A review of methodologies used in research on cadastral development

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Abstract

World-wide, much attention has been given to cadastral development. As a consequence of experiences made during recent decades, several authors have stated the need of research in the domain of cadastre and proposed methodologies to be used.

The purpose of this paper is to contribute to the acceptance of research methodologies needed for cadastral development, and thereby enhance theory in the cadastral domain. The paper reviews nine publications on cadastral and identifies the methodologies used. The review focuses on the institutional, social, political and economic aspects of cadastral development, rather than on the technical aspects.

The main conclusion of this paper is that the methodologies used are largely those of the social sciences. That agrees with the notion that cadastre relates as much to people and institutions, as it relates to land, and that cadastral systems are shaped by social, political and economic conditions, as by technology. Since the geodetic survey profession has been the keeper of the cadastre, geodetic surveyors will have to deal ever more with social science matters, a fact that universities will have to consider. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Recent decades have witnessed a rising interest in cadastre, accompanied by the production of a vast amount of work, not only on cadastre but also on related domains, such as registration of property rights and geographic and land information systems. Work in the cadastral domain has been carried out mainly in the following contexts:

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the establishment of cadastres in developing countries, where, together with land title registration, it is a means of providing security of tenure, aiming at fighting poverty and underdevelopment (Dale & McLaughlin, 1988; McLaughlin & de Soto, 1994; UNIMEC, 1996; Williamson, 1995, 1997);

the (re)establishment of cadastres in Central and Eastern European countries, whose economies went through a transition towards private ownership of land (Dale, 1997b; UNECE, 1996);

the use of cadastre as a base to the development of land information systems in countries where cadastres are well established, as is the case of the Northern European countries (Enemark, 1997; Larsen, 1995; Stubkjær, 1991, 1992);

the use of new technologies in the acquisition and management of cadastral information (Felus & Lida, 2001; Majid & Williamson, 1999; Polley & Williamson, 1999);

the identification of patterns of evolution, such as privatisation, cost recovery policies, automation of processes, which may shape cadastres in the future (Kaufmann & Steudler, 1998).

The professionals who have been dealing with these cadastral issues, either from the technical, research or consultant perspective, cover a few different professional areas: geodetic surveyors, lawyers, geographic information systems experts, land management experts, to name a few. Still, the vast majority are the geodetic surveyors. (The use of the expressions geodetic surveyor and geodetic survey profession is in accordance with the terminology proposed by the European Council of Geodetic Surveyors/Comité de Liaison des Géomètres Européens—CLGE—Stannard, 1996). The profession of geodetic surveyors has been the keeper of the cadastre, as a result of a traditional predominance of measuring and mapping within the cadastral activities.

However, the aforementioned work shows that the focus of the cadastral issues has changed: the critical questions are not so much the technical ones, but rather the institutional, social, political and economic ones (Dale, 1985, 1992; Zevenbergen, 1998). This has led to the present situation in which geodetic surveyors are dealing with social science matters, i.e. matters which have been outside their traditional field of expertise. Furthermore, this has raised the fundamental question of which theoretical framework to refer to, when dealing with questions in the domain of cadastre. Several authors have acknowledged the need of research in order to establish a body of theory for cadastre, stressing namely the need of a definition of concepts and identification of methodologies. Already in 1985, Dale drew attention to the fact that “sub-disciplines of surveying such as geodesy held and still hold greater excitement and have attracted substantial research. Cadastre has not. With few exceptions it was not until the 1970s that any serious attempt was made to […] carry out further research and place the study of cadastre on a more respectable intellectual footing”. In the last decade there has been a growing pace of contributions to a theory for cadastre. The International Federation of Surveyors (FIG) has promoted important reflection work, specially on the principles to be followed in
order to create efficient cadastral systems, which has resulted in a set of reference documents: “The FIG Statement on the cadastre” (FIG, 1995), “The Bogor Declaration” (UNIMEC, 1996), “The Bathurst Declaration” (FIG, 1999) and “Cadastre 2014” (Kaufmann & Steudler, 1998). Several authors (Bittner, von Wolff & Frank, 2000; Fourie & van Gysen, 1995; Williamson & Fourie, 1998; Zevenbergen, 1998) have proposed methodologies to be used in research on cadastral development, which are mainly borrowed from social science theory and to which we refer in Section 3. Last, but not least, Commission 7 of FIG carried out, between 1994 and 1998, a benchmarking project to compare the performance of cadastral systems internationally (see more detailed description in Section 3). The authors met considerable difficulties when comparing data from different countries (Steudler, Williamson, Kaufmann, & Grant, 1997) and therefore initiated a process of standardisation of definitions. One conclusion was that more progress has to be made in the definition of concepts and terminology, so that it will be possible to develop appropriate indicators of performance of cadastral systems.

The motivation for this paper was made up by all those contributions to a theoretical framework for cadastral studies, together with the demand for further research. The purpose of this paper is to contribute to the acceptance of research methodologies needed for cadastral development, and thereby enhance theory in the cadastral domain. We analyse nine recent publications, chosen in the context of a review of the literature on cadastre, and identify the methodologies that were used. Hopefully, this identification of methodologies will inform on ongoing development work.

An additional factor of motivation for this paper was the fact that the methodologies used for research on cadastral development should be considered in the education of geodetic surveyors. There is no reason why geodetic surveyors should not remain the main keepers of cadastre. Therefore, conclusions in this matter may be important to the education institutions, namely to the universities.

This paper proceeds with a description of the criteria used in choosing the publications to be analysed, and the method of analysis. Section 3 presents the identification of the methodologies together with the analysis and a brief review of the publications, which are the following:

“Using the Case Study Methodology for Cadastral Reform” by Williamson and Fourie (1998),
“The interrelated influence of the technical, legal and organisational aspects on the functioning of land registrations (cadastres)” by Zevenbergen (1998),
“Constructing Cadastral Reform Theory in South Africa” by Fourie and van Gysen (1995),
“El Catastro in Europa” by Castanyer and Canet (1990),
“Cadastral trends: a synthesis” by Ting and Williamson (1999),
“The Development of Cadastral Systems: An Alternative View” by Tan (1999),
“Benchmarking cadastral systems” by Steudler et al. (1997),
“Real Estate and the Ontology of Cadastral Studies” by Stubkjær (2000),
“The Structure of Reality in a Cadaster” by Bittner et al. (2000).
Section 4 contains a discussion of the outcome of that analysis, and Section 5 presents the conclusions.

2. Criteria, method of analysis and basic concepts

2.1. Criteria

The process to select the publications to be analysed started by considering publications on cadastre at the international level and, from that, making a first selection, according to the following main criteria:

- recent publications, i.e. dating mainly from the last 10 years;
- publications by academic researchers belonging to University departments;
- publications by major international organisations—the International Federation of Surveyors (FIG), the United Nations (UN), the World Bank;
- publications of a broad geographic scope, i.e. of interest to a range of countries, not just to a specific jurisdiction;
- publications that explicitly referred to research work or to the use of research methodologies.

Although we intended to make a review at a world-wide level, we are aware that it was limited by the language factor: English being the dominant language of scientific and technical diffusion, works in other languages tend, even if unintentionally, to be overlooked. Furthermore, the major source of information was the Internet, which led to a predominance of information thereby available. Another factor implicit in the selection may have been the background of the authors of this paper: both are geodetic surveyors, university teachers/researchers and continental European.

This first selection led us to a set of 60 papers and books (the majority of which are referred to within this paper). Among those 60 publications, some major types can be identified, according to the subjects covered and/or to the approaches taken by the authors:

1. guidelines for development of cadastral systems and for land administration (FAO, 1995; FIG, 1995, 1999; NRC, 1983; UNECE, 1996; UNIMEC, 1996);
2. case studies followed by comparative analysis (Castanyer & Canet, 1990; Kaufmann & Steudler, 1998; Steudler et al., 1997; Zevenbergen, 1998);
3. studies of particular experiences which lessons may be useful to other jurisdictions (Fourie & van Gysen, 1995; McLaughlin & de Soto, 1994);
4. comprehensive text books (Dale & McLaughlin, 1989, 1999; Larsson, 1991);
5. contributions to a theoretical framework for cadastral studies, mostly relating to ontology and methodology (Bittner et al., 2000; Stubkjaer, 2000; Stubkjaer & Ferland, 2000; Williamson & Fourie, 1998).
From the 60 reviewed publications we made a second and final selection, choosing publications which, explicitly or implicitly, refer to methodologies for research on cadastral development. By an implicit reference to methodologies we mean the use of methodologies which are identifiable, even though the authors didn’t state them. An example of this is the case of the Spanish study, which contains a set of systematic, methodologically coherent case studies, but in which we found no reference to case study methodology. From this final selection we obtained the nine above-mentioned publications.

2.2. Method of analysis

The analysis of the publications was made according to a frame consisting of the aspects we wanted to identify in each of the works: subject matter, questions, methodology, results and validity. We illustrate our position by referring to the following quotation, although it regards biology and the philosophy of nature, rather than research on cadastral development:

Biologists and philosophers alike have devoted much attention to a variety of issues regarding the subject matter and the methodology of biology, resulting in a sizeable output of written material, formulating philosophical questions that are still arising and framing answers to acknowledged difficulties. (Encyclopædia Britannica Online: “Nature, Philosophy of”, Available: http://search.eb.com/bol/topic? eu=115092&sctn=12, accessed 14 June 2001; emphasis added).

In the quotation we emphasise the terms: subject matter, methodology, and questions. Subject matter refers to what the work is about. Questions reflect the objectives of an investigation. The same subject matter may be investigated from diverse points of view, and with the aim of answering a variety of questions. For example, the benchmarking project by Steudler et al. (1997) had the aim of comparing the performance of cadastral systems world-wide, while the Spanish study had the less ambitious aim of describing and comparing a few European systems. The questions raised through these two investigations were different, while the subject matter was largely the same. Methodology, in the context of science, can be defined as “a system of explicit rules and procedures on which research is based and against which claims for knowledge are evaluated” (Frankfort-Nachmias & Nachmias, 1992, p. 14). In this paper we will use the term methodology in a broad sense, encompassing methodologies, methodological approaches, the corresponding methods and techniques, such as case studies, interviews, questionnaires, participant observations, etc.

We consider it a quality that a paper presents explicitly, what are the subject matter and questions that are addressed by the paper, and what methodology was used to arrive at the answers to the questions posed. We add two criteria to the three above: the paper ought to reflect the validity of the results of the investigation. Like the geodetic surveyor almost by routine checks the accuracy of field measurements to assess the degree of conformity between his results and the truth of the real world, so the cadastral researcher should reason about the validity of statements made, not
necessarily to assess truth, but at least to assess internal coherence. As stated by Graziano and Raulin (1997, pp. 188, 63): “The term validity has several meanings, the most basic of which refers to methodological soundness or appropriateness … When we ask ‘Does this study really answer the question it posed?’ … we are asking questions about validity. Validity refers to how well a study, a procedure or a measure does what it is supposed to do’. We’ll refer to validity in this sense (which occasionally may include aspects of reliability). Finally, it is a criterion that the cadastral investigations draw upon existing scientific knowledge. This is not only cost effective; it is also due to our predecessors. And it is the way for cadastr to establish links with neighbouring disciplines and thus gain recognition as a discipline in its own right.

The production and recognition of knowledge requires a common language within the community of producers and users of that knowledge, so that it can be disseminated, tested and used by others. It is outside our current purpose to present a definition of concepts and terminology within the cadastral field, but we shall nevertheless make explicit our understanding of the very basic concepts of cadastral and cadastral systems—a small exercise that will illustrate the looseness still prevailing in our field of work, and for which we all share responsibility.

2.3. Basic concepts

“The term cadastre is used in different ways by almost every country […]” (Dale, 1997a). In the literature, several and somewhat contradictory definitions can be found (emphasis added on all):

A Cadastre is normally a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection. (FIG, 1995)

Strictly speaking, a cadastre is a record of areas and values of land and of landholders that originally was compiled for purposes of taxation. In many countries there is, however, no longer any land tax and in practice the cadastre serves two other equally important purposes. It provides a ready means of precise description and identification of particular pieces of land and it acts as a continuous record of rights in land. (FAO, 1995, p.20)

Cadastre is a methodically arranged public inventory of data concerning properties within a certain country or district, based on a survey of their boundaries. Such properties are systematically identified by means of some
separate designation. The outlines of the property and the parcel identifier normally are shown on large-scale maps which, together with registers, may show for each separate property the nature, size, value and legal rights associated with the parcel. (Henssen, 1995, p.1)

The cadastre is an information system consisting of two parts: a series of maps or plans showing the size and location of all land parcels together with text records that describe the attributes of the land. It is distinguished from a land registration system [...]. (UNECE, 1996, p. 4)

Cadastre—Juridical, a register of ownership of parcels of land; fiscal, a register of properties recording their value; multi-purpose, a register of attributes of parcels of land. (Dale & McLaughlin, 1989, p. 255)

In continental Europe, cadastre and legal land registers were born separately: “In many parts of Europe, the cadastre evolved as a support for land taxation, while the legal processes of land registration were dealt with separately by lawyers and the records entered in land books, for example the German Grundbuch. Dual systems therefore emerged” (UNECE, 1996, p. 4). Cadastre was created for taxation purposes and its aim was to record (1) the land value subject to tax, and (2) the identification of the tax payer who, in many cases, was not the same person as the land owner. This distinction can be found in a very explicit way, for instance in the Portuguese cadastral law of 1926. Later, cadastre in many, but not all, European countries developed a close link with the legal land register, and the taxation purposes lost their predominance. Nevertheless, deep differences subsist today, ranging from the southern European countries where the fiscal function is still predominant (France, Italy, Portugal), if not exclusive (Spain), to the northern European countries, where the fiscal function is less important (cf. Castanyer & Canet, 1990). In several non-European countries, the development of cadastre was a very different process, as in the case of Australia, where cadastre was born to serve legal land registration (Ting & Williamson, 1999, p. 48). It is due to these different histories that definitions of cadastre also differ, specially regarding the registration of legal rights. For better and for worse, the richness of local histories stands in the way of standardisation (cf. Tan, 1999). Dowson and Sheppard, acknowledging the difficulty of a definition, took the approach of identifying the distinctive nature, i.e. the fundamental quality, of a cadastre, which is its geospatial and identifying component, independently of the textual attributes that are recorded:

It is impossible to give a definition of a Cadastre which is both terse and comprehensive, but its distinctive character is readily recognised and may be expressed as the marriage of (a) a technical record of the parcellation of the land [...] usually represented on plans of suitable scale, with (b) authoritative documentary record, whether of a fiscal or proprietary nature or of the two combined, usually embodied in appropriate associated registers. (1952, as in Dale & McLaughlin, 1999, p. 7)
This approach is also taken by Larsson (1991, p. 16) (emphasis added):

Cadastre’ thus had a distinct meaning as a specific type of land record—supported by maps [...]. Essentially, a cadastre is thus a systematic description of the land units within an area. The description is made by maps that identify the location and boundaries of every unit, and by records. In the records, the most essential information is the identification number and the area of the unit [...]. Additional information may sometimes be found in the cadastral records or in adjacent records.

Sharing this understanding, we maintain that the essential quality of cadastre is its geospatial component, which allows an unambiguous identification of land parcels (or any other land object, for that matter). The purpose for which this identification is then used, is of secondary importance. The spatial component of cadastre is what may give its definition a universal character (in spite of the local histories). Summing up, by cadastre we understand: a systematic and official description of land parcels, which includes for each parcel a unique identifier. Furthermore, the description includes text records on attributes of each parcel. The prototypical means of identification is a large-scale map that provides information on parcel boundaries. The choice of attributes may vary widely both in space and time. That doesn’t, however, compromise the consistency of the definition of cadastre: the focus of cadastre is spatial, not legal or fiscal. As Larsson (id., ibid.) concluded: “it is now acceptable to use the term [cadastre] even to refer to land records which do not include information on land values and ownership”.

Complementary to the definition of cadastre is the definition of a cadastral system. The use of the expression ‘cadastral system’ is done in a very loose way. Most of the time its meaning is not made explicit, even if significant use of the expression is made, as in “Land Registration and Cadastral Systems” (Larsson, 1991). Often it is used as a synonym for ‘cadastre’ (with whatever meaning the author understands this term), as when the Bogor Declaration states: “There is strong need to fully integrate and rationalise land title registry and cadastral systems [...]” (UNIMEC, 1996, p.5), or as in (Nichols, 1993, p. 98): “Today, three forms of cadastral systems are distinguished: fiscal cadastral [...]; juridical cadastral [...]; multipurpose cadastral [...].”

Nevertheless, a few definitions of cadastral system can be found in the most recent literature:

A cadastral system is a combination of a land registration and a cadastre. (Bogaerts, 1999, p. 1.2);

A cadastral system consists of two parts, the land registration and the cadastre. (Zevenbergen & Bogaerts, 2000, p. III.70).

These definitions show an agreement on the concept of a cadastral system: the combination of a cadastre—with its spatial focus—and a land register—with its legal
focus. A definition of cadastre that doesn’t include registration of legal rights, like the one we propose, is then coherent with these definitions of cadastral system. Finally, also coherent with them, is the definition of land registration proposed by the Meeting of Officials on Land Administration: “Land registration is the official recording of legally recognised rights in land and is usually part of a cadastral system.” (UNECE/MOLA).

The terms ‘cadastre’ and ‘cadastral system’ are, however, unsatisfactorily close. We relate this closeness to different conceptualisations of the cadastral institution in countries with different administrative traditions. Nevertheless, to our knowledge, no satisfactory alternatives have been found.

3. The methodologies

Through the analysis of the publications, the results of which are presented in Table 1, we find the use of several methodological approaches, methods, techniques and applications of theory from neighbouring fields to research in the domain of cadastre. Two aspects became apparent: the frequent use of case studies, and the borrowing of theory from the social sciences.

3.1. Case study methodology

The case study methodology is the most frequently used. It was used in five of the nine cases, and is explicitly proposed as a methodology to be applied to cadastral reform by Williamson and Fourie (1998). They seek to adopt “rigorous research methods” (p. 283) to cadastral reform. The basis for that need of a methodological improvement is the observation made by Williamson and Fourie that, although many cadastral reform projects are under way all over the world, often supported by organisations such as the World Bank, the UN and the European Union, those reform projects very often don’t respond to the expectations of those who conceived them. The focus of their paper is not on alternative reforms, but rather on better research methods. Those methods should provide a better understanding of the existing cadastral systems, and a capacity to adapt reform to local conditions.

Adopting methods from social sciences is presented as a logical process. On one hand, cadastral systems are highly determined by social and cultural factors, and those factors, together with their relations to cadastre, need to be understood in any process of cadastral reform. As Dale (1985, p. 356) had stated: “[...] unlike other aspects of land surveying which are depersonal, the cadastre is as much about people as it is about land, law and technology.” On the other hand, several methods are already established in the recognised bodies of theory of the social sciences. Adopting those methods will allow the much needed understanding of the local conditions that influence cadastral development. It will also contribute to a fundamental body of theory for cadastre and land registration. In adapting the case study methodology to cadastre, Williamson and Fourie proceed to present methods for data acquisition, which include interviews and participant observation. They build a “Cadastral
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reform methodology” comprising three stages: case studies, comparisons and solutions. Finally, the Thailand Land Titling Project and an Australian Digital Cadastral Data Base Workshop are referred in relation to the application of this methodology. In this last example, data were supplied by representatives of different jurisdictions, which resulted in difficulties to compare the respective case studies, due to differences in concepts and definitions. The same problem was referred by Steudler et al. (1997) in the benchmarking project, and is dealt with, from a theoretical point of view, in the paper by Stubkjær (2000).

Coming back to case studies, a characteristic of the case study methodology is that its main purpose is not to provide a solution for a stated problem, but to allow for an examination of a phenomenon. Rather than to provide a solution, it provides an understanding. Either for the researcher or the consultant, this is a methodology to be used to understand the existing cadastral systems, and therefore prior to the construction of models or the development of solutions. Both Zevenbergen (1998) and Fourie and van Gysen (1995) use it in that way. In his paper, Zevenbergen presents the results of four case studies, which he carried out in order to build a conceptual model of land registration. The chosen countries—the Netherlands, Indonesia, Austria and Ghana—make up a heterogeneous set, so that different aspects of land registration are present, as well as different technical, legal and organisational settings. His paper illustrates both the use of case studies methodologies and the attempt to give a contribution to a fundamental body of theory for cadastre and land registration. As the author says: “Although the consultants who are involved in numerous of these projects [to introduce or improve land registration] have gained considerable working expertise, there has been relatively little attention to describing land registration in a theoretically sound conceptual model. Such a model is needed, both for academic and practical reasons.” (p. 2).

Fourie and van Gysen present an extensive project aimed at understanding the process of change regarding the cadastre, in consequence of the major socio-political changes that occurred in South Africa in the mid 1990s. Based on that understanding, the authors identified plausible scenarios for the future of cadastre and for the geodetic survey profession, and suggested ways for adaptation to change. A comprehensive set of methodological tools was used in this project. Besides case studies, also interviews, documentary research, debate, participant observation and comparative analyses were used, together with an approach from ‘development anthropology’ (p. 4), as well as several social theories “such as network theory, structure and functionalism, transactional analysis, the dialectical relationship and coalition/alliance formation” (p. 8). The purpose was to analyse the socio-political factors, together with the technical, administrative and economic factors, which determine changes in cadastral systems. The project was developed through a close cooperation with the geodetic survey industry, with whom Fourie and van Gysen kept an extended debate. As a result of the project, the authors arrived at a “socio-political conceptual framework” (p. 7) which allowed them to analyse the South African cadastre and to make predictions. Some of the ideas produced within this project were later included in policy and legislative measures carried out by the government; others originated new products for the geodetic survey market.
Case studies, together with comparative analyses and questionnaires, were used in a study carried out in the late 1980s by the Spanish cadastral agency, under the Ministry of Finance, presented in “El Catastro en Europa” [Cadastre in Europe] (Castanyer & Canet, 1990). It consists of five case studies, covering the cadastral and land registration systems of five Western European countries—France, Italy, the Netherlands, the United Kingdom and the former West Germany—followed by a comparative analysis, and a presentation of the Spanish cadastre. The motivation for such a study was the fact that Spain had just gone through a process of total renovation of the cadastre, a process which was made possible by a strong political commitment, and which required very significant financial resources. The aim was to understand how the Spanish cadastre compared to European cadastres and look for lessons from the experience of other countries which could be applied to the Spanish case.

The study was restricted to EEC countries and started with a questionnaire sent to seven countries, from which five were chosen, on the basis of their similarity with the Spanish legal–administrative–fiscal system (p. 13). The case studies were carried out by the first author with the technical supervision of the second author, through visits to the organisations related to the cadastre and the collection of documents. The five cases were analysed through a common frame made up of the following aspects (allowing for some variations in the case of the United Kingdom): administrative situation; legal situation; role of the cadastral organisations; contents of cadastral registers and maps; land valuation system; purpose of cadastral information; relation cadastre-land registration; accessibility to cadastral information; degree of computerisation; updating methods. The comparative analysis showed some significant differences among the countries, mainly in legal and administrative aspects, but showed also some common patterns of evolution, such as a stronger link between cadastre and land registration, a wider range of users, a growing degree of accessibility to cadastral information, and increasing computerisation, followed by automatic production of statistics. It also showed that the Spanish cadastre was on the right track, in spite of its very prominent fiscal focus.

The usefulness of such work transcends its applicability to the Spanish case. It provides detailed and coherent information on a significant set of European cadastral systems, and its conclusions can be useful to other countries in the process of developing their cadastral systems, namely other European countries such as Portugal and Greece. As pointed out in the Bathurst Declaration (FIG, 1999): “By examining solutions in other countries one can achieve a better understanding of the problems in one’s own region.”

3.2. Other methodologies

After case studies, the most used methodological tools, among the nine works we are considering, are documentary research, questionnaires, interviews, comparative analyses and participant observation.

Documentary research, also used by Fourie and van Gysen (1995), is the main basis for the papers authored by Williamson and Ting (1999) and Tan (1999), who also uses a case study. Williamson and Ting establish a relationship between the
evolution of cadastral systems through time and the changes in the relationship between humankind and land, which in turn has been shaped by human history. They identify four major phases in history: from the agricultural revolution to feudalism; from the industrial revolution to World War II; the post World War II period; and from the 1980s onward. To each of this phases corresponds a different type of relationship between humankind and land. Land started by being the primary source of wealth, evolved to become a tradable commodity, thus originating land markets, was then recognised as a scarce resource, the use of which had to be planned, and the final phase brought concerns for the environment, sustainable development and social equity, which created the need of substantial amounts of information that can support further planning.

According to Williamson and Ting, there is a correlation between these trends in the humankind/land relationship and the development of cadastres. To the first phase corresponds a cadastre the role of which was to record ownership and to support taxation. Then it became a tool for land transfers. Then a tool for urban and regional planning. And finally a multi-purpose cadastre. This process has evolved at different paces in different regions, and therefore, different countries can be at different stages in this evolution. The authors proceed to identify trends for the future evolution of cadastre. The major trends in society nowadays are concern for the environment, sustainable development and social equity. As to specific trends of evolution for cadastral systems, some have been identified, in particular through the study “Cadastre 2014” (Kaufmann & Steudler, 1998). Those trends comprise the use of modern technologies such has GIS, a high degree of privatisation, a tendency to be cost recovering and the inclusion of all legal land objects in addition to the traditional parcels.

The paper by Tan presents an alternative view to the one stated in the previous paper. Tan argues that the major factor in the evolution of cadastral systems, instead of broad historical trends, is national/internal factors, namely conflicts among stakeholders that result in state action that determines cadastral change. The evolution process described by Ting and Williamson is considered to be simplistic, and even if to be applied only to western systems, then the definition of “western” is missing. A brief study of the evolution of cadastre in Singapore is presented, for which the author presents a description of historical phases based in internal factors, different from Ting and Williamson's general four phases, the validity of which (independently of their influence on cadastre) the author also questions. In short, Tan urges for a clear definition of the subject matter and endorses the reliance on “authoritative historical works” (p. 159), thus standing for the use of well established knowledge.

Questionnaires were used as a preliminary approach in the Spanish study and were the base of the large-scope benchmarking project carried out by Commission 7 of FIG. It is described by Steudler et al. (1997) in “Benchmarking Cadastral Systems”. The purpose of this project was “to compare the performance of cadastral systems internationally” (p. 87). The interest of such project derives from the fact that during the last decade there was a considerable production of guidelines to create good, efficient cadastral systems, but no definitive methodologies have been developed to evaluate the efficiency of a cadastral system.
The project started with the choice of appropriate indicators of performance of cadastral systems. Benchmarking depends on data of good quality, so that the comparative analysis may be conclusive. Therefore, much importance was accorded in this project to the development of appropriate indicators. Then, a questionnaire for data collection was distributed among delegates and corresponding members of Commission 7, covering 53 countries or states.

The questionnaire comprised two parts—a first one regarding the jurisdiction’s economic indicators, and a second one regarding the cadastral system, characterised through indicators intended to portray the following aspects: size and contents; performance and reliability; completeness; structure of personnel; cost and benefit. The contents of the cadastral system were described through a list of the items present in each of the three elements “cadastral map”, “land title” and “cadastral index”. Those items were:

- control points, parcels, buildings, land cover, contour lines, other;
- property owner, buildings, mortgages, other;
- owner, address, parcel, title reference, other.

For the other aspects, the following main indicators were chosen: number of land parcels, annual number of new parcels, annual number of boundary disputes, time to subdivide land, annual number of land transfers, annual number of title disputes, time to transfer land, percentage of land covered by cadastral plans, percentage of parcels which are registered, number and salary of surveyors, number and salary of lawyers/solicitors, cost per parcel of initial data acquisition (with separate costs for the geometric and the legal components), annual cost of maintenance per parcel (with separate costs for the geometric and the legal components), cost of a parcel subdivision, cost of a land transfer.

The indicators in this last set are all quantifiable parameters. Their choice presupposes a knowledge of how cadastral systems work in all of the countries covered by the study. Furthermore, since no descriptive non-quantifiable indicators are considered, there was no room in this study for the description of the specifics of each system. This approach differs considerably from the one taken by the Spanish study, the aim of which was to understand how each system works, comprising its particularities. The benchmarking project relies therefore, as any form of benchmarking, on the condition of comparability.

Determining the indicators for performance of cadastral systems presented considerable difficulties due to the fact that in different countries there are different interpretations of cadastral terms and definitions, as a consequence of “cultural, legal, social and institutional differences” (p. 87). This problem has been widely acknowledged in several situations, and affects the most fundamental definitions: “One of the differences between the jurisdictions is that different states define parcel boundaries differently. [...] The result is that the concept of a land parcel in the different Australian jurisdictions is different.” (Williamson & Ting, 1999). During the project there was extensive discussion regarding the definitions used in the questionnaire, although the complete standardisation of definitions was not
Those different interpretations are presumably one major cause of the great dispersion of values presented by different countries for the same indicators. Therefore, the paper presents the collected data, without attempting to draw conclusions. It is the intention of Commission 7 to continue the project and especially to refine the process of data collection.

The fact that the authors met serious difficulties when comparing data from different countries and therefore initiated a process of standardisation of definitions, suggests the need of a body of basic theory of cadastral systems which includes a definition of concepts that may serve world-wide applications, in accordance with one of the Bathurst Declaration recommendations: “Recognising the difficulties in interpretation of the many land administration related terms, develop a readily accessible thesaurus […] to facilitate a better understanding of the terminology used.” (FIG, 1999, p. 9).

This need of theoretical tools to use in the domain of cadastre has lead to the application of theories borrowed from the adjoining domains that are the social sciences. That approach was used by Fourie and van Gysen (1995), as mentioned above, and also by Stubkjær (2000) and Bittner et al. (2000).

3.3. Application of social-sciences theories

Stubkjær (2000) addresses the need to create an ontology of the cadastral domain, in order to “establish a coherent knowledge base in this field” (p. 97). The complexity of that task derives from the fact that the object of cadastre, i.e. the unit of real estate, is an entity which relates to other phenomena through aspects of diverse nature: economic, legal, political, spatial. As a consequence, any conceptualisation in the cadastral domain must take into account the conceptualisations already established in the domains of economics, law, political science and geosciences. Therefore, the study of the ontologies of the different domains, which relate to the cadastre, is needed. Notions like scientific community and information community may be useful in understanding that different communities have different ontologies, and still can share information as long as part of their ontologies is common. The cadastral ontology ought to be developed in a way that facilitates the recognition of it by the neighbouring disciplines.

On the spatial dimension of the real estate unit, Stubkjær presents a classification of boundaries, of spatial reference frames and of socio-economic spatial units. Further on he presents a comprehensive view of the cadastral domain, with the different elements that form part of it and their interrelations.

The establishment of an ontology of the cadastral domain would generate conditions for the creation of universally valid knowledge, allowing cadastral studies to move beyond the limits of specific cultural settings. However desirable that is, argues the author, the feasibility of the establishment of such ontology is not yet demonstrated.

In the paper “The Structure of Reality in a Cadastre”, Bittner et al. (2000) apply Searle’s theory of social reality in order to understand the institutional structure that the cadastre is intended to represent correctly. Searle’s theory introduces an
explanation on how an institutional reality is constructed on the base of a physical reality. It establishes that the institutional facts exist because people agree on them, there is an element of “collective intentionality” (p. 88). The institutional reality that the cadastre needs to understand in order to represent, is made possible by the application of rules—constitutive rules—which can be codified, and of which laws are examples. Institutions are then defined as “sets of constitutive rules” (p. 92). Ownership is therefore an institution, and an owner is an institutional fact.

The application of this theory to the cadastral domain is done with the purpose of building more efficient cadastral systems, through a better understanding of reality.

The concepts of Searle’s theory are then applied to the case of the transfer of ownership of a parcel, and a conceptual model is built for the structure of reality in a cadastre. In this model, we find the ontological categories of phenomena, which exist on what is called levels of reality, the physical and the institutional level. These categories are: subjects (physical persons/legal persons), objects (land, papers/parcels, documents) and events (actions performed by persons/transfer of ownership). For the analysis of the structure of reality in a cadastre, it is therefore necessary to take three aspects into account: the ontological categories, the levels of reality, and the elements of the system, i.e. facts vs. rules. The paper presents these aspects as the axes of a 3-D reference system that can be used to analyse their interconnections. Bittner et al. conclude that the application of Searle’s theory requires the representation of human intentions and behaviour, for which agent theory can be of use, and therefore complement this application.

4. Discussion

The analysis of the publications consisted mainly in identifying, for each publication, the ‘values’ of the ‘attributes’ subject matter, questions, methodology, results and validity. When stating the outcome of this analysis, presented in Table 1, we tried to keep close to the authors’ own words. Having found no evidence of inconsistencies in the use of terminology (among these nine authors), there was no reason for us to do otherwise. Nevertheless, it is not certain that all authors assign the same meaning to the same term. The contents of the table therefore correspond largely to what the authors made explicit.

The values of some attributes are easier to assess than others: subject matter, questions and results are generally more explicit than methodology, and factors of validity are the less explicit. Again we remind that under validity we did not look for truth in the sense of conformity with the real world, rather we looked for internal consistency and methodological soundness. Only in one of the cases—the benchmarking project—the authors refer very explicitly to factors of validity, when acknowledging that the use of the definitions allowed for questionnaire responses that were not comparable.

The methodological tools which we identified—encompassing case studies, documentary research, questionnaires, interviews, comparative analyses and participant observation—are mainly borrowed from the social sciences. To our knowledge, such
a review has not been presented so far. However, as this review was just one of the first efforts to pinpoint methodologies, the future set of methodologies for the cadastral domain is expected to be much richer, most likely including also IT development methodology that increasingly applies social science research (cf. Stubkjær, 1999, quoting Hirschheim, Klein, & Lyytinen, 1995).

The reasons for identifying methodologies lie both in the academic area ('fundamental' research) and in the consultancy area ('applied' or 'action' research). The intention is to contribute to a set of knowledge tools that may be useful not only when the aim is to describe, understand and explain reality, but also when the aim is to change that reality. The presented nine publications reflect a breadth of attitudes towards cadastral issues that ranges from the more academic approaches (Stubkjær, Bittner et. al.) to more action oriented ones (Fourie & van Gysen, Castanier & Canet). Whichever the approach, it is important that we fundament our claims for knowledge, grounding them, among others, in clear definitions of the subject matter, assessments of validity and appropriate use of methodologies: “by making the rules of methodology explicit, public and accessible, the framework for replication and constructive criticism is set forth.” (Frankfort-Nachmias & Nachmias, 1992, p. 16).

The confirmation that researchers and consultants are using tools provided by the social sciences relates to the much stated fact that the questions arising in the domain of cadastre are not limited to the more traditional technical and legal matters, but have extended to social, economic and political matters: “the non-technical problems of handling information have not been solved. In almost every case, it is the ability to overcome the management and institutional problems, not the technical, that determines the success or otherwise of land information systems. This is particularly the case of cadastre… Cadastral systems in many developing countries are failing because of inadequacies in their management and organisational control, rather than because of inherent defects in their design.” (Dale, 1992, p. 293). This brings about the need to broaden the scope of the education of the geodetic surveyor, which traditionally has focused mainly on natural science matters, by including subjects from the areas of the social sciences. Those education institutions, who find ways to develop competencies in social science methodologies, are likely to become among the leaders of this growing research field.

5. Conclusions

The main conclusion of this paper is that the methodologies used are largely those of the social sciences. That agrees with the notion that cadastre relates as much to people as it relates to land, and that cadastral systems are shaped by social, political and economic conditions, as by legal and technological factors.

In developing a method to analyse the publications, we found it relevant to identify some aspects of the work presented in them: subject matter, questions asked, methodologies applied, results and validity of the results. These aspects make up the analysis frame we used to reach conclusions.
The most explicit and elaborated set of methodologies within the review appears to be the one offered by Williamson and Fourie (1998) and Fourie and van Gysen (1995) who refer to further cadastre related social theory.

Although at universities you would mostly find cadastral issues organised within the area of geodetic survey, that is, in natural science faculties, we find no reason why geodetic surveyors should not remain, as traditionally, the main keepers of cadastre. But the fact that geodetic surveyors will have to deal ever more with social science matters, is a fact that institutions responsible for the education of land surveyors, and specially the universities, will have to consider.

The body of reviewed papers, as well as the literature they refer to, provides for a substantial base and direction for further research on cadastral development. It becomes apparent that cadastre will have to relate to neighbouring fields of knowledge in a more substantial way, in order to gain recognition as a discipline in its own right. If we are to deal with cadastral issues in a scientific manner, adequately sustaining our claims for knowledge, we should keep in mind that “Science is not united by its subject matter but rather by its methodology.” (Frankfort-Nachmias & Nachmias, 1992, p. 14).

References


