Workshop on Data Ecosystems and Spatial Data Infrastructure - Facilitators for Data Value Creation

Joint workshop of Danish Agency for Data Supply and Infrastructure, KU Leuven, TU Delft, IGN France, DAFAGO and EuroSDR, December 12th-13th 2023 - Copenhagen, Denmark

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Publication date
2024

Document Version
Final published version

Citation (APA)
Shaharudin, A., López Reyes, M. E., Pantazatou, K., Storm, I., Larsen, B., van Loenen, B., & Kronborg Mazzoli, U. (2024). *Workshop on Data Ecosystems and Spatial Data Infrastructure - Facilitators for Data Value Creation: Joint workshop of Danish Agency for Data Supply and Infrastructure, KU Leuven, TU Delft, IGN France, DAFAGO and EuroSDR, December 12th-13th 2023 - Copenhagen, Denmark*. EuroSDR/European Spatial Data Research.

EuroSDR

European Spatial Data Research

May 2024

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Official Workshop Report

Published by EuroSDR

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Table of contents

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Official Workshop Report

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Abstract

The world is becoming more and more data driven. There are many ways to collect, analyse and disseminate data, and data ecosystems are among the most important environments that we have for facilitating this. Spatial data is one of the data types in data ecosystems, and data ecosystems play a key role in further value creation of the spatial data created, maintained and shared in the SDI. The workshop on "Data Ecosystems and Spatial Data Infrastructure (SDI) - facilitators for data value creation" brought together the views from actors ranging from the Local and National Authorities from Norway, Sweden and Denmark, European organisations such as the EC Joint Research Centre, The Alexandra Institute, and researchers working from different domains like spatial data, energy transition and building infrastructure. This report summarises the key takeaways from the presentations and the discussions during the breakout sessions that followed each of the topics as well as presenting a synthesis of the main findings of the workshop including the main take-aways for the SDI community.

Acknowledgement

The workshop was hosted by the Danish Agency for Data Supply and Infrastructure with the support of the EuroSDR´s secretariat.

The workshop owes its success to the diligent guidance and commitment of a knowledgeable program committee. Their expertise and dedication were instrumental in bringing this event to fruition.

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The contributions to the workshop and workshop report by Ashraf Shaharudin, Malena López Reyes, Birger Larsen, and Bastiaan van Loenen are part of the "Towards a Sustainable Open Data ECOsystem" (ODECO) project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955569.

1 INTRODUCTION

The world is becoming more and more data-driven. There are many ways to collect, analyse and disseminate data, and data ecosystems are among the most important environments that we have for facilitating this. Spatial data is one of the data types in data ecosystems, and data ecosystems play a key role in further value creation of the spatial data created, maintained and shared in the spatial data infrastructure (SDI).

The workshop on "Data Ecosystems and Spatial Data Infrastructure (SDI) – Facilitators for Data Value Creation" [1] brought together the views from actors from the local and national authorities of Norway, Sweden and Denmark, European organisations such as the EC Joint Research Centre and The Alexandra Institute, and researchers working from various domains such as spatial data, energy transition and building infrastructure.

The workshop aimed at generating insights into data ecosystems (DE) in the context of spatial data infrastructure (SDI), identifying concepts and challenges to uncover relevant research topics, encouraging the development of best practice recommendations, and spurring collaboration on use cases across domains and sectors. In particular, it was dedicated to identifying the pros and cons of transitioning from SDIs to DEs through the presentation of technical reports and practical use cases, followed by discussions among participants on relevant key questions during breakout sessions.

The almost 30 participants, from eight different countries, discussed in three topical sessions relevant issues revolving around the developments from spatial data infrastructure to spatial data ecosystems:

Topic 1: Moving from spatial data infrastructure (SDI) to data ecosystems
Topic 2: Value creation for all stakeholders – from supplier-driven to demand-driven
Topic 3: Development of data ecosystems – new business and financial models

Each session started with presentations providing different views on the topic, followed by discussion in small groups. The results of the group discussions were then shared plenary with the rest of the group. A list of important terms and concepts within the SDI and data ecosystem area was shared with all participants (see Appendix 2: Glossary – terms and concepts) to guide a common framework of understanding for the workshop participants during the workshop.

This report is structured around the three workshop topics, highlighting the key takeaways from the presentations and the discussions during the breakout sessions that followed each of the topics, as well as presenting a synthesis of the main findings of the workshop, including the main takeaways for the SDI community.

2 TOPIC 1: MOVING FROM SPATIAL DATA INFRASTRUCTURE (SDI) TO DATA ECOSYSTEMS

Speakers of the first workshop session, "Moving from spatial data infrastructure (SDI) to spatial data ecosystems", presented problems, challenges and opportunities related to the function of well-known SDIs (e.g., SDIs based on INSPIRE) and their potential transition to DEs or data spaces. Over time, the requirements from agencies in data supply and infrastructure have changed. From being a data provider, providing data to the public through digital solutions, they are now required to take on the role of data facilitator. SDIs based on INSPIRE were characterised as public sector-centric, requiring the hardcoding of technical aspects in legislation using complex specifications while being strongly influenced by specific data standards. Since SDIs are strictly defined, secure systems that provide one-way interaction with users (producer-driven), communication of demands from users to producers is not always well supported and often takes time. All these characteristics contribute to the fact that developing new services for an SDI requires time.

[1] https://eurosdr.net/workshops/workshop-data-ecosystems-and-spatial-data-infrastructure

2.1 Presentations Topic 1: Moving from Spatial Data Infrastructure (SDI) to Data Ecosystems

Alexander Kotsev from the Joint Research Center (JRC), the European Commission's science and knowledge service, presented "Beyond SDI – Evolution towards the Common European Green Deal Data Space". The JRC is responsible for reviewing the INSPIRE Directive, which aims to establish a European Spatial Data Infrastructure (SDI). The review report, released in 2021, covered both the positives and negatives, along with a vision for the future. The INSPIRE Directive is recognised for improving efficiency at the national level in many countries, resulting in numerous use cases with over 70,000 available datasets. However, these use cases are predominantly in the public domain. The vision should be to serve broader purposes, requiring INSPIRE to be modernised by aligning more closely with the structure of "data ecosystems". This shift should also aim to move participants beyond merely "checking off" requirements in INSPIRE, which happens sometimes. As national spatial data requirements might differ from those stated by the INSPIRE directive, many EU countries, in their effort to meet all INSPIRE requirements, either developed SDIs according to the INSPIRE directive with the addition of custom extensions or moved on to develop parallel solutions (one SDI implementing INSPIRE and another SDI adhering to the national spatial data requirements). To address these problems, the European Commission contemplates funding the creation of a European Common Data Space that is not based on the description of a technical infrastructure but is more like a DE. DEs are described as dynamic, interactive, user-driven, and service-oriented systems. For this new concept to succeed, it is important to, besides considering the FAIR principles (i.e., making data findable, accessible, interoperable, and reusable), also try to implement the CARE principles (i.e., considering the collective benefit, authority to control, responsibility and ethics related to the collection and dissemination of data) with the addition of establishing a new set of key performance indicators (KPIs). Having said that, SDIs might still have a role to fulfil as facilitators of the secure use of core geospatial data and metadata repositories (making data findable according to the FAIR principles). Though the requirements of the INSPIRE directive are many and hard to implement, it is good to have goals to aspire to, even though they will never be fully met. Even in a DE implementation, maintaining standards remains important, particularly if the objective is to support the development of services that rely on the processing of both real-time and non-real-time data, realising the potential of concepts such as digital twins.

The difference between "data ecosystems", a concept that emerged in the 2010s, and SDIs was discussed throughout the workshop. It became evident that there are slightly different understandings of a data ecosystem, likely stemming from its less rigid definition compared to SDIs. **Serena Coetzee from the University of Pretoria highlighted this in her presentation "Challenges and opportunities for spatial data infrastructures in the emerging and evolving geospatial ecosystem"**. Data ecosystems are perceived as self-organising, dynamic, and diverse, providing greater flexibility to adapt to new technologies and demands. Within a data ecosystem, competition and collaboration exist, necessitating adaptation for survival- similar to a natural ecosystem. In contrast, SDIs are often "over-specified" and sometimes tied to specific structures and technologies due to legislation—highlighted as a problem in the review report of INSPIRE. This rigidity makes it challenging to adapt, posing difficulties in staying relevant. Serena proposed looking at organisations as the living things of the system and considering artificial actors as part of them. She pointed out ecosystems as self-organised systems where competition would naturally emerge, and some actors would not survive. In that sense, diversity is a necessary and beneficial factor, and it is crucial to understand the role of the government in a data ecosystem. She pointed out that building the data infrastructure was necessary in the beginning, and today, it is time to move the focus towards the use of data. She highlighted the risks of over-specifying data governance, referring to the proposal of 9 Common European Data Spaces themes. However, as we transition to data ecosystems, several practices need to persist, including the implementation of standards which ensure interoperability. Interoperability remains as crucial as ever, especially with the need for cross-collaboration to maximise the utilisation of our data in addressing the challenges of the green transition.

Data Spaces represents the EU's vision for an alternative data exchange infrastructure, acknowledging the benefits of data ecosystems while establishing certain rules to abide by. **Lea Schick of the Alexandra Institute presented the concept in her presentation "Data Spaces – EU's visions for alternative data exchange infrastructures"**. A data space is a distributed system defined by a governance framework that enables secure and trustworthy data transactions between participants while supporting trust and data sovereignty. A data space differs from a data ecosystem in that the latter has no rules, while a data space has a governance framework to which actors belong. A data space is implemented by one or more infrastructures and enables one or more use cases. The European digital strategy vision aims for a unified market within each of the nine defined data spaces. These spaces should comprise intermediaries that ensure data becomes discoverable and facilitate the negotiations of license/purchase agreements. The potential presented by new technologies, such as AI, is acknowledged, and there is a commitment to remaining flexible to avoid missing out on these developments. These governmental infrastructures are intended to deliver value, both monetarily and socially, recognising the importance of ensuring that the vast power associated with data does not end up solely in the hands of big tech companies.

2.2 Breakout session 1

Questions for breakout session 1:

- In your opinion, what are the main differences between an SDI and a data ecosystem?
- What is the future role of SDI in the digital transformation (development)?

Takeaways for the SDI community from breakout session 1:

- Regarding the differences between SDI and data ecosystems, participants discussed the importance of focusing on what people will finally get from data. In the past twenty years, the role of the government, through SDI, was mainly on data provision. This workshop discussed the turn towards data facilitation, with the data ecosystem concept as a means.
- Participants highlighted the importance of research and education in this regard because data need to be combined across domains to generate meaningful outcomes. Geometric representations should harmonise the languages between different domains.
- Regarding the future role of SDI, participants pointed out that the organisational and regulatory aspects are key challenges. They mentioned a clash between legislation and governance; regulations must be more agile to iterate and allow cross-functional collaboration and alignment. Currently, legislation is the basis of data initiatives, yet it takes time to formulate and implement legislation.
- Participants also discussed the inclusivity of data availability. Regular people should be able to answer important questions for them with data. In that sense, data transparency, provenance, and reliability are important. Data quality requirements are changing dynamically in a DE depending on the use case needs of different organisations. Participants raised the question of who will be responsible for collecting those demands and defining data quality requirements.
- Topics regarding data ethics, such as the CARE framework, were also discussed. Participants highlighted the need to reflect on defining data value and mechanisms to prioritise which data. The provider's perspective is limited; hence, there is a need to consider the perspectives of other actors with various use cases.
- In the era dominated by SDIs, there are still problems with some data being locally stored and not published/shared with the public, especially research data or government data that falls outside the data schema of existing SDIs. DEs could be an answer to this as they are dynamic and self-regulated; however, legacy problems around data formats should still be addressed.

3 TOPIC 2: VALUE CREATION FOR ALL STAKEHOLDERS – FROM SUPPLIER-DRIVEN TO DEMAND-DRIVEN

Presenters of the second workshop session, "Value creation for all stakeholders – from supplier-driven to demand-driven", highlighted key issues of SDI that need to be addressed before moving to a more dynamic setup of DE. Since geodata included in a DE may be used for purposes other than those they were originally created for, questions arise on how issues related to data and metadata quality will be dealt with. Many government geodata are created based on legislation and often require additional input from citizens and professionals. These inputs usually remain unutilised due to the combined effect of overwhelming maintenance costs and limited funds. As it is uncertain whether the government will continue to fund such initiatives in the future, it is essential to develop models that highlight value creation for all DE actors (users and producers). Use cases where citizens and professionals can contribute this data at an acceptable level of accuracy/quality voluntarily were presented (e.g., home condition reports for selling an apartment/house, home evaluation for mortgages, real estate cadastral planning zone inaccuracies, etc.). DE's benefits (updated, high-quality datasets), challenges (trust: only trusted users are approved as authorised data providers and are bound to act with professional integrity and offer liability insurance; incentives: use of verified and updated data in conjunction with triggering events is a requirement; funding: end-users interested in triggering a data contribution event are responsible for covering the costs associated with this data contribution event), and caveats (e.g., who takes up the role of the DE driver? Will the dataset authorities embrace this model?) were also presented.

3.1 Presentations Topic 2: Value creation for all stakeholders – from supplier-driven to demand-driven

This session highlighted barriers between data users and producers/facilitators, often leading to discovered mistakes remaining unreported. It frustrates users and deteriorates trust in the data. In this context, **Karoline Arnfinnsdatter Skaar (Norwegian Mapping Authority) showed in her presentation "Reference Frames: The foundation of Spatial Data Infrastructure"** the relevance of considering different scales of standardisation, i.e. global or European versus national reference frames. She argued that the alignment on standardisation of these frames is a cornerstone to managing and sharing data across applications and scales (national v. European). Different reference frames may result in presumably erroneous data. Cross-border reference frames for operations are a key and emerging challenge since new applications and data use go beyond traditional use. These new users should be as important as future users. Her presentation asks how we should meet future spatial data use needs. And how do virtual worlds and augmented reality collide with the real world, and what does this imply?

Lars Hägg (Swedish National Mapping Agency) presented in "Building a digital infrastructure for local data on a national level" the implementation of the digital-first strategy in Sweden. To develop this project, the Swedish government did a 300-stakeholder analysis. The results highlight the lack of standards, data discoverability, expensive costs, no central point for access, legal and data fragmentation, lack of data machine-readable formats, lack of legal support, low local governments' capabilities to digitalise and unclear responsibilities as some of the challenges. Swedish government developed a national basic cadastral and geographic information data domain and a five-year digitalisation goal. The government established a coordinator role with responsibilities such as security checks and support management and established processes and roles. One of the lessons learned from implementing the strategy is that specification development takes time; it took them 3 years due to the lack of consideration of legal frameworks. The need to secure resources from the start is important, for which they raised the question of whether businesses should be involved. Cooperation was one of the key elements; they started with 8 municipalities and finished with 280. They learned that formality

serves national institutions, but on a local scale, informality is more suitable as formality brings legal issues.

Line Hvingel (Local Government Denmark), in her presentation, "Trying to grasp the role of being the owner of open public data", presented the cooperation between the association of Danish municipalities with the agency of data supply through a project called GeoFA. The project allowed municipalities to voluntarily put data, especially data that did not have a "home", in a one-stop portal. The project presents a bottom-up approach in which they were "hit by an ecosystem". The project currently has a lot of new users through informal collaborations. The challenges of GeoFA are that it is voluntary, there is a lot of unused data, maintaining consistent quality is difficult, and human resources are limited to handle the data management. GeoFA is confronted by questions around agility versus stability and whether municipalities should contribute resources to the project.

Another reason for a data ecosystem where users are active contributors is to understand the demands better. To do so and further encourage the creation of appealing data, **Thorben Hansen of GeoAdvice suggested in his presentation "Demand-driven improvement of government geodata"** to update existing key performance indicators (KPIs) from, for instance, the number of data layers to the number of users and data impact. This will incentivise the creation of data that is more useful. It would also make it easier to decide to discard unused data, which has naturally "died" in the ecosystem and is only a burden. He also pointed out questions related to the open data challenges, such as how to cover the costs of providing data when it is provided for free to users. He presented the challenges for three scenarios: home conditions reports, mortgage houses, and real estate cadastral handling. He also pointed out the challenge of changing a traditional upstream model (supplier-driven) towards a downstream model (demand-driven) and the need for an ecosystem that cuts across different data types. He emphasised the need for collaboration-based business models, with attention to trust, incentives, and funding.

Another way to ensure demand-driven value creation for stakeholders is to collaborate with them from the start. **Lars Bodum, Aalborg University, presented "The Digital Underground – Enhancing documentation and safeguarding of our technical infrastructure in subterranean environments",** a project on 3D point clouds sharing of conduit trenches/construction holes. Sometimes, data from authorities may not reflect reality underground accurately, which may result in maintenance work disruption and an increase in cost. Hence, through the project, researchers from Aalborg University develop a virtual reality tool for underground infrastructure to help address the problem.

3.2 Breakout session 2

Questions for breakout session 2:

- How do you understand the transition from supplier to demand driven?
- How can users contribute to value creation e.g., by taking the role as both consumers and producers in the ecosystem? (circularity)

Takeaways for the SDI community from breakout session 2:

- In retrospect, SDI was developed with user needs in mind. But the user was limited to mainly militaries. Now, geodata users have expanded with a wide range of applications.
- The switch from SDI to DE could be more about a change from supplier-driven to value-driven than from supplier-driven to demand-driven value creation. In this context, important questions to consider are to whom these data are valuable, for what purposes, and what are the conflicts.

- Consequently, there should be discussions and decision-making on who should fund the implementation of data initiatives. For example, house owners may be interested in buildings' data, but if the producer does not see value in providing such data, they may not prioritise it.
- We should find the motivations for the actors to engage and produce data. This is especially important to address the problem of certain organisations providing more funds than others for data collection, even though other organisations profit from this data, too.
- There should be a shift from producing more data towards needed data, especially since producing and providing data comes with a cost.

4 TOPIC 3: DEVELOPMENT OF DATA ECOSYSTEMS – NEW BUSINESS AND FINANCIAL MODELS

Many issues related to the third topic of the workshop, "Development of data ecosystems – new business and financial models", have already been touched upon in the previous two sessions. Once a shared vision is established, stakeholder expectations should be aligned with technical possibilities. It may be a sound approach to create a small use case that can be iterated among collaborating parties. This approach reduces the likelihood of investing significant resources in initiatives that may not be sustainable. Another business model opportunity in the data ecosystem involves acting as a third-party facilitator for companies seeking access to data.

4.1 Presentations Topic 3: Development of data ecosystems – new business and financial models

María Elena López Reyes (Aalborg University) presented "Navigating the ecosystem perspective to maximise the value of open government data". She presented some theoretical background of the social-use value of open government data. She demonstrated the social-use value of six use cases from GeoFA and the dynamics and output of using GeoFA data. She highlighted the need to understand what motivates people/organisations to contribute to GeoFA (and open data initiatives in general).

Ashraf Shaharudin (Delft University of Technology) presented "Designing sustainable business models for open data intermediaries". He described the role of open data intermediaries as third-party actors that enhance the supply, use, and flow of open data. Yet, he argued that their business model development is still limited. Through interviews with several open data providers, he identified shortcomings in current open data ecosystems, which could be turned into value propositions by open data intermediaries. He also envisioned various potential contributions and types of open data intermediaries. He also briefly described the case of Esri to illustrate an example of an elaborate open data intermediation business model.

Another use case highlighting the importance of how value creation for all in a DE can contribute to a more green, coherent, and energy-efficient utility sector was presented by **Stig Fredslund Kjeldsen (the Danish Energy Agency) in "A data space approach to a green, coherent and energy efficient utility sector"**. The utility sector's digitisation has the potential to accelerate the development of faster, improved, and more cost-effective solutions for current climate and energy challenges while enhancing supply security. The Danish Energy Agency is working to establish a data space for utility data. Strategies involve collaboration with key stakeholders in and around the utility sector to adopt a demand-driven approach in overcoming barriers that impede the realisation of digitisation's full potential in creating a sustainable and energy-efficient utility sector. Spatial data forms a crucial foundation for the success of these initiatives and must adhere to community-defined specification rules for collection and

national or international geodata standards for data representation and dissemination. To define specifications on geodata collection methods and decide on appropriate geodata standards, it is essential that all stakeholders meet and discuss. Government authorities such as the Danish Energy could provide a platform for these discussions to take place and act as a coordinator.

Peter Knudsen (SDFI) and Nils Mulvad (Kaas & Mulvad) co-presented on "DAFAGO – Danish forum for private sector working with Basic Data and other public data". SDFI cooperates with different scale entities, including DAFAGO, to get constructive feedback. Together, they have developed a strategic framework to work with critical data and provide rules and standards. Nils shared the experiences of DAFAGO (a collective of private companies working with public data). Their main problem is limited awareness of available data and difficulty accessing it. The presenters argue that users should be able to answer important questions with data. Facilitating networking and collaborative development is key.

4.2 Breakout session 3

Questions for breakout session 3:

- What do you think are the main challenges in evolving data ecosystem?
- How can new business models and financial models support value creation for all?

Takeaways for the SDI community from breakout session 3:

- The costs of providing data lie in a different place from the benefits, i.e., the public usually takes on the data collection cost while private sector companies and individual citizens benefit from accessing and processing this data. Thus, it is pertinent to design more sustainable business models; for instance, co-financing may be considered.
- Collaboration is a necessary and key aspect of developing sustainable business models. Capacity-building strategies spotting what needs to be developed are also important.
- Public authorities could be responsible for facilitating room for discussion between parties/actors from the public and private sectors related to the topic of a particular DE.
- It is usually a long process to get data from a source before you get to the point where you can start using it. This is because data harmonisation and cleaning take time. Another reason is the lack of sufficient metadata describing the data, which requires additional time for conducting detective work to decide whether the data is of sufficient quality.
- In a diverse sector like energy, the roles need to come into dialogue and negotiation, and there is a lack of competence. The smaller actors need help with the operational part of it.
- Prototyping is a good tool for showcasing the value of data and connecting data producers with data users to track which data should be produced.
- To ensure the sustainability of the DE, there is a need to ensure the commitment of decision-makers. Sometimes, the head of the organisation is motivated to develop the data ecosystem but not the rest of the organisation.

5 REFLECTION AND CONCLUSION

During the workshop, the conversations focused on the shift from traditional spatial provider-centre infrastructures to a more flexible and demand-driven data ecosystem. Most of the discussions in this direction were centred around prioritising data and ensuring its sustainability. Our impression was that, further than talking about user-drivenness and demand-drivenness, the SDI community has been challenged by their own practice due to the need to share and integrate data across domains, sectors, and scales, all this to leverage or maximise its use. The main challenge in that regard is finding mechanisms to determine what data is relevant for specific projects, what could be its future use, and by whom. Also, in that sense, some of the participants brought to the table the challenges of making data sharing more inclusive, with some presenters promoting perspectives such as data spaces.

The presenters discussed different perspectives from the practice and theory, from which the most challenging aspects are related to collaboration in the legal, governance, operational, technical, and ethical aspects:

- From a **legal perspective**, the participants discussed the relevance of understanding the limitations from the beginning of any spatial data initiative. They also mentioned that maintaining a balance is important to avoid over-regulating.
- From a **governance perspective**, some of the cases presented show the outcomes of informal cooperation, making it evident that keeping a flexible and adaptable approach towards data sharing is essential.
- From an **operational perspective**, it was mentioned that one of the key advantages of data is that it persists over time. However, the challenge lies in finding ways to enable it to persist. The main obstacle in this respect is the lack of funding for data maintenance.
- From a **technical perspective**, participants highlighted the challenge of sharing data across sectors; therefore, data quality, specifications and interoperability aspects are important. They also highlighted the importance of data formats, as new formats are emerging in a context where there is abundant data; how will we deal with them?
- From an **ethical perspective**, the challenges are related to privacy and security. Regarding privacy, the questions are about how to safely engage people actively participating in the ecosystem by sharing data and giving feedback. In the security aspect, the question is what data would be openly shared and who has access to it.

We made the following observations and reflections:

- Spatial data infrastructures started as user-driven infrastructures with direct interaction between data providers (e.g., mapping agencies) and users (e.g., the military). After the National Mapping Agencies loosened their ties with the Ministry of Defence, other users in the public domain started to use the mapping data, still interacting with the National Mapping Agencies. After the release of open data, the user community continued to increase, resulting in an overwhelming number of users and user types. With this, the direct connection with users has, to some extent, become loose/ lost, which results in what is generally considered a provider-driven infrastructure. Conclusion: the success of the use of the datasets has resulted in a failure in user-drivenness. Or in other words one may argue that the success is the explanation of the failure.
- Hindsight is a wonderful thing – we should learn from past experiences of what worked and what didn't work and why. The history of the SDI development could offer valuable insights for developing other (open) data ecosystems. The risk of not learning from the past is not only that we might reinvent the wheel, starting from scratch and potentially wasting resources along

the way, but we might also repeat the same mistakes! As a straightforward example, data space initiatives experienced issues similar to the INSPIRE initiative and directive almost 20 years ago (e.g. lacking use cases, thematic data themes and generic data specifications).

- Related to this, we should engage with people with a lot of experience, e.g. in the SDI area. Of course, the types and users of data have expanded, and we should engage with a wide variety of stakeholders, but people who have spent decades developing data policy/initiatives, such as those involved in SDI, certainly have a lot of insights to offer.
- There is a risk that we might get carried away (and lost) with new concepts, terms and potentially buzzwords that keep emerging, from ecosystems to data spaces to intermediaries (to name a few). So, as a community, it is crucial for us to clarify what we mean by all these concepts or terms and how they differentiate from each other. We might be referring to the same thing but using different concepts or terms. Perhaps avoid the temptation of inventing new concepts or terms without first checking whether the 'community' (however defined) already has a concept or term we're trying to refer to. Otherwise, we risk contributing to the community's confusion.
- We believe that we should all practice humility, including (especially!) researchers. Sometimes, we may think we have made a groundbreaking discovery or invented something new, but in reality, we may have just reinvented something that already exists. While this isn't necessarily a problem, engaging with people with a lot of experience in the field is vital to ensure that our knowledge and innovations are built on top of the existing knowledge and innovations.

Our general impression of the workshop is that the SDI community is a highly experienced data community and open-minded yet has its feet on the ground, which was very refreshing to experience. Of course, we might not find the answers (yet) to all the questions we raised, but the workshop gave a clear impression of a community that wants to make fundamental changes on the ground.

Overall, it has been a fascinating workshop. What made it especially valuable was the mix of backgrounds of the participants and presenters. It offered insights into different aspects of the future needs of SDIs, from the technical to the societal. Concrete examples could be understood within the theoretical framework. It created a common ground for us to come together in exciting discussions during the breakout sessions. Hopefully, this kind of workshop will continue as it can help form a shared vision across sectors.

6 ABSTRACTS

Abstracts Session 1:
Moving from spatial data infrastructure (SDI) to data ecosystems

- Beyond SDI - Evolution towards the Common European Green Deal Data Space
  Sara Thabit Gonzalez, Marco Minghinie, Jordi Escriu, Alexander Kotsev

- Challenges and opportunities for spatial data infrastructures in the emerging and evolving geospatial ecosystem
  Serena Coetzee

- Data Spaces – EU's visions for alternative data exchange infrastructures
  Lea Schick

Abstracts Session 2:
Value creation for all stakeholders - from supplier driven to demand driven

- Reference Frames: The foundation of Spatial Data Infrastructure
  Karoline Arnfinnsdatter Skaar
- Building a digital infrastructure for local data on a national level
  Lars Hägg
- Trying to grasp the role of being the owner of open public data
  Line Hvingel, María Elena López Reyes and Birger Larsen
- Demand-driven improvement of government geodata
  Thorben Hansen, Lennart Hansen and Bent Hulegaard Jensen
- The Digital Underground - Enhancing Documentation and Safeguarding of Our Technical Infrastructure in Subterranean Environments
  Lasse Hedegaard Hansen, Frida Dalbjerg Kunnerup, Simon Wyke, Lars Bodum

Abstracts Session 3:
Development of data ecosystems – new business and financial models

- Navigating the Ecosystem Perspective to Maximise the Value of Open Government Data
  María Elena López Reyes, Birger Larsen, and Line Hvingel
- Designing Sustainable Business Models for Open Data Intermediaries
  Ashraf Shaharudin
- A data space approach to a green, coherent and energy efficient utility sector
  Stig Fredslund Kjeldsen
- DAFAGO - Danish forum working with basic data and other public data- formed by private companies to share knowledge and build collaboration
  Nils Mulvad, Johnny Bauer and Peter Knudsen

6.1 Abstracts Session 1:
Moving from spatial data infrastructure (SDI) to data ecosystems

Beyond SDI - Evolution towards the Common European Green Deal Data Space [2]

Sara Thabit Gonzalez, Marco Minghini, Jordi Escriu, Alexander Kotsev
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During the past few decades, Europe has been advancing an integrated approach to environmental data sharing which has led to the emergence of contemporary spatial data infrastructures (SDIs). SDIs as we know them brought multiple novelties and contributed to the ambitious agenda for a more sustainable and climate-neutral European future. The implementation of INSPIRE set a model for the rest of the world on aspects such as data interoperability, harmonization, data governance and data sharing tools.

However, besides these extensive contributions, the implementation of SDIs in Europe has not been an easy task. The current landscape is characterized by complex and highly specialized standards and geospatial data frameworks, a provider-centric legal framework, heterogeneous implementation levels across countries, inefficiencies, gaps and overlaps in the production of datasets, among others (Kotsev et al., 2021). In fact, these shortcomings are common not only to SDIs, but to the EU data economy as a whole, where data sharing and data re-use practices for public purposes also remain limited due to a lack of governance frameworks, data culture, and motivations (Liva et al., 2023).

As a response, the European Commission has put forward, within the context of the "Europe fit for the digital age" priority, an ambitious agenda aiming to unlock the benefits of data for citizens and businesses. Leveraging on the impacts of its regulatory influence within and beyond European countries (Bradford, 2020), a set of horizontal provisions for data sharing (largely stemming from the European strategy for data) have been defined – namely the Data Act, Data Governance Act (DGA), Implementing Act on High-value datasets, and the Interoperable Europe Act. These legal instruments, combined, are expected to have strong impacts on the functioning and dynamics of data sharing systems, and facilitate the establishment of a single market for data (European strategy for data, 2020). Its implementation is envisioned through sector-specific data spaces, pulling together and creating value from personal and non-personal data from all actors in the data economy: businesses, citizens, public authorities and other organizations (Farrell et al., 2023).

Within this favourable policy context, there is an emerging opportunity to modernize SDIs and align them with the current technological, economic, and social trends, and to support the growth of the common European data spaces. To achieve this endeavour, multiple factors must be taken into account. These include leveraging new data sources that can enhance or complement public sector information, embracing methods that prioritize inclusivity and focus on user needs, and implementing agile standards and more versatile software tools (Kotsev et al., 2021). Furthermore, the presence of new players (e.g., data intermediaries and data altruism organisations) and clearer governance guidelines defined by the horizontal provisions, would help to establish incentives and value creation in data sharing practices.

Our study will focus on the European Green Deal Data Space, to showcase possible evolutionary pathways for integrating SDIs as enablers of the emerging common European data spaces. We will explain the potential benefits of doing so – from enabling greater access and use of data, to reduced operation and maintenance efforts and new data products and services – as well as the complexities and obstacles that may arise in such transition. Finally, we will emphasize the need to integrate a geospatial strategy across all the different European data spaces, leveraging economic, social, and environmental value for both citizens and other actors in the data economy.

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Challenges and opportunities for spatial data infrastructures in the emerging and evolving geospatial ecosystem [3]

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In the 1980s and 1990s, with the move from information on paper to digital information, the concept of a data or information infrastructure emerged, based on the concept of a physical infrastructure. This metaphor or analogy was also applied to geospatial data or information, and called a spatial data infrastructure (SDI), generally referred to as the "technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data". SDIs (especially in early years) tended to focus on supplying data to a target audience; later, there was a realization that demand for data should also be considered.

In the past decade or so, the natural ecosystem has been used as a metaphor or analogy in the world of data and digital ecosystems and it has been applied to geospatial information. Based on the concept of an ecosystem, a geospatial ecosystem is a community of providers and users in conjunction with the geospatial information and technologies of their environment, interacting as a system. Similar to infrastructures, this is still based on systems thinking but with a much wider scope. Also, an infrastructure is often built, operated and managed according to design specifications, while ecosystems constantly evolve and reorganize themselves in response to disturbances. The ecosystem analogy implies that agents mutually benefit from their interactions; if there is no benefit, agents change or disappear.

In this presentation, I will reflect on the impact of the emerging and evolving geospatial ecosystem on SDI components, data acquisition, processing, storage and distribution. The focus will be on challenges and opportunities related to the characteristics of an ecosystem that are different from infrastructures, and how these can be navigated towards improved utilization of geospatial data.

[3] See presentation:
https://www.eurosdr.net/sites/default/files/images/inline/1.2_challenges_and_opportunities_for_spatial_data_infrastructures_in_the_emerging_and_evolving_geospatial_ecosystem.pdf

Data Spaces – EU's visions for alternative data exchange infrastructures [4]

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The European Data Strategy establishes Common European Data Spaces as a novel approach to exchanging data in the future. Data spaces are infrastructures for decentralised and trustworthy data exchange. The vision is to create common European data spaces within a variety of domains such as energy, health, mobility, agriculture, skills, tourism, production etc. In addition to allocating massive funding, the Commission is also passing several legislations supporting data spaces such as the Data Act, the Data Governance Act, and the European Interoperability Framework.

Data spaces are proposed as a tool for utilising fragmented data currently held by companies, organisations and individuals, but also as a technology-agnostic tool for sharing data without having to rely on data from major hyperscalers. Data spaces primarily serve as an interoperability and standardisation project, where participants of a data space need to agree on and adhere to commonly agreed principles. Data spaces are not only a European project, but are also being developed across many international stakeholders.

This presentation will give a thorough introduction to data spaces, incl. the concept, key stakeholders, as well as an introduction to a couple of the common European data spaces currently under development.

[4] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/1.3_data_spaces_-_eus_vision_for_alternative_data_exchange_infrastructures.pdf

6.2 Abstracts Session 2:
Value creation for all stakeholders - from supplier driven to demand driven

Reference Frames: The foundation of Spatial Data Infrastructure [5]

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Reference frames, such as EUREF89 and ITRF14, are the cornerstone of geographic data, positioning, and the broader Spatial Data Infrastructure (SDI). SDIs rely on consistent and standardized reference frames to effectively manage, share, and use spatial data across diverse applications and systems. To achieve seamless on-the-fly transformations and data management, it's essential to understand three key distinctions: differences between various reference frames, differences between diverse projections, and the differentiation between reference frames and projections themselves. Each distinction plays a crucial role in how we capture, use, and transform spatial data, ensuring that when data is shifted from one system to another, its integrity remains uncompromised.

Complexities of transformations and projections

With numerous transformations, projections, and reference frames available, choosing the right one can be a challenge. The dynamic nature of the Earth, such as continental plate movements, presents challenges globally. Scandinavia faces a unique challenge with land elevation changes. To address these issues, the Nordic Geodetic Commission (NKG) has the foundational data to create a unified Scandinavian reference frame. Understanding technical nuances, such as choosing between the UTM projection and the Mercator projection, or distinguishing the characteristics of EUREF89 from ITRF14, greatly impacts geospatial data accuracy and interpretation. Reference frames are updated at irregular intervals, making it challenging to stay updated on new releases.

Challenges within Intelligent Transport Systems

The Intelligent Transportation Systems (ITS) community highlights the escalating demand for consistent reference frames. As vehicles become more interconnected and automated, the importance of pinpoint positioning and accurate geospatial information grows. This becomes particularly evident when a vehicle crosses borders and accesses data from different national and international sources. Given these challenges, the path ahead lies in creating a unified reference frame for Europe.

Collaborative Solutions

The Norwegian Mapping Authority believes that the geodesy sector holds the responsibility to simplify the usage of positions and coordinates across Europe. We should bypass national and local reference frame variants in both horizontal and vertical dimensions. Emphasis should be on ensuring that even those without geodetic expertise can seamlessly utilize geographic data, maps, and positions from diverse sources. We see European collaboration as a cornerstone to effectively tackle these challenges. We aim to establish a consolidated and precise reference frame that ease use and management of SDIs.

[5] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/2.1_reference_frames_-_the_foundation_of_spatial_data_infrastructure.pdf

Building a digital infrastructure for local data on a national level [6]

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In Sweden a new spatial data infrastructure is being established, with the aim to provide a demand driven data creation, maintenance, and dissemination, in the digital planning and building processes. But we also know that most part of this data is also the same datasets needed in other national processes where spatial data is needed, therefor the datasets are called National base data. (Grunddata). This is also one of the suggested national base data domains (grunddatadomäner) within Ena – the Swedish digital infrastructure.

The infrastructure is based on four national roles: Producers, Consumers, Coordination and Data host, and the incentives are built on a mix of laws, agreements, and benefits for municipalities in form of possibilities of more efficient processes.

The infrastructure itself is strengthening the data circulation in the ecosystem, but also replacing downloading of data with consuming services or streaming data. This is created by supplying national standardization of National specifications, and a national single point of availability to national standardized, information security adopted open data by open standardized formats, The National geodata platform.

To create national specifications and data, a national framework for the exchange of Geodata, is to be followed as well as a democratic open process for designing structured datasets in cooperation with all stakeholders (commercial, government, scientific, citizen) to meet their demands.

The SDI will in this way create value both in the internal processes in the municipality as well as providing open data available for innovative new solutions.

The Swedish mapping and cadastral authority aim to get a firmer mechanism for the National specifications and for all producers' responsibility to provide data and have had high hopes in open data directive and interoperability frameworks, but these have so far not met our needs.

[6] See presentation:
https://www.eurosdr.net/sites/default/files/images/inline/2.2_building_a_digital_infrastructure_for_local_data_on_a_national_level.pdf

Trying to grasp the role of being the owner of open public data [7]

María Elena López Reyes[1], Birger Larsen[1], Line Hvingel[2]
[1]Aalborg University, Copenhagen, Denmark
[2]KL, Copenhagen, Denmark

GeoDanmark is a collaboration between the Agency for Data Supply and Infrastructure (SDFI) and the Local Government Denmark (KL) with the primary goal of maintaining the national topographical map known as GeoDanmark Basic Data (GeoDanmark Grunddata). This data serves as a key resource for public administration and business purposes. It is classified as basic data (grunddata), which means it is available for free via the national data platform Datafordeleren. Additionally, GeoDanmark is involved in various other data projects and owns the data set Geographical Subject Data (Geografiske Fagdata or GeoFa), which contains datasets utilised in public administration. GeoDanmark provides the foundational elements required for maps, such as roads, buildings, or water features. In contrast, GeoFA offers specific data for various domains, including outdoor tourism, roads and traffic, school planning, and mobility.

GeoFA can be considered Open Government Data (OGD), as it is non-privacy-restricted and non-confidential data funded by public resources, and it is readily available for use or distribution without any restrictions. While other initiatives in the Danish context, such as OpenData.dk, are also OGD, they lack a national data model, making them less comparable and geographically dispersed. GeoFA, on the other hand, proposes a national data model for all this data, and even if its use is voluntary and not all national coverage is available, it is highly adaptable and agile, which makes it cost-effective for users. The data is available in standard exchange formats and is free of charge, making it easily accessible to public authorities, businesses, NGOs, and citizens alike. For instance, information on shelters and routes can be found on municipal web solutions, the Nature Agency's udinaturen.dk, the Vestkyst app by Dansk Kyst and Naturturisme, and the Shelters app.

GeoDanmark is faced with a new challenge in dealing with this kind of dataset. They are met with both practical and strategic questions. On a practical level, they must meet user expectations while dealing with varying levels of data completeness. Additionally, they need to ensure on one hand system agility and on the other hand end user stability while balancing the workload for authorities with tasks such as updating and correcting data. They must also decide whether other authorities, beyond SDFI and municipalities, should pay for related costs given the fact the data is relevant to public administration tasks. On a strategic level, they must communicate the level of service and support, since GeoFA constitutes less than 10% of GeoDanmark budget. Furthermore, they need to manage data governance when municipal and state agencies co-fund projects. They must strike a balance in supporting citizens, private entities and public authorities and determine whether public data availability should be considered a citizen service.

Although there are many questions, there is no doubt that OGD creates value. GeoFA has effectively partnered with various organisations and there are now various successful cases. For example, data on routes is being enriched with information from various actors like disability-information, route-type and surface, recreational values and tourism information. To ensure that GeoFA is headed in the right direction, KL is collaborating with Aalborg University to identify the practical obstacles and develop conceptual frameworks to promote the collaboration and best practices across domains and sectors. During this workshop, our aim is to discuss the theoretical framing of the challenges we face.

Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955569.

[7] See presentation:
https://www.eurosdr.net/sites/default/files/images/inline/2.3_trying_to_grasp_the_role_of_being_the_owner_of_open_public_data.pdf

Demand-driven improvement of government geodata [8]

Thorben Hansen (geoadvice), Lennart Hansen (LIFA) and Bent Hulegaard Jensen (Geopartner), Copenhagen, Denmark

Geodata from government registers is increasingly becoming readily available. Open data initiatives have removed cost of data from the point of use, implementation of the INSPIRE directive has standardized and matured the way geodata is disseminated, and todays focus on data ecosystems makes geodata an embedded element in data driven value creation within many domains and sectors.

Increased use of data – including for purposes it was not originally intended – challenges data quality. Much government geodata is created based on legislation, and often requires input that by nature must be collected on location. A much-needed quality improvement of such data in a traditional government environment requires a considerable amount of government resources, resources that will hardly become available even though substantial legal and financial interests are tied to the data.

Knowledge about the topics covered by government registers often resides in citizens and professionals, but generally remain unutilized due to overwhelming costs for collection and coordination. Initiatives around crowdsourcing and volunteered geographic information have shown that it is feasible to tap the knowledge of the crowd and aggregate it into shared data resources.

Can a similar approach be used to tap knowledge from citizens and professionals into government registers? What are the incentives for citizens and professionals to contribute to government registers with data improvements, and how can it be assured that the contributed data does improve the quality of the registers (and not e.g., is improperly influenced by to the legal or financial significance of data in the register)?

The presentation will discuss a model, where concepts and mechanisms from digital business platforms are used to define players and their roles for a sustainable ecosystem around government registers based on circular value creation.

[8] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/2.4_demand-driven_improvement_of_government_geodata_-_thorben_hansen.pdf

The Digital Underground - Enhancing Documentation and Safeguarding of Our Technical Infrastructure in Subterranean Environments [9]

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When delving deep into the underground, whether conducted by utility companies, entrepreneurs, or other contractors, the persistently looming concern is the substantial risk posed to vital technical infrastructure, including cables, wires, and pipes. Such damage not only disrupts essential services but also triggers direct and indirect ramifications, leading to significant financial losses for all stakeholders—ranging from the entities involved and citizens to society as a whole. While total elimination of excavation-related damages is unattainable, there exists substantial potential to curtail their extent and associated costs. This can be achieved by enhancing the accuracy, frequency, and shared accessibility of documentation pertaining to the technical installations and infrastructures present at the excavation sites.

Notable efforts have been instigated by governmental bodies and responsible authorities, mandating companies, and entrepreneurs to solicit information prior to excavation. The resultant Spatial Data Infrastructure (SDI), established upon this legislative framework, is in a state of ongoing refinement and maturation. Denmark's introduction of The Danish Register of Underground Cable Owners (LER) version 2.0 in 2020 represents a pivotal development. As of this year (2023), cable proprietors are mandated to contribute their line data in standardized formats through web-based data portals.

While this serves as a commendable stride, bolstering the evolution of a contemporary SDI within this domain, it concurrently underscores a fundamental limitation inherent to government-driven SDI implementation. A telling exemplar, drawn from the LER 2.0 instance, lies in the absence of precise information concerning the vertical dimension—specifically, the depth at which pipes, cables, or wires are situated in precise geographic coordinates. The absence of third-dimensional data—a measure of how deep excavation can proceed—continues to underlie numerous costly excavation damages.

The Digital Underground project represents a collaborative endeavour encompassing utility companies, entrepreneurs, a surveying enterprise, and Aalborg University. Its primary objective is twofold: (1) to explore innovative and more sophisticated surveying methodologies and, more significantly, (2) to establish an SDI characterized by the open exchange of information-rich data sets, including 3D point clouds, among industry stakeholders. The acquisition of point cloud data is facilitated by smartphones, which capture video recordings subsequently processed using photogrammetric software through a cloud-based solution. Originally developed for specialized applications within the surveying domain, this approach has demonstrated both robust stability and considerable potential as a foundation for a future SDI-centred ecosystem. The forthcoming presentation will narrate the trajectory of the project and elucidate the outcomes arising from this collaborative synergy.

Notably, the project's financial backing is provided by DigitalLead—Denmark's national cluster for digital technologies and gathering point for digital innovation.

[9] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/2.5_the_digital_underground_-_enhancing_documentation_and_safeguarding_of_our_technical_infrastructure_in_subterranean_environments.pdf

6.3 Abstracts Session 3:
Development of data ecosystems – new business and financial models

Navigating the Ecosystem Perspective to Maximise the Value of Open Government Data [10]

María Elena López Reyes[1], Birger Larsen[1], Line Hvingel[2]
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[2]KL, Copenhagen, Denmark

The utilisation of open government data (OGD) has experienced significant expansion in recent years, with an emphasis on its publication. However, the genuine potential of OGD lies not in its dissemination but in its meaningful use. A critical challenge is the supplier-centric approach adopted by many open data initiatives, which limits the benefits that could be created by the interconnections between providers, users, and the communities that stand to gain from it. To overcome the challenges, researchers and practitioners have turned to an ecosystem perspective on OGD. This stance shifts from the conventional linear data processing model to a more dynamic data cycle, emphasising collaboration, componentisation, and openness. The paradigm shift highlights the importance of distributed peer-to-peer networks and the formation of communities centred around common interests in data sharing. However, there is still a gap in empirically observing the connection between the practices surrounding the use of open data and the creation and delivery of value to understand the transition from a supplier-driven focus to an ecosystem-oriented approach.

Through a multiple exploratory case study, we focused on the relationships within a local network of actors using open government geographical data from the Danish governmental initiative Geographical Subject Data (Geografiske Fagdata - GeoFA). We conducted semi-structured interviews to explore the connection between the practices and the creation and delivery of social value using GeoFA data. We employed and adapted the social value open government data articulation theoretical framework defined in prior research to guide the analysis. We presented the results in a collaborative workshop with the same network of users to illuminate the prerequisites for leveraging open government data to pursue value creation and delivery. The proposal for this workshop is 1) to present the results from the research and 2) to validate with experts in the field the methodological proposal designed to understand ecosystem formation for value creation processes using OGD.

Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955569.

[10] See presentation:
https://www.eurosdr.net/sites/default/files/images/inline/3.1_navigating_the_ecosystem_perspective_to_maximise_the_value_of_open_government_data.pdf

Designing Sustainable Business Models for Open Data Intermediaries [11]

Ashraf Shaharudin
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Open data is widely claimed to offer numerous socioeconomic values from improving governance, to enhancing scientific research, and stimulating innovation and economic opportunities. It allows data to be re-used by various parties including public organizations, companies, civil society groups, and researchers. Against the backdrop of multifaceted challenges that the world is facing from threats of climate change, to societal polarization, and economic inequalities, there are calls from all sides for all segments of society to come together and address these problems as a collective. Open data sharing and re-using could be one of the first steps for this.

However, to date, the realized value of open data remains ambiguous. Temiz et al. (2022) argued that open data investments in many public and private organizations are likely driven by legitimacy-seeking instead of genuine value creation. This may explain the sluggish development of open data in certain countries and sectors as its promises are not yet fully realized. As captured by many studies, there are various impediments in the generation of value from open data such as skills incompatibility, limited usability of data, and lack of data literacy.

Open data intermediaries, which are "third-party actors who provide specialized resources and capabilities to (i) enhance the supply, flow, and/or use of open data and/or (ii) strengthen the relationships among various open data stakeholders" (Shaharudin et al., 2023) play an important role to address some of the issues. Nevertheless, research on and tools for designing their business models are limited. While generic tools such as the business model canvas by Osterwalder & Pigneur (2010) may be useful to some extent, they are not specific enough to explicitly include considerations that are rather unique to open data intermediaries such as the financial viability of using resources that is also freely available to anyone, that is open data. Besides, they also do not account "ecosystem" view in generating business models.

Therefore, the objective of this presentation is to solicit feedback in developing a businessmodel generation tool specific to open data intermediaries. An initial framework has been conceived based on desk research, which will be used as a starting point. The framework encapsulates various elements across the value proposition (what is offered), value creation (how it is offered), and value capture (what is gained from offering the value proposition) dimensions. The elements can be mixed and matched to imagine various possible business models of open data intermediaries. This presentation will be one of the multiple activities carried out to iteratively improve the business model generation tool on at least two fronts: imagining new business model elements beyond what was captured via desk research, and including perspectives from other actors in the open data ecosystem besides open data intermediaries.

Acknowledgement: This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 955569.

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[11] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/3.2_designing_sustainable_business_models_for_open_data_intermediaries.pdf

A data space approach to a green, coherent and energy efficient utility sector [12]

Stig Fredslund Kjeldsen
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The digitalization of the utility sector can foster faster, better and more cost effective solutions to the current climate- and energy challenges and support the security of supply. The presentation will detail how the Danish Energy Agency is working actively towards the creation of a data space for utility data. Methods include bringing together important players in and around the utility sector for a demand driven approach on how to resolve barriers obstructing the realization of digitization's full potential of a green, coherent and energy efficient utility sector. Spatial data is part of the foundation for the success of these efforts.

[12] See presentation:
https://www.eurosdr.net/sites/default/files/images/inline/3.3_a_data_space_approach_to_a_green_coherent_and_energy_efficient_utility_sector.pdf

DAFAGO - Danish forum working with basic data and other public data- formed by private companies to share knowledge and build collaboration [13]

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[i)] Kaas & Mulvad, Copenhagen, Denmark
[ii)] Danish Agency for Data Supply and Infrastructure, Copenhagen, Denmark

DAFAGO is a forum where companies with mutual interest for the use of Basic Data and other public data can meet to share ideas and experiences – and build cross-functional collaboration wherever it makes sense. DAFAGO is privately build community and is a part of the Basic Data Ecosytem. The basis for the forum is the common believe that the value of cooperation far outweighs the risks because of the potential for re-use of work, innovation across companies and with the public sector. DAFAGO also firmly believes that the potential for value creation upon basic data and public data is vast and not yet fully achieved at all.

Common Basic Data has a proven track record as a driver for growth and efficiency in Denmark. It is in an international context quite uniquely made available through a coherent data model across data domains through one distribution platform free of charge.

In this context Niels Mulvad will give a presentation in order to give an insight to the private initiative among data driven businesses which substantiates the visions within the strategic plan for basic data.

Peter Knudsen (Chief Advisor, Agency for Data Supply and Infrastructure in Denmark) will join the presentation in order to give the agency's perspective on the strategic importance of the initiative and private-public collaboration as such.

[13] See presentation: https://www.eurosdr.net/sites/default/files/images/inline/3.4_dafago_-_danish_forum_working_with_basic_data_and_other_public_data.pdf

APPENDIX 1: WORKSHOP PROGRAMME

Time	Author	Title
12:00	**Lunch**	
		Topic 1 Moving from spatial data infrastructure (SDI) to data ecosystems (DE)
12:30	Sine Valbjørn Schlüter	Welcome, practicalities, scope and expectations
12:40	Alexander Kotsev	Beyond SDI - Evolution towards the Common European Green Deal Data Space
13:00	Serena Coetzee	Challenges and opportunities for spatial data infrastructures in the emerging and evolving geospatial ecosystem
13:20	Lea Schick	Data Spaces – EU's visions for alternative data exchange infrastructures
13:50	*Breakout session*	
		Topic 2 Value creation for all stakeholders – From supplier-driven to demand-driven
14:30	Karoline Arnfinnsdatter Skaar	Reference Frames: The foundation of Spatial Data Infrastructure
14:50	Lars Hägg	Building a digital infrastructure for local data on a national level
15:10	Line Hvingel	Trying to grasp the role of being the owner of open public data
15:30	*Coffee*	
15:50	Thorben Hansen	Demand-driven improvement of government geodata
16:10	Lars Bodum	The Digital Underground - Enhancing Documentation and Safeguarding of Our Technical Infrastructure in Subterranean Environments
16:30	*Breakout session*	
17:45	Adjourn	
19:00	*Dinner*	
09:00	Welcome day 2	Recap and practicalities
		Topic 3 Development of data ecosystems – New business and financial models
09:10	María Elena López Reyes	Navigating the Ecosystem Perspective to Maximise the Value of Open Government Data
09:30	Ashraf Shaharudin	Designing Sustainable Business Models for Open Data Intermediaries
09:50	*Coffee*	
10:10	Stig Fredslund Kjeldsen	A data space approach to a green, coherent and energy efficient utility sector
10:30	Peter Knudsen & Nils Mulvad	DAFAGO – Danish forum for private sector working with Basic Data and other public data
10.50	*Short break*	
11:00	*Breakout session*	
11:45	Wrap up and feedback	
12:15	*Lunch*	

APPENDIX 2: GLOSSARY – TERMS AND CONCEPTS

Sometimes the same word is used with different meanings – and sometimes different words are used with the same meaning. Terms and concepts around data ecosystems and spatial data infrastructure are still evolving, and occasionally terms and concepts are defined differently in different contexts.

Spatial data infrastructure
The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilisation of geospatial data[14].

Data ecosystem
The complex environment of co-dependent networks and actors that contribute to data collection, transfer, and use. Can span across sectors - such as healthcare or finance, to inform one another's practices.[15] Often consists of numerous data assemblages.

Geospatial data ecosystem
Data ecosystem, in which a community of actors interacts via the geospatial information and technologies in their environment.[16]

Data space
A distributed system defined by a governance framework that enables secure and trustworthy data transactions between participants while supporting trust and data sovereignty. A data space is implemented by one or more infrastructures and enables one or more use cases[17].

Data intermediary
Actor who provides specialised resources and capabilities to (i) enhance the supply, flow, and/or use of data and/or (ii) strengthen the relationships among various data stakeholders[18].

Digital (business) platform
A business based on enabling value-creating interactions between external producers and consumers. Provides an open, participative infrastructure for these interactions and sets governance conditions for them[19]

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[14] Executive Order 12906 - Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure - April 11, 1994 (https://www.govinfo.gov/content/pkg/WCPD-1994-04-18/pdf/WCPD-1994-04-18-Pg779.pdf)

[15] Marcelo Iury S. Oliveira and Bernadette Farias Lóscio (2018) What is a data ecosystem? *In Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age, DG.O 2018, Delft, The Netherlands, pp. 74:1–74:9. ACM*. (https://dl.acm.org/doi/10.1145/3209281.3209335)

[16] Coetzee, S., Gould, M., McCormack, B., Mohamed Ghouse, Z., Scott, G., Kmoch, A., Alameh, N., Strobl, J., Wytzisk, A., Devarajan, T. (2021). Towards a sustainable geospatial ecosystem beyond SDIs. *10.13140/RG.2.2.22555.39203*.(https://www.researchgate.net/publication/353702298_Towards_a_sustainable_geospatial_ecosystem_beyond_SDIs)

[17] Data Spaces Support Centre (DSSC) Glossary, Version 2.0 (September 2023) (core concepts: https://dssc.eu/space/Glossary/176554052/2.+Core+Concepts – full glossary: (https://dssc.eu/space/Glossary/176553985/DSSC+Glossary+%7C+Version+2.0+%7C+September+2023)

[18] Shaharudin, Ashraf, Bastiaan van Loenen, Marijn Janssen (2023). Towards a Common Definition of Open Data Intermediaries, *Digital Government: Research and Practice, 4:2, 14 June 2023, Article No.: 6, pp 1–21* (https://repository.tudelft.nl/islandora/object/uuid%3A29f658ec-ef3c-470a-a71c-4871b84d98fc)

[19] Geoffrey G. Parker, Marshall W. Van Alstyne, Sangeet Paul Choudary (2016) Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You: How Networked Markets Are Transforming the Economy—and How to Make Them Work for You (https://www.goodreads.com/quotes/9086841-a-platform-is-a-business-based-on-enabling-value-creating-interactions)

APPENDIX 3: STICKY NOTES FROM THE GROUP (TABLE) DISCUSSIONS

	Topic 1	Topic 2	Topic 3
Table 1	• SDI – One way? Multidirectional • The difference is a mindset • LEGO bricks are there – less given what to build • Data ecosystem concept is at most 100 percent in opposition to the traditional concept of SDI based on Basic Data • Evolution instead of revolution • Keep what is valuable counting; semantics in assets role in standardisation • Blend SDI with other data spaces • Interdependencies between actors (SDI and SDE) • Circular (users deliver back to the ecosystem) • Users drive the system • Inclusive (SDI is only governments whereas SDE includes the rest) • SDI is an enabler for data ecosystems • SDI goes across multiple data ecosystems • Data ecosystems typically engage more data infrastructure • The difference between data ecosystem and data spaces is rules. SDI belongs in both. You need permanent cooperation between providers and users incl. feedback loop • The future: SDI + governance. From data distribution to data facilitator	• Requires feedback solutions – and another kind of service-oriented unit • What is the possibility to distribute/export • Users as part of the governance of an ecosystem • Data intermediates can help users and provides work together • User needs must guide how content is maintained/created • Incentives must reflect user needs • Demand should always be the driver bur historically there has been focus on demands of the public body suppling data • Private sector can act as an intermediator between suppliers and users • Governance communication: Feedback loops, new actors – new roles, no ivory town, you have to listen, you have to share, you have to cooperate • Allow the wisdom of the cloud to become part of your data system (feedback loop) • Value creation – Thorbens story to feed in to data systems e.g. feedback/input/questions • User's more involved in the driver's seat – see Lines story	• How to gain and learn + elevate? Public free data and data spaces. • Digital Norway: a platform for data where participants also contribute financially • Non-financial values – Co2-reduction has a lot of political attention • Organisational, legal and mental barriers. Trust • CSR-D as a new currency – value creation in transparency • Value creation – beneficial owner vs. investment ropomille (not always) • I see mostly opportunities, not challenges. Even eco systems make the cake bigger, not smaller • Context: No one size fits all replicability and scalability • What are new business models? Social value driven? • Data tax? Data spaces → membership fee • Users often not included in co-design/co-creation • Sustainability of project results • Main challenges: what is the value that each of the participants in the ecosystem is getting. Governance: what are the rules and who is setting the rules?
Table 2	• SDI will be a facilitator for data ecosystems • Difference: SDI is a foundation where data ecosystems is at the layer above • Difference: SDI solely focuses on geospatial data. Ecosystems are broader. Geodata should be included in relevant ecosystems. • Ontologies evolve over time. From SDI to ecosystems • Future: SDI are important as geodata creates value in most ecosystems. • SDI to facilitate access to the ecosystem – so much data can be specialised. • SDI will remain the foundation for geodata • SDI should have a capacity building role • Ecosystems have a wider community and is more dynamic compared to SDI • Data ecosystems are evolved SDI	• We talk about value creation what about value capture? And who is going to implement it what do they get out of it. To make it memorable (er lidt i tvivl om denne seddel – gul) • More involvement but challenge how to facilitate this hesitation among users to participate – why? How do we invite this exchange • Users should feel like they can make a difference. Someone cares if they find errors in data/have an idea for change. Channels to report their thoughts • It becomes difficult when more domain specific • Data needs someone to take care of it • Shorten the feedback cycle from users. Supplier to demand driver • Involve users, give them responsibility, ownership. Supplier to driver drive	• Ambitions can overgrow reality – IA needs to be possible to immigrate markets • Avoid redundancy: parallel developments → natural in ecosystems (some will die) • Communication with users show parental value in using the data • Managing new version of data. Proper version control and documentation • Managing versions of applications… outdated software/not working = lose users • Value proposition → value creation → value capture = multiple channels • Skin in the game • Digital ecosystem maturing in sectors such as insurance industry • Bridging where the cost drivers are where value is created • Organisational level within sectors/industries is sometimes low

	• Does an ecosystem need a digital platform? Who is building it? • What does geodata mean for the way we define SDI? • Foundation for data ecosystem (in relation to data capacities) • What will this mean to the institutions such as OGC-TC211? • Change facilitator allowing to make changes to ecosystem • SDI vs. data ecosystem: user driven instead of supply driven (various groups of users with different objectives and skills), circular values instead of linear value, inclusive (not only public but also private sector and civil society)	• Supply- demand calls for private-public collaboration • Should sector association play a role. The set standards/rules for sharing data? • Somebody has to spear the political process to set demands for legislation calling for the update of data in certain processes… is NMA's equipped	• Finding + identifying and nurturing. Win-win collaboration • Measure/monitor value creation in order to continue powers that be
Table 3	• What data is important to share through a DE? What are the needs of the people? • SDIs are still the engine behind the DE • Legal aspects of DE must come before practical implementation • Spatial data geometry issues (harmonisation) important! • Legacy problems of data formats from different time points (data harmonisation) • Who sets the data quality requirements in a DE? • Who is responsible for collecting the data requirements (dynamic change) in a DE system? • Data requirements (quality) are changing dynamically in a DE (depending on the use case needs of different used organisations). Who is responsible for collecting those demands and introducing changes in specifications • Problems with some data still being locally stored and not published/shared with the public • Issues to be solved in a DE • Difference SDI/ecosystem: ecosystem is about the value and purpose, self-organised, flexible. SDI is the technical infrastructure. Future role: ways of working lesson. • Ecosystem need reference system and geometric	• How to deal with certain organisations funding more than others (cable)? • Natural evolution from supplier to demand driven – as users find value in better quality data • Who is creating the data (public authority or private company) and how is it distributed when data of high quality is required for different services (3D building info) • Value creation: More than a change from supplier to demand. I believe its about working towards value-driven thinking and ask the questions of to who is the value, for what purposes and what are the conflicts. • Value-driven DE – need to find the value in every dataset to include and update it • Potential GDPR issues for user-volunteered info • From supplier to demand driven: natural evolution from data scarcity to data abundancy → need for prioritisation (since data comes at a cost) • What is in it for the data producer to produce data?	• Collaborate • Challenges of solving data ecosystems: confliction business interests/prisonizations. Costs & benefit. Security considerations. • Extended view on how to understand value • Value can be gained in many ways. The monetary aspect might come into the picture in later stages • Standards have to be in agile settings to make the ecosystem flexible • Business and financial markets • Collaboration comes as a key aspect for being able to develop business models • Capacity building strategies spotting the needs to be developed are also important • It's important to come up with integral wats of working where trustable modes of cooperation are important • Standardisation and operation can be cloned by developing communities of practice that can shape the decisions. How these are formed is the question. • What are the data used for? Who will pay/use data?
Table 4	• Is building SDI always necessary today? As it was 20-30 years ago • Which rules? Which governance? The key factors to play with… • Need a good metadata standardised • How to involve the end-users? Feedback and motivation • Easier to use and share geographical data	• Design "things" with users is mandatory / all stakeholders = to associate users at the beginning of any project • Users have to be motivated to contribute to the ecosystem • As data providers we need to be more user-oriented. What does the users actually need? • Crowd sourcing. Involve users from the start	• How can we measure the value creation (of any kind) and put it into light? • Challenges: sustainability. Prioritising • Easy way to update when you as user find an error • GDPR stops many ideas-Common rules in EU. Denmark is very strongly regulated

	• Value creation is essential. Unused data doesn't bring anything. How to be in touch with users? Feedback loop in systems? • It is not about how to implement ecosystems – they are emerging. How do we use them? Describe them? What kind of governance is needed? • Reference frame and transformations should be handled by the systems, not the users • SDI is part of data ecosystem • Data ecosystem. Many/several data sources. Value creation. Actors (active users/producers) • Open data vs. authoritative data → find balance • SDI remains one of the pillars • Homogenous quality data. Who will pay to maintain if data is open? • SDI and data ecosystems. How big is the difference in practice? But true, from tech to human • SDI and data ecosystems. More fluent? More formel. How do you steer a data ecosystem. • SDI and data ecosystem. Can vary in size.	• In addition to open data, we should have open system • Shift the focus from producing more data to producing needed data. More data users – producer initiated • Demand- driven requires: low cost-systems, steering of framework not constant, close dialogue, include all stakeholders, focus on "needed" instead of more, demands. "open systems", motivation • Better maintaining of data • Demand-driven depends on the kind of data. Ownership will not work	• Reduce taxes for updated data. May be a discount on 5 % if your data is updated by professional • Professional access to change registers. Insurance guaranty • Authorities must pay, when you give in a mistake in register • Maybe in registers define the needed important information (shall be updated) and second information only updated in cases • Multiple wats of funding could be the key for new business and financial models • New business and financial models: co-funding? Ad-hoc funding? Freebies/gold/platinum in terms of a data ecosystem. Acknowledge that data has value – data producers must have resources and data maintenance could be extended • New business and financial values: sustainability, commitment, the why (decision makers and data producer), the benefits are elsewhere than the costs • New governance model: more collaborative horizontal governance models