

e-Ready Legislation - the Spatial Dimension

Line Hvingel and Lasse Baaner, Denmark

Keywords: e-Government, Land Administration, Spatial Data Infrastructure, Geographical Information, Authoritative Data

SUMMARY

In general, digital society challenges traditional modes of legislation and rulings. Dissimilar compositions of the legislation and non-comparable spatial representations of the legal content makes traditional legislation unfit for e-Government. Lacking attention may lead to the undermining of the trustworthiness of administration systems. On the other hand, a successful adaption of legislation to a digital setup could help promote good service towards citizens and businesses, and according to land administration theories maybe even promote societal sustainability in large. Based on studies on Denmark, different challenges within digital land administration solutions are demonstrated. This paper discusses how legislation needs to change in order to be 'e-Ready'.

Digital forvaltning udfordrer den måde, vi traditionelt har tænkt lovgivning på. Uens opbygning af lovgivning gør det svært for digitale systemer at tolke loven og uens afbildninger af lovens indhold i en rumlig kontekst gør traditionel lovgivning uegnet ift. digital forvaltning. Denne artikel viser, at et manglende fokus på nytænkning af lovgivning i en digital verden vil være meget bekymrende. Manglende fokus vil ligefrem kunne betyde, at tilliden til vores forvaltningssystemer nedbrydes. Lykkes omstillingen af lovgivning til den digital kontekst, vil det på den anden side have en enorm betydning, idet det vil kunne understøtte bedre service rettet mod både borgere og virksomheder, og måske endda gennem en mere effektive arealforvaltning være med til at understøtte en bæredygtig udvikling. I artiklen analyseres forskellige implementerede digitale arealforvaltningsløsninger i Danmark, og det fremstår tydeligt, at det har alvorlige konsekvenser at bruge den almindelige lovgivning i disse digitale løsninger. Artiklen ender med at pege på mulige løsninger.

e-Ready Legislation - the Spatial Dimension

Line HVINGEL and Lasse BAANER, Denmark

1. INTRODUCTION

The theme *From the wisdom of ages to the challenges of modern world* frames this paper quite well. Throughout centuries, society in large has developed laws and administration systems aiming at a sustainable societal development in an economic, environmental, as well as social manner. In recent decades, e-Government has swept the globe, aiming at efficiency and improved service. Traditionally, e-Government is understood as a new and improved way of *communicating* and *transacting* digitally between governments and citizens, businesses and other governments, as well as internally within a government (Baum et. al, 2000). Also, e-Government aims at automating existing administrative processes, hence being cost reductive, more efficient, and faster at the same time.

E-Government challenges the nature and considerations underpinning traditional legislation. An example could be the notion of *cyberspace* challenging the notion of *legal jurisdictions*.

Legal considerations in the digital domain can be found, but often they tend to be of a technical nature, aiming at overcoming the barriers of access to and interchange of data, security of data, as well as pricing issues etc. However, in order to avoid undermining of the trustworthiness of the current legal and administrative systems, the challenges embedded in the law itself also need to be addressed.

The Danish e-Land Registry can be displayed as an illustration. In 2009, the land registry was digitalised, available for the public at large at www.tinglysning.dk. For each property in Denmark, the Danish land registry contains information on *ownership*, *property value*, *easements* and *other burdens*. In general, easements are entered in the land registry as an act of perfection in order to obtain legal protection against ‘third parties’. The cadastral number ties the registrations to the property in question and hence the cadastral map is an inherent part of the land registry.

A search in the database by the address or the cadastral number results in a page in the land registry showing all rights and restrictions attached to the property.

You can also search this information by clicking on a map. As illustrated in figure 1, the map itself will also show the existence and placements of easements.

Unfortunately, the process of registering easements on the map is an ad-hoc approach and easements are placed in the map when cadastral changes are made to a property. Hence, the map actually only shows a small percentage of all the easements in the land registry.

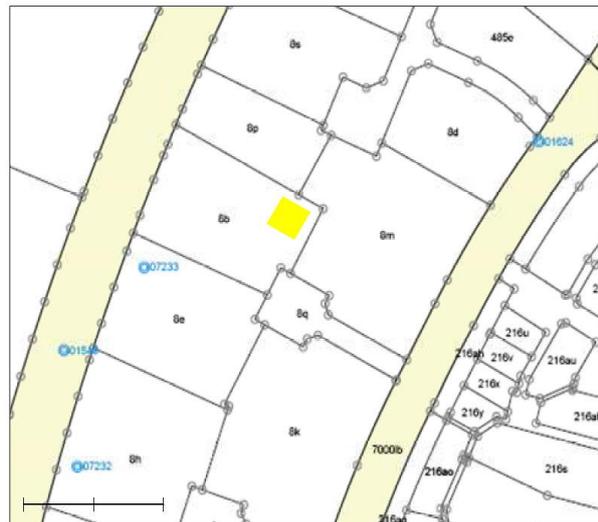


Figure 1. The map showing an easement (the yellow box) in the Danish e-Land Registry

What should the state of the law in this area be, if a property owner or developer has checked the map for easements and did not find any? A legal decision based on the map-enquiry would probably be dismissed, but should the owner have the law on his side due to legitimate expectations, based on the fact that he has investigated an authoritative register and found no registered restrictions?

Legislation always has an inherent spatial component, as all legislation is tied to geography through the concept of jurisdiction. The spatial dimension of legislation can be more or less explicit. Most codified environmental law related to planning, land use and environmental protection has an explicit spatial dimension. Hence, maps easily support the legislative and administrative process. Other provisions may have a more implicit spatiality that are difficult to map. Examples could be restrictions on certain behaviours in 'public spaces', permit requirements on 'arable land' or rights that apply to 'homes' as known from the European Convention on Human Rights. Although difficult to map, these legal norms are understood through the concept of space. In short, these different understandings and uses of spatiality complicates e-Government where unequivocal correlations are needed in order to be interpreted by the IT-systems.

This paper will focus on *legislation* within e-Government and secondly address issues in order to obtain sound digital administrative systems, especially focusing on the spatially of legislation in e-Government. By analysing ongoing e-Government implementation in Denmark, this paper will clarify the role of legislation in e-Government and the legal value of spatial representation of legislation, ending up forming a generic model of legal considerations to be made in e-Government.

2. THEORETICAL FRAMEWORK

Legislation has a content that applies to a subject, often a ‘person’. This content often gives some possibilities/rights or some restrictions/proscriptions. The ruling may be attached to ‘a place’ and/or for ‘a given time’.

This chapter sets up the theoretical framework for the analysis, focusing on the role of legislation, the relationship between the ruling and the subject and finally the relationship to the spatial representation, in order to detect the legality of the spatial representation of the legislation.

The legality of the spatial representation is investigated throughout the concepts of *e-Government*, *Spatial data infrastructures* as well as *Land administration systems*.

2.1 e-Government

E-Government originated in the technological pull of the invention and development of computers and the Internet. E-Government is a multifaceted movement with the general aim of digitising *communication* between government and individuals, businesses, public employees and government agencies (Siau et al., 2005).

Keng Siau and Yuan Long (2005) argue that a synthesis model based on existing theories of the development and maturity of e-Government comprises of the following five stages: web presence, interaction, transaction, transformation and e-democracy.

In the general theory of e-Government the spatial dimension, and especially the use of a map, is not recognised. Discussion of the relationship between e-Government and digital public administration is also lacking. As stated, e-Government is viewed as communication among stakeholders. However, e-Government must also include the transformation of public administration into this digital environment. In this paper, this broader understanding of e-Government is used.

2.2 Spatial Data Infrastructure (SDI)

Discussions of the understanding of the concept of SDI have taken place since the early 1990s. For an exposition of the historical discourse, see Homborg et al. (2009), and for an elaborated understanding of the components of SDI, see Vancauwenberghe et al. (2014). In this paper, the definitions established by Nebert (2004) and Rajabifard (2003) are used.

A spatial data infrastructure is a framework of *policies, standards and technologies that enable data providers to publish, and users to access and integrate, distributed heterogeneous geospatial information* (Nebert, 2004). In other words, an SDI is required to link data producers and data users.

An SDI make take on many different forms, from the most abstract form on the global level (often more focused on processes than actual product outcome) to the most concrete corporate SDIs with a strong focus on the product (sometimes overlooking the need for policies on maintenance, metadata, organisational factors and so on).

The interplay of *data* and *people* is the most important and fundamental role of the SDI model, and therefore, their existence is a precondition for the model. The main technological components of *access network*, *policies* and *standards* comprise the facilitating platform for this interplay, giving access to, and use of, spatial information (Rajabifard, 2003).

The element *policies* implies rulings on for instance standards. And, indirectly the model supposes that users requirements will reflect back on the quality level of data.

2.3 People-Land relationship and Land administration systems

Considerations on the people-land relationship can be traced far back in history. Henssen and Williamson (1990) describes the basic relationship as ‘people’ (equals ‘who’, represented by ‘The owner’) and ‘land’ (meaning ‘Where’ and ‘How much’, represented by ‘The parcel’). And, the relationship is constituted by ‘How’ in terms of ‘A right’ (title). This kind of static description is elaborated by Zevenbergen (2004) into a model consisting of parcel, rights and rights holder, and each of the three elements needs to be handled accordingly for instance in a subdivision process. When determining the ownership of a property, the model by Zevenbergen builds on the same considerations on ‘who’, ‘how much’ and ‘how’. However, in a procedural view the three elements can be changed and transferred individually as well as altogether.

The relationship between a person and a parcel is refined in the Land Administration Domain Model (LADM) (ISO 19152:2012). This ISO-standard secures the definitions and relations of objects. In an IT-system based on topology, this standard will secure accordance between mapping objects and e.g. restrictions. For instance, a local urban plan will relate exactly to the properties in question.

The people-land relation is handled though a registration system. Either a system, that as a whole handles the people-land relationship, or as a subdivided system where the land is registered in one system and the rights and rights-holder in another.

This core relation between land and people allows land management in large. As described by Williamson, Enemark, Wallace and Rajabifard in the book ‘Land Administration for Sustainable Development’ (2010), land information is needed for the whole of the land administration system.

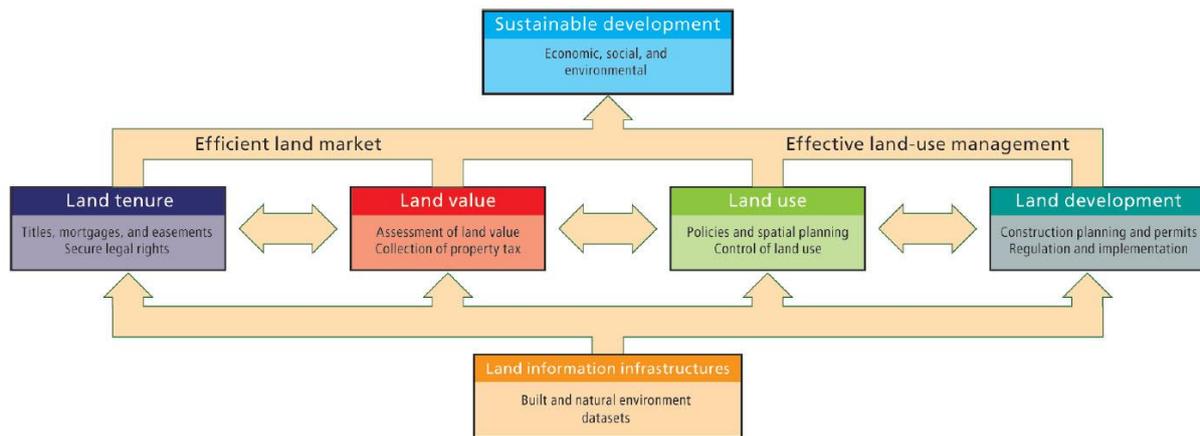


Figure 2. The land administration model (Williamson et al., 2010, page 119)

With the information on land (parcels, addresses etc.), tenure functions can be developed handling the people-land relationship, including rights and rights-holders as described above. Based on this information, taxation on land can be implemented securing an efficient land market, and hence help promoting a sustainable economic societal development. Furthermore, land use planning and land development regulations can be made securing an effective land-use management, and hence supporting an environmental as well as economic and societal development.

With information as the backbone in the model, the land administration model bridges into the discipline of spatial data infrastructures. Though, called land information infrastructures and focusing on datasets, the model and the description hereof acknowledges the need of an SDI (Williamson et. al. (2010) p. 224-261).

2.4 Considerations on the role of legislation and spatial data in the theories

Neither the theory of land administration systems or spatial data infrastructures touches explicitly on the requirements on the *data* used in the systems. It is assumed in the land administration discipline that a cadastre showing the parcel boundaries in itself is enough, regardless of any immediate quality requirements. Given the use of topology and the ISO 19152:2012 standard this may be true.

Within the discipline of land registration and cadastral systems, legal aspects are an essential part of the system considerations (Zevenbergen, 2002). The trustworthiness and hence effectiveness of a cadastral system requires legal procedures securing the rightful ownership of property as well as other private rights and restrictions attached to the property. Traditionally, this is secured in a land registration act and a subdivision act. In practice, the other functions described in the land administration model, figure 2, are also regulated through legislation: Traditionally, by taxation legislation, as well as planning and land use legislation.

In that way, the system is trustworthy. However, when transforming the systems into a digital setup, the data quality becomes of great concern. Based on the theories and models on land registration and land administration, the following analysis will clarify the challenges within digital government, ending up outlining considerations to be taken into account in the future development of the digital systems.

3. ANALYSIS

Denmark is one of the frontrunners in regard of e-Government. The basic settings are in place and by November the 1st 2014, all communication between governmental agencies and citizens must be digitally. The newest digitalisation strategy from the Danish Government is from 2011 and is the latest in a ten years period of strategies.

3.1 Focus on legislation in e-Government implementation

The legal challenges in e-Government are mentioned in various strategies, but often in a general manner and not addressing specific focus areas directly. For instance, the latest e-Government strategy in Denmark states that ... *all unnecessary legal barriers to digital collaboration at work need to be removed* (The Danish Government, 2011, page 40). The strategy then elaborates on how legislation should enhance digital self-service, and outline principles for digital communication, cloud computing and it-procurements and purchasing.

Actually, the strategy mentions the need for rethinking the legislation-process in the digital context: *When new legislation is being put together, opportunities for digitalization must be considered from the start. This applies to areas such as mandatory digital correspondence, the reuse of data and the use of the e-Government infrastructure* (The Danish Government, 2011, page 41). No further description is made on how this should be implemented.

In the EU digital agenda, the focus on 'e-ready' legislation is not present in the strategy's seven key areas:

1. Create a new and stable broadband regulatory environment.
2. New public digital service infrastructures through Connecting Europe Facility loans
3. Launch Grand Coalition on Digital Skills and Jobs
4. Propose EU cyber-security strategy and Directive
5. Update EU's Copyright Framework
6. Accelerate cloud computing through public sector buying power
7. Launch new electronics industrial strategy – an "Airbus of Chips"

(European Commission, 2010)

As discussed by Hvingel et Baaner (2014), the discussion and understanding of the legal implications of digital land administration depend on the maturity of e-Government. The technical aspects need to be in place at the initial phases, and later the more detailed discussions on the legality of data can take place.

3.2 Focus on legality of spatial data in e-Government implementation

The former strategies focused on the development of portals with public information and services towards citizens and businesses respectively, and the necessary IT-infrastructures, standards and security. The latest strategy is a turning point since this strategy for the first time focuses on land administration and the reuse of public data. As stated in the strategy's focus area no. 8, called 'A Shared Platform for Efficient Environmental Administration' *Our living conditions and well-being rely on a diversity of natural resources and a healthy environment. It is therefore essential that we plan and manage our natural resources and the environment efficiently. And to do this, we need cohesive, nationwide data on the environment that citizens, companies and authorities can trust* (The Danish Government, 2011, page 32). The need for compatible data is amplified by the fact that both national, regional, and local municipal authorities are responsible for various parts of environmental administration, and hence the registrations need to be cross-organisational and across geographical boundaries. According to the strategy, the use of shared, quality-assured environmental data is key to efficient environmental administration. By the usage of standardisation of and access to data the goal is to enable companies to process environmental cases faster and more efficiently and making *reporting, applications and court proceedings less complicated* (The Danish Government, 2011, page 32). Finally, the strategy stresses the fact that it is particularly important that all environmental data comply with the same basic geographical data.

This remark gives birth to a so-called Basic Data Model appointing core public information (e.g. data on individuals, businesses, addresses, real properties and geography (i.e. digital maps)) as 'public basic data' (The Danish Government et al., 2012).

Therefore, on a strategic level the awareness and importance of land administration is in place. And within the digital government, the importance of appointed core public data and reuse hereof is recognised. Still, in practice the use and the legal status of spatial data are hard to grasp, as the following cases will show.

3.3 The Danish Natural Environment Portal

The Danish Natural Environment Portal is the official portal for public environmental information in Denmark. The portal is quite advanced allowing viewing, finding, drawing, measuring, importing and exporting of environmental data. As background for the various data, different official maps can be chosen (the so-called basic data as described above). In figure 3, one of these features, the viewing service, displays the existence of all protecting zones surrounding lakes, streams, forests, churches, and protected stonewalls. In this case in the municipality Silkeborg.

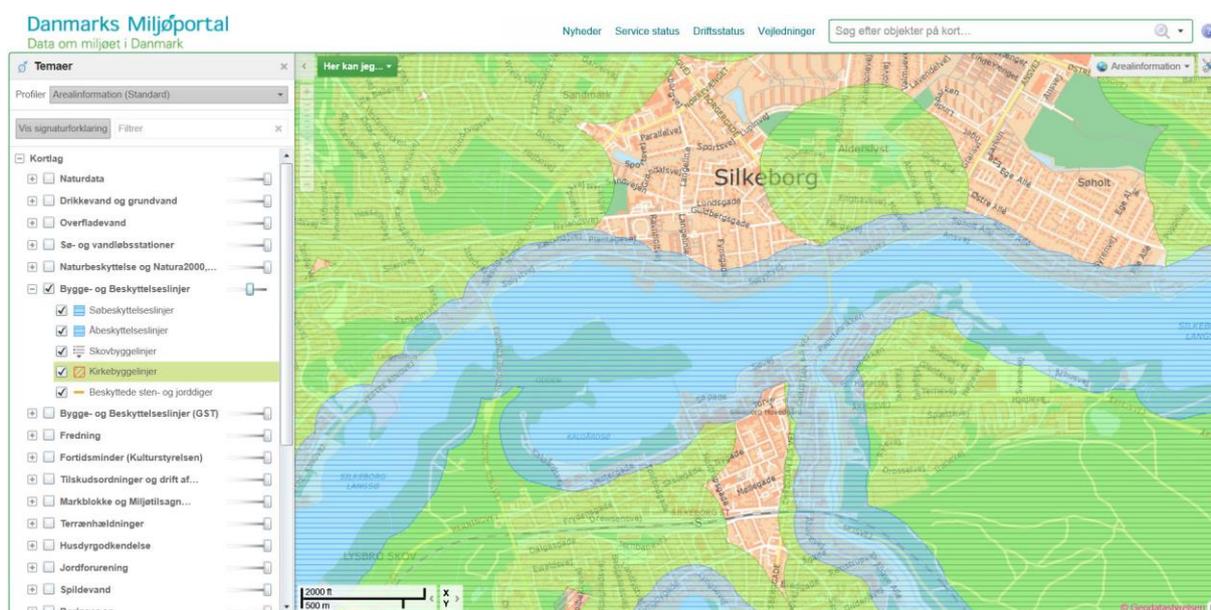


Figure 3. Screen dump from www.kort.arealinfo.dk displaying building- and protection lines.

All of these protection zones have legal provision in the Danish Nature Protection Act (LBK no. 951 of the 03/07/2013). For instance, in Denmark a lake over three hectare is encircled by a protection zone to a distance of 150 metres from the lakeside, within which you are forbidden to alter or built. The visualisation of the protection zone is a case of ‘de jure’ boundaries, but in practice, the boundaries are implemented as ‘de facto’ boundaries, since this governmental online GIS solutions show the boundaries aligned with other precise boundaries. Since the wording of the legislation constitutes the state of the law, a lake protection zone disappears if the lake is reduced in size, for instance due to warm weather, and emerge if a lake is extended beyond the given size by natural or manmade means.

The portal does deliver some metadata for the protection zones, like the responsible authority, but nothing about the legal status of the registration. Intuitively, the registrations probably seem correct and trustworthy. No court rulings or administrative appeals have yet decided on the legal status of the portals registrations.

3.4 The digital building permit

The digital building permit was a project running for three years, beginning in 2009. The outcome of the project was tested in six municipalities, and the expected savings totalled 10,000 man hours in the participating municipalities. The prototype of the system is shown in Figure 4. The idea was to create a self-service solution, allowing the applicant to draw the desired building (or addition to an existing building) on a map, after which the system would immediately return a ruling on the building permit application.

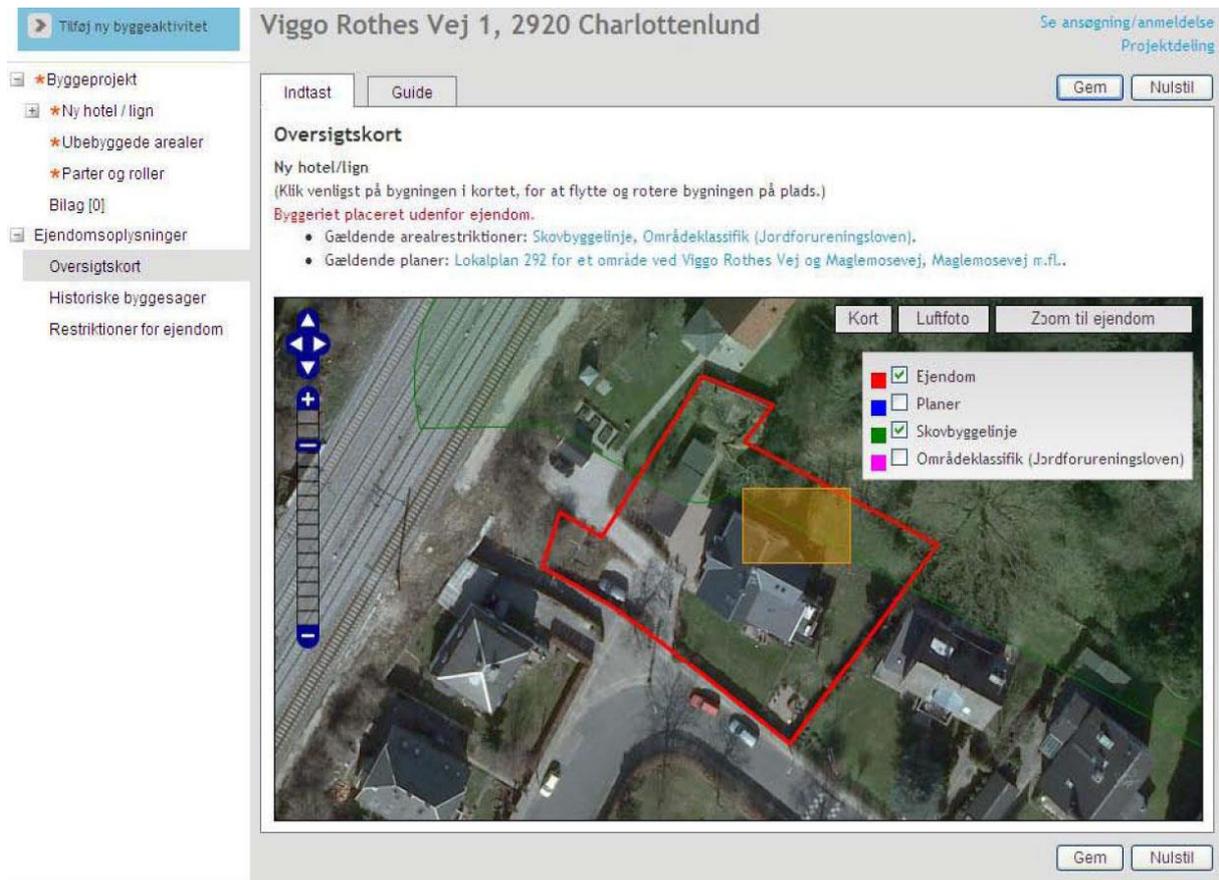


Figure 4. A mock-up illustration the idea behind the digital building permit.

In the illustration, the system returns the answer that the building would fall outside the property, that it would fall inside a forest protection zone, that the ground is designated as 'polluted', and finally, that the property is subject to local planning. This result is alarming. Firstly, the forest protection zone is a de jure boundary as just illustrated. Additionally, the cadastral map of Denmark is of highly variable accuracy, and since local plans base their locations on the cadastral map, this affects them, too. By default, all urban areas are designated 'diffuse polluted soil'. The registration of polluted soil has no legal relevance for a building permit, but obliges those involved in a building project to notify the municipality if soil is removed from the site to another location.

At the beginning of the digital building permit project, expectations were high, and in 2011, the project was awarded an innovation prize by The Association of Municipal Engineering (KTC). However, as the project developed, the obstacles became evident, and the final report of 2012 stated that the expected savings could not be obtained by implementing the system. Still, the system has some good qualities, in terms of support for decision-making. In the evaluation report, it is mentioned that there is a need for an IT-supported simplification of existing legislation. According to the report, this simplification of the law in 'an IT-supported way' supports the goal of immediate rulings. But with no further elaboration on, what this means.

4. DISCUSSION

Based on the findings from the analysis, an overall understanding of the challenges tied to role of legislation in e-Government can be categorised as consisting of 1) data security and privacy, 2) the content of the administrative law and the rulings, 3) standardisation of legislation to support e-Government, and 4) the process of making legal decisions:

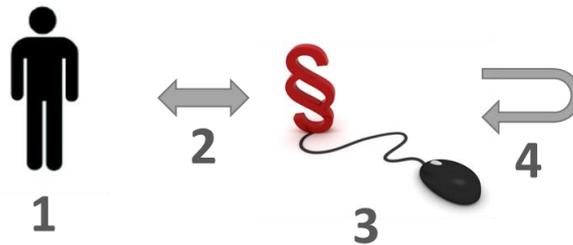


Figure 5. The four focus areas for the role of legislation in e-Government

1. Legislation need to secure the *protection* of personal information/identity and *security* when processing personal information. In Denmark, this has been the case for a long time. As stated earlier, the latest strategy in addition focus on legislation to outline principles for digital communication, cloud computing, it-procurements, and purchasing for IT. In the future, the procedures from administrative law could benefit e-Government in terms of rules for case handling, comprising rules for communication, storage of case data and access to documents. Another relevant area to come is the *ownership* to data. For instance tracking data from a cell phone.
2. As stated in the analysis *...by the usage of standardisation of and access to data, the goal is to enabled companies to process environmental cases faster and more efficiently and making reporting, applications and court proceedings less complicated.* By using standards and reusing modules of regulation, the rulings ought to be faster. One of the preconditions is a clear link between the object of the legislation (the person) and the ruling. The Land Administration Domain Model (LADM) aid this development. Likewise, the Danish basic data model is a valuable contribution to this infrastructure. Still, the goal of ‘immediate rulings’ is not easily obtained, as the cases show. This may be due to lack of data standards and/or data quality. But, it could also be due to the fact, that rulings often involve some kind of legal judgement, which is disregarded in this technical approach.
3. The law itself also needs to adapt to the digital context. To benefit fully from digitalisation, the new legislation needs to consider digitalisation from the ground up when devising new legislation for a certain area. This could help ensure that the regulation of an area is suitable for the reuse of data and for automated ruling. Firstly, this implies a more standardised composition of the law, secondly a digital approach to the content of the law itself when it comes to defining *who, what, when* and *where*. Digital government and the use of today’s geographical information systems have changed the conditions on which spatial regulations are perceived and applied.

- Traditionally the question had been to where a certain provision apply, but today with digital maps and information systems you ask the question of what applies to this area
4. Finally as mentioned in the analysis, the process of making amendments could also benefit from the new possibilities in the digital environment. For instance, mandatory hearing could gain from the possibilities of digital media. In Denmark, municipal plans for instance only goes through the formal hearing processes online.

In Denmark, the awareness on the role of legislation in support of e-Government has a strong focus on the first bullet point. The adaption of the basic data model opens the discussion on more IT-supportive legislation, as a contribution to bullet number 2 and 3. The findings support the hypothesis that discussion and understanding of the legal implications of digital land administration depend on the maturity of e-Government. Hardware and data is a prerequisite for e-Government, and the refined discussion on the digital public administration follows afterwards. The examples from Denmark showing solutions on 'immediate rulings' stress the need for supplementing the technical/engineering perspective with legal considerations. The solutions both built on the ability to do conflict analysis in GIS, and ignore the legal wording of the legislation as well as legal subsumption of the facts in the given context.

Within the traditional GIS-discipline, or IT-discourses in general, data is required to have a certain quality. Traditionally, data quality is defined through a set of criteria for evaluating spatial information including lineage, positional accuracy, attribute accuracy, logical consistency, completeness, semantic accuracy, usage and temporal quality (van Oort, 2005). The importance of land information (or spatial information) is recognised both within theories and models on land administration systems as well as spatial data infrastructure, but no requirements are made for the quality of these 'basic' data.

Some countries have begun discussing the role of data, and appointed some of the public data as core public data sets that must be used as reference data for other sectorial data sets. This is a step on the way, but does not solve the inconsistency and obstacles in the land regulation and the adherent spatial allocation of the regulation. In Denmark, the latest digitalisation strategy even states that these data are authoritative, understood as trustworthy. But, as the analysis in this paper shows, data are not authoritative, understood as trustworthy when it comes to digital land administration solutions.

A distinct and significant feature of data sets used for land administration purposes is that they are representation of rights and duties or "a state-of-law", and hence not precise and accurate representation of physical objects like a house or a road. A characteristic of these 'spatio-legal' representations is that the representation often is tied to a procedural process ensuring compliance with the purpose of the law and often also considerations regarding the constitutional rights. This cannot easily be transferred to a digital administration system building on technology considerations. However, it is possible and the discussion are much needed, since the development within e-Government otherwise will create solutions that will devaluate the trust in existing land administration systems.

5. CONCLUSION

In 2001, Ian Williamson drew this dream-scenario in regard of the relationship between legal regulations and the map, figure 6.

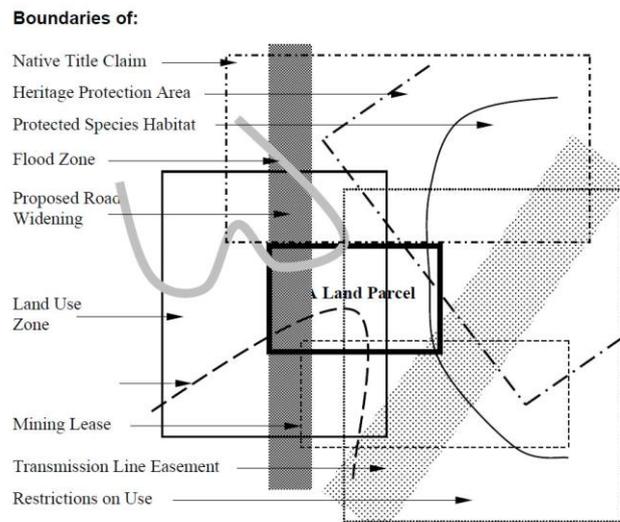


Figure 6. Original figure text “Schematic of overlapping rights, restrictions and responsibilities in a modern multi-purpose cadaster (Williamson et al, 2001)

It pictures a system allowing all rights and restrictions to be visible on a map. By selecting a specific property, all information attached to this property would be delivered.

Technologically, this solution is possible today. However, the analysis in this paper has shown that legal matters impede the solution in practice. Representations of legal regulations are not always as easy to locate in a map as physical objects. Often, the origin of these representations have had no requirements of accuracy attached to them and no understanding of data structuring and topology. Furthermore, these data are generally tied to procedural processes. If knowledge on these ‘spatio-legal’ data are not present, technology pushes for development of systems and services aiming at ‘immediately’ processing of cases, resulting in not only bad solutions but actually foul decisions undermining the trust in the system at large.

Hence, discussion on how to deal with the relationship between legislation (land administration) and the representation in the map is in order. Land administration legislation needs to be re- thought within a digital environment. This discussion needs to focus on the legal constructions and the state of the law; Is it the map itself or the underlying datasets, that constitutes the ‘law’, then it will be possible to establish an increased number of automatised rulings. However, doing this requires further discussions on the quality of the data used in the solution, as well as incorporation of hearing processes, legal judgements etc. Inspired by system-development methodology, reusable sub-elements could be a way forward, defining reusable legislation and procedures, securing the necessary overview and efficiency within e-Ready legislation.

REFERENCES

- Baum, C. and A. Di Maio, 2000, Gartner's Four Phases of E-Government Model, Gartner Group, Research Note, available at: <https://www.gartner.com/doc/317292/gartners-phases-egovernment-model>, Accessed October 20, 2014.
- Danish Government, The/Danish Regions/Local Government Denmark, August 2011, The Digital Path To Future Welfare Egovernment Strategy 2011-2015. Available at http://www.digst.dk/~media/Files/Digitaliseringsstrategi/Tilgaengeligg_engelsk_strategi.pdf. Accessed October 14, 2014.
- Danish Government, The/Danish Regions/Local Government Denmark, October 2012, Good Basic Data For Everyone - A Driver For Growth And Efficiency. Available at http://uk.fm.dk/publications/2012/good-basic-data-for-everyone/~media/Publikationer/Imported/2012/Gode%20grunddata%20til%20alle/BasicData_UK_web_2012.10.08.ashx. Accessed October 14, 2014.
- Enemark, S. and A. Rajabifard, 2011, Spatially Enabled society, In *Geoforum Perspektiv*, volume 20, pp. 6-14.
- European Commission, 19.05.2010, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions - A Digital Agenda For Europe, COM(2010)245
- Henssen, J.L.G. and Williamson, I.P., 1990, Land registration, cadastre and its interaction; a world perspective, *Proceedings XIX FIG Congress*, Commission 7, Paper 701.1, Helsinki 1990, p. 14-43.
- Homburg V. and Y. Georgiadou (2009) A Tale of Two Trajectories: How Spatial Data Infrastructures Travel in Time and Space, *The Information Society: An International Journal*, 25:5, 303–314, DOI: 10.1080/01972240903212524
- Hvingel, L. and L. Baaner, 2014, Spatial data infrastructures – legal implications. *International Journal of Spatial Data Infrastructure Research* (under review)
- Nebert, D. (2004). *The SDI cookbook*. Report. GSDI - Global Spatial Data Infrastructure
- Rajabifard, A., Feeney, M.-E., and I. Williamson (2003). *Spatial Data Infrastructures: Concept, Nature and SDI Hierarchy*. *Developing Spatial Data Infrastructures: From Concept to Reality*. Taylor and Francis, London, New York, pp. 17–40
- Siau, K. and Y. Long (2005). Synthesizing e-government stage models – a meta-synthesis based on meta-ethnography approach. *Industrial Management & Data Systems*. Vol. 105 (4), 2005, pp. 443–458
- Zevenbergen, J., 2002, *Systems of Land Registration - Aspects and Effects*, Publications on Geodesy 51 (ISBN 90 6132 277 4), Delft: NCG, Netherlands Geodetic Commission.
- Zevenbergen, J., 2004, *A Systems Approach to Land Registration and Cadastre*. *Nordic Journal of Surveying and Real Estate Research*, Volume 1, page 11-24, 2004.
- Van Oort, P., 2005, *Spatial data quality: from description to application*. Nederlandse Commissie voor Geodesie.
- Rajabifard, A., Feeney, M.-E., and I. Williamson, 2003, *Spatial Data Infrastructures: Concept, Nature and SDI Hierarchy*. *Developing Spatial Data Infrastructures: From Concept to Reality*. Taylor and Francis, London, New York, pp. 17-40
- Vancauwenberghe, G., Dessers, E., Crompvoets, J. and D. Vandenbroucke (2014). *Realizing Data Sharing: The Role of Spatial Data Infrastructures*. In book: *Open Government. Opportunities and Challenges for Public Governance*, Publisher: Springer, Editors: Mila Gascó-Hernández, pp.155-170
- Williamson, I., Enemark, S., Wallace, J. and A. Rajabifard, 2010, *Land Administration for Sustainable Development*. ESRI press. ISBN 978-1-58948-041-4
- Williamson, I., and L. Ting, 2001, Land administration and cadastral trends—a framework for re-engineering, *Computers, Environment and Urban Systems* 25.4, pp. 339-366.

BIOGRAPHICAL NOTES

Associate professor at the Department of Planning and Development at Aalborg University. Educated surveyor. Teaching and research within geoinformation, SDI, and land management. Editor in chief of Geoforum Perspektiv. One of the main local organisers behind the INSPIRE conference 2014 in Denmark. Honored with the GI Norden Award of Honour in 2014.

Mr. Lasse Baaner B.Sc. LLM Ph.D. Assistant professor at Department of Food- and Resource Economics, Copenhagen University. Conducting teaching and research in the field of environmental law and nature management.

CONTACTS

Mrs. Line Hvingel
Aalborg University
Skibbrogade 5, 1st. floor
9000 Aalborg
DK Denmark
Tel. +45 61 71 71 64
Email: hvingel@land.aau.dk
Web site: www.en.aau.dk