



'Invisible' constraints on 3D innovation in land administration: A case study on the city of Melbourne

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ABSTRACT

Excitement about the potential of 3D technologies to support production and management of complex building information has extended to the land administration sector. Structural characteristics of high-rise buildings are compounding complexity in the design and layout of private, public and communal ownership rights, restrictions and responsibilities, leaving a legacy of ongoing management issues for urban communities. Despite the premise of 3D innovations and significant technical progress, widespread adoption remains elusive. Attention is turning to understanding the social and cultural influences – the 'invisible' constraints, otherwise regarded as institutional aspects, to explain deeply embedded attitudes and behaviours that are posing resistant to current change strategies. An interpretive case study in the city of Melbourne provides context for exploring institutional issues within the land administration sector regarding high-rise developments. The plan of subdivision is used to trace institutional influences, conceptualising these as regulative, normative and cultural-cognitive elements. These elements constrain stakeholders to current 2D ways of behaving, limiting movement towards 3D innovation. The findings suggest clear institutional 'gaps' that deliberate strategies will need to address, but also highlight the importance of understanding the interdependency between all elements for strategic response. Finally, the findings indicate that a new focal actor that is in a position to generate the required intention for change has not emerged and therefore, an industry-wide strategic response is not apparent.

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Introduction

People who deal with big buildings are getting excited about 3D. Mostly, this has centred around Building Information Models (BIM) and the potential it holds for improving data interoperability and collaboration amongst the different professions involved in building development – notorious productivity issues for Architecture, Engineering and Construction (AEC) sector (Egan, 1998). These issues – associated with traditional 2D ways of working – has been estimated to cost the industry almost \$16 billion annually in the United States (Gallaher et al., 2004) and around \$12 billion annually within Australia (Engineers Australia (Queensland Division), 2005). At a project level, Rahman (2010) estimated that such data loss could account for approximately 30 percent of total costs – and these are only costs that are accrued during development. Throw

into this mix the fact that management costs of a building over its lifecycle will be at least three times its capital costs (Schade, 2007) – which depends on data coming out of the development process – and a fairly dismal economic scenario emerges.

As many of these big buildings become adopted for residential purposes, another equally important legacy of structural complexity has emerged: the impact of physical structure on design, layout and definition of private and communal ownership rights registered through strata¹ titles, restrictions and responsibilities (RRR). This information, generated and managed by the land administration sector (comprising surveyors, land registries, local government units, planners and strata managers,² amongst others), is

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¹ Strata titles supports the ability to separately own part of a property, such as an apartment and its associated spaces such as car parks or storage areas, in a multi-unit development, with shared ownership of common areas within the development, typically termed 'common property' e.g. gyms, pools, gardens, etc. (Strata Community Australia, 2014a).

² Strata managers are professionals to administer owners corporations (comprising all lot owners in a development) according to legislative requirements and to ensure that common properties are maintained for the benefit of all lot owners (Strata Community Australia, 2014b).

fundamental to development as it enables the commoditisation of property by defining and securing tradeable rights to land resources and property assets. In high-rise structures, ownership boundaries, essentially cognitive in nature, are, in reality, layers of invisible, intersecting, interleaving, oddly shaped blocks of space that cross over different physical planes and structural levels. Abstracting and representing these 3D spaces across pages and pages of 2D plans of subdivision are now pushing the boundaries of representative and cognitive efficiency.

As complex high-rise structures become the mainstream functional model in cities, there is a growing realisation that finding a path that transcends traditional (2D-based) paradigms in information production, transaction and management and associated work processes is now a pressing necessity. The AEC industry has been focused on adopting and implementing BIM, while the land administration industry has been developing data models that can accommodate 3D RRR information (Van Oosterom et al., 2013), data models that integrate legal and structural information (Aien, 2013), and implementing these data models for land administration purposes (e.g. Stoter et al., 2013; Shojaei et al., 2013).

But 3D innovation has proven to be a tricky business. Despite the benefits of proven technological functions, widespread adoption remains elusive. Indeed, a rich body of literature suggests a focus so far on the technical aspects is part of the problem, and it is as vital to understand the social conditions of the environment in which the innovation is to be embedded (e.g. Giddens, 1984; Pinch and Bijker, 1987). To complicate matters, technological innovation in open, complex systems – characteristics recognisable in both the AEC and land administration sectors by their networked and multi-stakeholder natures, is even trickier. Past experiences of innovation in similar systems suggest that since collective action is required for the innovation to take hold, power plays amongst stakeholders leave the process more vulnerable to politics and contests for resources (Tushman and Rosenkopf, 1992; Aldrich, 1999; Swaminathan and Wade, 2001; Dowell et al., 2002).

Attention has been turning towards identifying the social and cultural factors – the ‘invisible’ constraints – that go further towards explaining behaviours and attitudes that are resisting change. The importance of this development in the research agenda is articulated in comments by Nigel Clark, the technical director of the national BIM initiative in the United Kingdom, who commented, “It will be the cultural and behavioural changes that many will find most difficult, and yet I believe these will prove to be the most important if we are to be successful” (NBS, 2013: 04–05). Similar initiatives are only just emerging in the land administration sector.

Therefore, this paper aims to explore the social and cultural environment underpinning production and use of complex building information, but from a land administration perspective. The main objective will be to develop a better understanding of the social and cultural – otherwise known as institutional – environment and associated structures that underpin land administration processes, primarily to facilitate registration and strata management of properties in high-rise developments. The research question central to this paper is therefore: how could the current institutional environment (pertaining to land administration) be constraining efforts to leverage 3D innovations for managing land and property information?

A case study on the urban municipality of the City of Melbourne in Australia provides context for building knowledge. This work builds on an earlier paper, which argued that the characteristics of the institutional environment underpinning land development and management should be investigated to reveal potential barriers to technological innovation (Ho et al., 2013). This research also

forms part of a larger project investigating 3D land and property information management. Institutional theory provides the main theoretical framework as it attends to “the role of rules, the effect of culture, and the importance of history in explaining social structure and behaviour” (Scott, 2003: 879). A better understanding of what drives current behaviour will provide a foundation for developing strategies attuned to supporting 3D innovation in the land administration industry; ultimately, this will help connect 3D innovation in the land administration sector with the broader movement occurring across the global development industry to help realise a truly integrated land and property information stream.

The paper is structured as follows. First, theoretical perspectives are presented, followed by the research approach. Based on the data collection, relevant information processes across development and strata management are presented as an integrated process and a system common to all the stakeholders. Key themes that emerged from the case study are then described, following which the application of institutional theory provides a way to frame interpretation of these themes as potential constraints against 3D innovation through their continued reinforcement of current 2D based practices. Finally, the paper concludes with a summary and directions for future research.

Literature review

Technological innovation and institutions

Since Schumpeter's (1934) early work on innovation, the economic paradigm (rationality, utility maximisation, theories of the firm) has dominated strategies for diffusing technological innovation (Damanpour, 1991; Fichmann, 2004; Dosi, 1982). But the growing link between technology and productivity of organisations shifted the focus to organisations, its structures and the people within (Barley and Tolbert, 1997; Orlikowski, 2000; Morton et al., 2006), leading to awareness of the necessity to better understand the social environment that the innovation is to be embedded within (e.g. Giddens, 1984; Pinch and Bijker, 1987; Orlikowski and Robey, 1991; Orlikowski and Barley, 2001; Dowell et al., 2002; Geels, 2004).

This led to the growing use of institutional theory as a framework within the domains of information systems and information technology research for understanding the social characteristics of organisations and to help explain diffusion of new technologies (e.g. Björck, 2004; Mignerat and Rivard, 2009). In particular, new institutionalism, with its focus on sociological aspects of institutions, has played a popular role (Ingram and Clay, 2000). The key proposition of new institutionalism is that actions are constrained or enabled by prevailing ‘invisible’ social structures, and the choice to act in a certain way can be conscious or unconsciously influenced (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; North, 1990; Ostrom, 1990, 2005; Scott, 1995, 2001; Ingram and Clay, 2000). Amongst the various perspectives in new institutionalism, Scott's ‘Three Pillars’ framework is adopted to provide the theoretical and analytical foundation; justification for its use is provided in an earlier paper (Ho et al., 2013).

Scott proposed three main socially constructed ‘pillars’ that contribute to the existence of enduring social structures in society: regulative, normative or cultural-cognitive elements (Table 1 above). Although the distinctions between elements have been criticised as less than realistic (Thornton et al., 2012), he persisted for the purposes of facilitating analysis.

The regulative pillar composes mechanisms mainly driven by “force, fear, and expedience”, resulting in behaviour and actions that are conscious, concerted and reflect a high degree of rationality (Scott, 2003: 880). Rules, laws and sanctions tend to be

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