Land Governance in an Interconnected World
ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
WASHINGTON DC, MARCH 19-23, 2018

Draft discussion paper

WHAT SHOULD WE (NOT) DO WITH LAND ADMINISTRATION DATA?

The Risk of Privatization of Land Administration And Blockchain`s Code As Law

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Draft discussion Paper, prepared for presentation at the
"2017 WORLD BANK CONFERENCE ON LAND AND POVERTY"
The World Bank - Washington DC, March 19-23, 2018

1. NEW POSSIBILITIES BY IT-DEVELOPMENTS

Because of more recent IT-developments, such as Internet of Things ("IoT"), rapid validation systems, potentially using blockchain, artificial intelligence (AI), and big data, it gets more and more easy to collect, share, link, interpret and sell data on a wide-spread basis. New possibilities are born every day. When it comes to data regarding land and properties, Land Registries and Cadasters are at the hart and sometimes even the source of this information and these activities. Some of the Land Administration entities make use of these new technological possibilities and create new services or information products. But there may be a downside to these developments.

2. INTERNET OF THINGS – MORE DATA

All kinds of devices, home appliances, vehicles and physical elements (of properties) are - and more will be - embedded with sensors, electronics and software. Combining these low-cost connected sensors and other tooling enables these uniquely identifiable objects to connect and exchange data, using the existing internet infrastructure and perhaps blockchain technology. Data, originating from various ecosystems, are getting increasingly integrated and inter-connected. This phenomenon is called the Internet of Things, or "IoT" in short.

In an environment that calls for immediate actions regarding the creation of a circular economy, e.g. the continuously growing cities in the metropolitan area (Randstad) in the Netherlands, there is a need for smart answers to several issues, e.g. a growing energy consumption, environmental issues, reduced accessibility and scarce public spaces that are shared by many functions, partly due to cities being overrun by tourists and a flow of migrants. Through the open knowledge platform 'Making Sense for Society', hosted by Geonovum, the Dutch governmental executive body for the Geo-information domain, Kadaster embraces the development on sensor (meta-)data and a sensor registry, as explained by HEIDE *et al (*2017). This registry should contain all sensors in public space and (therefore) could give an overview of all kinds of information, show effects and help to draw conclusions. HEIDE *et al* (2017) have addressed several questions with regard to the quality and types of data that are collected. The answers to the questions how to safeguard the privacy of citizens and how to rely on the quality of the data are very important, not only for a sensor registry, but also for land registries.

3. BIG DATA

In modern society data are collected, shared and linked like never before. Sometimes without realizing, in other cases with their explicit consent, people share large amounts of data with (giant) software companies (e.g. Google and Facebook) or other developers of applications, installed on their smart phones. Collecting, processing and sharing or selling these data is the business model of many software (app) developers. In a sense many Land Administration entities act more or less in the same way. They provide any required information which they market as part of their business model.

Land Administration entities are using data stored under their supervision to create derived and (in a technical sense) manipulated data in order to provide any required information. Land registries regularly register these data because of their statutory function. Notaries and conveyancers add legal information about, e.g., transfer and mortgages, judicial enforcement officers adding legal information about, e.g., seizures and attachment and governments add geospatial information.

Commercial parties and IT-specialists gradually make use of Land Administration data and sometimes offer supplementary services. They occasionally use Land Administration data as a small part in a larger collection of data. On the one hand this combination of Land Administration data and other non-Land Administration data results in a very broad use of these data with possibly great social value and use. One of the most commonly used examples perhaps is the use of navigation software. Another example that is broadly used is (statistical) data with regard to price developments. These examples show the possibilities Land Administration information may offer.

KING, B.J. (1994) contends that the crucial element in the evolution of information acquisition and transfer is the acquired ability to donate information to others. Yet, by using ‘big data’ and other technological solutions this donation of information seems to increase hand over fist.

Adding additional data to data derived from a Land Administration as well as offering supplementary services may lead to inconsistencies and sometimes even (derivative) liability. The improper use of (Land Administration) data implicates potential risks, especially since these data are used in all kinds of modern IT-solutions without a (legal) explanation of the meaning of the data. It is not always clear what is the exact value that can be awarded to data. In other words: in a Big Data ‘Lake’ it might be very difficult to catch the right fish.

As addressed by CROWDER, J.A. *et al* (2014), the problem with data analysis and lack of quality user interaction within that process are not a new problem.

How can (big) data be placed in a way it leads to information and a (correct) interpretation of data? For this, I will use the DIKW hierarchy.

The DIKW hierarchy consists of the Data > Information > Knowledge > Wisdom scheme.

What is meant by this DIKW pyramid is often discussed and explained in different ways. Although ACKOFF classifies the content of the human mind into five categories by introducing a class he calls 'Understanding' between 'Knowledge' and 'Wisdom', for this paper I (mis)use the DIKW[1] hierarchy to clarify that (big) data by itself can be considered a constant, although it is constantly changing, while information is a variable that redefines data for each specific use. Information can be derived from data as it connects certain data elements and 'merges' them into information. In this context sequencing certain (big) data leads to certain information. This information can be perceived and interpreted in different manners and may lead to a certain conclusion.

The pure set of data does not always mean it tells you what you want to know. To create knowledge of (Land Administration) processes one needs to process or know how to clarify the data and the information that has been retrieved from this data. Knowledge can be seen as information that has been embodied in humans or, from an IT-solutions perspective, is encoded into business rules or smart applications (or perhaps even smart contracts). In the end from this knowledge one can combine certain elements, draw conclusions and 'play' with this knowledge, to somehow create a certain stage of wisdom. But to get to this stage of wisdom, the basic elements should be in order, the data and information should be absolutely reliable.

To improve data assets (within an organization) BARBALET (2014) repeats some information management concepts: first one would need to improve the quality of data. Next to that the availability of data should be increased. It should be easy to use. For this, to better transform and add value new technology can be introduced and finally, new or external data sources can

[1] In the DIKW model as it is displayed in its true meaning, that 'Data' layer is not referring to (Land Administration) data at all. It refers to observed signals, symbols or stimuli, where 'Information' refers to data that are processed to be meaningful or useful (giving answers to 'what', 'where', 'who' and 'when'.) 'Knowledge' relates to the application of data and information ('how'). It provides framed, contextual information and expert insights whereas 'Wisdom' refers to evaluated understanding and to increase effectiveness. ACKOFF`s class of 'Understanding' is conveyed by explanations and answers the 'why' question.

be added. The use of structured data, metadata and Linked Data may deliver an answer to the question with regard to the proper use of big data.

4. META DATA & STRUCTURED DATA

Noticing this, the need for an extra layer of data with regard the Land Administration data may be necessary. This extra layer, the meta data, may concern the quality of the data (e.g. the year it was collected or registered, a brief explanation of certain elements or the legal value) or a thesaurus or factsheet. Another possibility to prevent the accidental misuse of data, is connecting data the right way. For this, it is advisable to publish data in a structured way, so that they can be interlinked and become more useful through semantic queries. MOLERO *et al* (2010) described the division of data by database specialists into three major kinds of data: structured data, semi-structured data, and unstructured data. Structured data usually can be found in relational database management systems (RDBMS), because of its highly structured nature, using simple data entry forms. Because of this, many Land Administration systems make use of these systems, using a specific language (SQL) to create queries and updating if the tables. Unstructured data has no formal rules to format and organize to create data. Without these rules it is (maybe) more easy to create data. On the other hand, to search and store data is more difficult. Semi-structured data is somewhere in between. A standardized form to order products in an on-line office supplies store can be seen as an example of structured data. A notarial deed in its purest form consists of free text and is therefore an example of unstructured data, as are data created by the aforementioned IoT sensors. The so-called stylesheet, a (partly) standardized notarial deed, supplemented with an XML-file, in order to process a deed automatically in the Dutch Land Registry, may clarify best what is meant by semi-structured data. For a full description of these so-called stylesheets I refer to last years` paper (VOS *et al,* 2017). For Geo-related information the most commonly used format is GML (OOSTEROM *et al*, 2009). Because of the semi-structured markup language, it is rather simple to exchange data. As described by LEMMEN *et* al (2015), hard work has been done in order to create international recognized standards of data models in the land administration domain. As concluded by LEMMEN (2012), the common pattern for well–functioning Land Administration(s) (systems) is one of the key principles of the Land Administration Domain Model (LADM). It consists of a triple: Object (spatial unit) – Right (right in rem and/or personal right) – subject (titleholder

of the right that is related to the object). This triple is also known as the 'ABC-structure', as this structure has been identified by the IMOLA project of the European Land Registry Association (ELRA)[2]. With this project ELRA aimed to produce a model for standardized land registry output, the European Land Registry Document (ELRD). It formulates reference information within a structure of common fields (a template), developed through an XSD / XML scheme that allows semi-automatic processing of information through shared rules with metadata derived from a thesaurus. It is published by a style sheet, giving homogeneity to the registration information, which will flow through the e-Justice portal re-using the building blocks defined by e-Codex and ISA.

In other words, a standardized form regarding Land Registry information, provided with explanatory material in order to form a clear idea of the (legal) meaning of the registered rights in another Land Registry within the European Union. This information will be provided in the different languages that are used by the members of ELRA.

It was only very recent (February 28th, 2018) that ELRA held its kick-off Conference for IMOLA II, the succeeding project, again a project awarded with a grant by the European Commission.

This problem should help to solve the interoperability problems amongst the EU Member States that are also a member of ELRA. Solving the problems regarding the reuse of information and, more specifically, the implicit knowledge encoded in the different registries are the main targets of this project. By making use of a virtual collaborative development environment where tools can exchange and share data, information and knowledge, IMOLA II aims to provide an interoperability platform. For this it will use a semantic shared repository (Knowledge Repository), among Land Registers in Europe. Controlled vocabularies are essential for this project. The Knowledge Repository should consist of vocabularies, glossaries and thesaurus and should be disclosed by a web service. A **thesaurus** is a reference work that lists words grouped together according to similarity of meaning, but also to draw distinctions between similar words; it consists of hierarchical relations between concepts and other relations. A **taxonomy** can be described as a model of concepts, indicating which concepts have a broader meaning. This classification of things or concepts include the principles that underlie such

[2] See: www.elra.eu/imola. Retrieved 2018-03-12.

classification. On a national level Dutch Kadaster has already defined (part of) the elements that are needed in the IMOLA II project by using Linked Data.

5. LINKED DATA

As (governmental) data nowadays is provided using web services, but often as an ordinary data file, in most cases this sharing of information is a so-called 'point-to-point solution. The data therefore are not easy to use on a larger scale. One of the main reasons for this limited use is the implicit, assumed, context in which the data are useful.

In computing, Linked Data is a method of publishing structured data so that it can be interlinked and become more useful through semantic queries. It builds upon standard Web technologies such as http:, RDF and URI`s and extends web pages to share information in a way that can be read automatically by computers.[3]

In other words, Linked Data seems a very useful technology to disclose (public sector) information directly to the 'web'. By using Linked Data the data are disclosed via the 'web' at once, made available to everyone, from a recognizable source. Linked data can be published, including the context: the explanation of the meaning of data and meta data. These meta data may contain information with regard to the method of gathering, completeness, timeliness or origin of the data. The metadata can be published in the same way and form as the data itself. It therefore is a very consistent way of publishing information that provides a (possible) solution for technical and semantical interoperability problems.

A semantic heart, defining the coherence between different registers, can be supplemented with ontologies of each and every registry. In such an ontology the coherence of the concepts (e.g. of 'price', 'right', or 'person') can be defined. It is only the structure if the coherence – the semantic heart – needs to be managed centrally. This way, every organization can determine its own coherence at the level of the data themselves. This way, a constructor can indicate that a certain building is not suitable for habitation, where the persons register can determine the building is inhabited by two persons and the tax authority may conclude that there are people living in cohabitation, so one of these two persons, who claimed to inhabit the building just by himself has to redeem housing benefits. As far as this information is not contrary to the right of privacy, this data can be shared between governmental agencies and the outer world.

[3] See: https://en.wikipedia.org/wiki/Linked_data. Retrieved 2018-03-12.

A fine example of the implementation of Linked (open) Data is the Catalogue System (Stelselcatalogus) as explained hereafter.

The 'Catalogue System' (Stelselcatalogus) of the Netherlands provides an insight in the content of the key registers. The system of key registers[4] in the Netherlands is explained in an article in ELRA`s 4th Annual Publication (VOS, 2011). Key registers contain the vital information from the government, as the data of all citizens, businesses and institutions are included. They play a key role in providing information (sharing data) as these data are guaranteed by the governmental organizations, regarding the availability, access, continuity, actuality, quality and price. Because of this high quality, the government can use this information without further investigation in their work. One of the elements of the system of key registers is the Catalogue System (Stelselcatalogus). This system provides insight into the content of the key registers, the meaning of these data and how these data are connected. By making use of this Catalogue System one can conclude rather easily how to fit these data into one's own system. Dutch Kadaster has defined its key register on land and rights (basisregistratie kadaster) as a semantic network, including the link to national legislation (Kadasterwet) that itself is disclosed as linked open data. This way a maximum insight in the meaning and background of the key register on land and rights is realized.

A logic next step is publishing the data recorded in the key register if and when possible without violating the privacy of people whose data are registered in this register. For geographical data this already is the policy for several years, as has also been defined regarding INSPIRE, as has also been displayed by TIANEN, E. (2017).

By making use of Linked Data there is no need for redundancy in data (any more). Up until now many registers use certain data in their own registers, that are recorded in other registers (as well). No copies of these data need to be made, no infrastructural connections need to be realized. Linked Data provides the possibility to refer to the requested data instantly, by making use of 'resolvable uri`s'. These are URI`s (unique resource identifiers) that give access to those data themselves. Each data element gets its own URI and URI`s give each webpage a unique address on the internet, so it is easy to refer to each specific part of information.

Data are no longer inseparably connected to the context of their application. They now carry their own meaning, using metadata and semantics. These semantics are no longer recorded in

[4] Key registers are also known as authentic registers, base registers, or basic registers.

databases. By making use of standardized vocabularies computers can interpret and link data by themselves. BERNERS-LEE (2006) outlined four principles of linked data in his "Linked Data" note of 2006:

1. Use URI`s to name (identify) things.
2. Use HTTP URI`s so that these things can be looked up (interpreted, "dereferenced").
3. Provide useful information about what a name identifies when it's looked up, using open standards such as RDF, SPARQL, etc.
4. Refer to other things using their HTTP URI-based names when publishing data on the Web.

As is stated by Using these principles, data will be published *as* a webpage instead of *on* a webpage. The World Wide Web Consortium (W3C)[5] is an international community where Member organizations, staff and the public work together to develop Web standards. Amongst else, W3C created web standards to set out data models for Linked Data, e.g. SKOS (Simple Knowledge Organization System). SKOS is designed for representation of any type of structured controlled vocabulary. Its main objective is to enable any publication and use of vocabularies such as Linked Data. In 2014 in the Netherlands such a world, making use of a platform called PiLOD: platform implementation of Linked (Open) Data, as explained at the website on best practices for meaningful connected computing, was initiated.[6]

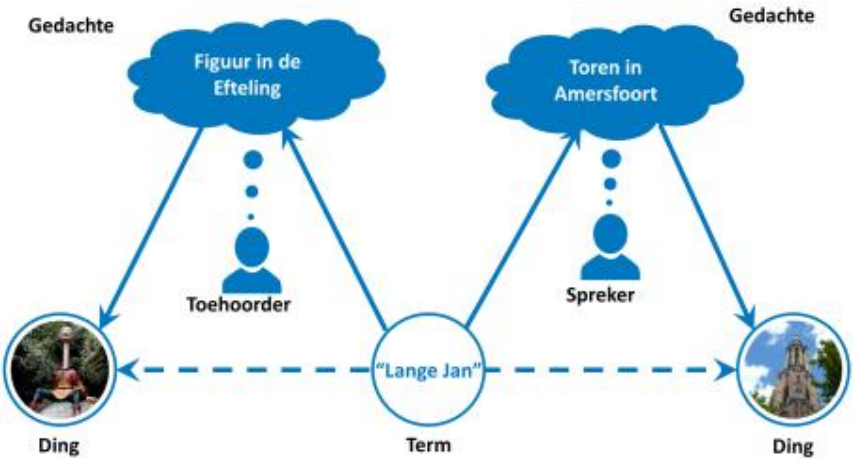
BRATTINGA *et al* (2014) describe the use as to organize Knowledge Organization Systems as a thesaurus (internally) and to compare on definitions of concepts (externally). They explain BP4mc2 (Best Practices for Meaningful Connected Computing) as a method to describe the meaning, structure and dynamics of an information system, based on the legal and other professional guidelines and making use of semantical and Linked Data concepts. To design a system of Linked Data, it is important to distinguish the following three 'realities'.

Three realities

In the world of Linked Data a distinction between three types of reality has to be made: the 'natural' reality, the institutional reality and the administrative reality. These three realities are interlinked. Linked (Open) Data is a means to link all three worlds. BRATTINGA *et al* (2014)

[5] https://www.w3.org/ Retrieved 2018-03-12.
[6] http://www.bp4mc2.org Retrieved 2018-03-12

describe the **'natural' reality** as a reality in which an actor communicates or abstracts in relation to an object. The actor creates a thought with regard to this object and connects this thought to a term that indicates this object. When two actors understands each other's thoughts there will be no problem. Without this mutual alignment one could easily misunderstand the other actor. This would lead to misunderstandings with sometimes major consequences. Different contexts create wrongful references to other terms or definitions.

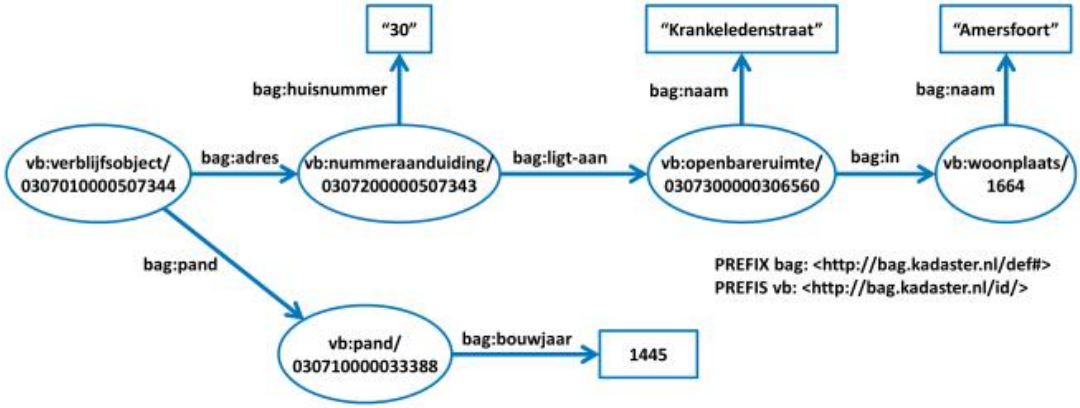


The natural reality is constantly in motion. In the **institutional reality** institutions prescribe their intentions and opinion with regard to a specific domain. Objects in the natural reality will be formalized as facts in the institutional reality. These facts are embedded in formal terms. These terms will be formalized in legislation or standards. In the **administrative reality** these legal terms are presented as linked data in triples. Triples are brief sentences, consisting of a subject, an object and a predicate.[7]

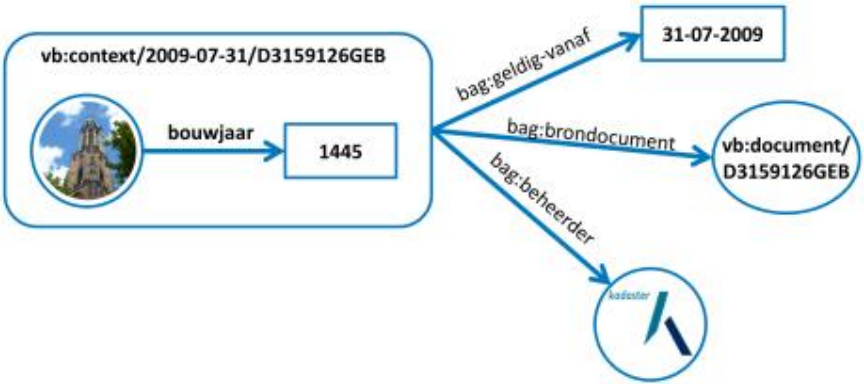
A subject can be an object in another triple. In case of an object that will not be used to refer to anything else, it is called a 'literal' and in a scheme it will be indicated as a rectangle.

[7] https://www.w3.org/TR/rdf-concepts/#section-triples. Retrieved 2018-03-12

Instead of using pictures, the true RDF scheme would show the following:



Because of being a short sentence, triples cannot store context. That is why a set of triples are displayed as a 'named graph', which by itself has got a URI as well.



BRATTINGA *et al* (2014) describe the birth of a child as a life event, leading to an institutional event (in this case: determining its nationality), by creating an administrative event (registering the child`s birth at the municipality). In case all three realities correspond to one another, the situation is compliant to the purpose of the administration and institution. This is not necessarily always the case.

A Land Administration system contains information with regard to the 'triple' subject – object – right (LEMMEN, 2012). In the Dutch situation, the Land Registry system being a deeds based system, the Land Registry does not always contain information with regard to the actual owner. In other words, the Dutch Land Registry, being one of the key registers in the Netherlands, contains the administrative reality, reflecting the natural reality as far as it is defined in the institutional reality. This does mean that there can be a discrepancy between the natural and the administrative reality. Although it does contain information with regard to a person and therefore has a relation between a certain object (parcel, building or any other immovable), a subject (a natural or legal person) and a right (in rem), this does not mean it shows the actual (legal) situation, the natural reality, in all cases (e.g. the register is not referring to the actual owner in case of a deceased person or a case of adverse possession[8]). Linked data perhaps could be of help to align the 'triple reality' with the 'Land Administration triple' in case of added information from other registers or adjusting the institutional reality.

The administrative reality is of importance. It prevents people to argue, it may freshen the memory of those who forgot what they have been discussing and what they did agreed on. An administrative reality is in the interest of justice and helps to maintain the rule of law, as agreements that are registered help to find the institutional facts (e.g.: the judge who decides in a case by addressing his contextual explanation).

In the Netherlands it has been agreed to use the following URI-pattern:

```
http://{domain}/{type}/{concept}/{reference}
```

where `{domain}` is preferably reserved to the register and `{type}`indicates the type of URI (e.g.: "id" for identifying an object, "doc"for metadata/ underpinning document and "def" for

[8] Both situations *can* be registered in the Dutch Land Registry, although there is no legal obligation to do so.

defining a term). The `{concept}` is not important for the computer; it indicates the user of the URI the concept which it belongs to. Finally, `{reference}`is the identifying name of code of the individual object. TIANEN (2017) describes a slightly different URI format for geographic types of information (spatial information): `http://{domain name}/{URI type}/{dataset identifier}/{local identifier}[/{version identifier}]`. TIANEN (2017) also mentions the risk of using place names, since many places have the same names (Paris, Texas), there are endonymes, eksonymes and different conjugations in different languages etc. The goal of Linked Data is to give more meaning to information by defining the specific contexts, e.g. to the name of the city (Paris) or the attribute (e.g.: Geodesy).

6. ARTIFICIAL INTELLIGENCE

Computers are becoming more and more capable of solving problems and 'learning' things that up until now only human beings could solve or learn. When in 1997 IBM`s chess playing computer (Deep Blue) succeeded in defeating Garry Kasparov, many people were of the opinion that the computer was not really intelligent. Instead, Deep Blue had used "brute force methods". This is also known as the "AI effect": people discounting the behaviour of an computational program, a practical AI success, by arguing that it is not real intelligence, see amongst many others, MCCORDUCK (2004). It is hardly noticed that practical benefits of AI and even the existence of AI in many software products, often without even being called AI.

It is hard to define the term 'intelligence'. This makes it even harder to define what 'Artificial Intelligence' really means. A generally accepted test for AI is the Turing test: a test "of a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human'.[9] If a human evaluator cannot reliably distinguish the communication from the machine from the human, the machine is said to have passed the test. According to HARNAD (1992) this test is not about fooling a person, but about generating human cognitive capacity.

Now that data and databases can be interlinked rather easily by making use of Linked (open) Data, the next stage may (or will?) be the use of "intelligent agents" to an even larger extend. POOLE *et al* (1998) describe these 'agents' as being 'any device that perceives its environment

[9] https://en.wikipedia.org/wiki/Turing_test. Retrieved 2018-03-12

and takes actions that maximize its chance of successfully achieving its goals'. RUSSEL *et* al (2009) are of the meaning that the term "Artificial Intelligence" should be implied when a machine mimics 'cognitive' functions that human associate with other human minds, such as "learning" and "problem solving". Computers nowadays can interpret complex data, including images and videos. Natural Language Processing (NLP), the process where AI can understand human speech, is more or less successful [10] and cars are driving autonomously at a growing pace.

It becomes clear that nowadays computers are getting increasingly intelligent. Articial neural networks (ANNs), being computer systems inspired by the biological neural networks that constitute animal brains. These networks progressively improve performance - or 'learn' - on tasks by considering examples, generally without task-specific programming. The connected nodes in the network are called artifical neurons. They can transmit a signal from one to another. AUERSWALD (2017, p. 202) describes IBM`s Cognitive Cooking project which is an experiment to find out if computers can be creative. He states that algorithmic support for human decision-making, and even human creativity, is the essence of cognitive computing.

Next to philosophical and ethical questions the use of AI raises legal questions. And of course this may also have an impact on various professions, including appraisers and legal professionals (e.g. judges, notaries, and judges).

7. BLOCKCHAIN

One of the most influential developments of the last decade seems to be the introduction of blockchain. Blockchain technology is heralded as a solution to long-standing land administration challenges. Whether blockchain and land administration truly will last in a happy marriage (VOS, ed. 2017), has been discussed in-dept in the European Property Law Journal`s special issue on blockchain.

Many authors have defined the technology differently, but all with in some way the same elements. We (VOS *et al*, 2017) defined blockchain as a type of distributed ledger that records transactions between parties, without the need for a trusted third party or trust within the group. It contains an authentication and verification system which allows for the irreversible and open

[10] https://www.ibm.com/watson/services/natural-language-understanding/. Retrieved 2018-03-12

documentation of verified transactions of any type (AUERSWALD (2017, p. 206)). It is an architecture for the issuance of currency and the documentation of transactions that is based on code rather than individual discretion. One could state that it is a system for electronic transactions that does not rely on trust.

The blockchain is a digitized decentralized public ledger that contains records of completed transactions otherwise known as blocks. A copy of the ledger is kept by nodes that are participants in the processing of these transactions and transactions are added by way of consensus between the nodes. All nodes perform their own calculations to ensure that a given block in the chain is accurate and authentic.

Because it is decentralized, virtually immutable and it offers security and resilience advantages over traditional transactional databases and record keeping systems, blockchain technology is being touted as the replacement of the traditional Land Administration systems.

Despite the absence of the first genuine adoption – the technology, although rather new, is already presented 10 years ago – blockchain technology presents some attractive features. It is able to ensure data integrity and security, it is transparent – although only a pointer or hash-value referring to the underlying documents are stored on the blockchain - and it is possible to store, maintain and verify the information, including a copy of all transactions, on all the notes. Pilots and initial implementations using blockchain technology to strengthen land registration have occurred or will occur in various countries, e.g.: Sweden, Dubai, Georgia, Ukraine, Honduras, Brazil and India (Andhra Pradesh). Some of these (possible) implementations are described more into detail by e.g. VOS *et al* (2017), GRAGLIA *et al* (2018) and LEMIEUX (2018).

Many points of attention have to be taken into account and some challenges need to be overcome. In last year`s paper many of these challenges have been described. (VOS *et al*, 2017), e.g.:

1. Several types of consensus mechanism (e.g. Proof of Work, which does not seem very sustainable due to the intense use of electricity, and Proof of Stake. The downside of this mechanism is the (possible) control of a limited (group of) entities with a large stake in the network;
2. The theoretical ‘51% attack’. This attack is a theoretical possibility that once one party controls 51% of the miners in the blockchain network, this party validate or invalidate

transactions at will and may even be capable of rewriting past transactions. We discussed the possibilty of a balance attack by a messaging delay;

3. Ownership by a private key. Once (due to an attack or otherwise) you lose your private key, you will lose control of your asset;
4. Complexity of smart contracts. Because these contracts can be quite complex and difficult to fully comprehend, they may introduce vulnerabilities into the system. We referred to the infamous DAO-hack. Quite recently, NIKOLIĆ *et al* (2018) published a report on the vulnerability of smart contracts, showing three examples of such vulnerabilities, leading to 'greedy, prodigal and suicidal contracts';
5. Lack of Governance in a public blockchain. Referring to the aftermath of the DAO-hack we concluded that due to the distributed character of a blockchain, nobody has control of it. There was no emergency scenario to defend the system from a hack.

Despite these challenges, as ANAND *et al* (2016) also recognized most of these characteristics, VOS, (2016) and VOS *et al* (2017) recognized the abovementioned characteristics as (possible) applications in the context of land administration and addressed many of the potential applications of blockchain by using existing and easy available technology 'for land information management combined with improved governance and better standard information technology (IT) practices'.

From a technical perspective the challenges addressed have to be taken on board, prior to implementing the complete Land Registry on a blockchain. Once these issues have been dealt with, it seems that (in some systems) legal issues need to be addressed and solved as well.[11] As mentioned in last years` paper, it is advisable to put transactions and or (hashing referring to) documents on the blockchain by the official Land Administration entity itself. That way, one knows the quality of the first data entry on the blockchain. Another possibility could be the attestation of the information by the official Land Administration authority in case other parties add Land Administration information on the blockchain. In such a case the Registrar (or Land

[11] The Wall Street Journal reports that there are still obstacles to overcome in Sweden before Blockchain can be adopted on a wide scale for real estate dealings, namely that digital signatures fo registering or purchasing properties are currently illegal under Swedish law. See: https://www.wsj.com/articles/a-pioneer-in-real-estate-blockchain-emerges-in-europe-1520337601. Retrieved 2018-03-12

Registry official) states a declaration by which the information is declared accurate (at the time it was put on the blockchain). Using attestations, implies the use of so-called *Oracles*.

Furthermore it is advisable to keep and manage the blockchain by the Land Administration entity (so-called private blockchain) instead of using the means of a permissionless or public blockchain. In case of a private blockchain, the risk of a vendor-lock-in should be eliminated; the Land Administration should not be depending on the services of a computer service provider.

Due to the fact that it does not seem possible to put large documents (deeds) on the blockchain, because storage of data in a transaction on the blockchain still is limited, it is advisable to keep the original contracts safe on a system that (still) cannot be altered. Yet, the underlying documents should not be stored on a single database, since this database can or will be proven the weakest link once the database would be corrupted, broken or tampered with. We mentioned the InterPlanetary File System (IPFS), where nodes form a distributed file system, as a possible solution.

LEMMEN *et al* (2017) describe the need for further standardization, including standardization of transactions of rights (*in rem*) as a possible first step to implement a blockchain-based Land Administration system. It is advisable to let all parties involved in the Real Estate chain agree on these standards. Particularly in cross border cases, this standardization may be time-consuming, (partly) because of different views and perspectives.

Finally, it seems wise to create multiple search entrees for transparency and publicity purposes, once (all) transactions and data are put on the blockchain. In most Land Registry systems it has been made possible to have an inquiry by using the parcel identification number, the name of the title holders, the address (if present) of the parcel or building or by using the Cadastral map. These search entrees should not be lost.

It is mentioned that the bundle of property rights can be unbundled by making use of blockchain. This would imply that the owner of a property could sell an easement to a neighbor or could grant a usufruct to his child. This would be done without the intervention of a Notary, licensed conveyancer, surveyor or registrar. It could also mean that people can buy a share in a (rental) property and receive a corresponding portion of the rental income, using blockchain both as a transfer system of ownership of shares and as a payment method. Buyers will purchase shares in a leased immovable, each of them receiving a share in the rent payments, in return to this

investment. Next to that they will have a voting right with regard to the purpose and future of the asset (do they want to sell the immovable or remain leasing it to the resident).

This fractional ownership is defined by GRAGLIA *et al* (2018) as "multiple parties sharing the rights and responsibilities of owning a real asset (i.e., a house, a condominium, or a commercial building) much like multi-investor leases", whereas BENNET *et al* (2018) describe these initiatives, perhaps more appropriate, as fractional property ***investment*** and describe the process as breaking land parcels into 'conceptual shares'. In reality one does not become the owner of a share of the (ownership of) the real estate, but obtains a beneficial interest in a residential property by buying a 'share', a 'brick', in a unit trust that holds the property you are interested in or in a Management Investment Scheme, which is regulated as a managed fund.

There are multiple examples of fractional ownership on a blockchain solution. Two of these examples are Brickx,[12] owned by an Australian Limited, and Domacom.[13] Other examples concern the Dutch initiatives called BLandlord[14] and Bloqhouse[15].

Like the Brickx initiative investors buy and sell a conceptual share in a managed marketplace and receive, in return, an equal share of the regular rent payments and a portion of the property value if it is sold. In some of the fractional property investment initiatives the acquired rights can also include the right to use the property of a certain amount of time each year, which more or less seems like a timeshare scheme.

The approach of these initiatives is intended to reduce the high costs and fees of institutional professionals (e.g. notaries and Land Registries). These initiatives are concepts somewhere in between the land sector and the fintech sector. The initiatives cut real estate objects into smaller 'virtual units' or new rights (*in rem*?) that are not (yet) registered in (all) Land Registry systems and imply a certain use right, right to control/ operate or a profitability right. The advantage of buying a 'fractional right' are indeed lower costs: a notary or land registry is not needed, since you do not become the legal owner of a share of the parcel but you will become the owner of (just) a 'share'. It is for every participant to decide whether (s)he wants the legal certainty that comes with legal ownership, based on the 'ancient' system performed by institutional

[12] https://www.brickx.com/. Retrieved 2018-03-12
[13] https://domacom.com.au/. Retrieved 2018-03-12
[14] https://www.blandlord.com/. Retrieved 2018-03-12
[15] https://bloqhouse.com/. Retrieved 2018-03-12

professionals, or (s)he does rely on the services of the newborn fractional ownership initiatives (privately owned marketplaces or managed funds).

What these initiatives appear to realize is a shift in the trusted third party landscape. The other changing element is the shift from legal ownership to owning a 'economical fraction' or 'virtual unit' perhaps. The legal ownership of the parcel that has been broken into 'conceptual shares' does not belong to the owner of a share; the ownership of the parcel belongs to a legal entity (trust, limited or foundation) that actually bought the parcel. It is not clear whether all owners of shares do realize they have got no – or but a very limited - entitlement to the legal right in rem. Finally, there is a concern with regard to public safety and the legal and economic stability of a country, as mentioned by GRAGLIA *et al* (2018). There has to be a possibility for countries to retain sovereign control of property markets, in order to regulate the economy and enforce the law. GRAGLIA *et al* (2018) mention the need for integration of national laws, taxes, fees, and regulations into smart contracts, as blockchains become more integrated into registries. I would add to this the integration of international law (e.g. European Regulations) and jurisprudence. For all of these elements, there is a need to create and implement an extra layer of metadata and/or linked data ('linked legislation') to smart contracts that will execute the terms of the agreement within the context of law.

8. THE EFFECT OF MODERN TECHNOLOGY ON PROFESSIONALS

By using modern technology as mentioned above, things may – or will – change. Despite the fact that there is and will be much debate on the use of some of these technologies that create the 'technological evolution'. These debates will concern various questions concerning (e.g.) ethics, economics and legal matters. The recently deceased pre-eminent scientist and early adopter of all kinds of communication technologies, HAWKINS (2014) warned artificial intelligence could end mankind, stating that "Humans, who are limited by slow biological evolution, couldn`t compete and would be superseded". Some of the expected effects and results may have effect on professional parties and entities. They may concern the judges, appraisers, notaries and registrars and the Real Estate (conveyancing) chain in its full range.

In the Netherlands the Real Estate property market is completely digitized. From a practical point of view, in order to buy or sell an immovable is hardly possible without the use of an

electronic market place[16], mostly[17] owned by Real Estate Agents. This creates a system where in most cases both buyer and seller make use of the services of a Real Estate Agent. Not using their services would imply the lack of use of the electronic market place and the network of the agent, which negatively influences the position of the buyer.

All information with regard to the current owner of an immovable is disclosed on-line for two euro`s and forty cents by Dutch Kadaster. For the transfer of ownership the services of a notary are required. (S)He has to execute a deed of transfer that needs to be recorded and registered at Kadasters` public registers. This is done electronically. About 45% of all notarial deeds are processed completely automatically, without any human interference. For this, Kadaster uses so-called stylesheets, as described in VOS (2017) and explained more into depth LOUWMAN *et al* (2012).

a. Appraiser

From a traditional perspective, the services of an appraiser are used in case an immovable has to be assessed. This will mostly be the case for financing an immovable (when buying), refinancing an immovable (lower interest rate) and in cases when to levy property taxes.

As described by BERVOETS *et al* (2018) the property valuation system, is a base for property taxes. Nowadays all immovable property is assessed annually by municipalities. Not only the municipality itself, but also other layers of government, as they are obliged to use these data, profit from the work from the municipalities, as the latter are legally obliged to share their data and the assessed value with the other governments. This annual appraisal and assessment is done with the value reference date set one year prior to the year of use.

The owner of an immovable assessing the taxation value of his property made by the municipality, makes use of an on-line system, checking the characteristics of the reference buildings. If the owner does not agree with the taxation value or the designated reference buildings, he can make a complaint. This can be done by using on-line services (as well).

[16] The most commonly used market place is Funda: www.funda.nl. Retrieved 2018-03-12. This platform is owned by the largest branch organization of real estate agents and appraisers in the Netherlands, NVM.

[17] One of the exceptions is Jaap.nl: www.jaap.nl. Retrieved 2018-03-12. This platform is a search engine, not owned by real estate agents. It gives an overview of all the immovable property that is for sale at the moment the search entry is made. Finding the immovable one would like to inspect, results in the contact information of the seller, mostly being a real estate agent, commissioned by the owner of the immovable.

Combining the Cadastral data with all kinds of other data creates an infinite flow of data. This makes it possible to determine the value of an object from a distance, without the inspection of an assessor, and to predict price developments. The use of interlinked modeling calculations are growing at a rapid pace. This might result in a decrease in the number of appraisers, as is predicted[18] by the Netherlands Council for Real Estate Assessment and Kadasterdata[19].

b. Judges & lawyers in general

Most lawyers have to examine documents, reports and preceding court rulings (jurisprudence), in order to reach an opinion. This is time-consuming. GROSSMAN *et al*, (2017) co-created Technology Assisted Review (TAR), also known as predictive coding or computer-assisted review (CAR). In their paper, TAR is described as "the process of using computer software to categorize each document in a collection as responsive or not, or to prioritize the documents from most to least likely to be responsive, based on a human's review and coding of a small subset of the documents in the collection." The American court system is currently being serviced by the use of Artificial Intelligence. Researchers use computers to analyze data from thousands of court cases. With the help of that data, computers can predict whether a defendant will commit a new crime or fail to return to court. To make pretrial decisions about defendants, judges are now guided by computer algorithms before ruling whether criminal defendants can return to everyday life, or remain locked up awaiting trial.[20] Artificial Intelligence is reshaping, if not eliminating, some of the judges' most basic tasks. The question that arises is whether this will lead to data driven objectivity or not.

Predictive justice is also a matter of debate in the Netherlands.[21] As is stated at the report, new technologies will change the role of lawyers and trusted third parties (banks and accountants)

[18] Het Financieele Dagblad (2018). De taxateur verandert in een computer. Groeiende datastromen maken taxatie op afstand nauwkeuriger. En met de computer zijn er in de toekomst nog veel meer mogelijkheden voor woningtaxatie, March 9., 2018. See: https://fd.nl/werk-en-geld/1244625/de-taxateur-verandert-in-een-computer. Retrieved 2018-03-12

[19] Kadasterdata is a trade name of a private company, reselling information from Kadaster, Statistics Netherlands (CBS), and other (governmental) organizations. The chosen trade name, Kadasterdata, sometimes causes confusion with regard to the origin and accuracy of the requested data. Kadasterdata is *not* part of or related to Dutch Kadaster. By explicitly mentioning the fact that this company is not part of Kadaster, the number of complaints with regard to the information of Kadasterdata has decreased in time.

[20] https://nypost.com/2018/01/31/artificial-intelligence-is-coming-for-both-judges-and-defendants/. Retrieved 2018-03-12

[21] https://www.nrc.nl/nieuws/2018/01/11/de-besliscomputer-disciplineert-iedereen-ook-de-rechter-a1587772. Retrieved 2018-03-12

and will make certain activities obsolete. Opinions are mixed regarding the level of which certain legal activities from lawyers will be replaced by computers (e.g. FREY *et al.*, (2013), McGINNIS *et al.*, (2014), and SUSSKIND *et al.*, (2015)).

In 2012, at the IPRA|Cinder Conference in Amsterdam I concluded my presentation with the recommendation that lawyers should behave as *inventive solution-thinkers* in a world full of changes. The responsibility for the decision to adopt new technologies and legal possibilities will lie with the lawyer, since the lawyer maintains legal certainty (LOUWMAN *et al*, 2012).

c. Land Registry

By continuously developing the Land Registry working processes and system, from an external point of view, the activities within a Land Registry perhaps may seem to be simplified to a large extend. This might also be the reason why the Research and Documentation Center (WODC)[22] of the Dutch Ministery of Justice and Safety describes Dutch Kadaster as being 'nothing more than a list that keeps data changes' in its report (VOERT *et al.*, (2016)) and many start-ups and other entities are starting to design a blockchain-based conveyancing system. Yet, most of the Real Estate Chains and Land Administration processes are simple in appearance only.

Because of these IT-developments the Land Administration processes themselves are subject of interest, not only for parties depending on this information and activities (the more traditional entities and professionals – e.g. Notaries, Licensed Surveyors and conveyancers, and financial institutions), but also for other interested parties. In reality in many blockchain Proof of Concepts, Mock-ups and pilot programs the complexity of legal and Land Administration systems is often underestimated. This perhaps is also the reason why up until now, apart from archiving so-called hashes or pointers that refer to the underpinning deeds, no blockchain-base Land Administration system in the world has been put into practice. Nevertheless, in future, after scrutinizing the full chain into depth and working in close cooperation with the legislator and the stakeholders in the Real Estate Chain blockchain developments possibly will be put into practice. Swedish Lantmäteriet seems to neare completion of the technical research, as it will conduct[23] its first blockchain property transaction.

[22] https://english.wodc.nl/ Retrieved 2018-03-12
[23] https://cointelegraph.com/news/swedish-government-land-registry-soon-to-conduct-first-blockchain-property-transaction. Retrieved 2018-03-12

As mentioned before (VOS, 2012 & VOS, 2016), lawyers should shake hands with the 'disruptive generation', a generation creating new technical solutions for different purposes, in order to ensure legal knowledge. Whether legal proceedings and checks are executed by a computerized system or by hand, it is important that liability is covered. Somebody needs to be responsible, accountable – and therefore liable – for the proper functioning of the system. Next to that, there should be a person who is able to solve (legal) issues that occur in case something goes wrong. Therefore, it is my believe that the role of lawyers is not expected to be (completely) replaced by these disruptive technologies. People rely on technology, but want to revert to a lawyer in case of problems. A fine example regarding Brazil`s antiquated land titling system and the experiences with the attempt to introduce a blockchain-based Land Administration system to register the Amazon rainforest, was recently described by MENDES (2018). Registration involves a legal analysis, with a lawyer checking the authenticity of identity documents, title deeds and government allocations, as well as cross-checking to avoid double titling. In future blockchain, combined with other technology, may be able to perform these activities, but up until now there is no such system in place. WILSON (2018) states that governments, especially in developing countries, that are serious about innovating conveyancing need to focus their effort on facilitating property rights. WILSON states that storing data in a transparent and distributed way can be done using distributed ledgers, yet, unless they can be used easily by the people who need them most, their utility will always be limited. Granting property rights can`t be solved by technology in isolation since it is not a technical problem, but is also depending on governing a system of checks & balances, accountability and liability. Last year we concluded that for this purpose storing documents on the blockchain does not seem feasible yet. Storing documents on the blockchain is currently limited to hashes/ pointers that refer to these documents, which makes storing these documents themselves the weakest link (VOS *et al*, 2017).

To govern a well-functioning blockchain-based system of Land Administration, involving checks & balances and accountability & liability, perhaps an extra layer is needed. This layer includes the functioning of the legal system and the standardized transactions within this system, using some kind of market place of templates, or stylesheets, as was introduced in the Dutch Real Estate chain in 2006. These stylesheets can be seen as an early version of *smart contracts.*

The ultimate (blockchain-based) system of Land Administration may also need references to the relevant legislation or jurisprudence, as described in the chapter on Linked Data. Next to that, it is conceivable that there will be made use of guardians or custodians, servicing minors and disabled people in such a system. In difficult cases licensed conveyancers, notaries, registrars, surveyors or judges may act as so-called *Oracles.*

9. THE PRIVATISATION OF LAND REGISTERS

Taking into account these recent IT developments, the question arises whether Land Registers can be privatized or not. Machine learning applications will increase their footprint, a large variety of Artificial Intelligence products is and will be introduced, technology interconnecting data (Linked Data) and objects (Internet of Things) is already common practice, while collecting, sharing, interpreting and selling data. Next to these IT-developments, the (value of) Land Administration data seems to be an important reason for parties to show interest in Land Administration (processes and) entities themselves. Private, profit driven, corporates are eager to take over governmental Land Administration entities. This may even be enhanced by the character of many public land registers: open to the public. In some countries or States privatization has been discussed, considered and sometimes realized. It is striking that most of these countries or states are under a Torrens system of registration. In such a system the results are final. As far as I know there is no country or state under a deeds system of registration that is subject to privatization. Possibly the reason for this may be the lack of property protection through Indefeasibility of Title in a deeds-based system, although – from a private contractors point of view – this lack of protection would imply there would possibly be less financial risks for the contractor. Since there is no (or hardly any) state-backed guarantee on registered titles in a deeds-based system, there will be (less or) no need for a clause in the contract of lease concerning the right of recourse when a title would be affected. Some (or perhaps all) of the existing cases of (to be) privatized land registers are listed below.

Examples

- In **New South Wales** (Australia) the State government has ‘leased’ the operation of that

State Land Registry in 2016 to a consortium (Hastings Funds Management and First State Super) for $ 2.6 billion dollars.[24]

- Following New South Wales, in **South Australia** a commercial consortium called Land Services SA has won the right to manage that State`s Land Title and Registry system for the duration of 40 years, including the right to commercialize related data. The two investors (Macquarie Infrastructure and Real Assets, & the Public Sector Pension Investment Board) paid $1.6 billion dollars for this deal in 2017.[25] The SA treasurer SA Treasurer stated that the Government would continue to set fees and charges for title searches and other land services. He said the general public would not notice any difference to the service following the transfer.
- The **Victoria**n titles registry office, Land Use Victoria, is also subject to privatization, as the Victorian state government will launch a tender in March 2018 to gain the right to run the state's land titles unit for the next 40-years. Subdivisions, application and survey will be excluded, as well as the official role of Registrar of Titles, which oversees the whole operation.[26]
- In **West Australia** (WA) the State`s titles office Landgate may also be privatized, as the WA Government appointed an investment bank to undertake a scoping study to ascertain the future of Landgate.[27]

In general, it seems that the above mentioned Australian States have (or will) grant the operation of the State`s Land Registry for the duration of 40 years, to commercial entities (consortia). The privatization took/ will take place because of reinvesting the money by building infrastructures. The official role of the Registrar of Title, as well as the surveying activities are excluded from this lease agreement. Next to that, NSW, Victoria and WA have decided that registration of all property transfers, mortgages and

[24] http://www.abc.net.au/news/2017-04-12/$2.6-billion-price-tag-on-nsw-land-titles-registry-sale/8439176. Retrieved 2018-03-12
[25] http://www.abc.net.au/news/2017-08-10/sa-government-sells-lands-titles-office-data-for-1.6-billion/8794468. Retrieved 2018-03-12
[26] https://www.propertyobserver.com.au/finding/location/vic/81466-victoria-land-titles-set-for-privatisation.html. Retrieved 2018-03-12
[27] https://www.macrobusiness.com.au/2018/02/wa-join-reckless-land-registry-privatisation/. Retrieved 2018-03-12

other changes must be done through an electronic conveyancing system. PEXA is the only platform available.[28]

- In the Canadian provinces of **Ontario** a private operator (Teranet) administers the buying, selling and subdivision of properties. It was already in 1991 that Teranet engaged in a public-private partnership (between the province and a private sector company) in order to modernize the titling system. A license was issued by the government to operate the land administration system, reserving the land registry documents by the province. In 2003 the province sold half of its shares in Teranet to a private consortium.[29] Seven years later (2010), after dealing with initial problems, the province extended Teranet's operating licences for fifty years.
- In 2014 the Province of **Manitoba** followed the example by issuing a license to Teranet to run its land registry for 30 years,[30]with automatic renewal terms of 10 years, unless either party gives notice at least 24 months before the end of the term it does not wish to extend. In such a case, at the end of the term, Manitoba must elect to:

  a. pay Teranet's wind-down costs (including employee severance and termination costs); or

  b. in addition to buying the Teranet assets needed to operate (at book value) and assuming contracts, Manitoba will pay Teranet a commercially reasonable rate for a non-exclusive license to use the TPR Software; or

  c. enter into a new agreement with Teranet.[31]

  The only things Manitoba maintained ownership of, is the information in the databases. In case there will (ex sub b) not be issued a license to use the software, one of the biggest concerns when it comes to end the term with a software-driven private operator is data migration.
- In the province of **Alberta** the Real Estate Council concluded that neither outsourcing nor privatization is in the public interest. There should be no erosion of land titles

[28] https://thewest.com.au/opinion/nick-evans-is-the-sale-of-landgate-worth-the-risks-ng-b88701339z. Retrieved 2018-03-12
[29] https://www.theglobeandmail.com/news/national/province-sells-share-of-land-registry-firm/article1020241/. Retrieved 2018-03-12
[30] https://www.gov.mb.ca/finance/pubs/teranet.pdf. Retrieved 2018-03-12
[31] Ibid at 26.

protections', as was stated in the report.[32] It was concluded that adoption of the models of central and eastern Canadian land titles legal/ transaction models are significantly different and for this reason Alberta legislation and business practices within the real estate industry would likely require significant changes. One of the main concerns with regard to privatizing Alberta`s Land Titles system was the loss of expertise and knowledge.[33]

- The province of **Nova Scotia** did also draw conclusions on the matter of privatization and concluded (2016) there would be no considerable gain from privatizing three provincial registries.[34] The revenue gains would be marginal. There were five vendors expressing interest to take over the registries.
- In the UK the Government had plans (2014) and launched (2016) a consultation[35] setting out the options to move the Land Registry from operations to the private sector.

  Her Majesty's Land Registry (HMLR) is a non-ministerial department and an Executive Agency of the Department for Business, Innovation and Skills. HMLR has operated as a 'Trading Fund', meaning it is required to ensure that its income from fees covers all expenses under normal operating conditions. This financial model is quite similar to the Dutch Land Registry (Kadaster) financial model. The main statutory function of HMLR is to keep a register of title to freehold and leasehold land throughout **England and Wales**. On behalf of the Crown, it guarantees title to registered estates and interests in land. In 2016 the sell-off plans were paused, although not dropped[36] completely, by the Government. In the Briefing Paper of the House of Commons (2016)[37] it is stated that a range of potential negative impacts have been identified, concerning public trust, impartiality, service quality, fees and access to data. In the Autumn Statement 2016 the Government announced that – following the consultation - it has decided 'that HM Land

[32] https://www.reca.ca/consumers/standards/PDF/Privatization-of-Land-Titles.pdf. Retrieved 2018-03-12
[33] Ibid at 28, p. 6.
[34] http://www.cbc.ca/news/canada/nova-scotia/registries-privatize-government-private-sector-service-nova-scotia-1.3540782. Retrieved 2018-03-12
[35] https://www.gov.uk/government/news/consultation-launched-on-land-registrys-future-operating-model. Retrieved 2018-03-12
[36] https://www.homewardlegal.co.uk/blog/are-land-registry-privatisation-plans-be-scrapped. Retrieved 2018-03-12
[37] http://researchbriefings.files.parliament.uk/documents/CBP-7556/CBP-7556.pdf. Retrieved 2018-03-12

Registry should focus on becoming a more digital data-driven registration business, and to do this will remain in the public sector'.[38]

The most frequently stated arguments *not* to privatize the Land Registry organizations are listed below.

- Since records are digitized in the above mentioned cases, the information can be disclosed electronically and therefore swiftly. Because of this electronic disclosure of information, the **procedures for electronic transfer** are – or can be – **perfectly alright**.
- There is a **risk of a *vendor-lock-in***. Due to the fact that in the above mentioned cases privatization of Land Register organizations resulted in the use of software, created and maintained by one private operator, (some of) these Land Registries seems fully depending on the well-functioning of both the software and the private operator, in some cases also being the owner of the intellectual property of the used software. To prevent the dependency on this well-functioning (e.g. in case of bankruptcy, a *freeze* of the software due to a *hack* or otherwise) and the continuation of Land Registry activities, one might consider a *escrow arrangement* or a *source code depot arrangement.* This implies the use of a Trusted Third Party who saves a copy of the source code underlying the Land Registry software. It has been agreed that this source code will be disclosed to the Land Registry organization in certain cases (e.g. bankruptcy, late payments, and measurable lack of service). It is of the utmost importance that the most recent copies of the software are stored in the vault, owned by or under the sole control of this trusted third party. It can even be agreed upon that the vault will physically be stored at the land registry office.
- **Anti-competitive behavior**. It is argued that there is little incentive to provide a better service. It is to be considered in case of a upcoming privatization to gradually release the revenues of the agreement. Next to that, it may be advisable to offer a prospective financial inducement in case of realizing added value or realizing, if possible, an even higher level of performance.

38 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571556/autumn_statement_2016_print.pdf. Retrieved 2018-03-12

It some cases it is assumed that in order to improve the bottom line, services will be cut, resulting in a blow-out of transaction times and an increase in errors made. In the case of Ontario this seems not to be the case. Otherwise the government would not have extended the license for another period in time.

It may even be the case that, while current land registry systems are rather efficient, the use of private contractors provide an opportunity to harness technologies that transforms these systems for more automated, faster and more efficient processes. This may possibly result in lower intermediate fees and cutting red tape.

- On the other hand, there is a **risk of raising fees**, in order to make more profit or to cover (additional) costs. It is advisable to include a provision in the agreement for the Land Registry office to limit increases in fees to stable and predictable limits of the Consumer Price Index Plus One to protect consumers, as has been done in the Alberta agreement.

  To put things in perspective, especially since all kinds of applications and data are interlinked in many computerized Land Registry systems, hiring private operators to realize these connections or adding service(s) is not uncommon. For these services and connecting activities it is also important to prevent the dependence on these contractors by adding certain clauses to the servicing contracts.
- The **risk of affecting state-backed guarantee** on registered titles has also been mentioned more than once. Normally, any person suffering loss due to an error, incorrect or incomplete data in the Land Registry will be compensated, at least in case of a Torrens Land Registry system. What will happen in case of an error due to a *bug* in the software or any other shortage, caused by the private contractor? Will the compensation be limited to a maximum amount or number of errors a year? And if not, will the contractor be able to compensate the Land Registry for the compensation payments made to the public due to the State guarantee because of the Indefeasibility of Title ? Once again the risk of bankruptcy enters the picture. On the other hand, before privatization it was also possible that an error occurs. This may or may not[39] have an impact on the privatization process.

[39] E.g. , see: http://www.illawarramercury.com.au/story/4259781/stuff-up-saw-140-home-buyers-not-told-about-new-motorway/. Retrieved 2018-03-12

- Another point matter of concern is the **security of the database** and the integrity of the system. It should not be possible to affect the integrity of the data or the accessibility of the access rights. Non authorized persons should not be able to enter the land registry administration system or its databases. Authorized persons should have access at all time. It should be made possible to track changes in the system at all time, to prevent misuse or unauthorized changes.
- There may be the prospect of moving activities and jobs elsewhere, or even overseas.[40]
- Last but not least: **privacy issues**. As Torrens systems, but also many European Land Registry systems, the Dutch system included, are open to the public. This does not mean that the contractor or any other (legal) entity should be able to perform searches in the land registry data, in order to add services or compile a database. Therefore, the contractor shall contractually not in any form whatsoever lawfully be able to have access, view, search or disclose any document or information without a legitimate interest. This legitimate interest can only be access in order to provide the services as requested and agreed upon. Concerning EU residential personal data, it will be of the utmost importance to comply with the European privacy regulation (GDPR[41]).

10. CONCLUDING REMARKS

For more than two centuries Land Registries have been building trust in the real estate market to make impersonal exchange possible and reliable (ARRUÑADA, 2012). Due to registration systems and the use of modern technology in these systems, security of title has increased in the last two centuries. As MEGARRY *et al* (2000, p. 201) noted, land transfers are not as simple as dealing with shares, because the object of property is different and the rights over land are more complex. Complex systems and structures of trust are hardwired into modern real estate (conveyancing) systems, resulting in legacy infrastructure, in some cases making it slow and expensive to adjust to societal developments.

This complexity automatically leads to various ways of the completion of transactions and may also be the reason why the use of modern technology is helpful, but – as concluded earlier (VOS, 2016) – will not be the solution to deal with the inexhaustible variety of transactions.

[40] http://theconversation.com/privatised-land-title-offices-can-harness-new-technologies-to-provide-a-better-service-83352. Retrieved 2018-03-12
[41] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679. Retrieved 2018-03-12

Due to new interventions and response to jurisprudence and societal problems, e.g. climate change, the variety of transactions is not to be foreseen. With regard to the latter, floating parcels, as described by VAN DER PLANK (2015), may be part of the solution to floods. To transfer property of a floating parcel, a close description of the parcel is needed, as is determining the legal capacity and ownership of the seller. As NOGUEROLES PEIRÓ *et al* (2017) stated: 'lawyers are still needed, both in civilian and common law traditions, to sell a right over a piece of land.' The role of the lawyer, adding legal certainty, as legality is not guaranteed with the checks of nodes, is not (to be) discarded as land registries are not a simple database or system of storage, although GRAGLIA *et al* take a different view. As stated earlier (LOUWMAN *et al* 2012), new technology should be embraced by lawyers, as it could be used to improve the existing land registry systems.

REFERENCES

ACKOFF, R.L. (1989), From data to wisdom, Journal of Applied Systems Analysis 16, p. 3-9.

ANAND, A., MCKIBBIN, M., & PICHEL, F., Colored Coins: Bitcoin, Blockchain, and Land Administration. Annual World Bank Conference on Land and Poverty 2016: Scaling Up Responsible Land Governance. Washington.

ARRUÑADA, B., (2012), Institutional Foundations of Impersonal Exchange. University of Chicago Press, Chicago-London.

AUERSWALD, P.E., (2017), The Code economy: a forty-thousand-year history, New York, NY: Oxford University Press.

BARBALET, F. (2014), The economics of Information Management. (Blog) http://xlfe.net/blog/2014/04/13/the-economics-of-information-management/. Retrieved 2018-03-12

VOERT, M. TER, & BEENAKKERS, E.M.T. (ass.), (2016), Legal professions in the future. Developments witin the legal services of advocates, notaries and bailiffs, WODC, Den Haag, summary in English: https://english.wodc.nl/binaries/Cahier%202016-13_Summary_nw_tcm29-235330.pdf. Retrieved 2018-03-12

BENNET, R., PICKERING, M., & SARGENT, J. (2018), Innovations in Land Data Governance: Unstructured Data, NOSQL, Blockchain, and Big Data, Analytics Unpacked. *Annual World Bank Conference on Land and Poverty 2018: Land Governance in an Interconnected World*. Washington.

BERVOETS, B. P.P., KATHMANN, R. M., & KUIJPER, M., (2018). The advantages of a mixed system of property taxation. How different layers of government can use different bases for different property taxes, but still make use of the data collection of municipalities. *Annual World Bank Conference on Land and Poverty 2018: Land Governance in an Interconnected World*. Washington.

BERNERS-LEE, T. (2006), "Linked Data" note. https://www.w3.org/DesignIssues/LinkedData.html (last change 2009/06/18). Retrieved 2018-03-12.

BRATTINGA, M., OVERBEEK, H., & SANTEMA, A. (2014). Best Practices for meaningful connected computing (BP4MC2). PiLOD praktijkervaringen - betekenisvol verbinden van informatie. (Dutch only). http://bp4mc2.org/. Retrieved 2018-03-12.

CROWDER, J.A., CARBONE, J.A., & FRIESS, S.A. (2014), Artifical Cognition Architectures. Springer, New York, NY.

FREY, C.B., & OSBORNE, M.A., (2013). The future of employment: How suspectible are jobs to computerization? Oxford: Oxford Martin Publication.

GRAGLIA, M., & MELLON, Ch., (2018), Blockchain, Real estate, and Land Governance. *Annual World Bank Conference on Land and Poverty 2018: Land Governance in an Interconnected World*. Washington

GROSSMAN, M.R., & CORMACK, G.V., (2017), Technology-assisted review in electronic discovery. https://judicialstudies.duke.edu/wp-content/uploads/2017/07/Panel-1_TECHNOLOGY-ASSISTED-REVIEW-IN-ELECTRONIC-DISCOVERY.pdf Retrieved 2018-03-12

HARNAD, S. (1992), The Turing Test Is Not A Trick: Turing Indistinguishability Is A Scientific Criterion. Sigart Bulletin, 3(4): 9-10.

HAWKINS, S. (2014), interview with the BBC, see: http://www.bbc.com/news/technology-30290540. Retrieved 2018-03-12

HEIDE, VAN DER, J.J., GRUS, M.M., & NOUWENS, J.C.A.J. (2017), Making Sense for Society. *UDMS, 2017: 2nd International Conference on Smart Data and Smart Cities (2017).* Puebla, Mexico.

KING, B.J. (1994), The Information Continuum. Evolution of Social Information Transfer in Monkeys, Apes, and Hominids. School of American Research Press, U.S.

LEMIEUX, V.L., (2018), Evaluating the Use of Blockchain in Land Transactions: An Archival Science Perspective. *Annual World Bank Conference on Land and Poverty 2018: Land Governance in an Interconnected World*. Washington

LEMMEN, C.H.J., (2012), A domain Model for Land Administration. Delft University of Technology, Delft, the Netherlands (PhD thesis).

LEMMEN, C., VOS, J., & BEENTJES, B. (2017), Ongoing Development of Land Administration Standards, European Property Law Journal, 2017, vol 6, no 3, De Gruyter.

LEMMEN, C., OOSTEROM, VAN, P., & BENNET, R. (2015), The land administration domain model. Land Use Policy, 49, 535-545.

LOUWMAN, W., & VOS. J., (2012), Electronic & Cross-border conveyancing techniques – Cutting edge law practices. IPRA|CINDER, 2012: 18th IPRA-CINDER INTERNATIONAL LAND REGISTRATION CONGRESS. Amsterdam, The Netherlands. Published in: XVIII CONGRESO INTERNACIONAL DE DERECHO REGISTRAL IPRA-CINDER, Tirant Lo Blanch, Valencia, 2016.

MEGARRY, R. & WADE, W., (2000), The Law of Real Property. Thomson, Sweet & Maxwell, London.

MENDES, K., (2018), Can blockchain save the Amazon in corruption-mired Brazil?, published on: http://www.thisisplace.org/i/?id=2fcd742b-ec68-4be5-8f9e-9ab89919ef1c&lipi=urn%3Ali%3Apage%3Ad_flagship3_pulse_read%3BG0DjdeYMSdOP4Ykqs5r%2BTw%3D%3D. Retrieved 2018-03-12

McCORDUCK, P., (2004), Machines who think. A personal inquiry into the History and Prospects of Artificial Intelligence, Matick, Massachusetts, A K Peters Ltd.

McGINNIS, J.O., & PEARCE, R.G., (2014). The great disruption: How machine intelligence will transform the role of lawyers in the delivery of legal services. Fordham Law Review, 82, 30-41.

NIKOLIĆ, I., KOLLURI, A., SERGEY, I., SAXENA, P., & HOBOR, A. (2018), Finding The Greedy, Prodigal, and Suicidal Contracts at Scale. Cornell University Library: arXiv:1802.06038v1 [cs.CR]

NOGUEROLES PEIRÓ, N.N., & MARTINEZ GARCÍA, E.J., (2017), Blockchain and Land Registration Systems, European Property Law Journal, 2017, vol 6, no 3, De Gruyter.

OOSTEROM, VAN, P., GROOTHEDDE, A., LEMMEN, C., MOLEN, VAN DER, P., & UITERMARK, H. (2009), Land Administration as a Cornerstone in the Global Spatial Information Infrastructure. IJSDIR, 4, 298-331. Palmer, D., Fricska, S., & Wehrmann, B. (2009). Towards improved land governance. UN-HABITAT.

PLANK, VAN DER, P.J., (2015), De introductie van drijvende percelen, WPNR 2015-7071, P. 662. (available in the Dutch language only).

POOLE, D., MACKWORTH, A., & GOEBEL, R. (1998), Computational Intelligence: A Logical Approach. New York: Oxford University Press.

RUSSEL, S.J., & NORVIG, P. (2009), Artificial Intelligence: A Modern Approach. Upper Saddle River, New Jersey: Prentice Hall.

SUSSKIND, R., & SUSSKIND, D. (2015). The future of the professions: How technology will transform the work of human experts. Oxford: Oxford University Press.

TIANEN, E. (2017), Georef – Linked Data Deployment for Spatial Data; Finnish Initiative, FIG Working Week 2017. Surveying the world of tomorrow - From digitalisation to augmented reality, Helsinki, Finland, May 29–June 2, 2017.

VOS, J., (2011), Authentic Registers in The Netherlands. Technical ambition in relation to reliability and legal certainty, ELRA, Annual Publication series, no. 4, Brussels. Also published online: https://www.elra.eu/authentic-registers-in-the-netherlands/. Retrieved 2018-03-12

VOS, J., (2016), The impact of (disruptive) information technology and the role of the Registrar in (future) e-conveyancing – part II. IPRA|CINDER, 2016: 20th IPRA-CINDER INTERNATIONAL LAND REGISTRATION CONGRESS. Dubai. Published in: XX CONGRESO MUNDIAL DE DERECHO REGISTRAL – 20th WORLD LAND REGISTRATION CONGRESS, IPRA-CINDER, Tirant Lo Blanch, Valencia, 2017.

VOS, J., ed. (2017), Blockchain and Land Administration: a happy marriage?, European Property Law Journal, 2017, vol 6, no 3, De Gruyter.

VOS, J., (2017), Blockchain-based Land Administration. Feasible, illusory or a panacea?, Annual Publication, ELRA, Brussels. https://www.elra.eu/wp-content/uploads/2017/02/10.-Jacques-Vos-Blockchain-based-Land-Registry.pdf. Retrieved 2018-03-12

VOS, J. LEMMEN, Ch., BEENTJES, B., (2017), Blockchain-based Land Administration. Feasible, illusory or a panacea? *Annual World Bank Conference on Land and Poverty 2017: Responsible Land Governance: Towards an Evidence Based Approach*. Washington.

WILSON, D. (2018), Why the blockchain isn`t enough to fix land registries. https://www.linkedin.com/pulse/why-blockchain-isnt-enough-fix-land-registries-dominic-wilson/ Retrieved 2018-03-12.