SUMMARY

of the doctoral thesis entitled:

RESEARCH ON THE IMPLEMENTATION OF A DISTRIBUTED PAN-EUROPEAN RESEARCH INFRASTRUCTURE

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The PhD thesis contains a thorough presentation of the process for creating an a pan-European distributed research infrastructure sustained by the European Strategy Forum on Research Infrastructures (DRI ESFRI) that involves following multiple subsequent phases from idea/concept/design to implementation and operation, mandatory steps so that the research infrastructure to be approved, sustained and promoted by ESFRI throughout this long period spanning at least 10 years.

The **overarching objective** of the document is to prepare a business model and a financial model for building a DRI ESFRI.

To fulfil this objectif, the following **specific objectives (OS)** were established:

SO1 – Preparing the business model

SO2 – Preparing the cost estimate model for th Central Hub and National Nodes

SO3 – Preparing the cost book

SO4 – Creating the financial plan for the Central Hub

SO5 – Carrying out the cost-benefit analysis

SO6 – Identifing financing sources and ensuring the financial sustainability of the research infrastructure in the long run

SO7 – Analysing the main risks at both Central Hub and National Nodes levels and indicating the key success factors

Degree of novelty of the research thesis

The concept of a DRI ESFRI appeared in 2002 when EFSRI was set up as an organisation dedicated to the development of these large-scale RIs that require investments of tens, hundreds or even billions of euros. As these involve substantial funds, ESFRI has decided that starting from 2016, it will require a comprehensive analysis of the costs of RIs throughout their whole lifecycle, grouped by:

- capital value;
- design costs;
- preparation costs;
- construction/implementation costs;
- operation costs and
- decommissioning/termination costs.

These cost values are indicative, and often generally estimated, proving to be inaccurate, not only because they are understood differently by RIs, but also, due to a lack of knowledge in financial modeling. For this reason, ESFRI supports the need for a sound financial management based on obtaining reliable data. ESFRI also emphasizes the development of a rigorously prepared business model, financial plan and cost book with a high level of confidence.

As such, I prepared the cost analysis, developed the financial and business plan to demonstrate the DRI ESFRI financial sustainability. In addition, I also performed the cost-benefit analysis for this research infrastructure. All these documents are based on a thorough analysis of the entire infrastructure starting from the context, structure, equipment and human resources involved by each institute, types of services to be provided, target group, benefits, etc. Considering the large number of members and all that such complex project entails, it is appropriate to establish a logical reasoning which leads to the achievement of these reliable results, essential to the European Commission and other decision-makers in terms of setting up and financing DRIs.

The research led to the realisation of a concrete, realistic and well-substantiated plan, which would justify the necessary financing and the efficiency of the investment.

Part I – Bibliographic Study of the doctoral thesis contains the scientific documentation, in which the typology of DRI ESFRI and the role they have at the European level are described, highlighting the importance and the significant impact they aim for the whole society.

Chapter I - ***Definition and role of research infrastructures at European level*** explains the strategic role that ESFRI has in building these research infrastructures and the Roadmaps that are drawn up and revised periodically, both ESFRI and the nationale ones. A map of the countries that have adopted this Roadmap has been prepared to highlight the large number of countries that have embraced ESFRI's mission and their recognition by national governments, as well as the efforts made by these governments to support them politically and economically. Also, the chapter includes the typology of ESFRI research infrastructures and their lifecycle starting from the idea/concept until the moment they are finally operational.

Chapter II - ***Context and necessity of setting-up a distributed research infrastructure*** describes the European context, how the EU research policy was created and developed, drawing attention to the need of building up such research infrastructures and the problems they face along their lifecycle, the great challenge being of ensuring long-term sustainability.

Consequently, this part underlines the strategic role of RIs in tackling the current and next challenges of global society, as well as the particular importance that research and innovation activity has, especially in the six key areas of the 21st century (S&A, ENV, EN, SFI, ISC and DIGIT) which are the main concerns of the European Commission and Member State governments attention and beyond.

Part II - *Own research* focuses on the business model of a DRI ESFRI based on the case study of a similar RI in which Romania is involved and which has reached the maturity level expected by ESFRI so that its partners can move to the next stage, namely, submitting the application for its establishment, in the form of a legal entity regulated by ESFRI and entitled the European Research Infrastructure Consortium (ERIC).

The study contains the descriptive part and the financial part of the RI business plan.

Chapter III - *Structure, objectives and relevance of a distributed pan-European research infrastructure in the domain Health and Food* has seven sub-chapters and briefly presents the history of the DRI ESFRI, its structure and importance in the landscape of European research infrastructures, strategic objectives, phases it has gone through and the main concerns it tackles given the European and international framework. Also, the paper entails the grounds for developing the RI, countries involved, architecture, activities and services to be provided, scientific relevance, mission and objectives, lifecycle phases and impact on the economy and society.

Chapter IV - ***Financial Modeling of a pan-European Distributed Research Infrastructure in the domain Health and Food*** is divided into seven sub-chapters which tackles extensively how to make a business plan with an emphasis on the financial side of a DRI ESFRI. This is an example of good practice for organizations that want to develop such a research infrastructure and must demonstrate that they have reached the level of financial maturity that ESFRI requires. Each sub-chapter contains the research methodology for developing a DRI ESFRI, as follows:

- Establishing the research methodology for both internal and external assessment of DRI ESFRI
- Establishing the research methodology for developing the business model
- Establishing research methodology for cost estimation and analysis
- Establishing the research methodology for revenue estimate and analysis
- Establishing the research methodology for drawing up the financial plan
- Establishing the research methodology for cost-benefit analysis (CBA).

Subchapters 4.2 – *Assessment of Political, Economic, Social, Technological, Legal and Environmental items*, **4.3 - *Assessment of Advantages, Drawbacks, Opportunities and Obstacles*** **and 4.4** - ***Stakeholder Assessment***, analyse the factors at the macro-economic level that can influence the DRI ESFRI's implementation and operation, highlight the DRI ESFRI's strengths and the opportunities it can exploit, indicate some weak points and the external threats against which it needs to take some action. DRI ESFRI's users are also divided and analysed according to their level of

interest and the power they can have over the activities carried out by the DRI ESFRI, which led to a better definition of DRI ESFRI's services and access modes. Therefore, these sub-chapters contain the assessment of both external and internal items and of the stakeholders interested in the research infrastructure to better understand the context at the macro-economic level, what are its strengths and how it can develop in the future, how it should position itself against key actors, but also to indicate the risks that may occur and find the most appropriate measures to ensure its long-term sustainability.

Subchapter 4.5 - ***Business Model Canvas*** presents the business model, followed by the description of each of the 9 blocks that compose it: key partners (subchapter 4.5.2), key resources (subchapter 4.5.3), key activities (subchapter 4.5.4), core services or value proposition (subchapter 4.5.5), key users (subchapter 4.5.6), key relationships (subchapter 4.5.7), channels (subchapter 4.5.8), cost structure (subchapter 4.5.9) and the financial plan or revenue streams (subchapter 4.5.10).

The business model is the fundamental tool in any decision-making process. It contains a comprehensive plan on how the DRI ESFRI will achieve its strategic objectives by outlining the strategy, governance, services to be provided, research landscape, mode of operation and the most appropriate source of funding that will ensure successful construction and operation of this large and complex DRI ESFRI.

The business model presents the creation and sustainability of a DRI ESFRI on the long term and highlights the main milestones in terms of infrastructure, activities, operation and funding for the smooth DRI ESFRI's implementation and management.

The business model is built and developed starting from the society needs and expectations in the domain Health and Food, using a DRI ESFRI as a case study. The distributed research infrastructure will include 38 prominent research institutes from 13 countries.

It will be organized under the ERIC model which entails a Central Hub as a single legal entity located in the Host Country and several National Nodes at country level.

Subchapters 4.5.2 – *Key Partners*, 4.5.3 – *Key Resources* and 4.5.4 – *Key Activities* describe the stakeholders involved in the RI, the activities that the RI will carry out and the resources for carrying out the activities.

Subchapter 4.5.5 – *Core services* illustrates the services that the DRI ESFRI will provide to the market for different categories of users.

Subchapters 4.5.6 – *Key Users*, 4.5.7 – *Key Relationships* and 4.5.8 – *Channels* conveys the users to whom the proposed services are addressed.

Subchapters 4.5.9 – *Cost structure* presents the cost estimation model in a rigorous way, taking into account the DRI ESFRI's governance, services provided, financing opportunities, etc.

The cost book includes a breakdown of the main cost items such as personnel costs, new investments, upgrades, training, maintenance, consumables, travel, overheads and others required to perform R&D activities. The register contains an

estimate of the costs per each partner institute, at the level of Central Hub and National Nodes. It indicates the estimated costs for setting up and exploring the ERIC and the entire DRI, offering a comprehensive overview of the partners' endowments in line with their contribution to DRI ESFRI. Costs have been estimated and presented for all phases of the DRI ESFRI's lifecycle.

Finally, the estimated total cost for the reference period of 25 years is provided to provide an indicative value, summing up all the costs involved in such a complex research infrastructure.

The cost book presents the financial data and information collected from all the partners involved, the calculations for estimating the costs being carried out for the establishment and exploitation of the ERIC, as well as for the other partners as support units, being those in charge of carrying out the research and development activities. Accordingly, the cost book took into account all partners, as it is the intention of each partner to join ERIC at some point.

Sub-chapter 4.5.10 – *Financial Plan* conveys the definition and estimation of revenues for the ERIC's construction and operation of as an independent legal entity, while the National Nodes will be solely responsible for securing sufficient funds to cover their own expenses regardless of funding sources. Therefore, the financial plan illustrates the financial projections for the ERIC only with the financial contribution of the NNs as cash inflows and its start-up and operating costs as cash flows.

The financial plan demonstrates the long-term viability of the research infrastructure. It involves making financial forecasts, estimating the annual revenues generated by the ERIC to cover all costs incurred by the DRI ESFRI and the appropriate sources of funding required to be secured for the sustainability of the future ERIC on a lasting basis. It provides a financial projection of both annual cash inflows and outflows based on reasonable assumptions. Cash outflows are based on the cost book and have been correlated with NNs' financial commitments.

The financial plan is an essential part of the business model, as it provides a clearer long-term picture of the ERIC's financial performance, which will help partners make the right decisions about the allocation of funds to support planned investments, overcome possible financial deficiencies or take corrective action and adjust the plan appropriately so that the preestablished goals and objectives are met.

The cash flow projection for ERIC explains how it will perform financially, the revenue category and the wide range of costs related to its status and strategic role. 4 scenarios were examined considering the probability of certain NNs joining the ERIC and in the end, the financial forecast was drawn up to prove its financial sustainability.

The financial plan illustrates a positive cash flow secured over a 5-year period, in line with the NNs' financial commitment.

Subchapter 4.6 – *Cost-benefit analysis* emphasizes the calculation of the financial ratios and the need of securing the finances to support such a DRI ESFRI throughout the analysed period, i.e., from the design phase to the termination phase.

Subchapter 4.7 - *Economic analysis* describes the main economic benefits that could be quantified based on a certain approach so as to demonstrate the added value that DRI ESFRI will have on the whole society.

Subchapter 4.8 - *Sensitivity analysis* presents the impact that variations in critical parameters can have on financial and economic ratios.

Subchapter 4.9 - *Risk analysis* provides information related to the main risks identified for both Central Hub and National Nodes, along with their assessment in terms of the likelihood that an event could materialise and have negative consequences, as well as strategies for their reduction/elimination. Similar to the analysis of costs and revenues, risks were identified and analysed separately, being grouped into risks specific to the Central Hub and risks specific to National Nodes.

Subchapter 4.10 – *Key success factors* outlines the major aspects that will ensure the DRI ESFRI's long-term success.

Conclusion: The PhD thesis provides a detailed plan for the creation of a DRI ESFRI, providing all the necessary data and information to partners, decision makers and any other interested party. It answers the 5 main questions: ***who*** will administer the new DRI ESFRI, ***what*** are the mission, objectives and activities that the DRI ESFRI will carry out, ***where*** the DRI ESFRI will be located, ***when*** the DRI ESFRI will be constructed and ***how*** it will be created. Consequently, the development of an DRI ESFRI is a long-term, complex process, given its structure and size, which involves substantial financial and economic resources.