The Land Code

Xavier COMTESSE, Daniel STEUDLER, and Jeffrey HUANG, Switzerland

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SUMMARY

Traditionally, the management of territory relied on a particular form of representation: the map. Of course with the arrival of computers and databases these representations have continued to evolve by virtually adding layers representing different attributes of territories and providing a more detailed and sophisticated representation. A new science of geographic information territories was born: geomatics! Today everything is still accelerating with the latest technologies of the digital revolution including "Big Data", the Internet of Things, the "Blockchain" predictive algorithms of "Deep Learning" etc. These techniques offer analytical tools for introducing the notions of anticipation and prediction into land management. The new technologies of the digital revolution bring even more. They do not stop at the mere consideration of Big Data. Blockchains, for instance, will allow through their chain-based structuring of contracts to manage the deeds and land records in a whole new way by bypassing the work currently done by notaries and municipal offices holding registers. When reviewing these transformations, it becomes apparent that the representation of territories, and their management and governance will again change dramatically.

In this paper, we therefore propose a whole new approach to master this new situation. One can envisage a representation (codification) of the territory that could be called: "The Land Code." This term would refer to the fact that the proposed model would be both computational and legal. Blockchains where computer code encrypts the management of territories (plots, properties, houses, or other land objects and thus affecting even cadastres and land registries) gives a clear indication of what the future may hold. "The Land Code" would thus be both digital (computer code) and legal since the "code" would serve as "law". Inspired by the RFC of the Internet, one could thus imagine the creation of a "land code," both at an international and at a national level. These "laws" would be derived from the codes (computational) and implemented in the new administrative services of the nations. For example, "Blockchains" would replace the land records. The future role of governments would consequently be to provide such platforms that are open to and encourage the establishment of land codes. The different stakeholders and parties of territorial management could then "plug in" into the ecosystem (platform) set up by governments.

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INTRODUCTION

Traditionally, the management of territory relied on a particular form of representation: the map. Accordingly, for centuries, the map was not only a precious tool for measuring land ownership (cadastre), travels and explorations (providing orientation across territories and seas) but also an effective tool for the spatial governance of territories (borders). With the map, it was possible to have a representation of land, property and certain objects and attributes of the territory on the same sheet of paper.

Each era, each region has built both a legal apparatus and regulatory institutions for the measurement, control and arbitration (private or public), as well as for the management of these territories. Land registers and notaries are two examples of such institutions. Trades were created by establishing such legal environments. The "land code" has thus developed over the centuries.

Here we can refer to the intervention of Napoleon, who, to a large extent, structured the modern vision of territorial management by the nation state. The "Napoleonic Code", enacted in March 1804, consolidates the laws and the set of rules determining the status of persons (Book I), property (Book II) and relations between private persons (Books III and IV). By creating these three categories: people, goods and relationships, the code organizes and structures the institutions in charge of implementation, including registration and warranty, control and arbitration. For the management of the territories, this was a remarkable change; land management hitherto focused on property taxation, and thus became a geo-political and economic issue. We see a shift from a static management to a dynamic approach to land. Surveying and measuring the land becomes a determining factor in the economic development of land. The evolutionary value of real estate prices can take off. Economic rationality takes over from the divine landownership by the aristocrats. The "code" is at the source of progress. It will be the same today with the digital revolution.

Of course, with the arrival of computers and databases these representations continue to evolve by virtually adding new dimensions, such as 3D or time (4D) or even a fifth dimension, representing the prediction, anticipation, and acceleration of time, which is in some ways the expression of the erratic movements observed on the territories: rising waters, earthquakes, landslides or massive displacements of populations that lead to random urban constructions.

Computer technology has enabled us to establish and construct a more sophisticated representation of the territory than the paper maps, notably by creating superimposed layers representing different themes and topics with land objects, and thus offering a new and more detailed representation of the land. A new science of geographic land information is born: geomatics!

Today, it is a fact that large amounts of data are available (Big Data), and that new techniques of representation and analysis are emerging: the digital revolution. The management of territories will once again change completely.

THESES

Today everything is still accelerating with the latest technologies of the digital revolution including "Big Data", the Internet of Things (IoT), the "Blockchain" predictive algorithms of "Deep Learning", etc. These new techniques offer analytical tools for introducing the notions of anticipation and prediction into land management. This is a radical departure from previous statistical tools for modelling and simulation. The change from anticipation to prediction seems to be minimal at first sight, but it is important to grasp the difference: between anticipation and simulation, time changes its dimension. We go from a serial data analysis of historical information to a form of "continuous presence" caused by ongoing streams of real-time data from the huge number of sensors and cameras that are installed across the territories. With this continuous stream of data, a fundamentally new vision – a clearer vision – of the future appears!

In summary, we have, on one side, a projection of the past and, on the other, an actual prediction of the future. This is because using simulation to get an idea of the future, remains ultimately a "linear extrapolation" of the past; while with predictive analysis based on Big Data, we truly change dimensions.

The new technologies of the digital revolution bring even more options. They do not stop at the mere consideration of Big Data.

Consider the following three examples:
- First, the "Blockchains". Blockchains will allow through their chain-based structuring of contracts to manage deeds and land records in a whole new way by bypassing the work currently done by notaries and municipal offices maintaining registers. Indeed, when the transactions of land deeds are inscribed into the code (computer code), they become accessible, transparent, traceable, encrypted and secure. Each transaction is linked electronically to one another, and the number of errors is reduced because verification is universal due to constant, mutual interrogation made by the concerned parties. The intermediaries are not needed any longer and disappear. The system becomes open, decentralized and multiple. But even more, the law (the code) has become the code (computer).

- Secondly, the Internet of Things (IoT) enables objects to communicate with each other and to exchange data. Sensors and cameras installed in the territories (or moving along the latter) will produce astronomical amounts of data. The IoT will connect hundreds of billions of objects from the territories with each other (and ultimately with us), generating more data every day than we could have ever imagined. In doing so, IoT will provide a completely new picture of the territory, which suddenly has become a major producer of data, information and, consequently, of sense. We still need to develop the tools to analyse this enormous, live and uninterrupted flow of data. Only machines (e.g. using "Deep Learning" algorithms) will be able to do so. Once again it is the "computer" code that will enable it, presaging a world where everything has become digital.

- And finally the algorithms, some of which could be of the "Deep Learning" type. As we already see now, geoinformation will be produced in such numbers that only virtual machines will be able to analyse and derive conclusions to humans. The images and film sequences captured by cameras from the territories will be analysed by self-learning algorithms of "Deep Learning". They will report the anomalies, accidents or any unforeseen activities on the land. Land will thereby be managed by algorithms. And the governance of the land will thus pass from humans to virtual machines. The code will change in nature. Formerly interpreted by humans, the code will be algorithmic. Computers will interpret the code according to precise regulations still to be developed and for which it will be necessary that the different levels of government play key roles as arbitrators and even active stakeholders together with the private companies and the citizens.

DEVELOPMENT

When reviewing these transformations, it becomes clear that the representation of territories, and their management and governance will again change dramatically.

The current transformation is characterized by the transition of governance into the digital code (software). Up to now, for each evolution a legal apparatus has been set up and institutions were established. This time it will be different, everything will be in the "land code". State or private institutions will have to adapt to this new reality or they may face the threat of becoming obsolete (for example, notaries and land registers are likely to be affected by the appearance of Blockchains).

This major change in land management will be a direct result of the digital revolution that has transformed the world economy and institutions.

It will be imperative to take these changes into account at the policy level of governments and administrations, and anticipate and react to the consequences in order not to fall victim to these developments.

This is the aim of this paper: to propose a fundamentally new approach to master this new situation.
First, we identify three key elements of this new digital representation:

1. Parcels
2. Objects and attributes of the territory, and the
3. Relationships between them

From this simple classification, one can imagine a new representation / codification of the territory that might be called: "The Land Code". This term would refer to the fact that the proposed model would be both computational and legal. Computational because everything is in the software code, and legal because the code would also be the law. The example of "Blockchains" where computer code encrypts the management of territories (plots, objects, houses or other ... and becoming even cadastral and land register) gives a clear indication of what the future may hold. The other obvious example is the Internet where the standards (laws of governance) are inscribed into the computer code. Everything is codified in both senses of the term.

"The Land Code" would thus be both digital (computer code) and legal since the "code" would serve as "law".

It would consist of three "Books" containing the algorithms of definition, measurement and arbitration for the land, parcels or other object of the cadastre for the first "Book" and attributes and objects of geo-information for the second. Finally, in the third "Book", one would find all the evolutionary relations between the first two categories. The latter "Book" would be, in a way, that of evolution, of codified changes and transformations, such as planning plans, legal constraints and other administrative frameworks marking the evolution of things (4D and 5D in our previous vision papers, see Steudler and Comtesse, 2016, and Steudler, 2015).

In advancing this hypothesis, we will create a true reversal of "uses and customs" because in this interpretation of the future, the computer coding will precede legal codification. To illustrate this, the historical RFC (Request For Comment) of the Internet, may provide a useful analogy. RFC, literally standing for "request for comments" are a numbered series of official documents describing the technical aspects of Internet governance and technologies (routers, servers, etc.) intervening in the ecosystem. A small part of the RFC reaches the status of standards (laws) when they pass the fire test for adoption, namely through their actual usage. Indeed, when a RFC is implemented, it means that people actually use it otherwise it is simply registered and remains a dead letter. It is the usage that determines the validity of choice, not a vote! This is a real novelty for our democracies, and leads evidently to other considerations.

CONCLUSION

Inspired by the RFC of the Internet, one could thus imagine the creation of a "land code," both at an international and at a national level. These "laws" would be derived from the codes (computational) and implemented in the new administrative services of the nations. For example, "Blockchains" would replace the land records, as well as notarial records.

The future role of governments would consequently be to provide such platforms that are open to and encourage the establishment of (computational) land codes. The different stakeholders and parties of territorial management could then "plug in" into the ecosystem (platform) set up by governments.

The "land code," in analogy to the "RFC" of the Internet, would be the "constitutional" support for the digital management of territories. Three "Books" would compose the "code": the parcels (cadastre), the objects / attributes (geo-informatics) and the relationships (describing the evolutions with dynamic links in the fourth and fifth dimension).

This vision may appear revolutionary today but risks to be seen as a banality tomorrow.

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BIOGRAPHICAL NOTES

Xavier Comtesse gained a degree in mathematics and a PhD in computer science from the University of Geneva, Switzerland. He has been passionate about communication and computers since the 1970s. In addition to being the creator of three start-ups in Geneva, a pioneering digital work in publishing (Zoe editions), communication (one of the first Swiss local radio stations: Tonic), telecommunications (an Internet start-up: Concept Modern), he is also an innovator in diplomacy (Swissnex Network, a kind of science & technology consulate). In 2002, he was appointed as the first director of the French-speaking think tank Avenir Suisse. In 2012, he launched, in co-creation on behalf of the Chamber of Commerce of Neuchâtel and Industry, the 'Swiss Creative Center' dedicated to the new industrial revolution (FabLab, Design Thinking and Think Tank).

Daniel Steudler holds a PhD degree from the University of Melbourne, Australia and is a scientific associate with the Swiss Federal Office of Topography swisstopo, working for the Federal Directorate for Cadastral Surveying. He has been active in FIG-Commission 7 for many years and was chair of the FIG-Task Force on «Spatially Enabled Society». He published widely in the cadastral field and consulted internationally in land administration and cadastral issues. Since March 2015, he is chair of the EuroGeographics "Cadastre and Land Registry" Knowledge Exchange Network.

Jeffrey Huang is the Director of the Media x Design Laboratory and a Full Professor at the Faculty of Computer and Communication Sciences, and at the Faculty of Architecture, Civil and Environmental Engineering (EPFL). He holds a DiplArch from ETH Zurich, and Masters and Doctoral Degrees from Harvard University, where he was awarded the Gerald McCue medal for academic excellence. He was also a Visiting Professor at Tsinghua University, a Visiting Fellow at Stanford University's d.school, and a Berkman Fellow at Harvard University (Berkman Klein Center for Internet & Society). His research examines the convergence of physical and digital architecture.

CONTACTS

Dr. Xavier Comtesse
Swiss Creative Center, SWITZERLAND
Email: xavier@comtesse.io
Web site: www.swisscreativecenter.ch
Dr. Daniel Steudler
Swiss Federal Office of Topography swisstopo, CH-3084 Wabern, SWITZERLAND
Email: Daniel.Steudler@swisstopo.ch
Web site: www.swisstopo.ch or www.cadastre.ch
Prof. Jeffrey Huang
EPFL IC IINFCOM LDM1
BC 104 (Bâtiment BC)
Station 14, CH-1015 Lausanne, SWITZERLAND
Email: jeffrey.huang@epfl.ch
Web site: http://ldm.epfl.ch