CONFERENCE REPORT

Kartverket – Norwegian Mapping Authority
November 2021

This report prepared by Elena Busch, Kartverket and Andrew Coote, ConsultingWhere, represents a summary of proceedings, presentations and main conclusions of the regional conference organised by Kartverket on 27-29.10.2021

Conference web page https://kartverket.no/en/about-kartverket/international-services/great-interest-in-the-international-conference

ACKNOWLEDGEMENTS

We would like to acknowledge and express our gratitude to the Norwegian Ministry of Foreign Affairs for many years of financial support towards capacity development projects in Eastern Europe, West Balkans, Central Asia, and other regions, and for making these regional conferences possible. We would like to thank specifically Marianne Kvan, Deputy Director Grants, and Dr. John Mikel Kvistad, Norway's Ambassador to Central Asia, for their contribution and help with the conference.

We would like to give special thanks to the leadership of the Norwegian Mapping Authority and in particular to Johnny Welle, the Director General, and Hans Christian Munthe-Kaas, Director Global Geodesy, for their belief, contribution, and time spent.

We would also like to thank all involved in the preparation and carrying out of the conference, which would have never been a success without your contribution and invaluable support:

- John Kedar, who prepared and chaired Day 1 and helped with drafting this report;
- Rumyana Tonchovska, who prepared and chaired Day 2; and
- Astrid Hvattum, who prepared and chaired Day 3.

Also, we would like to thank our speakers for their wonderful insights.

Finally, our words of sincere gratuity go to Wilhelm Bøe for creativity and patience in designing conference graphic profile; to Hanna Hauan – for publicity and social media coverage; and to Ole Magnus Grønli for reporting on the conference.

Many thanks to all of you for sharing experiences, forward thinking ideas and inspirational visions!

Disclaimer

PREFACE

Dear Reader,

We are delighted to share with you this publication, which provides a summary of all contributions presented at the conference 'Geospatial Information for Digital Transformation" held as a hybrid event in Oslo on 27-29 October 2021.

During the past 20 years, the Norwegian Mapping Authority has been implementing a range of capacity development projects in Eastern Europe, West Balkans, Central Asia, and other regions with support from the Norwegian Ministry of Foreign Affairs.

Every autumn since 2016, we have held a physical conference hosted by one of our partner countries, to share what we have learned and celebrate successes. As a result of COVID-19, we were forced to cancel the 2020 event.

It was nice to be able this year to move back towards normality with this hybrid conference. As well as those connected from home or office settings, we had groups that met in person in Bishkek, Kyrgyzstan, Kiev, Ukraine, and in Oslo.

It gives us a special pleasure to share this report directly with all of you - 491 participants from 51 countries who had registered for the event. All recordings and proceedings are also made publicly available on the conference website.

We keep receiving positive feedback on the conference, which warms our hearts and inspires us to new endeavours. We hope to continue the tradition and meet you online or in person in 2022.

Hans Christian Munthe-Kaas

Elena Busch

Andrew Coote

@Participants' feedback

*…"Thank you and the Norwegian Mapping Authority for the 3-day conference that was **excellent** in terms of content, speakers and organizers. It was a great opportunity to share experience of different countries and look into future trends. Since pandemic I participated in numerous online events and the last week conference is really one of the most distinguished and superbly organized event, I must admit. Once again, our deep appreciation and gratitude to you and Kartverket!"*

Hans Christian Munthe-Kaas
Director
Global Geodesy
Kartverket, Norway

Elena Busch
Senior Engineer
Global Geodesy
Kartverket, Norway

Andrew Coote
Chief Executive
ConsultingWhere
United Kingdom

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KEY TAKEAWAYS

Overarching message – **Building a successful NSDI is a long-term process**.

The IGIF offers an excellent framework for future development. NMAs need to adapt to remain relevant. Enhancing human capacity is essential to meeting future challenges. Data sharing, so data is created once and use 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. As aid budgets are increasingly squeezed, developing countries need to look to other sources of funding.

Governance - the importance of recruiting a champion (politician or business leader) in a position to make or influence decisions cannot be over-emphasized.

Policy - NSDIs need to be seen to clearly align with government or organizational policy drivers. There are multiple policy areas where geospatial can make positive impact, but these vary by country and change over time. Digital transformation, mitigating climate change, national security and tackling health emergencies currently feature in most countries.

Legal - a clear legal mandate is required for establishing an NSDI. It is not always necessary to seek to create a specific NSDI Act. In some countries, existing laws can be modified to provide the mandate.

Finance - almost all change requires investment (be it in people, data, or systems). NSDI initiatives need to establish the socio-economic and environmental benefits to government, business, and society of what is proposed. A range of tools and guidelines are now available to assist.

Data – geospatial information management should focus on the creation of sustainable datasets, with a process for continuous revision (to keep them up to date) embedded in thinking from the start. The scope of the NSDI should be defined to manage the themes that underpin the widest possible set of use cases. Fitness for purpose should be a defining principle in establishing good practice in data creation and management.

Innovation - NSDI is a bridgehead in strengthening geospatial information management, however, the long-term goal should be creating a knowledge infrastructure encompassing predictive analysis and other tools.

Standards - quality and interoperability standards for geospatial data and processes have been established at an international level and their adoption and use facilitates this aspect of NSDI creation. Interoperability is not just a technical task but has organisational and legal aspects.

Partnerships - NSDI strengthening needs to include the requirements of private sector users and citizens. International partnerships allow countries to benefit from lessons learned in the wider community.

Capacity Building – strengthening spatial awareness in schools will provide the best opportunity of bringing top talent into the industry. Supporting multi-disciplinary teaching of geospatial concepts in tertiary and life-long learning programs will increase the skills base and encourage widest adoption.

Communications – crafting clear, short, and intelligible value propositions are necessary to selling the value of NSDI. On-going outreach to all stakeholder communities is needed to keep long-term motivation and interest.

DAY 1: OPENING SESSION

Geospatial Information for Digital Transformation

Johnny Welle, Director General, Kartverket, Norway

Dear Participants!

The world is experiencing a fourth industrial revolution, often referred to as the Information age. It is built upon the internet and requires a comprehensive infrastructure of information to drive it. We usually relate the term infrastructure to physical objects. Everybody recognizes that the road network is part of the fundamental infrastructure each country needs to support economic growth, allowing goods to flow between different locations. Although less tangible, in the respect that it cannot be so easily seen, information is also an increasingly fundamental infrastructure to support what is often referred to as evidence-based decision-making.

One of the primary components of a National Information Infrastructure (NII) is the location of a nation's assets, including land, natural resources, and the built environment. Such information can add most value to the economy through open and transparent data sharing.

This is not easy to achieve and requires implementation of the long-term best practice in management of multiple issues of governance, technology, and people, to build what is referred to as a Spatial Data Infrastructure (SDI). The term has historically focused on the collection of data and the implementation of technologies, but in August 2020, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) adopted the Integrated Geospatial Information Framework (IGIF) to update and widen this concept.

Norwegian Mapping Authority has been at the forefront of assisting developing countries in the implementation of this new framework. Later today, we will hear presentations from the United Nations and World Bank on how this is being progressed globally and from local experts in specific countries in Eastern Europe and Central Asia.

Peter Drucker, the world-renowned management guru, first coined the phrase "Unless we measure it, we can't manage it". Essentially, what we do as an industry, is we measure the world - humanity's most fundamental asset. However, we go further than just measurement, we also provide the tools to analyse key components of decision-making – answering the question "where?" and increasingly to also explain "why?" and predict "what?" will happen next. Our work is therefore a crucial component of the ongoing Digital Transformation of our world.

Johnny Welle
Director General
Kartverket, Norway

Johnny Welle has a long career in development and management of digital transformation in the public and private industry.

He is from the district of Sunnmøre in the Coastal zone of Norway and he likes to see opportunities and create solutions through knowledge, data sharing and new partnerships.

The geospatial industry brings to the table a set of increasingly sophisticated set of data and tools, from Artificial Intelligence to increasingly high-resolution satellite imagery, offering the potential to reduce the cost of producing actionable information.

However, we need to do more - money is scarce and particularly aid budgets worldwide are being squeezed in the wake of the COVID pandemic. Therefore, developing countries cannot build sustainable business models based on external support alone.

In Norway, we have long and successful tradition of both data and cost sharing through a cooperation known as Norway Digital, by which over 400 different organisations share the cost of maintaining the national geospatial infrastructure, contributing according to the value to their organisations. Other innovative funding solutions lie in public private partnerships, characterized by investment risk and reward being shared between partners.

So, a second theme of our conference is sustainability, and tomorrow we will focus on the societal benefits of geospatial information - how we measure those benefits and build clear messages to present to our senior decision makers in government and business.

Finally, in our third day we will be looking into the "crystal ball" to identify the important trends and future technological advances that will be key to digital transformation. These will include considering new markets for geospatial information, such as finance and consumer applications. But also, its pivotal role in decision-making in relation to the challenge of climate change and achieving the United Nations Sustainable Development Goals.

There has never been a more exciting time to be involved in the geospatial industry and we hope this conference will help to inspire you all to contribute on the journey.

Enjoy the conference!

@Participants' feedback

"The conference was excellent with some great presentations. Well done putting it together!"

"I must say that I am very happy to have had the opportunity to participate in such an excellent event, both organizationally and even more so in terms of content. If I am ever in a position to organize an online event, yours will serve, as a benchmark."

"I would like to let you know that I was very impressed by the professional level of the event organization. You did a great job (and it is not just a compliment!). I was happy to get the chance to share our thoughts and capabilities and look forward for further contacts with the conference participants."

Norwegian Support to Capacity Development of Land Sector Abroad

Dr. John Mikal Kvistad, Ambassador to Central Asia, Ministry of Foreign Affairs, Norway

Dear Everyone!

In 2006, The Norwegian Ministry of Foreign Affairs started funding aid projects abroad related to land administration, mapping and sea navigation with emphasis on combating poverty through capacity building. It is now just great to take stock of what has been accomplished.

The main purpose has been improved governance on central, regional and local levels, sustainable land use, secure land markets and safe navigation at sea. The effects on society are improved governance and enhanced public services to private and public sectors. In practice, this means improved and more transparent access to up-to-date electronic maps and registers for a wide range of usage in public and private sectors. The main products are digital geographic information, accessible to all on the Internet.

Securing property rights and efficient land registration constitutes a cornerstone in any modern economy. It provides confidence to individuals and businesses to invest in land, allow private companies to borrow capital to expand job opportunities, and enable governments to collect property taxes, which are necessary to finance provision of infrastructure and services to all citizens.

Dr. John Mikal Kvistad
Ambassador to Central Asia, Ministry of Foreign Affairs, Norway

Dr. John Mikal Kvistad is a Norwegian diplomat and he has been associated with the Norwegian Ministry of Foreign Affairs since 1994.

Without land tenure systems that work, economies risk missing the foundation for sustainable growth, threatening the livelihoods of the poor and vulnerable the most. It is simply not possible to end poverty and boost shared prosperity without making serious progress on land and property rights. That is precisely why the work that the Norwegian Mapping Authority and all their partners do is fully supported by us in the Ministry of Foreign Affairs.

I will now say a few words about your accomplishments at country level:

- After the collapse of the Soviet Union, there was no nationwide updating of maps in **the Kyrgyz Republic**. Finally, in 2019 a new and long-awaited aerial imagery was accomplished with Norwegian support. A new digital terrain model will be published. Moreover, Kyrgyzstan is very active with the implementation of the SDGs. New geospatial data from the project will support the country's engagement in the UN's Agenda 2030.

- A new modern mapping authority in **Albania** with a functioning geoportal, providing public access to topographic maps, is now in place. Hence, Albania can fulfill their national hydrographic obligations in accordance with the UN Convention on Safety of Life at Sea, after training and receiving a fully equipped vessel for sea mapping.

- There are now Digital Archive Systems fully rolled-out for the Mapping Authorities in both entities of **Bosnia-Herzegovina**. A densified and upgraded national positioning system is operational in both entities of the country.

- All cadastral maps are entered into the central database in **Kosovo**. Furthermore, an updated address register with signs for road names and house numbers are in place.

- The central Address Register system is ready for rollout in **Montenegro**, ensuring a unique address for all citizens and businesses, supporting future census, political elections and the development of social-economic prosperity. A modern data infrastructure for data management and data distribution has been implemented, enabling effective map production at the state Real Estate Administration.

- You have established a Digital Terrain and Surface Model covering 2/3 of territory of **North Macedonia**, which is very valuable for spatial planning, crisis management, and map analysis related to flood exposed areas.

- You have procured software and the development of a strategy for strengthening information security capacities of the Geodetic Authority in **Serbia**.

- We are happy to see that the production of up-to-date 1:50 000 scale maps in a seamless database are available in a public geoportal in **Ukraine**. A satellite-based positioning system with services is operational, and an Integrated Geospatial Information Framework action plan is in place.

- In **Georgia**, you are working towards forming a basemap for the National Spatial Data Infrastructure to support national reporting on the implementation of the UN Sustainable Development Goals. This is also urgently needed for completion of the state programme on land privatization and registration. The project will establish a mechanism for sharing geodata with users at central and local governmental levels, the private sector and the general public.

- The Norwegian Mapping Authority has been active in **Moldova** since 2006 and has successfully implemented four projects delivering two generations of orthophotos and digital terrain model. A new IT system for property registration and cadastre has been developed. You have improved technical and professional capacities at the Agency for Land Relations and Cadastre. Furthermore, a new basemap for the whole of Moldova has been produced. No wonder that the World Bank has made very positive remarks on your impressive work in Moldova.

Finally, I would very much like to point out that it is very positive that the Norwegian Mapping Authority has agreed to cooperate with the World Bank on the implementation of Integrated Geospatial Information Framework in Georgia, Moldova, Kyrgyzstan and Ukraine. The excellent cooperation between the Norwegian Mapping Authority and their partners has inspired the World Bank. This will certainly mean a lot for other countries and regions around the world.

Summing up, I can only applaud your strong efforts and everything that you have accomplished. It is truly impressive.

So, I offer you our sincere congratulations and warm greetings from our Foreign Minister!

Thank you!

Enabling Digital Government through Geospatial Data and Location Intelligence: What needs to be done with information management in accession countries

Léa Bodossian, Secretary General and Executive Director, Eurogeographics

Léa has a passion for geography, political sciences and European affairs. She has held a number of high-level representations, communication and management positions within the European Commission and in an EU Agency.

By training, Léa is a spatial planner and a researcher with a specialisation in economic development nearby airports. She holds Masters Degrees in Spatial planning, Political Science and European Affairs. Léa was appointed Secretary General and Executive Director of EuroGeographics in 2020.

Léa Bodossian
Secretary General and Executive Director, Eurogeographics

EuroGeographics (EG) is an association of National Mapping and Cadastral Agencies (NMCA) spending EUR 1.5 billion annually and employing 66,000 people. Its role focuses on knowledge exchange, representation and data aggregation, she said, "we will be judged by the impact we have". Generically EG aims to support the EU in creation of policies and to meet the statistical needs monitoring policy implementation and surveillance.

NMCAs needed to align with three big priorities - **the European Green Deal, creating an economy that works for people and a Europe fit for the digital age.**

She picked out Northern Macedonia, Armenia and Ukraine were those making strides to meet EU accession requirements. Her advice, grounded in what she had seen in her previous role in the aviation industry was to focus on collaboration, collaboration and collaboration.

A Future Vision for National Mapping and Cadastre Authorities

Dr. Robin McLaren, Know Edge, Scotland

Dr. Robin McLaren is currently a director of Know Edge and is a prominent consultant in land administration. He has been at the forefront of the GIS revolution and is recognised as an expert in Spatial Data Infrastructures and Land Policy. Robin has an honorary doctorate from the University of Glasgow for contributions to geomatics and land administration and is an Honorary Fellow at the School of Geosciences, University of Edinburgh.

Robin looked first at the drivers for change in NMCAs, Google, Apple and others were competing "head on" for their markets, their core value proposition as the only provider of national mapping was being undermined and they were not "stepping up" to the challenge of developing new business models. Others in Government such as Statistics and Space agencies had much higher profile, and he could see the NMA function being consumed into them in many countries. In Hungary, the NMA he had helped to set up in the 1990s no longer existed.

Options for survival included **moving from "collectors of data to collators"** - becoming specialist system integrators. Other options were to position themselves to take a wider role on digital transformation through coordinating the development of key registers, offering value added services such data dissemination and quality accreditation and, where there was currently a void, to coordinate earth observation work. In the land administration sphere he saw embracing a fit for

purpose approach as essential, current practices were too expensive and Governments would find alternatives if they resisted making fundamental cultural changes. He described their situation with a quote "change is not a threat but an opportunity, survival is not a goal, but transformative success is." In discussion he described the greatest challenge to change as lack of human capacity and an inability to present compelling arguments for investment to policy makers.

Key Registers in the Netherlands

Haico van der Vegt, Kadaster, The Netherlands

Haico works as a regional manager at Kadaster International, the international branch of the Cadastre, Land Registry and Mapping Agency of the Netherlands. He is responsible for the development cooperation in Asia, Arab States and Europe. As a spatial data infrastructure expert, he is involved in many national and international SDI implementation projects.

Haico focused on one of Robin's themes, the value of geospatial in integrating national registers. He explained the concept of the authentic register as a single source of the truth, and the power of being able to synchronize a set of registers so citizens only had to notify Government once of changes, such as moving house. The register was an essential part of Government machinery, in the digital age underpinning planning decisions of all types. He explained that creating key registers was not a quick process it has taken 20 years in the Netherlands to reach the current state where 10 registers were effectively acting as a single system of systems. The system had a common architecture, and many components were reused in all registers. The benefits were many including higher quality data, reduced duplication and improved fraud detection (gaining tax concessions by claiming to live in three places at once was no longer possible).

Haico then explained the principles that underpinned all of registers, which importantly included a common finance model, mandated use by all public authorities, documented quality standards and active involvement of all stakeholders from the financing customer (Ministry of Internal Affairs) to citizens. Some of the key lessons learned were that it could not be "bolted on", many business processes needed to be adjusted, it is a make to try to do everything at once but except that the infrastructure only has to be "good enough" and the money saved is more important than the cost. There is a lot more detail on this important opportunity in Haico's presentation.

@Participants' feedback *"I am attending to the conference "Geospatial Information for digital transformation" and congrats for your work! This conference is really important because it raises the awareness for such important topics! There are topics under discussion that people sometimes forget how important they are whenever the goal is to build up the National Spatial Data Infrastructure, namely the human interoperability and the impact that it has on the changing of behaviours of all the people involved and of the ones to whom the spatial data is being built to (end users)."*

DAY 1: INTEGRATED GEOSPATIAL INFORMATION FRAMEWORK - LAND CASE STUDIES

Norwegian Support to the IGIF implementation

Chair: John Kedar, John Kedar Geospatial Initiatives, United Kingdom

John Kedar
Director
John Kedar Geospatial Initiatives
United Kingdom

John Kedar is a global geospatial strategy advisor. Previous employments include a career in the British Army and more recently as Director of International Engagement in Great Britain's national mapping agency, Ordnance Survey.

In this work, he is an advocate of the United Nations Integrated Geospatial Information Framework. Elsewhere he chairs a collaboration of government and businesses developing a future geospatial concept, the Geospatial Knowledge Infrastructure and is a contributing editor to Geospatial World.

This session was focused on the United Nations Integrated Geospatial Information Framework (IGIF). The chair, John Kedar, thanked Kartverket for providing this great opportunity to discuss the IGIF. He also expressed appreciation for the work Kartverket has done globally, citing particularly his discussions with Georgian government agencies that have benefited from Norway's contribution.

John hoped that the session would provide delegates a strategic understanding of the IGIF and, through four national case studies, an insight into ways in which it is being used. With speakers covering the IGIF itself, the World Bank's use of it to help nations gain funding and the creation of associated action plans by Kartverket partnered national agencies; we were ready for an informative afternoon.

Keynote: Bridging the Digital Divide

Gregory Scott, United Nations Statistics Division

Gregory Scott
Inter-Regional Advisor
Global Geospatial Information Management
United Nations Statistic Division

Greg Scott joined the United Nations Statistics Division in 2012 with the specific task of establishing the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) and growing its relevance and status with Member States and related International Organizations involved in national, regional and global geospatial information management. In his role as Secretariat, Greg provides strategic policy advice and leadership, and guides the development, coordination and implementation of the substantive content for the Committee of Experts.

Greg opened the debate by stressing that geospatial information is a critical component of both national infrastructures and the knowledge economy; a blueprint of what happens where and the means to integrate a wide variety of government services. He set out the case for the IGIF, linking it to a range of global development agendas and stressing the importance of data in

delivery of the sustainable development goals, the changing expectations of citizens and to digital transformation. Geospatial information has emerged as a major contributor to economic transformation in many countries, including e-government, e-services and e-commerce.

Greg recognised that many nations risked being left behind by the growing digital divide but offered that the IGIF provided a reference guide for developing and strengthening national arrangements in geospatial information management and therefore assists countries in bridging the geospatial digital divide.

In particular, he highlighted the opportunities to developing nations provided by IGIF pathway 5, the innovation pathway, coupled with effective governance (IGIF pathway 1) and improved communication (pathway 9).

He stressed that NSDIs were one infrastructure that could benefit from IGIF but many nations were now looking beyond NSDIs and the framework supported all geospatial infrastructures.

Finally, he listed 37 countries that were already using the IGIF in developing national strategies and action plans. All UN GGIM IGIF resources are openly available online at https://ggim.un.org/IGIF/

Keynote: World Bank Methodology for IGIF Implementation

Kathrine Kelm, World Bank

Kathrine is a senior land administration specialist at the World Bank, currently covering the East Asia Pacific region.

Kathrine is a land lawyer and is leading the global geospatial project, focusing on supporting IGIF country level implementation to enhance technical support, capacity strengthening, and financing for geospatial information and infrastructure.

IGIF action plans are only the start of the future geospatial information development journey and project funding for delivery, including for maintained authoritative data, requires national funding or the support of institutions like the World Bank.

The World Bank, who collaborated with the UN in developing the IGIF, was represented by Katherine Kelm who has become the driving force for IGIF within the Bank.

She explained how World Bank funding is allocated - working through country partnership frameworks, which are a good start point to determine whether World Bank loans are a suitable option.

She explained that geospatial enhancements would rarely justify projects on their own, but that national agencies should work with their governments to link IGIF action plan initiatives with larger projects, such as Mongolia's digital transformation project.

Kathrine Kelm

Senior land administration specialist
World Bank

She noted the courses offered by the Bank's Open Learning Campus and introduced a series of IGIF tools the Bank has developed to support nations all of which are in use in the Kartverket partner projects. These include one to support socio-economic impact assessments to help with business case development.

Leaders from each of the four partner countries supported by Kartverket then provided national insights into the role IGIF was playing in their development.

The Georgian Case: IGIF for Strengthening NSDI

Nino Bakhia, National Agency of Public Registry, Georgia

Nino Bakhia is Head of Addressing Service at the National Agency of Public Registry under the Ministry of Justice of Georgia since 2018. She received her Master's degree in Land Management from Stockholm Royal Institute of Technology in 2007. Since 2007, she has been working in various departments of the National Agency of Public Registry, representing one of the core spatial data producing authorities of Georgia.

On behalf of the National Agency of Public Services Nino expressed her gratitude to the Norwegian government and Kartverket for many-year support to land sector in Georgia providing core data sets, enhancing professional and technical capacity and implementation of the IGIF.

She discussed the 2013 government resolution that set up a state commission to develop the Georgian NSDI and the challenges of delivering against it. She talked through the use of the World Bank IGIF tools to identify current strengths and weaknesses in the provision of good geospatial information and alignments to government policy all of which informed an action plan.

She noted the development of over 70 use cases and a socio-economic benefits impact assessment. The action plan is set out with each initiative clearly linked to an IGIF strategic pathway. Nino voiced a common challenge in many nations in that there was no budget for NSDI and thus a reliance on donor organisations to date. She also stressed how the process of developing the documents had led to positive re-engagement with stakeholders across government and the private sector.

Kyrgyzstan: A Model for Sustainable Base Mapping

Simon Wills, ConsultingWhere, United Kingdom

Simon Wills has over twenty-five years of experience in the development and use of information systems, specialising in the management of location-enabled applications and statistical modelling of spatial data. He is a geologist by background and worked in Botswana in the field of remote sensing for many years undertaking both managerial and senior consultancy work for the local distributor of Esri and ERDAS software. Now working with ConsultingWhere, he was part of the team assessing the socio-economic benefits of strengthening geospatial infrastructure in Mongolia and is now leading the consultancy team advising on the implementation of IGIF in Kyrgyzstan.

Simon presented a model for sustainable base mapping in Kyrgyzstan. In particular, he examined two use cases that aligned with government priorities. Fit-for-purpose land registration using Orthoimagery would cost around quarter the price of traditional survey methods and thus also help to increase security of tenure. However, this change would need political commitment and adaptation of the legislation and regulatory framework.

The second use case focused on disaster risk management and in particular the capital city Bishkek given creeping development towards a geological fault line. Benefits of the latter case were difficult to quantify, but nationally the benefits of the use of geospatial data and technologies to prepare and react to the current level of natural disasters was estimated at US$ 2.7m annually.

Republic of Moldova: NSDI National Action Plan

Pavel Ivancenco, Agency for Land Relations and Cadastre

Pavel Ivancenco has been working at the Agency for Land Relations and Cadastre of Moldova since 2015. He took part in the development of the Law on National Spatial Data Infrastructure for Moldova and governmental decisions on its implementation.
Pavel is responsible for administration of national SDI geoportal, validation and publishing metadata and geospatial data themes. He has been closely involved in the implementation of the Integrated Geospatial Information Framework in Moldova, supported by Kartverket and ConsultingWhere.

Pavel described Moldova's development of a NSDI country action plan. As with Georgia, and thanks to Norwegian support, the baseline assessment showed good data holdings but development is necessary elsewhere. The geospatial alignment with policy drivers' assessment identified land administration, disaster risk management, agriculture, local government and emergency services as key drivers to justify resources. Pavel also offered an insight into the country action plan, which includes initiatives to complete national basemap coverage, roll out a national geocoded street address database and upskilling across government agencies.

IGIF Implementation in Ukraine: Challenges, Results and Perspectives

Dmytro Makarenko, Research Institute for Geodesy and Cartography, Ukraine

Dmytro Makarenko is an international relations specialist with over 10 - year experience in various governmental positions in Ukraine.

During 2014 – 2020, he was working at the State Service of Ukraine for Geodesy, Cartography and Cadastre. In 2020, Dmytro joined a team of NSDI developers at Research Institute of Geodesy and Cartography, to support ongoing geospatial process in the country. In this capacity, he is engaged in the Norwegian funded project in Ukraine supporting implementation of the IGIF in Ukraine.

In the last presentation, Dmytro Makarenko discussed the challenges, results and perspectives of IGIF implementation in Ukraine. He described 18 years of history in trying to get the NSDI implemented and the two IGIF baseline assessments completed in Ukraine in 2019 and 2021, both giving different results particularly in the data pathway.

He described the key findings from the baseline assessment in the light of significant NSDI progress over the last 2 years but raised concerns over sustainability. He stressed the need to simplify the topic and to have clear examples of cross sector benefits.

Most importantly, he argued that a champion is essential if an action plan is actually going to be implemented. Reflecting on the NSDI history in Ukraine, Dmytro also offered that sustained communications and evidence of progress were fundamental in keeping NSDI moving forward.

Panel Discussion

Chaired by John Kedar, John Kedar Geospatial Initiatives, United Kingdom

- Future directions of IGIF – what is next?
- Influencing decision makers – what are the key strategies?
- How to improve communication and encourage response?
- Are there still challenges with data sharing?

To wrap up the afternoon session, John invited three panellists to join him to discuss the IGIF and its implementation: Greg Scott, who has led IGIF development since its inception, Katherine Kelm, who has woven the IGIF into many aspects of World Bank geospatial delivery and Andrew Coote who has delivered several IGIF action plans using the World Bank methodology. The panel discussed a range of questions posed by the chair and delegates.

In communicating our message, panelists were clear that we have to understand decision makers' needs and priorities, and link geospatial information to this bigger agenda.

Communications is part of the key to winning resources, particularly as donor funding is becoming more difficult to attain. We should seek to reduce costs using new technologies and demonstrate economic value to win sustained government funding. Part of this debate will be on opening up foundation data. Panellists tended to agree that open data should be an intent for nations given the value of its use, often for public good rather than financial gain, but recognised that revenue generation is often necessary to maintain data where national governments will not fund this. National geospatial agencies need to be clear on where they can derive such revenue, perhaps from high end services or from offering well maintained data and move away from continuing to create data and services that are ably met by the private sector, such as road navigation datasets.

The involvement of industry in national geospatial information provision sparked debate on public private partnerships for geospatial information. These are at an early stage, with few practical examples, but the need for partnerships and collaboration in a wider context was accepted, especially as we move further into the realm of digital twins and smart cities. These partnerships were also seen as relevant in innovation, bringing together data, government initiatives, geospatial expertise, and access to funding to support entrepreneurs seeking to include location within their business offerings.

The term 'SDI' was questioned by one delegate, arguing that it portrays a 'stand-alone' infrastructure rather than a catalyst and enabler. Panellists did feel that we needed to think beyond the original concepts of SDIs, more into the knowledge and impact space. To quote Greg 'Think of SDI as an engine but it is what the vehicle does that is important'. Understanding what is beyond SDI is being actively considered in many quarters globally, but the process of determining what a new infrastructure would look like

Gregory Scott

Inter-Regional Advisor
Global Geospatial Information Management
United Nations Statistic Division

Kathrine Kelm

Senior land administration specialist
World Bank

Andrew Coote

Chief Executive
ConsultingWhere
United Kingdom

was leading to confusion amongst stakeholders grappling to improve geospatial information within nations. The IGIF as a framework is agnostic to this thinking. However, with so many countries now using it, panellists offered thoughts on getting more value from the IGIF in future.

Katherine advocated continued effort to build powerful use cases and the use of IGIF at sub-national level, particularly in cities, which tended to have greater flexibility and consequently are faster adopters. Andy suggested refining the current framework and noted the UN GGIM High Level Group that is taking this forward, and Greg closed by advocating the need for the IGIF to be seen as a 'brand' externally to the geospatial community in the same way that SDGs are recognised.

John concluded the session by suggesting that geospatial data is not an attractive subject to decision-makers but is an essential foundation. He felt that we need to collaborate with the wider digital ecosystem to deliver the knowledge and services that directly help users solve their challenges. This in turn would allow the geospatial community to get closer to the decision makers that resource our activities. He reiterated his thanks to Kartverket and the organisers and thanked the Day One speakers and delegates from across the World for a great day of conversation.

DAY 2: GEOSPATIAL INFORMATION FOR THE BENEFITS OF SOCIETY

The Benefits of Geospatial information to Society

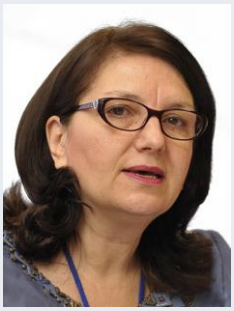
Andrew Coote, ConsultingWhere, United Kingdom
Rumyana Tonchovska, Food and Agriculture Organisation of the United Nations

The theme of the day was the Benefits of Geospatial information to Society. The chair, Andrew Coote, opened the session by suggesting that central message for today might be that - **if it is not clear that your project will deliver benefits for society then why are you proposing investment in doing it.**

Andrew Coote
Chief Executive and
Principal Consultant
ConsultingWhere
United Kingdom

Andrew has over thirty years' experience in the development and use of information systems, specialising in the management of location-enabled applications.
He has held senior management positions in both the public and private sector in the UK and Seychelles.
His expertise lies in strategy development and implementation, return on investment and market assessment.
He has undertaken an extensive range of strategic assignments in East Asia, Eastern Europe, Southern Africa, Australasia, North and South America and the Middle East for customers including the World Bank, European Union, United Nations Food and Agriculture Organisation, Land Information New Zealand and Ordnance Survey.

Rumyana Tonchovska
Senior Land Administration-Information Technology Officer
UN FAO
Italy



Rumyana holds a Master's Degree in Information Technology, and is a certified international IT Project Manager with practical experience in design, development and implementation of large-scale complex information systems for land tenure, indirect finance and building Spatial Data Infrastructure.
She has 26 years' work experience from over 23 countries in Eastern Europe, Asia and Africa.
Under the FAO – World Bank Cooperative Program, 70% of her time is allocated to support the Bank-financed land administration projects.
Rumyana is leading various innovations to test new approaches and technologies, aiming at improving tenure governance, making best use of the available geospatial data and technologies, and building local capacity for evidence-based policymaking.
She has been actively involved in the development of the Integrated Geospatial Information Framework and its implementation at country level.

Keynote: The Socio-Economic Benefits of Earth Observation

Steven Ramage, Head of External Relations, Group on Earth Observation, Switzerland

Steven has a long-standing understanding of the needs to demonstrate socio-economic and now environmental benefits.

Group on Earth Observation has 100 individuals (30 staff plus member representatives), working on 65 different activities in field of climate change mitigation. It operates through a regional level organisation similar UN GGIM. It has developed an open knowledge portal and is working through creating collateral along four tracks, starting with technology and data, then policy briefs and practical guidance and finally routes to finance.

The branding is **"the four Cs" capacity, communication, collaboration and commercial.**

Steve believes a key concept is human interoperability – not about technical skills but more about **motivation, incentives, and perception.**

GEO have achieved impressive grant funding from Microsoft ($3m) for the planetary computer project, Norwegian government ($50m) for tropical deforestation and close to $6m from Google.

GEO believes that to unlock finance, you must focus on **Results, Impact and Value** – a recent success of this approach was drought prediction work that triggered UN funding for improving food security.

Other developing world examples include work with the Honduras State Energy Authority identifying that release of water from major dams would mitigate a major flooding problem affecting 65% of GDP of the most productive valley in the country. He suggested that use for intelligence and insights such as these are useful, but the focus need to move to evidence to support good governance.

He moved on to explain the value of open data and the need to bring in NMCAs to support this.

In response to the question about practical measures to present a more joined up vision between GEO and UN GGIM, he said that GEO was open to closer collaboration on sharing experience and strategies for working together to open-up routes to finance.

Steven Ramage
Head of External Relations
Group on Earth Observation

Switzerland

Steven leads external relations (communication and policy teams) at the Group on Earth Observations (GEO) Secretariat in Geneva, Switzerland. He is on the Governing Board of Digital Earth Africa, Digital Earth Pacific and is a member of the UK Space Agency Earth Observations Advisory Committee.

Steven was an owner and director of 1Spatial for 10 years working with national mapping and cadastre agencies globally. He then joined the Open Geospatial Consortium (OGC) as Executive Director before becoming Managing Director at Ordnance Survey International.

Socio-Economic Impact Assessment

Alan Smart, ACIL Allen, Australia

Alan Smart is an engineer and economist with knowledge and experience in the economics of geospatial systems. He is a Senior Associate of ACIL Allen Consulting and Chair of the Tasmanian Spatial Information Council. He is one of the foremost global experts in geo-economics.

Alan began by introducing some of the economic principles underpinning assessment of value. The value of fundamental geospatial data as a public good needs to be established - what value does it bring to the welfare of citizens. He explained the nature of value, we generally understand the concept of value of data in use, but ecological value, options and existence value are less well understood. Existence value might be explained by using the example of the Great Barrier Reef in Australia; we may not visit it but recognise its value as an asset and do not want it destroyed. Another aspect of value is bequest value – such as leaving the planet in a fit state to be enjoyed by generations to come. Alan also explained the concept of demand and supply and that consumer and producer surplus represents value to economy.

He thought that most studies focus on measuring productivity improvements from geospatial i.e. producing more for same resources. This was exemplified by use of such techniques to determine the value of digital twin creation to help master planning in Queensland, Australia, covering surveying, asset management and construction. Another example was productivity improvements from use of augmented GNSS. Finally, he used the example of improved emergency response to save lives and how this can be expressed in monetary terms.

Data Ethics - Location Privacy and More

Denise McKenzie, Locus Charter Community

Denise is a strategic advisor, partnership builder, and presenter with over 20 years of experience with the global geospatial community. She works internationally to evangelise the benefits, value, and application of location data across Government, Private Sector, and Academia and her experience covers a broad range of domains including Smart Cities & IoT, Agriculture, Defence, Sustainability, Insurance and Development. This diversity ensures that she works where geospatial meets mainstream technology.

Denise explained the ethics is not just about privacy, although that would perhaps be the topic that gets most "airtime". Other important aspects include responsibility and trust in what happens about data about us, also the need for transparency and accountability of those, using geospatial information.

She related an experience where data can get intrusive and "creepy". We tend to be happy to allow a system to control our lighting but deeply uncomfortable if the system stores the information that it is my child turning on a light, which with IoT - Internet of Things, is entirely possible.

A further challenge relates to data retention. Tracing apps developed for combatting COVID-19 store a lot of personal information – however, it is not clear what will happen to that data after the need for pandemic purposes finishes.

Today we are expressing almost every aspect of our world through data – but there is a lack of balance emerging of who has access to what data and how it is being used. This does matter to us because geospatial information is becoming more and more important to decision-making

about what happens to our world and us. As data producers and integrators we need to make sure we are collecting the right information but whether we are doing that in the right way and for the right reasons. It is important to think about un-intended consequences of what we do.

The **Locus Charter** of principles was developed to help practitioners avoid hurting anyone by what they collect and release, avoid bias that may lead to communities being disadvantaged financially and in other way. However, recognising it is important not to scare people or give them an excuse for not releasing data, so the first principle is realizing potential to do good.

In the subsequent discussion, Denise stressed the danger of opting out of making your data available – by doing so, you risk becoming not visible and in consequence, decisions being made that do not take your view into account.

NSDI in Norway

Arvid Lillethun, Advisory Director NSDI, Norwegian Mapping Authority

Arvid Lillethun work on national data infrastructure in Norway, covering geoportal development, sharing arrangements, coordination of data flows, user requirements and contents management. He is a member of the EU Inspire Maintenance and Implementation Group. Arvid has extended experience with the NSDI development projects in many countries. He is competent in the Integrated Geospatial Information Framework, UN GGIM global fundamental data, FAIR framework, and environmental reporting.

Development of NSDI has been a 30-year journey for Kartverket. A rich data fabric has been created and a broad user community established. However, there is a recognition that the organization must move on and set new ambitious goals. New strategic directions from the Norwegian government concerning digital economy, sustainability, and data-driven economy, all of which recognise NSDI as a vital resource to support these strategies.

The importance of having got that recognition in these national strategies is significant and although not stated, has clearly taken a lot of effort to ensure their "placement" in these documents. In the new Norwegian GI 2.0 strategy developed to intercept these national initiatives, the private sector has a key role to play in marketing the NSDI acting as ambassadors for innovation.

One of the uniquely successful aspects of NSDI in Norway is the Norway Digital concept (Geovekst-Geogrowth) central to which is cost sharing for development of particularly large scale basemaps under the slogan of "give a little, get a lot". As well as public sector organisations, private sector telecoms, hydroelectric power and agriculture companies pay a substantial share of the overall cost in return for access to the outputs and involvement in setting priorities.

The architecture of the national NSDI embodies **sharing in both directions**, with many organisations contributing their data as well as receiving it. All this needs coordination and building and maintaining trust - this is the key role that Kartverket plays.

The needs of users are evolving fast, more use cases now demand 3D data, dynamically maintained available through easy-to-use machine-to-machine APIs and 24/7 access.

The Norwegian National Geoportal is not a centralizing mechanism but harvests information from many sources and is interoperable with many other portals serving other sectors – it is part of a system of systems.

Key lessons learned in the process are **need for long-term commitment, a sharing culture based on trust and respect, two-way stream of data exchange, joint funding, and adherence to standards - particularly useful are the new generation of OGC APIs**.

Satellite images are also tightly integrated into the geoportal. Process of adding new drone data from construction projects into the NSDI is an innovation where the business case being developed to prove the value of sharing. Boundary between private and public sector is an open dialogue, but it must remain flexible.

Development of NSDI in Croatia from Interoperability Perspective

Tomislav Ciceli, State Geodetic Administration, Croatia

Since 2011, Tomislav has been working intensively in the field of spatial data infrastructures at the national level as the Head of the NSDI Division in the State Geodetic Administration of Croatia. He participates in all activities important for the establishment of the NSDI; from organizational through work in NSDI bodies; He is the Secretary of the NSDI Council and was the leader of the Working group dedicated to spatial data, through technical segments related to the development of the national geoportal and knowledge transfer activities through conferences and workshops. Before that, for a period of about 10 years, he worked in the field of photogrammetry, remote sensing, and GIS at the University of Zagreb. Tomislav's motto is "Making a personal contribution to the creation of a digital Earth".

Tomislav explained that interoperability has several levels, each of which must be operationalized before the next one will be successful.

In Croatia, they started with tackling legal interoperability by establishing a policy and legal framework. This was followed with organisational interoperability achieved through building trust between stakeholders. Only after this did they reach the semantic and technical interoperability needed to create their national geoportal. The overall process has taken from 2007 to today. However, they have now created a system where 54 separate organizations are sharing their data through the geoportal, 590 metadata records are maintained and 287 services.

Tomislav also "unpacked" the complexity of what we mean by quality, from the expert view of harmonization and error detection to the ordinary user where quality is defined by ease of use. He stressed the need to continuous work on raising awareness at many levels. To finish, he quoted David Schell, the founder of OGC in saying, **"interoperability appears to be about integration of information, but it is really about the coordination of organisational behaviour".**

In discussion, on determining "fitness-for-purpose" it was recognised that only narrow range of users need millimetric accuracy. Further, perceived lack of quality is often used as a reason not to publish data which is failing to appreciate that as people use the data, quality will be improved by their feedback.

Experiences from Poland on Open Data Policy

Marcin Grudzień, Head Office of Geodesy and Cartography of Poland

Marcin is a specialist in data analysis. He has taken an active part in building the fourth-biggest public sector IT system in Poland, addressing its stakeholders' technical, semantic, operational, and legal aspects. Marcin has extensive experience in all tasks related to complex IT-system development processes: from initial phase - analysis of cross-sector user requirements, standards and available data sets, identification of requirements including data analysis, through development and implementation including supervising of contractors and quality control of deliverables, up to daily administration and maintenance of a big IT GIS system.

Currently, he works in the National Mapping Authority of Poland as a Deputy Director of the Strategy and International Cooperation Department. He is also the Chair of EuroGeographics' INSPIRE Knowledge Exchange Network.

Marcin works at the head office of the Geodesy and Cartography (GUGiK) in Poland, the National Mapping Authority, which is responsible for 15 INSPIRE themes.

He explained the reasons for making data open are essentially two-fold. Firstly, if the data is free then many private sector organisations create services using it, this generates new revenues, employment for additional people and, through them paying their taxes, more income to Government. The second reason is that in many cases they found that the revenues to Government departments from selling the data was less than the cost of administering the collection of the fees.

GuGiK started their journey in 2014 by making addresses, administrative boundaries, geographical names and low-resolution DTMs open. This was successful and in 2020, most of the datasets were opened including 1:10K topographic basemaps, Orthoimagery, DEM (including LiDAR), geodetic network points. Cadastral parcels and building footprints were also partially opened.

He described the extensive set of services that have been developed for viewing and downloading the open data and its simultaneous publication on the Polish open data portal. The increase in usage since the services went live is impressive. GuGiK are helping local governments integrate their data with over 80% of the 380 municipalities now publishing cadastral parcels of buildings. GuGiK wish to open aerial imagery and large-scale topographic maps, but this requires changes to laws, which will take some time.

Marcin invited the audience to look at the GuGiK website and to follow the links to where they have shared on GitHub, their processes, which will be a useful resource to other countries looking to follow their example.

GEOSPATIAL INFORMATION FOR THE BENEFITS OF SOCIETY

The Benefits of Geospatial information to Society

Rumyana Tonchovska from the Food and Agriculture Organization of the United Nations was the chair for the afternoon session.

She set out the challenging context in which we are operating, highlighting the global health pandemic, climate change, and water and energy security. As with all crises, they bring opportunities for change but in many developing countries, they lack the human capacity to take advantage.

Further, donors and national governments are stretched fighting these crises, precipitating a strong need to do more with less. So, justifying spending money on geospatial becomes more and more important.

The speakers of the afternoon session are focused on aspects of how they have or would recommend tackling these challenges.

Fit-for-Purpose Land Administration

Gavin Adlington, Independent Land Administration Expert

Over the years Gavin Adlington has developed a unique breadth of knowledge and a deep understanding of all matters relating to land registration and cadastre systems, especially with regard to the successful implementation of projects involving mass systematic registration of title and the establishment of institutions that can successfully manage real estate registration and cadastres.

Gavin spent over 20 years with the World Bank during which time he undertook land administration projects in 46 countries and advise another 20 – he modestly described his job during that time as trying to make projects work. Establishing where the parcels are is the most basic need of land administration. Fit-for-Purpose land administration is what he has done where projects have been successful. The technical aspects of survey are complex but the legal and institutional issues, at scale are far more challenging.

Remembering that the customer is the citizen is a key principle, he described fit for purpose as **SCARF – Simple, Cheap, Accessible, Reliable and Fast.**

The need to be a professional, who not only knows the rules but also can interpret them in the context of the country in which they are working, is key to fitness for purpose. He gave practical examples from different continents and pointed to the recent free book written on Real estate registration and cadastre: Practical Lessons and experiences, which contains many more (gadlandreg.org) which has been downloaded in more than 120 countries.

In the discussion session he identified that some of the biggest barriers were often lawyers and surveyors with a vested interest in preventing land registration. At the core of resistance to change was often corruption.

Many of the projects that Gavin advised on or led were in the Eastern Europe and Central Asia region where major reforms were being implemented following the collapse of the socialist systems and change over to market economies in the early 1990's, but he covered many countries in other regions as well. He has worked primarily for the World Bank through the last 20+ years of his career, eventually becoming the global lead specialist for land and geospatial matters worldwide for the

World Bank. He retired in 2015 but has since then continued to work as a consultant in the same sector.

In December 2013, Gavin received the Michael Barrett Award from the Royal Institution of Chartered Surveyors of the United Kingdom "to the person whom in the opinion of the panel/ division has contributed most to the understanding of the subjects of land transfer, registration and administration, encroachments, cadastre and boundary issues, or the administration of the laws regarding them with the UK and overseas". This is a prestigious award given once per year to one individual worldwide.

Digitalization Transformation in Serbia

Darko Vucetic, Republic Geodetic Authority, Serbia

Darko Vucetic is a Head of the Centre for Geospatial Information Management at the Republic Geodetic Authority of Serbia. His main activity is to seek and provide the most optimal solutions based on geospatial data management to all public sector institutions within the NSDI and to ensure strategic approach for geospatial data use at the national level.

The Centre apply innovative approaches and technologies, develop fit-for-purpose solutions, methodologies and business processes, and provide capacity building and awareness rising for usage of geospatial data.

Darko has been with the Republic Geodetic Authority (RGA) for 10 years and during that time has, with his colleagues, achieved truly transformational change. At the start, there over 4.5 million buildings had not been registered. The business processes needed to implement registration laws were a tangled mess, duplication was extreme and there was a lack of trust and transparency.

A rapid programme of digital transformation to implement a range of e-services is estimated to have saved 6 million hours of public time and yielded government efficiency of €38 million.

The digitization also supported many of the changes necessitated by the arrival of the COVID pandemic, enabling the real estate market to continue to perform at similar levels to pre-pandemic. Using the same infrastructure, the Geoserbia platform was used to assemble the data on schools, buildings, medical facilities, and social welfare to provide the evidence-base for decision making on finding disease hot spots, protecting vulnerable people, and keeping supply chains operational.

Darko observed that registration is never popular or high profile, so a strong communication team is essential, much of his task is to keep their successes in the news. This was recently recognised by their director receiving the digital reformer of the year award for Serbia.

In the Questions and Answers, when asked about sustainability he called out the World Bank loan as having been critical. They have also recently completed a socio-economic impact assessment using the IGIF principles and demonstrated a 5:1 Return on Investment for their work on NSDI. This will be a valuable tool in their advocacy of continued investment.

Developing Moldovan NSDI through EU Twinning Project and other donors support

Maria Ovdii, Agency for Land Relations and Cadastre of Moldova
Sanja Zekušić, State Geodetic Administration, Croatia

Maria Ovdii is a Head of NSDI department and a secretary to NSDI committee in Moldova, working for the Agency for Land Relations and Cadastre (ALRC). She has been instrumental in gaining and coordinating support from a wide range of donors over many years including Kartverket, the World Bank, US AID, JICA and most recently the EU Twinning project.

She explained that a 15-year collaboration and capacity development assistance provided by Kartverket has been extensive including support for two generations of Orthoimagery production, digital terrain modelling and digital base mapping of the whole territory. It had recently been extended to cover the production of an IGIF Country Action Plan for Moldova. The USAID project has over a 5-year period focused on support for local government.

Sanja Zekusic is a Senior Consultant at the State Geodetic Administration of Croatia. Since 2006, she has been responsible for preparation and implementation of projects funded by the EU and other donors, including international development cooperation. Since 2015, she has been involved in the implementation of the EU funded Twinning land administration projects in Moldova.

Sanja explained how EU twinning project, which she manages, is focused on improving spatial data services with the involvement of experts from NMAs in the Netherlands, Croatia, and Poland. In year 1 (2021) they have been focusing, amongst other topics, on establishing a strategic framework of the geoportal including guidelines on data specifications, GIS training of over 100 government staff and identifying necessary legislative changes. Next year they are moving on to look at the NSDI business model, licensing policy, the university geospatial programs and to initiate pilot projects and study visits.

In discussion, Maria expressed the intention to publish the guidelines and other deliverables of the EU Twinning project publicly once agreed. The coordination of a wide group of stakeholders to fully realise the benefits of this work was proving challenging and a major priority was increasing capacity at the agency.

Use of UAVs in Crisis Situations

Mats Mikalsen Kristensen, Vice President, Unmanned Systems, Andøya Space, Norway
Tore Jensen, Technical Advisor, Geodata, Norway

Mats is from the government owned company Andøya Space. As Vice President of Andøya Space Unmanned, he gets to work with the best team in the drone business and enjoys having some of the most advanced technology.

Tore Jensen is a Technical Adviser at Geodata – the Esri distributor in Norway. He has long experience with Esri software. Since 2005, Tore has been specialized in GIS in Public Administration, Emergency Preparedness, Police, Fire, Defence and Health.

The presenters very cleverly weaved their story together, presenting almost alternate slides. They explained the components of their capability, the drone platform, range of sensors, pilots (still needed by regulation although autonomous operation is technically feasible) and the imagery processing augmented with machine learning. They can integrate all the drone imagery into existing 3D models as well as link to parcel and road information in the immediate vicinity and more widely.

For emergency planning, the capability enables them to perform desktop rehearsals, identify access points for vehicles, responders and assess hazardous materials. Accurate DTMs can also be created for flood risk areas. They also use the system, implemented in ArcGIS, to assess who need to be evacuated if an incident should occur.

The system was put into active use for emergency management, following a massive landslide in Gjerdrum, just north of Oslo. The slides show graphically the position that faced rescuers with very poor weather and many air and ground assets needing to be deployed simultaneously.

The drones used by Andøya Space were not able fly immediately the team arrived at the incident, because of rescue helicopter traffic, so it was dark when airspace was available. Fortunately, the team had researched use of thermal imaging sensors and were able to successfully map the area despite very poor weather. They completed a survey of the main rescue area, where 10 houses had been destroyed, in just over an hour using two drones. The imagery was then processed, and imagery assembled within a further two hours. This allowed the position of these houses to be pinpointed for rescuers to focus their search. In addition, the system was used to calculate the volume of the slide (1.4 million cubic metres of material). The imagery was also used by the National Geotechnical Institute to help identify the causes of the landslide.

Experiences from Georgia: New Datasets

Galaktion Hahubia, National Agency of Public Registry, Georgia

Galaktion works at the National Agency of Public Registry of Georgia as a Geodesy and Cartography Coordinator. He is also engaged in the Norwegian funded projects a Technical Manager responsible for quality assurance of geospatial data and mapping database.

In his presentation, Galaktion addressed the extensive series of projects undertaken in Georgia with the support of Kartverket, under a project called Maps for Sustainable Development. The main work had been the capture of aerial imagery for 45.000 sq.km of Georgia. The imagery was used to produce orthophotos and contour maps initially. This was extended to the production of digital topographic base maps at varying level of detail in urban and rural areas. The maps are now approaching completion and will be uploaded onto their geoportal and made available as open data. Thanks to Norwegian support, Georgia has received an up-to-date reference data – orthophotos, Digital Terrain Model and digital large-scale topographic maps needed for their National Spatial Data Infrastructure.

Use of Geospatial Data by Local Public Authorities in Moldova

Alexandru Morcov, Congress of Local Authorities, Moldova

Alexandru works for the Congress of Local Authorities in Moldova (CALM) and is a surveyor by background, so is in a very good position to coordinate efforts to leverage geospatial information in local authorities.

The use of geospatial data in paper form was quite comprehensive in Soviet times but stagnated for a long period after the collapse of the Soviet Union. Efforts to re-establish capability at a local level started in 2007 with the first Norwegian government funded project to create orthophoto mapping.

Another key development was the completion of the geoportal, which allowed local authorities to access geospatial data online. Subsequently with the help of Norway and USAID, several applications have been developed covering different user cases including public transport tracking and fault reporting. A call centre is now in place to answer questions from the public concerning these applications and software provided to enable local authorities to keep data up to date. CALM has commissioned a training centre for upskilling local authority staff, with GIS as one of the first offerings.
Hiring good people however remains a key problem. CALM is looking with Government at the possibility of establishing shared services for geospatial data management, by which smaller authorities can delegate their power to undertake certain operations to other bodies. Further, legislative change may be recommended to oblige private surveyors to share information captured as part of their work with municipalities.

Panel Discussion

Chaired by Rumyana Tonchovska, Food and Agriculture Organisation of the United Nations

- **What role can NSDI play in delivering Digital Transformation?**

Darko Vucetic – playing a key coordination role brings big pressures to perform, many NMAs are not well prepared with right personnel to respond, often losing their best personnel to better salaries in the private sector. It also brings the need to fight against those who do not want change. NMAs are also in a weak position as they have constraints on their business model, often stopping them competing for commercial revenue opportunities.

John Kedar – identified joining up key registers as a big opportunity, particularly the national address register, which can become the consistent "thread" running through all registers. The more imaginative administrations will recognise that digital transformation is not just about automating existing processes but using the opportunity to re-engineer with a focus on the outcomes not the inputs.

Gavin Adlington – observed that radical change requires a lot of patience to gradual change minds and accepting that the pace of change will initially be slow, but the evidence of success is increasingly evident in many countries.

- **How to create a sustainable business model?**

Consideration of fundamental financial issues needs to be central to thinking from the beginning.

It is often better to bring together a collation of a small number of willing partners, demonstrate financial benefits through pilot projects but in the context of an overall long-term strategy – think big but start small.

Sustainability requires investment in people with a shared vision and commitment to the cause.

- **How to measure impact?**

The right focus helps. We need to think about who we are trying to convince and their objectives – essentially how will investment in NSDI make them more successful. Every World Bank project starts with producing a Project Appraisal Document (PAD), which contains an economic justification of the planned investment - these are good sources of metrics.

There is an increasing number of economic studies on geospatial data that can also help. Some recent commercial deals, such as the franchising of land registration in New South Wales, Australia for USD 2.6 Billion, show that the private sector recognizes the value – more for the value of the information contained than the register itself.

Gavin Adlington advised that getting a good economist onto your team and leaving them to explain the value was often a successful tactic.

Darko Vucetic had undertaken a recent socio-economic impact assessment – they calculated a 5:1 return on investment. However, in selling the proposition had focused on showing NSDI as a money-making machine for Government because of its unique ability to increase land and property tax revenues, whilst making citizens happy as the value of their land increased.

- **What are the key ethical issues in geospatial data use?**

John Kedar gave a great example of unintentional bias where drilling down into COVID statistics suggested a concentration on a single apartment block which happened to be a single point representing the centre of a much larger area.

Gavin Adlington felt that consideration of open data was more complex today because the unintended consequence might mean personal information could be more easily exposed by big data analysis of multiple data sources.

Darko Vucetic explained how weaknesses discovered by cyber security analysis of the Geoserbia platform kept him awake at night.

In her summing up of a fascinating day, **Rumyana Tonchovska** suggested that working together and sharing experience the NSDI community would be stronger and better recognised for what value it can add to the economic prosperity of our countries.

John Kedar
Director
John Kedar Geospatial Initiatives
United Kingdom

Darko Vucetic
Republic Geodetic Authority
Serbia

Gavin Adlington
Independent Land Administration Expert
United Kingdom

DAY 3: INTO THE FUTURE – EMERGING APPLICATION AREAS

Setting-up the Scene

Chair: Astrid Hvattum, Head of Business Intelligence and Innovation, Geodata, Norway

Astrid is a dedicated technology optimist, business developer, strategic advisor and technology blogger. She is a Head of Business Intelligence and Innovation at Geodata – a Norwegian company, which by Astrid's words, "lives and breathes four dimensions."

Astrid Hvattum
Head of Business Intelligence and Innovation

GEODATA
Norway

Setting-up the scene, Astrid commenced the day with an inspirational introduction emphasising her firm belief that anything and everything is possible if we put our minds into it and that specifically Spatial Data and Technology are key elements in reaching a sustainable future.

She underlined that we need to

- Have technology, information, applications, and solutions
- Understand local specifics and changes that occur over time
- Connect our efforts to our governments' goals, visions and aspirations
- Show how spatial data can help to understand impacts and to becoming data-driven
- Demonstrate endless possibilities geospatial provides, especially when driven by crises
- Convince that geospatial provides dynamic evidence for data-driven decision-making

New technologies provide us with exciting possibilities of getting "a lot for less":

- Airborne imagery and machine learning combined, gives us an up-to-date overview, and occurred changes show changes
- Raster analytics and Artificial Intelligence can take you even further
- Lidar-data can show us what the naked eye cannot see
- Drones can document and we can map – live, in detail, and in three dimensions

Astrid pointed out that we would need to reach out to the public to engage, to interact, and to get accurate information on what is happening and where. It is important to use difference sources for collecting and spreading the information – for example, crowd sourcing or social media as a source of information in emergencies.

At the same time, it will be increasingly important to establish and implement national and international standards, to create trust in the data we provide, and to be able to work towards common goals in the international society. We need to create standards that makes it possible to compare apples and apples – even if the data comes from different sources and countries.

We have created and collected data for decades. Now, we need to think about how we can connect the dots and make a digital copy of our surroundings.

The most important is not if this digital copy is perfect from day one, but if and how it can grow and show what is already in place with information about quality. How it evolves over time through an always updated, dynamic, and visualized representation of your data.

Astrid concluded stating that her goal was for all participants to be inspired, so after these three day they would get ideas for new possible values and partnerships, new potential buyers and users, new ways of attracting employees, new ways of collecting data and a good plan for the future.

Keynote: Spatial Knowledge Infrastructure

Dr. Lesley Arnold, CEO, Geospatial Frameworks, Australia

Dr Lesley Arnold is Director Geospatial Frameworks Australia. She works with governments to develop strategies, policies and implementation plans for spatial information reform, open data initiatives and spatial innovation globally.

Lesley currently works with the United Nations and World Bank supporting countries to strengthen their geospatial information management capabilities towards implementing the 2030 Agenda for Sustainable Development, and is one of the lead authors of the UN-GGIM Integrated Geospatial Information Framework.

She is currently a Board of Director of AuScope and the Australia Urban Research Innovation Network (AURIN), and is President-elect and Board Member of the Surveying and Spatial Sciences Institute, Australia.

Lesley has worked with several committees to achieve incremental change including the Intergovernmental Committee on Surveying and Mapping (ISCM) Australia to develop Cadastre 2034 strategy and the Elevation and Depth 2030 Strategy.

Dr. Lesley Arnold
CEO
Geospatial Frameworks
Australia

Lesley continued the inspirational picture drawn by Astrid and talked about the transformational shift required for spatial data enabling infrastructures to achieve a Spatial Knowledge Infrastructure (SKI) and, in particular, knowledge on-demand. She noted that this was a paradigm shift from current SDI technologies that are based on Web 2.0 technologies and data delivery; to an enabling environment based on Web 3.0 technologies that enable knowledge inferencing.

Lesley started with a technology focus. She talked about research conducted by the Cooperative Centre for Spatial Information (CRCSI) (now FrontierSI) where they experimented with Sematic Web technologies and integrated data on the Web, under its spatial infrastructure program with over ten PhDs and Post Docs, and industry partners. The Program looked at all aspects of SDI data supply chains and developed a vision for the SKI - a network of data analytics, expertise and policies that assist people, whether individually or in collaboration, to integrate in real-time, spatial knowledge into everyday decision-making and problem solving.

Lesley touched upon what is necessary to achieve this vision of knowledge on-demand for decision-making. She pointed out that this relies on government engagement, higher technical skill levels and some required prerequisite technologies, such as linked data formats, automated workflows and ontologies. She stated that we are now in an SDI/SKI hybrid environment, where access to machine-actionable data is becoming a reality and proof of concepts developed. There is still much to do to achieve the envisaged SKI to move beyond current SDIs.

In conclusion, Lesley provided a fuller picture using the Integrated Geospatial Information Framework (IGIF) as the means for digital transformation. She called upon participants to start creating and exposing data as linked data, as well as linkable metadata so that it can be found by machines. According to Lesley, this will lead to innovation potential, particularly in the open source community. There is free and open-source software, such as Protégé, that can be used to develop ontologies and you can build on and adapt the many existing ontologies that already exist. Visit W3C and GitHub to find out more. https://www.w3.org/wiki/Lists_of_ontologies.

The link to the CRCSI research poster is here https://www.crcsi.com.au/assets/Resources/CRCSI-Program-3-overview.pdf and more papers can be found in the CRCSI Library here https://www.crcsi.com.au/library/. The white paper on SKI is located here https://www.crcsi.com.au/assets/Program-3/CRCSI-Towards-Spatial-Knowledge-Whitepaper-web-May2017.pdf.

Transforming National Mapping & Cadastre with Deep Learning

Nick Land, Business Development Manager, National Mapping & Cadastre, Esri

Nick is a senior manager at Esri with over 20-year experience working in the field of survey, mapping, cadastre, land registration, GIS, LIS, and SDIs. Before joining Esri, Nick was Executive Director of EuroGeographics – the European Association representing National Mapping, Cadastre and Land Registry Authorities. Prior to this, he was a Director at Ordnance Survey – Great Britain's national mapping agency.

In his current role at Esri, Nick's focus is on maximising the value of GIS in support of national mapping, cadastre and SDIs, including INSPIRE implementation.

Dr. Nick Land
Business Development Manager,
National Mapping & Cadastre

Esri

In his presentation, Nick talked about artificial intelligence and how it can be applied to the work of the National Mapping and Cadastre Agencies - NMCAs, and in particular how it can be used to modernise map production. In the world of technology, we see many incremental changes and developments and then we see some bigger changes. The topic of Artificial Intelligence is one of those potential game changes for NMCAs.

Nick went through the challenges facing NMCAs – from budget constraints and growing users' demands to increasing competition from alternative data providers and outdated architecture. These challenges are forcing NMCAs to think about their mission and their vision. Nick suggested that this mission is evolving. Still, they have a core mission to deliver high quality authoritative data. The challenge is to make this data as accurate and complete as possible. Many NMCAs are becoming centres of Geospatial Information Excellence, designed to show where and how geospatial data play its part in stimulating economic growth.

Further, Nick demonstrated how AI could improve the map production, especially in the commencing stage of the mapping workflow – collection of data and identification of changes to various data features. Nick touched upon difference aspects of Deep Learning related to AI applications for mapping updates. He presented examples from Ordnance Survey Ireland, Cyprus, the Netherlands, Great Britain, and Kuwait. These use cases showed that use of AI/DLS allows NMCA to be more responsive, to improve data quality, to save time and money, to expand internal capacity and maximize return on investment.

In conclusion, Nick stated that

- Deep Learning and the use of Artificial Intelligence is delivering a real benefit now. It is going to be better and better, but it is clearly a very useful tool when it comes to change-detection and feature extraction.
- It is an iterative and incremental approach for gradual quality improvement, and you have to be focused on your specific use case.
- Training data is an absolute key in the process, but we must see deep learning is one of the tools in the overall GIS toolbox.

Precision Agriculture

Marc Tondriaux, Chairman, European Association of Remote Sensing Companies

Marc Tondriaux has been working in the Space sector for more than 35 years after 7 years spent as a telecom engineer at the French Telecom Research Centre. He joined Matra Espace in 1985 for the validation of the SPOT 1 control centre and has continued working for this company, which became Matra Marconi Space, and then EADS Astrium and Airbus. He has been given different responsibilities, including Director of the Ground Systems Division and then of the EO Services Directorate during 11 years, gathering and managing Spot Image and the various Infoterra subsidiaries created in 6 European countries, launching and managing the development of the Spot6/7 investment program. He left Airbus in 2014, just before his retirement, for co-creating the TerraNIS company, specialised in EO services for Agriculture, Viticulture and Environment, which gathers now 20 employees, and where he is still President.

Marc Tondriaux joined the EARSC Board of Directors in 2017, where he took the responsibility of coordinating the working groups dealing with Small Companies Support, and with Applications for Local and Regional Institutions, in line with the actions he had started with the creation of the Eugenius SME's association of EO services providers. During the Annual General Meeting of EARSC in June 2021, members voted the composition of the new Board of Directors who nominated Marc Tondriaux as Chairman.

Marc presented European Association of Remote Sensing EARSC, which is an association founded in 1989 and dedicated to helping European companies in the Earth Observation downstream sector. Nowadays, EARSC has 133 members from 24 countries.

Marc stated that agriculture is the second most important industry sector in Europe and the use of Earth Observation in precision agriculture was becoming hugely influential. He explained the objectives of using Precision Agriculture are firstly, to achieve efficient yielding results in changing environmental and climate conditions, and secondly, to develop sustainable practices, with preservation of the natural resources, biodiversity, and the environment. These objectives can be achieved by extracting valuable information from a variety of imagery data captured by satellites, drones and airplanes. In conclusion, Marc provided several examples of Earth Observation applications to the agriculture sector.

High Precision Satellite Imagery

Rene Griesbach, Regional Manager Presales, Planetlabs, Germany

Rene Griesbach is the Regional Director Pre-Sales for Europe, Middle East and Africa at Planet Labs Germany GmbH in Berlin. He studied "Aerial Photogrammetry" and "Remote Sensing" and holds a Ph.D. in Aerospace Imaging from the Siberian State Academy for Geodesy. In his career, he led aerial and marine survey projects in Germany, Nigeria and the Emirate of Sharjah (UAE), before he joined RapidEye AG to develop satellite data applications in 2007. In this role, Rene worked in and managed a number of application research projects under the EU FP7/Horizon2020 and Interreg programs, funded by German Space Agency DLR, German Development Aid Agency GIZ, by ESA and others. Later, RapidEye AG was acquired by BlackBridge AG and then by Planet Inc.

Today, he and his team of engineers consults Planet customers worldwide in the most effective use of satellite imagery for agriculture, forestry, hydrography, energy, infrastructure, business intelligence and other domains.

Rene was delighted to share his insights on new technology and use of satellite imagery, and what it could bring to different users.

He started with an introduction of his company's mission "to image the whole world every day, making change visible, accessible and actionable." Rene stated that precision imagery is satellite imagery suitable to create a model of the Earth, which is precise in time, location and information content provided. He went through various products offered by Planetlabs. They have recently developed a new platform SuperDove to be more compatible with public data from Sentinel-2. They are also pioneering advanced techniques to harmonize, clean, integrate and fuse data streams from multiple sensors to produce consistent, comprehensive, and sensor-agnostic data, applying an adapted version of the Cubesat-Enabled Spatio-Temporal Enhancement Method (CESTEM). The innovative technology is applicable in many areas – Defence and Intelligence, Energy and Infrastructure, Civil Government, Finance and Business Intelligence, Agriculture, Mapping, Emergency Management, Forestry, Insurance, etc. Data provided by Planetlabs has a fully API based data access. It supports OGS standards like WMS/WMTS/XYZ and it provides integration directly into ArcGIS Pro and QGIS.

Smart City Platform Enabling Digital Twin: Helsinki 3D+ project

Jarmo Suomisto, City of Helsinki, City Executive Office, Finland

Jarmo Suomisto is a manager of Helsinki 3D+ and responsible of creating, maintaining and delivering virtual models over the whole city. Jarmo has been working for over 25 years with 3D and GIS in building design and city planning. He has practical understanding of the great potential of 3D.

Jarmo is an architect by education possessing a Master of Science degree in Civil Engineering from Helsinki University of Technology.
https://www.linkedin.com/in/jarmo-suomisto-08231aa6@Helsinki3D

Helsinki 3D+ project integrates new technology and workflows for processes and city services. The project is a 2020 and 2016 "Year in Infrastructure Award" winner and 2019 "London Tech Fest" Main Award winner. www.hel.fi/3D

Jarmo started with presenting the 3D+project team and a history of Helsinki 3D project, which has started 36 years ago. The call for urban digital twin was based on the strategic goal to efficiently manage city resources using 3D as a tool to create better life through better services: **Better understanding – Better decision – Better city – Quality of Life.**

Helsinki Smart Digital Twin 2021has two production lines - the City GML Semantic Model and Reality Model. Combined both models, it forms an open innovation platform which is open for downloading and further use.

Jarmo underlined that integrating the twin platform into city processes has many benefits – economic, environmental and societal. City of Helsinki uses moto "Digitally first" to all city processes and programmes, such as "Safe City", "Carbon Neutrality" and other.

Jarmo told about Helsinki strategic plan called "The most functional city in the world", which has one of the goals to become a carbon-neutral city by 2035. Heating was identified as a major factor of greenhouse gas emissions (56%).
https://www.hel.fi/static/liitteet/kaupunkiymparisto/julkaisut/esitteet/HNH2035_en_summary_14022019.pdf

They created Energy and Climate Atlas using 3D+ platform, to monitor heating surfaces, structure and other attribute data of over 80000 buildings – over 1 million surfaces, to calculate and predict heating effects and plan renovation programs.

Another application created with Helsinki Smart Digital Twin 2021 is GeoEnergy potential, which provides information for depth down to 300 meters.

Elaborating on the meaning of technology, Jarmo argued that technology determine only 25%, but 75% is other things – new way of thinking and innovative behavioral changes.

In response to the question on what cost and benefits are, Jarmo said that social return is more important. The achieved results do have real value to people. On cost-side, the investment was about 1-3 million euro during last six years. If you want to start a similar project, you should think analyze your resources – human and financial; what kind and type of model would suit your use case; and apply step – by – step approach.

Helsinki 3D+ website www.hel.fi/3D
Helsinki Energy and Climate Atlas https://kartta.hel.fi/3d/atlas
Open Energy Atlas data in Helsinki Region Infoshare https://hri.fi/fi/dataset/helsingin-3d-kaupunkimalli
Energy and Climate atlas video clip (no audio) https://youtu.be/Cr-M1bla7K0
Heat Demand Prediction of Buildings Using a 3D City Model Presentation by Enni Airaksinen https://youtu.be/J6r-cCL25O0
3D City Models and Minecraft Helsinki as open data in Helsinki Region Infoshare https://hri.fi/data/en_GB/dataset/helsingin-3d-kaupunkimalli
Helsinki 3D+Youtube channel https://www.youtube.com/channel/UCC5zVtGUdLXRI354lghLLqg/videos

Geospatial for Finance Industry

Christophe Christiaen, Oxford University Sustainable Finance Programme, United Kingdom

Christophe is the Data, Innovation and Impact Lead within the Oxford Sustainable Finance Programme, developing innovation strategy and partnerships for the UK Centre for Greening Finance and Investment as well as the Spatial Finance Initiative, which he co-founded.

He also created and runs the Satellite Applications Catapult's Sustainable Finance value stream, stimulating geospatial technology innovations for the financial services market. At the Catapult, he has worked across numerous national and international technology innovation projects in strategy advisory capacities and supported multiple technology start-ups and SMEs with the commercialisation of their products.

Previously Christophe held roles at the European Space Agency, working as a business analyst and at Henkel, working across credit management and sales controlling. Christophe holds an MSc in Business Engineering from the University of Antwerp, specialising in finance, accountancy, and environmental economics.

Christophe is the data and innovation lead at the UK centre for Green Finance and Investment and co-founder of the spatial finance initiative. He set out a convincing case for a huge opportunity for geospatial in the finance sector. Green finance is a hot topic, with investors increasingly wanting to channel funds to sustainable projects. This is not only because of environmental concerns, but also growing evidence that such projects financial outperform those made in projects likely to be adversely affected by climate change. Further, many governments are setting up mechanisms to force financial institutions to report on climate related risks in regulating their fitness to operate. This type of reporting relies on good, granular data and existing sources, based on self- disclosure, are often very general, historical, and non-standard, making objective comparison difficult. Geospatial data, particularly from earth observation, answers this need – it reflects the real world, is detailed enough to identify individual assets, offers global coverage and rapid refresh.

Christophe highlighted many use cases, including monitoring global supply chains, underpinning the carbon credit market and measuring greenhouse gas emissions of individual power plants. He also explained that often the outputs of analysis are spreadsheets that can be easily fed into existing financial analytics, rather than as geographical visualizations. In summing up and subsequent discussion, he explained that financial services sector spends and estimated USD33 billion per annum on data and the proportion spent to support ESG (Environmental, Social and Governance) decisions was increasing rapidly. A wide range of future applications is still emerging, which geospatial and EO professionals were well placed to exploit by working together.

KartAI Project

Ivar Oveland, Norwegian Mapping Authority

Ivar Oveland holds a PhD from the Norwegian University of Life Sciences where his major subject was in the borderland between robotics, geomatics and building information models.

He worked 13 years in the private airborne LIDAR industry. Today, he works at the Norwegian Mapping Authority with projects related to research and development.

Ivar is the lead researcher on this project, a joint initiative involving public and private sector partners and funded by the Norwegian regional growth fund. It aims to improve the quality of the cadastre through crowd sourcing. The problem for municipal government is that although the volume of building applications is decreasing, the costs of processing them is increasing. Further, there are known issues with the quality of the cadastre, which is acute in the north and west of Norway.

The potential solution is to better integrate data sources (aerial imagery, topographic basemaps and LiDAR); develop automated machine learning to identify buildings that are missing or wrongly classified and through an active dialogue with landowners to verify results from applying machine learning. The project will run from 2021 to 2023 and offers a very high cost-benefit return.

Hybrid Approaches for Sustainable Base Mapping

Anders Nesse, Norconsult Information Systems, Norway

Anders Nesse is a Geomatics expert and advisor at Norconsult AS, a Norwegian based engineering company with more than 5 000 employees.

Anders graduated in 1990 with his Master of Science degree in Photogrammetry and Surveying. He has more than 30 year of experience in photogrammetric mapping from public and private sector. He has worked in projects on implementation of modern mapping techniques in the Nordic countries, Europe, Asia, Africa, and former Soviet states as Georgia, Kyrgyzstan and Moldova.

Anders has been an expert advisor on many mapping projects in developing countries, so he knows a lot about the practicalities of base mapping. He described the hybrid approach as using the best of many different acquisition techniques now available to minimise cost and maximize value. Aerial capture using fixed wing aircraft, he views as still giving the best value for creating the base, with 20cm accuracy as sufficient for most purposes, with photogrammetry as the key technique for integrating data from different platforms.

His shopping list was:

- Satellite images for vegetation, change detection, climate change

- Drone data for update individual buildings and infrastructure
- Multi-head aerial cameras for 3D city modelling (oblique and vertical)
- LiDAR for elevation, forestry, calculation of biomass
- Handheld tools (smartphones) for micro area change.

His top tip was to keep the data model simple and to look carefully at comparative acquisition costs, he quoted the recent example from Kyrgyzstan, where in one day using a conventional aircraft, they had acquired data for a strip of country 125Km wide.

Panel Discussion

Chaired by Astrid Hvattum, Head of Business Intelligence and Innovation, Geodata, Norway

The panel session focusing on the Future, was chaired by Astrid Hvattum from Geodata. Her panellists were Lesley Arnold, Director of Geospatial Frameworks, Nick Land, Esri Europe and Anders Nesse, Norconsult, Norway.

How Feasible is it to rely on satellite Imagery for National Mapping?

Nick Land positioned this as a tradeoff between what data was available and what are the key use cases for national mapping. NMAs now need to understand all the options, not just satellite imagery, but drones and crowd sourced data as well as conventional ground and aerial survey.

Further, the specification for a topographic base was changing; IGIF specified 14 different data themes including all type of physical infrastructure including electricity, gas and telecoms networks, which can be remotely captured, but also those that are human geography such as administrative boundaries and addresses.

Lesley Arnold saw satellite imagery as a great way to involve community groups and children in data to learn to interpret data.

Anders Nesse added that the hyper-spectral sensors now part of many satellites give us the ability to add to national spatial data inventories what we cannot see with our eyes such as vegetation change and carbon emissions.

Is Artificial Intelligence fact or fiction and will it cost me my job?

The panel felt that any process that a human being carries out can be automated, if we define well enough the rules and workflow. However, it is unlikely to replace the human as it allows them to move up the value chain contributing more directly to decision making.

Further, that the deep learning (a better term than AI perhaps) is no longer only the preserve of data scientists with the tools more accessible to users who have geospatial skills. This is a core competence of the NMAs, we come with "spatial inside" that can open up many opportunities if we shift from a focus on "general purpose" series mapping to providing more bespoke products and

Dr. Lesley Arnold
CEO
Geospatial Frameworks

Australia

Dr. Nick Land

Business Development Manager,
National Mapping & Cadastre

Esri

Anders Nesse,
Norconsult Information Systems, Norway

services customized to particular use cases. In doing this, change management was particularly important. The panel felt AI was in danger of being oversold and good training data was key to success in deep learning initiatives.

Looking further into the future: What are the known unknowns?

The panel was optimistic for the future of geospatial science. The role of BIM in construction, requiring more granular and integrated data continuously updated for both inside and outside buildings was a huge opportunity.

As with many others, they felt the work being done in Helsinki was an inspiration and the way that Jarmo Suomisto and his team has directly linked their work to the mayor's policy plan pointed the way for such initiatives.

Lesley Arnold highlighted the semantic web and the potential of crowd sourcing as a huge untapped resource for data capture and validation, but worried about the power of large corporations to control innovation and stunt this source of innovation. Knowledge on demand was a few years away yet and, in many countries, there was still a lot of data to capture and maintain before the semantic web could be realized. The role of the state in this process needed to continue to counterbalance information being controlled by the private sector to the detriment of the public good.

Anders Nesse looked forward 10 years, to being able to instantly visualize geospatial data to 1cm resolution on your smartphone for any location in the world, and get to his house in northern Norway by autonomous car! Video games using geospatial was also a growing opportunity.

Nick Land saw the big known future challenges being data sharing and governance, which were both "people issues".

Is Location Ethics important?

Astrid asked the panel to focus on the value and issues of General Data Protection Regulation (GDPR). The panel had mixed views, but agreed that individuals wanting to take control of their own data was an unstoppable trend. This introduced an issue of trust for the industry, that we need to make sure our uses of geospatial data are both ethically defensible and protect society from being unknowingly manipulated. The audience was referred to the talk by Denise McKenzie introduced the locus charter which sets out the principles of location ethics.

Key takeaways highlighted by the panel were

- The power of the semantic web

- IGIF as framework for strengthening geospatial data infrastructures

- The need to connect data more directly to policymaking and the need for collaboration.

Astrid wound up the conference by thanking the organizers for arranging such a wide ranging and thought-provoking set of presentations.

Participants' countries