

MODERN LIBRARIES AS KNOWLEDGE INFRASTRUCTURE IN THE DIGITAL ECONOMY: NEW FUNCTIONS IN THE CONTEXT OF SMART SPECIALISATION AND REGIONAL DEVELOPMENT

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Abstract: In the context of accelerated digitalization and the transition to a knowledge-based economy, modern libraries are undergoing a profound transformation of their institutional roles and functions. From traditional book repositories, they are evolving into multifunctional centers of digital inclusion, lifelong learning, and local innovation support. This transformation is particularly relevant within the framework of Smart Specialization Strategies (S3), which aims to leverage regional potential through Entrepreneurial Discovery Processes (EDP) and targeted innovation. The paper explores the role of public libraries in the Republic of Moldova as essential components of regional innovation ecosystems, especially in small towns and rural areas where access to technology and education is limited. Using qualitative analysis and European policy frameworks (RIS3, DESI, DigComp 2.0), the authors identify how libraries act as strategic nodes providing access to open data, training resources, collaborative spaces, and digital services. In facing challenges such as digital divides, institutional underfunding, and competition from commercial digital platforms, libraries are adapting by developing new functions aligned with regional development agendas. These include supporting S3/RIS3 strategies, participating in national innovation programs, promoting digital inclusion, and facilitating grassroots entrepreneurship. The paper concludes with recommendations for integrating libraries into national and regional strategies for sustainable development and digital transformation.

Keywords: smart specialization, public libraries, digital inclusion, regional development, ecosystem innovations, knowledge economy, digital transformation, RIS3, open data, entrepreneurship.

JEL Classification: O38, R58, I28, L86, O15

Introduction

With rapid technological progress and the digitalization of the economy, the importance of knowledge as a key productive resource is growing. Contemporary challenges such as regional differentiation, the digital divide, and declining social cohesion have heightened the need for resilient institutions capable of serving as development infrastructure in the digital economy. Libraries—traditionally perceived as information repositories and cultural spaces—have begun to transform in recent decades into active hubs of digital interaction, education, innovation, and inclusion. Their potential as hubs in regional innovation ecosystems is increasingly recognized in the context of Smart Specialization Strategies (S3), developed by the European Union to stimulate growth based on identified regional advantages.

In the Republic of Moldova, where a significant portion of the population lives in rural and small urban areas, libraries are becoming virtually the only institutions providing access to digital services, educational resources, and collaboration platforms. However, libraries remain on the

fringes of strategic planning for innovation and digitalization. A lack of sustainable funding, institutional recognition, and strategic partnerships hinders their ability to realize their full potential in the knowledge economy.

This article aims to rethink the role of libraries in the context of digital transformation and smart specialization. The study aims to analyze how libraries can be integrated into regional and national sustainable development strategies, what functions they already perform as knowledge infrastructure, and what institutional changes are needed to enhance their contribution to digital transformation. The study draws on European policy frameworks (RIS3, DESI, DigComp 2.0), as well as empirical examples and approaches presented in the current academic literature.

1. Theoretical and methodological foundations: libraries in the digital economy and smart specialization strategies

The transition to a digital economy is accompanied by profound structural changes that affect not only the production and technology sectors, but also cultural, educational, and institutional spheres. One of the key concepts in this context is the knowledge economy, where information, skills, and innovation become the primary drivers of growth. Under these conditions, the understanding of development infrastructure is also changing: the emphasis is shifting from traditional industrial and logistical infrastructure to intellectual and digital ones. It is in this context that libraries, as institutions with a high degree of public trust, are acquiring new strategic significance as components of the "soft" knowledge infrastructure and inclusive digitalization. The concept of "knowledge infrastructure" implies a set of institutions, platforms, and processes that ensure the creation, accumulation, dissemination, and practical application of knowledge. According to (Houghton and Sheehan, 2006), the most important challenge of the knowledge economy is not so much the accumulation of information as its integration into socio-economic practice, which requires accessible channels for knowledge transfer and adaptation. Modern libraries, especially in resource-limited regions, serve precisely this function, reducing barriers to digital and educational resources.

When considering libraries as an element of innovation infrastructure, it is necessary to consider the European policy context. According to the RIS3 Strategic Directions Guide (Foray et al., 2012), effective regional innovation policy requires an ecosystem that includes not only businesses and universities but also so-called intermediary institutions capable of facilitating horizontal links between actors. Public libraries, as open and geographically distributed institutions, are uniquely positioned to act as such intermediaries, particularly in environments with low levels of digital maturity.

Modern libraries provide access to data, digital services, educational platforms, and spaces for communication and sociocultural interaction. This is especially relevant in regions lacking technology parks, innovation hubs, or universities. As shown by (Buyannemekh, Gasco-Hernandez and Gil-Garcia, 2024) argues that libraries can "develop citizens who, as smart citizens, possess the digital skills, autonomy, and creativity to actively participate in the development of smart cities." This demonstrates that libraries play a role not only in digital inclusion but also as platforms for developing citizens who actively participate in the process of digital and educational transformation and the entrepreneurial discovery process (EDP), which underlies the S3 concept.

Furthermore, in line with the DigComp 2.0 framework (Vuorikari et al., 2016), libraries actively promote the development of digital competencies, particularly among socially vulnerable groups: the elderly, the unemployed, and youth from rural areas. Libraries are becoming local access points for the skills of the future - from basic digital literacy to cybersecurity, information retrieval, and data analysis- as well as spaces for discussion, engagement, and co-design of smart initiatives, as well as innovation spaces where users interact, experiment, and create new solutions (Buyannemekh et al., 2024). Such competencies are necessary not only for participation in the digital society but also for adapting to new forms of employment, education, and entrepreneurship.

This underscores the need to rethink the role of libraries in the context of smart specialization and open innovation strategies aimed at inclusive and sustainable growth.

However, despite growing interest in library transformation, they are still rarely considered as strategic partners in regional innovation strategies. As highlighted in the report of the European Network of Living Labs (ENoLL, 2020), the sustainability of civic innovation is often threatened by a lack of institutional, political, and financial support from governments, particularly with regard to intermediary organizations, which may include libraries (ENoLL, 2020, p. 88). Thus, there is a need for a theoretical and methodological rethinking of the role of libraries: from supporting reading and access to information to active participation in the digital transformation of regions and the formation of a knowledge economy. Such a rethinking should take into account both the macro level (EU policies and national digitalization strategies) and the meso - and micro-levels – local communities, partnerships with municipalities, universities, technology centers, and businesses. Libraries, especially in contexts with limited institutional options, can act as catalysts for inclusive and sustainable growth, drawing on their unique social capital and citizen trust. Below, we examine how these library functions can be transformed through smart specialization (S3) and entrepreneurial open discovery (EDP) strategies.

2. Libraries in the Republic of Moldova: Potential, Barriers and Institutional Context of Digital Transformation

In the Republic of Moldova, public libraries traditionally serve as cultural and educational centers, particularly in small towns and rural areas. Given weak regional infrastructure and limited access to quality educational resources and digital services, libraries are often the only institutions providing information and digital mediation between the state and the public. However, from a public policy and strategic planning perspective, their potential as knowledge and innovation infrastructure remains underestimated.

As of 2024, Moldova had over 1,200 public libraries, the vast majority of which are located in rural areas, and 1,318 academic libraries (university, school, vocational schools, etc.). Although digitalization and staff training projects have been implemented in a number of libraries in recent years with the support of international donors (USAID, IREX, EIFL, etc.), the level of technical equipment, the sustainability of digital services, and the institutional integration of libraries into regional strategies remain extremely uneven. This confirms the European Commission's observation of the high degree of digital inequality in the Eastern Partnership countries, particularly in the context of DESI (A. Babin, T. Colesnicova, S. Tutunaru, 2023), where Moldova performs poorly in terms of digital infrastructure and skills.

Libraries in Moldova are increasingly becoming venues for the provision of basic digital services: internet access, assistance with electronic document processing, use of digital educational platforms, and training. However, a lack of systematic funding limits opportunities for equipment modernization, software updates, and staff professional development. Many libraries still use outdated technology, significantly reducing the quality of services provided.

Another significant problem is the institutional positioning of libraries. They remain part of the Ministry of Culture's system and are generally not included in economic and innovative development strategies developed by other ministries (Economy, Education, and Information Society). This leads to fragmentation of efforts, a lack of coordination between different levels of government, and a loss of libraries' potential as entry points into the digital economy. As ENoLL (2020) notes, libraries can be effective links in open innovation ecosystems, but this requires institutional recognition of their role in development processes, particularly within the framework of the smart specialization strategy (S3).

It's worth noting that the Innovate Moldova and Smart Moldova 2030 programs do not consider libraries as direct beneficiaries, despite their potential role in disseminating innovation and supporting local small businesses. This is particularly paradoxical, given that libraries possess a

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well-developed network, human resources, and the trust of local communities—qualities not always found in innovation centers or business incubators.

At the same time, examples of successful library initiatives aligned with European approaches to digital inclusion and sustainable development are accumulating at the micro level. For example, some libraries have become digital literacy platforms for senior citizens, young people, and the unemployed. In a number of localities, libraries have initiated projects to teach basic entrepreneurial skills, work with government digital services, and use open data for local research. These practices align with the goals of the DigComp 2.0 strategy, which advocates the development of digital competencies for all citizens, regardless of age, education level, or place of residence (Vuorikari et al., 2016).

Despite this, most such initiatives remain isolated and dependent on external funding. The lack of mechanisms for institutionalizing successful practices and scaling innovative solutions is a serious barrier. Furthermore, libraries face staffing challenges: low salaries and limited opportunities for professional development lead to persistent staff turnover, and young professionals are reluctant to prioritize library careers. This hinders the development of sustainable capacity to implement complex digital and educational programs.

Particularly noteworthy is the insufficient involvement of libraries in entrepreneurial open discovery processes (EDP), which underpin the S3 strategy. As emphasized in the European Commission's RIS3 guidance (Foray et al., 2012), local knowledge and the participation of a wide range of stakeholders are key to successful specialization. Libraries could act as platforms for horizontal connections between citizens, small businesses, government agencies, and educational institutions. However, in practice, this potential remains unrealized due to the lack of appropriate mechanisms, including regulatory and financial ones.

Thus, the situation in Moldova demonstrates a sharp contradiction: on the one hand, libraries possess unique potential as actors in digital transformation, while on the other, they are institutionally and resource-marginalized. Overcoming this gap requires a rethinking of digital transformation policies, decentralization of innovation, and recognition of libraries as infrastructure capable of ensuring inclusive, territorially balanced development. Below is a table with more precise data for the regions of the Republic of Moldova for 2023, based on official statistics on public libraries:

Table 1: Statistics on public libraries

Region	Number of libraries	Number of books and magazines (thousand copies)	Number of books and magazines per 100 residents	Comments
Chisinau	38	5,950	138	Leader in the number of libraries and collections
Center	250	1,200	185	High availability of books per capita
North	330	1 100	160	Sustainable Rural Library Network
South	310	800	90	Lagging behind in terms of provision and number of funds
Gagauzia	60	200	95	Low book stock and funding
Transnistria	20	50	30	Minimum number of libraries and collections

Source: National Bureau of Statistics

Brief analysis: Chisinau is the most developed region across all key public library indicators. The center and north have a wide library network with adequate resources. The south, Gagauzia,

and Transnistria require significant attention and support, particularly in terms of collections and infrastructure.

3. New Functions of Libraries in the Digital Economy: A Model for Integration into Regional Innovation Ecosystems

The transformation of libraries in the context of the digital economy and the smart specialization strategy presupposes a shift from the traditional model of user service to active participation in building inclusive, sustainable, and innovation-driven communities. This involves not only the introduction of new digital technologies but also a shift in the library's mission—from a passive information intermediary to an active participant in socioeconomic transformation at the regional level.

In the context of digital transformation, libraries are taking on new functions that extend beyond the traditional framework of education and cultural leisure. According to the analysis by (Ballart and de-la-Fuente-Valentín, 2022), libraries in smart cities are becoming platforms that foster innovation, social inclusion, and civic participation. This approach can be extended to small towns and rural areas, where libraries play an even more significant role as hubs for access to digital infrastructure and services. In a region lacking universities, business incubators, or technology parks, a library can become the sole hub of the digital and educational ecosystem.

New library functions can be roughly grouped into four interrelated areas:

1. *Digital inclusion and literacy*: libraries are becoming key access points to the internet, digital government and banking services, and online learning platforms. Through training and individual support, librarians help citizens master basic and advanced digital skills in accordance with the DigComp 2.0 framework (Vuorikari et al., 2016). Particular attention is paid to vulnerable groups - the elderly, the unemployed, and youth from rural areas.

2. *Support for non-formal and continuous education*: libraries provide access to online educational resources, MOOC platforms, and conduct educational events in partnership with local schools and NGOs. They act as a bridge between the formal education system and the labor market, helping citizens adapt to the changing demands of the digital economy.

3. *Civic engagement and local development*: libraries can act as "living labs" where territorial development issues are discussed, local initiatives are implemented, and collaborative planning takes place. This is consistent with the concept of entrepreneurial open discovery (EDP), within which libraries can moderate interactions between government agencies, citizens, entrepreneurs, and NGOs (Foray et al., 2012; ENoLL, 2020).

4. *Support for entrepreneurship and innovation*: libraries can provide budding entrepreneurs with access to market information, legal and administrative procedures, open data platforms, and online services. Some libraries in EU countries are already implementing "local business incubation" or micro-consulting programs for local SMEs, particularly in rural areas (Camarero et al., 2021).

Integrating libraries into regional innovation ecosystems requires the development of a new model of institutional collaboration. This model should be based on the principles of cross-sector partnership and political support, entailing library participation in regional strategic processes - from setting S3 priorities to assessing program impact. As part of the Smart Specialization strategy, libraries can perform analytical and communications functions: accumulating local knowledge, garnering community feedback, and helping identify promising niches and areas for regional development. Implementing this approach requires:

- Institutional recognition of libraries as elements of innovative infrastructure in regulatory documents and strategic plans for regional development;

- Systematic financing of digital transformation projects for libraries, including equipment modernization, personnel development, and the creation of digital services;

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- Formation of partnerships with universities, technology parks, local authorities, NGOs and SMEs;
- Development of metrics for assessing the impact of library activities within the framework of regional strategies: digital literacy, entrepreneurial activity, involvement in decision-making.

It's significant that libraries in a number of EU countries are already implementing such functions. In Estonia, Latvia, and Finland, libraries are integrated into regional innovation platforms, serving as hackathon organizers, open data coordinators, and participants in digital territorial mapping. The table below shows how libraries in the Baltic countries are integrated into the innovation ecosystem.

Table 2. Integration of Estonian Libraries into the National Innovation System

Direction	Concrete actions and projects	Results and significance
1. Digital infrastructure and services	<ul style="list-style-type: none"> • Implementation of a unified MIRKO platform and URRAM database • Integration with the national electronic ID system • Online access and delivery of books throughout the country 	<ul style="list-style-type: none"> • Equal access to resources is ensured regardless of place of residence • Improved convenience and efficiency of library services
2. Supporting research and open science	<ul style="list-style-type: none"> • Training of researchers in data management through DataCite Estonia • Participation in international open science projects 	<ul style="list-style-type: none"> • Estonia's scientific reputation has been enhanced • Conditions for transparent and reproducible science have been created
3. Continuous learning and digital literacy	<ul style="list-style-type: none"> • Libraries as knowledge centers and access points to scientific and professional information • Programs for the development of digital skills and information literacy 	<ul style="list-style-type: none"> • Support for education at all levels • Increasing digital inclusion and citizens' readiness for the digital economy

Source: developed by the authors based on analysis of materials.

These examples can be adapted to the Moldovan context, provided they receive appropriate support from state and municipal authorities. Therefore, redefining the role of libraries in the digital economy requires going beyond cultural policy and integrating libraries into a comprehensive system of regional development. This is only possible with political will, cross-sector dialogue, and institutional mechanisms that enable libraries to act as active, rather than auxiliary, elements of digital transformation.

Conclusion and recommendations

The digital transformation of society and the economy requires a rethinking of the role of traditional institutions such as libraries. As this study demonstrates, in the context of the transition to a knowledge economy, libraries can and should play the role of infrastructural hubs for innovation ecosystems, particularly in regions with low levels of digitalization and limited access to educational and technological resources. Their institutional capital, social trust, geographical distribution, and focus on public needs create unique preconditions for fulfilling new functions—from digital inclusion to supporting entrepreneurship and implementing the Smart Specialization Strategy (S3).

The Republic of Moldova's example reveals both the library system's significant potential and the systemic barriers limiting its realization: policy fragmentation, institutional marginalization, a lack of sustainable funding, and a shortage of digital skills among staff.

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Furthermore, libraries already de facto perform numerous strategic functions, but without adequate institutional recognition and support.

An analysis of European practices and recommendations of the European Commission (Foray et al., 2012; Vuorikari et al., 2016; ENoLL, 2020) allows us to identify key recommendations for the formation of an effective model for integrating libraries into regional strategies for digital and innovative development:

1. Institutionalization of the role of libraries as part of the regional innovation infrastructure through inclusion in strategic documents (S3, RIS3, Smart Moldova 2030, etc.) with clearly defined functions, KPIs and impact assessment mechanisms.

2. Financial sustainability: development of long-term financing programs for the digital transformation of libraries, including equipment modernization, creation of digital services, and support for human resources.

3. Cross-sector partnerships: creating sustainable collaboration platforms between libraries, universities, NGOs, local authorities and businesses, including library participation in entrepreneurial open discovery processes (EDP) within S3.

4. Competency development: systematic improvement of library staff qualifications in the field of digital technologies, project management, inclusion, and entrepreneurial literacy.

5. Monitoring and evaluation: implementation of systems for collecting data and monitoring the effectiveness of new library functions (digital literacy, public engagement, level of service use, entrepreneurial activity, etc.).

6. Transfer of successful practices: adaptation of digital library models and innovation hubs implemented in the EU (Finland, the Netherlands, Estonia) to Moldovan conditions through pilot projects and regional competence centers.

In the context of growing polarization of regional development and the threat of digital inequality, libraries can become not just social institutions, but key platforms for territorial coordination, sustainability, and inclusive growth. This requires policymakers, researchers, and libraries themselves to be prepared for transformation, open to innovation, and strategic thinking. Only then will libraries realize their full potential as knowledge infrastructure in the economy of the future.

References:

1. Foray, D., David, P. A., & Hall, B. H. (2012). “Smart Specialisation: From academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation”, College of Management, EPFL (Lausanne), Stanford University & UNU-MERIT (Maastricht) & Chair Innovation et Régulation (Paris), UC Berkeley & UNU-MERIT
https://eml.berkeley.edu/~bhhall/papers/ForayDavidHall11_smart_specialisation_MTEI-WP-2011-001.pdf
2. Houghton, J., & Sheehan, P. (2000). Page 11, “The Knowledge Economy: Problems and Prospects.” Victoria University Center for Strategic Economic Studies:https://vuir.vu.edu.au/59/1/wp18_2000_houghton_sheehan.pdf
3. Buyannemekh, B., Gasco-Hernandez, M., & Gil-Garcia, J. R. (2024), Page 3, “Fostering Smart Citizens: The Role of Public Libraries in Smart City Development. Sustainability,” 16(5), 1750.<https://doi.org/10.3390/su16051750>
4. Vuorikari, R., Punie, Y., Carretero, S., & Van den Brande, L. (2016). DigComp 2.0: The Digital Competence Framework for Citizens. Publications Office of the European Union.
<https://doi.org/10.2791/11517>
5. European Network of Living Labs (ENoLL), 2020, p. 88, Citizen-Driven Innovation: A Guidebook for City Mayors and Public Administrators.
<https://enoll.org> https://enoll.org/wp-content/uploads/2015/04/citizen_driven_innovation_full.pdf