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D1.2 Updated demand analysis

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Executive summary

This deliverable presents the updated demand analysis developed within WP1 of the DIGITAfrica project. Building upon the baseline assessment reported in Deliverable D1.1, it consolidates the outcomes of the second phase of stakeholder consultations, updates the analysis of digital research infrastructure capacities, examines opportunities for leveraging existing European Research Infrastructures, and identifies a first set of flagship services and pilot deployment scenarios for a future Pan-African Research Infrastructure (RI) for Digital Sciences.

A central component of this deliverable is the reporting of the Second DIGITAfrica Consultation Workshop organised in Tunis in April 2026. The workshop brought together researchers, policymakers, infrastructure providers, industry representatives, innovation actors, and international organisations from Africa and Europe to validate the DIGITAfrica vision and discuss implementation pathways for a future federated infrastructure. The discussions confirmed broad support for the development of a distributed and collaborative research infrastructure capable of supporting experimentation, data-intensive research, artificial intelligence, capacity building, and innovation. Stakeholders consistently emphasised the importance of data sovereignty, human capacity development, sustainable governance models, and progressive deployment approaches capable of accommodating different levels of infrastructure maturity across participating countries.

The deliverable also analyses the capabilities of the two European Research Infrastructures contributing to DIGITAfrica: SLICES-RI and SoBigData RI. The assessment identifies several mature services and components that can be reused or adapted within the African context, including federated authentication and authorisation systems, metadata and data management services, virtual research environments, experiment orchestration platforms, cloud and high-performance computing services, advanced analytics tools, and digital training platforms. The analysis demonstrates how existing European experience can accelerate the development of a future African infrastructure while reducing implementation risks and promoting interoperability with international research ecosystems.

Building upon the needs identified through the consultation process and the opportunities offered by reusable infrastructure components, the deliverable proposes four flagship service families addressing priority scientific and societal challenges that are relevant for the African context. These include an AI and Data Innovation Platform, a Smart Agriculture and Environmental Intelligence Platform, a Digital Health and Telemedicine Platform, and a Digital Education and Capacity Building Platform.

Overall, the findings reinforce the conclusion that a federated and distributed infrastructure model represents the most appropriate approach for supporting digital science research across Africa. No single institution or country possesses all the capabilities required to address the growing demands of artificial intelligence, data-intensive science, advanced networking, and digital experimentation. By enabling the sharing of resources, services,



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expertise, and best practices across institutional and national boundaries, DIGITAfrica can contribute to the emergence of a sustainable Pan-African ecosystem for Digital Sciences.

The results presented in this deliverable provide a foundation for the next phases of the project. They will guide the refinement of technical blueprints, the implementation of pilot deployments, and the continued engagement of stakeholder communities through the DIGITAfrica Stakeholder Forum.

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Abbreviations

Abbreviation	Definition
IoT	Internet of Things
AI	Artificial Intelligence
NREN	National Research and Education Networks
RI	Research Infrastructure
AU	African Union
FAIR	Findable, Accessible, Interoperable, Reusable
ERIC	European Research Infrastructure Consortium
EOSC	European Open Science Cloud
HPC	High-Performance Computing
ML	Machine Learning

1 Introduction

1.1 Objective of the deliverable

The objective of this deliverable is to provide an updated demand analysis for the future Pan-African RI for Digital Sciences envisioned by the DIGITAfrica project. Building upon the baseline assessment presented in Deliverable D1.1 **Erreur ! Source du renvoi introuvable.**, this document consolidates the results of the second phase of the demand analysis activities conducted within Work Package 1.

The deliverable has three main objectives. First, it updates the understanding of the African digital research infrastructure landscape by incorporating new information collected during the second year of the project and extending the analysis to additional initiatives and infrastructures beyond the countries initially investigated in Deliverable D1.1 (namely Tunisia, Kenya, South Africa, Senegal and Cameroon). Second, it reports on the outcomes of the second consultation workshop organised in Tunis, which represented the final stakeholder consultation activity foreseen within WP1 and provided important feedback on the DIGITAfrica vision, implementation approach, governance considerations, and technical blueprints. Third, it identifies opportunities for leveraging existing European Research Infrastructures, in particular SLICES-RI and SoBigData RI, and translates the needs expressed by stakeholders into a set of flagship services and pilot deployment scenarios that can guide the subsequent phases of the project.

1.2 Scope and Methodology

The work presented in this deliverable follows the iterative methodology adopted throughout WP 1. The methodology spans the four WP1 tasks and progressively refines the understanding of infrastructure needs and opportunities:

- **Task 1.1** established the overall methodological framework and consultation strategy; engaged stakeholders through consultation activities and workshops
- **Task 1.2** analysed the existing capacities of digital research infrastructures within the participating countries and identified key strengths, gaps, and development priorities.
- **Task 1.3** analysed the existing research communities in digital research sciences within the participating countries and identified key research areas and collaboration opportunities.
- **Task 1.4** translated the identified needs into candidate flagship services, deployment scenarios, and pilot concepts capable of demonstrating the value and relevance of a future Pan-African RI for Digital Sciences.

The present deliverable therefore represents the final outcome of the WP1 demand analysis process and provides key inputs for the technical, organisational, and sustainability activities that will be carried out during the remainder of the project.

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1.3 Evolution from D1.1 to D1.2

Deliverable D1.1 provided the initial demand analysis for DIGITAfrica by documenting the state of digital research infrastructures across the five African partner countries and reporting the outcomes of the first consultation workshop held in Cape Town in April 2025. The analysis highlighted the fragmented nature of the existing infrastructure landscape, identified major capacity gaps, and collected initial requirements from research and innovation communities.

The present deliverable extends and refines this work in several important ways. First, the landscape analysis has been updated to include new developments and emerging initiatives identified during the second year of the project. Particular attention has been given to recent investments in digital research infrastructures, high-performance computing facilities, AI ecosystems, innovation hubs, and National Research and Education Networks, providing a broader perspective on the evolving African digital research infrastructure landscape.

Second, the deliverable reports on the outcomes of the Second DIGITAfrica Consultation Workshop organised in Tunis in April 2026. While the first workshop focused primarily on identifying needs and challenges, the second workshop concentrated on implementation approaches, governance and sustainability aspects, infrastructure blueprints, proof-of-concepts, and capacity-building priorities. As a result, the consultation process evolved from exploratory discussions towards the validation of concrete infrastructure concepts and deployment models.

Third, D1.2 introduces a detailed analysis of the capabilities offered by the European Research Infrastructures SLICES-RI and SoBigData RI and identifies a set of reusable services and components that can be adapted to the African context. This analysis represents an important step towards transforming stakeholder requirements into practical implementation solutions.

Finally, the deliverable concludes the demand analysis process by identifying a set of flagship services and pilot deployment scenarios that address the priorities repeatedly highlighted during the consultations. These flagship services provide a bridge between the infrastructure capabilities under development within DIGITAfrica and the scientific, societal, and innovation challenges faced by African communities.

1.4 Document structure

The remainder of this deliverable is organised as follows.

- Section 2 presents an updated overview of the landscape of digital research infrastructures and research communities, highlighting recent developments and emerging initiatives relevant to the DIGITAfrica vision.
- Section 3 reports on the consultation activities conducted during the second phase of the project and provides a detailed account of the Second DIGITAfrica Consultation Workshop organised in Tunis. The section also summarises the main

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findings emerging from stakeholder discussions and their implications for the future infrastructure.

- Section 4 analyses the experience and capabilities of the European Research Infrastructures SLICES-RI and SoBigData RI. It describes the most relevant services and technical components that can be reused or adapted within DIGITAfrica and discusses the adaptations required to address African requirements and deployment conditions.
- Section 5 presents the flagship services and pilot deployment scenarios identified through the demand analysis process. These services illustrate how the future DIGITAfrica infrastructure can address priority scientific and societal challenges while supporting research, innovation, experimentation, and capacity building.
- Finally, Section 6 summarises the main conclusions of the deliverable and outlines the implications of the findings for the subsequent phases of the DIGITAfrica project.

2 Updated Landscape of RI Capacities and Communities

2.1 Updated mapping of research infrastructures

Building upon the baseline assessment presented in Deliverable D1.1 **Erreur ! Source du renvoi introuvable.**, the second year of DIGITAfrica provided an opportunity to further investigate emerging digital research infrastructures and strategic initiatives beyond the countries initially analysed. While the findings of D1.1 highlighted a fragmented but rapidly evolving landscape of digital research infrastructures across the partner countries, several developments observed during the consultation activities and desk analysis confirm a growing momentum towards the establishment of more advanced and interconnected digital research ecosystems across Africa.

A notable trend concerns the evolving role of National Research and Education Networks (NRENs). Traditionally focused on providing connectivity services to universities and research institutions, several African NRENs are progressively extending their portfolios to include advanced digital services such as cloud computing, data management, and high-performance computing. This evolution reflects a broader recognition that connectivity alone is insufficient to support modern digital science and that NRENs can play a strategic role as operators of shared research infrastructure services.

Kenya provides a representative example of this evolution. In addition to the services already identified in D1.1, the Kenya Education Network Trust (KENET) has recently expanded its infrastructure portfolio through the deployment of the CHUI High-Performance Computing platform¹. The infrastructure provides GPU-enabled computing resources designed to support artificial intelligence, machine learning, data analytics, scientific simulations, and other computationally intensive research activities. The platform complements the KENET Virtual Laboratory and Open Access Data Repository services, creating a more comprehensive digital research environment for Kenyan universities and research institutions. The initiative demonstrates how NRENs can become key enablers of advanced digital science capabilities at the national level. For **Senegal**, The National Cyberinfrastructure for Higher Education, Research and Innovation (CINERI, <https://cineri.sn/>) serves as the national digital backbone for research and education, providing shared infrastructure, inter-institutional connectivity, secure data management services, and access to the national high-performance computing resources (TAOUEY supercomputer). CINERI supports data-intensive research, innovation, and collaboration across academic, governmental, and private-sector stakeholders.

Beyond the DIGITAfrica partner countries, additional examples of emerging digital research infrastructure ecosystems can be observed. In **Ghana**, the Ghana Academic and Research Network (GARNET) continues to strengthen the national research and education ecosystem

¹ <https://hpc.kenet.or.ke/public/index.html>

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through the provision of dedicated connectivity services and integration within the West and Central African Research and Education Network (WACREN). Through this regional framework, Ghanaian institutions gain access to international research networks and collaborative digital services while contributing to the development of a more integrated West African research infrastructure landscape.

Benin represents another interesting case through the Sèmè City initiative², which combines higher education, research, innovation, entrepreneurship, and technology transfer within an integrated innovation ecosystem. Although not a research infrastructure in the traditional sense, Sèmè City demonstrates how digital research capabilities can be embedded within broader innovation and skills-development strategies. The initiative supports experimentation, startup incubation, digital training, and collaboration between academia and industry, providing a model for linking research infrastructures with innovation-driven economic development.

Similarly, **Rwanda** continues to position itself as a regional digital innovation hub through investments in digital public infrastructure, cloud services, innovation ecosystems, and policy frameworks supporting digital transformation. Supported by initiatives such as the Smart Africa Alliance³, the country has established favourable conditions for future research infrastructure development while promoting regional cooperation in digital technologies and innovation.

Another significant development observed since the publication of D1.1 concerns the rapid *growth of artificial intelligence and data-oriented infrastructures across Africa*. Several countries have launched national AI strategies, established AI innovation hubs, and initiated programmes aimed at strengthening local capacities in data science, machine learning, and responsible artificial intelligence⁴. This trend reflects an increasing recognition of AI as a strategic technology for economic development, scientific research, and public service innovation. At the continental level, the adoption of the African Union Continental Artificial Intelligence Strategy **Erreur ! Source du renvoi introuvable**. further reinforces this trajectory by promoting investment in computing infrastructures, data ecosystems, AI skills development, and governance frameworks. These initiatives increasingly emphasise the importance of local data ownership, and the creation of African digital assets capable of supporting context-specific innovation. The emergence of these ecosystems confirms the growing relevance of research infrastructures capable of providing shared computing resources, experimentation environments, data services, and collaborative platforms for AI-driven research and innovation.

Collectively, these developments demonstrate that the African digital research infrastructure landscape is gradually evolving from isolated institutional initiatives towards more interconnected ecosystems combining connectivity, computing, data services, experimentation facilities, and innovation support mechanisms. While important challenges

² <https://semecity.bj>

³ <https://smartafrica.org>

⁴ <https://www.aipolicy.africa/>

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remain, the observed progress provides encouraging evidence of the growing readiness of African research communities to participate in federated digital research infrastructures at national, regional, and continental scales.

2.2 Cross-country comparative analysis

The updated analysis confirms several common patterns across the countries examined in DIGITAfrica as well as the additional initiatives identified during the second year of the project. Although significant differences remain in terms of infrastructure maturity, funding availability, and institutional capacities, a number of converging trends can be observed.

A first common trend concerns the strategic role of National Research and Education Networks. Across multiple countries, NRENs increasingly constitute the backbone of national digital research ecosystems. Organisations such as KENET in Kenya, GARNET in Ghana, WACREN in West Africa, ASREN in North Africa and the Middle East, and SANReN in South Africa are progressively evolving beyond connectivity provision towards the delivery of advanced digital services. This evolution creates opportunities for future federated infrastructures capable of sharing resources and services across national boundaries.

A second trend concerns the gradual emergence of high-performance computing capabilities. South Africa remains the most advanced country in this domain through the National Integrated Cyberinfrastructure System and the Centre for High Performance Computing. Senegal has recently strengthened its capabilities through the deployment of the TAOUEY supercomputer, while Kenya is expanding access to HPC services through KENET's CHUI platform. These initiatives indicate a growing recognition of advanced computing resources as critical enablers of data-intensive research and artificial intelligence applications.

The analysis also reveals a rapid expansion of AI-related initiatives across the continent. Countries such as Senegal, South Africa, Kenya, Rwanda, and Ghana have launched AI strategies, innovation programmes, or dedicated centres supporting artificial intelligence research and deployment. While the maturity of these initiatives varies significantly, they collectively demonstrate a growing demand for shared AI infrastructures, computational resources, data services, and experimentation platforms.

Data governance and digital sovereignty constitute another recurring theme. Stakeholders consistently emphasise the importance of maintaining local ownership of data resources while enabling collaboration across institutions and countries. This concern is particularly evident in discussions related to artificial intelligence, healthcare, public services, and digital innovation. As a result, distributed data management models and federated data-sharing mechanisms are increasingly viewed as essential components of future research infrastructures.

Despite these positive developments, several challenges remain common across most countries. Funding limitations continue to constrain infrastructure deployment and long-term sustainability. Shortages of specialised technical personnel affect both infrastructure operation and research activities. Connectivity limitations remain significant in several

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regions, while fragmentation between institutions often prevents the efficient sharing of resources and expertise.

Taken together, the comparative analysis reinforces one of the central conclusions emerging from both D1.1 and the second consultation workshop: no single institution or country possesses all the capabilities required to support advanced digital science research. Consequently, a federated and distributed infrastructure model appears to be the most appropriate approach for addressing current limitations while enabling progressive growth and long-term sustainability. The experiences observed across the different countries further validate the strategic direction adopted by DIGITAfrica and support the development of a pan-African infrastructure based on interoperability, shared services, and collaborative governance.

3 Consultation Workshops

The consultation activities carried out within DIGITAfrica constitute a central component of the project methodology for defining the future Pan-African RI for Digital Sciences. Building upon the initial demand analysis performed during the first year of the project, the consultation process aims to continuously engage the scientific, innovation, policy, and industrial communities in order to validate emerging requirements, assess infrastructure priorities, and refine the strategic and technical vision of DIGITAfrica.

The first phase of the consultation process was documented in Deliverable D1.1 and included the inaugural consultation workshop held at the University of Cape Town in April 2025. That workshop provided the first comprehensive assessment of research priorities, infrastructure gaps, and capacity-building needs across the participating countries and established an initial dialogue around the concept of a Pan-African research infrastructure for Digital Sciences.

The present deliverable extends this analysis by reporting on the second consultation workshop organised in Tunis in April 2026. While the first workshop primarily focused on identifying needs and expectations, the second workshop represented an important transition towards implementation. Discussions concentrated on validating the DIGITAfrica vision, examining governance and sustainability aspects, presenting the first technical blueprints and proof-of-concepts, analysing national and regional digital research strategies, and identifying concrete opportunities for collaboration, deployment, and capacity building.

The outcomes of these consultation activities provide essential input for the subsequent phases of the project, including the definition of flagship services, the adaptation of SLICES and SoBigData capabilities to the African context, and the formulation of a long-term roadmap for a sustainable Pan-African digital research infrastructure.

3.1 Overview of consultation process

The consultation process described in this deliverable was implemented within WP1 as part of the demand analysis activities aimed at assessing the needs, expectations, and priorities of the research and innovation communities targeted by DIGITAfrica. The objective of this consultation process was to provide evidence-based input for the design of a future Pan-African RI for Digital Sciences by identifying infrastructure gaps, validating user requirements, and collecting strategic recommendations from a broad range of stakeholders.

The consultation methodology adopted in WP1 combined desk analysis, stakeholder engagement activities, expert discussions, and dedicated consultation workshops. This iterative approach enabled the project to progressively refine its understanding of the African digital research infrastructure landscape while ensuring that the proposed infrastructure concepts remained aligned with the needs of the scientific, innovation, policy, and industrial communities.

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The first phase of the consultation process culminated in the inaugural consultation workshop organised at the University of Cape Town (South Africa) in April 2025⁵. The workshop focused on identifying research priorities, analysing infrastructure gaps, and assessing capacity-building requirements across the participating countries. The outcomes of this first consultation exercise were documented in Deliverable D1.1 and constituted a key input to the initial demand analysis and requirements gathering activities.

The second phase of the consultation process was carried out during the next 12 months following the consultation workshop in Cape Town and culminated in the second consultation workshop organised at the University of Manouba (Tunisia) in April 2026⁶. While the first workshop concentrated on identifying needs and challenges, the second workshop focused on validating the DIGITAfrica vision, discussing implementation approaches, presenting the first technical blueprints and proof-of-concepts, and engaging stakeholders in discussions on governance, sustainability, deployment models, and capacity-building priorities.

Together, these two consultation workshops constitute the main stakeholder consultation activities foreseen within WP1 and provide the final input to the demand analysis process. Their outcomes directly support the definition of the DIGITAfrica technical roadmap, the identification of reusable services and components, and the selection of flagship services and use cases presented in this deliverable.

Following the completion of WP1 at Month 18, stakeholder engagement activities will continue through the mechanisms established within WP5. In particular, the DIGITAfrica Stakeholder Forum will become the primary instrument for maintaining dialogue with research communities, policymakers, infrastructure providers, industry representatives, and other relevant stakeholders. While the consultation workshops reported in this deliverable were primarily focused on requirements gathering and validation, the Stakeholder Forum will support longer-term community building, dissemination, adoption, and sustainability activities throughout the remainder of the project.

3.2 Second consultation workshop

The Second DIGITAfrica Consultation Workshop was organised by the University of Manouba (UMA), with the support of Sorbonne University (SU), CNR and University of Cape Town (UCT), on 28-29 April 2026 and represented the final consultation activity carried out within WP 1. Building upon the outcomes of the inaugural consultation workshop organised in Cape Town in April 2025, the Tunis workshop marked an important transition from the identification of needs and infrastructure gaps towards the validation of implementation approaches and the discussion of concrete technical solutions.

⁵ <https://www.digitafrica.eu/digitafrica-launches-in-cape-town-supporting-and-spearheading-digital-sciences-and-research-infrastructure-in-africa/>

⁶ <https://www.digitafrica.eu/2nd-digitafrica-consultation-workshop/>

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The workshop brought together a broad range of stakeholders from Africa and Europe, including researchers, university leaders, policymakers, representatives of research and education networks, international organisations, innovation hubs, development agencies, industry actors, and representatives of established European RIs. Through keynote presentations, thematic sessions, panel discussions, technical demonstrations, and hands-on activities, participants explored the strategic, organisational, and technical dimensions of a future Pan-African Research Infrastructure for Digital Sciences.

The programme was organised around several complementary themes. The discussions addressed the DIGITAfrica vision and its alignment with African and European research and innovation priorities, the opportunities and challenges associated with Pan-African research collaboration, the role of European Research Infrastructures as sources of experience and reusable services, the presentation of the first DIGITAfrica blueprints and proof-of-concepts, national perspectives on digital research and innovation, and the skills and capacity-building requirements necessary to support the long-term sustainability of the infrastructure.

Compared to the first consultation workshop, which primarily focused on assessing infrastructure needs and identifying research priorities, the Tunis workshop placed greater emphasis on implementation pathways, technical architectures, and stakeholder engagement mechanisms. As such, the workshop provided a valuable opportunity to validate the emerging DIGITAfrica roadmap and collect feedback on the proposed infrastructure services, deployment models, and collaboration mechanisms that will underpin the future Pan-African infrastructure. Table 1 overviews the schedule of the first day of the workshop, while the following sections summarise the main discussions and outcomes of each workshop session.

Table 1: Schedule of Day 1

Time	Session Description	Speakers	Moderators
9:00-9:30	Opening Session	<ul style="list-style-type: none"> - <i>Welcome remarks</i> Prof Ameer Cherif, President UMA, Tunisia - <i>EU-Africa cooperation</i> Patricia Postigo Mclaughlin, Policy officer at European Commission, Belgium - <i>Welcome remarks</i> Mr. Murat Bilaswad Chief of Cabinet, Ministry of Higher Education and Scientific Research, Tunisia 	Prof. Farouk Kamoun, UMA, Tunisia
9:30-10:00	Keynote 1: DIGITAfrica vision and the European research infrastructure framework	<ul style="list-style-type: none"> - Prof Serge Fdida, Sorbonne Université, France 	Prof. Farouk Kamoun, UMA, Tunisia

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10:00-10:30	Keynote 2: Research Landscape in Tunisia	<ul style="list-style-type: none"> - Prof. Mourad Bellassoued, Director General for Scientific Research (DGRS), Chief of Cabinet, Ministry of Higher Education and Scientific Research, Tunisia 	Prof. Farouk Kamoun, UMA, Tunisia
10:30 - 11:30	Panel 1: Enabling Pan-African Research Collaboration: Landscape, Funding and Opportunities	<ul style="list-style-type: none"> - Thomas Basikolo Programme Coordinator, Telecommunication Standardization Bureau, ITU - Sami Trimech Director of Strategic Development and Planning at the Arab ICT Organization, AICTO, Tunisia - Dr. Fathi El Mansouri Consultant to the General Secretariat of the Federation of Arab Scientific Research Councils- League of Arab States, FASRC, Egypt - Prof. Brando Okolo Senior Advisor, STI, African Union Development Agency-NEPAD, South Africa - Calvin Nangue Strategic advisor, Smart Africa Alliance, Rwanda 	Prof. Dr.-Ing. habil. Thomas Magedanz, Technische Universität Berlin, Germany
11:30 - 11:50	Coffee Break		
11:50 - 12:40	Session 1: From Concepts to Demonstrators: DIGITAfrica Blueprints & Proof-of-Concepts	<ul style="list-style-type: none"> - <i>Heterogeneous Networking Blueprint</i> Prof. Joyce Mwangama, University of Cape Town, South Africa - <i>Edge-Interoperable AI & ML Blueprint</i> Prof. Louis Fendji, University of Ngaoundéré, Cameroon 	Raffaele Bruno, CNR-IIT, Italy
12:40 - 14:00	Lunch		
14:00 - 14:50	Session 2: Research Infrastructures as Enablers for Research & Innovation: EU Success Stories	<ul style="list-style-type: none"> - <i>SLICES-RI: Scientific Large-Scale Infrastructure for Computing / Communication Experimental Studies</i> Raffaele Bruno CNR-IIT, Italy - <i>SoBigData RI: Data & AI Services for Digital Sciences</i> 	Prof. Anja Habacha Chaibi, UMA, Tunisia

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		Prof Giulio Rossetti CNR-ISTI, Italy	
14:50 - 15:50	Session 3: National Perspectives on Digital Research and Innovation	<ul style="list-style-type: none"> - <i>A Comprehensive Map of Senegal's and Pan-African AI Strategy</i> Prof Seydina Moussa Ndiaye, Cheikh Hamidou Kane Digital University (UN-CHK), Senegal - <i>From Local Talent to Global Impact: How African Centers of Excellence Drive Digital Innovation</i> Behjet Bousofara Director General, Talan, Tunisia - <i>Sèmè City: a flagship innovation, education, and entrepreneurship initiative in Benin.</i> Dr Mahuna Akplogan Head of the Department of Innovation Valorization, Sèmè City Development Agency, Benin - <i>University of Manouba Research Landscape</i> Prof. Azza Frikha, Vice President, University de la Manouba, Tunisia - <i>Cloud and HPC: a Higher Education & Resarch Infrastructure</i> Prof. Saoussen Krichen Head of Al-Khawarizmi Computing Center, Manouba, Tunisia 	Prof. Mohamed Jemni, The Arab League Educational, Cultural and Scientific Organization, ALECSO, Tunisia
15:50 - 16:10	Coffee Break		
16:10 - 17:10	Panel 2: Empowering Research & Innovation Communities: Priorities, Skills and Capacity Building	<ul style="list-style-type: none"> - Prof. Joughaina Gherib Vice president International Association of Universities (IAU), UNESCO Chair Holder, UMA, Tunisia - Yousef Torman CEO, Arab States Research and Education Network (ASREN), Jordan - Prof. Eyouléki Tcheyi Gnadi Palanga CEO, West and Central African Research and Education Network (WACREN), Ghana - Carmela Salzano Senior Project Officer, Campus Africa, UNESCO, France - John Matogo Corporate Social Responsibility 	Prof. Vitalis Ozianyi, Strathmore University, Kenya

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		Leader for Africa & the Middle East, IBM, Kenya - Alais, Olivier Programme Coordinator, Telecommunication Standardization Bureau (TSB), ITU, Switzerland	
17:10 - 17:30	Closing Session: Getting Involved in DIGITAfrica	- Prof. Serge Fdida, SU, France,	

Day 1 (28 April) began with an opening session establishing the strategic context of the workshop and emphasised the importance of developing a sustainable Pan-African RI for Digital Sciences. Representatives from the University of Manouba, the Tunisian Ministry of Higher Education and Scientific Research, and the European Commission highlighted the growing importance of digital infrastructures, artificial intelligence, and data-driven innovation for Africa’s scientific and socio-economic development. Speakers emphasised the need to strengthen cooperation between Africa and Europe while ensuring that future infrastructures are designed around African priorities and ownership. Particular attention was given to the role of research infrastructures as long-term scientific instruments capable of supporting research excellence, innovation, training, and digital sovereignty.

A recurrent message throughout the opening session was that DIGITAfrica should not be viewed as a technology transfer initiative but rather as a co-construction process that leverages European experience while addressing African challenges through locally relevant solutions. The workshop was therefore positioned as a critical step towards moving from vision to implementation through the development of technical blueprints, stakeholder engagement, and future deployment strategies

Keynote 1 - DIGITAfrica vision and the European research infrastructure framework

The keynote presentation introduced the overall DIGITAfrica vision and explained how the project draws inspiration from established European Research Infrastructures such as SLICES-RI and SoBigData RI. Research infrastructures were presented as scientific instruments that provide shared capabilities for experimentation, innovation, training, and collaboration. The discussion highlighted the strategic role of digital infrastructures in supporting digital innovation ecosystems. The presentation also introduced the concept of DIGITAfrica blueprints as reusable and scalable infrastructure templates that can be deployed under different levels of infrastructure maturity. The blueprint approach was presented as a mechanism to facilitate gradual adoption while ensuring interoperability and reproducibility across participating institutions. Particular emphasis was placed on capacity building, open science principles, and the development of a long-term roadmap towards a future Pan-African digital research infrastructure.

Keynote 2 - Research Landscape in Tunisia

The second keynote provided an overview of Tunisia’s research and innovation ecosystem. The presentation described the structure of the Tunisian research system, including

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universities, research centres, laboratories, technology parks, and support agencies. It highlighted the country's strengths in scientific production, international collaboration, and human capital development while also identifying persistent challenges related to funding, technology transfer, and industry engagement. Particular attention was given to Tunisia's long-term research and innovation strategy, which seeks to strengthen scientific excellence, increase socio-economic impact, and improve the integration of research outcomes into industrial and societal applications. The presentation illustrated how national research strategies can provide useful reference models for the development of digital research infrastructures at both national and regional levels.

Panel 1 - Enabling Pan-African Research Collaboration: Landscape, Funding and Opportunities

The first panel explored the current landscape of African research collaboration and discussed mechanisms capable of supporting sustainable cross-border cooperation. Representatives from AUDA-NEPAD, ITU, Smart Africa, AICTO, and the Federation of Arab Scientific Research Councils highlighted common challenges affecting research and innovation ecosystems across the continent. These included fragmented research activities, insufficient investment in research infrastructures, limited researcher mobility, and the absence of large-scale shared facilities. The discussion also identified opportunities arising from existing regional initiatives, including National Research and Education Networks (NRENs), regional research networks, international cooperation programmes, and emerging digital infrastructure projects. Participants stressed the importance of aligning existing initiatives, improving policy coordination, strengthening funding mechanisms, and developing governance models capable of supporting long-term infrastructure sustainability.

Session 1 - From Concepts to Demonstrators: DIGITAfrica Blueprints & Proof-of-Concepts

This session presented the first concrete technical outcomes of the project through the introduction of the Heterogeneous Networking Blueprint and the Edge-Interoperable AI and Machine Learning Blueprint. The presentations demonstrated how the blueprint methodology translates strategic requirements into deployable infrastructure components capable of supporting experimentation, education, and innovation.

The Heterogeneous Networking Blueprint addresses connectivity challenges through a modular architecture supporting different deployment scenarios, ranging from resource-constrained environments to fully federated research infrastructures. The blueprint incorporates open networking technologies and aims to support experimentation with next-generation communication systems while remaining adaptable to diverse African contexts.

The AI and Machine Learning Blueprint focuses on distributed AI infrastructures capable of supporting local data processing, AI model development, and edge computing. Particular emphasis was placed on data sovereignty, affordability, interoperability, and the use of open-source technologies. The blueprint was presented as a practical framework for supporting AI experimentation while reducing dependence on external cloud infrastructures.

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Session 2 - Research Infrastructures as Enablers for Research & Innovation: EU Success Stories

The session dedicated to SLICES-RI and SoBigData RI provided concrete examples of how large-scale research infrastructures can support scientific communities through shared services, federated governance, reproducible experimentation, and advanced data management capabilities. Speakers described the governance, technical architecture, and service portfolios of both infrastructures, highlighting lessons learned from their development and operation.

Several services were identified as particularly relevant for DIGITAfrica, including federated authentication and authorisation systems, FAIR data management services, metadata catalogues, virtual research environments, cloud and high-performance computing resources, experiment orchestration platforms, and advanced analytics services. Discussions also highlighted the importance of open science practices and interoperability with broader scientific ecosystems such as EOSC.

Session 3 - National Perspectives on Digital Research and Innovation -

The session showcased different national approaches to digital transformation, artificial intelligence, innovation ecosystems, and digital infrastructure development. The presentation from Prof. Seydina Moussa Ndiaye emphasised the role of AI and data strategies as instruments for national development and regional leadership, stressing the need to move from policy formulation towards implementation through data spaces, governance mechanisms, and digital infrastructures.

The Tunisian industrial perspective highlighted the role of Centres of Excellence and innovation ecosystems in bridging the gap between academic research and industrial deployment. The concept of industrialised innovation was presented as a mechanism for transforming research outcomes into scalable products and services through structured collaboration between universities and industry.

The Sèmè City initiative in Benin illustrated how integrated innovation districts can combine education, entrepreneurship, research, and technology transfer to foster innovation-driven development. Meanwhile, the University of Manouba and the Al-Khwarizmi Computing Centre presented national capacities in digital research, cloud computing, and high-performance computing, demonstrating the growing role of digital infrastructures within higher education and research ecosystems.

Panel 2 - Empowering Research & Innovation Communities: Priorities, Skills and Capacity Building

The final panel focused on the human dimension of research infrastructures. Participants agreed that infrastructure development must be accompanied by substantial investments in skills, training, and community building. Representatives from UNESCO, ITU, IBM, WACREN, and ASREN highlighted persistent shortages of expertise in areas such as AI, cybersecurity, cloud computing, data science, and digital infrastructure management.

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The discussion stressed the importance of creating sustainable training ecosystems through digital learning platforms, regional mobility programmes, communities of practice, research networks, and practical experimentation environments. Speakers also emphasised that capacity building should address not only researchers but also technical personnel, infrastructure operators, innovators, and future entrepreneurs.



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Figure 1: Highlights from Day 1 of the DIGITAfrica Workshop (technical sessions).

Day 2 (29 April) was dedicated to practical hands-on training activities designed to familiarise participants with the technical solutions and services that underpin the DIGITAfrica vision. Two parallel hands-on sessions were organised, corresponding to the two European Research Infrastructures contributing to DIGITAfrica: SLICES-RI and SoBigData RI.

The SLICES-RI training session focused on the Heterogeneous Networking Blueprint and introduced participants to the fundamentals of 5G experimentation using the SLICES infrastructure. The tutorial provided a step-by-step introduction to the deployment of a virtual 5G network based on OpenAirInterface components and executed within the SLICES-RI experimentation environment. Participants were guided through the process of accessing the SLICES infrastructure, configuring experimental environments, deploying virtualised network functions, and analysing the interaction between the different components of a 5G architecture. Particular attention was given to understanding the operation of 5G core network components, and simulated radio access networks. The session illustrated how the DIGITAfrica networking blueprint can be used as a reusable educational and experimentation platform for teaching, research, and technology validation in next-generation communication systems.

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The SoBigData RI training session focused on computational social science, data analytics, and artificial intelligence methods for analysing online information ecosystems. Through a practical case study on the identification of epistemic enclaves and polarisation dynamics, participants were introduced to the use of the SoBigData platform and its associated analytical tools. The training covered the complete workflow from network exploration and community detection to the simulation of opinion dynamics and polarisation processes. Participants worked with several open-source tools, including NetworkX, CDlib, NDlib, and YSocial, to analyse social networks, detect echo chambers, evaluate community structures, and simulate the effects of algorithmic bias on opinion formation. The hands-on exercises demonstrated how advanced data science methodologies can be applied to study social behaviour, misinformation, and digital public spaces while leveraging the computational services provided by SoBigData RI.

The two training sessions attracted strong interest from participants and provided valuable opportunities for direct interaction with the technologies and services discussed during the workshop. Beyond the acquisition of technical skills, the hands-on activities demonstrated the practical applicability of the DIGITAfrica blueprints and highlighted the potential of European Research Infrastructure services to support education, experimentation, and collaborative research within African institutions.



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Figure 2: Highlights from Day 2 of the DIGITAfrica Workshop (hands-on sessions).

3.3 Main Findings and Implications for DIGITAfrica

The discussions held during the Second DIGITAfrica Consultation Workshop revealed a broad convergence among stakeholders regarding both the strategic relevance of a Pan-African Research Infrastructure for Digital Sciences and the main priorities that should guide its development. Although participants represented diverse scientific domains, institutional contexts, and geographical regions, several common themes emerged consistently throughout the workshop.

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3.3.1 Need for Federated and Shared Research Infrastructures

A recurring message across multiple sessions was the fragmentation of the current African digital research infrastructure landscape. Existing infrastructures, expertise, and resources are often distributed across institutions and countries with limited interoperability and coordination. Participants highlighted that no single institution or country can independently provide all the capabilities required to support advanced research in areas such as artificial intelligence, data science, cloud computing, advanced networking, and digital experimentation.

This finding reinforces the relevance of the DIGITAfrica vision based on a federated infrastructure model, where resources and services can be shared across institutional and national boundaries while preserving local ownership and governance. The experiences presented by SLICES-RI, SoBigData RI, WACREN, ASREN, and other regional initiatives demonstrated that federation represents a practical and sustainable approach for addressing resource limitations while promoting collaboration and interoperability.

3.3.2 Data Sovereignty and African Ownership

Several discussions emphasised the growing importance of data as a strategic asset for scientific research, innovation, and artificial intelligence. Participants expressed concerns regarding dependence on external cloud infrastructures, limited local computing resources, and insufficient control over research data and digital assets. At the same time, speakers highlighted the importance of developing African datasets, AI models, and digital services that reflect local realities, languages, and societal needs.

These discussions suggest that DIGITAfrica should not only provide technical infrastructure but also support mechanisms for data sovereignty, local data governance, and responsible AI development. Metadata catalogues, distributed data management services, and federated data-sharing mechanisms emerged as particularly relevant capabilities in this context.

3.3.3 AI and Data-Driven Research as Strategic Priorities

Artificial intelligence and data-intensive research were consistently identified as priority areas across both scientific and policy discussions. National initiatives presented during the workshop, particularly from Senegal and Tunisia, highlighted the growing role of AI in national development strategies, while innovation initiatives such as Sèmè City illustrated the increasing demand for AI-enabled innovation ecosystems.

Participants stressed that future research infrastructures must support the complete AI lifecycle, including data acquisition, data management, model development, experimentation, deployment, and validation. This finding directly validates the relevance of the DIGITAfrica AI and Machine Learning Blueprint and supports the inclusion of AI-related services among the flagship capabilities of the future infrastructure.

3.3.4 Importance of Progressive and Adaptable Deployment Models

The presentation of the DIGITAfrica blueprints generated considerable interest because they addressed one of the major challenges identified during the consultation process: the heterogeneity of infrastructure maturity across African institutions.

Participants repeatedly emphasised that future infrastructure services must be deployable under different levels of technological readiness and resource availability. The blueprint methodology was recognised as a practical mechanism for enabling progressive adoption, allowing institutions to participate regardless of their current level of infrastructure development. This finding supports the continued development of modular, reusable, and scalable deployment models capable of accommodating diverse institutional contexts.

3.3.5 Skills Development as a Foundational Requirement

One of the strongest messages emerging from the workshop concerned the critical importance of human capacity development. Stakeholders consistently identified shortages of specialised skills as a major barrier to the adoption, operation, and sustainability of digital research infrastructures. The challenge extends beyond researchers and includes infrastructure operators, technical staff, software developers, data stewards, and innovation managers.

The workshop highlighted the need for a comprehensive capacity-building strategy combining formal education, professional training, digital learning platforms, practical experimentation environments, mobility programmes, and communities of practice. The experiences presented by SLICES-RI, SoBigData RI, UNESCO, ITU, WACREN, ASREN, and IBM confirmed that sustainable infrastructures require equally sustainable investment in people and skills.

DIGITAfrica properly articulates its blueprint methodology with the training necessary to onboard the required skills to the relevant community of students and practitioners.

4 Leveraging SLICES and SoBigData

4.1 Overview of SLICES and SoBigData capabilities

4.1.1 Overview of SLICES RI

SLICES-RI is a distributed European Research Infrastructure designed as a large-scale scientific instrument for experimental research on digital infrastructures and services **Erreur ! Source du renvoi introuvable..** Its technical architecture has been developed to support experimentation across the full digital continuum, including cloud computing, edge infrastructures, networking, wireless systems, IoT platforms, AI-enabled infrastructures, and emerging 6G technologies. The infrastructure federates heterogeneous experimental facilities operated by multiple national nodes while providing researchers with a unified environment for designing, deploying, executing, monitoring, and reproducing complex experiments.

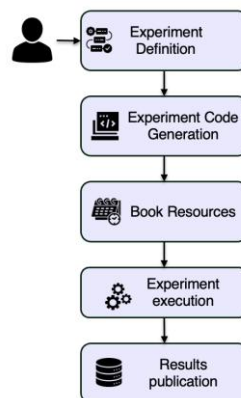


Figure 3: SLICES intent-based blueprint methodology.

The overall SLICES architecture follows a service-oriented design in which infrastructure resources and capabilities are exposed through interoperable services that can be combined and extended according to the needs of specific research communities **Erreur ! Source du renvoi introuvable..** Rather than enforcing a single technology stack, orchestration platform, or virtualization framework, SLICES embraces heterogeneity as a core design principle, enabling the integration of diverse resources and experimental environments while maintaining a consistent user experience across the federation. This approach allows national facilities to preserve local autonomy while participating in a common European experimentation platform.

At the core of the architecture lies a set of common services that provide fundamental functionalities required by all experiments. These services include federated authentication and authorisation, experiment management, resource discovery, monitoring, connectivity, storage, data management, and experiment reproducibility. Access to the infrastructure is provided through a central portal that acts as a single-entry point for users, projects, and experiments, while domain-specific services and dashboards allow researchers to interact

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with specialised experimental environments. The architecture also includes command-line interfaces and programmable APIs that support automated workflows and integration with external tools.

A key architectural feature of SLICES is the separation between generic infrastructure services and community-oriented experimentation services. Basic services provide access to fundamental resources such as bare-metal servers, virtual machines, storage systems, networking facilities, edge devices, and IoT platforms. On top of these building blocks, SLICES introduces the concept of blueprints, which package resources, software components, orchestration logic, and workflows into reusable experimentation environments tailored to specific scientific domains. Current blueprints support areas such as Beyond-5G and 6G networking, Federated Learning, Cloud-Edge Continuum computing, Artificial Intelligence infrastructures, and Quantum Key Distribution. This layered approach enables researchers to benefit from pre-configured experimental environments while preserving access to lower-level infrastructure resources when needed.

Reproducibility constitutes another fundamental design principle of SLICES. The infrastructure incorporates dedicated orchestration and lifecycle management services that support the deployment, execution, monitoring, and repetition of experiments across heterogeneous sites. Experiments are treated as scientific artefacts that can be reproduced, validated, and shared, ensuring that results obtained on one infrastructure can be replicated on other facilities participating in the federation. This reproducibility-by-design approach extends beyond experimental workflows to include infrastructure configurations, datasets, software artefacts, and execution environments.

To support Open Science practices, SLICES integrates metadata and data management capabilities directly into its architecture. The Metadata Registry System (MRS) and the Data Management Infrastructure (DMI) implement FAIR principles by enabling the description, discovery, publication, and reuse of datasets, software, workflows, infrastructure resources, and experiment outcomes. These components provide machine-actionable metadata, persistent identifiers, and standardised interfaces that facilitate interoperability with external infrastructures and services. In particular, the architecture has been designed to align with the European Open Science Cloud (EOSC) Interoperability Framework, enabling future integration with EOSC catalogues, federated authentication services, and research data ecosystems.

4.1.2 Overview of SoBigData RI

SoBigData RI⁷ is a distributed, pan-European Research Infrastructure for social data science, organised as a network of national nodes structured around thematic research spaces. Each node contributes data collections, services, and domain expertise, while the Italian node acts as the central hub and main entry point to the e-infrastructure. Through this organisation, the nodes federate heterogeneous resources under a common framework for

⁷ <https://www.sobigdata.eu>.

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responsible data access and use, aligning technical operations with ethical, legal, and open science principles.

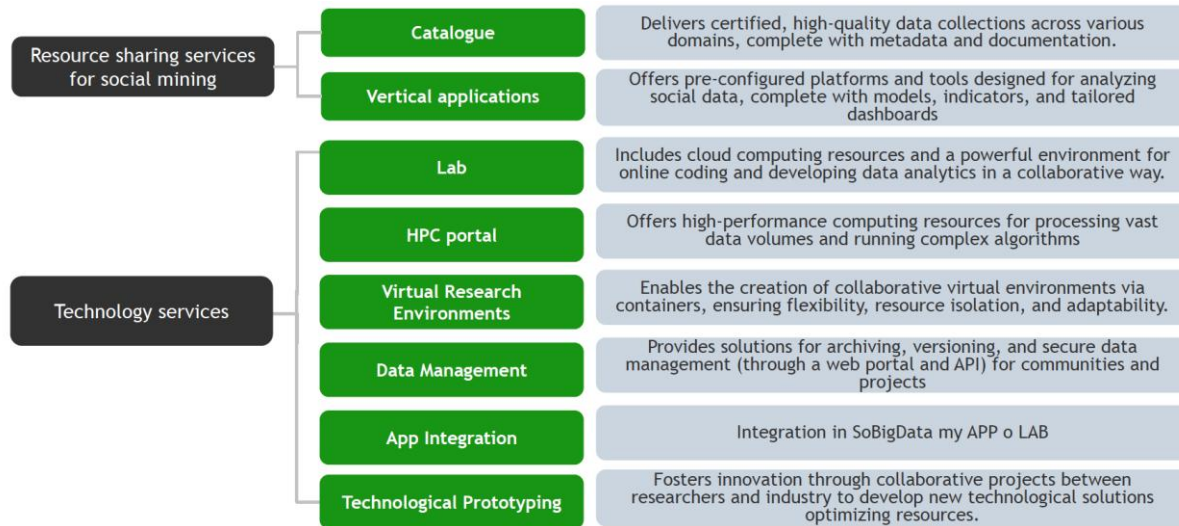


Figure 4: SoBigData services portfolio

SoBigData RI provides a comprehensive and integrated suite of digital services designed to support the full research lifecycle in social data science. Rather than operating as standalone components, these services are conceived as a coherent ecosystem that enables data access, analysis, collaboration, and reuse within a governed and reproducible environment.

SoBigData RI integrates Digital resources, a federated hardware as the digital backbone, and a community network to realize a portfolio of services to support data-intensive social science research. The infrastructure offers a unified gateway and network portal through which users can access datasets, methodologies, applications, and Virtual Research Environments. Large-scale experiments and analyses are enabled by a high-performance computational layer that includes High Performance Computing (HPC) resources, storage systems, JupyterHub, Galaxy, and specialized libraries.

4.2 Reusable services and components

An important objective of DIGITAfrica is to leverage existing technological assets and operational experience from established European Research Infrastructures in order to accelerate the development of a future pan-African digital research infrastructure. Rather than designing all services from scratch, DIGITAfrica can build upon mature solutions that have already been validated through large-scale deployments and active scientific communities.

The analysis conducted within DIGITAfrica identified a number of services and technical components that can be directly reused or adapted to the African context. In particular, SLICES-RI provides mature solutions for federated authentication and authorisation, metadata and data management, experiment orchestration, and resource discovery, while

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SoBigData RI offers advanced capabilities for data management, analytics, virtual research environments, and collaborative data science. Together, these infrastructures provide a valuable set of technical building blocks that can significantly reduce development effort and implementation risks while ensuring compatibility with international standards and European Open Science Cloud (EOSC) practices.

The following sections describe the most relevant services and components that have been identified as candidates for reuse within DIGITAfrica.

4.2.1 SLICES services

Among the different services offered by SLICES-RI, the Authentication and Authorisation Infrastructure (AAI) and the Metadata Registry System/Data Management Infrastructure (MRS/DMI) have been identified as the most relevant reusable components for DIGITAfrica.

SLICES-RI implements a federated **Authentication and Authorisation Infrastructure (AAI)** that provides a common security framework across all infrastructure services and experimental facilities. The architecture is organised around a central user and project authority integrated with the SLICES portal, which acts as the main entry point for user registration, project management, experiment administration, and access control. The AAI relies on widely adopted standards, including OpenID Connect (OIDC), OAuth 2.0, and JSON Web Tokens (JWT), ensuring interoperability with external identity providers and federated infrastructures.

The authorisation model is based on projects and experiments. Users are associated with one or more projects, which define access rights to infrastructure resources and services. Once authenticated, users obtain short-lived JWT tokens that contain user, project, and experiment-related information. These tokens are subsequently used by all infrastructure services to verify permissions and retrieve user attributes without requiring local user databases. This approach simplifies service integration, improves security, and ensures consistency of authorisation policies across the federation.

The architecture supports both web-based and programmatic access. Interactive applications use standard OAuth2/OpenID Connect authentication flows, while command-line interfaces, APIs, and automation tools rely on JWT-based authentication mechanisms. The same security framework is therefore applied consistently across graphical interfaces, experiment orchestration systems, monitoring services, and data management services.

From an interoperability perspective, the SLICES AAI has been designed to align with the EOSC Authentication and Authorisation Infrastructure architecture and the AARC Blueprint recommendations **Erreur ! Source du renvoi introuvable.** It supports federated identity management through eduGAIN and adopts standards compatible with EOSC federated services. This design provides a mature foundation that could be reused within DIGITAfrica to support secure access across multiple countries, institutions, and research communities while facilitating future interoperability with European and international research infrastructures.

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The SLICES **Metadata Registry System (MRS)** and **Data Management Infrastructure (DMI)** constitute the core framework supporting FAIR data management and experimental reproducibility. These components were specifically designed to support Open Science principles by ensuring that datasets, software artefacts, workflows, infrastructure resources, and experiment outputs remain discoverable, accessible, interoperable, reusable, and reproducible throughout their lifecycle.

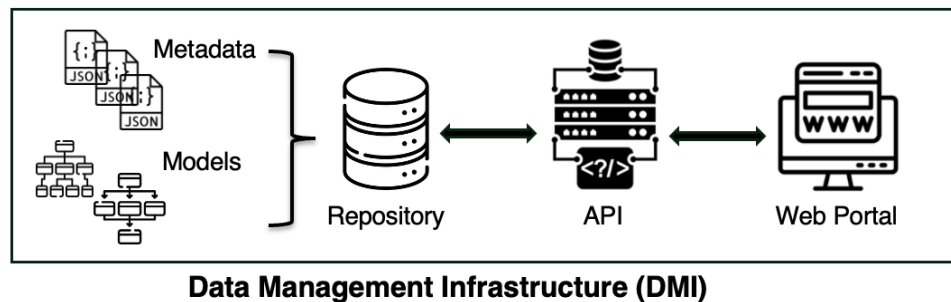


Figure 5: SLICES DMI.

The Metadata Registry System acts as a central catalogue for all digital objects managed within the infrastructure. It implements the concept of SLICES FAIR Digital Objects (SFDOs), which provide a machine-actionable representation of research artefacts through a hierarchical metadata model. The metadata model combines generic attributes supporting discovery and interoperability with domain-specific attributes required for advanced experimentation workflows. Through this approach, not only datasets and publications, but also infrastructure resources, experiment descriptions, monitoring information, software components, and workflows can be represented and discovered in a uniform manner.

The current implementation of the MRS consists of three main components:

- A PostgreSQL database providing persistent metadata storage;
- A backend service exposing REST APIs for metadata management, access control, reporting, and interoperability functions;
- A web-based portal supporting search, discovery, metadata management, and reporting functionalities.

The MRS also supports metadata versioning, import/export mechanisms, machine-actionable metadata descriptions, and integration with external catalogues. In addition, it provides the foundation for resource discovery within SLICES-RI by maintaining structured descriptions of infrastructure resources, their capabilities, availability, and relationships. This metadata-driven approach enables automated resource selection and orchestration while supporting interoperability with external infrastructures.

Complementing the MRS, the Data Management Infrastructure manages the complete lifecycle of experimental data. The DMI supports data collection, storage, processing, publication, archiving, provenance management, and lineage tracking. It was explicitly designed to support Experimental Research Reproducibility as a Service (ERRaaS), ensuring

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that experiments can be accurately reproduced by preserving not only datasets but also metadata, workflows, software environments, infrastructure configurations, and execution contexts.

The DMI architecture is organised into multiple functional layers covering data storage, data processing, experiment management, metadata management, and researcher access environments. It incorporates support for FAIR Digital Objects, persistent identifiers (PIDs), metadata registries, data governance policies, quality assurance procedures, and secure access control mechanisms. The storage layer is implemented using S3-compatible object storage technologies and provides scalable and secure storage for experimental artefacts and research datasets.

A fundamental characteristic of the SLICES DMI is its alignment with the EOSC Interoperability Framework. The architecture supports metadata crosswalks, persistent identifiers, FAIR Digital Objects, federated authentication, and standardised APIs for metadata exchange. This enables the publication and discovery of datasets, services, and research products through EOSC catalogues and facilitates interoperability with other research infrastructures.

4.2.2 SoBigData services

SoBigData RI can offer the DIGITAfrica community a set of resources and services that can be accessed free of charge and used to support the advancement of data science across the African continent. Table 4.1 provides a summary of the main SoBigData services available to the DIGITAfrica community.

Resource sharing services for social mining

Catalogue: Delivers certified, high-quality data collections across various domains, complete with metadata and documentation.

Advanced Analysis Tools: Provides libraries, frameworks, and applications for processing social data, building models, and visualising results.

Vertical Applications: Offers pre-configured platforms and tools designed for analysing social data, complete with models, indicators, and dashboards tailored to specific sector needs.

Technology services

SoBigData Lab: Includes cloud computing resources and a powerful environment for online coding and developing data analytics in a collaborative way.

HPC Infrastructure: Offers high-performance computing resources for processing vast data volumes and running complex algorithms.

VREs for Communities: Enables the creation of collaborative virtual environments via containers, ensuring flexibility, resource isolation, and adaptability.

Workspaces and FAIR Data Management Services: Provides solutions for archiving, versioning, and secure data management (through a web portal and API).

Table 4.1 Description of SoBigData RI offered services

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The **Catalogue**⁸ is the main application for searching datasets within SoBigData RI. The Catalogue provides a tool for the publication of research objects, including data, methods, libraries, and tools, promoting their FAIRness. The Catalogue is based on the D4science catalogue engine, which is widely adopted by several communities, including those in marine science, the humanities, and health sciences, and is built upon CKAN, an open-source data portal platform. This strategic choice provides a robust foundation for managing a wide array of research objects and datasets. The use of CKAN, ensures that the Catalogue adheres to recognised standards for data publication and metadata management. The Catalogue's technical architecture is built on the gCube framework, which allows data model customisation to fit the specific needs of various research communities. This enables the creation of tailored catalogues for different virtual research environments (VREs), ensuring that metadata fields and object types are relevant to the specific domain. This customisation capability is crucial for maximising the discoverability and reusability of research outputs, as it allows communities to define a rich metadata schema that accurately describes their resources. Users can find resources by entering keywords and browse the resulting list of available resources. The metadata associated with each item are freely accessible and provide detailed information not only about the dataset itself, but also about access conditions, usage, provenance, and related documentation.

The **Advanced Analysis Tools** service provides libraries, frameworks, and ready-to-use applications for processing social data, building analytical and predictive models, and visualising results. These tools integrate cutting-edge Artificial Intelligence methods with domain-specific approaches for application areas of high societal impact, such as misinformation, mobility, sustainability, health, well-being, and the social implications of AI.

The **Vertical Applications** service offers pre-configured platforms and tools for analysing social data, including models, indicators, and dashboards tailored to specific sector needs and designed to support evidence-based research in application areas of high societal impact.

The **SoBigData Lab** provides technological services for developing and executing data analytics and includes several integrated components. It includes:

- **Cloud Computing Platform (CCP):** The SoBigData CCP is a service that provides on-demand and scalable access to computing resources, allowing researchers to execute containerized methods, such as algorithms, scripts, models, and computational pipelines, without needing to manage the underlying physical infrastructure or software dependencies. The platform is built on a modern architecture that leverages containerization for consistent and isolated execution environments, ensuring that research outputs are highly reproducible regardless of the user's local setup. The platform's design focuses on abstracting technical implementation details to enhance scientific reproducibility and collaboration, offering several key benefits,

⁸ <https://sobigdata.d4science.org/catalogue-sobigdata>

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including faster time-to-science, scalability, increased productivity, and high performance. The CCP's execution engine supports a wide range of runtimes, including those based on Python, Julia, Bash, Galaxy, and Jupyter Notebooks, and it is deployed in Docker Swarm clusters. The platform also supports runtime environments with GPUs, which are provided to authorized users within the SoBigData community. The CCP also aligns with Open Science principles by tracking provenance using standards like PROV-O, ensuring that all methods and their outputs are fully documented, versioned, and reusable.

- *JupyterHub*: it provides the community with a versatile and powerful environment for online coding and data analytics. It is an integrated platform for creating live documents that capture the entire research process, from developing and documenting code to visualising results and communicating findings. To deliver this experience to a large and diverse group of researchers, SoBigData did not deploy a single-user instance. Instead, they made a strategic choice to spawn JupyterLab instances through JupyterHub, which is itself deployed on a Kubernetes cluster. This architecture is central to the e-infrastructure's ability to serve its community effectively. JupyterHub acts as a multi-user server, providing a critical layer of security and convenience by authenticating users and managing their individual, isolated sessions. A key technical complexity that SoBigData has successfully navigated is the addition of the Workspace as a sidecar container within the JupyterLab environment. This architectural decision allows the Workspace, with all of a user's data and methods, to be mounted directly into the JupyterLab session. For the end-user, this means that their research materials are immediately accessible, eliminating the need to manually transfer files and streamlining the entire workflow. Furthermore, because the Workspace enables easy sharing of data and methods among colleagues, this technical integration provides a powerful collaborative capability.
- *Galaxy Workflow*: it is a web-based platform designed for data-intensive research, empowering users to perform, reproduce, and share complex computational analyses through a user-friendly graphical interface. The platform's graphical user interface (GUI) simplifies the process of data analysis, making it accessible to researchers with varying computational expertise, while its emphasis on reproducibility and transparency ensures that every step of a workflow is meticulously recorded. To offer this service to a large community, the SoBigData infrastructure has made an architectural decision to deploy Galaxy as a service spawned by JupyterHub and orchestrated by Kubernetes. While this underlying architecture is shared with other services like JupyterLab, its application to Galaxy is particularly impactful. This setup allows SoBigData to provide a highly scalable and reliable Galaxy environment, abstracting away the technical complexities from the end-user.

The HPC service provide on-demand access to high-performance computing resources for large-scale data analytics and AI workloads. It enables processing complex social and behavioural datasets, running advanced simulations, and training data-intensive models without investing in a dedicated infrastructure. The portal supports scalable computing environments, integrated tools, and controlled access to sensitive data, ensuring

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compliance with security and regulatory requirements. The HPC infrastructure provides significant computing power, including:

- Thousands of CPU cores for parallel processing
- GPU accelerators (e.g., NVIDIA A100) for AI and deep learning
- Large-scale storage (petabyte-level) for big data
- High-capacity RAM for memory-intensive workloads

By offering reliable, high-capacity computing services tailored to data-driven projects, the SoBigData HPC infrastructure helps organisations accelerate innovation, optimise performance, and bring data-driven solutions to production faster.

With the customized deployments of Virtual Research Environments (**VREs**), the RI creates collaborative space for sharing data or performing experiments to projects, initiatives, or simple groups of researchers upon request. A VRE can be public or closed and is managed by its owner through a web portal for access control. It is designed to enhance research innovation and to include dedicated and ad-hoc specializations of the other digital services (e.g., specific requirements for computational resources or additional storage space). Furthermore, the RI supports the provision of virtual machines accessible to all its users (upon creation of an account) within the Jupyter Hub with a minimum configuration. If the user requires more computational power the RI can create ad-hoc virtual machine configurations based on its needs. This can be done by submitting an application form downloadable in the SoBigData Lab page. Through this form a specific configuration can be requested, including the number of cores, RAM, Storage, or GPUs, together with a description of the objectives of the analysis to be performed. This request will be evaluated by the internal committee checking not only the availability of technological resources but also the ethical aspect and implications of the analysis.

The SoBigData **Workspace** offers a personal and collaborative storage space for users to manage their research products, including data, software code, and documents. The service is built on the gCube software framework, which provides a high-level abstraction layer over various storage back-ends, ensuring seamless and transparent data access. Its key features include centralised storage that is automatically replicated on multiple storage devices and locations to guarantee fault tolerance, low latency, and scalability. By using a widely adopted standard, the platform enhances interoperability, allowing researchers to easily integrate their workflows with a vast ecosystem of existing tools, applications, and libraries that are S3-compatible. This standardisation ensures that the Workspace is not a siloed system but rather a flexible and open environment that can connect with a wide array of computational resources and data sources, accelerating research and collaboration. This service empowers collaborative capabilities by allowing researchers to share their data and resources with colleagues or entire VREs.

4.3 Adaptation to African context

The services and components provided by SLICES-RI and SoBigData RI constitute a valuable foundation for the future DIGIT Africa infrastructure. Nevertheless, their deployment within

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the African context requires several adaptations to address the heterogeneous levels of infrastructure maturity, connectivity constraints, limited operational resources, and the need to support progressive infrastructure growth across participating countries.

A first adaptation concerns the deployment model of the infrastructure services. The SLICES Authentication and Authorisation Infrastructure (AAI), the Metadata Registry System (MRS), the Data Management Infrastructure (DMI), and the SoBigData virtual research environments have been designed for highly interconnected research environments. Within DIGIT Africa, these services will need to operate across institutions with significantly different levels of digital readiness and available infrastructure. Consequently, the infrastructure should support a progressive deployment strategy, allowing institutions to initially deploy lightweight local instances of services while preserving interoperability with future regional and continental federations. This approach enables the gradual integration of new sites and services without requiring a fully developed infrastructure from the outset.

A second adaptation concerns identity management and federated access. The SLICES AAI architecture, based on OpenID Connect, OAuth2, and token-based authorisation, provides a suitable framework for implementing federated access control across DIGIT Africa. However, unlike the European context where federated identity services are often available through national research and education networks, DIGIT Africa must support a wider diversity of identity providers and authentication mechanisms. The infrastructure should therefore allow the coexistence of local institutional identities, national identity federations where available, and external identity providers while maintaining a common authorisation framework across the infrastructure.

The metadata and data management services inherited from SLICES and SoBigData also require adaptations to address African requirements related to data sovereignty, connectivity, and local data availability. While the MRS, DMI, and SoBigData catalogue services provide mature solutions for FAIR data management, their deployment within DIGIT Africa should prioritise distributed data storage and local control of research data. Metadata catalogues can remain globally accessible, while datasets and experimental artefacts may be stored locally and synchronised selectively across the federation according to institutional policies and available network capacity. This approach combines FAIR principles with the need to maintain ownership and governance of research data within participating institutions and countries.

Connectivity constraints also influence the implementation of data-intensive services. Several African institutions operate under limited bandwidth conditions or intermittent connectivity. Consequently, catalogue services, metadata repositories, virtual research environments, and collaborative workspaces should support asynchronous operation and delayed synchronisation mechanisms. In particular, metadata publication and experiment documentation services should remain operational even when external connectivity is temporarily unavailable, allowing local experimentation activities to continue without disruption.

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The experimentation and virtual research environment services offered by SLICES and SoBigData should also be adapted to accommodate a broader range of hardware platforms and operational environments. Whereas European infrastructures often assume access to dedicated clusters, GPU resources, and stable cloud infrastructures, DIGITAfrica deployments should support lightweight edge platforms, commodity servers, and energy-efficient computing resources. The adoption of container-based technologies, Kubernetes-compatible orchestration platforms, and open-source software stacks facilitates this flexibility while preserving compatibility with the original infrastructure services.

5 Flagship Services and Use Cases

One of the main objectives of DIGITAfrica is not only to define a technical architecture for a future Pan-African Research Infrastructure for Digital Sciences, but also to demonstrate how such an infrastructure can generate tangible scientific, societal, and economic benefits. While the technical blueprints developed within the project provide reusable building blocks and deployment models, and the baseline services identified in D2.1 **Erreur ! Source du renvoi introuvable.** define the fundamental capabilities required by the infrastructure, it is equally important to articulate how these capabilities can be combined to address concrete challenges faced by African research and innovation communities.

In this context, flagship services represent integrated service ecosystems built upon the DIGITAfrica blueprints and reusable infrastructure components. They provide a user-oriented perspective of the future infrastructure by translating technical capabilities into functional platforms capable of supporting research, experimentation, innovation, education, and technology transfer in specific application domains. As such, flagship services act as demonstrators of the value proposition of DIGITAfrica, illustrating how the infrastructure can contribute to addressing priority challenges identified during the consultation process.

The flagship services presented in this section should not be interpreted as fully defined operational services. Rather, they constitute reference service families that guide the implementation of future pilot deployments and proof-of-concept activities. Each flagship service combines multiple infrastructure capabilities, including networking, computing, data management, artificial intelligence, experimentation environments, and training services, into coherent platforms addressing specific scientific and societal needs. To demonstrate their practical relevance, each flagship service is accompanied by a set of representative pilot deployment scenarios. These pilots provide concrete examples of how the proposed services could be implemented within participating institutions and countries while validating the technical, organisational, and governance assumptions underpinning the DIGITAfrica vision. Together, the flagship services and pilot deployments constitute an important bridge between the demand analysis activities conducted within WP1 and the subsequent technical implementation and validation activities that will be carried out during the remainder of the project.

5.1 Selection Criteria and Methodology

The identification of DIGITAfrica flagship services represents the final outcome of the demand analysis activities conducted within WP1. The process combined the evidence collected through the landscape analysis, stakeholder consultations, and consultation workshops with the technical opportunities offered by the reusable services and blueprints presented in Section 4, and the analysis of basis service needs conducted in D2.1 **Erreur ! Source du renvoi introuvable.**

Unlike the baseline services defined in WP2, which describe the fundamental technical capabilities required by the future infrastructure, flagship services represent integrated

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service bundles designed to address high-priority scientific and societal challenges. They provide a bridge between infrastructure capabilities and real-world applications, demonstrating how the future DIGITAfrica Research Infrastructure can generate value for researchers, innovators, policymakers, and society at large.

The selection process followed four complementary criteria. First, flagship services were required to address strategic priorities consistently identified across the participating countries and stakeholder communities. Second, they had to be implementable through a progressive deployment strategy compatible with the heterogeneous levels of infrastructure maturity observed across Africa. Third, they needed to leverage existing technological assets originating from SLICES-RI, SoBigData RI, and the DIGITAfrica blueprints in order to maximise sustainability and reduce implementation risks. Finally, the selected services were required to demonstrate significant potential impact in terms of scientific excellence, innovation, and socio-economic development.

The analysis converged towards four flagship service families that collectively address the major priorities identified during the consultation process: Artificial Intelligence and Data Innovation, Smart Agriculture and Environmental Intelligence, Digital Health and Telemedicine, and Digital Education and Capacity Building. Together, these services constitute representative examples of how a future Pan-African Research Infrastructure for Digital Sciences could support both advanced research and societal innovation.

5.2 AI and Data Innovation Platform

Artificial Intelligence and data-intensive research emerged as one of the strongest priorities throughout the consultation process. Stakeholders consistently highlighted the need for local AI capacities, access to computational resources, support for data-driven innovation, and mechanisms to reduce dependence on external cloud providers. The *AI and Data Innovation Platform* is therefore proposed as a flagship service supporting the complete lifecycle of data-driven research and innovation. The platform combines the DIGITAfrica Edge-Interoperable AI and Machine Learning Blueprint with reusable services originating from SoBigData RI and SLICES-RI. Researchers gain access to computational resources, virtual research environments, experiment management services, data catalogues, collaborative workspaces, and AI development environments through a common federated platform.

The service supports the development, training, validation, deployment, and reproducibility of AI models while promoting FAIR data management and responsible AI practices. Through federated learning mechanisms, the platform enables collaborative model development without requiring sensitive datasets to leave local institutions, thereby addressing data sovereignty requirements that were repeatedly emphasised during the consultation activities.

Pilot Deployments

Several pilot deployments can be envisaged as proof-of-concepts for this flagship service. A first pilot could focus on federated AI experimentation across partner universities

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participating in DIGITAfrica. Institutions would deploy local AI nodes following the Edge-AI Blueprint and collaboratively develop machine learning models using distributed datasets. A second pilot could establish a Pan-African AI Sandbox where researchers, startups, and students access shared AI development environments through JupyterHub, SoBigData computational services, and federated authentication mechanisms. This environment would support experimentation, reproducibility, and training activities while validating the interoperability of the DIGITAfrica architecture. As application scenario, In the DIGITAfrica project we will primarily focus on AI for healthcare diagnostics but also climate modelling, and digital public services could be considered.

5.3 Smart Agriculture and Environmental Intelligence Platform

Agriculture represents one of the most strategic sectors across Africa and emerged as a priority domain in the consultations conducted in Kenya, Senegal, Cameroon, and South Africa. Stakeholders repeatedly highlighted the need for data-driven approaches capable of supporting food security, climate resilience, water management, and sustainable agricultural practices. The *Smart Agriculture and Environmental Intelligence Platform* combines heterogeneous networking infrastructures, IoT systems, edge computing capabilities, AI analytics services, and distributed data management platforms. The service enables the collection, processing, analysis, and sharing of environmental and agricultural data originating from sensors, weather stations, drones, and remote sensing infrastructures. The platform supports experimentation with precision agriculture techniques, climate monitoring services, and decision-support systems capable of operating under diverse connectivity conditions. The combination of local edge processing and regional AI capabilities allows institutions to maintain local control over data while benefiting from continental-scale analytics capabilities.

Pilot Deployments

A first pilot deployment could focus on precision agriculture testbeds in Kenya and Senegal. IoT sensors deployed in agricultural fields would collect soil, climate, and crop information, while local Edge-AI nodes would perform data processing and inference close to the data source. Typical applications include crop disease detection, irrigation optimisation, yield prediction, drought monitoring, biodiversity assessment, climate adaptation strategies, and environmental sustainability monitoring.

5.4 Digital Health and Telemedicine Platform

Healthcare was consistently identified as one of the domains where digital research infrastructures could generate immediate societal impact. Participants highlighted the need for improved access to healthcare services, support for medical research, secure management of health data, and AI-enabled healthcare innovation. The *Digital Health and Telemedicine Platform* combines secure data management infrastructures, federated identity services, AI analytics capabilities, virtual research environments, and edge computing resources to support collaborative healthcare applications. The platform is

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designed around principles of privacy, security, interoperability, and data sovereignty. Sensitive medical data remain under local institutional control while research collaboration is enabled through federated services and distributed AI techniques.

Pilot Deployments

A first pilot could connect university hospitals and healthcare institutions in Tunisia and South Africa using the DIGITAfrica infrastructure. The pilot would support teleconsultation services, distributed medical data analysis, and collaborative AI model development for diagnostic support. A second pilot could focus on federated learning for medical image analysis. Healthcare institutions would train AI models collaboratively without transferring patient data, demonstrating the relevance of distributed AI infrastructures for sensitive research domains. Applications include telemedicine, remote diagnosis, AI-assisted medical imaging, healthcare training, and digital public health services.

5.5 Digital Education and Capacity Building Platform

One of the strongest findings emerging from both consultation workshops concerned the critical importance of human capacity development. Stakeholders consistently emphasised that infrastructure investments must be accompanied by sustainable mechanisms for education, training, skills development, and community building. The *Digital Education and Capacity Building Platform* therefore represents a transversal flagship service supporting all other domains. The platform combines virtual laboratories, online learning environments, experimentation platforms, educational datasets, and collaborative workspaces into a common educational ecosystem. Building upon the DIGITAfrica blueprints and the educational services already available within SLICES-RI and SoBigData RI, the platform provides practical training opportunities in areas such as AI, networking, cloud computing, data science, cybersecurity, and digital innovation.

Pilot Deployments

The educational laboratories already demonstrated during the Tunis workshop provide an initial proof-of-concept for this flagship service. Future pilots could deploy lightweight educational nodes in universities across participating countries, offering remote access to AI laboratories, networking testbeds, and virtual experimentation environments. Another pilot could establish a Pan-African Digital Sciences Academy, integrating online courses, practical laboratories, micro-credentials, and communities of practice around the DIGITAfrica infrastructure. Applications include virtual laboratories, AI training programmes, professional certification programmes, undergraduate and postgraduate education, and lifelong learning initiatives.

6 Conclusion

This deliverable concludes the demand analysis activities carried out within WP1 of the DIGITAfrica project. Building upon the initial findings reported in Deliverable D1.1, the present document provides an updated understanding of the African digital research infrastructure landscape and translates the identified needs into concrete directions for the future development of a Pan-African Research Infrastructure for Digital Sciences.

The analyses presented throughout this deliverable confirm the existence of a rapidly evolving but still highly fragmented digital research infrastructure ecosystem across Africa. While important progress has been achieved through national initiatives, National Research and Education Networks, high-performance computing deployments, innovation hubs, and emerging artificial intelligence ecosystems, significant disparities remain in terms of infrastructure maturity, access to advanced computing resources, connectivity, technical expertise, and long-term sustainability. At the same time, the growing number of national digital strategies, AI initiatives, and regional infrastructure projects demonstrates an increasing recognition of digital sciences as a strategic driver of scientific excellence, innovation, and socio-economic development.

The consultation activities conducted throughout WP1 have consistently highlighted a common set of priorities across countries and stakeholder communities. These include the need for shared and interoperable research infrastructures, support for data-intensive and AI-driven research, mechanisms for strengthening data sovereignty and responsible innovation, sustainable capacity-building programmes, and governance frameworks capable of supporting long-term collaboration across institutions and national borders. The outcomes of the Second DIGITAfrica Consultation Workshop further confirmed broad stakeholder support for the federated infrastructure vision proposed by the project and provided valuable feedback on implementation approaches, governance models, and deployment strategies.

An important contribution of this deliverable is the analysis of existing European Research Infrastructures and their relevance for the African context. The experiences of SLICES-RI and SoBigData RI demonstrate that federated infrastructures can successfully support large and diverse scientific communities through shared services, common governance frameworks, and reusable technical components. The identification of reusable services such as federated authentication and authorisation, metadata and data management systems, virtual research environments, cloud and HPC resources, experiment orchestration services, and digital training platforms provides a concrete foundation upon which DIGITAfrica can build its future infrastructure.

The flagship services proposed in this deliverable represent the first translation of stakeholder requirements into integrated infrastructure capabilities. The AI and Data Innovation Platform, the Smart Agriculture and Environmental Intelligence Platform, the Digital Health and Telemedicine Platform, and the Digital Education and Capacity Building Platform collectively illustrate how a future Pan-African digital research infrastructure can support both scientific research and societal impact. These flagship services are not

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intended as final implementations but rather as representative deployment scenarios capable of guiding future pilot activities and validating the relevance of the DIGITAfrica approach.

The findings of this deliverable also reinforce a central conclusion that emerged repeatedly throughout the project: the future African digital research infrastructure ecosystem should be based on a tightly coordinated federated and distributed model rather than a fully centralised approach. The diversity of national contexts, levels of infrastructure maturity, regulatory frameworks, and available resources make a flexible and modular architecture essential. A federated model enables institutions and countries to contribute according to their capacities while benefiting from shared services, interoperability, and collaborative governance mechanisms.

With the completion of WP1, DIGITAfrica now transitions from the demand analysis phase towards the implementation and validation phase. The results presented in this deliverable provide the foundation for the subsequent technical activities focused on blueprint refinement, pilot deployments, service integration, and infrastructure experimentation. They also provide essential input for the sustainability, governance, and stakeholder engagement activities that will continue throughout the project.

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