DIGITAL TRANSFORMATION AND INNOVATION IN THE REPUBLIC OF MOLDOVA

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Abstract: *In August 2020, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) adopted the Integrated Geospatial Information Framework (IGIF), which provides the strategic guidance that enables sub-national or national-specific The IGIF aims to assist countries to move towards Digital Transformation throw e-economies, e-services, e-commerce and to provide a basis and guide for developing, integrating and strengthening geospatial information management in countries worldwide.*

IGIF defines 9 pathways to reach this goal, as Governance and Institutions, Policy and Legal, Financial, Data, Innovation Standards, Partnerships, Capacity and Education and Communication and Engagement.

Through these means, IGIF will help to bridge the geospatial digital divide between developed and developing countries and to support the 2030 Agenda for Sustainable Development. Through these means, IGIF will help to bridge the geospatial digital divide between developed and developing countries and to support the 2030 Agenda for Sustainable Development.

During 2021-2023, with the technical support of Norwegian Government, the IGIF was implemented in the Republic of Moldova. Since the endorsement of IGIF, the Norwegian Mapping Authority has taken an active role in promoting the implementation of IGIF in the Republic of Moldova.

The paper describes the status of Geospatial Information Management in the Republic of Moldova, structured around the nine IGIF pathways, including Governance, Policy, Financial, Spatial Data, Innovation, Standards, Partnerships, Capacity and Education, Communication and Engagement.

Key words: *Geospatial data; Digital Transformation; Innovation; The Integrated Geospatial Information Framework (IGIF).*

1. Introduction

1.1. Republic of Moldova at a glance

The Republic of Moldova is a relatively small country in Eastern Europe with an area of approximately 34 thousand sq. km between Romania and Ukraine and a population of 2,6 million (National Bureau of Statistics of the Republic of Moldova, 2022). Moldova gained independence in 1991, officially recognized as a United Nations member in 1992.

In 2014, the country signed an Association Agreement and a Free Trade Agreement (EU-Moldova DCFTA, 2014) with the EU connecting Moldovan products to this market. One outcome of the DCFTA was redrafting the country’s customs legislation and procedures in line with EU standards and aligning with the EU’s Customs Code.

EU integration prospects have driven the governments’ policy reform agenda since 2009. These developing links with the EU have been a significant contributing factor in the progress of the various policies supporting the development of the geospatial landscape in Moldova and have been one of the drivers behind the development of its National Spatial Data Infrastructure (Kartverket, ConsultingWhere, 2022).

In April 2012, the Government of Moldova joined the Open Government Partnership initiative where it committed to increase public access to information, promote transparency of governance and ensure citizens’ participation to governance, by using advanced information technologies. One of the tools that ensure Government openness is the open data portal http://www.date.gov.md , where all government institutions are able to share data sets. The Open Data portal currently includes around 1 255 data sets and 15 709 resources.

With donor support of Norwegian Ministry of Foreign Affairs (NMFA) throw Norwegian Mapping and Cadastre Authority (SK), JICA and EU funds a National Spatial Data infrastructure (NSDI) is being created in Moldova under the responsibility of Agency for Geodesy, Cartography and Cadastre (AGCC) https://www.agcc.gov.md/.

A NSDI law according EU INSPIRE Directives was approved in 2016 and a Geo-portal, including a number of geospatial datasets and services, has been developed https://geoportalinds.gov.md/en/geoportalhome-2/ . NSDI Geo-portal currently includes 148 network services, 47 subjects and 329 metadata records.

The European Union supported the Republic of Moldova with the EU Twining Project „Improving Spatial Data Services in the Republic of Moldova following EU standards”. Project was launched in September 2020 and closed in October, 2023. The partners from three EU Member States, Croatia, Poland and the Netherlands provides the support to the beneficiary:

- Croatian State Geodetic Administration as a lead partner and
- Polish Head Office of Geodesy and Cartography and the Netherlands Enterprise Agency as junior partners with the support of
- Croatian Central Finance and Contracting Agency, Faculty of geodesy on Zagreb University and
- Dutch Kadastre.

1.2. Land reform and lack of up-to-date maps

Moldova has undergone a massive land privatization program called land reform. The main goal of the land reform was to transfer state-owned land to private ownership and establish a class of property owners. To organize the land reform in Moldova, a governmental public authority – the Agency for Geodesy, Cartography and Cadastre (AGCC), was established in 1994. Supported by USAID – the United States Agency for International Development and World Bank, Moldova made good progress with land privatization during 1997 – 2006.

At the time, the existing topographic maps were only on paper, 25–30 years old, and unsuitable for property registration. Moreover, the scale of maps 1:10 000 and 1:25 000 was small for the subdivision of former agricultural collective farms and for planning new property boundaries.

The absence of appropriate regulations for cadastral works and the lack of reliable maps led to 10% of newly established properties being mapped with various errors.

Figure 2: Aerial images captured in 2007 were used to identify errors in the mass privatization program. Photo: Lars Mardal, Brede Gundersen, Kartverket, 2007.

Due to the lack of a comprehensive approach, privatizing former collective farms resulted in land fragmentation. In most cases, an owner was given two or more parcels – parts of arable lands, pastures, orchards, vegetable gardens, walnut trees, etc. The areas were divided into several narrow but very long individual parcels that resembled ”a patchwork quilt.”

Figure 3: Land fragmentation in Moldova: Former collective farms were subdivided into many-parcel “patchwork quilt.” Lars Mardal, Brede Gundersen, Kartverket, 2007.

Land fragmentation is economically disadvantageous: If the neighbours disagree on using parcels, machinery farming would be impossible. Some owners managed to let or sell their lots to resourceful investors. Many have left their land.

To improve the situation, measures called ‘land consolidation’ are required. Land consolidation leads to parcel reallotment. The authorities negotiate a fair parcel exchange with property owners to suit better machinery agriculture. And the process must be supported by updated geospatial information – aerial imagery and base maps.

2. Norwegian Support to the Geospatial Sector in Moldova

During the past sixteen years, assistance from Norway has contributed to establishing the geospatial industry and improving public services in Moldova. The main development

goal of the program was to achieve economic growth supported by a functioning land market and tools for good land management. Kartverket, jointly with the AGCC, implemented projects supporting efficient, secure, and transparent land registration by providing access to up-to-date geographical information throughout the country.

The Government of Norway annually provided 5 million NOK (ca. 0,5 million USD, as of March 2023) to the program, which totaled almost 84 million NOK (ca. 8,5 million USD, as of 2023). Ninety percent of the funds were used for direct investments to create geographical data, deliver technical solutions and modern IT systems, and build the local human and technical capacity. Between 2006 – 2023, eight projects were implemented, and the people of Moldova received:

- Two generations of nationwide aerial imagery, digital elevation model, and orthophotos
- First national geoportal with free and open access to orthophotos
- First nationwide geographical positioning system MOLDPOS
- IT system for property registration and cadastre MOLDLIS
- First digital large-scale base map
- First national Geographical Names Register and regulations
- Action and investment plans for National Spatial Data Infrastructure.

The Norwegian–funded program has significantly improved the Agency’s data storage and distribution capacity to ensure constant and stable access to geospatial data by various groups of users.

Last three years, the program was also focused on supporting local public authorities with equipment, training, and geospatial data, in close collaboration with the Congress of Local Authorities from Moldova (CALM):

- 150 local municipalities have received workstations and training on using maps, digital elevation models, and orthophotos for territory planning and evidence-based decision–making.
- 200 local municipalities have received master copies of territory plans and maps, which they can use daily.

3. Implementation of the Integrated Geospatial Information Framework in Moldova

The Integrated Geospatial Information Framework – IGIF, jointly developed by the United Nations and the World Bank, supports the development of national infrastructures for geospatial information management in lower and middle-income countries.

The IGIF offers an excellent framework for future development. The IGIF offers an excellent framework for future development. Data sharing, so data is created once and used many times, is a key principle. Significant investment is needed to build long-term sustainable solutions, but the benefits are substantial and impact many sectors of national economies.

Since the endorsement of IGIF, the Norwegian Mapping Authority has taken an active role in promoting the implementation of IGIF in Moldova.

The IGIF comprises of three (3) parts as separate, but connected, documents:

- **Part 1:** Overarching Strategic Framework presents a forward-looking Framework built on national needs and circumstances, focusing on policy, perspectives, and elements of geospatial information. It sets the context of ‘why’ geospatial information management is a critical element of national social, economic, and environmental development.

- **Part 2:** Implementation Guide is the detailed document that provides the 'what', the specific guidance and actions to be taken in implementing the Framework. The aim is to provide guidance for governments to establish 'nationally' integrated geospatial information frameworks in such a way that transformational, albeit staged, change is enabled, visible and sustainable.
- **Part 3:** Country-level Action Plans provide templates and guides to operationalize the Framework in a national and sub-national context. Providing the 'how, when and who' approach, this document will assist countries to prepare and implement their own country-level Action Plans taking into consideration national circumstances and priorities.

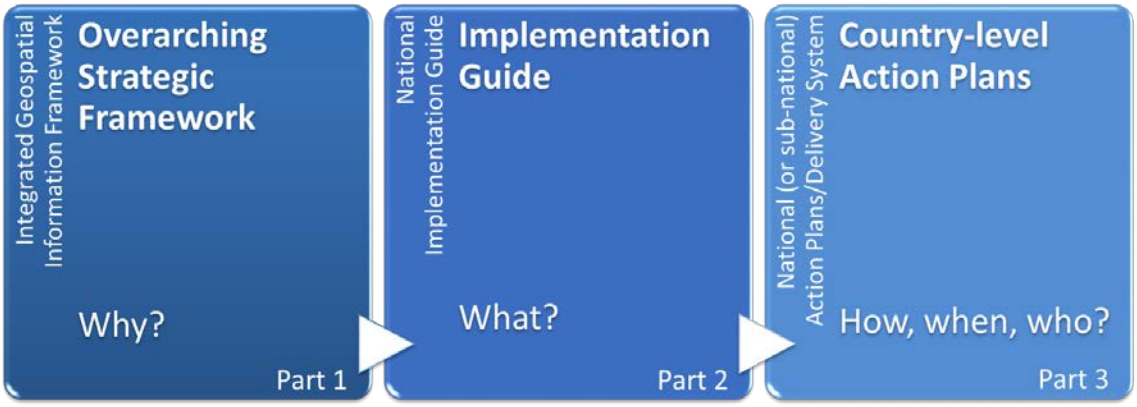

Figure 4: The 3 component documents of the Integrated Geospatial Information Framework.

World Bank IGIF Implementation Methodology

The World Bank Group has established an IGIF Implementation Methodology and corresponding analytical toolkit to support the use of the IGIF and incrementally create SDIs customized to specific countries and priorities. The graphic below illustrates the sequence and relationship of these analytical tools used to arrive at the implementation of the SDI. The symbology shows the analytical tools (in orange), key inputs (in blue), the IGIF in purple, outcomes (in green) and uses arrows to different types of information flows.

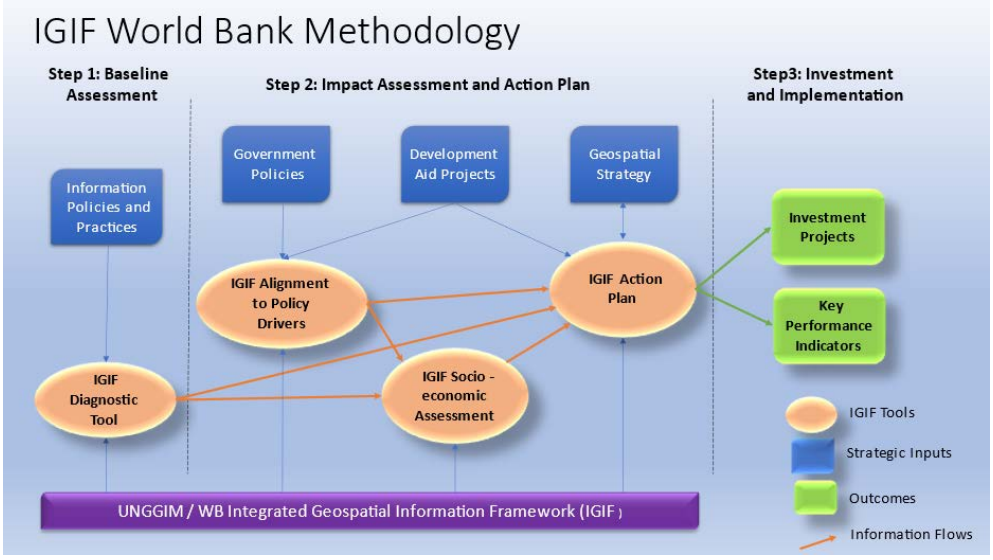

Figure 5: World Bank IGIF Implementation Methodology

In summary, this methodology has been applied as follows:

Step 1: Baseline Assessment

A single integrated tool is used for this purpose:

Analytical Tool 1 - IGIF Baseline Diagnostic Tool (DT): this provides an assessment of the “as is” position of geospatial information management in the country, structured around the nine IGIF pathways, including governance, policy, financial, human capacity, and technical perspectives.

Step 2: Impact Assessment and Action Plan

Three tools are used to build a prioritized, cost-justified roadmap for strengthening integrated geospatial information management:

Analytical Tool 2.1 - IGIF Alignment to Government Policy Drivers: this tool is used to align the Government’s strategic objectives and international commitments to specific spatial use cases (applications) and then prioritizes them based on how well they support and accelerate achieving these strategic objectives.

Analytical Tool 2.2 - IGIF Socio-Economic Impact Assessment: this tool delivers an assessment of the socio-economic business case for investment in an SDI from both qualitative and quantitative perspectives. It is informed by the outputs from the previous two tools outlined above.

Analytical Tool 2.3 – IGIF Action Plan: this tool builds on the previous deliverables to create or update a high-level geospatial strategy and a corresponding costed plan roadmap for SDI enhancements, presented as a series of interdependent policy interventions and implementation projects.

Step 3: Investment and Implementation

Once the Action Plan has been approved in terms of scope, investment plan and priorities, then work will commence to identify sources of government and international funding.

The Baseline Assessment aimed to present the status of the National SDI in Moldova as a basis for the Action Plan. The diagnostic method assessed the “as is” position of geospatial information management in the country, structured around the nine IGIF pathways, including governance, policy, financial, human capacity, and technical perspectives.

The Republic of Moldova completed a Baseline Assessment of current geospatial information management practices during February – April 2021. The findings, organized in terms of the IGIF Strategic Pathways, reflects the outcome from this baseline assessment. A score of 100 is the maximum achievable, and awarded only if the NSDI, in relation to the strategic pathway being assessed, is fully developed and sustainable.

The Baseline Assessment scores, and a summary of the current situation for each of the strategic pathways, is as follows:

- **Governance and Institutions (Score = 53):** Moldova has high level support for the implementation of a National SDI with clear institutional arrangements defined in Law (law no 254 from 2016 on National

Spatial Data Infrastructure[1] governs much of the activity associated with the implementation of IGIF).

- **Policy and Legal (Score = 32):** Legislation for a National SDI in Moldova is good. The country benefits from having Law 254 from 2016 on national spatial data infrastructures which provides the framework for the implementation of the SDI. This Law, together with various amendments included in 2018, sets the general rules about the establishment of the National SDI and establishes the legal and policy framework for the implementation of the SDI.
- **Financial (Score = 18):** Moldova has been successful at accessing external funding. There has been, and continues to be, excellent collaboration with various international donors which have provided funding for projects which support the implementation of the National SDI. However, outside of the various donors, there appears to be a lack of a cohesive and consistent understanding of how the implementation of the National SDI will continue to be financed.
- **Data (Score = 54):** The primary geospatial and statistical data holdings are well organized and mainly conform to the UN-GGIM recommended fundamental themes. Moldova has established a good geodetic infrastructure, there is a common national geodetic datum reference, projection and co-ordinate system which is accessible and used by most stakeholders. A data framework has been established with the management of fundamental datasets in the M Cloud as a secure storage and retrieval environment.
- **Innovation (Score = 44):** There are examples where innovation is being used in support of geospatial activities but this tends to be done on an individual basis by individual stakeholders, or by the private sector. Moldova has a very well-developed ICT infrastructure which will facilitate the implementation of the National SDI, the geoportals are well established but there was no evidence of any formal investment for geospatial innovation projects such as innovation hubs/centre of excellence responsible for actively managing and communicating information. Despite the evidence of some strong Academia there is no 'centre of excellence' which would provide a focus for geospatial research.
- **Standards (Score = 33):** The implementation of standards in Moldova is based on the Law 254 from 2016 and is strongly aligned with the EU INSPIRE Directive. National data standards and technical specifications have been defined for the geospatial domain. Initiatives have been taken to establish a community of practice to share skills, knowledge, and experiences about the implementation of standards. Additionally, Moldova is nationally represented on international Standards Development Organizations, such as ISO and CEN.
- **Partnerships (Score = 43):** There is collaboration between some of the public sector Stakeholders. Collaborations between public sector institutions and academia have also been successfully established. However more needs to be done to raise awareness, promote, encourage and support public private partnerships (PPP), looking for opportunities for establishing PPP joint ventures with the objective of developing and delivering new or improved geospatial products and services.
- **Capacity and Education (Score = 30):** The benefits and value of geospatial information has been raised across key decision makers, institutions in government, and across the education sector. The Universities provide courses designed to develop the geospatial information management competences and skills required by the geospatial information sector workforce, and in-house technical training is available.

[1] https://www.legis.md/cautare/getResults?doc_id=105790&lang=ro

- **Communication and Engagement (Score = 32):** Stakeholder engagement is ongoing but is ad-hoc, not very active, does not cover all the relevant Stakeholder groups and, such communication and engagement as exists, needs to be improved. The consequence of this all is that stakeholders are not fully informed of the significant progress and efforts being made with the SDI. Stakeholder engagement and communication needs to be consistent, regular, and reliable and would benefit from a more formal approach as part of an Outreach plan.

Further, an analysis of how the geospatial industry aligned with the national policy drivers and priorities was done. The result showed that Moldova had a solid basis for implementing the National Spatial Data Infrastructure. There is a good legal framework, a clear objective - EU integration, and a consistent approach across the various policy areas, supported by a stakeholder community whose geospatial activities are closely aligned with the multiple policy goals and objectives.

The final output from this study was the list of stakeholders. The list identified many stakeholders whose responsibilities include activities likely to provide input to the socio-economic impact assessment.

Figure 6: The IGIF reports for the Republic of Moldova are available at AGCC, 2023.

4. Innovation and digital transformation in the field of geospatial information management

IGIF identifies four key elements for innovation in the field of geospatial information management: 1) Technology Advancements; 2) Innovation and Creativity; 3) Improved processes and 4) Bridging the Geospatial Divide. The elements are shown in Picture 7: The four elements of the Innovation Pathway of IGIF (based on UN, 2020)

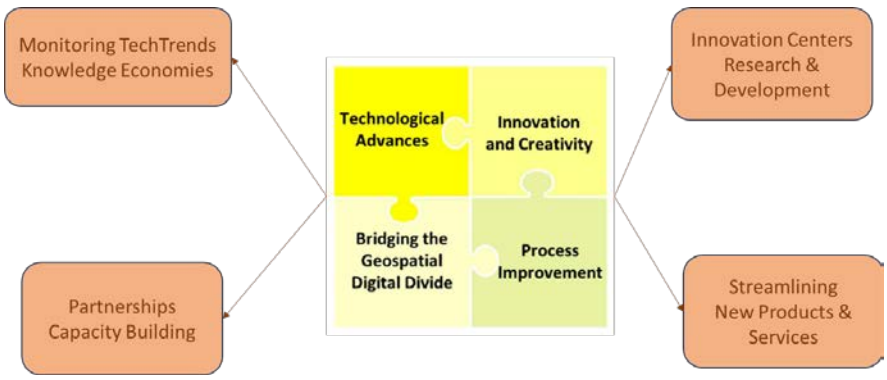

Figure 7. The four elements of the Innovation Pathway of IGIF (based on UN, 2020)

The most important initiatives related to (digital) innovation in Moldova are steered by the Ministry of Development and Digitalization. This includes the Digital Transformation Strategy for the period 2023-2030[2]. The document sets the vision for the digital transformation of the country until 2030 and reaffirms the commitment to build a modern digital society, centered on citizens and aligned with the European integration agenda.

Universities (and other Higher Education Institutes) and research centres are already involved in the Moldovan NSDI through working groups, projects and particular initiatives. Universities are offering academic training, but potentially also vocational training, and perform research activities that might and will be relevant for geospatial innovation. A close collaboration is essential for the CoI, but also the other way around, the activities of the CoI can lead to adaptations in the academic curricula, e.g. by integrating results from joint projects.

The most important role for universities, is to contribute to the development of vocational training programmes that the CoI will set-up. The Center of Excellence operated by the Technical University of Moldova can and should play a crucial role in this context. Furthermore, universities conduct research activities such as thesis work performed by students, PhD projects, (applied) research projects. The results of this work can feed activities of the CoI. The research can also be jointly defined. A new idea for an innovative project can lead to the definition of a thesis or PhD project. The CoI could suggest topics for thesis or PhD projects. The other way around, a thesis or PhD project can lead to the definition of a new innovative project, supported by the CoI, involving different partners.

One particular way of collaboration is the organization of internships. The universities could stimulate students – preferably through a formalized course – to perform an internships within geospatial companies. Such internships can focus on particular research topics or experiments during which geospatial data and innovative technologies are tested or used. This in turn can lead to new innovative ideas around which a new project is defined. It is advisable to set-up formalized agreements between the universities and research centers in which the roles, commitments and procedures are described.

5. Conclusions

A significant milestone for Moldova was the publication of Law 254 of 2016[3] on national spatial data infrastructures. The scope of the Law includes all spatial data sets as specified in the annexes to the Law, data content, data availability, data sharing, metadata, interoperability of the data, data services, data access, data use, together with the relevant responsibilities of the public entities and third parties. The spatial data sets identified in Annex 1, 2, and 3 of the Law are based on the EU Directive INSPIRE[4] and represents a broader range of data themes than the fundamental datasets covered by IGIF.

The geoportals are well established but there is no evidence of a national strategy for geospatial digital transformation. There is the national strategy 'Digital Moldova 2030'[5] published in 2018, which describes a number of sustainable development objectives, but the strategy does not specify geospatial data or services. There is no evidence of any formal investment for geospatial innovation projects or innovation hubs actively managing and communicating information.

[2] https://mded.gov.md/wp-content/uploads/2023/11/STD_EN.pdf.
[3] https://www.legis.md/cautare/getResults?doc_id=105790&lang=ro
[4] https://inspire.ec.europa.eu/Themes/Data-Specifications/2892
[5] https://moldova.un.org/en/15729-national-development-strategy-moldova-2030-approved-government

The UN-GGIM Integrated Geospatial Information Framework (IGIF) defines Innovation as one of its key pathways for better geospatial information management.

There are initiatives within Moldova focused on innovation but there appears to be little connection with geospatial. Open access to fundamental geospatial data for start-ups and researchers would help to stimulate innovation in the sector.

IGIF defines four elements for innovation in the field of geospatial information management: 1) Technology Advancements; 2) Innovation and Creativity; 3) Improved processes and 4) Bridging the Geospatial Divide.

The mission of universities is education, research and connection with the socio-economic environment. The Technical University of Moldova signed 2 cooperation general agreements with the Agency of Geodesy, Cartography and Cadastre in October 2023 and September 2024. With maximum efforts both entities are going to develop the Geospatial Center of Innovation at Technical University of Moldova.

It is very important because it exists intention to create a Moldovan Geospatial Center of Innovation. When setting-up and developing the Geospatial Center of Innovation all four elements should be considered. Innovation needs first to look in the modernization of (data production) processes and requires thinking and acting outside the box. A good way to do this, is to try new things by experimenting, which also includes ‘learning-while-doing’ to create new products.

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7. Biographical Notes

Maria Ovdii, doctor is the University lecture at the Technical University of Moldova. She worked as the Head of Geodesy, Cartography, and Geospatial Information at the Agency for Geodesy, Cartography and Cadastre of the Republic of Moldova during 2000-2024. In addition, she served as a Secretary to the NSDI committee of Moldova. Ms. Ovdii has been instrumental in gaining and coordinating support from various donors over many years, including Kartverket, the World Bank, USAID, JICA, and, most recently, the EU Twinning project.

Livia Nistor-Lopatenco is the Associate Professor, Ph.Dr, Dean at the Faculty of Construction, Geodesy and Cadastre at the Technical University of Moldova. Work experience: 24 years at the Technical University of Moldova - Faculty of Constructions, Geodesy and Cadastre (start with University assistant, continued with: Assistant lecturer, Senior lecturer, Associate Professor, Responsible for Master studies at Faculty Cadastre, Geodesy and Constructions, Head of Chair Geodesy, Cadastre and Geotechnics). Now, she is Dean of the Faculty of Constructions, Geodesy and Cadastre, Technical University of Moldova. She is responsible for the educational process at the Faculty of Constructions, Geodesy and Cadastre on cycle I, II and III. From 2016 until now, she is responsible for the integral educational process at the Faculty of Constructions, Geodesy and Cadastre.

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