Cadastral development in Norway: the need for improvement

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Abstract

Cadastral systems provides important information for the public and private sectors. To understand the functions and impacts of a cadastral system one needs to understand its development. The Norwegian cadastral system has its origins in the 1600s and is defined as a German style cadastral system. In the early 1800s an economic survey was initiated in the kingdom of Denmark-Norway to modernize the tax cadastres. After the defeat in the Napoleonic wars, Norway entered into a union with Sweden in 1814 and the survey was stopped. Consequently, cadastral mapping would not be introduced in Norway until 1960, and at that time photogrammetric methods with poor quality control were used, Land subdivisions were undertaken by laymen until 1980.

The paper describes cadastral development in Norway, challenges that have arisen and how they can be addressed. Measures to improve the system are proposed.

Cadastre, cadastral development, land administration, surveying, quality

Introduction

Cadastral system in Norway means, in the context of this paper, the registration system that provides information about real properties and in which the main elements are the land register (providing legal information on land rights) and the cadastre (providing spatial information on land parcels, addresses and buildings).

Cadastral development in this context means development of the cadastral system and the institutions surrounding this information system.

This paper addresses the following research questions: What are current challenges in the Norwegian cadastral system, how did they come about, and how can they be addressed?

The main focus is establishment and maintenance of the cadastral map, the boundary determination process and related quality issues. Quality issues related to building and address information (which is also a part of the cadastre), fall outside the topic of this paper. Building and address information is normally triggered by processing of building applications.

The Norwegian cadastral development history falls into two periods – from the 1600s to 1960, and after 1960. Up to 1960, the cadastral system in rural areas was based on the old tax cadastre and it included no map showing the property objects. Urban areas – cities and towns – had systems of their own that were based on cadastral surveying and maps from late 1800s and onwards. The cities of Oslo and Bergen introduced cadastral surveying even earlier.

The economic mapping project started circa 1960 and combined topographic mapping and mapping of boundaries in scale 1:5 000. The economic mapping project marks the start of modernization of the cadastral system. It led to a land registration and cadastral reform from 1980 in which nationwide cadastral surveying and a new multipurpose cadastre – the GAB system – were introduced. The events of the modernization period after 1960 have led to the present Norwegian cadastral mapping concept and -spatial information system.

The paper is based on the dr.philos. thesis “Cadastral Development in Norway” (Mjøs 2016). This thesis is composed of seven papers in Norwegian, describing various aspects of the development of the cadastral and mapping system in Norway, plus a comparative analysis of this development with other German style cadastral systems, in English, in the summary article of the thesis. The methodology and structure of this paper follows that of the thesis, in which the basic elements are comparative analysis and qualitative method based on observations and literature.

For an overview of the Norwegian cadastral system and land market, some key figures for 2018 are presented in Tables 1 - 3:

Population	Area (Svalbard and Jan Mayen not included)	Built area	Agriculture land
5 328 212	323 809 km^2	5 473 km^2 (1,7 %)	11 167 km^2 (3,4 %)

Table 1. Basic statistics Norway (Statistics Norway 2019).

	Ground property	Land lease	Section (Condominium, Commercial)	Property in strata (3D property)	Others*	Apartment in housing cooperative**
Units	2 572 246	154 858	555 315	643	2 974	359 823

Table 2: Cadastral units per December 31 2018 (Røkke 2019, Ringheim 2019).

* Rights established before 1980, typically waterfall rights

** Only registered in the land register

	Residential	Leisure	Agricultural	Industry	Commercial and office	Transportation	Apartment in housing cooperative
Units	139 006	29 836	6 581	3 198	2 241	447	40 806

Table 3. Property transactions in 2018 (Statistics Norway 2019)

The notified sales volume in 2018 for residential, leisure, agricultural, industry and commercial/office properties was 468 735 000 000 NOK (apartments in housing cooperatives not included). The notified sales volume in 2018 for apartments in housing cooperatives was 84 107 000 000 NOK (Statistics Norway 2019).

Cadastral development from early 1600s to 1960

The Norwegian cadastral system is a German style cadastral system. A German style cadastral system is a title registration system with two main entities, land book and

cadastre. Basic features are that titles are registered in the land book based on cadastral identifications, registered titles are guaranteed by the state, boundaries are determined by cadastral surveys carried out by licensed surveyors or government officers, and cadastral registration is prior to land registration. (Williamson et al. 2010, p. 66). The relationships between the Norwegian system and the German and Austrian systems are documented and discussed by professor L.M.B. Aubert, after a study tour to Germany (Aubert 1892).

The Norwegian cadastral system history starts in the 1600s, when Norway was united with Denmark. The land register originates from provisions concerning protocols introduced by local courts in early 1600s for the purpose of documenting and protecting property transactions. Throughout the 1700s the land register developed as a system to protect transactions in the land market and to support changes in tenure systems, from tenant farmers to owner farmers. A tax cadastre was established in the latter half of the 1600s for the purpose of levying tax – the cadastre of 1670. Records in the cadastre of 1670 included 1) the farm by name - which could comprise several individual farm units 2) tax value (*no:skyld*) and 3) names of the owners and tenant farmers and the part of tax value they owned, or used, and which of the owners were responsible for arranging the tenancy. The tax authorities soon started assigning identification numbers to the farms within their district and by 1722-1723 all farms had their numbers. In Denmark, a country with an intensive agricultural sector, the first cadastre implemented in 1687 was based on surveying, and in the latter 1700s enclosure processes were implemented based on surveying and mapping. In Norway, with expansive mountain areas and only a few per cent arable land area, the cadastre was based purely on valuation, and enclosure (land consolidation) was not initiated during the 1700s (Mjøs 2016).

Mandatory boundary mapping when boundary disputes were brought to court was introduced by legislation in 1719. As a consequence, a small group of licensed surveyors (*no: kartkonduktør*), normally military officers, were licensed for such tasks. The licensed surveyors operated throughout the 1800s and well into the 1900s (Engelstad 1981).

In 1764 legislation was introduced requiring written boundary descriptions when land was subdivided in rural areas. Land subdivisions and boundary descriptions were to be conducted by the local judge and 6 laymen who were appointed for each subdivision.

In 1804-1805 a process started in Denmark - Norway to modernize the tax system by introducing cadastral mapping. In Denmark the modernisation was based on land consolidation maps from the enclosure process in the late 1700s, in Norway by cadastral surveying combined with military topographic mapping in scale 1:10 000. The union with Denmark was dissolved in 1814 and Norway came into loose union with Sweden. In Norway, the cadastral survey was stopped in 1815-16 due to the poor financial situation and resistance from farmers (Mjøs 2016). In Denmark, the modernization was completed in 1822 and a modernized cadastre based on cadastral maps was introduced in 1844.

From here on, Norway would take a different course in surveying and mapping than neighbouring countries and other countries in Northern Europe. In Norway the cadastre was revised purely by valuation and a new cadastre was introduced in 1838. In addition to revising the tax value, the individual property units (*no:bruk*) within the farm were assigned identification numbers in this revision. Assignment of identification numbers to individual property units laid the foundation for reforms by new legislation in 1845 – 1848. The number of laymen was reduced to 4 (for each subdivision), and the

land subdivision protocol with boundary descriptions was to be registered in the land register. The land register and the tax cadastre were coordinated and individual property units had their own folios in the land register. However, the property units were not identified by a cadastral map showing the parcels, but rather by the number identifying the property, which could comprise several parcels.

Parallel with international development, the Norwegian taxation system became gradually more income based throughout the 1800s. State property tax was abolished in 1838. The cadastral tax became income for the municipalities, which were now established. The state thus had little interest in cadastral mapping.

The land consolidation courts (LCC) were established in 1859 due to the need to rearrange property in rural areas (Fernández 2008). The main task was initially to consolidate fragmented land use and to dissolve or otherwise rearrange the use of farm commons to modernize and increase the efficiency of agriculture. LCC conducted massive rearrangements of agricultural land, especially during the ensuing 60-70 years, and produced huge volumes of land consolidation maps that showed boundaries prior to and after the land consolidation process. The maps were ”island maps” and not connected to the geodetic reference system. The LCC were assigned authority to resolve disputes about boundaries, rights and ownership as early as 1882, but only the actual disputes within the area of a land consolidation case that needed to be resolved for implementation.

In cities and towns, where the tax cadastre for rural areas was not implemented, individual cadastres did develop. Bergen, the most important city in Norway at the time, introduced legislation for cadastral surveying prior to title deeds registration in 1700. When the first building laws were introduced in the major cities around 1830, these laws had statutes for cadastral surveying, chief surveyor and a cadastre. A cadastral

survey was made a prerequisite for registering change of ownership in the land register, if no previous cadastral survey existed. From the latter 1800s, cadastral surveying was introduced in minor cities and towns as well, on an individual basis.

Several efforts to modernise the cadastral system were made around 1900. In the first decades of the new century, initiatives were taken to introduce economic mapping drawing on the joint resources of the LCC and the Geographic Survey (today Norwegian Mapping Authority). The LCC were now making large numbers of land consolidation maps in scales proper for cadastral maps. However, the initiatives failed due to professional disagreements (Sejersted, et al. 1900). If the necessary cooperation could have been established, cadastral maps could be based on land consolidation maps, as was the case in Denmark (Enemark and Højgaard 2017), and this could have been the basis for a national cadastral map in Norway. In 1909 a new land subdivision law was passed emphasizing procedures for boundary marking and boundary descriptions. This corresponds with the change in character of the system, away from taxation purposes and toward dispute prevention and legal protection of owners and creditors. Now the land subdivisions were to be conducted by 3 laymen appointed for the individual case by the local sheriff. In rural areas, the system of laymen conducting land subdivisions would persist until 1980 (Mjøs 2016).

Through the 1800s the taxation system developed from being primarily property tax based to being income tax based, and the tax cadastre gradually lost its role and importance. The land register developed throughout the 1900s as the totally dominating element in the cadastral system in rural areas, where metes-and-bounds boundary descriptions made by laymen were recorded when land was subdivided. The main role of the cadastre was to produce identification numbers for new properties. Cities and towns had developed their own individual cadastres.

In 1924 a new general building law for the whole country was adopted and came into effect for all cities and towns in 1929. Cadastral surveys were to be referenced to a geodetic framework, and coordinates were gradually introduced in survey certificates (Mjøs 2014a).

In 1935 the land registration law was adopted. This law required the land registrar (local judge) to examine documents and refuse to register documents not fulfilling the requirements of the law. The law required the State to compensate for losses incurred by registration errors (Mjøs 2014b). When the land registration law of 1935 was adopted, the land register changed from a deeds system to a title system, according to Raff's four characteristics of a title system (Raff 2003 p. 14).

From 1934 the LCC were given the authority to conduct boundary surveys as independent court cases, including settlement of disputes. It is at this point the private land surveyors who emerged in the 1700s to make maps during boundary disputes, leave the stage and disappear. They were probably outcompeted by the land consolidation courts in rural areas and municipal surveying in cities. In 1950 the LCC's authority was extended to include rights. Surveys of boundaries and rights were to become a predominant type of case for the LCC, and this is the typical type of case handled by the LCC today (Mjøs 2016).

Parallel with the development of municipal surveying and the LCC, private surveying and mapping companies also offered services to the private and public sectors. For example, the General Map of Bergen 1879-81 was produced by the company *Kontoret for private Oppmaalings og Kartarbeider* (Harris 1991 p. 61), and the triangulation of Bergen in 1914 was undertaken by the company *Ingeniør Dahls oppmåling* (Nysæter 2018).

Table 4 summarizes highlights of cadastral development up to 1960.

Rural areas		Cities and towns	
1633	Written court protocols at Tings		
1672	The old tax cadastre	1700	Legislation for mandatory cadastral surveying in Bergen
1719	Legislation introducing compulsory mapping when land disputes are brought to court		
1738	Land register protocols sorted by farm names		
1764	Legislation introducing written boundary descriptions when land is subdivided		
1838	New tax cadastre	1827 1830	Building laws for respectively Christiania (Oslo) Bergen introducing compulsory cadastral surveying, chief surveyor and urban cadastre
1848	Coordination of cadastres and land register based on the property identification number of the cadastre		
1859	Land consolidation courts are established	1869	Building law for Trondheim introducing compulsory cadastral surveying, chief surveyor and urban cadastre
1886	Revised tax cadastre	1882	Law giving cities and towns possibility to introduce compulsory cadastral surveying and chief surveyor
1909	Land subdivision law	1896	General building law giving cities and towns possibility to introduce compulsory cadastral surveying and chief surveyor
		1924	General building law introducing compulsory cadastral surveying and urban cadastre for all cities and towns
1935	Land registration law. Transformation from deeds to title system.		
1960	The economic mapping project.		

Table 4. Highlights of cadastral development 1600 - 1960

Reconstruction and housing needs after the WWII led to greater focus on land use and community planning. Lack of maps in greater scales and land information to support public planning and control activities in rural areas was apparent. These needs and reduced costs for mapping as a result of new photogrammetric methods were

catalysts when economic mapping and cadastral reforms were introduced from circa 1960.

Cadastral development after 1960

The economic mapping project

Following local initiatives in 1957 by counties and municipalities to make economic maps based on photogrammetry, the government started to elaborate how these regional and local mapping activities could be coordinated and fit into a future national economic map. The national economic mapping project started around 1960, with final approval of guidelines and financial plan by the Parliament in 1964.

Throughout the 1960s and 1970s and well into the 1980s, the economic mapping project was implemented for most of the country based on photogrammetric mapping. The project was implemented at the county level. A unit within the Geographic Survey was given responsibility for national coordination of the project. The LCC were responsible for property mapping until 1977 when county mapping offices were established under the Ministry of Environment (MoE) and took over the economic mapping project. After 1986 the county mapping offices were a part of the Norwegian Mapping Authority. Aerial photography was carried out by 4 private companies and photogrammetric maps were constructed by 9 private companies (Paule 1997 p. 86). Property boundaries were mapped on the basis of aerial photographs. In the first stages only properties larger than 5 000 m^2 were to be mapped. Boundaries were temporarily marked on the ground by the landowners, using markers visible in the aerial photographs. Importantly, the procedures did not include any boundary adjudication process, nor formal approval processes. Roughly calculated, 50 % of the boundaries were registered in the economic mapping project. When the economic mapping was

finally completed in 2002, 32 000 map sheets had been produced covering a total area of 185 000 km^2, mostly in scale 1:5 000 and from the sea up to the timberline (Mjøs and Leiknes 2007, Mjøs and Sevatdal 2011, Leiknes et al. 2014, Mjøs 2014b).

Cadastral reform after 1980

The system in which laymen undertake land subdivisions in rural areas was considered outdated and inadequate for future maintenance of the economic maps. Work to revise the land subdivision law of 1909 started around 1966. Two alternatives were considered to replace the laymen system: a handover to the LCC, or a full introduction of municipal surveying (also in rural areas). A law committee submitted their proposal for a new cadastral law in 1972, recommending nationwide municipal surveying.

A new land subdivision law passed the Parliament in 1978 and came into force in 1980. With enactment of the land subdivision law in 1980, municipalities became the "first line" cadastral authority. This included responsibility for carrying out cadastral surveys when land was subdivided or leased for more than 10 years, for assigning new property identifications and issuing survey certificates. The new law abolished the procedure of compulsory surveying when title was conveyed if there was no prior proper survey. This was due to an expected shortage of surveying capacity and the risk of delays in property transactions. Municipalities also became responsible for updating the new cadastre – the GAB system - that would now replace the old tax cadastre. The GAB system was a computerized (initially mainframe) database consisting of a ground property register (G), address register (A) and building register (B). The system linked address and building information to the ground property. The GAB system was developed under the MoE. GAB did not include a cadastral map, and there were no specifications for a continuous cadastral map in the land subdivision law of 1978.

Survey certificates were to be registered in the land register. In the new legislation, no steps were taken to meet the increased demands for cadastral surveying services. No specific requirements for education or authorisation of surveyors were introduced. The municipality could freely appoint any person as a land surveyor, and also outsource cadastral surveying to others, such as other municipalities or private surveyors.

Until 1980, the preferred boundary mark in rural areas was a boundary stone or a cross (normally approx.10 x 10 cm) in stone or bedrock. Natural features were frequently used as boundary lines, as when a boundary is described as following a river, creek or slope. In cities and towns, wooden pegs, iron pegs or “anything available” were used, like discarded water pipes or bicycle handlebars (Mjøs and Leiknes 2007). In 1980 a standardized aluminium boundary mark was introduced, which became the prevailing boundary mark. The idea was that only boundary marks approved by the Ministry could be used to identify land parcels in the field (Anon 1980); however, this had no legal basis (Mjøs 2014).

Figure 1. The typical boundary mark in rural areas prior to 1980, cross in bedrock, renewed with the new aluminium boundary marker introduced in 1980. Photo: L. B. Mjøs

In 1986 The Geographic Survey, the Hydrographic Survey and the 18 County Mapping Offices were merged into what is today the Norwegian Mapping Authority

(NMA). But NMA was not given any formal role in cadastral surveying, even if there were personnel at some county mapping offices who occasionally advised the municipalities. Nevertheless, NMA would take over the responsibility to manage the GAB system.

Establishment of digital boundary maps started in the mid-1980s. Generally we can say that NMA started by digitizing economic maps through their county mapping offices, and the municipalities started by digitizing survey certificates. A national standard for digital boundary maps was introduced in 1991, and the work was coordinated starting in 1992. In the mid-1990's it became apparent that there was insufficient personnel with the necessary qualifications, that the quality of cadastral surveys was poor, and that the information in the GAB-system and boundary maps was poor. In 1996 MoE appointed a law committee that presented a draft for new land subdivision and cadastre law in 1999. Proposals were presented to integrate the GAB system and boundary maps into a new national cadastre and to introduce a system of private authorized surveyors replacing the municipal cadastral surveyors.

A new cadastre and land subdivision law passed the Parliament in 2005 introducing authorization of municipal surveyors and private companies conducting cadastral surveys. Municipal surveyors resisted privatization, and after change in the parliamentary majority the new labour-dominated government presented an amendment to the law to Parliament, abolishing privatization and authorized surveyors. The system of municipal surveying was to be continued. A new cadastre integrating the GAB system and the boundary maps was developed, though, and became established from 2007 to 2009. The new cadastre and land subdivision law, and the new cadastre replacing the GAB and boundary maps, came into force on January 2, 2010.

The land subdivision law of 1978 also provided a basis for modernizing the land register. The law facilitated future digitalization of the land register by introducing a nationwide and uniform cadastral identification number system. The digitization of the folios of the land register took place 1987 – 1994, but land registration still had to be carried out at local courts.

In 2002 it was decided that land registration should be moved from the local courts to NMA, due to the need to modernize the court system. From 2004 to 2007 the records of the local land registries were sequentially moved to a central Land Registry at NMA in Hønefoss (Mjøs and Leiknes 2007, Mjøs and Sevatdal 2011, Leiknes et al. 2014, Mjøs 2014b).

Table 5 summarizes highlights of the cadastral development after 1960.

Rural areas		Cities and towns
1960	The economic mapping project.	
1965	Nationwide building law. The municipalities can by their own decision introduce cadastral surveying in rural areas.	
1980	Land subdivision law introducing nationwide municipal cadastral surveying. The tax cadastre is abolished and the GAB system is introduced.	
1985	Digitization of boundaries in economic maps and survey certificates.	
1987	Digitization of land register.	
2003	Land register moves from local courts to NMA in Hønefoss.	
2010	Land subdivision and cadastre law. Nationwide cadastral map.	

Table 5. Highlights of cadastral development after 1960

The present situation – initiatives for change

Since 2010 the land register and the cadastre have been central registers managed by the NMA at Hønefoss, who has full responsibility for the land book and general supervision of the cadastre. The cadastre is updated by operators in the municipalities and the municipalities are responsible for cadastral surveying. The LCC can undertake cadastral

surveying when boundaries are “unclear”. Private companies offer surveying and mapping services. In a survey, Iversen (2015) found that 22 of 28 responding companies (of a total of 54 contacted) had provided cadastral surveying services to municipalities. An important initiative was forwarded in 2015. Private surveying companies approached Parliament through their association *Geomatikkbedriftene* to promote the benefits of private cadastral surveyors in Norway. The private surveying companies argued that they could do the job more efficiently and for lower cost than the municipalities. A majority of the Parliament at the time was in favour and asked the Government to elaborate a proposal for the future organisation of cadastral surveying, including assessment of the need for authorisation of the surveyor. On August 19th 2016 a proposal was sent to public hearing from Ministry of Local Government and Modernisation (MoLGM 2016) with these main elements:

1) cadastral surveying to be undertaken as a professional service with free pricing

2) introduction of authorisation of the person responsible for a cadastral survey

3) requirements for education and practice in line with the requirements of other European countries and in accordance with the regulations for services in the European Economic Area (EEA) (bachelor's degree, 2 years practice, exam).

The proposal further stated that present practitioners would be able to attain authorization based on their professional skills, and that cadastral surveying could be carried out by both public and private entities with an employed authorized land surveyor. Responsibility for updating the cadastral map was proposed transferred from the municipalities to NMA, which was also to be responsible for granting authorisations. The hearing responses to the proposal (more than 200), a majority of

which were submitted from the municipalities, were mainly negative. On June 16th 2017 MoLGM presented a proposition to the Parliament with the main proposals from 2016 (MoLGM 2017). On March 15th 2018 the Parliament, which had seen a shift in the majority in the Parliamentary elections in 2017, rejected the essentials of the proposal. Cadastral surveying and updating of the cadastral map was still to be a municipal responsibility, but Parliament decided to introduce authorisation. The person responsible for a cadastral survey must have a license (*no: landmålerbrev*) issued by the MoLGM. According to the Parliamentary decision, the Ministry can, upon application, issue license to persons who have

1. Reached the age of majority (18 years) and are capable of conducting cadastral surveys
2. Have approved education
3. Have at least two years of relevant experience after completion of education
4. Have passed an authorization test.

Will authorisation and licensing of cadastral surveyors meet the challenges in the system and fulfil the need for improvement? In the next sections it will be discussed the present organisation and outline three major problems. Finally it will be identified possible measures to improve the Norwegian cadastral system.

Problem 1: Lack of educational requirements for cadastral surveyors

As discussed above, the question about education and authorization has been a core element in the proposals for modernisation.

There are no legal requirements for education, defined skills or examination to become a municipal cadastral surveyor. Ensuring that the cadastral surveyor has the

necessary competence is the responsibility of the individual municipality. In a bachelor's thesis in 2017 it was found that 28 % of the interviewed cadastral surveyors had no relevant education (Kristiansen et al. 2017). For municipal cadastral registrars a short course (6 days) provided by NMA is required. A land consolidation judge must fulfil the educational requirement, which is a formal master education designated by the Norwegian Courts Administration.

Lack of education requirements for cadastral surveyors is the first of the major problems in the cadastral system.

The absence of legal requirements for education and skills for the cadastral surveyor of course delimits the responsibility imposed by law on the cadastral surveyor for determination of legal boundaries and this leads us to the second problem, the boundary determination system.

Problem 2: The boundary determination system

A national cadastral map has been established and has been in use since 2010. Generally speaking the cadastral map for rural areas originates from the economic mapping project that started circa 1960, while in cities and towns it originates from survey certificates and municipal maps. After 1980, and especially from 2000 to 2010, there was a major effort to complete maps with "missing properties" using a variety of methods. Massive data capture, rather than quality control, was the focus. In 2014 approximately 10 % of the properties were registered only by a central point (i.e. without boundaries) or were not registered at all in the cadastral map (Mjøs 2014). In 2016 the Ministry itself documented that 25 % of registered properties have fictive boundaries recorded (MoLGM 2016). In the public hearing for the Parliamentary committee on January 18 2018, Tekna (The Norwegian Society of Graduate Technical and Scientific Professionals) claimed that 50 % of registered properties are registered

with boundaries with inadequate quality. The many missing boundaries and poor quality of registered boundaries indicates failure in the boundary determination system.

It follows from the cadastral law § 33 that in a cadastral survey the boundary identified by the parties are to be surveyed and registered: “A cadastral survey is clarifying and describing boundaries and rights in accordance with the parties' claims and documents presented, and otherwise provides information and documentation necessary for registration in cadastre and land register”. The cadastre and land subdivision law makes no provisions nor sets any responsibility for the cadastral surveyor to determine the legal boundary, and neither the land consolidation judge nor the municipal surveyor has a formal obligation to perform investigations in Norway. Determination of rights to land, including determination of the boundary between neighbours, is a private matter. The role of the cadastral surveyor is as a public servant, allowing private parties to bring forward documents and statements and record them in a public procedure. The municipal surveyor and the land consolidation judge are responsible for ensuring that the case is investigated, but neither of them have a duty to carry out investigations. It is the responsibility of the parties to make investigations, present relevant documents or evidence, and identify the boundaries in the field. Many municipal surveyors will assist parties in reconstructing previous surveys, but reconstruction and determination of a boundary is in principle the responsibility of the adjoining landowners. If the land consolidation judge makes investigations on his or her own initiative, this could constitute a procedural error and become a subject of appeal to the court of appeal (*no:lagmannsretten*) (Mjøs 2016).

When the new cadastre and land subdivision law came into force in 2010, survey certificates were abolished. Registration of boundaries after 2010 is based on registration of boundary points by map coordinates referenced to the national geodetic

network (Euref89), and with relevant attributes and information about survey accuracy. The survey is normally not linked to permanent local control points or local terrain features such as house corners, massive walls or an adjacent geodetic control point. After the boundary point coordinates are registered in the cadastre, a report from the cadastre showing the relevant cadastral information (*no: matrikkelbrev*) is produced as the final product to the landowner(s).

There are no statutes in Norwegian law making neither a cadastral survey or the resulting coordinates legally binding for the landowners, and there are no statutes requiring an agreed change of a boundary to be registered. The landowners can adapt to a new boundary, and adapting to a new boundary will be binding for the owners without a cadastral survey. To what extent new and unregistered boundaries will be legally binding for successors will depend on physical circumstances, land use, information given, good faith etc. Rights of third parties will be protected, but third parties rights will normally be extinguished after 20 years under certain conditions, such that actual use is exercised in accordance with the requirements of adverse possession (Berg 2005, p. 212ff).

The very concept of "legally binding" *(no: rettsgyldig e.l*) is not very clear. The basic principle is that demarcations in the field are "more" binding than maps and coordinates. This is based on the idea that the parties – and their successors – will normally have clearly understood and adhered to visible physical features, more than they would to abstractions like maps and coordinates because the physical features are more accessible. But the whole issue might depend on local circumstances and be open to dispute. If the adjoining landowners do not agree about the boundary, it is a legal issue that can only be settled in court, if one of the parties takes such an initiative to resolve the dispute.

Zoning plans and future boundaries present a specific and problematic issue. Zoning plans identify lines separating different types of land use. Unfortunately, there is a widespread practice among public authorities to regard lines in zoning plans as "binding" also as boundaries between land parcels. Such practice is troublesome. When plans are made on the basis of a cadastral map of poor quality without taking this into account or making corrections, errors are introduced in the planning project. It is widespread practice today to consider boundaries marked in adopted zoning plans based on the cadastral map and the cadastral coordinates to be legally binding (Mjøs and Leiknes 2017). This means that the coordinates represented in the digitized plan are defined as the legal boundary by the municipal surveyors in the cadastral survey. Many cadastral surveyors understand this practice to be supported by MoE, who in 2012 published a paper in the ministerial journal underpinning this understanding (MoE 2012 p.15). Another practice that is on the rise, is that when a zoning plan shows property boundaries, new properties are registered based on coordinates of the plan without any field meeting and boundary marking. However, there are no regulations in Norwegian legislation that can make the coordinates legally binding. When determining a boundary in court, coordinates from a plan could be admissible evidence, but so could any other testimonial, documentary, or tangible evidence. The parties hold the burden of introducing evidence in court. The municipality will normally not be involved in the dispute.

Because of the practices described above, deviations between the plan and the actual implementation of the plan (i.e. construction of buildings and roads in the field), are not handled in a field survey. The following figure illustrates how roads and construction can thus be shown on a neighbour's property.

Figure 2. “Legally binding boundaries” based on the zoning plan. The location of the road in the terrain deviates from the plan (Mjøs and Leiknes 2017)

In a conflict situation, when agreement is not reached, it is common practice for municipal surveyors to step back, record the disagreement and advise the parties to take the issue to the land consolidation court to settle the dispute (Mjøs 2010). There is no deadline for appeal to court. The landowners can decide to live with the dispute or one of them can decide to bring the dispute to court.

A distinguishing feature of the Norwegian cadastral system compared to other countries is the high frequency of boundary disputes. In Denmark approximately 70 boundary disputes are handled by the Danish land surveyors per year, of which approx. 12% of the disputes are brought to court (Skovsgaard and Juulsager 2012). The number of disputes handled by the LCC in 2007 was approximately 1 000. This number includes disputes over boundaries and disputes over rights, typically rights of way. From 2002 to 2014 the number of cases brought to the LCC increased 67%, and from

2011 to 2015 the increase was 40 %. The Norwegian National Courts Administration expects that this development will continue (Domstoladministrasjonen 2015, p.19, Bakken 2016). It is reasonable to assume that there is a component of dispute in many of the cases brought to the LCC, and the number of disputes is increasing (Mjøs 2009, Mjøs and Sevatdal 2011).

Inadequate legislation, the lack of formal obligations for the cadastral surveyor or land consolidation judge to perform investigations, and the lack of mandatory registration of boundary changes, are leading to poor boundary determination. This is the second major problem in the cadastral system.

There is little pressure to solve the problems caused by poor boundary determination, and that leads to the third major problem, the fragmented organisational structure.

Problem 3: Fragmented organisational structure

The land register (*no:grunnboka*) is a central register kept by the NMA, who is the registrar. There are no notaries in Norway, but real estate agents are involved in the majority of formal land transactions. The land market is considered effective and well functioning, with a cadastral system providing the information necessary for land transactions and mortgaging.

Activities of NMA include maintaining and developing the cadastre and defining its contents, running courses for and issues licenses to the municipal registrars, and defining and developing some standardized formulas, such as a mandatory formula for requiring a cadastral survey. NMA approves the design of boundary marks, the geodetic network and standards for the geodetic surveying. NMA has established a "help-desk" (*no: matrikkelhjelpen*) a center of assistance for users of cadastral

information. In 2014, NMA was moved from MoE to MoLGM. MoLGM, under which NMA is an ordinary state agency, is responsible for development of laws and bylaws.

Municipalities are responsible for conducting cadastral surveys and updating the cadastre. The vast majority of cadastral surveys are related to land subdivisions. A land subdivision is subject to application to, and a permit from, the municipality. A cadastral survey will be required to grant permission to establish a new ground property (which can be comprised of several parcels) or a new land lease for more than 10 years. A cadastral survey is also a prerequisite for registration of a new property unit or a new land lease in the land register. If the boundaries are unclear or disputed and an agreement cannot be reached, the "toolbox" of the Norwegian cadastral surveyor is limited. The surveyor will complete the procedure, record both parties' statements in the protocol and produce coordinates based on his or her survey. The cadastral map is updated displaying the boundary as unclear/disputed. It is not mandatory for the landowners to meet in a cadastral survey; the minimum duty for the land surveyor is to survey the boundary claims presented by the parties that have met.

The 1978 cadastral law included no regulations for a continuous map and thus no limitations on municipalities in terms of adding supplements (missing properties) and making changes and corrections in the boundary map. The new legislation in force from 2010 did put extensive restrictions on updates by the municipalities. After 2010, parties of interest are to be notified of corrections, changes or addition of information in the cadastral map.

The County Governor settles appeals over the implementation of municipal cadastral surveys (the procedural rules).

The LCC represents the "second way" for a cadastral survey. LCC can conduct cadastral surveys as separate cases when the boundaries are "uncertain." These are

typically boundaries established prior to 1980 under the laymen system. LCC can decide in the matter if there is a boundary dispute. A cadastral survey conducted by the LCC is a mixture of cadastral surveying and court procedures. Normally the court cannot conduct ordinary subdivisions, if the LCC decides to do so, it can carry out a subdivision of a property that is involved in a land consolidation case. Under certain circumstances, LCC can conduct a land subdivision as a separate case, for example when a property is to be subdivided according to ownership fractions, typically land in co-ownership. Cadastral surveys undertaken by the LCC are registered in the cadastre by the municipality, who also assigns new property identification numbers if needed. Costs for municipal cadastral surveys are normally determined by a fixed fee system, but a few municipalities have fees based on hours used. The fees are determined by the municipal council, usually in connection with the budget for the coming year. The fees are limited to the municipality's total expenses for cadastral surveying and registration. Some municipalities choose to have low fees that do not cover the municipality's costs. Fees for a cadastral survey of a land subdivision of 750 m^2 varied in 2016 from 87 Euros (NOK 835) to 4 200 Euros (NOK 40 000) (MoLGM 2016). Costs for a cadastral survey conducted by the LCC are determined by a fix fee system that is uniform at national level. The costs for court proceedings are covered by the State. In 2012 the average cost for a land consolidation case was calculated to 19 300 Euros. Of this, 2 100 was covered by the parties, excluding expenses for lawyers and lay judges. If lawyers are included, the total costs can soon reach 50 000 Euros. It is normal for landowners in Norway to have regulations in their insurance agreement for coverage of expenses for lawyers up to 1G (IG = NOK 93 634 = 9 800 Euros). In a boundary survey in the LCC, costs are distributed among the parties according the usual rules for allocation of costs in court (Leiknes et al. 2014 p. 279).

A fragmented organisational structure for cadastral surveying is the third of the major problems in the cadastral system.

The need for improvement – paths forward

A nationwide cadastral map is now in place in Norway and we have procedures to register new properties and boundaries in this information system, but there are problems with updating and improving the quality of the map. Procedures for collecting missing information, correcting errors in registered information and capturing changes in existing properties are poorly developed, and there is little pressure to resolve these matters.

As explained above, the current system is characterized by a high and increasing frequency of disputes. One factor that may contribute to the increasing number of disputes is poor quality in cadastral surveys. Another factor is poor quality in the cadastral map, and that map and coordinates are systematically being overrated. This is reinforced by easy internet access to the map. A third cause for concern is the apparent increasing focus in the LCC on following court procedures and basing boundary determination on evidence presented by the parties and their lawyers, rather than recognizing the need to investigate the case for correct boundary determination from a more technical approach. This differs from Denmark, where investigations are mandatory for the land surveyor. Yet another aspect of the system is that poor map quality can cause problems and stop implementation of building projects. In summary, one can question whether a system with the described shortcomings can be used as an efficient tool for planning and decision-making in a spatially enabled society

(Rajabifard and Steudler 2012). In the following sections it will be outlined recommendations for improving the system.

Strengthening the educational system and educational requirements for land surveyors.

In connection with the economic mapping project and the following land subdivision reforms from 1980, no institution-building activities were initiated to design and establish a surveying profession. Initiatives to strengthen the educational system were not prioritized. In the mid-1990s, the initiative to replace the municipal surveying system with a system of private and authorized surveyors failed after resistance from members of the established system. A new initiative to introduce private surveyors in 2015, initiated by the private surveyors themselves, failed in Parliament on March 15th 2018. The process had once again turned into politics over the question of private or public surveyors. The Parliament did vote in favour of introducing authorisation (*no:landmålerbrev*) issued by the MoLGM for future cadastral surveyors. As a result, we expect that the municipalities will not be free to appoint any person to be in charge of a cadastral survey, but will have to appoint a person having authorisation issued by the Ministry to conduct the survey. The Parliamentary decision to introduce authorisation for becoming at cadastral surveyor is an important step forward to develop a profession of land experts capable of ensuring quality in cadastral surveys, and is in agreement with Mjøs's recommendations (Mjøs 2016). However, there are too few surveyors who can fulfil the educational requirements, and the decision has no roadmap as to how to ensure that a corps of land experts will evolve. If there is a lack of educated surveyors, there is a risk that adjustments will have to be made allowing surveyors not fulfilling the requirements to become cadastral surveyors.

Need for improvement: to strengthen the educational system and educational requirements for cadastral surveyors to ensure that all cadastral surveyors in the future have the education and skills required to ensure quality in cadastral surveys, and thus enable the establishment of a profession of cadastral surveying experts.

Strengthening the boundary determination system.

One consequence of the absence of legal requirements for education, defined skills or examination to become a municipal cadastral surveyor is that the authority and responsibility of the cadastral surveyor will be undermined. If the aim is to determine legal boundaries, this can only be achieved by highly skilled surveyors.

Two public bodies undertake cadastral surveying in Norway, the municipalities and the LCC. The municipal system is the predominant system. The municipal surveyor is in charge of surveying boundaries identified by the landowner. If the boundaries are unclear or disputed and an agreement cannot be reached, the cadastral surveyor registers the boundary as unclear/disputed, or surveys both parties' claims. There is no general mechanism in the municipal cadastral system for settling boundary disputes, except that the surveyor can mediate. The landowners themselves either agree, live with the dispute, or one of them takes the dispute to the court system - normally the LCC - to have it settled.

These procedures were not changed by the decision in Parliament on March 15th 2018. However, in paragraph 35 a statute is amended making it mandatory for the licensed surveyor to examine "relevant documents". Until now the cadastral surveyors have not had any statutory duty to present and investigate relevant documents. Many surveyors do search the land register for survey certificates, land subdivision protocols or land consolidation protocols, but the duty to retrieve and examine documents has been assigned to the landowners involved. It is unclear what the impact of this duty for

the surveyor to examine “relevant documents” will be. Most likely it will not lead to greater responsibility on the authorised surveyor to determine the legal and correct boundary. Introducing licensing of surveyors and the new provisions for examination of documents are steps forward, but the paragraph 33 in the cadastral law, which is unchanged, does not put any responsibility on the licensed surveyor to take a position on the location of the correct boundary. This question is left to the landowners. It will still be legal for the landowners to agree on a new boundary, without any requirement that the new boundary be surveyed and registered. This stands in contrast to Denmark, where the land surveyor is required to survey the correct and legal boundary, and the law mandates that boundary changes be surveyed and registered.

Need for improvement: A corps of authorized and skilled surveyors capable of determining the correct and legal boundary is needed. Statutes should be introduced requiring boundary changes to be registered, thus ensuring that the cadastral map is updated and correct. The cadastral surveyor should be required to carry out necessary investigations and determine the correct (legal) boundary.

Strengthening of a central body responsible for the cadastral map

The cadastral law of 1978, in force from 1980, imposed nationwide cadastral surveying as the responsibility of the individual municipality. The State played only a minor role. In the cadastre and land subdivision law in force from 2010, the distribution of responsibilities is changed. The focus of this law is more on the cadastre being a […] uniform and reliable register over all properties in the Country[…]. (cadastre and land subdivision law § 1). NMA is given an expanded authority, although still limited.

Need for improvement: a governmental body with overall responsibility for keeping the cadastral map updated at all times, in accordance with goals of the cadastral law, to attain a uniform and trustworthy national cadastre.

National and international experts in the field should be consulted when developing such a body.

Focus on research

Efforts to modernize the cadastre started by introducing the economic mapping project from 1960. The main focus was on the needs of the public sector and establishment of an information system and adequate tools for land use planning and -control. Little attention has been paid to developing those aspects of the cadastre that protect property ownership and prevent property disputes, i.e. the surveying and mapping of boundaries and their legal impacts.

When cadastral surveying was introduced for the whole country in 1980, the hope was that the surveying system would prevent and reduce the number of disputes. The minister of environment at the time, Gro Harlem Brundtland, highlighted an expected reduction of boundary disputes in her presentation to the Parliament as an expected effect. Dispute prevention is high in other countries with the German style cadastral system. The increasing number of disputes in Norway clearly indicates that the mechanisms in the system do not work as intended. More research is imperative to determine the causes of the high and increasing number of property disputes. Possible measures to make the system more preventive by nature should also be investigated. One measure that could be implemented immediately to facilitate research on dispute prevention is to make court decisions from the LCC and the ordinary courts as well as decisions from the County Governors, more available for research (Mjøs 2009).

The Norwegian cadastral system shares basic characteristics with the corresponding system in our neighbouring countries. They are all German style cadastral systems. Comparative studies of the Norwegian and other German style cadastral systems would be particularly interesting. One aspect that could be compared is the cost of cadastral surveys, which vary greatly among Norwegian municipalities and across national borders. Another topic of interest is the boundary disputes themselves. Why are there many boundary disputes in Norway, while in our neighbouring countries boundary disputes are only rarely brought to court? A third issue for comparative analysis is how the cadastral system is used as a tool by public authorities, the finance and insurance sector and as a tool for property conveyance. What are the country-to-country differences with respect to development of a "spatially enabled society" in which government uses “place” as a key for communicating with citizens?

Limited research is being conducted in Norway on land administration and cadastral mapping. No PhD activities has been initiated by the MoGLM or NMA in these fields. Future research should place a stronger focus on the functionality of the cadastral system and information to citizens to ensure that they understand the results and consequences of a cadastral survey.

Need for improvement: more research by academic institutions.

Conclusions

This paper presents cadastral development in Norway, with focus on the cadastral map, and describes problems and challenges resulting from this development. The Norwegian cadastral system is a result of choices and decision made during its development starting in the 1600s. Some decisions have been thoroughly discussed, while others have been taken on the basis of what seemed reasonable from the decisionmakers’ point of view at

the time. Some decisions have surely been wise, while others, in hindsight and with to-days knowledge, appear less wise. The proposed actions listed above can be summarized into a two-part strategy for improving the cadastral system. The objectives are to prevent disputes from escalating into conflicts in court, and in the longer term to improve the land information system.

1) Strengthen the land surveying educational system, introduce authorization and develop a profession of cadastral expert surveyors responsible for determining correct and legal boundaries. Initiate research activities and strengthen the central cadastral authority.

2) Work to complete the cadastral map by recording missing properties and improving the quality of registered information. This can be done by introducing sporadic cadastral surveying (when land is conveyed for the first time after a fixed date if the cadastral map does not show the legal situation) and methods to capture changes.

To achieve these goals, a central agency with clear responsibility for the cadastral map and its quality is needed.

The first step towards toward future improvement may have been taken by the Parliamentary decision of March 15th 2018, where state authorisation of surveyors responsible for the undertaking of cadastral surveying was introduced. It is not clear how the authorisation system will be implemented and how it will function in a municipal system with extensive autonomy. Even if introduction of authorisation is an important step forward to improve the system, it is unlikely to have a great impact without addressing underlying problems in the cadastral mapping system.

The success of future authorisation will depend on the decisions made and development paths established in the years to come.

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Abbreviations

LCC- Land Consolidation Courts

NMA – Norwegian Mapping Authority

GAB – Ground Property, Address and Building Register

MoE – Ministry of Environment

MoLGM – Ministry of Local Government and Modernisation