently implemented by the Nodes

The classification is based on a gradient of public subsidisation and user/customer contribution, allowing the identification of three main business models (plus one model currently not implemented by any Node).

Considering the proposed business models classification, the 14 Nodes undergoing the interviews can be roughly labelled as shown in Fig.11 (ELIXIR-IL was excluded as not delivering any kind of service at the time of the investigation).

Business models implementations (M18)

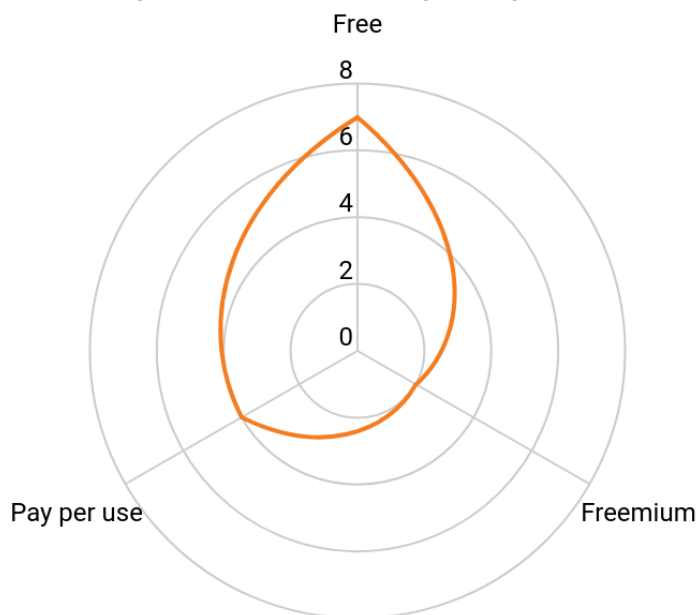


FIG.11 Classification of business models implemented by the Nodes.

The authors, anyway, would highlight that the summary presented with plot (Fig.11) could bring the readers to inaccurate conclusions if interpreted without a detailed analysis of how the services are currently delivered. The plot is generated from the authors' tentative labelling of the different business models implemented by the Nodes. From a deep analysis of the Business Models Catalog, the readers will easily understand how the application of business models to the delivery of DM/DS services is instead multifaceted and that different conditions are applied to different users, services and projects (e.g. different conditions can be applied to research institutions and private companies).

In order to allow a deep understanding of how business models are implemented within ELIXIR, here we present fact sheets for all the 8 Nodes where cost recovery strategies are in place.

For every fact sheet the following topics are covered:

- **How the DM/DS services are currently delivered**
- **The sustainability of the services, in their current implementation**
- **The cost recovery/revenue model in place**

Fact sheets composing the Business Models Catalog are presented as [Appendix 1](#) of the current document.

7. Conclusions

With the current document we propose a sketch of how DM/DS services are currently financially supported, and map how alternative funding strategies, other than the full public subsidisation, are implemented at national level.

At the start of the project most of the participating Nodes were offering some sort of DM/DS support, mainly in the form of consultancy and training. Although most Nodes had identified the importance of establishing data management support activities, the maturity of the provided support varied greatly between the Nodes, as indicated by self-assessment, which demonstrates the varying national circumstances under which the different ELIXIR Nodes have to operate to provide data management support. The almost lack of established business models among the Nodes was probably a consequence of data management being a relatively young discipline and most Nodes were still in an establishment phase in their DM operations.

After about 2 years from the beginning of the action, only a slight increase of the number of Nodes delivering DM/DS services could be observed. However, the collected evidences suggests that the quality of provided services improved, reflecting an increased maturity of the Nodes in this field.

Most of the Nodes are providing DM/DS services to the community through a broad range of activities, addressing the most common needs in terms of data management and stewardship. Services are still provided mainly in the fields of DM consulting and training. Remarkably, our investigation highlighted how Nodes providing dedicated IT infrastructure for data management have more than doubled in less than 2 years, again suggesting a maturity boost in the provision of DM/DS services by several Nodes.

Services delivery, in the current implementations, is only supported by public subsidisation in almost all the Nodes. Funds supporting DM/DS services usually come from a mix of public grants, provided by the local institution, national public funders and EU funded projects. In almost one third of cases, Nodes are moving towards the exploration of new sustainability strategies and models where part of the costs are recovered from final users.

As the ELIXIR Nodes are differently structured, a single one-size-fit-all sustainability strategy can not be advocated. Hence a catalog of fact sheets for all the approaches, different from the full public subsidisation was generated: the so called, Business Models Catalog.

Considering the gradient of public subsidisation and user/customer contribution, the authors of the current report characterised the implemented sustainability strategies under three (plus one) business models: Free, Freemium, Pay per use (Pay per use +).

Although a growing number of Nodes are moving towards the implementation of such business models, our investigation highlights how these strategies for most of the cases can be considered



only experimental, and so far, in several cases transactions are only virtual and cost recovery almost never happens in full.

In spite of DM/DS services being supported by temporary grants, in the vast majority of cases the nodes estimate that the DM/DS services are “*Likely to be sustainable*” for the future time frame, reflecting an optimistic sentiment about the services financial sustainability, services which are in turn expected to keep growing in the future.

8. Impact

The activities associated with the current deliverable had a direct impact across all the Nodes, especially on the ones undergoing the interviews, part of the *Comprehensive analysis of DM/DS services provision and BMs implementation (M21-22)*.

The interviews provided the opportunity for the Nodes to dedicate time for focusing on the current and future sustainability strategies for the delivery of DM/DS services and collect data about the current impact of the delivered services.

Several Nodes highlighted that undergoing the investigation allowed them to generate a clear picture of how DM/DS services are coordinated within the Country, and sketch a fair picture of the real future services sustainability.

A greater impact is expected in the mid-term future, by the Business Models Catalog being a source of inspiration, especially for Nodes where service provision is rapidly growing in maturity.

9. Next Steps

Outcomes gathered from the current investigation will contribute to the definition of the ELIXIR-CONVERGE Deliverable 1.4 - *ELIXIR Best Practises recommendations* due at M30, and will feed the ongoing discussion in the context of *ELIXIR-CONVERGE T4.5 - Supporting the long-term sustainability of ELIXIR*.

10. Deviation from Description of Action

The submission of the current deliverable is postponed of one month with respect to the original planned deadline (M24) as a main consequence of the need of collecting more feedback on the business models implementations from the Nodes. The definition of the fact sheets for the Business Models Catalog drafted during the interviews, required an additional round of feedback from the data management coordinators in order to improve the quality of the final product resulting in a little shift in the deliverable submission.

Appendix 1: the Business Models Catalog



Fact sheets for all the 8 Nodes where cost recovery strategies are in place are presented here.

Pdf version of the Business Models Catalog is archived in the [CONVERGE WP1 shared folder](#)⁴ (Google Drive).

Business models fact sheets

⁴ <https://drive.google.com/drive/u/2/folders/1zf-ysXEXcnW7I0QEKY5N6xQZ9iqf0T2Y>





ICT Solutions for Brilliant Mind

Infrastructure name

CSC – IT Center for Science Ltd

Website
<https://www.csc.fi/>

The ELIXIR Node in Finland is hosted at the CSC – IT Center for Science, and it is deeply involved in the effort of building national Data Management capacity.

CSC is a state-owned company with the mandate of providing high-quality ICT services for higher education institutions, research institutes, culture, public administration and enterprises.

CSC owners are the Finnish State (70%) and higher education institutions (30%).

Data Management services

Website/guidelines	Yes
Consultancy	Yes
IT infrastructure	Yes
Training	Yes
Others	Support in achieving compliance with national legal requirements for DM

Sustainability of the services

All CSC services are run as non-profit with public direct funding or invoiced to the research institutes using the services. CSC has a set of national frame agreements that cover the majority of public research institutes, government agencies, higher education institutes, state enterprises and private customers. All services are designed to be sustainable and the financial viability (I.E. a minimum customer base) is required for maintaining such services.

Cost recovery/revenue model

The use of CSC's computing, cloud storage and consulting services can be either free-of-charge use or paid use. The cost recovery model is based on Billing Units (BUs). CSC uses BUs to allocate resources to users, monitor the resource use and to charge the users when the use of the services does not fit the free-of-charge conditions. BUs represent ICT costs (storage, computation nodes, GPUs, data transfer capacity, data backup, virtual access, personnel) that are translated into invoices to the customers.

How are fees calculated?

CSC uses internal BUs that are calculated upon real ICT costs.

In most cases, customer institutes are university research units owning a part of CSC.



All details for the free of charge use of services is specified at <https://research.csc.fi/free-of-charge-use-cases> covering the following cases:

- Research in higher education institutions
- Research in state research institutes
- Education in higher education institutions
- Training provided by state research institutes
- Cooperation with companies in higher education institutions and state research institutes
- International usage
- Government's analysis, assessment and research activities
- Local IT support necessary to use cases mentioned above

When the conditions of free-of-charge use are not met, CSC uses BUs to charge the customers. In these cases CSC's billing model describes how BUs are consumed in different services.

Billing units and pricing model are specified at: <https://research.csc.fi/pricing>

Pricing estimates with a given computation and storage capacity can be done at <https://research.csc.fi/en/pricing#buc> where billing unit and euro pricing can be estimated.

Here below is an example of pricing for an entry-level service package.

CSC computing Base Package

The base package is the one designed to get started with the CSC's computing, cloud and storage services. It is also the minimum amount of BUs that can be purchased from CSC. It can be used for computing, cloud and related storage resources, unless otherwise agreed. The Base Package is charged once per project.

The Base Package includes

- 20 000 billing units
- 4 user accounts
- Support by CSC's experts via service desk

Price for this base package is 1190,00 € (VAT 0 %).

Additional resources and consulting services

- Billing units (20 000 BUs): 420,00 € (VAT 0 %)
- Additional user account: 30,00 € (VAT 0%)
- Consulting will be billed according to your contract with CSC.

As reference, one terabyte (TiB) of data storage consumes one billing unit per hour.

In 2020, the CSC supercomputing resources Puhti and Mahti were consumed with 761 million BUs. Storage services were consumed at around 110 million BUs.

How does the transaction work?



CSC offers research data management services mainly to public research institutes. Finnish law stipulates that services offered to the private sector are limited in proportion.

Transactions are facilitated by the set of national framework agreements that cover the majority of public research institutes, government agencies, higher education institutes, state enterprises and private customers. Further facilitation is due to the fact that institutions have BUs assigned as owner of CSC, and this implies most of the charges are only virtual, and do not reflect real budget transferring, every time a resource is used.

Invoiced sales cover all ICT, personnel and maintenance costs incurred for a given service.

VAT is added and is deductible by institutional customers.





Infrastructure name

ELIXIR Norway

Website<https://elixir.no/>

ELIXIR Norway is a collaboration between universities, coordinated from the University of Bergen, and including subnodes at the University of Oslo, the Arctic University of Norway in Tromsø, NTNU Trondheim and NMBU Ås.

The provision of Data Management services is handled by ELIXIR-NO in collaboration with four main external partners:

- [Centre for Digital Life Norway](#)⁵, (strategic partnership on research Data management)
- [NeIC](#)⁶ The Nordic e-Infrastructure Collaboration, (partners on sensitive data activities)
- [Uninett Sigma2](#)⁷, the national high performance computing infrastructure
- University Libraries

Data Management consultancy service is mainly provided via [BioMedData](#)⁸, a research infrastructure promoting FAIR data management within the life sciences. The project is a collaboration between 11 Norwegian life-science infrastructures, where 10 are data generating life science infrastructures within genomics (NorSeq, NIMG), proteomics (NAPI), imaging (NALMIN; NorMOLIM), biodiversity (GBIF Norway), biobanks (Biobank Norway, MoBa), structure determination (NorCryst) and small molecule screening (NOR-OPENSREEN).

Aim of BioMedData is the setup of a national network of data management experts promoting and facilitating professionalised and harmonised FAIR data management services.

Data Management training is provided under the ELIXIR-NO umbrella and usually provided by ELIXIR-NO personnel in collaboration with local resources like libraries and local research support units.

IT infrastructure supporting Data Management services provision on non sensitive data is based on the Norwegian e-infrastructure for life sciences (NeLS), a Galaxy instance on the national openstack cloud with 140TB active data storage plus 125TB long term storage, actually representing the workhorse for analysis, sharing and storage for high throughput genomics data.

Other IT services implemented in order to provide Data Management support, like the FAIRDOME-SEEK instance, are built around the NeLS infrastructure and are deeply integrated with it.

Due to this integration, Data Management consultancy and bioinformatics support services are deeply combined making, in turn, the discrimination between the two services almost fuzzy.

⁵<https://www.digitallifenorway.org/>

⁶<https://neic.no/>

⁷<https://www.sigma2.no/about-sigma2>

⁸<https://elixir.no/organization/biomeddata>



In this context users come from both directions. Some users approach the Bioinformatics support services and then they realise Data Management support services are needed too, while for some other users it works the other way around.

Data Management services

Website/guidelines	Yes
Consultancy	Yes
IT infrastructure	Yes
Training	Yes

Sustainability of the services

Almost all Data Management services are supported by public direct funding and sustainability is based on the national funding framework (usually 3-5 years).

The ELIXIR-NO is dependent on structural funding provided by the Research Council of Norway. The current funding cycle will be over on 31/12/2021.

BioMedData is again funded by the Norwegian Research Council but it follows a different time frame and will be supported for the next 2 years (2020-2024).

Cost recovery model is in place but does not generate incomes over the costs sustained to provide the service and at the current state of implementation it can not be considered as self-sustainable.

Cost recovery/revenue model

ELIXIR-NO offers an infrastructure for storage of scientific data, intended for research projects with larger sets of data (minimum 1TB). Free HPC resources and storage is provided to projects with funding from the Norwegian Research Council of less than 15 MNOK (~1.5 Million €), or any storage project with funding from the Norwegian Research Council with needs below 10 TiB.

It has to be noted that under the aforementioned circumstances storage and HPC are offered for free to users but ELIXIR-NO has to refund the national research infrastructure for the use of such resources through funding provided by the Research Council of Norway for operation of ELIXIR-NO.

Data Management consultancy is provided free-of-charge for up to 2 days per project. Starting from 2022 the free-of-charge support will be lowered to 1 day and hourly fee will rise.

Training is provided free of charge with funding from the Norwegian Research Council in collaboration with local partners.

How are fees calculated?

The cost for the services is based on cost models consisting of actual cost elements from service suppliers for operational cost and investment costs.

All research projects with a Norwegian partner with funding from national funding bodies and EU grants are entitled to store life science data and use HPC resources in NeLS. This also includes private companies and governmental research institutions with funding from the Norwegian Research Council.



Research projects that do not fall into the definition above can still apply for a storage quota and HPC resources, but these projects will be treated according to a [User Contribution Model²](#).

The model introduces four different categories:

- Large projects with funding from the Norwegian Research Council of 15 MNOK or more or storage needs above 10 TiB, paying for operational expenses (covered above)
- Non-commercial projects needing dedicated resources, paying for capital and operational expenses
- Commercial research and industry which will pay the full cost price
- Non-contributing projects which are smaller projects not in any of the above categories

For requests that require platform contribution for more than 2 days, an agreement between the user and the platform must be made. The agreement should cover the type and cost of the service. If applicable, the agreement should also cover a plan for publication and co-authorship.

Data Management consultancy provided for more than 2 days is charged 750,00 NOK (~75,00€) per hour, for academic projects (or based on the hourly rate of the staff involved).

Starting from 2020 the free-of-charge support will be lowered to 1 day and fee raised to 850,00 NOK (~85,00,€).

Additional bespoke long term academic or industry collaborations are allowed and projects requiring an effort beyond technical assistance/consultancy may be set up as a research collaboration, E.G. by providing funding for a percentage of the position of a helpdesk member.

How does the transaction work?

Fees are invoiced by the head node institution (UiB) to the customer institution including VAT and overheads, if the transaction does not happen within the same institution.

For long term support, the collaboration should be part of a grant and consortium agreement with dedicated funding to the respective host institution

²<https://www.sigma2.no/user-contribution-model>


Infrastructure name

NBIS - National Bioinformatics Infrastructure Sweden

Website

<https://nbis.se/>

The ELIXIR Node in Sweden is hosted at the NBIS - National Bioinformatics Infrastructure Sweden. NBIS is a distributed national research infrastructure supported by the Swedish Research Council, all major Swedish universities and the Knut and Alice Wallenberg Foundation, providing state-of-the-art bioinformatics to the Swedish life science researchers community.

NBIS forms the bioinformatics platform of the SciLifeLab - Science for Life Laboratory, an institution for the advancement of molecular biosciences in Sweden, a national resource of technologies and expertise, available to life scientists, funded as a national research infrastructure by the Swedish government.

NBIS is predominantly offering bioinformatics analysis support via infrastructure and tools for bioinformatics analysis, together with the provision of Data Management solutions.

Due to the integration of Data Management and bioinformatics support, the discrimination between the two services can sometimes be fuzzy.

Scientific computing and storage are provided to Swedish researchers by *SNIC - Swedish National Infrastructure for Computing*, a national research infrastructure that makes available large-scale high-performance computing resources, storage capacity, and advanced user support.

Data Management services

Website/guidelines	Y
Consultancy	Y
IT infrastructure	Y
Training	Y
Others	Hands-on support on FAIR repository submission

Sustainability of the services

Almost all Data Management and bioinformatics services provided by NBIS are supported by public funding and sustainability is based on the national funding framework, mainly bundled with the funding of the SciLifeLab (4 years rounds) and of national infrastructure grants from the Swedish Research Council (also 4 years rounds).

As a considerable part of Data Management services are financially supported by the Swedish Research Council and Swedish universities, it is not considered fair to fully recover costs from researchers at universities or at other public institutions.



A cost recovery system is in place for bioinformatics analysis services but, as a consequence of previous considerations, fees are subsidised. This is logical, since the universities co-fund the national infrastructure. The current user fee system is sustainable.

Cost recovery/revenue model

At present, NBIS provides basic Data Management support (10 hours ca., and up to 3 hours for bioinformatics consultancy) free-of-charge, mainly to encourage researchers to publish data in agreement with FAIR best practices.

The basic support is usually represented by one or more meetings with a coordinator and one or more bioinformatics experts. The meeting can be realised in person or online.

Cost recovery model applies to extensive Data Management support and it is based on an hourly fee.

How are fees calculated?

NBIS offers Data Management and bioinformatics support for a subsidised fee, currently 800,00 SEK (~80,00€) per hour to researchers from public institutions.

The fee applied to research institutions is based on calculation of personnel costs and some indirect costs, and is still subsidised. An agreement between NBIS and the users, mainly focused on the total amount of support hours, is set before the delivery of the support service.

A different fee applies to private companies where the calculation is based on full cost recovery, currently 1800,00 SEK (~180,00€) per hour.

At the time of this investigation no companies have applied for Data Management services so far.

How does the transaction work?

NBIS sends the invoice to the users, based on the agreement stipulated before the delivery of the support service and no overheads are applied within universities.

For bigger efforts, where NBIS is an active part of the research projects, NBIS normally is included in the grant application.

For private companies VAT is applied.

**Infrastructure name**

DTL - Dutch Techcentre for Life Sciences

Website<https://www.dtls.nl/>

The ELIXIR Node in The Netherlands is hosted at the Dutch Techcentre for Life Sciences (DTL), a foundation whose partners are universities, small and large companies and academic hospitals. ELIXIR-NL is involved in an extensive coordination effort, reflected in its portfolio of training and coordination activities.

Through this coordinating effort, DTL/ELIXIR-NL has been standing at the birth of the development of the FAIR principles, and since then also works on distributing this expertise over the Country.

In the Netherlands, the national IT infrastructure is handled by [SURF](#)¹⁰, a collaborative organisation for the provision of IT services and facilities for education and research.

ELIXIR-NL does not provide DM services or support, *per se*, but via its coordination activities is deeply involved in DM-related activities within the Country, both inside and outside (E.G. in the context of the National Programme Open Science) the Life Sciences domain. Undoubtedly, its members themselves are practically involved in DM-related activities. Aim of the Node to extend its ambitions and provide national DM services, but currently there is no national funding that can make this possible. On the other hand it has to be highlighted that the Node has many other activities that are very relevant to DM but do not themselves form DM services, such as community and training/capacity building, including participation in tasks like defining the roles and career paths for data stewards; these activities are now not fully represented in this document because they are out of scope of the survey.

DM services are provided by Competence Centers set up as 3 levels:

- National Expertise Center.
A national center handled at SURF. It is cross institutional and cross disciplinary.
- Local Digital Competence Centers
These centers are hosted mainly at universities and university medical centers.
Local centers are institution-specific but not discipline-specific.
Local centers are currently set up on the base of project proposals granted by the main national funding organization (The Dutch Research Council, NWO).
- Thematic Digital Competence Centers.
These centers are discipline-specific but cross institutional with the aim of connecting the expertise of national and local competence centers.
At the time of this investigation, thematic centers are still in a start-up phase.

¹⁰<https://www.surf.nl/en>



The expectation is to develop centers that will revolve around 3 different topics:

- life sciences and health (expected to be coordinated by DTL/ELIXIR-NL)
- natural hard sciences and engineering
- social sciences and humanities

Also thematic centers are set up on the base of project proposals granted by NWO.

Data Management services

Website/guidelines	Yes (local; to be expected: and thematic)
Consultancy	Yes (local and national, to be expected: thematic as well)
IT infrastructure	Yes (mainly provided via SURF)
Training	Yes (local and national and thematic)

Sustainability of the services

DTL is a non profit foundation, with members as universities, university medical centers and private companies, providing a contribution for their memberships, In addition, it has an active role in many european and national projects. As a consequence, DTL is not depending on just a single grant that has to be renewed within a specific time-frame, guaranteeing the sustainability of the foundation in the long run.

SURF provides services under a cost recovery scheme, allowing members to benefit from economies of scale and avoiding them to reinvent the wheel on their own. Institutions can purchase services by concluding services agreements.

Current funding scheme for Local Digital Competence Centers is implemented as one-time financial injection and expectations the services will become self-sustaining afterward, possibly supported by cost recovery schemes towards final users.

Institutions can apply for seed grants in order to startup competence centers. If a grant proposal is funded, only 1/3 of the requested amount is financed by the national funder (NWO) while the local institution is requested to cover the other 2/3 of expenditures. Application process is interactive and based on a discussion between the national funder and the local institution where a precise sustainability plan is requested, expecting the service to become self-sustainable after a kick-off phase. Sustainability is handled with different strategies depending on the institutions. Some examples can be found in the paragraph below.

Cost recovery/revenue model

Cost recovery mechanisms are different and depend on the local institution.

Some examples are listed below :

- institutions allocate a yearly fixed amount to provide services with no charge.
All the support requests arriving after the allocated budget is over are charged to users - EG: Erasmus Medical Center
- fees for services are 50% subsidised by the institution and 50% recovered from users for every project - EG: IT Services at the Utrecht University

- basic support is provided for free, if extensive support is needed, long-term/advanced support is charged to users
- data managers for a research project, work part time as part of a competence center. Under this scheme, one or more persons from the research project work physically in the data hub part-time on their project, benefitting from the expertise of the data center staff - EG: University of Maastricht

How are fees calculated?

Fees are calculated in different ways depending on the local institution.

Calculation is never based on the expected value of the service but calculated on real costs and subsidised costs.

How does the transaction work?

Most of the time, transactions are handled within the same institution as users tend to contact their local competence center.

In case of fees applied from other institutions/centers, NWO allows transferring part of the research budget to DM providers.

Issues are encountered for funding services that need to survive after a grant is over, e.g. funding long term storage isn't allowed after the end of a project.



**Infrastructure name**

ELIXIR-UK

Website<https://elixiruknode.org/>

The UK Node of ELIXIR consists of 21 organisations, where all members are universities or research institutes.

In the UK, data management services in the Life Sciences are provided commonly by research institutes or universities, hosting local data management services, infrastructure and managers/stewards. In addition to local provision, national services exist for specific data types and communities, and examples of these are detailed below including provision for health data, and data in the social sciences

As a reflection of the university-centric organisation, where the provision of data management service differs between institutions, ELIXIR-UK coordinates and informs university members about FAIR best practice, training and tools with the aim of creating synergies within the Country.

ELIXIR-UK is deeply involved in the effort of building national Data Management capacity, with particular focus on promoting the adoption of FAIR best practises, spreading the use of already existing registries.

Relevant effort is also placed on the [data steward training program](#)¹¹ aimed at increasing capacity building and professionalisation of data stewardships at universities and research institutes.

Examples of national IT infrastructure, services and support for life sciences are:

- [NHS TREs](#)¹² (National Health Service Trusted Research Environments) enable secure access to approved health and care data by trusted researchers. TREs enable collaboration, data linking and sharing, and researchers gain access to the data they are permitted to see, and all approved data flows are published on the [Data Release Register](#)¹³. Exemplar projects include the [British Heart Foundation Data Service](#)¹⁴ and the [Health Data Research Hub for Cancer](#)¹⁵.
- [CLIMB](#) project, a 5-year initiative to deliver a bioinformatics platform to support academic research groups, government agencies and health services providing cloud-based compute, storage, and analysis tools for microbiologists, together with a wide range of bioinformatics training activities.
- NERC [EDS](#)¹⁶ (Natural Environment Research Council Environmental Data Service) data archive for environmental scientists working in the UK and around the world.

¹¹<https://elixiruknode.org/fair-data-stewardship-training-project/>

¹²<https://digital.nhs.uk/coronavirus/coronavirus-data-services-updates/trusted-research-environment-service-for-england>

¹³<https://digital.nhs.uk/services/data-access-request-service-dars/data-uses-register>

¹⁴<https://www.bmj.com/content/373/bmj.n826>

¹⁵<https://www.data-can.org.uk/health-data/trusted-research-environment/>

¹⁶<https://nerc.ukri.org/research/sites/environmental-data-service-eds/>



- [UK Data Archive](https://www.data-archive.ac.uk/)¹⁷ UK's largest collection of social, economic and population data.

Additionally, an example of national IT infrastructure for general RDM, though not specifically catering for the Life Sciences includes:

- [Jisc](https://www.jisc.ac.uk/)¹⁸, a not-for-profit company that provides archive, network, IT services and digital resources in support of higher education institutions and research.

Data Management services

Website/guidelines	Yes (via ELIXIR-UK webpage, RDMkit, FAIR Cookbook and FAIRsharing)
Consultancy	Yes (locally at Universities and Research Institutes)
IT infrastructure	Yes
Training	Yes

Sustainability of the services

In the current university-centric implementation, the delivery of local data management services is considered to be sustainable in the long term, as it relies on university budgets that tend to be stable and not influenced by the life cycle specific grants. While this is sustainable, it is not easily scalable as different universities have different capacities. This may limit access to some researchers whose institutions cannot accommodate their research. Having noted this, a survey in 2021 led by ELIXIR-UK, and commissioned by major UK funders in the life sciences (bioFAIR) identified an urgent need to build capacity and RDM know-how in UK research institutions and their researchers, through building a national infrastructure. Presently, the national coordination effort provided by ELIXIR-UK is based on specific grants, supporting the effort for a time frame of 5 years ca.

Cost recovery/revenue model

Costs are recovered (partially or fully) at university level from the research teams using data management resources.

To this aim researchers are now commonly including appropriate costs for data management on grant proposals, usually including storage/archiving, HPC costs and FTEs for bioinformatics/data stewardship. For national awards (UKRI) costs are recovered explicitly for specialist platforms (like TRE) from awards, otherwise it's recovered from grant overheads.

How are fees calculated?

Costs for data management are calculated according to the size and type of data. Most costs are calculated based on supporting projects/users, rather than capital.

How does the transaction work?

Where transactions are handled within the institution, broadly, three costing mechanisms can exist and are employed appropriately depending on research institute and funder:

- Storage and/or data stewardship is costed directly for the project (direct costs)
- Costs are indirect, and recovered as a percentage of a named/unnamed applicant on a grant

¹⁷<https://www.data-archive.ac.uk/>

¹⁸<https://www.jisc.ac.uk/>



- The cost of data storage and/or data stewardship is covered by a preexisting award, providing research infrastructure.

As transactions happen within the same institution no taxation or additional overheads are usually charged.



BioData.pt**Infrastructure name**

BioData.pt

Website<https://www.biodata.pt/>

BioData.pt is the Portuguese distributed infrastructure for biological data, hosting the Portuguese node of ELIXIR.

It is a non-profit, private association of 12 research and innovation organisations supporting the national scientific community spreading best practices in data management and state of the art data analysis.

An additional aim of BioData.pt is to provide services to industry and make research outcomes available for innovation, namely in sectors such as agro-food and forestry, sea, and health.

BioData.pt services include training programmes and computing facilities, as well as consulting services in data analysis and management, and several community services reflecting the ELIXIR structure.

Details about provided services can be found at <http://services.biodata.pt/index.html> articulating in:

- Bioinformatics services
- Data management services
- Computing services

Data Management (DM) services delivery is steered and coordinated at national level by BioData.pt with members/partners of local institutions actually providing the services.

The main services include:

- Project data management, including data management planning and data management activities of research projects or project applications, in a package that can include:
 - Data management plan (DMP) draft/consulting
 - Data storage
 - Data curation/annotation
 - Data management plan execution (e.g. data publication after project is complete)
 - Training
- [Data management portal](https://dmportal.biodata.pt/)¹⁹, via a dedicated Dataverse resource
- [Ready for BioData Management](http://ready4biodatamanagement.biodata.pt/)²⁰, a capacity building programme to empower researchers in data management

The IT infrastructure for delivery of data management services and data analysis is mainly provided with the support of the Institute for Systems and Computer Engineering, Research and Development (INESC-ID) (<https://www.inesc-id.pt/>), a private non-profit institute dedicated to Research and Development and Innovation Organization (R&D+I) in the fields of Computer Science and Electrical and Computer Engineering.

¹⁹<https://dmportal.biodata.pt/>

²⁰<http://ready4biodatamanagement.biodata.pt/>



Data Management services

Website/guidelines	Y
Consultancy	Y
IT infrastructure	Y
Training	Y

Sustainability of the services

DM services provision is almost entirely handled by BioData.pt, which relies on funds from competitive funding projects.

Generally costs related to data management are not included in grant proposals (or largely underestimated) strongly limiting the setup of a sustainable cost recovery scheme for services provided by the Node.

As a consequence, the provision of the services, in its current implementation, can not be considered sustainable in the long run. The current funding scheme guarantees services delivery on a 3 years time frame, at the latest.

Cost recovery/revenue model

At present, cost recovery is very limited and applied almost only to DMP drafting/consulting and execution:

- Project data management - support is provided with no charge at the proposal writing stage. If the proposal got funded, part of the grant dedicated to data management is then recovered by BioData.pt
- Dataverse resource - the data management portal currently hosts research data with no charge
- Training - Ready for BioData Management courses are provided as free-of-charge in collaboration with the other research units that are part of the Node

IT resources are provided under [three service categories](#)²¹:

- Standard, free for 1 month, renewable for a maximum of 3 times, providing:
 - 1 vCPU
 - 4 GB RAM
 - 10 GB disk
- Premium and Plus, costs are provided on requests, based on the needed resources, which fall on the following ranges:
 - 10/20 vCPUs
 - 32/64 GB RAM
 - 20 GB disk + optional S3 storage
 - Custom configuration and installation
 - Access to helpdesk

How are fees calculated?

Costs for data management support are based on man power, while IT resources are cost based on equipment depreciation and energy.

²¹http://services.biodata.pt/virtual_machine.html



How does the transaction work?

When a consulting service is paid, fees are transferred directly to the institution that actually provides the service.





Infrastructure nameIFB – Institut Français de Bioinformatique

Website<https://www.france-bioinformatique.fr/en/home/>

The French Node of ELIXIR is hosted at the Institut Français de Bioinformatique (IFB), composed of a coordinating platform (IFB-core), 21 member bioinformatics platforms, 7 contributing platforms and 8 associated teams affiliated to the main French research organisations.

One of IFB/ELIXIR-FR's missions is the provision of tools, expertise, and training to enrich the service bundle to the French bioinformatic community. It ensures the sustainability of the national bioinformatic resources by its involvement in the development of data processing and analysis tools and a long-term storage solution.

[IFB/ELIXIR-FR](#)²² services can be grouped into five categories: databases, tools, training, project support and provision of IT infrastructure. Data management (DM) activities for the life sciences in France are coordinated at the institutional level (e.g. CNRS, INRAE, INSERM and CEA) with a generic approach and at the Node level, with a focus on OMICs and their links with other types of data. Node partners are delivering DM as well as [training](#)²³ in FAIR-data and FAIR-bioinfo activities, encouraging the adoption of DM best practises and open science principles. All these levels of activities are actively collaborating to improve their impact.

In the French Node, demand for guidelines in DM and Data Management Plans (DMP) models is growing rapidly as the focus is becoming very specific, where specialisation is required around various research fields and also different purposes. The Node efforts on addressing this fast-paced demand are shown by the recruitment of several positions on DM, as well as the incorporation of data-brokers in different projects in the areas of health and rare diseases. The landscape for the provision of DM support is diverse, where some partners, like the ones involved in the plant community, have achieved a fairly advanced level of specialisation, whether additional efforts are needed in other fields, where only general guidelines are provided.

Currently IFB/ELIXIR-FR offers a helpdesk that guides and supports users on demands addressed to IFB/ELIXIR-FR, whether it is project support, software development, deployment, or data management.

Bioinformatic IT resources in the country are provided by the [National Network of Computing Resources \(NNCR\)](#)²⁴ of IFB/ELIXIR-FR. The main infrastructure delivers computing and storage and is mostly dedicated to data analysis services and workflows. This IT infrastructure is a core part of the services provided by IFB/ELIXIR-FR, but, with the exception of training, no dedicated resources have been

²²<https://www.france-bioinformatique.fr/en/services/>

²³<https://www.france-bioinformatique.fr/formation/>

²⁴<https://www.france-bioinformatique.fr/en/compute-and-storage/>



implemented for data management so far.

In 2021, IFB/ELIXIR-FR was granted a 16.5 M euros budget by the French government for the [MUDIS4LS](#)²⁵ (Mutualised Digital Spaces for FAIR data in Life and Health Sciences) project. This project paves the 2021-2025 roadmap by federating the 21 member platforms in the life-long orchestration of data fluxes generated by research projects targeting different communities of life and health sciences: marine ecology, health, microbiology, agriculture and environment. It will consolidate and expand the hosting in four national and seven regional centers and finance the purchase of new servers; also planned is the provision of long-term storage.

Importantly, these services will be developed, set-up and provided within a research management environment resting on automated data flows and a data management strategy covering the complete data life-cycle.

Thus, a great contribution from this project is expected in the field of data management; furthermore the project's roadmap also addresses the need for more financially sustainable services.

Data Management services

Website/guidelines	Yes (mainly via DoRANum ²⁶ + datapartage.inrae ²⁷ + RDMkit ²⁸)
Consultancy	No
IT infrastructure	Yes (via NNCR ²⁹)
Training	Yes (Planning ³⁰)

Sustainability of the services

In their current implementation, IFB/ELIXIR-FR services almost totally rely on government funding, and to a minor extent, on EU/EC competitive grants. The national funding roadmap follows a 4-5 year framework and, as national demand for DM services is rapidly growing, there is a high probability that this topic will be considered as a priority in the next round of financing.

One aim of the MUDIS4LS project is to move forward in making the delivery of IFB/ELIXIR-FR services more sustainable, thanks to the implementation of a costs recovery strategy. Moreover, as MUDIS4LS is the foundation for the development of others national infrastructures (e.g. the [EMERGEN](#)³¹ and [ABRomics](#)³² platforms for the surveillance and research in genomics), it is expected that these national

²⁵<https://www.france-bioinformatique.fr/en/news/mudis4ls-the-project-for-shared-digital-spaces-for-life-sciences/>

²⁶<https://doranum.fr/>

²⁷<https://datapartage.inrae.fr/>

²⁸<https://rdmkit.elixir-europe.org/>

²⁹<https://www.france-bioinformatique.fr/en/compute-and-storage/>

³⁰<https://www.france-bioinformatique.fr/en/training/>

³¹<https://www.france-bioinformatique.fr/actualites/consortium-emergen-le-sequencage-pour-la-sante-publique-au-service-du-controle-de-la-pandemie-covid-19/>

³²<https://www.france-bioinformatique.fr/actualites/abromics-une-plateforme-numerique-sur-la-resistance-antimicrobienne-pour-stocker-integrer-analyser-et-partager-des-donnees-multi-omiques/>



platforms will be made sustainable by IFB/ELIXIR-FR supporting research organisms and the French Ministry.

Cost recovery/revenue model

Currently cost recovery mechanisms are set in place locally for the provision of specific services or support and based on *ad hoc* agreements.

It is possible to roughly estimate that less than 1% of total costs are recovered from users.

Contributions may be requested for participating at training events, but fees tend to be largely subsidised. Training is usually organised locally at universities and research institutions, in collaboration with IFB/ELIXIR-FR and fees are typically collected by the organising institution, in order to recover some of the costs.

As said, the MUDIS4LS roadmap includes a cost recovery chapter; its aim is to bring cost recovery from the current 1% to 20% over the next few years.





Infrastructure name

ELIXIR-LU

Website<https://elixir-luxembourg.org/>

ELIXIR-LU is the Luxembourg Node of ELIXIR, aiming at facilitating long-term access to research data and tools for scientists in both academia and industry, allowing data reuse in the life sciences.

ELIXIR-LU is hosted at the University of Luxemburg and mainly made by members of the same institution, with no distributed infrastructure.

On data management, the Node currently focuses on coordinating the definition and implementation of national guidelines in data protection and technical solutions.

Partnerships within the Node, allow the delivery of the following data management services:

- providing data sustainability solutions (hosting) to support data reuse by the community,
- providing expertise on data protection aspects of DMPs and DPIAs - partnership with University of Luxembourg's DPOs,
- maintaining the data management related IT infrastructure - partnerships with the Luxembourg Centre for Systems Biomedicine's (LCSB) Bioinformatics Core R3 Group,
- providing support in preparation of data hosting agreements - partnership with the LCSB Legal Support Office,

The data management services provision mainly revolve around the following 4 resources:

- Local iteration of [DMPonline](#)³³
- The [Innovative Medicines Initiative Data Catalog](#)³⁴, a collection of project-level metadata from large research initiatives in a diverse range of fields
- [Data Information System \(DAISY\)](#)³⁵, a data bookkeeping application designed to help biomedical research institutions with their GDPR compliance.
- The [FAIR Cookbook](#)³⁶ (jointly with ELIXIR-UK), an online resource for the Life Sciences with recipes that help researchers to make and keep data Findable, Accessible, Interoperable and Reusable (FAIR)

Bioinformatics and data support services are also provided, but to a minor extent.

Data Management services

³³<https://dmponline.elixir-luxembourg.org>

³⁴<https://datacatalog.elixir-luxembourg.org>

³⁵<https://daisy-demo.elixir-luxembourg.org>

³⁶<https://fairplus.github.io/the-fair-cookbook/content/home.html>



Website/guidelines	Yes
Consultancy	Yes (provided on a best effort base)
IT infrastructure	Yes
Training	Yes

Sustainability of the services

Currently ELIXIR-LU is supported via structured funds from the Ministry of Higher Education and Research (MESR), renewed every 4 years with a long term commitment. Structured funds are vehiculated from the ministry as part of funds dedicated to the university and this guarantees a stable funding perspective for the future.

A relevant in kind contribution is provided by the University of Luxembourg/ELIXIR-LU members.

Cost recovery/revenue model

As ELIXIR-LU is already funded by the government, data management services are provided with no charge to users for most of the cases.

Storage is provided for free for small datasets and consulting is provided with no charge for short consultations.

Mandatory condition for providing any kind of data management service is that data has to be accessible to the community. Data needs to be curated by the data provider and must be validated by the Node data quality control team before data is stored by the Node service platforms.

Under limited conditions, users could be requested to provide a financial contribution (e.g. dataset with large volume).

Storage for big datasets is evaluated case by case: if the datasets would have a relevant value for the community, storage is still provided for free, otherways some costs are charged to users.

Regardless of whether the data providers are charged or not, datasets have always to be made accessible by the community (open or controlled access).

Consultancy and data management support for big projects is usually provided after including ELIXIR-LU within the beneficiaries at the time of grant proposal writing and with FTEs are allocated accordingly.

In case of services provided to private companies, these are provided on the basis of service agreements.

How are fees calculated?

For service under service agreements, consulting and data management is charged based on the personnel cost of the people involved in the delivery of the service.

Storage (when not fitting to the free service scenario) is charged on the base of prices paid by the university to storage vendors.

How does the transaction work?

For big projects, ELIXIR-LU requests to be included as a partner in the action, and FTEs requests are calculated case by case, based on the kind of requested efforts.



For industry or other national non-public users /customers, a service agreement or a joint project funded by the customer has to be signed in advance of the provision of any kind of services.

