

# **Delivering 3D Land and Property Management: A Consideration of Institutional Challenges in an Australian Context**

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**Key words:** institutions, 3D, land and property, information, management, institutional analysis, requirements, challenges, new institutional economics

## **SUMMARY**

Urbanisation presents myriad challenges for countries, primarily by increasing pressure on limited land resources through demands for housing, services and infrastructure. This is exacerbated in city centres, where land values are often highest, resulting in acute needs to effectively manage land resources while capitalising on land and property assets. A worldwide trend towards adopting and using 3D technologies and information to improve the management of land and property is apparent. Within land administration, the trend is evident in the development and implementation of 3D cadastres. However, the ability to introduce and sustainably use new technologies to improve land and property management depends on understanding the current institutional environment that underpins relevant processes.

Institutions feature prominently in land administration literature but analysis is often undertaken without a theoretical framework specific to institutions. This precludes the ability to make comparisons across jurisdictions to deepen understanding of why some institutions work while others fail. This paper applies and incorporates insights from new institutional economics and the Institutional Analysis and Development Framework as an appropriate framework for analysis of the institutions supporting land and property information. Some preliminary considerations are provided. These identify institutional issues in using land and property information from an Australian perspective, specifically the state of Victoria, within the context of moving towards a 3D environment. They also assist diagnosis of future issues and potential directions for research.

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## **1. INTRODUCTION**

Urbanisation presents myriad challenges for countries, primarily by increasing pressure on limited land resources through demands for housing, services and infrastructure. This is exacerbated in city centres, where land values are often highest, resulting in acute needs to effectively manage land resources while capitalising on land and property assets. Sustainable management and development of land and property represent some of the most complex challenges today. Achievement of sustainable development goals is therefore increasingly predicated on achievement of sustainable urbanisation.

Driven by sustainability and economic objectives, many cities around the world are moving towards complex vertical multi-unit and multi-functional developments to provide adequate and affordable housing, business spaces and services for increasing populations. Cities are also simultaneously defining themselves through architectural innovation and design, which traditionally represents status and power, and provide symbols of history and identity (e.g. King, 2004; Adam, 2008, 2012). Strategically, differentiation through increasing architectural articulation positions the competitiveness of a city in the global economy; operationally, this adds an additional layer of complexity to the management of these structurally complex buildings. Consequently, these developments and their corollary rights, restrictions and responsibilities (RRRs) challenge current land administration practices, particularly where the management of RRRs is based on the concept of a land parcel.

In parallel, and perhaps in response to the complexities of understanding, managing and designing contemporary urban spaces, utilisation of 3D technologies and 3D digital information for many aspects of land use and planning has increased. These 3D technological innovations that evolved from traditional CAD and GIS tools are valued for the benefits they can potentially bring to urban management, by assisting coordination and integration of multi-source information. A growing body of research now examines ways to apply these technologies to benefit land administration practices and processes. Mostly, efforts are focused on developing and implementing 3D cadastres and use a technical approach, or because of the legal nature of property rights, a legislative approach (Paulsson and Paasch, 2011). A systematic investigation of the benefit of 3D technologies in providing a mirror of the physical world, and their potential for coordinating multi-source information is overdue, as is the relationship among 3D tools used in land administration processes and other nascent trends in building information models (BIM) and 3D city models.

The background for this paper is an ongoing research project into land and property information and management in 3D. The significant technical elements of the project are contextualised by exploring the institutional requirements for delivering a 3D property map.

Planning to introduce and sustainably use new technologies requires consideration of drivers and disruptors of systemic change in well-established and conservative systems of administration, as well as how proposed changes may affect interactions between different stakeholders. As Polski and Ostrom (1999: 5) argued, “institutions delimit capacity for social change” – identification of the current capacity for change will facilitate an understanding of how technological change might be delivered with minimum impost on resources.

A preliminary analysis of the institutional environment and issues in using land and property information is called for, and, to focus land administration in developed democratic economies, the Australian perspective is used. New institutional economics (NIE) where institutional analysis combines transactional, behavioural and organisational realities, is used as the theoretical framework. NIE was chosen as it is accepted in land administration literature and is based on the classical microeconomic theory that links exchange to markets.

The discussion here is in four parts. The first part is an overview of institutional economics and NIE with a literature review of the conceptualisation of institutions within land administration, specifically the current research into 3D property maps. The second part introduces the broad Australian land administration environment and the state of Victoria provides a localised context. The paper then introduces the Institutional Analysis and Development (IAD) Framework as a basis structuring institutional analysis. Finally, conclusions on the direction of future research are provided that pose preliminary questions around the institutional requirements needed to deliver land and property management in 3D.

## **2. INSTITUTIONS**

Institutions exist everywhere and are a fundamental part of social interactions. They are “human-constructed constraints or opportunities within which individual choices take place and which shape the consequences of their choices” (McGinnis, 2011: 170). Seen as instrumental in political order, institutions are important because they evolve from local customs and beliefs, and strengthen to form normative rule-based structures (both formal and informal) that prescribe or preclude behaviours in actions at all levels of society (e.g. Ostrom, 2005). Economists applied this socio-cognitive behaviour to strengthen theories about decision-making and how behaviour affects transactions and markets, resulting in the field of institutional economics and its contemporary variant, new institutional economics (NIE).

### **2.1. Institutional economics and new institutional economics (NIE)**

Institutional economics and its contemporary variant, NIE, both position institutions as key to exchange (of information, goods, etc) and therefore, markets. To varying degrees, both fields of study raised the importance of institutions within society and shifted the neoclassical assumption of ‘utility-maximising’ individuals by respectively arguing for the importance of social customs, beliefs and habits, and introduction of the concept of bounded rationality in decision-making (e.g. Hodgson, 1998; Liu, 2011).

Institutional economics developed in America in the early 1900s. Its approach saw institutions as the only way to link human action with economic behaviour, and therefore protagonists argued for the need to consider institutions as the core of (neoclassical) economic theory

(Hamilton, 1919). Institutional economics was focused on describing institutions and failed to provide resilient and relevant linkages between its analysis and economic and political issues it was strongly linked to, leading to the development of new institutional economics (e.g. DiMaggio and Powell, 1991).

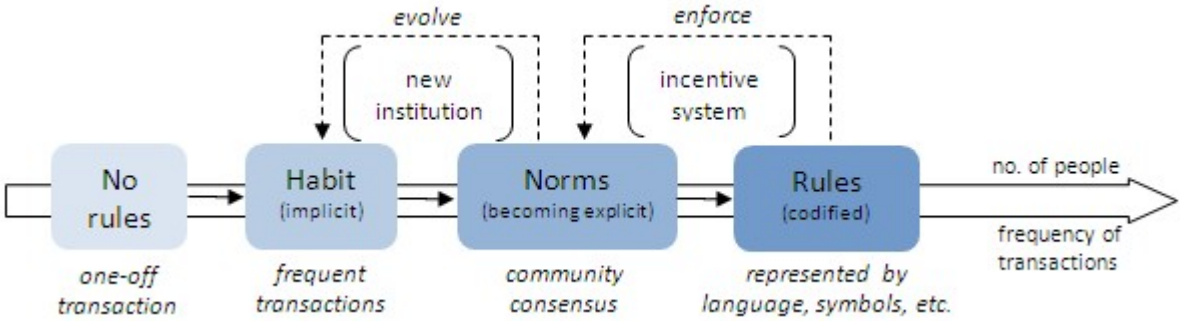
## **2.2 NIE: transaction costs as a measure of institutions**

NIE evolved to bolster the analytical aspect of institutional economics by drawing on theories and concepts from other disciplines to incorporate more realistic assumptions around decision-making behaviour. Essentially, the main proposition of NIE is that institutions (and an understanding of their mechanisms and effects) are crucial for economic performance (Furubotn and Richter, 2005). NIE is predicated on using transaction cost as the fundamental unit of economic decision-making. This enabled the existence and persistence of institutions to be measured and analysed in terms of costs and benefits to an individual, group or organisation (e.g. Coase, 1997; DiMaggio and Powell, 1991; North 1992). There is often an assumption that stable institutions persist simply because they are right (e.g. Williamson, 1985). However, institutions are often less than appropriate because they have difficulties to change things and because the cost of enacting change may be greater than the benefits that change might bring (e.g. Akerlofm 1976; Zucker, 1986; Mathews, 1986—in DiMaggio and Powell, 1991). While it is important to understand how institutions come about and operate, it is just as important to determine if institutions are responding appropriately to needs and how best to implement change—this is especially important to those who have the responsibility for shaping and developing rules for society (Ostrom, 2005).

## **2.3 Institutions and rules**

Despite achieving (arguably) mainstream status, the study of institutions continues to lack a unanimously agreed-upon definition for what constitutes an institution (e.g. Commons, 1931; Ostrom, 1986; Scott, 1987; Crawford and Ostrom, 1995; Williamson, 2000; Aoki, 2005; Hodgson, 2006). The economist, Douglass North, coined one of the most well-known and used NIE definitions of institutions—“rules of the game” (North, 1990: 1). North’s definition gives a sense of the importance of rules in the NIE conceptualisation of institutions. Rules can be regarded as the thematic cornerstone and broadly encompass a range of terminology—conventions, norms, laws, standards, etc., all generally exhibiting some degree of normative characteristic that has the potential to be codified (e.g. Ostrom, 1986; North, 1990; Crawford and Ostrom, 1995; Hodgson, 2006; Ostrom and Hess, 2007). They can be formal or informal (e.g. North, 1994; Crawford and Ostrom, 2005), administrative or operational (Ostrom and Hess, 2007), endogenous or exogenous (or subjective or objective) (Aoki, 2001). The ability to codify rules either through language or other symbolic representation enables the enforcement of rules (Hodgson, 2006). Rules help to reduce risk, uncertainty and information asymmetries by establishing expectations around behaviour during transactions. The linkage between rules and repetitive, patterned behaviour is firmly entrenched in institutional literature, where the formation and sustenance of rules, and rule-based behaviours, are directly attributed to repetitive interactions between human agents and provide the basis for incentive systems (Crawford and Ostrom, 1995; Hodgson, 2006). Figure 1 below shows the process in the development of institutions and the effect of enforcement on evolving institutions. It shows how interactions, which may begin as one-off transactions, can develop into habits and norms over time as the frequency of these transactions increase. This is also

dependent on the behaviour being regarded as beneficial in terms of overcoming information asymmetries during the exchange. Once the benefit of this behaviour is evident and community consensus favours the behaviour, the norms may become codified as rules. If there is significant cost to the community when individuals do not behave in this way, the rules may be enforced, which creates an incentive system. Over time, the institutions may evolve to form new institutions.



**Figure 1. A simplified process showing the development of institutions**

Given the adoption and use of North’s definition of institutions (e.g. van der Molen, 2001; Williamson et al, 2010) and the application of transaction cost theory (e.g. Zevenbergen et al, 2007) in land administration literature, a general use and acceptance of NIE can be inferred. However, despite the centrality of rules in NIE literature, relatively little research explicitly explores and analyse the rules that underpin land administration and its systems. The following section considers the conceptualisation of institutions within land administration and whether better land administration is available from a more robust application of NIE discourse, particularly in understanding the current institutional framework in terms of rules.

**3. INSTITUTIONS AND LAND ADMINISTRATION**

Across land administration literature, there is widespread acknowledgement that land administration systems (LAS) reflect the relationship that people have with land. This is often referred to in the literature as institutions, and is considered an important aspect of land administration and cadastral research (e.g. Williamson and Fourie, 1998; Enemark, 2004). LAS were defined by the United Nations Economic Commission for Europe to be “the processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies. It is considered to include land registration, cadastral surveying and mapping, fiscal, legal and multi-purpose cadastres and land information systems” (UN-ECE, 1996: 14).

This focus on processes emphasises technical issues, and may explain a tendency for land administration literature to be ambiguous in its conceptualisation of institutions: the term ‘institution’ is also used to reference organisations and agencies. For example, when Williamson et al (2010: 95) stated that “land administration is basically about processes, not institutions”, they have acknowledged the importance of reviewing processes in cadastral reform irrespective of where administrative responsibilities for these processes might lie.

They further noted, “key land administration processes are clearly business processes, though conducted mainly by government institutions” (Williamson et al, 2010: 96). Similarly, Enemark (2006: 5) wrote that “institutions may relate to organisations such as national agencies or local authorities”, yet also accepted that institutions could be related to North’s expression as “rules of the game in a society”. This ambiguity is not uncommon but it is important to retain a distinction. North (1990: 4-5) argued for the importance of this distinction, defining organisations to be “groups of individuals bound by some common purpose to achieve objectives” and can be viewed as performing a crucial role as “agents of institutional change” when conceived as participants in institutions. This perspective, or at least the conceptual distinction, is common across NIE literature (e.g. Scott, 1987; North, 1994; Ostrom, 2005).

In summary, two main institutional paradigms appear to proliferate in land administration: institutions in support of land rights and security of tenure (e.g. Feder and Feeny, 1991; Deininger and Feder, 1998; van der Molen, 2004), and institutions in support of organisational reform.

### **3.1 Applications of NIE in land administration**

There is precedent for the use and application of both institutional economics and NIE in the study of land and property, especially in addressing land and property rights (e.g. Denman, 1978; Baland and Platteau, 1998; van der Molen, 2004). Institutional economics was first introduced and incorporated into land management by Donald Denman, who developed a new interdisciplinary area of study called land economy in the 1960s (e.g. Denman, 1878) and “conceived of the proprietary land unit as the fundamental unit of decision-making in relation to the use of land” (Nicholls, 1999). He developed land economy as a specialized version of political economy and saw property as a fundamental institution for ordering decision-making about land and its use, and a source of power over land and resources.

With respect to applications of NIE in terms of rules, published research applies Searle’s theory of social reality (which underpins the cognitive aspect of rules) to investigate the notion of ‘reality’ in a property map and how this is socially constructed by institutional components such as cadastral legislation and interactions between different actors (Bittner, 2001). In terms of transaction cost theory, one of the most significant applications within land administration is the European COST G9 initiative, where experts from various disciplines came together to model real property transactions as a way of improving market transparency and reducing real property transaction costs. Some of this research from the project led to the proposal that a cadastral system should be considered a socio-technical system as opposed to a purely technical one (Ottens, 2004), which could then be positioned as an infrastructure that underpins transactions in real property (Stubkjær, 2005). Most recently, Vaskovich (2012) concluded her study on the impact of property institutions on real property processes in Belarus, also utilising transaction cost theory.

In the Australian context, while there has been little direct and explicit application of NIE theories or concepts, though significant research explores the collaborative relationships that facilitate spatial data sharing, primarily through SDI initiatives. Warnest (2005) considered the situation in Australia at a national level, and within the context of federated countries,

where the absence of a collaborative framework impinged upon data transactions as part of the national SDI. McDougall (2007) investigated the relationships between local and sub-national governments in facilitating SDI initiatives and found that formalisation of partnerships around large data sharing initiatives served as de facto coordination mechanisms. These partnerships were heavily influenced by the prevailing institutional environment, which had a “significant influence in shaping the collaborative strategies which support spatial data sharing environments” (McDougall, 2007: 204). More closely aligned with 3D cadastres, Kalantari (2008) recognised the limitations of most LAS to recognise and manage new interests in land due to the constraints of the traditional parcel-based system. He conceptualised a new concept for land administration data models—the legal property object and through its implementation, examined some of the institutional aspects of an LAS, particularly within the state of Victoria. To some extent, institutional dimensions can be extrapolated since research in these areas provides baseline information about the data flow process and organisational interactions and transactions—all of which can be used to form an initial picture of the current institutional environment in Australia.

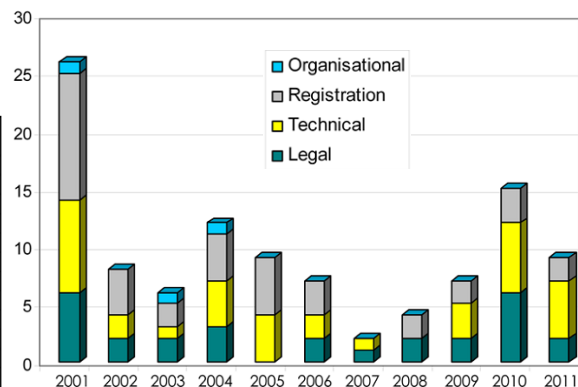
### **3.2 Institutions in the area of 3D cadastres**

As previously mentioned, there appears to be two main institutional paradigms appear to operate in land administration: institutions in support of land rights and security of tenure, and institutions in support of organisational reform. Accordingly, the push towards developing 3D cadastres can certainly be viewed as a way to leverage the growing maturity of 3D technologies to evolve LAS and its processes to improve land rights and security of tenure. What is perhaps less evident, is what reform is required from an organisational perspective to support such an evolution.

The research trends in this burgeoning area of cadastral research supports this: in their survey of topics in 3D property research over a ten year period from 2001 (see figure 2 below), Paulsson and Paasch (2011) found that institutional topics (i.e. legal and organisational) accounted for only 30 per cent (31 instances of primary research) of all research. Of this, the research was almost overwhelmingly (just over 90 per cent) focused on legal aspects, with few instances of primary research being conducted on the organisational aspects in support of 3D cadastres. This is despite an early linkage made between the implementation of 3D cadastres and the need for sound and appropriate institutional frameworks (van der Molen, 2003). Within existing research that are relevant to institutions, legal aspects dominate:

- the concept of 3D property objects (e.g. Stoter and Zevenbergen, 2001; Stoter, 2004; Paulsson, 2007; Paulsson, 2008; Karki et al, 2010);
- jurisdictional legislative limits (e.g. Huml, 2001; Sandberg, 2001; Stoter and Ploeger, 2003; Papaefthymiou et al, 2004; Aien et al, 2011; Tan and Hussin, 2012); and
- legislative developments (e.g. Onsrud, 2002; Eriksson and Adolfsson, 2006; Stoter and van Oosterom, 2006; Ploeger, 2011).

Year	Legal	Technical	Registration	Organisational	Total/year
2001	6 (8)	8 (5)	11 (5)	1 (6)	26
2002	2 (1)	2 (2)	4 (3)	0 (1)	8
2003	2 (2)	1 (0)	2 (4)	1 (1)	6
2004	3 (3)	4 (4)	4 (4)	1 (1)	12
2005	0 (2)	4 (1)	5 (0)	0 (0)	9
2006	2 (1)	2 (1)	3 (2)	0 (0)	7
2007	1 (0)	1 (0)	0 (0)	0 (1)	2
2008	2 (0)	0 (1)	2 (0)	0 (3)	4
2009	2 (1)	3 (0)	2 (1)	0 (1)	7
2010	6 (4)	6 (2)	3 (2)	0 (2)	15
2011	2 (3)	5 (0)	2 (5)	0 (3)	9
<b>Total</b>	<b>28 (25)</b>	<b>36 (16)</b>	<b>38 (26)</b>	<b>3 (19)</b>	<b>105 (86)</b>



**Figure 2. Distribution and breakdown of surveyed 3D research publications and topic distribution (Paulsson and Paasch, 2011)**

In summary, while research into institutions within land administration exists, it is not often carried out within an institutional framework. This precludes the ability of researchers to make comparisons across different jurisdictions and deepen understanding of why some institutional arrangements work, while others do not. The bulk of research on spatial data infrastructure (SDI) development and implementation explores institutional arrangements with the aim of facilitating collaboration (e.g. Onsrud and Rushton, 1995; Ploeger and van Loenen, 2005). While different frameworks borrowing from economic theory, organisational theory and network analysis have been used, exploration of institutions as a sociological phenomenon is rare, as is analysis of impacts on the efficiency of processes, especially across different actors and organisations. Warnest (2005: 65) noted the lack of contribution the GIS and spatial information literature has made to partnerships, particularly in “how to forge relationships between the organisations or how to manage their ongoing operational and financial sustainability”.

Incorporation of the insights from NIE is likely to facilitate a more substantial theoretical basis for analysis of LAS and its components (encompassing organisations and processes). This is especially essential where an innovation is proposed: in this case land and property management in 3D. However, a business case to support this innovation necessarily requires an examination of the institutional arrangements in modern cadastres, which performs a core function in any LAS. Understanding the functions, processes and their contextual meaning and influences within cadastres will provide a sound foundation to build an argument for the need to modernise the institution of the cadastre. A concentration on the technical transition from 2D to 3D environments will not provide a substantial change path in institutions or the processes that they influence.

The following section will provide an overview of land administration in Australia, before focusing on the state of Victoria to provide a more localised context in which to examine the institutional environment of its cadastre.



## 4. LAND ADMINISTRATION IN AUSTRALIA

Australia is a federated country comprising six states and two territories and occupies an entire continent. Federation did not affect many roles of government, including land administration, which remained a responsibility of the mid-tier state governments, a typical arrangement in federated countries.

More than 70 per cent (approximately 15 million) of Australia's population (of 22 million) is concentrated within its five largest urban regions (Department of Infrastructure and Transport, 2011), making it one of the most urbanised countries in the world. The management of such large and dynamic urban areas will only become more challenging as population pressures increase. The challenges of urbanisation are recognised at all levels of government and contributed to a growing federal interest in land and property information—2011 saw the publication of the 'National Urban Policy', the first policy of its type produced by this level. This growing interest in land or spatial information also resulted in the establishment of the Office for Spatial Policy (OSP) in 2011 to “strengthen whole-of-Australian Government spatial data policy leadership” (Department of Resources, Energy and Trading, 2012). The OSP joins Geoscience Australia as one of a handful of national statutory organisations in this area, although non-statutory organisations such as the Australian New Zealand Land Information Council (ANZLIC), the Intergovernmental Committee on Surveying and Mapping (ICSM) and PSMA Australia Limited have played a significant de facto coordination role at a national level given that all three organisations include representation from the various state governments.

### 4.1 Land and Property Information in Australia

The administration of land in Australia is founded on the Torrens land registration system and land and property information produced by processes managed at state and local levels. At a national level, activities relevant to land and property information focus mainly on development of standards (e.g. through ICSM) and policies (e.g. through ANZLIC) to improve coordination of information between states. PSMA has been vital in the compilation of fundamental national datasets related to land, principally the development of CADLite to provide an authoritative national cadastral land parcel dataset and the Geocoded National Address File (G-NAF). In particular, the G-NAF is significant for its reliance on information from processes managed by both state and local governments (McDougall, 2007).

The administration and management of land resources at a state level results in datasets being held by diverse statutory agencies according to the variable needs of their local context and history of their jurisdiction. For example, land registries tend to be responsible for the cadastre (or property map), which plays a central role in providing records of boundaries related to recording of land ownership; planning, land use and heritage datasets may be held by planning departments; environmental datasets may reside within natural resource departments. Other organisations that hold information related to land and property include providers of utility services like gas, electricity, sewerage and water (McDougall, 2007). Local governments have administrative responsibility for managing processes related to planning and building, which generate large volumes of property information. Somers (1987 in McDougall, 2007) estimated that approximately 80 per cent of all local government

transactions relate to land, buildings or some other spatial aspect. Local governments therefore often require detailed and large-scale land and property information to support management strategies (McDougall, 2007).

The development of digital cadastral databases by state governments enabled local governments to leverage cadastral information for the purposes of managing property more effectively (McDougall, 2007). There is often an emphasis on using the parcel as the basis for managing land and property information as the land parcel is the fundamental unit in the cadastre. For example, Bennett (2009) considered the question of how the management of property rights, restrictions and responsibilities (RRRs) could be improved at the parcel level given that only a small percentage of all interests associated with a property were on title. In reality, the parcel is not ideal for effective management of land and property RRRs: parcels can have a one-to-many relationship with properties (e.g. in complex developments) and properties can have a one-to-many relationship with parcels in rural areas (McDougall, 2007). Additionally, the property, and not the parcel, often links the community with services such as utilities, postal services and the electoral roll. In response, Kalantari (2008) proposed the concept of the spatially referenced legal property object as the basis for organising land and property RRRs as it has the potential to capture a wider array of RRR information.

3D objects, or indeed, a 3D platform, offer an even more effective way to capture and manage information about interests in land and property. However, this suggestion depends on integration of land and property information derived from different sources. Every jurisdiction experiences issues in integration, and approaches options in unique ways: the Australian state of Victoria faces an array of issues that are typical.

#### **4.2 Land and Property Information in Victoria**

Like much of Australia, land in Victoria can be classified as one of two main categories: freehold (private ownership) and Crown land (which is administered by the state). Land administration is primarily provided by Land Victoria, which collects, manages and disseminates property information, and Spatial Information Infrastructure Information Business Technology, which manages Victoria's fundamental spatial datasets. Both organisations reside within the Department of Sustainability and Environment.

In terms of parcel information, Vicmap Property serves as the property map base (cadastre) for the state and includes spatial information at various scales. The cadastre is linked with the Victorian Online Title System (VOTS), a non-spatial database which holds a record of all land titles and relevant information such as mortgages, through further cross-reference using lot and plan numbers. Property-based information is currently available through a Property Report; title searches and certificates through an online service that provides relevant information such as planning provisions, address, electoral division, etc, or contact with the custodian agency. Registration services are being expanded to include broader information on other interests in land such as water rights and carbon credits. Overall, the system does not provide a straightforward link between property and parcel information and there was a need for the user to "perform table joins to obtain relationships between parcel and property (within Vicmap Property), or to determine which property has what address (with Vicmap Address)

using Standard Parcel Identifier (SPI), lot and plan number, council property number (CPN) and cross reference to Vicmap Address data model” (Kalantari, 2008: 99).

#### 4.2.1 Issues with the current cadastre

The Victorian system has benefitted tremendously from adopting new technologies (conversion to electronic titles and a digital cadastral database) but this has also resulted in a complex system of maps and title information, as well as increased errors in information (Bennett, 2009). This is particularly exacerbated in multi-level developments—in their case study on Victoria, Aien et al (2011) found ad hoc recording of underground features in the cadastre and no information recorded for vertical developments above ground, where cross-sectional diagrams in the plans of subdivision were used. This dependence starts to falter in physically complex buildings where cross-sections cannot represent the entire shape of the building, this limits the utility of this approach.

Bennett (2009) demonstrated the issues within the current cadastral system in Victoria in managing the diverse range of interests that typically applies to property using a single-storey dwelling in his case study. These issues are further compounded by the challenges in understanding and managing ownership rights relevant to buildings, which currently accounts for approximately 40 percent of subdivision plans in the cadastre. A property map that does not adequately manage land and property RRRs will inevitably impact on the overall administration and management of land and property. 3D innovations are appealing for providing an object-oriented approach for organising interests, and providing a visualisation of these interests (which are abstract and relative concepts) and their relationship with affiliated physical objects (which are absolute and objective). Moving away from a parcel-based approach has primary benefits in improving comprehension of ownership boundaries and associated RRRs, which delivers secondary benefits in management and capitalisation.

Since technological developments for land and property information have tended to trigger institutional challenges (Grant and Williamson, 2003 in McDougall 2007), it is necessary to first understand the current institutional environment that underpins the use of land and property information in general before introducing technological change.

### **4.3 The Victorian Institutional Environment**

In terms of the prevailing institutional environment in Victoria, the Victorian Spatial Information Strategy (VSIS), developed by the Victorian Spatial Council (VSC), provides strategic direction for the state’s spatial community. The most recent VSIS exhorts the importance of nurturing the appropriate institutional environment, which should be based on collaboration. This environment will facilitate collaboration and engagement across all sectors by incorporating “collaborative decision-making”, “collaboration and partnerships in the development of new products and services”, and “adoption of new technologies to support delivery of and access to spatial information” (VSC, 2011: 7). Additionally, the VSC acknowledges that ultimately, having the right institutional arrangements underpins all other strategic and operational challenges as they provide the incentive system for participation (VSC, 2011). Appropriate incentives are crucial in any institution. A key challenge to designing incentives to overcome organisational self-interest (a potential obstacle in moving towards 3D solutions) lies in identifying improvements in collaboration. In this instance, what

drives collaboration (i.e. further common interests) among stakeholders of land and property information needs to be precisely identified.

Within Victoria, appropriate incentive systems relied on economic impetus such as the decreasing flow of revenue from the federal governments as well as the costs of duplication. For example, the Property Information Project (PIP) that commenced in the late 1990s brought together state and local governments to create an authoritative state property layer. At that time, local governments created and maintained their own property and cadastral information and were charged substantial fees for accessing state information due to cost recovery models of operation in state government departments applied since the late 1980s (McDougall, 2007). In this instance, the incentive for collaboration was equally attractive for both parties: the local governments benefited from funding of the project by the state government (through Land Victoria) and free use of the new cadastre and frequent updates; the state government obtained an authoritative and maintained information layer to augment Vicmap (Jacoby et al, 2002). Achievement of completeness of information had far-reaching benefits beyond data reconciliation in the short-term. The development of supporting processes improved the state-local government relationship and perpetuated positive long-term institutional changes. An increasing awareness of the benefits of spatially enabled governments and society, while indirectly related to economic drivers, is also influential. The VSIS identified spatial enablement as a key strategic direction with benefits in information management and therefore decision-making to facilitate sustainable development objectives (VSC, 2011).

Examination of the state of collaboration between land and property information stakeholders and information flows around land and property information in Victoria generally shows the diversity of directions in information flows, reflecting the variety of processes, stakeholders and repositories of land and property information within the state. For example, Kalantari (2008) provided a map of the Victorian land administration system in terms of electronic and non-electronic flow of data processes (see figure 3 below), where collaboration is in part facilitated by technology. Tambuwala et al (2012) mapped information flows between state and national organisations in the context of land tax and interest rates and demonstrated information asymmetries between state and federal levels of government.

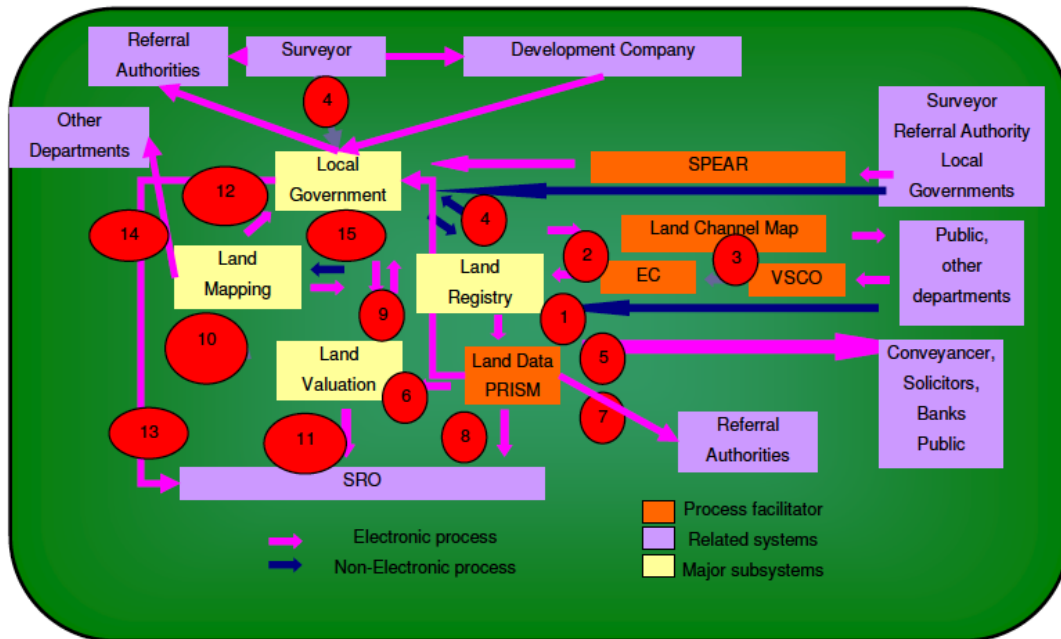


Figure 3. The Victorian land administration system (Kalantari, 2008: 97)

The complex landscape of land administration requires a stronger theoretical basis by which to examine and analyse institutional arrangements, beyond what has already been accomplished in pursuit of spatial data infrastructure initiatives. Theories developed by NIE offer appropriate frameworks for analysis of land and property information.

## 5. THE INSTITUTIONAL ENVIRONMENT, COLLABORATION AND POTENTIAL APPLICATIONS FOR NIE

Despite significant evidence in GIS research demonstrating the negative economics of non-collaboration (e.g. Pinto and Onsrud, 1995), these practices still persist. Mainstream theories about successful collaboration, or collective action, examine the importance of group size and homogeneity within the group—smaller and more homogeneous groups are more likely to contribute due to the potential for greater dividends as well as to further common interests (Olson, 1965). Paradoxically, successful action in larger groups can also be attributed to decreased costs to the individual and greater diversity in skills (Esteban and Ray, 2001). The dynamics of collaboration within GIS are additionally complicated when land administration to be considered a public good (Bennett et al, 2012), which emphasises the non-excludability from use of the good by non-paying consumers and changes the economic dynamics of the domain. However, even if the actual administration of land may be categorised as a public good, land and property information might be still treated as requiring pricing policies that exclude and ration use in order to offset the cost of collection and maintenance.

The concept of the commons for cultural or knowledge purposes (where commons refers to a resource that is neither wholly public nor private) frames consideration of access and dissemination of digital information (Hess and Ostrom, 2007) and can be applied to land and

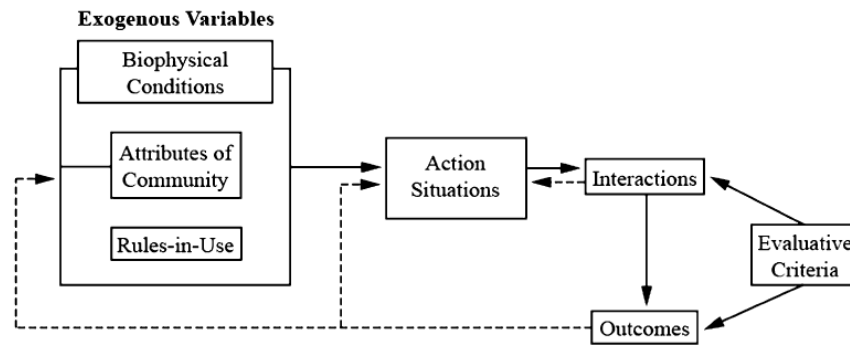
property information—or cadastral commons. Analysis of the means of collaboration, the feature of successful implementation of a commons, can then benefit from the broad theory of NIE. In particular, Elinor Ostrom’s work on common pool resources demonstrated that communities can craft successful informal institutions to manage access to resources and that changes to formal institutions (such as legislation) are not necessarily always effective. For example, the National Government Information Sharing Strategy developed by the federal government advocates broad incentives related to “timely, reliable and appropriate information sharing” in terms of improved governance (AGIMO, 2009), but lacks an enforcement aspect to provide disincentives for agencies. This limits the effectiveness of the policy. In contrast, the VSC acknowledged the benefit of a ‘rules framework’ that includes changes to legislation, but also the development of best practice principles to provide for greater “flexibility and durability to the rules that will be developed” (VSC, 2011: 15), an implied advocacy of more informal institutional arrangements.

Successful adaptation of an institutional environment therefore requires both an understanding of existing collaboration issues and the rules and incentive systems available to promote or deter collaboration. In the context of land and property information use, production and management, issues range from technical standards and data formats; to operational factors such as costs and protection of jurisdictional responsibilities (e.g. politics of multiple-level governments); and cognitive concepts endemic to stakeholders. To this extent, the Institutional Analysis and Development (IAD) framework, derived from the NIE tradition, offers an appropriate tool for understanding collaborations and the institutional arrangements that influence these settings, providing the basis for better policy design.

### **5.1 Overview of the IAD Framework**

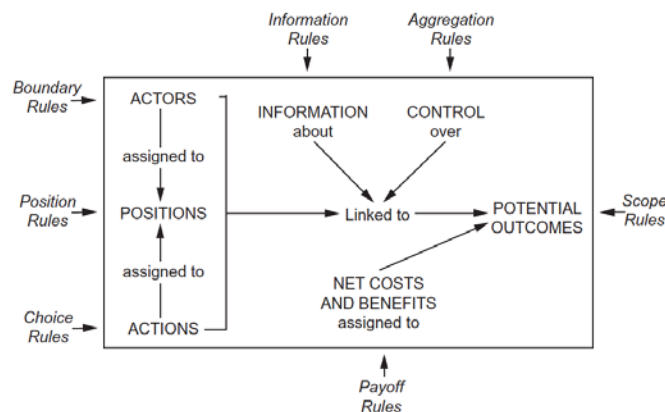
Institutional analysis requires deconstruction of the institutional environment into components to identify the relationships between them (McGinnis, 2011). The IAD enables analysts to collect information about institutions in a structured way by providing a multi-layer schema that provides a list of “independent variables that a researcher should keep in plain sight to explain individual and group behaviour” (Gibson, 2005: 229 in Ostrom and Hess, 2007: location 544). The IAD builds on a systems-based approach with inputs, outputs and a feedback system (McGinnis, 2011) and therefore enables detailed analysis of variables and interactions within a policy or institutional context. More relevant to this research, the IAD is regarded as appropriate for analysing knowledge resources where technology is advancing rapidly (Ostrom and Hess, 2007).

The IAD is designed to mimic the complexity of real world situations, while remaining sufficiently simple to facilitate theoretical analysis and comparison. Within the IAD, institutions are defined as “a set of prescriptions and constraints that humans use to organise all forms of repetitive and structured interactions” (Ostrom, 2005: 1), and can include rules, norms and strategies (Crawford and Ostrom, 1995). Institutions are further categorised as formal or informal, and associated prescriptions defined respectively as ‘rules-in-form’ and ‘rules-in-use’.



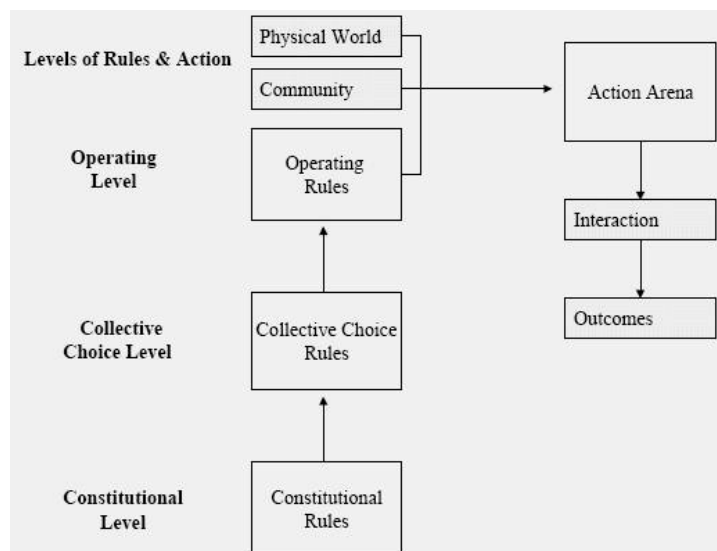
**Figure 4. The IAD Framework (Ostrom, 2010: 646)**

The core of the IAD is the action situation where decisions are made, and is therefore the focus of analysis. Figure 4 above shows the three main categories of variables that affect the structure of the action situation: the physical environment, the characteristics of the community and the informal prescriptions that prevail. While rules can be changed, the type of change may be restricted by the other two variables (Ostrom, 1986).



**Figure 5. The internal mechanism of the action situation and the influence of rules-in-use on different parts of the action situation (Ostrom, 2011)**

Essentially, the ‘rules-in-use’ are the set of rules to which participants would make reference if asked to explain and justify their actions” (Ostrom, 2011: 18). These rules are further delineated to comprise boundary rules, position rules, choice rules, information rules, aggregation rules, scope rules and payoff rules. These rule types influence different parts of the action situation (see figure 5 above) and are important as they delimit factors such as entry and exit (boundary rules) and permissible actions (choice rules).



**Figure 6. Three levels of rule analysis (Polski and Ostrom, 1999)**

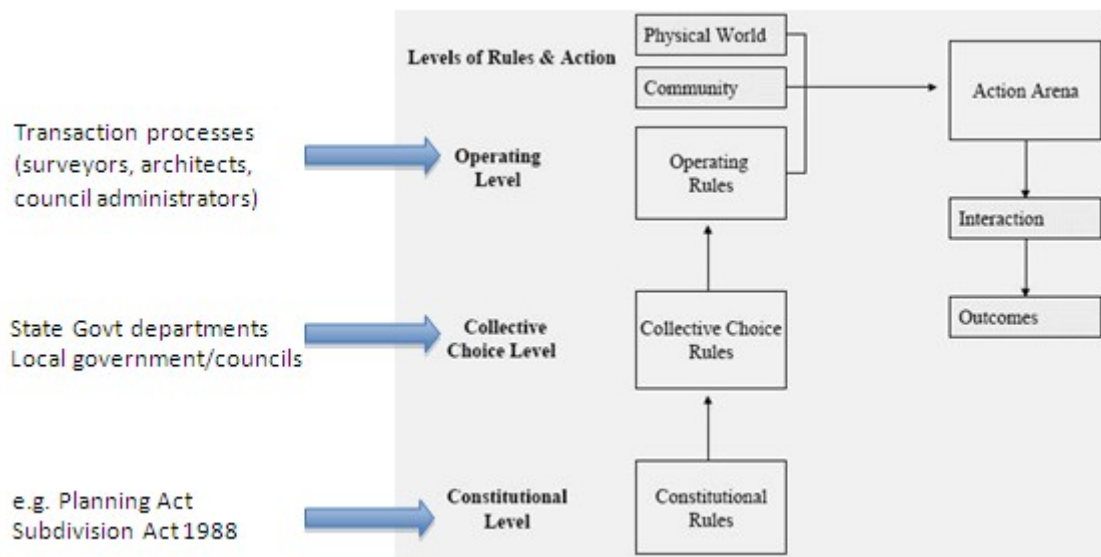
The action situation also functions as a nested set of situations at three levels – constitutional choice, collective choice and operational choice (see figure 6 above). This reflects many polycentric governance situations be they multiple levels (local, state, national) or across different sectors (private, public, or other types of organisations).

## 5.2 Applications of the IAD Framework

The IAD will elucidate the rules-in-use that influence core actions by different stakeholders within the land development process and their interactions around key processes in land and property management such as subdivision or registration. Structured collection of information around the seven rule types will inevitably identify some of the current incentives and disincentives in the production, use and management of land and property information within Australia.

Changes involved in moving from a 2D to a 3D environment are potentially contested between lower and higher institutions. The IAD also facilitates understanding of how operational processes are influenced by higher-level institutions. As mentioned earlier, the current research on 3D cadastres emphasises legislative aspects, which do not apply in Victoria since existing laws pertaining to land and property (e.g. the Subdivision Act 1988) do not specifically exclude, limit or legislate against the use of 3D information or 3D objects. At the local government level, 3D models are increasingly used as a way of organising property information (e.g. City of Melbourne). As a result, obstacles to the implementation of a 3D environment are likely to lie with existing operational transactions and workflow processes.





**Figure 7. Potential for moving towards a 3D environment: considerations at the three institutional levels in Victoria**

## 6. CONCLUSION AND FUTURE DIRECTIONS FOR RESEARCH

The ability to introduce and sustainably use new technologies in land and property management is dependent on understanding the prevailing institutional environment. Institutions have always featured prominently in land administration theory and practice. However the discipline of land administration does not have a native theoretical framework within which to centre understanding of institutions. Given developments in sister disciplines, NIE can happily fill the gap. Use of transaction cost as the fundamental unit of economic decision-making provides a way to measure and analyse institutions in terms of costs and benefits to individuals, groups and organisations. Central to NIE discourse is the concept of rules and their influence on behaviour, particularly by offering incentive systems for action. The insights from NIE will provide a substantial and cross-disciplinary theoretical basis for analysis of land administration systems and their components (encompassing organisations and processes). Importantly this theoretical basis will improve the capacity of land administrators to recommend and manage change in response to human and technical drivers.

This overview of land administration in Australia and Victoria relied on the limitations of the current system in effectively managing land and property interests and resulting information asymmetries across different levels of government. The limitations provide the context for examining institutional challenges and incentives for positive change in agencies and in the institutions they use. The IAD was introduced as an appropriate framework to examine the informal rules that govern land and property information transactions and to focus analysis at the operational level. The next steps involve applying the theoretical approach in the empirical institutional operations of land and property information transactions, to establish what institutional changes will facilitate the move towards a 3D environment and to provide the basis for appropriate policy design.

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**Author/s:**

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**Title:**

Delivering 3D land and property management: a consideration of institutional challenges in an Australian context

**Date:**

2012

**Citation:**

Ho, S., & Rajabifard, A. (2012). Delivering 3D land and property management: a consideration of institutional challenges in an Australian context. In Third International FIG Workshop on 3D Cadastres: Developments and Practices, Shenzhen, China.

**Publication Status:**

Published

**Persistent Link:**

<http://hdl.handle.net/11343/32709>

**File Description:**

Delivering 3D land and property management: a consideration of institutional challenges in an Australian context

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