

From Parcel to Global Cadastre: Challenges and Issues of the Post-Reform Quebec Cadastre

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SUMMARY

The Government of Quebec aims to update Quebec's cadastre by providing an accurate computer-based representation of private land division in the province of Quebec. The cadastral reform is a unique project in terms of its scope, production methodology and final product characteristics. The end result of the cadastral reform will be a system no longer based on single parcel paper maps, but a global digital map.

Despite the strict framework for production of the Quebec cadastral reform, in 1992 the renewal of the Quebec cadastre has raised questions which were not foreseen at the outset, and the aim of our study is to describe the challenges and problems that have come with this transition.

First of all, the effects of the new cadastral system on the professional activity of land-surveyors were not entirely identified and estimated. In the past, the idea of integration was absent and land-surveyors used to work on single lots without taking into account the neighboring estates. Therefore, parcel cadastral plans suffer from problems such as distortion and lack of integration within the land division framework.

The main challenge will be to ensure the improvement of the global cadastral plan, enhancing the consistency of the map in accordance with field survey data and applying procedures of correction, particularly when scale or projection changes are required.

From Parcel to Global Cadastre: Challenges and Issues of the Post-Reform Quebec Cadastre

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1. INTRODUCTION

The Quebec land register has existed since 1860, but it was incomplete and contained inaccuracies. The Government of Quebec began to prepare a new cadastral map in order to show all properties correctly in 1985¹. After initiating the cadastral reform program², problems concerning the fact that there were no legal dispositions to make the correlation between former literal descriptions of land in titles and the new cadastral image of the parcel arose (Delage et al., 2004; Brochu and Beaulieu, 1999). In 1991, the Government of Quebec halted the reform process in order to adopt and sanction such a disposition³.

After some adjustments (particularly the decision to develop a cadastral database to support the creation of a global plan), the reform resumed in 1992 under the responsibility of the Ministry of Natural Resources and Wildlife. The goal of the “second version” of this program was to update Quebec's cadastre by providing an accurate computer-based representation of the cadastered territory of Quebec (Boutin, 1995). Cadastral renewal work began in 1994, and about 3.7 million private properties (lots) are targeted for computerization on the provincial scale by the end of the reform process (previewed for 2021).

The cadastral reform is, consequently, a project of unprecedented dimensions, and unique in terms of its production methodology and final product characteristics. In fact, the end result of cadastral reform will be a system no longer based on single parcels, but on a global plan. It will represent the whole set of private properties within the province of Quebec and consist of a digitalized, georeferenced and constantly updated cartographic model of land divisions.

Despite the strict framework of production of the Quebec cadastral reform, the operation of renewing the Quebec cadastre has raised questions which were not foreseen at the outset, and the aim of our study is to describe the challenges and problems that come with this transition. First of all, the effects of the new cadastral system on the professional activity of land-

¹ <http://www.mrnf.gouv.qc.ca/english/land/cadastre/index.jsp>.

² In accordance with the enforcement of the *Act to promote the reform of the cadastre in Québec*, R.S.Q., c. R-3.1.

³ *Act to promote the reform of the cadastre in Québec*, R.S.Q., c. R-3.1, par. 19.2, creating a presumption of concordance between the titles description and the cadastral lot: « the description of the lot contained in the instrument of acquisition of the owner and in the acts evidencing the charges, prior claims, hypothecs or other rights affecting the lot is presumed to be concordant with that of the lot shown on the renewal plan. In case of discrepancy, the description contained in the instrument or acts need not be corrected by judgment or otherwise ».

surveyors were not entirely identified and estimated. In the past, the idea of parcel integration was absent and the land-surveyors used to work on a single lot without taking into account the other properties. Quite often nearby parcels were not accurately mapped and created in reciprocal overlapping. This anomaly could not always be detected when the lots were being defined, because the work of the land-surveyor was not based on an overall view.

Therefore, parcel cadastral plans suffer from problems such as distortion and lack of integration. In order to produce a reliable territorial representation, the land-surveyor must now integrate the results of his work at a global level. In Quebec, land-surveyors are the only professionals who are legally qualified to carry out cadastral operations. As a result, a future consideration will be the definition of their role in case of a mismatch between their opinion and a cadastral representation.

In the near future, the main challenge will be to ensure the improvement of the global cadastral plan, enhancing the consistency of the map in accordance with field survey data and applying procedures of correction, particularly when scale or projection changes are required. The final goal of the reform is to transform Quebec's cadastre into an instrument that supports the proper functioning of the land register, to benefit land-surveyors work and, as a result, the entire society.

2. THE QUEBEC CADASTRE AND THE REFORM PROGRAM

The Quebec cadastre was created in 1860 with the adoption of a law⁴ intended to compensate for weaknesses in land registry offices, which were created in 1830 for five Eastern Townships counties and in 1841 for the rest of the province⁵. Between 1830 and 1860, the "Name Index" registry was used to register deeds referring to property rights, on the basis of the names of the parties involved in the transaction. The limitations of this system became evident due to the complexity of maintaining an inventory of property rights for a particular piece of land. It did not protect citizens against fraudulent acts in cases where land titles were questionable. As a result, in order to protect the integrity of property rights established by registry offices, the State decided to create a cadastre throughout the province to support the creation of a buildings index, to which acts would be entered by cadastral lots numbers.

The 1860 cadastre system did not result in an official portrait of the land subdivisions regularly updated on maps. In addition, it could not be updated because of the legal option to create and register deeds on portions of cadastral lots without producing a cadastral subdivision map. Also, in the context of rapid development of information technologies, a cadastre based on paper maps soon became obsolete. The cadastre needed to be integrated into geospatial databases, increasingly used to support the process of territorial governance at local, regional and national scales.

⁴ *Act concerning registry offices and mortgages rights for Lower- Canada*, 23 Victoria, c. 59.

⁵ *Prescription* O.P.B.-C. 1841, c. 30.

Thus, the government of Quebec launched a cadastre reform program with the adoption of a law⁶ in 1985. The main objectives of this reform program were:

- Cadastral renewal: it is a major operation which aimed to renew the cadastral map by registering any parcels not already officially logged in the cadastre and correcting any errors or anomalies.
- Regular updating of the cadastral map: it must be updated after each operation that modifies land parcels; the updating is carried out under the terms and provisions of the Quebec Civil Code for land registration.
- Creating a multipurpose cadastre: it would be useful to different users, in particular, those municipalities and ministries with jurisdiction on the territory.

In 1991, the first attempt at reform ran into certain difficulties (Delage et al., 2004; Brochu and Beaulieu, 1999) which led to a suspension in order to correct certain problems. The reform program was finally restarted in 1992, and was promoted in conjunction with the land registration reform carried out by the enforcement of the new Quebec Civil Code, on January 1, 1994. The cadastre became part of the land register and was also used as the base for the publication of land entitlements and rights.

The relaunch of the cadastral reform program in 1992 was made possible by the creation of a legal presumption of concordance between the renovated cadastre and the land description in the deeds⁷. In fact, the cadastral reform was used to specify linear measurements and the surface area of each lot. However, this gain in precision could result in differences between the cadastre and descriptions contained in the land titles. To avoid the need for a legal judgement to correct the land titles, the legislator established a legal presumption of agreement in order to minimize the legal consequences of the reform on the ordinary citizen (Delage et al., 2004).

Moreover, a new technical concept of graphic tolerance was defined⁸. It allowed the cadastral registration of measurements differing from those shown on the map and calculated using the coordinates from the geometry of the lots. Following Ministry of Natural Resources and Wildlife guidelines⁹, these differences had to respect an order of magnitude established according to the scale of creation of the cadastral map. For example, the maximum difference between the registered linear measurements and those calculated using coordinates would be 21 centimetres for a scale of 1:1000. Consequently, the official measure is the one that appears digitally on the map, and not the one calculated from the coordinates of each lot corner.

⁶ *Act to promote the reform of the cadastre in Québec*, R.S.Q., c. R-3.1.

⁷ *Act to promote the reform of the cadastre in Québec*, R.S.Q., c. R-3.1, par. 19.2.

⁸ *Act to promote the reform of the cadastre in Québec*, R.S.Q., p. 29.

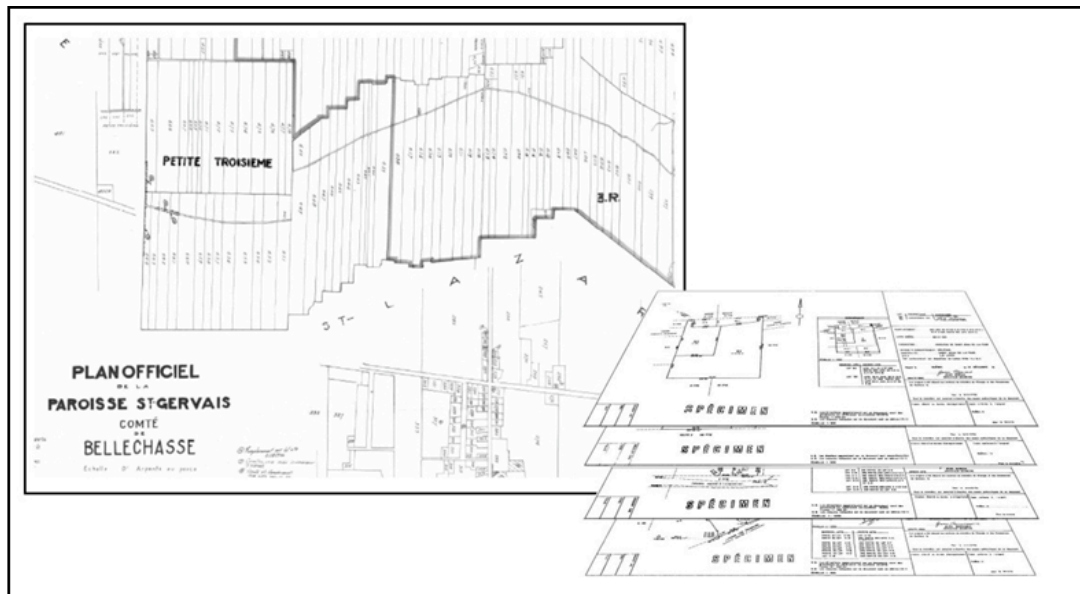
⁹ *Cadastral law*, art. 2, L.R.Q.,c. C-1.

With this legal presumption of agreement and the technical acceptance of tolerance, it is understood that the cadastral map may contain differences between two distinct realities: the physical reality of the surveyed terrain and the legal reality of land titles based on a series of legal acts. The political will to create a global cadastral map was thus hindered by technical and legal complications concerning land parcelling and cadastral map conformity.

3. THE GLOBAL CADASTRAL MAP

Before the reform, the Quebec cadastre consisted of original maps that reflected the private land divisions supplemented by numerous parcel plans of subdivisions deposited when new lots were created. At one time, when there were not too many divisions, the cadastral modifications were indicated in the margins of the original maps. Figure 1 illustrates an example of an original map, with notes in the margin, that documents any modifications to land divisions.

Figure 1 : Original map and parcel plans

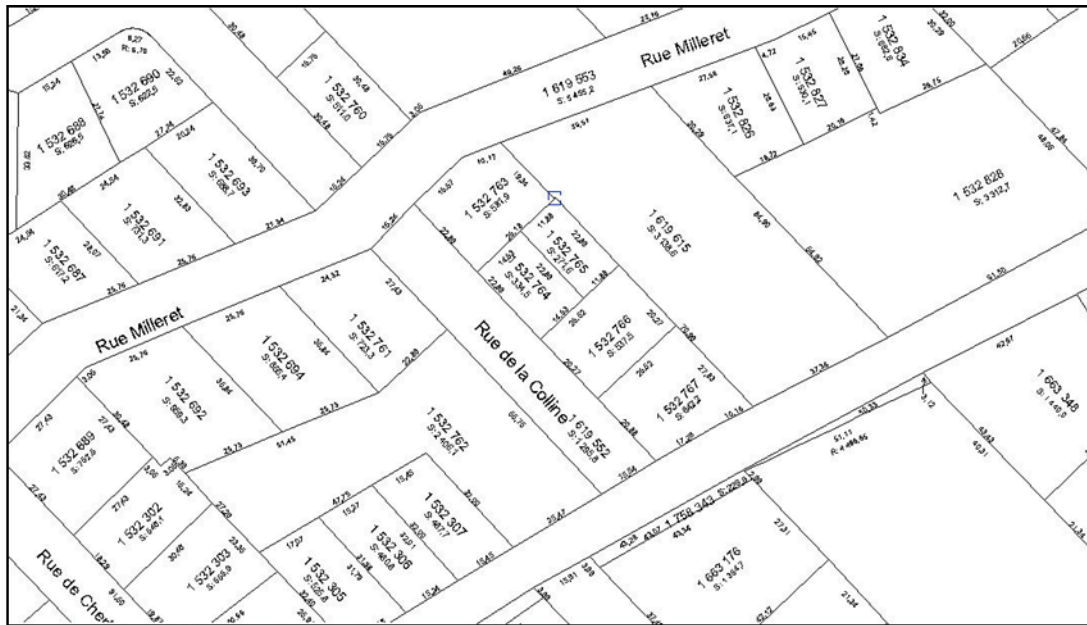


In a cadastral parcelling system, a lot could almost be considered as an island, completely independent of neighbouring lots. Modifications of its measurements and surface area do not necessarily involve adjustments to bordering lots. Thus, one of the fundamental conditions of this cadastral system is not coherent and true to the physical reality represented.

A global cadastre has its own characteristics. First of all, it represents the overall land subdivisions of a territory by modelling the lots in their relative positions (see an extract of the global map in Figure 2). Subsequently, modifications to one lot necessarily imply modifications to neighbouring lots. Thus, it is no longer an “isolated island”, but part of a “cadastral framework”.

The creation of a global map implies that the cadastral representation is as true as possible to the actual land subdivisions on the ground. Variations or differences could have annoying consequences, such as project delays or cancellation.

Figure 2: Extract of the global cadastral map

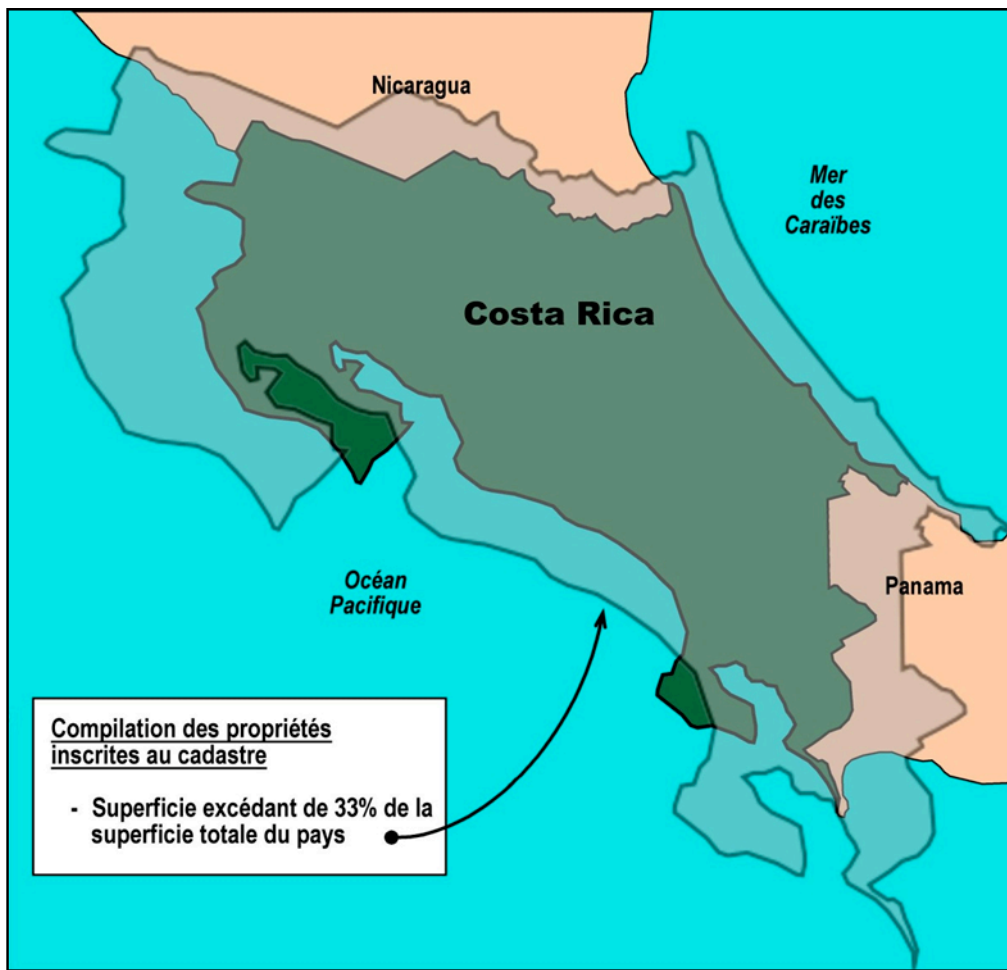


3.1 Coherence and fidelity between the field and the map

Fidelity is extremely important in the context of a global map. This brings us back to a fundamental problem of cartography, noting the difference between the cartographic representation and reality (Pickles, 2004). In certain cases, these differences have no consequence, as in the case where the cadastre is only being used to create an inventory of properties and lands, and to identify them for administrative purposes. However, in other cases these differences can cause numerous problems, especially when the cadastre is being used to represent and identify property rights during transactions where lot dimensions and area are established by entries to the global map instead of individual lot characteristics.

Coherence and fidelity are of primary importance and major variances between the ground and the cadastral map could cause loss of confidence in the property right protection system in place. For example, in Costa Rica, which has a parcel based cadastre there is a lack of georeferenciation and integration. As Daniel Roberge (2000) wrote “it is not uncommon to find many different maps from the same property or to have the wrong map registered for a property”. Approximately 80% of the lands are registered on the cadastre, and if we add the maps together, the result is an increase in total national geographic area of 33% (Roberge, 2000). From a cadastral point of view, Costa Rica would stretch out into the Caribbean and Pacific, towards Nicaragua and Panama, as illustrated by Figure 3.

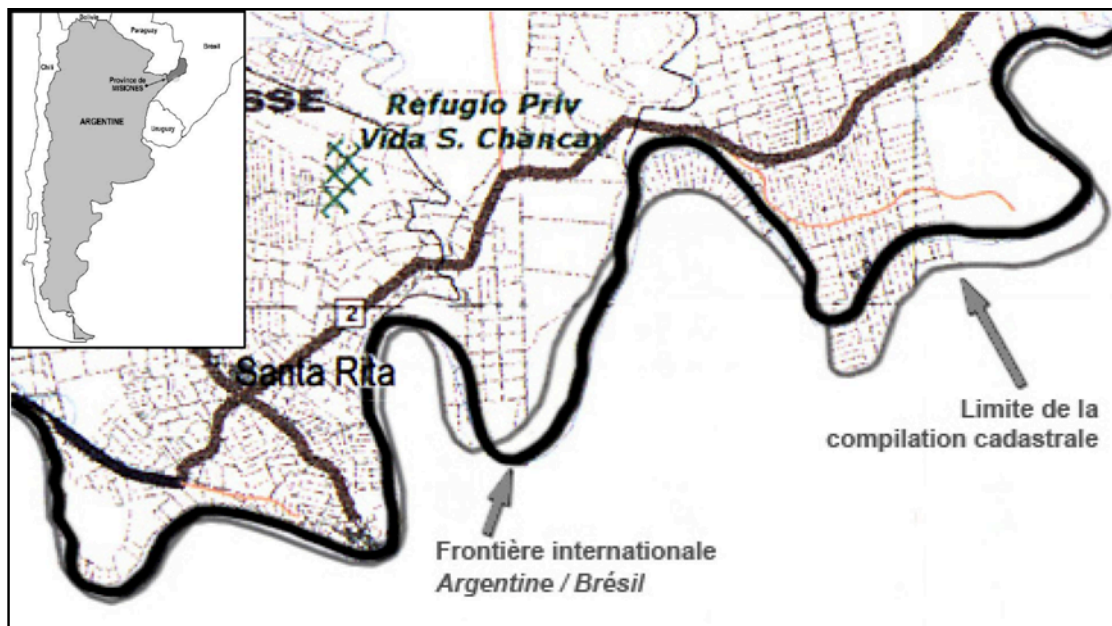
Figure 3: Costa Rica's cadastral area, greater than the country's actual area.



In Argentina, the cadastre is affected by similar problems: its structure is incomplete and includes major distortions (Flores and Urtubey, 2000). Provinces are responsible for the cadastre and use it to assess the value of real estate and determine property taxes. In order to evaluate the quality of these provincial cadastres, the province of Misiones compiled a overall parcel cadastral map. The results are rather revealing: in certain cases, the deviances between the map and reality attained 5 to 7 kilometres.

As a result, the cadastral lots cross the Brazilian border, as seen in Figure 4. Consequently, the spatial reference system (i.e. the geodetic network) employed in the cadastre contains many weaknesses. The creation of a global map is seriously hampered because of low quality georeferencing.

**Figure 4 : Map of cadastral compilation,
Misiones Province, Argentina (at <http://www.misiones.gov.ar/catastro/index2.htm>)**



A global cadastral system requires the establishment of geometrical and geospatial quality standards for the data (i.e. the shape, dimensions and positioning of the elements of the cadastre). The result is a certain rigidity in the creation and operation, but on the other hand, favours a greater overall coherence of the cadastre. The standardization of the coordinate system increases the utility of the cadastral map for many applications, particularly the activities of territorial governance (Kaufmann and Steudler, 1998). The cadastral map became a geometrical model of the existing territorial subdivisions. In order to build it, it is necessary to determine several control points distributed across the land. In 1999, standards for the presence and distribution of control points on the ground were developed in order to validate the correspondence of the cadastral map with the physical reality of the entire subdivisions.

4. LAND-SURVEYORS TERRITORIAL ANALYSIS

Some consequences of the reform are not entirely understood and managed yet. The introduction of a global map involved fundamental changes to the methodology used by land-surveyors. The reform constitutes the basis of a modified legal system which must be determined, defined, disciplined and controlled so that it can be applied as accurately as possible for the benefit of all citizens.

The cadastral renewal has effects on the practices of land-surveyors. Under the Quebec system, they are the only professionals who have legal authority to perform cadastral operations and, ultimately, cadastral reform itself. Moreover, various tasks carried out by the land-surveyor must take into account the cadastre and its legal implications for the

environment in which they work. The biggest dilemma is the real influence that the cadastre exerts on professional activities. Neither doctrines, nor jurisprudence serve to help answer these questions. Experience and sound judgement appear to be the only useful elements in this new “professional territory”.

The Quebec cadastre does not set property limits; it is not a legal cadastre as in Switzerland or Sweden. Its main objective is to specifically register each building bearing distinct land rights. For this reason, it is necessary “to represent building limits” without attaching an official and final character to them. In all cases, the land-surveyor cannot ignore the existence of the Quebec cadastre when surveying private properties. The preparation a certificate of localization must contain his comments and opinions on discrepancies between the land titles, occupation and the cadastre¹⁰. This requires the amalgamation of three realities: a legal reality (titles), a factual reality (occupation) and a cadastral reality (the lot).

Even if it does not set the property limits, we cannot ignore the probative force of the Quebec cadastre. Despite its solid technical value (graphic and descriptive databases, Ministry instructions and numerical format), certain precise details must be included in our consideration. Thus, the range of the cadastre cannot be examined independently of the legislative measures relating to it, specifically those of the Quebec Civil code. Indeed, the Quebec cadastre is defined in the context of the publication of rights, as it pertains to the land register¹¹. The cadastral registration is an indispensable condition in the publication of property rights¹².

When considering the influence of the cadastre, one must explore its utility in determining the characteristics (mainly measurements and surface area) of a property involved in a transaction. Indeed, article 3032 of the Civil code of Quebec affirms that “as of the day of the coming into effect of the cadastral map, the number given to a lot is its only designation and is enough in any document which refers to it¹³”. In practice, the consequence of this provision is that translative acts do not contain any further description of the building in question (i.e. the legal object), but only refers to the cadastral lot number. To establish the characteristics of the building, it is therefore necessary to refer in the cadastral map. The parties no longer exchange lands, but rather cadastral lots. Overtime, one can assume that the legal consequences of the cadastre will be strengthened to the point where they will be the basis for the designation of the land in question. The influence of the land register is not *de jure* (it is not set in law), but rather *de facto* (it evolves from practical use). Thus, the land-surveyor must be able to evaluate the influence of the cadastre in context.

¹⁰ *Regulation on the standard of practice relating to the localisation certificate, R.R.Q., c. A-23, r.7.1, art. 9.*

¹¹ *Quebec Civil Code*, art. 3027, al. 1.

¹² *Quebec Civil Code*, art. 3030, al. 1.

¹³ *Quebec Civil Code*, art. 3032, al. 1.

Hence, the land-surveyor needs to refer to the cadastral map and the officialised work of the other land-surveyor must be taken into account. His work must be integrated with the existing georeferenced map. This required fusion can be tricky if there are discrepancies or anomalies. The land-surveyor could have problems inserting his work into the cadastral framework, without having to modify or correct the global plan in order to improve it.

The surveyor's opinion about a building's delimitation can differ from the cadastral lot plan, as represented on the map (Delage et al., 2004). This situation can arise from the use of graphic tolerance during map creation, existing differences between land title descriptions and the actual layout on the ground, or finally, because of distortions induced by the cadastral improvement itself (especially in cases of surplus or deficit terrain distribution). Even if the cadastre does not delimit the buildings themselves, the land-surveyor must refer to it when he issues his opinion on the delimitation of a building. It is here that major concerns of the land-surveyors come to light, namely:

- How to analyze the conformity criterion (or variance) between a professional opinion on the delimitation of a building and the corresponding cadastral lot?
- What is the critical point of this criterion (when to take into account or ignore the variance)?
- What are the legal repercussions of an opinion that notes a variance between a building and its cadastral representation?

During an Order of Quebec land-surveyor training session held in March 2007 (Roy and Sylvestre, 2007), a new point of view was suggested for dealing with the various questions. First of all, the key elements (or cadastral data) used in the conformity analysis must be well defined. To this end, reference was made to the content of the official cadastral plan as outlined in article 3026 of the Quebec Civil code: "The certificate states the relative position of buildings on the cadastral map, indicates their limits, their dimensions and their capacities and assigns them an identification number"¹⁴.

Thus, the land-surveyor must evaluate the application of conformity criteria based on the lot's relative position to adjacent lots, the limits (mainly the form of the layout: straight line, curve), linear dimensions and the surface area. It is evident that angular measures and the geometric form of the lot are not official data to be considered. Should the land-surveyor ignore these two elements, which are of more or less importance when considering official lot data, particularly linear dimensions and surface area? This question deserves further investigation and must be supported by practice.

For example, if the land-surveyor notes that linear measurements and the surface area are the same, but a difference between the geometrical shape of the land and the one of the corresponding cadastral lot, what should he do? Should he modify the shape of the cadastral lot in order to make it correspond to his opinion, without significantly affecting linear

¹⁴ *Quebec Civil Code*, art. 3026, al. 1.

dimensions and the surface area (which constitutes the official data of the cadastre)? Another question to be asked is how to determine if the graphic tolerance will play a part during the creation of the plan, so as to explain the noted differences.

Many debates, discussions and exchanges are foreseen in the next few years on this question situated at the heart of the land-surveyor profession. The problem could be summarized by the following question: can the land-surveyor arbitrarily modify the geometrical configuration of cadastral lots in order to make them correspond to the opinions that he issues on the delimitation of the buildings? Is it contrary to the concept of global level, while inducing the differences between the true parcel and his cadastral representation? In this way, we would move away from the legal presumption of accuracy of the cadastral map¹⁵ and the idea of a land parcel cartographic model.

4.1 Cadastral map improvement

The concept of global level requires the establishment of improved cadastre processes. Of course, a massive operation like the cadastral reform is not perfect to the smallest detail, representing exactly and precisely each limit forming the land parcels. Political and economic requirements provide the framework for establishing quality standards for the reform of the cadastral product. The land-surveyor must be the major players in this process.

Many cadastre correction procedures exist, but these imply that it contains errors which need to be corrected. Sometimes the cadastre is not exact when compared with the reality of the parcels, or is formulated differently, and the level of exactitude of the cadastre is not sufficient for the required operation. In this case the cadastre is not erroneous, but it is, nevertheless, necessary to adjust it or improve it in order to be able to integrate it into certain cadastral operations for representing new parcels. If a project of allotment were carried out in a sector where, given the dimension on the ground, the scale of creation of the renovated map would be 1:5000. The new lots must, however, be created on a 1:1000 scale. Depending on the use of the graphic tolerance (which is five times larger on a 5000e scale - passing from 0,21 m to 1000e to 1,05 m with the 5000e), the operation of allotment could be very difficult to accomplish, even impossible, without an improvement to the cadastral representation of the basic lot.

The cadastral reform already shows promise for future challenges. Correction mechanisms for the cadastral map already exist, on the initiative of the owner or the Minister. These will have to be implemented in order to reduce times and waiting periods. This is one of the major criticisms that land-surveyor direct at the Head office of land surveying and cadastre. It is also necessary to foresee the possibility of an increase in requests over the next few years, as cadastral reform progressively advances. The other big challenge is to create mechanisms aimed at increasing the precision and accuracy of the plan, especially in cases where

¹⁵ *Quebec Civil Code*, art. 3027, al. 1.

operations carried out in the cadastre of Quebec require higher levels of quality (mainly in sectors affected by scaling of creation).

Finally, we can hope that such global improvement mechanisms will make it possible for the Quebec cadastre to become an instrument that is more supportive in the protection of rights and proper functioning of the real estate market.

5. CONCLUSION

Today, the reform of the Quebec cadastre raises questions which were not anticipated at the start of the process. Although the costs, production processes and features of the cadastral product were planned, the effects of the new cadastre on the professional practices of the land-surveyor have not been completely identified, characterized and controlled yet.

The creation of the global cadastral map has forced a revision in the practices of the land-surveyor and his role has grown in importance. From now on, he doesn't work on independent properties which are distinct from one another, but on an integrated cadastral system, where properties are interrelated on a global cadastral screen.

The main challenge in the next few years will be to ensure the improvement of the global cadastral map, using existing correction procedures and particularly with regard to the accuracy of the cadastral representation. Currently, some difficulties experienced by land-surveyors are not caused by errors in the plan, but by the need to obtain higher quality cadastral data, especially in areas subject to changes of scale or those affected by the use of graphic tolerances. This challenge represents a corollary in the global map, namely a constant search for higher coherence and fidelity between the cadastral map and the existing land parcels.

Finally, the program of cadastral reform offers unique instruments of land management. Given the unprecedented scope and nature of this program, it is only natural that all the repercussions and fallout could not have been foreseen, when it was relaunched in 1992. In the next few years, one of the most important challenges of land-surveyors will be to adjust and develop their practices in a way that will improve the cadastral map and make it a valuable instrument in the Quebec real estate.

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BIOGRAPHICAL NOTES

Elisabetta Genovese is a postdoctoral researcher at the Department of Geomatics at Laval University, in Quebec City (Canada) since January 2008. She completed a PhD in Development Policies and Territorial management (University of Trieste, Italy) in 2006, and obtained a master degree in Environmental Economics (University of Piemonte Orientale, Italy), in 2001. She worked at the European Commission, DG-JRC, in Ispra (Italy), from 2005 to 2008, and previously in 2003, within the Land Management & Natural Hazards Unit, on MOLAND and ADAM projects. She collaborated with the University of Piemonte Orientale as a researcher and teaching assistant, from 2001 to 2004. She is author of several scientific publications and technical reports about Territorial Assessment, Land Management, Urban Development connected to Natural Hazards, Environmental Economics, Economic Impact of Geographic Information and Volunteered Geographic Information.

Francis Roy is a professor at the Department of Geomatics at Laval University (in Quebec City, Canada) since September 2003. He teaches and realises research works in the fields of cadastral systems, land property, land administration, and town and country planning. He is particularly interested in land and cadastral reforms, in particular in Latin American countries, as well as in problems of integration of the private law of land property with public laws planning. After obtaining a bachelor degree diploma in Geomatics (Laval University, in 1990), he made studies in Land Use Planning and Regional Development at the master's degree level (Laval University, in 1992) and doctorate level (University of Montreal, in

1999). He has been a research professional in forestry (forest economics) in 1999. Then, from 2000 to 2003, he worked in a private business as a specialist in land management. He participated in several projects on cadastral reforms in various Latin American countries. He is also a Quebec land surveyor since 1991.

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