esteem3

Enabling Science through European Electron Microscopy

Innovation strategy white paper

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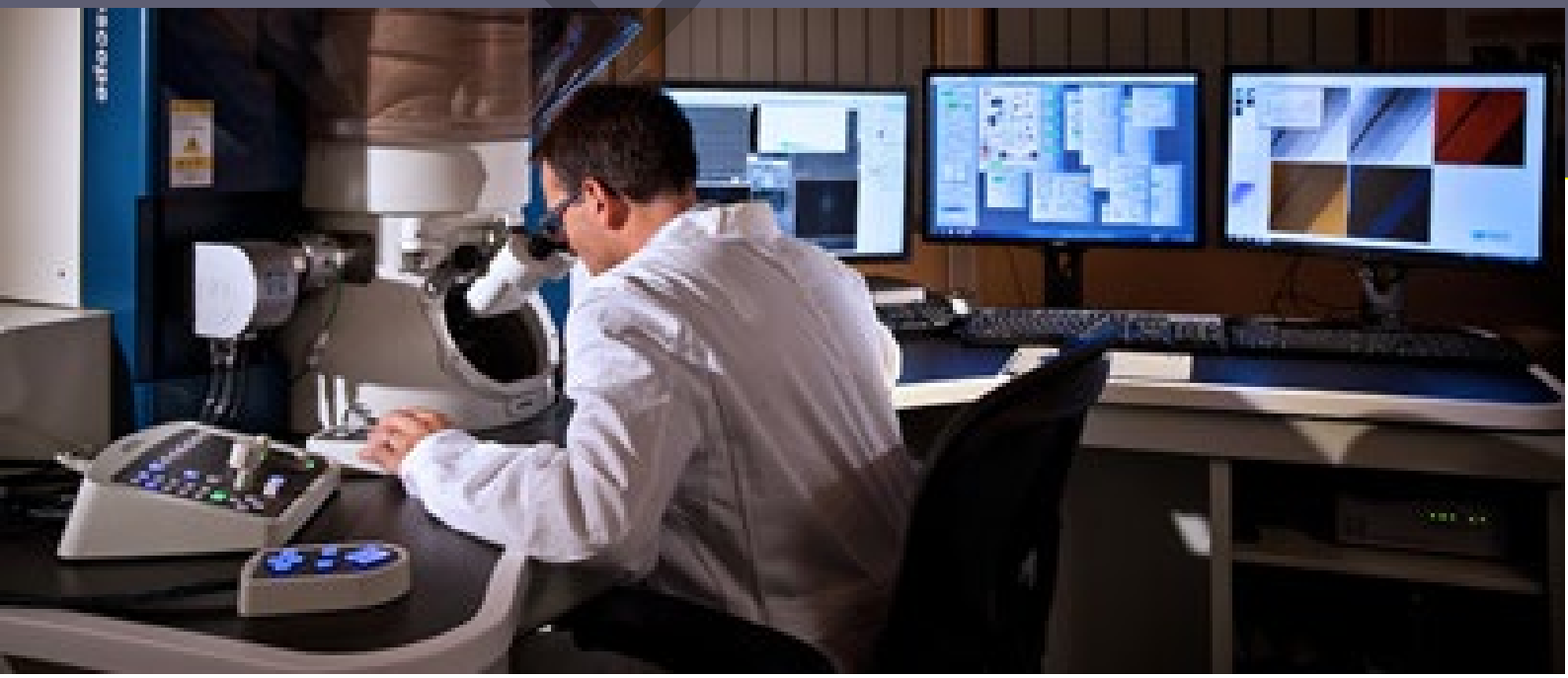

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Executive Summary

Innovation is crucial for research to progress and remain relevant to scientific, commercial and societal progress. An effective innovation strategy is therefore a key factor in the success of any research activity. This document summarises the various components of an innovation strategy in research and highlights their significance. In addition, increasingly important issues related to the sustainability of research infrastructures are highlighted.

Core Components of an Innovation Strategy for Research

There are a number of common core components relevant to all research infrastructures including those for EM.

Definition.

The first step in developing an innovation strategy is to identify and define the problem that needs to be addressed. This requires a thorough understanding of the research question and the context in which it arises.

Engagement.

Engagement is a critical component of the innovation process, which involves generating a wide range of ideas with contributions from all stakeholders. This can be done through various means such including workshops online platforms and surveys.

Evaluation.

From an initial list of ideas, it is essential to evaluate these based on appropriate criteria such as feasibility, cost-effectiveness, and impact. This involves a careful analysis of each idea to determine its potential for success and a ranking of plausible solutions.

Prototyping.

For ideas identified in the evaluation phase the next step may be to create a prototype or other suitable demonstrator. This allows testing of the feasibility of the idea in a controlled environment and the option to make adjustments as needed.

Testing and Iteration

Once a prototype has been developed, it needs to be tested in the real world to determine its effectiveness. This involves conducting experiments, gathering feedback, and making adjustments as needed.

Significance of an Innovation Strategy in Research:

An effective innovation strategy can have a significant impact on the success of a research project, particularly those which span long timeframes and involve significant investment / multiple parties. It can aid the identification of new and innovative solutions to complex problems, enhance collaboration, and improve the efficiency and effectiveness of the research process. Moreover, an innovation

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strategy can help to maintain competitiveness in a rapidly evolving research, commercial and societal landscape.

ESTEEM3 Innovation Strategy Workshop

ESTEEM3 organised an online workshop entitled “Innovation Strategy” on Wednesday 18th January 2023 (https://www.esteem3.eu/newsarchive?backRef=87&news=Innovation_Strategy_Workshop).

The workshop was attended by 85 participants from different European countries including representatives from academic, industry and funders /policy makers.

The following topics were covered during the workshop:

- Electron microscopy (big and small) data analysis with the Open-Source software & Open-Source community"
- How companies become engaged with Research Infrastructures
- SME Involvement/Challenge and Key Aspects for advanced technology Procurement

At the conclusion of the workshop, a number of broad recommendations / areas for further work in the area of research innovation and infrastructures were proposed:

1. Continued Improvement of Instrumentation
2. Data Analysis and Interpretation
3. Multi-Disciplinary Collaboration
4. Standardization of TEM Procedures
5. Education and Training.

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Sustainability

A sustainable research infrastructure is critical for advancing scientific knowledge and promoting innovation. It is, however, important to develop a research infrastructure that is efficient and effective but also sustainable, economically viable and environmentally friendly. The infrastructure must also be designed to support the evolving requirements of researchers. To achieve this, various models have been proposed to ensure that the research infrastructures demonstrate long term sustainability. In Europe, there has been an increasing interest in developing sustainable research infrastructures that can support a broad range of research activities.

The Importance of Sustainable Research Infrastructures

Sustainable research infrastructures are essential for conducting research that can address the most pressing societal challenges, including climate change, energy transition, health, and digital transformation, all of which are pillars of Horizon Europe. A sustainable research infrastructure is characterised by an ability to meet current and future research needs, while accounting for the

economic, social, and environmental impacts of its operation. It must be efficient, effective, and affordable, and it must be designed to minimize negative impacts on the environment, such as energy consumption, waste generation, and pollution.

Sustainable research infrastructures also play a crucial role in promoting innovation and developing collaborations between researchers, universities, research organizations, and industry. They provide an environment that enables researchers to access state-of-the-art equipment, advanced technologies, and expertise from different disciplines, enhancing their research capabilities and initiating new research opportunities.

Developing Sustainable Research Infrastructures:

Developing a sustainable research infrastructure requires a holistic approach that considers the entire lifecycle of the infrastructure, from planning and design to operation and maintenance. Accordingly, the development of a sustainable research infrastructure requires the integration of various factors, including energy efficiency, waste reduction, carbon neutrality, and social responsibility.

One of the key principles of any model for a sustainable research infrastructure is to minimize the environmental footprint of the infrastructure while maximising scientific output. This can be achieved by adopting green building practices, including, but not limited to the use of renewable energy sources, designing buildings to be energy-efficient, and implementing sustainable waste management practices. Sustainable research infrastructures also require the integration of sustainable procurement, which involve the selection of equipment and materials that are environmentally friendly and socially responsible.

A second important aspect of developing a sustainable research infrastructure is the involvement of stakeholders. Stakeholders can include researchers, universities, research organisations, industry, and the wider community. Stakeholder engagement at all stages in the development cycle is crucial in ensuring that a sustainable research infrastructure is designed and operated to meet the needs of all stakeholders, while also promoting sustainability and innovation.

Maintaining Sustainable Research Infrastructures:

Maintaining a sustainable research infrastructure requires ongoing efforts to monitor and optimise their performance. This can involve the implementation of energy management systems, waste reduction strategies, and regular scheduled maintenance and upgrades of equipment and facilities.

One of the key challenges of maintaining a sustainable research infrastructure is ensuring that they remain economically viable over the long term. This can be achieved by developing a sustainable funding model that considers the costs of operation and maintenance, as well as the long-term economic, social, and environmental benefits of the infrastructure. In practice this requires long term core funding which is not stochastic in nature and which is critically reviewed against a business plan.

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Models for Sustainable Research Infrastructures

The Green Research Infrastructure Model

The Green Research Infrastructure Model emphasises the use of renewable energy sources and sustainable building practices. This aims to reduce the environmental impact of a research infrastructure by promoting energy efficiency, waste reduction, and the use of sustainable materials. The model also encourages the use of public transportation, carpooling, and other sustainable transportation options to service the infrastructure.

The Socially Responsible Research Infrastructure Model

The Socially Responsible Research Infrastructure Model emphasises the importance of ethical and related social considerations in the development and maintenance of a research infrastructure. This model recognises that a research infrastructure can have a significant impact on local communities and the environment, particularly when the research infrastructure operates at large scale. Therefore, the model focuses on ensuring that the development and operation of a research infrastructures is carried out in a socially responsible manner with full community engagement at all stages in its development and operation.

The Circular Research Infrastructure Model

The Circular Research Infrastructure Model emphasises the importance of the circular economy in the development and operation of a research infrastructure. An important component of this model aims is waste reduction and maximal use of resources by promoting the reuse and recycling of materials. The model also encourages the use of renewable energy sources and sustainable building practices.

The Open Research Infrastructure Model

The Open Research Infrastructure Model is driven by the importance of open access to the research infrastructure at all levels whilst maintain commercial confidentiality as appropriate. This model recognises that access to a research infrastructure is essential for the advancement of science and technology and is often owned by the stakeholders. Therefore, the model promotes the sharing of the outputs from the research infrastructure and encourages the development of open-source data and analytics.

Conclusions

Innovation is essential for the success of research, and an effective innovation strategy can help researchers identify new and innovative solutions to complex problems. The components of an innovation strategy in research, including problem definition, engagement, evaluation, prototyping, testing, and iteration, are all critical to the success of any research program, particularly those that operate at scale.

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Sustainable research infrastructures are critical for the advancement of science and technology and should address the most pressing societal challenges. To ensure that the infrastructures have long term sustainability, various models are summarised. These models emphasise the importance of renewable energy sources, sustainable building practices, ethical considerations, the circular economy, and open access. Adopting these models, leads to research infrastructures are sustainable and contribute to the advancement of science and technology in a socially responsible manner. By developing and maintaining sustainable research infrastructures, Europe can continue to be at the forefront of scientific research and innovation while also promoting sustainable development.

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