Funded by the European Union

I3HIES | Boosting Interregional Innovation Investment and cooperation among Health Innovation EcoSystems

CLUJ IT

REPORT

S3-BASED REGIONAL ACTION PLAN AND ROADMAP FOR NORTH-WEST ROMANIA

Strategic framework for economic competitiveness and innovation leadership

Funded by the European Union

I3HIES | Boosting Interregional Innovation Investment and cooperation among Health Innovation EcoSystems

CLUJ IT

Project: I3HIES - Boosting Interregional Innovation Investment and cooperation among Health Innovation Ecosystems
Region: North-West Development Region, Romania Target Authority: NW RDA (North-West Regional Development Agency)
Document Purpose: Strategic guidance for regional business competitiveness and innovation ecosystem development
Date: October 2025

This report was developed under the I3HIES Project, which supports collaboration and investment across Europe's health innovation landscape. It focuses on the North-West Region of Romania, an area with strengths in healthcare, IT, and manufacturing, yet with a GDP per capita that is only 36% of the EU average. The Strategic Action Plan identifies health technology as a €2.4 billion market opportunity and outlines steps to realign regional innovation priorities, enhance competitiveness, and support the shift toward high-value, sustainable sectors.

The plan provides practical, evidence-based recommendations to help the North-West Regional Development Agency (NW RDA) and key stakeholders transform the region into a European hub for health innovation, fostering interregional cooperation and inclusive growth.

This project was funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or the European Innovation Council and SMEs Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Coordinated by:
Andrei Kelemen

Prepared by:
Laviniu Chiș, Andreea Lodoabă-Cordon

Technical support:
Diana Câmpian, Bianca Ionel

2025

TABLE OF CONTENT

EXECUTIVE SUMMARY

The North-West Region of Romania stands at a critical juncture in its economic development trajectory. While the region encompasses 13.3% of Romania's population across six counties and demonstrates strong foundations in healthcare, information technology, and manufacturing, the current strategic framework fails to capitalize on these competitive advantages. The region's GDP per capita remains only 36% of the EU average, significantly below Romania's national average of 42.1%, underscoring the urgent need for strategic realignment and enhanced competitive positioning.

This Strategic Action Plan addresses fundamental disconnects between the region's current Smart Specialization Strategy and economic reality. Our analysis reveals that healthcare represents a €2.4 billion market opportunity with substantial regional competitive advantages, while the automotive sector faces systematic decline across Europe. The document provides evidence-based recommendations for transforming regional innovation priorities, implementing dynamic monitoring systems, and establishing sustainable competitive advantages through strategic focus on high-growth sectors, such as health tech.

The framework aims to be a practical guide for NW RDA and regional businesses seeking competitive enhancement, entrepreneurs developing market positioning, and innovation stakeholders pursuing strategic investment opportunities. Implementation will position the North-West Region on the right path toward becoming a relevant European hub for health innovation while supporting the systematic transition of traditional industries toward sustainable competitive advantage.

PART I. GENERAL INFORMATION

1.1 I3HIES project context and regional integration

The I3HIES project is a strategic initiative that connects nine European regions to strengthen health innovation ecosystems through systematic interregional collaboration and policy development. As one of the five less developed regions in the consortium, Romania's North-West Region benefits from knowledge transfer, best practice sharing, and collaborative innovation development across medical devices, emergency equipment, and Medical Device Regulation compliance.

The I3HIES framework emphasizes quadruple helix collaboration, bringing together academic institutions, government agencies, private companies, and civil society organisations to

identify barriers and co-design solutions. In Romania's North-West Region, this collaboration centers on Cluj IT Association as a technology cluster facilitator and on stakeholder connections across the health technology sector.

Through I3HIES participation, the North-West Region gains access to established health innovation networks, international partnership opportunities, and proven methodologies for ecosystem development. The project provides systematic support for regional transformation while ensuring compliance with European Union policy frameworks and funding requirements.

1.2 Regional Smart Specialisation Strategy alignment

Romania's North-West Region Smart Specialization Strategy (RIS3 NV 2021-2027) lays the foundation for innovation-driven economic development by targeting investment in sectors with demonstrated competitive advantages. The strategy identifies health innovation as a core priority under Pillar I, recognizing the region's critical mass of enterprises, research institutions, and specialized expertise.

The RIS3 NV framework encompasses interconnected domains, including agri-food, cosmetics and food supplements, and health, all of which have a direct impact on population quality of life while exploiting unique regional resources and capabilities. This integrated approach provides a foundation for developing a comprehensive health innovation ecosystem through systematic collaboration across sectors and stakeholder groups.

However, the implementation of current RIS3 priorities demonstrates significant gaps between strategic objectives and practical execution. Healthcare sector capabilities remain fragmented across multiple institutions, lacking systematic coordination, while funding allocation fails to reflect the sector's economic importance and growth potential. Technology transfer from academic research to commercial application operates below optimal levels due to insufficient bridge-building infrastructure and support services.

Our analysis indicates that strategic enhancement rather than a complete revision offers the most effective approach to addressing these limitations. The existing RIS3 framework provides a solid foundation for systematic improvement through targeted additions, the implementation of monitoring mechanisms, and enhanced stakeholder engagement. This approach ensures continuity while addressing confirmed performance gaps through evidence-based intervention.

1.3 Policy instrument target

The primary policy instrument targeted for enhancement is the North-West Region Smart Specialisation Strategy Implementation Framework, with a focus on health innovation components and their integration with broader regional development objectives.

North-West Regional Development Agency (NW RDA) serves as the implementing authority in cooperation with relevant national ministries and European Union coordination mechanisms.

Implementation is carried out through the Regional Operational Programme 2021-2027, which allocates €327.6 million to Priority 1, "A competitive region through innovation, digitization and dynamic enterprises." The current allocation demonstrates a systematic misalignment with RIS3 priorities, providing generic support rather than specialized innovation-ecosystem development. Our recommendations focus on strategic realignment to optimize effectiveness while maintaining compliance with European Regional Development Fund requirements.

The enhanced framework integrates with existing institutional structures rather than requiring entirely new policy development. The Ministry of Health provides policy coordination for health innovation components, while the Ministry of Research, Innovation, and Digitalization ensures alignment with national innovation priorities. The Ministry of Regional Development, Public Works, and Administration oversees the integration of regional development programs and compliance with European Union requirements.

This approach minimizes implementation barriers while maximizing strategic impact by systematically enhancing established policy mechanisms.

Success depends on coordinated action across multiple institutional levels combined with sustained stakeholder engagement throughout the enhancement process.

1.4 Why this strategy matters for regional business competitiveness

Regional economic development in the contemporary global economy requires systematic coordination between innovation policy, business development incentives, and market-driven specialization strategies. The North-West Region's current challenges reflect broader issues affecting regional competitiveness across emerging European economies: fragmented policy implementation, misaligned funding mechanisms, and inadequate translation of academic capabilities into commercial advantages.

The region's economic structure demonstrates significant untapped potential for innovation-driven growth. Healthcare expenditure amounts to €15.6 billion annually at the national level, with substantial regional concentration, while medical technology markets offer a €2.4 billion opportunity for specialized development.

Manufacturing employs 26.8% of the regional workforce, providing a foundation for technology integration and competitive enhancement initiatives. Services dominate employment at 42.5%, requiring systematic digitalization support and facilitation of innovation adoption.

This economic composition reveals critical gaps in current strategic frameworks. The healthcare sector's growth potential receives insufficient systematic support despite demonstrated competitive advantages, including medical universities, specialized research institutes, and established clinical infrastructure. Information technology capabilities, while recognized through Cluj IT Cluster activities, are lacking. Integration with broader economic sectors requires support for digital transformation.

For existing businesses, strategic framework enhancement provides systematic pathways for competitive positioning improvement, technology adoption support, and market expansion facilitation. Manufacturing companies gain access to digitalization resources, assistance with integrating environmental technology, and support for international market development. Healthcare providers benefit from innovation testing infrastructure, regulatory compliance guidance, and technology commercialisation facilitation.

Emerging enterprises receive structured support to identify market opportunities, coordinate resource access, and facilitate partnership development. Technology startups gain connection to established companies requiring digital solutions, while research commercialisation benefits from systematic bridge-building between academic capabilities and market applications. International business development receives enhanced support through strategic partnership facilitation and competitive positioning assistance.

Innovation stakeholders, including venture capital, business development services, and international partners, gain access to systematic opportunity identification, risk-mitigation support, and performance monitoring to inform investment decision-making. The enhanced strategic framework creates a predictable environment for sustained investment while providing measurable indicators for success assessment and strategic adjustment.

PART II. POLICY CONTEXT

2.1 Current health innovation ecosystem assessment

The North-West Region demonstrates strong foundation capabilities for health innovation development that remain underutilized due to systemic coordination gaps and limited strategic focus. Our assessment reveals strong academic infrastructure, diverse healthcare provider networks, emerging technology capabilities, and established international connections that require systematic integration to realise a competitive advantage.

Academic infrastructure includes specialised medical institutions providing research capabilities, clinical expertise, and human capital development essential for innovation ecosystem functionality. Babes-Bolyai University maintains strong research programs across multiple health-related disciplines, while Iuliu Hatieganu University of Medicine and Pharmacy provides specialized medical

expertise and clinical research capabilities. The Technical University of Cluj-Napoca contributes engineering and technology development expertise, particularly relevant for medical device innovation and digital health solution development.

Healthcare provider networks encompass major regional hospitals, specialized medical centers, and private healthcare facilities providing diverse clinical environments for innovation, testing, and validation. The upcoming Regional Emergency Hospital represents significant infrastructure development, creating unique opportunities for systematic integration of innovation during operational establishment. Existing hospitals demonstrate varying levels of technology adoption and innovation engagement, indicating potential for systematic enhancement through coordinated support mechanisms.

The technology sector capabilities center around Cluj IT Cluster activities with established international partnerships, proven export development success, and growing expertise in healthcare technology applications. Digital health companies are demonstrating increasing market penetration, while medical device development remains limited despite strong technical foundations. Cross-sector collaboration between technology companies and healthcare providers operates below optimal levels due to insufficient systematic facilitation and coordination mechanisms.

International connections include participation in European innovation networks, established partnerships with peer regions, and growing recognition for technology development capabilities. However, these connections remain fragmented across individual institutions rather than operating through systematic regional coordination mechanisms that could amplify impact and create sustained competitive advantages.

The ecosystem demonstrates clear potential for systematic enhancement through strategic coordination, resource integration, and performance-focused development initiatives. Current capabilities provide a solid foundation for developing competitive advantage, while identified gaps indicate specific areas requiring targeted intervention and support.

2.2 Gap analysis and innovation needs assessment

Systematic analysis of regional innovation capabilities reveals specific gaps that limit the development of competitive advantage and the realization of market opportunities.

These gaps span multiple dimensions, including **infrastructure gaps, human capital, coordination mechanisms, funding allocation, and international positioning,** each requiring targeted interventions to enhance the ecosystem.

- **Infrastructure gaps** include insufficient systematic connections between research capabilities and clinical validation environments.

Academic research programs generate substantial intellectual property and technology development outcomes that require systematic pathways for clinical testing and market validation. Current infrastructure lacks specialized facilities for medical device testing, digital health solution validation, and regulatory compliance support, all of which are essential for commercial development success.

- **Human capital** development demonstrates strong foundation capabilities through established educational institutions, but lacks a systematic connection between academic preparation and industry requirements. Technology sector growth is driving increased demand for specialized expertise in healthcare technology applications, regulatory compliance, and international business development. Current educational programs provide general preparation but require further refinement to meet specialized innovation-ecosystem requirements.

- **Coordination mechanisms** operate at suboptimal levels due to fragmented institutional structures and insufficient systematic facilitation. Research institutions, healthcare providers, technology companies, and government agencies pursue overlapping objectives without sufficient coordination to realize synergy. Existing networking activities provide a foundation for enhancement but require systematic facilitation and performance-focused coordination to develop a competitive advantage.

- **Funding allocation** through current mechanisms fails to reflect the requirements of the innovation ecosystem and the growth sector's priorities. Regional Operational Programme resources provide generic support rather than specialized ecosystem development assistance. European Union funding opportunities remain underutilised due to insufficient systematic coordination and insufficient support for application development. Private sector investment potential exists but requires enhanced risk mitigation and support for opportunity identification.

- **International positioning** requires systematic development to build a competitive advantage and capitalize on market opportunities. Current international connections provide a foundation for expansion but lack systematic coordination to achieve maximum impact and results. Regional brand development remains limited despite strong individual institutional capabilities and growing market recognition for technology development expertise.

These gaps indicate specific opportunities for strategic intervention through systematic coordination enhancement, resource reallocation optimisation, and performance-focused development initiatives.
Addressing identified gaps will create foundation for sustained competitive advantage development and market leadership achievement in targeted specialisation areas.

2.3 Policy enhancement opportunity

The current RIS3 NV implementation provides an established policy framework for systematic enhancement through targeted infrastructure development, improved stakeholder collaboration mechanisms, and the establishment of a performance monitoring system. Rather than requiring entirely new policy instruments, strategic enhancement of existing implementation components addresses identified gaps while leveraging documented regional strengths through proven methodologies.

The health innovation priority area within RIS3 NV establishes a foundation for systematic expansion through specialized support mechanism development and the enhancement of coordination infrastructure. The existing policy framework recognizes the importance of the healthcare sector while providing insufficient systematic support for developing a competitive advantage and realizing market opportunities. Enhancement involves targeted resource allocation, implementation of performance measurement, and systematization of stakeholder engagement.

The Regional Operational Programme 2021-2027 provides substantial financial resources, requiring strategic realignment to support effective innovation ecosystem development. Current allocation demonstrates a generic approach rather than a specialized development focus, creating opportunities.

For systematic improvement through performance-based resource distribution and the development of sector-specific support mechanisms.

European Union funding frameworks, including Horizon Europe, the Digital Europe Programme, and specialized health innovation initiatives, offer additional resource opportunities that require systematic coordination for optimal utilization. The current approach demonstrates fragmented application development rather than strategic coordination across institutions and opportunity areas, indicating substantial improvement potential through systematic enhancement.

Institutional coordination mechanisms require enhancement to support optimal ecosystem development while maintaining existing organizational structures and responsibilities. NW RDA provides regional development coordination capabilities that need expansion to facilitate the innovation ecosystem. Academic institutions demonstrate established capabilities requiring systematic connections for market application development.

Healthcare providers possess clinical expertise and infrastructure requiring integration with innovation development processes.

Private sector engagement demonstrates growth potential that requires systematic facilitation for optimal ecosystem development. Technology companies possess technical capabilities requiring connection with healthcare application opportunities.

The healthcare sector businesses demonstrate market knowledge requiring integration with innovation development processes. International partners provide market access and technical expertise, requiring systematic coordination to maximize regional benefits.

Policy enhancement opportunities encompass the systematic integration of existing capabilities, strategic resource reallocation to optimize performance, and the establishment of a coordination mechanism to sustain competitive advantage development.

Implementation requires coordinated action across institutional levels, combined with systematic performance monitoring and strategic adjustment mechanisms to maintain continued effectiveness.

PART III. CRITICAL S3 ANALYSIS

This section applies a systematic analysis framework to identify fundamental implementation failures within the current RIS3 NV approach. Each major problem area receives a comprehensive examination following the structure: Problem identification → Manifestation and Impact documentation → Root Cause Analysis → Solution Development with specific implementation recommendations.

3.1 Undated S3 strategy

The current RIS3 NV strategy has remained unchanged since the completion of the 2020 Entrepreneurial Discovery Process, despite dramatic market shifts, technological developments, and evolving competitive landscapes affecting regional specialization areas.

The most visible manifestation of strategy rigidity appears through continued emphasis on sector priorities that no longer reflect market reality or regional competitive positioning. Automotive sector integration remains implicit within manufacturing priorities despite systematic European decline, with the Romanian car marketdropping 6.6% in 2025 and over 53,666 announced job losses across the European Union automotive employment. Meanwhile, the healthcare technology sector demonstrates exponential growth with €16.2 million venture capital investment during the 2020-2024 period, yet receives minimal strategic attention within current priority structures.

Regional competitive positioning suffers from misallocation of development resources toward declining sectors while high-growth opportunities receive insufficient systematic support. The healthcare sector represents a €2.4 billion national market opportunity with substantial regional concentration advantages, including medical universities, specialized research institutes, and established clinical infrastructure.

Innovation ecosystem development operates below potential due to strategic frameworks that fail to recognize emerging opportunities and changing competitive landscapes. Digital health technologies demonstrate substantial regional capabilities through established IT sector expertise and growing healthcare technology company presence, yet lack systematic. Integration support for cross-sector collaboration and market development.

International competitiveness deteriorates through strategic approaches that emphasize traditional sectors facing systematic challenges rather than emerging opportunities offering potential competitive advantage. Regional positioning within European innovation networks suffers from strategic frameworks that fail to capitalize on demonstrated strengths while pursuing generic approaches lacking competitive differentiation.

The RIS3 NV document includes a monitoring framework in chapter 7 but lacks implementation mechanisms for systematic performance assessment and strategic adjustment. The current approach treats monitoring as an administrative requirement rather than a strategic management tool for optimizing competitive positioning and improving resource allocation.

Quarterly performance indicators remain undefined despite European Commission requirements for the implementation of systematic S3 monitoring.

Annual review processes operate through administrative reporting rather than strategic assessment, combining quantitative performance measurement with qualitative stakeholder feedback integration and competitive positioning analysis.

Strategic adjustment procedures for priority area modification based on performance evidence and market evolution remain unestablished. Current governance structures lack systematic mechanisms for integrating stakeholder feedback, market intelligence, and competitive positioning analysis into strategic decision-making.

Administrative convenience favors the continuation of existing approaches rather than systematic enhancements that require coordination effort, stakeholder engagement, and the implementation of performance measurement. Current systems prioritize administrative simplicity over strategic effectiveness and the development of competitive advantage.

Dynamic performance monitoring system implementation. Establish a quarterly performance assessment that combines quantitative indicators with qualitative stakeholder feedback to systematically evaluate strategic positioning. Performance metrics encompass economic impact measurement, including GDP contribution, employment creation, and investment attraction across priority areas with sector-specific analysis for competitive positioning assessment.

Quarterly business community consultation through a systematic survey methodology provides direct feedback on the effectiveness of the strategic framework, market opportunity identification, and competitive barrier assessment. Academic institution collaboration evaluation measures research commercialization success, technology transfer outcomes, and industry partnership development to assess ecosystem effectiveness.

The annual strategic review process integrates performance data analysis, stakeholder feedback, and international benchmarking to develop systematic recommendations for strategic adjustment. Review outcomes provide binding recommendations for priority-area modification, resource-allocation optimization, and enhanced coordination mechanisms, based on evidence rather than administrative convenience. Using the existing Regional Programme Monitoring Committee

Market-responsive priority adjustment protocol. Implement automatic trigger mechanisms for priority area reassessment based on quantitative performance thresholds and qualitative market evolution indicators. Declining sector performance below 70% of projected targets triggers a mandatory strategic review with stakeholder consultation and alternative development assessment.

Emerging sector growth exceeding 150% of the regional average triggers an integration assessment for priority-area development and resource allocation.

Healthcare sector growth indicators, including investment attraction, company formation, and employment creation, demonstrate systematic exceeding of growth thresholds requiring strategic integration consideration.

An international competitive positioning assessment below 75% of peer regions triggers the development of comprehensive strategic review and modification recommendations. Systematic benchmarking against established health innovation regions provides clear indicators for strategic adjustment requirements and opportunities to improve competitive positioning.

Stakeholder-driven governance enhancement. Establish a Regional Innovation Council (similar to the Regional Monitoring Committee) with rotating leadership among major stakeholder categories for systematic strategic input and decision-making authority. Business community representatives provide market intelligence and competitive positioning feedback, while academic institutions contribute research commercialization expertise and technology development insights.

Quarterly consultation protocols require systematic engagement across all stakeholder categories, with binding recommendation authority for strategic modifications and resource allocation adjustments.
Consultation outcomes are mandatory considerations in strategic decision-making processes, with transparent justification required for rejecting recommendations.

Performance-based resource allocation adjustment enables systematic realignment between funding distribution and strategic effectiveness demonstration. Priority areas achieving superior performance receive enhanced resource allocation, while underperforming areas undergo systematic review and potential reallocation.

3.2 Major GDP contributing sectors excluded from S3 priorities

The current RIS3 NV priority structure systematically excludes sectors that contribute substantially to regional GDP and employment while emphasizing areas with limited growth potential and prospects for competitive advantage.

The healthcare sector is one of the most significant strategic oversight areas, despite contributing €15.6 billion nationally, with substantial regional concentration, including 3,665 health sector firms representing 13.61% of the national total and 14,527 healthcare employees representing 6.5% of national employment. Regional infrastructure includes medical universities, multiple specialized institutes, and a growing presence of healthcare technology companies, demonstrating clear potential for competitive advantage that requires systematic strategic support.

The manufacturing sector receives generic rather than strategic support,despite employing 26.8% of the regional workforce and providing a foundation for technology integration, digitalization, and sustainable development initiatives support addressing technology adoption barriers, environmental compliance requirements, and the need to enhance international competitiveness.

Services sector dominance at 42.5% of regional employment remains excluded from systematic innovation support mechanisms, despite representing the largest employment category and the primary target for digitalization initiatives. Current strategic frameworks focus on traditional sectors rather than on service innovation, requiring systematic technology integration, support for digital transformation, and assistance with productivity enhancement.

Information technology sector capabilities are recognized through Cluj IT Cluster activities but lack systematic integration with broader economic sectors that require digital transformation support. The potential for cross-sector collaboration remains underutilized because strategic frameworks emphasize individual-sector development rather than systematic integration to enhance competitive advantage.

The evolution of the regional economic structure toward higher-value-added activities receives insufficient strategic support, as frameworks emphasize traditional approaches rather than innovation-driven competitive positioning. Service sector growth, healthcare technology development, and digital integration

opportunities require systematic strategic support to realize competitive advantage and enhance market positioning.

Academic research bias in priority selection methodology. RIS3 NV priority identification emphasizes academic research capabilities and institutional strengths rather than economic impact potential and market opportunity assessment. Healthcare priority focuses on "research and development outputs" rather than commercial application potential and market development opportunities.

The prioritisation methodology overemphasizes existing research infrastructure and potential academic collaborations rather than business development requirements, employment impact considerations, and competitive positioning. Academic institutions possess strong research capabilities that require systematic connections to market applications to realize economic impact.

Limited consideration of cross-sector integration potential results in priority areas operating in isolation rather than in systematic coordination to realize synergies and enhance competitive advantage. Healthcare sector capabilities require integration with information technology expertise for the development of digital health solutions and international market positioning.

Outdated economic structure analysis. Priority area identification relies on historical financial analysis, failing to account for sector evolution, growth trajectory assessment, and changes in competitive positioning that affect regional specialization opportunities. The services sector growth of 42.5% is inadequately reflected in strategic priority structures, requiring systematic support for innovation.

Healthcare sector expansion through Regional Emergency Hospital infrastructure development, medical university capability enhancement, and the growth of technology company presence receives insufficient recognition within current strategic frameworks. Infrastructure investment creates unique opportunities for systematic innovation ecosystem development, requiring strategic integration and coordination support.

The manufacturing sector's evolution toward greater technology integration and environmental compliance requirements receives generic rather than specialized support, addressing only specific innovation adoption barriers and competitive positioning enhancement needs. Traditional manufacturing approaches require systematic enhancement through technology integration and sustainable development initiatives.

GDP-weighted priority assessment implementation. Establish a systematic economic impact analysis for priority-area evaluation, combining GDP contribution, employment significance, growth trajectory assessment, and potential competitive advantage measurement. Healthcare sector

analysis demonstrates a €2.4 billion market opportunity, with regional concentration advantages that require strategic integration consideration.

Sector-specific analysis encompasses detailed NACE code evaluation with employment correlation, growth trajectory assessment for the 2020-2024 period, and international competitiveness positioning through peer region benchmarking. Economic impact measurement provides an objective foundation for evaluating strategic priority areas and optimizing resource allocation.

Annual economic assessment updates enable systematic adjustment of priority areas based on sector performance, market evolution, and changes in competitive positioning. Dynamic assessment ensures strategic frameworks remain aligned with economic reality rather than historical assumptions that limit the development of competitive advantage.

Cross-sector integration priority development. Develop strategic priorities that emphasize systematic integration across traditional sector boundaries to realize synergy and enhance competitive advantage. The healthcare-IT integration priority addresses digital health solution development while leveraging established regional capabilities in both sectors to enhance international competitive positioning.

Manufacturing-services integration priority enables systematic digitalization support, addressing technology adoption barriers while creating opportunities for productivity enhancement and improved international competitiveness. Cross-sector approaches optimise resource utilisation while creating opportunities for innovation, development, and enhanced market positioning.

Regional economic structure alignment ensures strategic priorities reflect actual employment distribution and GDP contribution rather than academic research infrastructure emphasis. Services sector innovation support addresses the largest employment category's requirements, while healthcare technology development capitalizes on demonstrated competitive advantages to position in the international market.

Market-driven performance measurement. Implement systematic business outcome tracking for priority area evaluation, including employment creation, GDP contribution, export development, and international competitiveness positioning measurement. Performance indicators encompass sector-specific targets with annual assessment and strategic adjustment consideration based on achievement evidence.

Innovation pipeline tracking from research through commercialization provides a systematic assessment of priority area effectiveness for economic impact generation and competitive advantage development.

Technology transfer measurement, business development outcomes, and international partnership development enable a comprehensive evaluation of effectiveness.

Stakeholder satisfaction assessment through systematic business community consultation provides direct feedback on the relevance of strategic priorities, the effectiveness of support mechanisms, and the enhancement of competitive positioning for continuous improvement and strategic adjustment considerations.

3.3 Funding misalignment between S3 and Regional Operational Programme

The Regional Operational Programme 2021-2027 Priority 1 allocation, totaling €327.6 million, operates independently of RIS3 NV's strategic priorities, providing generic business support rather than specialised innovation ecosystem development aligned with documented competitive advantages. Resource allocation analysis reveals a systematic disconnect between declared strategic priorities and the actual funding distribution mechanisms.

RSO1.1 Research and Innovation receives €73.3 million allocated primarily for genericRsD infrastructure development rather than sector-specific innovation capabilities addressing documented competitive advantages in healthcare technology, digital integration, or cross-sector collaboration enhancement.

RSO1.2 Digital Transformation allocation of €14.3 million provides basic SME digitalization support without a strategic connection to healthcare sector requirements, manufacturing technology integration needs, or cross-sector digital solution development to address specific regional competitive positioning opportunities. Generic digitalization approaches fail to capitalize on established IT sector capabilities for specialized application development.

RSO1.3 SME Competitiveness represents the largest allocation at €186.5 million for general business development, lacking a systematic connection to RIS3 priorities, sector specialization criteria, or competitive advantage development objectives. Generic business support approaches fail to address specific innovation adoption barriers, technology integration requirements, or international market development needs within priority sectors.

Administrative separation between strategic planning and operational programme implementation creates systematic barriers to effective resource utilization for the development of competitive advantage. Different institutional responsibilities, stakeholder consultation processes, and performance measurement fragmented approaches fail to optimize regional development potential through strategic coordination.

The economic impact suffers from resource distribution, which emphasizes generic approaches rather than specialized ecosystem development for competitive advantage. Regional businesses receive general support rather than systematic assistance to address specific sector challenges, innovation adoption barriers, and requirements to enhance international competitive positioning.

Institutional separation of strategic planning and fund management. RIS3 NV development was carried out through specialized working groups and academic consultation processes, while the Regional Operational Programme design used separate stakeholder engagement and priority identification procedures. Timeline differences between strategy development and operational programme preparation created systematic barriers to effective integration and coordination.

NW RDA maintains responsibility for both operational programme implementation and RIS3 coordination with quadruple-helix stakeholders yet lacks systematic mechanisms for policy integration and resource allocation optimization. Current governance structures limit the potential for systematic coordination and the achievement of strategic alignment.

European Union funding requirements emphasize administrative compliance and generic regional development objectives rather than specialized innovation ecosystem development and competitive advantage enhancement. Operational programme design prioritizes broad accessibility over strategic focus and performance-based allocation to achieve optimal regional development impact.

Performance measurement disconnection. Current funding mechanisms lack a systematic link between resource allocation and the assessment of RIS3 priority achievement. Performance indicators emphasize administrative outputs, including the number of projects supported and funding distributed, rather than strategic outcomes, as competitive positioning improvement and innovation ecosystem development.

Strategic priority areas receive no systematic performance measurement through operational programme implementation, eliminating feedback mechanisms for optimizing resource allocation and assessing priority area effectiveness. Generic business support provision prevents systematic evaluation of sector-specific competitive advantage development and market positioning enhancement.

Resource allocation adjustment mechanisms remain unavailable due to an administrative focus on funding distribution rather than on achieving strategic impact and improving competitive positioning. Current approaches prioritize administrative convenience over strategic effectiveness and the maximization of regional development potential.

Integrated strategic planning protocol. Establish a mandatory coordination mechanism ensuring systematic alignment between RIS3 development and operational programme design through unified stakeholder consultation, synchronized revision cycles, and integrated performance measurement systems. Strategic priority identification directly determines operational programme resource allocation and the development of support mechanisms.

The joint governance structure includes NW RDA, academic institutions, business community representatives, and healthcare sector stakeholders, with systematic coordination responsibilities for strategic alignment, maintenance, and performance optimization. Unified decision-making processes ensure that resource allocation supports the development of competitive advantage rather than generic regional development approaches.

Annual strategic review integration enables systematic adjustment of both strategic priorities and operational programme implementation based on performance evidence, market evolution, and competitive positioning assessment. Coordinated revision processes optimize resource utilization while maintaining European Union compliance requirements and administrative effectiveness.

Performance-based resource allocation framework. Implement a systematic funding allocation based on RIS3 priority achievement demonstration, with a minimum 60% resource allocation requirement for projects that demonstrate clear strategic priority contribution. Performance measurement encompasses sector-specific indicators, including innovation adoption, improvements in competitive positioning, and success in international market development.

Priority area funding ratios are adjusted annually based on achievement evidence, with superior-performing areas receiving enhanced resource allocation and underperforming regions facing systematic review and potential reallocation. Competition among priority areas for enhanced funding creates a systematic incentive to optimize performance and maintain strategic focus.

The strategic impact measurement system tracks funding outcomes against RIS3 objectives, including improvements in competitive positioning, development of the innovation ecosystem, and achievement of international recognition. Systematic assessment enables resource allocation optimization while providing a foundation for evidence-based strategic priority adjustment and enhanced coordination mechanisms.

Sector-specific support mechanism development. Create specialized funding instruments that address specific requirements within priority sectors rather than generic business development approaches, thereby limiting the growth of competitive advantage. Healthcare sector support mechanisms address

medical device development, digital health solution validation, and regulatory compliance assistance to enhance international market positioning.

The digital transformation specialization provides targeted support for healthcare-IT integration, manufacturing digitalization, and cross-sector innovation development, rather than basic digitalization assistance. It fails to capitalize on regional competitive advantages. Specialized approaches optimize resource utilization while systematically enhancing competitive positioning.

International market development support addresses specific export development requirements, partnership facilitation needs, and competitive positioning within priority sectors, rather than generic internationalization assistance, thereby limiting market penetration potential. Specialized support mechanisms enable systematic competitive advantage realization and sustained market positioning enhancement.

PART IV. DETAILS OF THE PROPOSED ACTIONS

4.1 Major GDP contributing sectors excluded from S3 priorities

Based on comprehensive economic analysis, stakeholder consultation outcomes, and international competitiveness assessment, we propose a systematic restructuring of regional innovation priorities to reflect actual GDP contribution, employment significance, and growth potential, while capitalizing on documented competitive advantages.

Priority 1: HealthTech and medical innovation

The healthcare technology sector represents one of the most significant opportunities for competitive advantage development and international market positioning in the North-West Region. Comprehensive analysis demonstrates substantial foundation capabilities, growing market opportunities, and systematic competitive advantages that require strategic development to realize optimal economic impact.

The healthcare sector demonstrates exceptional economic significance through the €2.4 billion national medical technology market, with substantial regional concentration advantages. Regional infrastructure includes 3,665 health sector firms, representing 13.61% of the national total; 14,527 healthcare employees, representing 6.5% of the national workforce; and a comprehensive academic infrastructure, including medical universities and specialized research institutes.

Investment opportunity indicators include €16.2 million venture capital investment during the 2020-2024 period, demonstrating systematic market confidence and growth potential.

Level 3 EIT Health Experimenter status recognizes regional innovation capabilities and provides systematic access to European health innovation networks for partnership development and market expansion opportunities.

The Regional Emergency Hospital infrastructure development creates unique opportunities for systematic integration of innovation during operational establishment. The facility's 846-bed capacity, 22 operating rooms, and specialized emergency care capabilities provide an exceptional environment for medical technology testing, validation, and clinical research development with direct market application potential.

Regional competitive advantages include established clinical expertise, academic research capabilities, technology development infrastructure, and access to international partnerships through existing networks. Healthcare provider diversity encompasses major regional hospitals, specialized medical centers, and private healthcare facilities providing comprehensive validation environment for innovation testing and market development.

Implementation framework and strategic development

Medical device development receives systematic support through an integrated approach combining academic research capabilities with clinical validation infrastructure and regulatory compliance assistance. Regional Emergency Hospital serves as the primary innovation-testing environment, while existing medical institutions provide specialized validation capabilities across diverse healthcare applications.

Digital health solution development capitalizes on established information technology sector capabilities, combined with healthcare sector requirements, to deliver comprehensive platform development and market application. Cross-sector collaboration between IT companies and healthcare providers receives systematic facilitation to support innovation development and enhance competitive positioning.

Clinical research excellence builds upon existing medical university capabilities and specialized institute expertise to advance international partnership development and market positioning. Research commercialization receives systematic support through technology transfer facilitation, intellectual property development assistance, and business development coordination.

Regulatory compliance support addresses specific barriers facing regional companies, including Medical Device Regulation requirements, market access procedures, and international certification processes. Specialized assistance enables systematic development of competitive advantage while reducing market-entry barriers for regional innovation companies.

Performance indicators and success measurement

Quantitative performance measurement encompasses the medical device certifications achieved annually, with a target of 25+ successful certifications by 2028, demonstrating systematic development of competitive advantage and market penetration success. Digital health solution implementations across regional healthcare providers indicate ecosystem integration effectiveness and market validation achievement.

Innovation pipeline tracking measures clinical research commercialization projects from initial development through market application, with emphasis on international partnership development and export market penetration. Healthcare innovation export development provides a direct indicator of competitive positioning and market recognition.

The economic impact assessment includes employment creation in the healthcare technology sector, investment attraction from national and international sources, and improved GDP contribution through the development of higher-value-added activities. Regional competitive positioning measurement through international benchmarking indicates strategic priority effectiveness and continued development potential.

Stakeholder satisfaction assessment through systematic consultation with healthcare providers, technology companies, academic institutions, and business development organizations provides qualitative feedback for strategic adjustment consideration and support mechanism optimization.

Priority 2: Digital transformation and health tech integration

Digital transformation priority capitalizes on established regional information technology capabilities while systematically integrating with healthcare sector requirements to enhance competitive advantage and realize market opportunities. Strategic focus emphasizes cross-sector collaboration rather than generic digitalization approaches to optimize resource utilization and improve competitive positioning.

The information technology sector demonstrates established competitive advantages through Cluj IT Cluster activities, international partnership development, and growing expertise in healthcare technology applications. Regional capabilities include 15% of national IT employment and company presence, indicating a substantial foundation for systematic expansion and specialization development.

Healthcare digitalization opportunities build upon existing telemedicine penetration at 50% of regional healthcare providers and established teleradiology applications, demonstrating a systematic foundation for comprehensive digital health solution development. Cross-sector integration potential remains underutilized due to insufficient systematic

facilitation and coordination mechanisms requiring strategic intervention.

Digitalization of the services sector addresses the largest employment category, 42.5% of the regional workforce, requiring systematic support for technology adoption to enhance productivity and improve competitive positioning. Current approaches provide generic assistance rather than specialized support addressing specific sector requirements and market opportunity development.

International market development opportunities exist through established IT sector export capabilities combined with growing healthcare technology market demand, requiring systematic coordination for competitive advantage realization and market penetration enhancement.

Implementation approach and resource allocation

Healthcare IT specialization receives targeted support for medical software development, digital health platform creation, and clinical application advancement through systematic coordination between established IT capabilities and healthcare sector requirements. Specialized development addresses regulatory compliance, clinical validation, and market access requirements for international competitive positioning.

Cross-sector digitalization support addresses manufacturing technology integration, agricultural precision farming applications, and professional services enhancement through systematic facilitation of technology adoption. Specialized assistance addresses specific sector requirements rather than generic approaches, thereby limiting the development of competitive advantage.

Export development assistance provides systematic support for international market penetration through partnership facilitation, market intelligence, and competitive positioning. RegionalIT companies receive specialized support for healthcare technology market entry, while healthcare sector businesses gainaccess to digitalsolution development capabilities.

Innovation infrastructure development includes digital testing environments, validation services, and technology commercialization support, addressing specific regional requirements for systematic competitive advantage development and market opportunity realization.

Expected outcomes and impact measurement

Digital health solution development and implementation across regional healthcare providers demonstrates systematic integration success and competitive advantage. Cross-sector digitalization projects with measurable productivity improvements demonstrate effective resource allocation and the achievement of strategic priorities.

International market development through digital health export revenues and client acquisition provides a direct competitive positioning indicator and market recognition measurement. Regional IT sector employment growth, combined with advanced skills development, demonstrates an enhanced ecosystem and sustained development potential.

Healthcare-IT collaboration projects successfully launched and maintained indicate the achievement of cross-sector integration and the effectiveness of a systematic coordination mechanism. Innovation pipeline measurement, from initial development through commercialization, provides a comprehensive foundation for strategic priority assessment and adjustment.

Priority 3: Agri-food innovation with digital integration

Agricultural sector modernization acknowledges the traditional importance while recognizing limited growth potential, requiring a strategic focus on productivity enhancement rather than expansion. Digital technology integration provides a systematic pathway for competitive advantage development within realistic market constraints.

Sector development: realistic assessment

Agricultural employment is on a declining trajectory while maintaining regional significance, requiring productivity enhancement rather than expansion to sustain competitiveness.

Rural development challenges require systematic attention, while recognizing market limitations and competitive positioning constraints that affect the sector's development potential.

Food processing capabilities provide opportunities for value-added product development and market positioning enhancement through technology integration and quality improvement initiatives. Regional companies demonstrate foundational capabilities that require systematic enhancement to develop a competitive advantage and pursue market expansion opportunities.

Precision agriculture technology adoption offers a systematic pathway to improve productivity and enhance resource efficiency, addressing environmental compliance requirements while reducing operational costs. Digital technology integration enables the optimization of traditional agricultural practices to develop a competitive advantage within market constraints.

Rural entrepreneurship development addresses regional economic development requirements while providing systematic support for innovation adoption and market opportunity realization. Technology-based business development creates alternative opportunities for enhancing rural community economic development and improving competitive positioning.

Strategic implementation and resource optimization

Precision agriculture support includes IoT sensor deployment, data analytics application development, and assistance with the adoption of automated farming systems. Regional producers receive systematic technical support and financing facilitation for technology adoption, thereby addressing productivity enhancement and cost-reduction objectives.

Value-added food product development assistance addresses market opportunity identification, product development support, and market access facilitation for regional food processing companies. Systematic assistance includes technical support, regulatory compliance guidance, and coordination of marketing development.

Sustainable agricultural practices are adopted systematically to achieve environmental compliance and improve resource efficiency. Regional producers gain access to technical assistance, financing mechanisms, and certification support that address market requirements and enhance competitive positioning.

Rural technology business development provides systematic support for agricultural technology companies, service providers, and innovation adopters addressing economic diversification requirements and market opportunity realization within rural communities.

Impact measurement and strategic assessment

Agricultural productivity improvement through technology adoption provides a direct indicator of the effectiveness of strategic priorities and the achievement of competitive advantage. Systematic measurement includes yield enhancement, cost-reduction demonstration, and evidence of resource-efficiency improvement.

Value-added product development success through regional and national market penetration indicates the realization of market opportunity and the achievement of competitive positioning. Performance assessment includes new product launch success, market share development, and revenue growth measurement.

Reducing environmental impacts in agricultural production demonstrates sustainable development and regulatory compliance. Systematic assessment includes resource utilization efficiency, environmental footprint reduction, and achievement of sustainability certification.

Rural business development success through technology-based enterprise creation and sustained operation provides regional economic development indicator and strategic priority effectiveness measurement. Employment creation, revenue development, and market positioning achievement demonstrate strategic priority impact and continued development potential.

4.2 Stakeholders involved

Strategic implementation requires systematic coordination among diverse stakeholder categories with clear role definition, responsibility allocation, and performance accountability mechanisms. Success depends on sustained engagement across public sector institutions, academic organizations, private companies, and international partners with systematic coordination for optimal resource utilization and competitive advantage development.

North-West Regional DevelopmentAgency.

NW RDA serves as the primary implementing authority with strategic oversight responsibility for coordination, resource allocation management, and performance monitoring across all priority areas. The agency provides a systematic interface with national ministries, European Union funding authorities, and international development partners while maintaining effective regional stakeholder engagement and coordination.

Strategic responsibilities include operational programme implementation and modification for S3 alignment achievement, establishment and maintenance of a performance monitoring system, and coordination of stakeholder engagement across all priority areas. Resource allocation management encompasses budget distribution optimization, coordination of funding mechanisms, and implementation of strategic adjustments based on performance evidence and stakeholder feedback.

International partnership development receives systematic facilitation through NW RDA coordination, including participation in the European Union network, advancing peer-region collaboration, and coordinating the identification and application of global funding opportunities. Strategic positioning enhancement requires systematic effort, coordination, and advancement of international recognition through competitive advantage demonstration.

Performance accountability encompasses annual strategic review coordination, stakeholder satisfaction assessment implementation, and systematic adjustment recommendation development based on comprehensive evidence analysis. Continuous improvement mechanisms ensure optimal resource utilization and the development of competitive advantage through systematic performance optimization.

Healthcare sector institutions

Regional Emergency Hospital could provide a primary innovation testing environment and clinical validation capability for systematic healthcare technology development and market validation. Infrastructure development during operational establishment creates a unique opportunity to integrate innovation and coordinate systematically with technology companies and research institutions.

University medical institutions, including Iuliu Hațieganu University of Medicine and Pharmacy, provide specialized clinical expertise,

research capabilities, and academic coordination for systematic innovation development and international partnership advancement. Research commercialization receives systematic support through technology transfer facilitation and coordination of intellectual property development.

Healthcare provider networks encompassing regional hospitals, specialized medical centers, and private healthcare facilities provide clinical validation environments, user feedback mechanisms, and market development support, all of which are essential for innovation testing and competitive positioning. Systematic engagement ensures comprehensive validation and market acceptance development.

Medical professional organizations provide systematic input on clinical requirements, regulatory compliance needs, and professional development coordination to support optimal healthcare innovation development and market acceptance. Professional network engagement ensures systematic stakeholder support and facilitates market penetration.

Academic and research institutions

Babes-Bolyai University provides comprehensive research capabilities, academic infrastructure, and coordination of student engagement for systematic innovation development and human capital enhancement. Technology transfer coordination receives systematic support through commercial application facilitation and intellectual property development assistance.

The Technical University of Cluj-Napoca contributes specialized engineering expertise, medical device development capabilities, and technical validation services essential to healthcare technology development and competitive positioning. Research-industry collaboration receives systematic facilitation through project coordination and partnership development assistance.

Iuliu Hatieganu Medical and Pharmacy University provides clinical research expertise, regulatory compliance guidance, and professional development coordination addressing systematic healthcare innovation requirements and market validation needs. International partnership development receives systematic support through academic network coordination and collaborative research advancement.

Research institutes contribute specialized expertise, validation services, and intellectual property development support addressing specific innovation requirements and competitive positioning enhancement needs. Technology commercialization receives systematic assistance through business development coordination and market application facilitation.

Private sector and business community

Cluj IT Cluster provides technology sector coordination, business development support, and international partnership facilitation, addressing systematic digitalization

requirements and healthcare technology development opportunities. Cross-sector collaboration is systematically coordinated through networking facilitation and project development assistance.

Healthcare technology companies and emerging enterprises contribute innovation development expertise, market validation capabilities, and commercial application experience essential for competitive advantage development and market positioning enhancement.

Manufacturing companies provide systematic input on technology adoption requirements, digitalization support needs, and environmental compliance assistance, addressing competitive positioning enhancement and sustainable development objectives. Transition management receives systematic support through market diversification assistance and technology upgrade coordination.

Business development service providers provide systematic support for financing facilitation, market development assistance, and regulatory compliance coordination, addressing comprehensive business requirements and the development of competitive advantage.

International partners and networks

I3HIES consortium partners provide opportunities for systematic collaboration, best-practice sharing, and joint project development coordination, addressing international competitive positioning and market expansion.

Cross-regional learning enables optimal resource utilization and accelerates strategic development. European Union health innovation networks, including EIT Health, provide systematic access to international funding opportunities, partnership development and coordination, and market intelligence, which are essential for competitive advantage development and market positioning enhancement.

Peer regions with established health innovation capabilities provide mentorship opportunities, collaboration development, and coordinated competitive benchmarking, addressing systematic development needs and strategic positioning optimization requirements.

International funding organizations provide systematic access to resources, technical assistance coordination, and market development support, addressing comprehensive development requirements and opportunities to enhance competitive advantage.

4.3 Timeframe

Implementation follows a systematic five-year timeline with specific milestone achievement requirements, stakeholder engagement coordination, and performance assessment integration, enabling strategic adjustment and optimization throughout the development process.

Year 1 (2026):foundation development and strategic alignment

Establishing the strategic framework receives primary emphasis during the initial implementation year, including finalizing stakeholder agreement, developing the governance structure, and deploying the monitoring system. NW RDA coordinates comprehensive stakeholder engagement across all priority areas with systematic consultation and commitment development.

Regional Emergency Hospital integration planning occurs during the construction completion phase with systematic innovation, infrastructure development, and operational preparation coordination. Medical technology companies receive engagement coordination, while academic institutions develop research collaboration agreements and prepare validation services.

Healthcare technology priority area receives systematic development through market opportunity assessment, stakeholder engagement coordination, and initial project identification. Digital transformation integration planning addresses cross-sector Collaboration, development, and technology adoption support mechanism establishment.

Performance baseline establishment encompasses comprehensive economic indicator measurement, stakeholder engagement assessment, and international benchmarking development, providing a foundation for systematic monitoring and strategic adjustment implementation.

Year 2 (2027): core program implementation and infrastructure integration

Healthcare technology development is fully implemented through the integration of the Regional Emergency Hospital and the establishment of a systematic innovation testing environment. Medical device development projects launch with clinical validation support, while digital health solutions receive systematic development and market testing coordination.

Cross-sector digitalization acceleration addresses manufacturing technology adoption, professional services enhancement, and agricultural precision farming development through systematic technology integration and support for productivity enhancement. IT sector expertise is systematically integrated with traditional industries to develop a competitive advantage.

International partnership development advances through systematic engagement with peer regions, European Union networks, and the establishment of commercial collaborations. Market expansion opportunities are systematically developed through export assistance and international validation coordination.

Stakeholder engagement optimization occursthrough systematic consultation enhancement, performance feedback integration, and strategic coordination improvement, addressing identified challenges and developing opportunities.

Year 3 (2028): whole operation and competitive positioning enhancement

The Regional Emergency Hospital innovation ecosystem achieves full operational capacity through systematic medical technology testing, clinical validation services, and coordinated research commercialization. Healthcare technology companies demonstrate market penetration success with international partnership development and export achievement.

Manufacturing sector transition management demonstrates systematic success through automotive supplier market diversification, environmental technology adoption advancement, and sustainable development positioning achievement. Advanced manufacturing integration provides a competitive advantage, demonstrates development, and enhances productivity.

Digital transformation success across priority sectors provides systematic development of competitive advantage and advancement of international recognition. Healthcare-IT integration demonstrates systematic innovation development, while traditional-sector digitalization enhances productivity and improves market positioning.

International competitive positioning demonstrates systematic advancement through peer-region benchmarking, recognition in the European Union network, and market penetration in priority sectors, with sustained competitive advantage development.

Years 4-5 (2028-2031): competitive leadership and ecosystem maturity

Regional ecosystem achieves systematic competitive leadership recognition through international benchmarking, peer-region recognition, and market-positioning advancement within targeted specialization areas. Healthcare technology development demonstrates sustained market success with global expansion and partnership advancement.

Strategic priority areas achieve systematic integration and synergy development through cross-sector collaboration, innovation pipeline maturity, and the demonstration of competitive advantage sustainability. Economic impact indicators demonstrate substantial regional development achievement and continued growth potential.

International partnership expansion creates systematic market access enhancements, technology transfer advancements, and sustainable competitive positioning across

priority areas. Regional brand development achieves recognition for innovation excellence and business competitiveness within European health technology markets.

Sustainability planning addresses continued ecosystem development, integration of private sector investment, and strategic evolution coordination to maintain a sustained competitive advantage and realize continued development potential beyond the initial implementation timeline.

4.4 Monitoring of the action

A dynamic monitoring system implementation ensures systematic performance assessment, stakeholder feedback integration, and the ability to make strategic adjustments throughout the implementation process. Monitoring approaches combine quantitative indicator measurement, qualitative assessment, and international benchmarking to evaluate comprehensive effectiveness.

Comprehensive performance monitoring framework

Quarterly performance assessment encompasses economic impact measurement, innovation pipeline tracking, and stakeholder engagement evaluation across all priority areas with systematic reporting and strategic adjustment consideration. Economic indicators include GDP contribution development, employment creation achievement, and investment attraction success, with sector-specific analysis and competitive positioning assessment.

development, while traditional-sector digitalization enhances productivity and improves market positioning.

International competitive positioning demonstrates systematic advancement through peer-region benchmarking, recognition in the European Union network, and market penetration in priority sectors, with sustained competitive advantage development.

Stakeholder satisfaction assessment through systematic consultation across the business community, academic institutions, healthcare providers, and international partners provides qualitative feedback for strategic adjustment consideration and support mechanism enhancement. Engagement effectiveness measurement enables systematic coordination improvement and the optimization of competitive advantage development.

International benchmarking comparison with peer regions provides a systematic competitive positioning assessment and strategic development guidance. Performance relative to established health innovation regions enable systematic adjustment consideration and competitive advantage enhancement opportunity identification.

Annual strategic review and adjustment protocol

A comprehensive annual assessment integrates quantitative performance data with stakeholder feedback and international benchmarking to support systematic strategic evaluation and the

development of adjustment recommendations. The review process encompasses priority-area effectiveness assessment, resource-allocation optimization, and stakeholder-engagement enhancement identification.

Strategic adjustment recommendations are developed through evidence-based analysis and systematic stakeholder consultation, with the implementation timeline established and resource allocation modified and coordinated. Adjustment implementation is systematically monitored to assess effectiveness and support continued optimization.

Performance target establishment for the following implementation year incorporates lessons learned, stakeholder feedback, and requirements for enhancing competitive positioning. Target development receives systematic consultation and commitment development across all stakeholder categories for optimal achievement potential.

International partnership assessment and expansion planning address opportunities for systematic collaboration development, market access enhancement, and competitive positioning advancement. Partnership effectiveness evaluation enables systematic enhancement and strategic expansion consideration.

Digital monitoring platformand transparency

Real-time performance dashboard development provides systematic access to performance indicators, project development tracking, and competitive positioning assessment across all stakeholder categories. Platform functionality enables systematic transparency and stakeholder engagement optimization throughout the implementation process.

The stakeholder engagement portal facilitates systematic communication, project collaboration, coordination, and feedback integration, addressing comprehensive ecosystem development requirements and enhancing coordination. Digital collaboration tools optimize resource utilization and enhance competitive advantage and coordination.

The public transparency interface provides systematic access to information, success story documentation, and communication on competitive positioning, addressing regional brand development and investment attraction requirements. International visibility enhancement supports competitive advantage recognition and partnership development coordination.

Performance data publication addresses European Union reporting requirements while providing systematic evidence foundation for strategic adjustment consideration and international recognition advancement. Transparency mechanisms optimize stakeholder confidence and sustained engagement throughout implementation process.

PART V. LIVING LABSCASE STUDY: REGIONAL EMERGENCY HOSPITALINTEGRATION

The Regional Emergency Hospital Cluj-Napoca represents an exceptional opportunity for systematic healthcare innovation integration, demonstrating practical Living Labs methodology implementation within the broader S3 strategic framework. This case study illustrates how infrastructure development can systematically integrate innovation-testing capabilities while supporting the development of regional competitive advantage and the enhancement of international market positioning.

5.1 Regional emergency hospital living labs integration framework

The Regional Emergency Hospital provides a unique foundation for systematic healthcare innovation testing through a comprehensive clinical environment, advanced infrastructure, and strategic coordination with the regional innovation ecosystem. The expected construction completion by 2027 creates an exceptional opportunity for innovation in infrastructure integration during the operational establishment phase.

Hospital infrastructure and innovation capacity

The facility encompasses 846-bed capacity across specialized medical departments with 22 operating rooms and comprehensive emergency care capabilities providing diverse clinical environments for medical technology testing and validation. Infrastructure specifications include advanced medical equipment integration, comprehensive IT network capabilities, and modular design elements that enable systematic innovation, technology deployment, and testing coordination.

Emergency care specialization provides a particularly valuable environment for medical device testing under actual clinical conditions while maintaining patient safety and clinical effectiveness requirements. Emergency department operations create a systematic demand for technology solutions that optimize workflows, enhance diagnostics, and improve treatment effectiveness, providing a natural market for innovation development and validation.

Clinical department diversity encompasses cardiology, neurology, surgical specialties, and diagnostic services, providing a comprehensive testing environment for diverse medical technology applications. Department infrastructure enables systematic technology integration while maintaining clinical operation effectiveness and patient care quality requirements.

Research capability integration includes designated research areas, clinical trial coordination infrastructure, and academic partnership facilitation, addressing systematic requirements for innovation development and commercialization.

Research integration enables systematic technology validation while supporting academic collaboration and the coordination of international partnership development.

Innovation testing environment development

Systematic innovation testing capability development addresses medical device validation, digital health solution testing, and clinical workflow optimization through an integrated approach that combines clinical operational requirements with innovation development support. Testing environment design enables rapid technology deployment while maintaining clinical effectiveness and patient safety standards.

Medical device testing infrastructure includes comprehensive evaluation capabilities for diagnostic equipment, therapeutic devices, and clinical support systems with systematic validation protocols and regulatory compliance coordination. Testing capability enables systematic device development and advancement while supporting market validation and commercial application development.

Digital health solution validation encompasses electronic health record integration testing, clinical decision support system evaluation, and patient monitoring technology assessment with systematic clinical workflow integration and effectiveness measurement. Validation infrastructure enables systematic technology adoption while supporting productivity enhancement and improved clinical outcomes.

Clinical workflow optimization testing includes operational efficiency assessment, resource utilization measurement, and patient experience enhancement evaluation through systematic technology integration and performance measurement. Optimization testing enables systematic operational improvement while supporting cost reduction and quality enhancement.

Research and development coordination includes clinical research support, technology commercialization assistance, and facilitation of intellectual property development through systematic integration of academic partnerships and coordination of commercial applications. Research support enables systematic innovation advancement while supporting the development of competitive advantage and market positioning.

5.2 International best practice examplesand methodology adaptation

The Living Labs methodology demonstrates proven effectiveness across European healthcare innovation ecosystems, with systematic development of competitive advantage, technology commercialization success, and enhanced international market positioning.
International best practices provide a foundation for the Regional Emergency Hospital integration while addressing specific regional requirements and competitive positioning objectives.

Medical Delta Living Labs Network (Netherlands)

The Netherlands' Medical Delta network operates seven specialized Living Labs demonstrating systematic healthcare innovation development with measurable outcomes, including 40% faster time-to-market achievement, €15 million annual innovation investment attraction, and 200+ collaborative projects completed across specialized testing environments.

Medical Delta ResearchOR operates a real-life operating room environment, enabling systematic surgical technology development and validation through actual clinical operation integration. Innovation testing encompasses medical device evaluation, workflow optimization, and efficiency enhancement, supported by systematic clinical validation and market development coordination.

Medical Delta Geriatric Rehabilitation@Home provides a comprehensive rehabilitation solution that tests in actual home environments, addressing service connectivity challenges while demonstrating systematic user engagement and market validation methodology. Home-based testing enables comprehensive solution evaluation while supporting market acceptance development and the advancement of commercial applications.

Regional Emergency Hospital integration can adapt Medical Delta methodology through emergency care specialization, clinicalvalidation protocol development, and systematic innovation testing coordination, addressing specific regional competitive advantages and market positioning requirements.

University Hospital Mannheim INSPIRE Living Lab (Germany)

INSPIRE Living Lab operates an integrated hospital ward environment with 27 beds, designed for systematic innovation testing through flexible infrastructure, comprehensive connectivity, and systematic clinical integration. Innovation testing encompasses medical technology validation, digital health solution development, and clinical workflow optimization with real clinical operation integration.

Infrastructure design includes removable wall panels, extensive power and network connections, and flexible installation capability enabling rapid technology deployment and systematic testing coordination. Design flexibility allows diverse innovation testing while maintaining clinical operation effectiveness and patient care quality requirements.

Clinical integration methodology addresses systematic innovation testing within actual hospital workflows while maintaining patient safety standards and clinical effectiveness requirements. The integration approach enables comprehensive technology validation while supporting market acceptance, development, and commercial application advancement.

Regional Emergency Hospital can adapt the INSPIRE methodology through emergency care specialization, infrastructure flexibility integration, and systematic clinical validation protocol development, addressing specific regional innovation requirements and competitive positioning objectives.

Healthcare Living Lab Catalonia(Spain)

Healthcare Living Lab Catalonia provides comprehensive innovation support services, including co-creation facilitation, prototyping assistance, usability studies coordination, and clinical validation support, addressing systematic innovation development requirements and market validation coordination.

Service integration methodology encompasses innovation development coordination from initial concept through market application with systematic technical assistance, regulatory compliance support, and funding application coordination. A comprehensive service approach enables systematic innovation advancement while addressing diverse development requirements and market positioning needs.

Clinical validation expertise includes systematic testing protocol development, regulatory compliance coordination, and market acceptance assessment addressing comprehensive technology development requirements and commercial application advancement needs.
Regional Emergency Hospitalintegration can adapt the Catalonia methodology through comprehensive service development, the establishment of clinical validation expertise, and systematic innovation support coordination, thereby addressing regional competitive advantage development and international market positioning enhancement.

5.3 Implementation framework for healthtech innovation

The Regional Emergency Hospital Living Labs implementation follows a systematic methodology that addresses infrastructure development, stakeholder coordination, the establishment of innovation testing capabilities, and the integration of performance measurement. The implementation approach optimizes clinical operations integration while maximizing innovation development potential and achieving competitive advantage.

Phase 1. Infrastructure integration and operational preparation (2025-2027)

Infrastructure development coordination occurs during hospital construction, integrating systematic innovation capabilities and preparing technology infrastructure. Construction phase coordination enables optimal deployment of innovation infrastructure while maintaining adherence to the construction timeline and effective operational preparation.

Innovation space designation includes specialized testing areas,equipment installation preparation, and connectivity infrastructure development, addressing systematic technology

deployment requirements and clinical integration coordination. Space development optimizes innovation testing capability while maintaining clinical operation efficiency and patient care quality requirements.

Stakeholder engagement coordination encompasses healthcare provider consultation, medical technology company partnership development, and academic institution collaboration establishment, addressing comprehensive innovation ecosystem preparation and coordination effectiveness. Engagement coordination optimizes stakeholder commitment while supporting systematic innovation development and the creation of competitive advantage.

Technology infrastructure preparation includes enhancing IT network capabilities, coordinating medical equipment integration, developing testing protocols to address systematic innovation deployment requirements, and coordinating clinical validation. Infrastructure preparation enables comprehensive innovation testing while supporting technology advancement and market validation.

Phase 2: Operational launch and innovation testing deployment (2027-2028)

Hospital operational launch coordination integrates a systematic innovation-testing capability with the establishment of clinical services, addressing comprehensive healthcare provision requirements and innovation development.

Launch coordination optimizes clinical effectiveness while maximizing innovation, testing potential, and the development of competitive advantage.

Medical technology testing deployment encompasses device evaluation coordination, clinical validation implementation, and market development support, addressing systematic innovation advancement and commercial application development. Testing deployment enables comprehensive technology validation while supporting competitive positioning and market recognition.

Digital health solution integration includes enhancing the electronic health record system, implementing clinical decision support, deploying patient monitoring technology, and optimizing clinical workflows through systematic measurement of effectiveness. Solution integration enables systematic operational enhancements while supporting productivity improvements and advancing clinical outcomes.

Research program establishment includes clinical research coordination, technology commercialization support, and academic partnership development addressing systematic innovation advancement and intellectual property development. Research coordination enables systematic knowledge advancement while supporting the development of competitive advantage and the achievement of international recognition.

Phase 3: Ecosystem integration and competitive positioning (2028-2030)

Full ecosystem integration encompasses systematic coordination among hospital innovation capability, regional technology companies, academic research institutions, and international partners to develop a comprehensive competitive advantage and enhance market positioning.

Innovation pipeline development includes systematic project advancement from initial research through commercial application with emphasis on regional company development, international partnership advancement, and market penetration success. Pipeline development enables sustained innovation advancement while supporting economic growth and enhancing competitive positioning.

International recognition advancement encompasses European Living Labs network participation, peer collaboration development, and market positioning enhancement through systematic innovation success demonstration and competitive advantage advancement. Recognition development enables systematic market access enhancement while supporting continued innovation, development, and economic impact achievement.

Commercial sustainability achievement includes revenue generation through innovation services, technology licensing coordination, and consulting service development addressing systematic financial sustainability and continued development capability. Sustainability achievement enables systematic maintenance of competitive advantage while supporting continued innovation, advancement, and regional economic development.

5.4 Expected outcomes and S3 priority integration

Regional Emergency Hospital Living Labs implementation demonstrates systematic development of competitive healthcare technology advantage while integrating with broader S3 priority coordination and regional economic development objectives. Expected outcomes encompass innovation development success, economic impact achievement, and competitive positioning advancement.

Innovation development and technology commercialization success

Medical device development advancement includes systematic validation of 25+ devices annually by 2030, with emphasis on regional company technology advancement and international market penetration achievement. Device development success enables a regional company's competitive advantage development while supporting economic growth and employment creation.

Digital health solution deployment encompasses comprehensive healthcare provider technology adoption, clinical workflow optimization achievement, and productivity enhancement measurement across regional healthcare institutions. Solution deployment enables systematic operational improvement while

advancing competitive positioning and market recognition.

Clinical research commercialization involves systematically advancing research outcomes for market application, with an emphasis on intellectual property development, successful technology transfer, and the establishment of commercial partnerships. Research commercialization enables the use of academic capabilities while supporting economic development and creating a competitive advantage.

International partnership development encompasses establishing collaborations with European health innovation networks, advancing joint projects, and achieving market access through strategic relationship coordination. Partnership development enables systematic market expansion while supporting competitive positioning and continued innovation.

Economic impact and regional development achievement

Employment creation encompasses 150+ positions in the healthcare technology sector by 2030, including medical device development, digital health solution advancement, and clinical research coordination, with an emphasis on high-value employment and competitive advantage development. Employment creation enables regional economic growth while supporting skills development and advancing competitive positioning.

Sustainability achievement enables systematic maintenance of competitive advantage while supporting continued innovation, advancement, and regional economic development.

Investment attraction includes €25 million in venture capital and private-sector investment by 2030, addressing innovation development, commercial application advancement, and market expansion coordination. Investment attraction demonstrates market confidence while supporting sustained innovation and enhancing competitive advantage.

Export development encompasses €15 million in annual healthcare technology export revenue by 2030 through regional company international market penetration and competitive positioning. Export development enables systematic market expansion while supporting regional economic growth and advancing international recognition.

GDP contribution enhancement includes measurable regional economic impact through healthcare technology sector development, innovation ecosystem advancement, and competitive advantage achievement, addressing systematic economic development objectives and regional positioning enhancement.

Competitive positioning and international recognition

European Living Labs network membership achievement demonstrates recognition of systematic innovation capability and international

network integration, enabling continued partnership development and market access enhancement. Network participation enables systematic knowledge sharing while supporting the advancement of competitive advantage and the coordination of innovation development.

International benchmarking performance within the top 25% of peer regions for healthcare innovation capability, technology commercialization success, and economic impact achievement, addressing systematic competitive positioning objectives and market recognition advancement.

Regional brand development for healthcare technology innovation excellence enables systematic market positioning enhancement, investment attraction coordination, and partnership development facilitation, addressing continued competitive advantage development and economic impact achievement.

Sustainable competitive advantage establishment through systematic innovation capability development, market positioning achievement, and international recognition advancement, enabling continued ecosystem development and economic impact enhancement beyond the initial implementation timeline.

PART VI. IMPLEMENTATION ROADMAP

A comprehensive implementation roadmap provides a systematic coordination methodology that addresses timeline coordination, stakeholder responsibility allocation, resource mobilization, and performance evaluation across a five-year strategic development period. The implementation approach optimizes resource utilization while maintaining stakeholder engagement and a focus on developing competitive advantage.

6.1 Five-Year implementation timeline (2025-2030)

The strategic implementation timeline coordinates systematic development across priority areas while maintaining optimized resource allocation and a focus on competitive advantage development. Timeline coordination enables systematic milestone achievement while providing flexibility for strategic adjustment and performance optimization throughout the implementation period.

2025: Strategic foundation and stakeholder alignment

Strategic foundation development encompasses comprehensive stakeholder engagement, governance structure establishment, and performance monitoring system deployment, addressing systematic coordination requirements and competitive advantage development preparation.

Foundation development optimizes implementation effectiveness while ensuring sustained stakeholder commitment and maintaining strategic focus.

January-March 2025 coordination includes initiating the NW RDA strategic planning process, implementing comprehensive stakeholder consultation, and establishing a governance structure with transparent responsibility allocation and performance accountability mechanisms. Coordination activities establish a systematic foundation while optimizing stakeholder engagement and achieving strategic alignment.

April-June 2025 development encompasses priority-area initiative planning, with specific emphasis on healthcare technology development, digital transformation integration, and sustainable manufacturing coordination. Development activities optimize resource allocation while addressing requirements for competitive advantage development and market positioning enhancement.

July-September 2025 implementation includes aligning the funding mechanism through modifications to the Regional Operational Programme, optimizing utilization of European Union structural funds, and facilitating private-sector investment, addressing comprehensive resource mobilization and strategic development coordination.

October-December 2025 assessment encompasses establishing the performance baseline, evaluating stakeholder engagement, and considering strategic adjustments based on initial implementation experience and stakeholder feedback integration. Assessment activities provide a foundation for strategic optimization while maintaining a focus on competitive advantage development.

2026: Core implementation and infrastructure development

Core implementation emphasis encompasses healthcare technology priority advancement, Regional Emergency Hospital integration planning, and cross-sector collaboration development, addressing systematic competitive advantage development and market positioning enhancement coordination.

January-March 2026 advancement includes Regional Emergency Hospital innovation infrastructure integration planning, medical technology company engagement coordination, and clinical validation service development addressing systematic healthcare innovation capability establishment and competitive advantage development.

April-June 2026 deployment encompasses digital transformation acceleration across manufacturing digitalization, services-sector technology adoption, and healthcare-IT integration development, addressing cross-sector competitive advantage development and productivity enhancement.

July-September 2026 coordination includes international partnership development through peer-region collaboration, European Union network participation, and market access advancement, addressing systematic competitive positioning and international recognition development.

October-December 2026 evaluation encompasses a comprehensive performance assessment, stakeholder satisfaction measurement, and the implementation of strategic adjustments based on achievement evidence and a competitive positioning assessment. Evaluation activities optimize implementation effectiveness while maintaining strategic focus and efficient resource allocation.

2027: Full operation and market positioning

Full operational capability achievement encompasses the deployment of Regional Emergency Hospital Living Labs, comprehensive healthcare technology development, and systematic achievement of competitive advantage across priority areas to enhance market positioning and realize economic impact.

Healthcare technology development advances systematically through clinical validation success, medical device commercialization, and the deployment of digital health solutions across regional healthcare providers. Development success demonstrates a competitive advantage while supporting economic impact and international recognition.

positioning achievement. Transition success enables employment stability while building alternative competitive advantages and enhancing market positioning.

International competitive positioning advancement encompasses peer-region recognition, European Union network integration, and market penetration across healthcare technology, digital transformation, and sustainable manufacturing sectors. Positioning advancement enables systematic market access while supporting continued development of competitive advantage.

2028-2030: Competitive leadership and sustainability

Competitive leadership achievement encompasses systematic recognition within European health innovation networks, sustained economic impact development, and the establishment of ecosystem sustainability, addressing the maintenance and development of continued competitive advantage and the potential realization of its potential.

Regional ecosystem maturity demonstrates systematic integration across priority areas, stakeholder coordination effectiveness, and the sustainability of competitive advantage through continued innovation development and market positioning maintenance. Maturity achievement enables systematic recognition of leadership while supporting continued economic growth.

International market expansion encompasses systematic export development, partnership advancement, and sustainable competitive positioning across healthcare technology, digital solutions, and sustainable manufacturing, addressing ongoing economic impact and enhancing competitive advantage.

Strategic sustainability planning addresses the continuation of ecosystem development, the integration of private-sector investment, and the maintenance of competitive advantage beyond the initial implementation timeline. Sustainability planning enables continued development while optimizing resource efficiency and advancing market positioning.

6.2 The role of regional stakeholders

Systematic stakeholder coordination addresses transparent responsibility allocation, performance accountability, and collaborative relationship development across public sector institutions, academic organizations, private companies, and international partners. Stakeholder coordination optimizes resource utilization while maintaining competitive advantage, development focus, and effective strategic implementation.

NW RDA leadership and strategic coordination

NW RDA maintains primary implementation responsibility through strategic oversight coordination, resource allocation management, and performance monitoring implementation across all priority areas.

Agency coordination encompasses operational programme modifications for S3alignment, stakeholder engagement facilitation, and coordination of international partnership development.

Strategic planning responsibility includes annual review coordination, performance assessment implementation, and the development of strategic adjustment recommendations based on evidence analysis and stakeholder feedback integration.
Planning coordination optimizes strategic effectiveness while maintaining European Union compliance and administrative efficiency requirements.

Resource allocation management encompasses budget distribution across priority areas, coordination of funding mechanisms, and facilitation of private-sector investment, addressing systematic development of competitive advantage and achievement of economic impact. Resource management optimizes utilization efficiency while supporting sustained stakeholder engagement and strategic development coordination.

International coordination includes participation in the European Union network, peer-region collaboration development, and funding opportunity identification to address systematic competitive positioning enhancement and market access advancement.
International coordination enables strategic partnership development while supporting continued enhancement of competitive advantage and advancement of recognition.

International partnership coordination includes collaborative research advancement, technology transfer facilitation, and market access development, addressing systematic competitive positioning and international recognition. Partnership coordination enables systematic knowledge sharing while supporting continued innovation and enhancing competitive advantage.

Private sector and business community engagement

Cluj IT Cluster coordination provides technology sector facilitation, cross-sector collaboration development, and international partnership advancement, addressingsystematic digitalization support and healthcaretechnology development. Cluster coordination enables systematic business development while supporting competitive advantage achievement and market positioning enhancement.

Healthcare technology company participation includes innovation development, market validation, and commercial application advancement, addressing systematic competitive advantage development and economic impact achievement. Company engagement enables technology advancement while supporting regional economic growth and international market positioning.

Manufacturing company involvement includes technology adoption, environmental compliance advancement, and productivity enhancement coordination, addressing systematic competitive positioning improvement and sustainable development achievement.

Manufacturing engagement enables transition management while supporting the development of alternative competitive advantages and market positioning enhancements.

Business development service coordination includes financing facilitation, market development assistance, and regulatory compliance support, addressing comprehensive business requirement coordination and competitive advantage development. Service coordination enables systematic business support while optimizing competitive positioning, advancement, and market access achievement.

6.3 Sources of financing

A comprehensive financing strategy optimizes European Union structural fund utilization while coordinating national resources and private-sector investment to systematically mobilize resources and develop a competitive advantage. The financing approach ensures sustained resource availability while meeting European Union compliance and administrative effectiveness requirements.

European Union structural fund optimization

European Regional Development Fund utilization through the Regional Operational Programme modification provides €180 million, addressing innovation infrastructure development, technology adoption support, and competitive advantage development coordination. Fund utilization encompasses systematic alignment of priorities while maintaining European Union

compliance and optimizing administrative efficiency.

Horizon Europe program participation contributes €42 million, addressing healthcare innovation research, international collaboration development, and technology commercialization advancement. Programme participation enables systematic research advancement while supporting competitive positioning and international recognition.

Digital Europe Programme engagement provides €30 million to address cross-sector digitalization, innovation infrastructure development, and technology integration coordination. Programme engagement enables systematic digital transformation while supporting the development of competitive advantage and productivity enhancement.

Additional European Union funding opportunities include the Just Transition Fund for sustainable manufacturing development, EIT Health participation in healthcare innovation advancement, and specialized programme engagement to address specific sector requirements and competitive positioning enhancement needs.

National and regional resource coordination

The Romanian government's matching-fund provision meets European Union structural fund requirements while demonstrating national commitment to strategic development and achieving competitive advantage.

Government coordination includes a €63 million contribution addressing comprehensive development support and advancing strategic priorities.

NW RDA strategic allocation from regional development resources provides €25 million to address coordination enhancement, performance monitoring implementation, and stakeholder engagement facilitation. Regional investment demonstrates commitment while enabling systematic development of competitive advantage and strategic implementation coordination.

The national competitiveness programme contribution includes €17 million to address international market development, export facilitation, and coordination of competitive positioning enhancement. National resource coordination enables systematic market access while supporting the development of competitive advantage and the advancement of international recognition.

Ministry coordination encompasses policy alignment, regulatory compliance facilitation, and strategic development support, addressing comprehensive implementation coordination and the optimization of competitive advantage development. Ministry engagement ensures systematic institutional support while maintaining strategic focus and implementation effectiveness.

Private sector investment integration

Healthcare technology company investment provides €25 million addressing innovation development,

compliance and optimizing administrative efficiency.

Horizon Europe program participation contributes €42 million, addressing healthcare innovation research, international collaboration development, and technology commercialization advancement. Programme participation enables systematic research advancement while supporting competitive positioning and international recognition.

Digital Europe Programme engagement provides €30 million to address cross-sector digitalization, innovation infrastructure development, and technology integration coordination. Programme engagement enables systematic digital transformation while supporting the development of competitive advantage and productivity enhancement.

Additional European Union funding opportunities include the Just Transition Fund for sustainable manufacturing development, EIT Health participation in healthcare innovation advancement, and specialized programme engagement to address specific sector requirements and competitive positioning enhancement needs.

National and regional resource coordination

The Romanian government's matching-fund provision meets European Union structural fund requirements while demonstrating national commitment to strategic development and achieving competitive advantage.

Government coordination includes a €63 million contribution addressing comprehensive development support and advancing strategic priorities.

NW RDA strategic allocation from regional development resources provides €25 million to address coordination enhancement, performance monitoring implementation, and stakeholder engagement facilitation. Regional investment demonstrates commitment while enabling systematic development of competitive advantage and strategic implementation coordination.

The national competitiveness programme contribution includes €17 million to address international market development, export facilitation, and coordination of competitive positioning enhancement. National resource coordination enables systematic market access while supporting the development of competitive advantage and the advancement of international recognition.

Ministry coordination encompasses policy alignment, regulatory compliance facilitation, and strategic development support, addressing comprehensive implementation coordination and the optimization of competitive advantage development. Ministry engagement ensures systematic institutional support while maintaining strategic focus and implementation effectiveness.

Private sector investment integration

Healthcare technology company investment provides €25 million addressing innovation development,

market validation, and commercial application advancement. Private investment demonstrates market confidence while enabling systematic development of competitive advantage and achieving economic impact.

The information technology sector contribution includes €20 million, addressing cross-sector digitalization, healthcare IT development, and international market penetration coordination. IT investment enables systematic digital transformation while supporting the development of competitive advantage and market positioning.

Manufacturing sector investment provides €18 million, addressing technology adoption, environmental compliance advancement, and productivity enhancement coordination. Manufacturing investment enables transition management while supporting competitive advantage development and sustainable positioning achievement.

International private investment coordination includes venture capital engagement, strategic partnership development, and market expansion financing, addressing systematic competitive advantage enhancement and global market access advancement. International investment enables systematic growth while supporting continued competitive positioning and economic impact.

6.4 Evaluation and monitoring

A comprehensive evaluation methodology encompasses systematic performance assessment, stakeholder satisfaction measurement, and strategic adjustment implementation, addressing continued optimization and the development of competitive advantage throughout the implementation period. The evaluation approach combines quantitative indicator measurement, qualitative assessment, and international benchmarking to achieve optimal strategic effectiveness.

Annual performance assessment and strategic review

The annual comprehensive evaluation integrates quantitative performance data with stakeholder feedback and international benchmarking to support systematic strategic assessment and the development of adjustment recommendations. The evaluation methodology ensures evidence-based decision-making while maintaining competitive advantage, development focus, and optimized resource allocation.

Economic impact assessment encompasses GDP contribution measurement, employment creation tracking, and investment attraction evaluation across priority areas with sector-specific analysis and competitive positioning assessment. Impact measurement provides systematic evidence of strategic effectiveness while supporting consideration of adjustments and optimizing resource allocation.

Innovation development evaluation includes assessing technology commercialization success,

academic-industry collaboration effectiveness, international partnership advancement, and addressing systematic competitive advantage development and market positioning enhancement. Innovation assessment enables strategic optimization while supporting continued development, coordination, and performance enhancement.

Stakeholder satisfaction measurement through systematic consultation across the business community, academic institutions, healthcare providers, and international partners provides comprehensive integration of feedback and consideration of strategic adjustments. Satisfaction assessment enables relationship optimization while addressing identified challenges and improving coordination.

International benchmarking comparisons with peer regions provide a systematic competitive positioning assessment and strategic development guidance, enabling consideration of adjustments and identification of opportunities to enhance competitive advantage. Benchmarking analysis enables strategic optimization while supporting continued advancement in competitive positioning and recognition development.

Strategic adjustment implementation and optimization

Strategic modification implementation follows a systematic methodology that ensures stakeholder consultation, evidence-based decision-making, and the maintenance of coordination effectiveness throughout the adjustment process.

The modification approach enables responsive strategy optimization while maintaining a focus on competitive advantage development and stakeholder engagement effectiveness.

Performance trigger assessment includes quantitative threshold evaluation and qualitative market evolution analysis, providing systematic consideration for adjustment and evidence-based implementation of modifications. Trigger assessment enables responsive strategic coordination while maintaining a systematic development focus and enhancing competitive advantage.

Stakeholder feedback integration encompasses comprehensive consultation with systematic recommendation development and implementation coordination, addressing identified challenges and strategic enhancement opportunities. Feedback integration optimizes stakeholder relationships while supporting strategic effectiveness and the development of competitive advantage.

Resource allocation adjustment includes systematic funding redistribution based on performance evidence and competitive positioning assessment, enabling the optimization of strategic impact and the development of coordinated competitive advantage. Resource adjustment optimizes utilization efficiency while maintaining strategic focus and development effectiveness.

International coordination during strategic adjustment ensures continued partnership effectiveness and advancement in competitive positioning while enabling systematic modification and performance optimization. Coordination maintenance preserves international relationships while supporting strategic enhancement and the continued development of competitive advantage.

CONCLUSION

This Strategic Action Plan provides a comprehensive framework for transforming the North-West Region's competitive positioning through evidence-based Smart Specialization Strategy enhancement and systematic innovation ecosystem development. Implementation will address fundamental strategic limitations while capitalizing on documented regional competitive advantages for sustained economic development and international market positioning enhancement.

The analysis demonstrates clear imperative for strategic priority restructuring emphasizing healthcare technology development as primary competitive advantage with supporting priorities in digital transformation, sustainable manufacturing, and agricultural innovation. Healthcare sector represents €2.4 billion market opportunity with substantial regional concentration advantages requiring systematic strategic support for competitive advantage realization and international market positioning achievement.

The implementation of a dynamic monitoring framework addresses fundamental rigidity limitations in the current RIS3 approach while enabling systematic performance assessment, stakeholder feedback integration, and evidence-based strategic adjustment. The monitoring methodology ensures continued strategic relevance while optimizing resource allocation and developing competitive advantage throughout the implementation process.

Regional Emergency Hospital Living Labs integration provides a concrete demonstration of systematic innovation capability development while supporting broader strategic priorities and competitive advantage. Hospital integration creates a unique opportunity for healthcare technology testing and validation while establishing a foundation for international recognition and market positioning advancement. Implementation success requires sustained stakeholder engagement, systematic resource coordination, and strategic focus maintenance throughout the five-year development timeline. NW RDA leadership coordination, combined with comprehensive stakeholder participation and international partnership development, enables the achievement of competitive advantage and the realization of regional economic transformation.

The strategic framework positions the North-West Region for systematic competitive leadership within European health innovation networks while supporting sustainable economic development and international market recognition.

Strategic implementation will create a foundation for continued growth of competitive advantage and economic impact, extending beyond the initial implementation timeline through systematic capability building and market positioning enhancement.

GLOSSARY

- **Academic Industry Technology Transfer:** The processes and supports (IP, licensing, spin-outs) that move university research into commercial products/services in the region.
- **Agri-Food Innovation with Digital Integration:** Priority area focused on precision agriculture, value-added processing, and sustainability using IoT, data analytics, and automation to raise productivity rather than expand acreage.
- **Annual Strategic Review:** Evidence-based, once-per-year assessment integrating KPIs, stakeholder feedback, and international benchmarking to adjust priorities and funding.
- **Babes-Bolyai University (UBB):** Regional research university contributing health-related science and data disciplines to the health innovation ecosystem.
- **Clinical Validation:** Structured testing of medical devices/digital health in care settings to meet safety, effectiveness, and MDR/market access requirements.
- **Cluj IT Cluster:** Regional technology cluster coordinating cross-sector digitalization and HealthTech collaboration, exports, and partnerships.
- **Cross-Sector Integration:** Design of programs that link IT with healthcare, manufacturing, services, and agri-food to create new products, services, and productivity gains.
- **Digital Europe Programme:** EU funding line supporting digital transformation, infrastructures, and advanced digital skills used in the plan's financing mix.
- **Digital Health:** Software, platforms, and data solutions (e.g., EHR integration, decision support, telemedicine, teleradiology, remote monitoring) for care delivery and operations.
- **Digital Monitoring Platform:** Real-time dashboard and portal publishing KPIs, pipeline progress, and project status to ensure transparency and continuous feedback.
- **Digital Transformation:** Priority that leverages the region's IT base to modernize healthcare, manufacturing, services, and agriculture through specialized (not generic) digitalization support.
- **EIT Health:** EU network status recognizing regional capability and offering access to innovation partners and validation settings.
- **Entrepreneurial Discovery Process (EDP):** Stakeholder-driven method used in RIS3 to identify and refine smart specialization priorities.
- **ERDF / Regional Operational Programme (ROP) 2021–2027:** EU structural fund for innovation, digitization, and SME dynamism; currently misaligned with RIS3 priorities, prompting proposed re-alignment. (Includes RSO1.1 Research & Innovation, RSO1.2 Digital Transformation, RSO1.3 SME Competitiveness.)

- **Export Development:** Support for international market entry of regional HealthTech and digital solutions (market intelligence, partnerships, certification).
- **GDP-Weighted Priority Assessment:** Method to rank and adjust priorities using GDP share, employment, growth trajectory, and competitive positioning, updated annually.
- **Health Innovation Ecosystem:** Network of universities, hospitals, firms, cluster organizations, investors, and public agencies collaborating to develop, validate, and commercialize health solutions.
- **HealthTech:** Strategic priority centered on medical devices, diagnostics, digital health platforms, and clinical research commercialization.
- **Horizon Europe:** EU R&I framework program leveraged for research, pilots, and cross-border collaboration in the plan's financing mix.
- **I3HIES Project:** "Boosting Interregional Innovation Investment and cooperation among Health Innovation Ecosystems"; the project context and method anchoring this Regional Action Plan.
- **Implementation Roadmap (2025–2030):** Five-year phasing from foundation and alignment (2025–26) to full operation (2027) and competitive leadership (2028–30).
- **Innovation Pipeline:** End-to-end tracking from research to certification, deployment, exports, and investment, used as a core effectiveness metric.
- **INSPIRE Living Lab (Germany):** Referenced international exemplar: flexible, connected, real-world test environment for hospital-integrated validation.
- **Just Transition Fund (JTF):** Complementary EU instrument for sustainable manufacturing and green transitions included among potential sources.
- **Key Performance Indicators (KPIs):** Quarterly indicators covering economic impact (GDP, jobs, investment), innovation pipeline, and stakeholder engagement.
- **Living Lab (Healthcare):** Real-world clinical environment for co-creation, prototyping, usability studies, and validation (e.g., ORs, wards, emergency departments) to accelerate time-to-market.
- **Medical Device Regulation (MDR):** EU regulatory framework guiding device development, clinical evaluation, and certification; a focal point for compliance support.
- **Medical Delta Network (Netherlands):** International benchmark with specialized living labs showing faster time-to-market and strong investment leverage.
- **Monitoring & Transparency System:** Combination of quarterly reviews, annual strategic reviews, and a public dashboard to enforce performance-based governance.
- **North-West Development Region (Romania):** Territorial scope of the plan; includes major universities, clusters, hospitals, and manufacturing/service bases.
- **North-West Regional Development Agency (NW RDA):** Implementing authority coordinating RIS3 alignment, program/fund integration, stakeholder governance, and monitoring.

- **Performance-Based Resource Allocation**: Annual re-balancing of funds toward high-performing priorities; includes mandatory linkage of ROP funding to RIS3 results.
- **Priority Adjustment Triggers:** Automatic review thresholds that force reassessment.
- **Quadruple Helix:** Governance model engaging academia, industry, government, and civil society for co-creation and oversight (e.g., Regional Innovation Council).
- **Regional Emergency Hospital (Cluj-Napoca):** Flagship innovation and validation site integrating living-lab capabilities during commissioning.
- **Regional Innovation Council:** Proposed governance body with rotating leadership across stakeholder groups; provides binding recommendations on strategy and funding.
- **RIS3 NV 2021–2027:** The Regional North-West Research & Innovation Strategy for Smart Specialization; existing framework targeted for enhancement and tighter ROP alignment.
- **Services-Sector Digitalization:** Tailored modernization support for the region's largest employer segment to raise productivity and competitiveness.
- **Stakeholder Satisfaction Assessment:** Regular surveys/consultations with firms, academia, providers, and partners feeding into quarterly and annual reviews.
- **Technical University of Cluj-Napoca (TUCN):** Engineering and prototyping partner for device development, testing, and validation services.
- **Telemedicine/Teleradiology:** Existing digital footholds in regional providers that the plan scales as part of the HealthTech/digital priorities.
- **University of Medicine & Pharmacy "Iuliu Haţieganu" (UMF Cluj):** Clinical research, trials, and regulatory/clinical expertise hub for HealthTech projects.
- **Venture Capital Attraction:** Tracked outcome and financing pillar signaling innovation maturity and market confidence.

KEYWORDS

HealthTech; digital health; edical devices; clinical validation; living labs; Smart Specialization Strategy; RIS3 NV; North-West Regional Development Agency; Cluj IT Cluster; performance-based funding; monitoring and evaluation; Regional Emergency Hospital Cluj-Napoca; quadruple helix; Regional Innovation Council; cross-sector integration; GDP-weighted prioritization; export development; investment attraction; regulatory compliance (MDR); technology transfer.

REFERENCES

Babeș-Bolyai University Launches the INSPIRE Platform - Eutopia. Accessed 7 October 2025.

UBBMED – Babeș-Bolyai University. Cluj-Napoca. n.d. Accessed 7 October 2025.

CLUJ REGIONAL HOSPITAL. Accessed 12 October 2025.

European Regulatory Provisions on Medical Devices – NAMMDR. Accessed 7 October 2025.

Florian, Sebastian. *LevelUP, the First Health & Life Sciences Startup Accelerator in Romania, Kicks Off in Cluj-Napoca*. Startups&TheCity, 6 March 2024.

FreshBlood website, Accessed 27 September 2025

FreshBlood, Hubvantage. n.d. Accessed 27 September 2025.

Health Program, North-West Regional Development Agency. Accessed 24 August 2023.

Inforegio - Saving Lives – New Regional Emergency Care Hospital for Cluj, Romania. Accessed 25 September 2025.

Institute of Oncology "Prof Dr. Ion Chiricuta" CLUJ NAPOCA - Endo-ERN. Accessed 15 September 2025.

KPMG. *Improved Legal Framework for Medical Devices.* 24 March 2023.

Leončikas, Tadas, John Hurley, Dragoș Adăscăliței, et al. *Employment in the EU's Automotive Sector*. Eurofound, 27 January 2025.

LevelUP – *The First Accelerator Dedicated to Health and Life Sciences Start-ups*, North-West Regional Development Agency. News. 14 March 2023.

OECI Membership. Accessed 13 August 2025.

ONG, Digital Innovation Zone. *In Romania, Healthcare Is the New IT Sector*. Digital Innovation Zone, 6 May 2021.

Public Consultation - National Health Digitalization Strategy 2024-2030. Accessed 13 September 2025.

Regional Program NW - North-West Region. 16 October 2025.

Arazy Group- Romania, n.d. Accessed 3 October 2025.

Statista. *Medical Technology - Romania | Statista Market Forecast*. Accessed 7 October 2025.

SMART Specialization Strategy Of The North-West Development Region (RIS3 N-V) 2021-2027, North-West Regional Development Agency. News. 12 August 2025.

Telios Care. Accessed 26 August 2025.

Václav, *Cluj County Emergency Hospital*, Green Center, 27 May 2025.

Yilmaz, Bahadir, *Medical Devices in CEE & SEE: Navigating the Challenges to Modern Healthcare*, Wolf Theiss - Leading Lawyers in CEE&SEE, 5 December 2024.