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Towards 3D-enabled urban land administration: Strategic lessons from the bim initiative in singapore

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ABSTRACT

Over the last 15 years, there has been great interest and commensurate momentum in the land administration industry on realising the notion of '3D cadastres'. This leverages 3D digital technologies for producing, managing, registering and communicating information about complex, volumetrically defined land and property rights, restrictions and responsibilities (RRRs) that are commonly found in cities and urban areas around the world. There has been significant technical progress but implementation remains uncertain. This paper draws on research conducted on the implementation of 3D Building Information Models (BIM) for regulatory processes in the land development industry in Singapore to illustrate the range of strategies used to induce change in an instance of 3D digital innovation. The adoption of institutional theory as an analytical framework provides insight into the cultural and behavioural underpinnings of these strategies and what makes them particularly effective in producing a positive response to change. Given the similarity in the institutional characteristics of the land development and land administration industries, the case study findings are used to develop a framework of strategic principles that could conceivably be used to support ongoing international efforts to realise 3D cadastres.

1. Introduction

For more than a decade, the idea of '3D cadastres' has been percolating among the global land administration industry which is concerned with defining and recording the legal, geometric extent and location of land and property rights, restrictions and responsibilities (RRRs). This idea is oriented around the use of 3D digital information and communication technologies (ICT) for producing, managing, communicating and even registering information about complex RRRs. These are particularly prevalent in cities around the world, representing stratified and volumetrically defined spaces that are challenging traditional 2D-based information practices. There has been significant technical progress and there now exists several real possibilities for realising the technical implementation of 3D cadastres. However, organisational and professional implementation remains an altogether different story with no jurisdiction in the world yet able to successfully and sustainably introduce 3D cadastres.

At the same time, the global land development industry – that is concerned with construction and development – has also embarked on a journey of 3D innovation through the adoption and use of Building Information Models (BIM). They have been confronted with similar challenges in terms of implementation yet their success to date has been far more remarkable. Importantly, they have recognised the importance of focusing on the non-technical aspects of change as shown in comments by Nigel Clark, the technical director of the national BIM initiative in the United Kingdom, who noted, *"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).

This position motivates the aim of this paper. It draws on research conducted on the mandatory introduction of BIM for compliance checking in Singapore to illustrate the range of strategies used to support 3D innovation in regulated industries. Specifically, through the application of institutional theory, this exploratory research examines the institutional (social and cultural) underpinnings of strategies used to support BIM adoption in Singapore to develop a deeper understanding as to what makes them particularly effective in producing a positive response to change. At first glance, the land administration and land development industries seem autonomous; however, strong similarities in their institutional characteristics indicates the theoretical potential for

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learnings from one setting to be relevant to the other and for this research to be more broadly applicable.

The rest of the paper is structured accordingly. An overview of institutional theory is first provided before the research method is described. The case study background is then provided before the findings of the case study are presented. This is followed by a discussion and the findings are used to develop a conceptual framework of strategic principles which could conceivably be used to support ongoing efforts to realise 3D cadastres in the global land administration industry.

2. Innovation and institutions

There have been several dominant research perspectives that have contributed to our understanding of how innovation can be supported. Schumpeter's (1934) seminal work on the role of technological innovation in economic development perpetuated an overarching economic motivation. Numerous studies have emphasised the contribution of technological innovation towards improvements in productivity (e.g. Solow, 1957; Clark and Guy, 1998; Nadler and Tushman, 1999; Ives et al., 2003; Melville et al., 2004). This has provided the impetus for conceptualising innovation in terms of 'demand pull' – market forces as the basis of technological change, and 'technology push' – technological developments as an independent factor (Dosi, 1982).

In recent years however, there has been growing recognition of the limitations of such a perspective, with criticisms levelled at the lack of consideration given to the entire range of intervening factors impacting on innovation, or the interactions between them (Fichmann, 2004). This has motivated other investigations with a significant portion of more recent literature on technological innovation being derived from a focus on the firm (Dosi, 1988). This has led to the now widely accepted position that innovativeness at the organisational level is a product of both strategy and structure, where the challenge of innovation is believed to lie not only in developing new products, but also supporting processes at organisational and individual levels (Hollingsworth, 2000; Henfridsson et al., 2009).

In particular, cognitive models have become a key focus, with Barley and Tolbert (1997) observing that, *"organisations, and the individuals who populate them, are suspended in a web of values, norms, rules, beliefs, and taken-for-granted assumptions"* (p. 93). Cognitive models and the shared systems of values, norms, rules, beliefs and assumptions upon which they are based are nurtured and facilitated by social structures that are either dominant (central and stable systems of meanings and values) or emergent (new meanings and values that are being created in response to new practices or conditions) (Williams, 1980).

The significance of social structures – or institutions – have led to institutional theory playing a growing role in explaining issues of inertia towards adoption of technological innovations (e.g. Nelson, 1988; Orlikowski and Robey, 1991; King et al., 1994; Edquist, 1997; Damsgaard and Lyytinen, 2001; Nelson and Nelson, 2002). It has served to focus attention on the social and cultural elements that affect individual, group, organisational and even societal behaviour through the presence of formal and informal social structures, i.e. how behaviour is socially constructed (Meyer and Rowan, 1977; Meyer and Scott 1983; Meyer and Rowan, 1991; Barley and Tolbert, 1997). More importantly, it has served to frame innovation as a negotiation between current and emergent social structures, and consequently a contest between stability and change (Hargadon and Douglas, 2001).

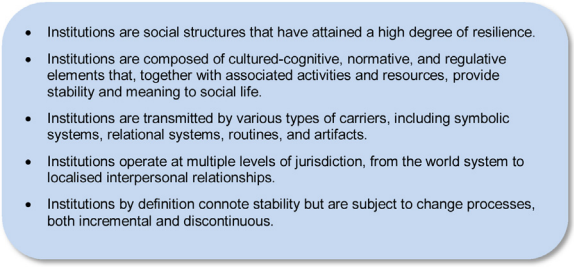

Fig. 1. Scott's omnibus conception of institutions (Scott, 2001: 48).

2.1. Definition of institutions

Institutional theory is less a single theory and more a collection of perspectives developed from philosophical foundations in economics, sociology and political science (Björck, 2004; Scott, 2008; Currie, 2009). There are varying definitions as to what institutions are and Scott (2001) attempts to bring together the salient attributes of institutions as shown in Fig. 1. In this paper, Scott's (1995) definition of institutions as *"regulative, normative, and cognitive structures and activities that provide stability and meaning for social behaviour"*(p. 33) is adopted.

Under this conceptualisation, culture, belief systems (such as religion), legislation, regulation and norms (social or professional) are some of the broad categories of examples of institutions. In the absence of complete information, institutions act to reduce risks and uncertainty by creating expectations about how others might behave during certain types of transactions; therefore, institutionalisation is *"the process of social interaction through which actors realise that their expectations in the behaviour of others will not be disappointed"* (Beckert, 1999: 782).

To facilitate innovation, understanding how institutions are created and become dominant provides a foundation for understanding the motivations behind current thinking, actions and behaviours. This is critical for understanding how to position an innovation (developing strategy) without being too far a leap from current practices, which would lead to the innovation being perceived as too risky. Therefore, it is necessary for the innovation, and associated change in behaviour, to be perceived as legitimate.

2.2. Legitimacy

The notion of legitimacy plays a fundamental role in institutional theory. It has been affiliated with cultural support (Meyer and Scott, 1983), acceptance by the public and the acknowledged right of an organisation to pursue its own aims (Knoke, 1985), access to resources for survival (Brown, 1998), and as *"a condition reflecting cultural alignment, normative support, or consonance with relevant rules or laws"* (Scott, 1995: 45).

At an individual level, seeking to legitimise behaviour can be achieved through adherence to formal laws or conforming with normative social practices since these tend to reflect cultural rules and mores (Weber, 1978). At an organisational level, this is obtained when firms conform to society's expectations of what a 'proper' organisation should look like and behave – those socially constructed, institutionalised ideas as to the form and function of organisations (Meyer and Rowan, 1977). Since legitimacy implies an acceptance by society, for organisations, obtaining legitimacy can mean that they are less likely to have their form or function questioned, even in times of variable performance. There are three types of institutional pressure that results in conformation to legitimate behaviour: coercive, mimetic and normative pressures (DiMaggio and Powell, 1983). Coercive pressure is often derived from forces that compel organisations to act such as legislation and