

## **The Cadastral Parcel Rejuvenated: Evolving from Property Unit to Core Element in Spatial Data Infrastructures**

**Martin SALZMANN, the Netherlands  
Julius ERNST, Austria**

**Key words:** Cadastre; e-Governance; Geoinformation/GI; GSDI; Land management

### **SUMMARY**

Until recently the cadastral parcel has been primarily used for land registration and land planning purposes. It has been pivotal in the cadastral domain in finding information on land and providing access to rights, restrictions and use. The European INSPIRE directive has defined the cadastral parcel as one of the core spatial data themes in the European Spatial Data Infrastructure (SDI). In the INSPIRE-context the parcel is the smallest, land-covering spatial element basically available in all (European) countries. This gives the parcel a new lease of life. Apart from being at the basis of land administration and land management it will more and more become a basic element in spatial information management in general. In this paper we focus on the role of the parcel as a spatial (geographic) element in SDI's rather than a meaningful object in land administration. This has been elaborated by a joint working group of EuroGeographics and the Permanent Committee on Cadastres in the European Union (PCC). We propose five key-elements that define the cadastral parcel in the European SDI as the smallest common geographic unit that is widely available and well updated. This entails a major harmonisation proposal for 30 European jurisdictions as the INSPIRE-directive will be implemented throughout the EU. In this quality the parcel is a locator. Its elements are related to its position, boundaries, area and its history. The parcel has the advantage that its updating is warranted given the importance of land administration. In a way the parcel has rejuvenated itself: it will continue to serve cadastres, land markets and land administration but increasingly will be the large-scale core element of SDI's. This is substantiated by comparing our results with the experiences in the development of cadastres and SDI's.

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**Martin SALZMANN, the Netherlands, and Julius ERNST, Austria**

## **1. INTRODUCTION**

The cadastral parcel has since long been a core element in land administration. With the evolution of many cadastres towards multi-purpose cadastres in the last decades, the parcel has become a core element in many national spatial data infrastructures. At the European level the INSPIRE-initiative (Infrastructure for Spatial Information in the European Community) has developed into a directive (INSPIRE, 2007) laying the foundation for a European Spatial Data Infrastructure.

The INSPIRE-directive not only defines what objects should be included in the European SDI, but also so-called implementation rules, required services and conditions under which the information should be made available. The environmental community has been at the basis of the INSPIRE-initiative, but its scope has widened and it now is the foundation for a European SDI. The INSPIRE-directive is special in the sense that it will harmonize the spatial data infrastructure for close to 30 jurisdictions with already well established national spatial data infrastructures (NSDI's).

One of the key-objects in INSPIRE is the cadastral parcel and in this paper we will discuss the proposal that has been made for the implementation of the cadastral parcel in the European SDI. A joint working group of EuroGeographics' Expert Group on Cadastre and Land Registry and the Permanent Committee on Cadastre in the European Union (PCC) has prepared the proposal for the definition of the parcel in INSPIRE and provides first guidelines for its implementation (EuroGeographics and PCC, 2007). This proposal will serve as input for the final, formal data specification and implementing rules. Our methodology differs from the existing approaches that we consider the case from the viewpoint of the SDI and not the land administration domain (which has been widely investigated).

We will show that the cadastral parcel has earned itself a new lease of life. The parcel is the smallest common spatial data element in Europe. In order to assess the potential of the parcel we have executed two surveys that give a good insight in the already extensive use of the parcel in the various national spatial data infrastructures (NSDI's). We will also look into the question to what level our findings are generally applicable.

## **2. INSPIRE AND THE CADASTRAL PARCEL**

In the INSPIRE directive distinguishes three categories of object types listed. The first two categories (listed in the so-called Annexes I and II) are considered core elements which have to be implemented Europe-wide (by 2009) and are subject to harmonization. The cadastral

parcel is considered a core data element of the directive (by listing it in Annex I). It is defined in the directive as ‘Areas defined by cadastral registers or equivalent’.

By putting the cadastral parcel in Annex I INSPIRE has made the cadastral parcel a cornerstone in the development of a European SDI. This also created the need of a proper proposal for the definition and implementation of the parcel by EuroGeographics and the PCC. In this way these organisations (and their members) would have influence on the design of the final definitions and implementation rules.

### **3. WORKING METHODOLOGY**

Our objectives were to analyse the use and potential of the cadastral parcel in SDI’s and to define the cadastral parcel and its key elements in such a way that it would fulfill the requirements of the European SDI as laid down in the INSPIRE-directive, could be implemented and could be sustained.

Considering the fact that there close to 30 jurisdictions in the European Union and our proposal should be fit to be implemented and used all over Europe, we needed a clear overview of the cadastral parcel in a technical sense and its use in the National Spatial Data Infrastructures. It was not only necessary to define the common elements but also we needed information to determine what information was common and could actually be shared. There existed excellent material on the role and use of the cadastral parcel for land administration purposes (e.g. UNECE, 2004) which was very helpful in our investigations. Our starting point was however the viewpoint of the SDI. From the SDI perspective we defined from existing reference material, operational experience of our agencies and common sense what elements were characteristic for the parcel as a spatial element. We marked the identifier, area, boundary, georeference and origin as potential core elements.

#### **3.1 Surveys**

We have executed two surveys which are extensively documented and available in (EuroGeographics and PCC, 2007).

The first survey was basically an inventory of the characteristics of the cadastral parcel in each European jurisdiction. The definition of the cadastral parcel in INSPIRE was, however, too general to execute such a survey. The INSPIRE definition has the advantage that it is generally valid. Disadvantage is that it is too vague to directly assess the key elements and implementation aspects of the cadastral parcel.

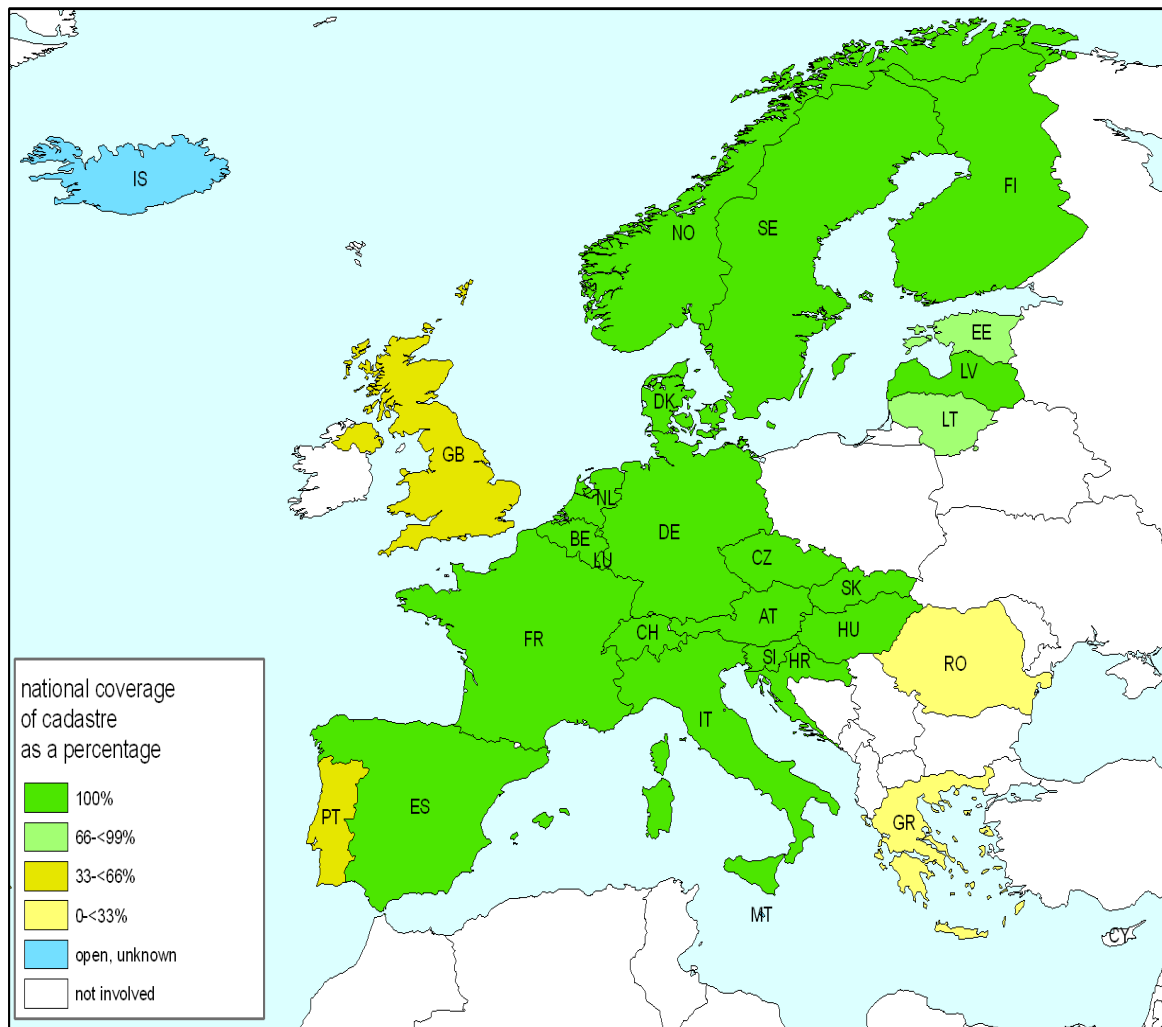
Therefore our working group started with the definition of the cadastral parcel as given by UNECE (2004), which reads: “a single closed area or polygon that is determined geographically by its boundaries, contains land under homogeneous property rights and is held in one ownership”. We were aware of the fact that this definition does mainly apply to continental Europe (and not to the common law countries) and is directly related to land administration, but at the same time this clear definition resulted in responses from over 25 countries. It enabled us to create a detailed inventory of the characteristics of the parcel across

Europe, focussing on coverage issues, digital availability, and core elements and additional attributes.

A second survey was issued to assess the use of the cadastral information (and in particular the cadastral parcel) in National Spatial Data Infrastructures throughout Europe. We felt that this would give a clear insight into the potential use and added value of the cadastral parcel in SDI's both at the national and European level. Moreover, this survey enabled us to assess in how far the uses of the cadastral parcels varied across Europe. Usage across Europe would underpin the direct use of the parcel as part of a European Spatial Data Infrastructure for specific purposes, whereas varied use in some areas would indicate that implementation Europe-wide could be difficult. We considered a wide range of application areas ranging from the (classical) land market to public safety and infrastructure management. We received over 20 responses

### **3.2 Results of the surveys**

The first survey has shown that the cadastral parcel is well established across Europe. It provides detailed information per jurisdiction on the elements attached to the parcel, its quality, (national) coverage, and availability. In Figure 1 we show that the cadastre has already a considerable coverage in Europe and may thus serve as core element in a European SDI

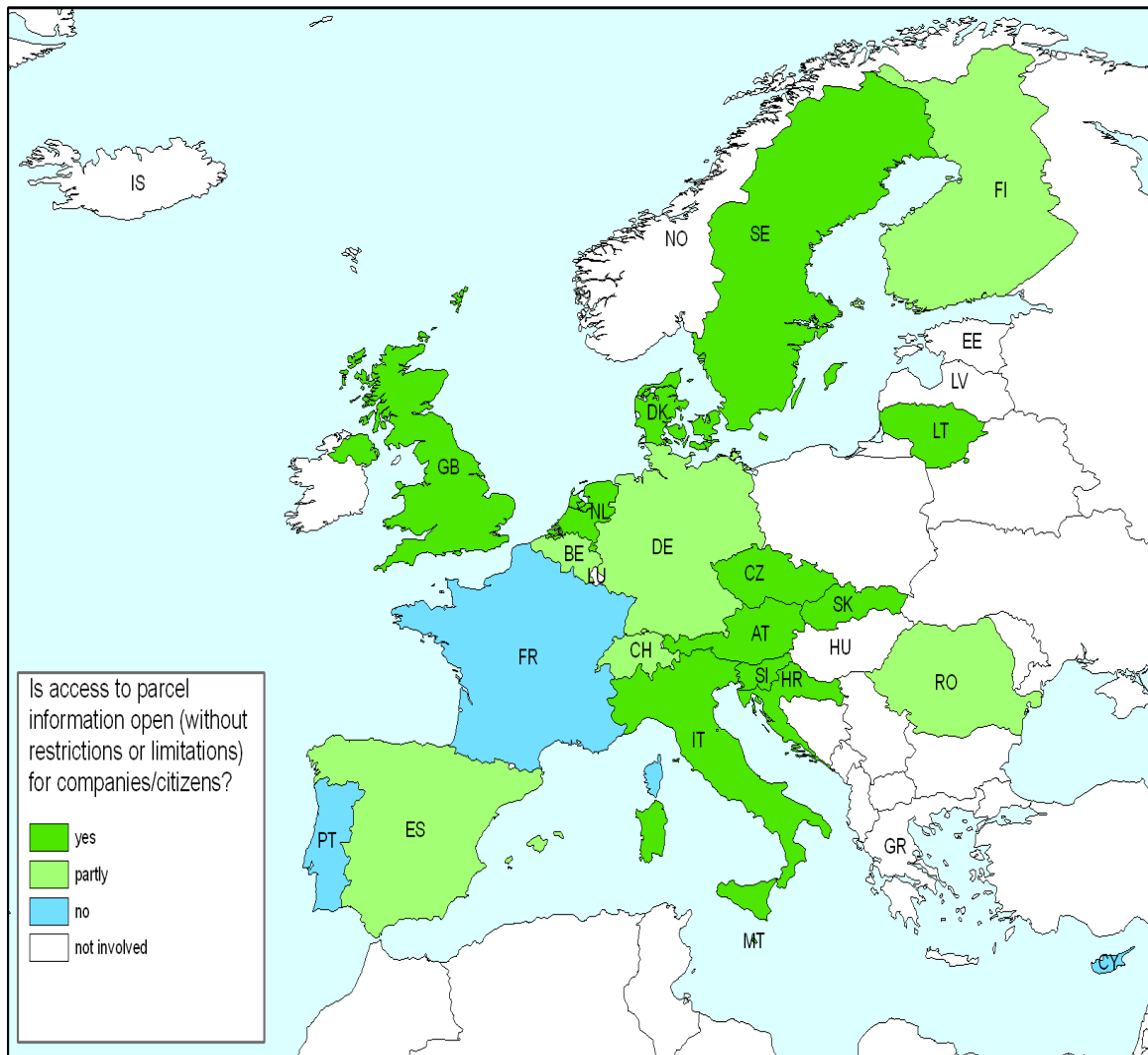


**Fig. 1:** National coverage of the cadastre (from (EuroGeographics and PCC, 2007)).

The results of the second survey (based on 20 responses) show that cadastral parcels are commonly used as an information object in important aspects of the land market (conveyance of property, mortgaging, easements and land/property taxation). Besides, in many countries the cadastral parcel is being used for planning purposes, environmental monitoring, subsidy-programmes, infrastructure management, public restrictions, public safety, geo-marketing and socio-economic analysis. This clearly shows the potential of the cadastral parcel as the (smallest) basic geographic element across Europe. Depending on the theme, however we saw differences in the actual use between countries. Furthermore there were large differences concerning the possible use or legally required use of the parcel for certain purposes.

### 3.3 Accessibility and availability of parcel data

Our surveys also touched on the issues of the accessibility (ease of access) and availability (right of access) of data related to the cadastral parcel. We found that in the field of accessibility large progress is being made in Europe. A survey on this aspect would show a steady improvement within, say, every 6 months. Availability of e.g. web services and portals is continuously increasing. A more fundamental issue is related to the availability of all information related to the cadastral parcel (including amongst others ownership, rights). We encountered large differences in availability for the private sector and citizens in this respect (see Fig. 2). This has been one of the major considerations to limit the definition of the cadastral parcel within the European SDI to being a locator, rather than a meaningful object in the sense of land registration. By this we think availability can be achieved quickly. Harmonisation of the parcel with all elements related to land registration is not foreseen as feasible in the near future.



**Fig 2:** availability of cadastral information for private companies and/or citizens (from (EuroGeographics and PCC, 2007)).

## 4. PROPOSAL FOR THE CADASTRAL PARCEL IN INSPIRE

### 4.1 Key elements of the cadastral parcel

The cadastral parcel is basically the smallest spatial object that is widely used across Europe for numerous applications in national spatial data infrastructures. We propose five key elements that define the cadastral parcel in the European SDI. These are:

- unique identifier;
- area;

- boundaries;
- geo-reference;
- origin and history.

We propose to use the cadastral parcel as a basic geographic unit or locator. Within INSPIRE the parcel will primarily be used as a locator in the geo-information sector in general (although by origin it has always been, and will remain to be, a meaningful object in its own right in the land market and for taxation purposes). Information on rights and ownership is not always available due to legal constraints.

An obvious candidate as a key element was the address (defined in Annex I of INSPIRE as: ‘a location of properties based on address identifiers, usually by road name, house number and postal code’). From our surveys we found that for parcels with buildings an address is usually available, but that in many countries this is not the case for parcels without buildings. Therefore we have not chosen address as a key element, but consider it as a very useful secondary locator. We found large deviation and variety in quality and coverage between the countries concerning the elements land cover (Annex II) and land use (Annex III) and therefore did not consider them suitable as key-element (although they are closely related to the purposes of INSPIRE).

We think the five core elements listed above make the cadastral parcel widely applicable, relatively easy to implement and a sustainable core element within the INSPIRE-framework.

## 4.2 Implementation issues

In order to diminish the variations in the elements and to promote interoperability between European countries we recommend that for each of the five key-elements some minimum requirements are to be met. These are basically implementation rules which were derived from the results of our surveys:

- **Unique identifier:** at least the unique national identifier should be used. Regarding a European unique identifier, we propose a composition of a country identifier and the (national) unique parcel identifier.
- **Area:** should be stated in square metres. Also an indication of the quality and the type (derived geometric or legally binding) regarding the metadata should be provided.
- **Boundaries:** at least raster data should be available as well as coordinates in the national system. Also an indication of its quality is important. Optional is closed polygon’s information.
- **Geo-reference:** coordinates in a national system are necessary. The coordinates have to exist as a point *within* the cadastral parcel because the reference point of the parcel, which is the basis of geo-referencing, has to be part of the parcel. We recommend using the geo-information already available in countries as a starting point.
- **Origin and history:** basically required is the date of the last change. Future developments might require extra details.



Working in the national reference system does not hamper interoperability in Europe; all national systems are well connected to the European reference frame.

In defining the core elements and their implementation we were aware that a full roll-out over Europe will still require effort. In some countries coverage is not yet nationwide (see Fig. 1), but we see an autonomous trend to reach this objective. On the other side our limited definition of the parcel based on its five key elements, makes its implementation feasible. Including information of ownership related issues would hamper its implementation at the moment and would delay the introduction of the parcel as a generally useful spatial object in the European SDI.

### **4.3 Status of the proposal**

In the coming months the drafting team on data specifications within INSPIRE will finalize the definition and implementation specifications of the primary data-elements of the INSPIRE-directive (listed in annexes I and II). Our work has been classified as reference material for the drafting teams by the European Commission.

## **5. USE OF THE CADASTRAL PARCEL IN SDI'S**

With the INSPIRE directive the cadastre and the cadastral parcel in particular are formally established as parts of a European (regional) spatial data infrastructure. At the local, provincial (state), and national level this is actually already common practice.

### **5.1 Cadastral perspective**

From the cadastral perspective much effort has been put in the development of cadastres in the realm of land administration (Kaufmann and Steudler, 1994; UNECE, 2004). Kaufmann and Steudler see the Cadastre as an institution that inventories and registers all rights and restrictions (both according to public and private law) that have an impact within a defined contour of the surface of the Earth. The parcel will be an important, but not the only, object at the base of the registration. In their study and their surveys they already notice that the cadastral parcel has full coverage in many jurisdictions. Considering the full registration of all rights and restrictions the cadastre (and thereby the parcel) must be an essential cornerstone in every jurisdiction (although they not state that explicitly). Important to note is that one of their major findings is that the cadastre of the future is cost recovering (this is already the case in many European countries). This makes the cadastral parcel a sustainable object in the SDI in the long run.

The UNECE (2004) focuses on the implementation of sustainable land administration system in Europe. Their findings correspond to a large extent to the trends described by Kaufmann and Steudler (1994), but also substantiate the findings of our own surveys. The UNECE report does not strive for harmonisation across Europe, but stresses common good practices. It lies the foundations for a good cadastre and as part of that a good definition of the cadastral

parcel. The UNECE reports also concludes that if a proper cadastre is in place its spatial element (the parcel) could be the basis for many processes in society (ranging from agricultural subsidies to land planning). All the key elements of the cadastral parcel we have chosen in our proposal are part of the conclusions and recommendations of UNECE.

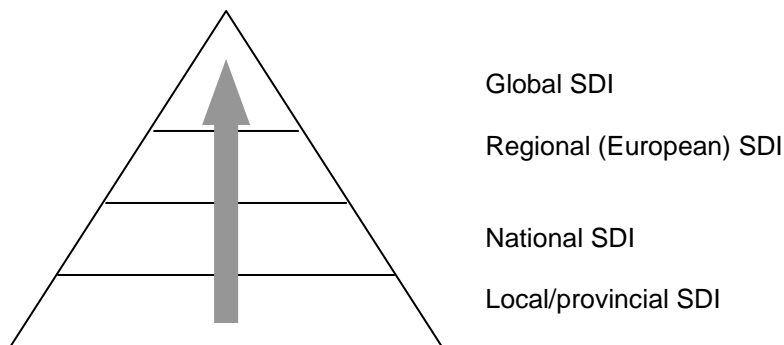
In the United States FGDC (2006) is striving for a uniform coverage of parcel data at all levels of government (from local to national). Like in Europe the United States face the situation that there exist various data sources (not so much along the lines of national jurisdictions as in Europe, but more along the lines of the legal mandates of the different levels of government). The definition of the key elements of the cadastral parcel in the US cadastral NSDI contains our five key-elements. It furthermore contains many elements related to ownership and value, being focussed primarily on land administration. In this sense the US SDI is already more mature using the parcel both as a locator and a property unit. It is interesting to note, however, that when specialized to various user groups (ranging from emergency services to energy management) three of our five key-elements are essential to all groups (parcel ID, the parcel outline (boundary), parcel centroid (georeference)). The only two other attributes interesting in the US parcel definition for all parties are the surface owner type (which we discarded because of availability issues) and the indication of improvements underway on the parcel. This to a large extent substantiates our proposal.

A nice overview of the status and role of the cadastres is provided in the Cadastral template ([www.cadastraltemplate.org](http://www.cadastraltemplate.org)). It contains a special chapter on the role of the cadastral layer in SDI and thereby provides an insight in the state of affairs worldwide.

The examples given above might suggest that the cadastral parcel will always be a pivotal element in the national or even regional SDI. This is not automatically the case. It will certainly be so in the densely populated and well administered parts of the world, but there exist large areas where the parcel is only properly defined (and used) in parts of the country (Fourie, 2001). In Africa, for example, there are regions where less than 10% of the land is part of a cadastre.

## 5.2 International perspective

Our conclusion is that the cadastral parcel as we know it (with its focus on land administration) will certainly be a core element of the local, provincial and national SDI's. In the regional SDI the cadastral parcel will first be introduced as a locator. Reasons for this are that the availability of all data related to the parcel varies over jurisdictions, many elements are similar but not harmonized, and finally the granularity of the parcel is too high for a general regional (i.e. European) SDI (see, e.g. (Nebert (ed.), 2004)).



**Fig 3:** Hierarchy of SDI's.

Over time the definitions of what are core and reference data of SDI at the different levels will evolve. Once we in Europe reach acceptance that the full cadastral dataset is core, also the European SDI will contain the cadastral parcel with all its elements (see Fig. 3).

In the meantime we see an European market for land information emerge. The EU policy of opening up financial markets and stimulating cross-border transactions, creates an environment in which at a European level and land information infrastructure comes into existence. The EULIS-service ([www.eulis.org](http://www.eulis.org)) is set up for this purpose. We expect that once this domain information infrastructure reaches a sufficient level of maturity, it will be embedded a European (spatial) data infrastructure. An important aspect in these endeavours is also the issue of availability of parcel data related to land administration (see §3.3) and the control over parcel data by the authorities in the various jurisdictions. Because of market pressure there is convergence, but not yet at the level that uniform, harmonised cadastral parcels are available across Europe.

Also at the policy level both EuroGeographics and the PCC foresee increasing exchange of cadastral information, harmonisation and increasing SDI-interopability (EuroGeographics, 2007). It is a gradual process due to the fact the European SDI is not created from scratch but is partly based on well established land administration systems with rules and regulations of their own.

## 6. CONCLUSIONS

The cadastral parcel will be a core spatial data theme in the European SDI through the INSPIRE-directive. We have defined core elements of the cadastral parcel based on an 'SDI-view' rather than the classical view of the parcel as being an property unit. Our surveys have shown that the cadastral parcel has a good coverage across Europe and is already widely used in many national spatial data infrastructures. In order to facilitate its implementation and to maximize its use we have proposed five key elements of the parcel. Based on this definition the cadastral parcel is used as the smallest, common spatial object widely available across Europe. The future will bring additional standardization. In the longer run also the cadastral parcel as property unit will be considered as part of the European SDI.

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## ACKNOWLEDGEMENTS

This paper has been inspired by and is to a large extent based on the work of our colleagues of the joint EG/PCC Working group on the Cadastral Parcel within NSDI's and INSPIRE. We wish to thank Berny Kersten (EuroGeographics Head Office), Wilhelm Zeddies (Germany), Ignacio Duran Boo (Spain), Amalia Velasco (Spain), Pierrette Fraisse (Belgium), Bo Lauri (Sweden), Pia Dahl Hojgaard (Denmark), Luigi Caraglio (Italy) and Francis Kaell (Luxembourg) for the many fruitful discussions, sharing of experiences and last but not least the hard work related to our workshops.

## BIOGRAPHICAL NOTES

**Martin Salzmann** is a senior strategy and policy consultant with the Cadastre, Land Registry and Mapping Agency (Kadaster) of the Netherlands. He was member of the EG/PCC working group on the Cadastral Parcel. His portfolio with the Kadaster includes the (emerging) system of key-registers in the Netherlands, strategic marketing and communication and HRM. Previously he has been heading the marketing and geodesy departments of the Kadaster and has worked as a consultant in quality assurance and cadastral surveying and mapping. Martin has been with the Cadastre since 1996.

**Julius Ernst** is a deputy director of the division for the Cadastral and Metrology offices and head of the Cadastral unit of the Austrian Federal Office of Metrology and Surveying (BEV). Additionally he is head of one of the BEV's Cadastral offices in Oberwart. At the Technical University of Vienna and at the University of Agriculture in Vienna he is lecturer for cadastre. In different international projects he has worked as a senior consultant for Cadastre and land administration. He was chair of the EG/PCC working group on the Cadastral Parcel.

## CONTACTS

Dr Martin Salzmann  
Kadaster (Cadastre, Land Registry and Mapping Agency of The Netherlands)  
PO Box 9046, 7300 GH Apeldoorn  
THE NETHERLANDS  
Tel.: +31-88-1833196  
E-mail: [martin.salzmann@kadaster.nl](mailto:martin.salzmann@kadaster.nl)  
Website: [www.kadaster.nl](http://www.kadaster.nl)

Dipl.-Ing Julius Ernst  
Bundesamt für Eich- und Vermessungswesen  
Schiffamtsgasse 1-3, A-1025 Wien  
AUSTRIA  
Tel: +43(0)1 21110 3703  
E-mail: [julius.ernst@bev.gv.at](mailto:julius.ernst@bev.gv.at)  
Website: [www.bev.gv.at](http://www.bev.gv.at)