Conceptualising the use of digital technologies in spatial planning a progress report on innovation in Britain.

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Conceptualising the Use of Digital Technologies in Spatial Planning:
A Progress Report on Innovation in Britain

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ABSTRACT

This article is about how best to frame the use of digital technology in spatial planning and how best to frame the evaluation of impact. The different sections argue the following points. First, the conceptualisation of digital technologies in spatial planning should pay less attention to the discourse of smart cities and more to pragmatic approaches that can cope with the Janus-faced character of technology and provide a bridge to planning theory. Then, as revealed by the assumptions of actor network theory, there are three main innovation paths—Prop-Tech, Civic-Tech, and Project-Tech—all of which have a different pattern of beneficiaries. Then, as revealed by structuration theory and unless moderated by professional ethics and explicit policy commitments, technology is likely to be concerned with the cost effectiveness of working practices. Finally, taking the various approaches together, spatial planning may be conceptualised as a field of heterogeneous elements (stakeholders and citizens, technology, place) with non-local governance and markets as external structuring forces.

KEYWORDS

Actor-Network Theory, Britain, Local Governance, Planning Practice, Smart Cities, Socio-Technical Studies, Strong Structuration, Structuration, Technical Democracy

1. INTRODUCTION

The aim of this paper is to provide a new analytical framework for the application of digital technologies in spatial planning- an analytical framework that will help set a research agenda and guide future studies of practice. Current discussions are typically characterised by a disjuncture between heavily critical, structural accounts of the smart city and more optimistic accounts based largely on the potential of technology to facilitate collective decision making. The aim here is to develop an alternative to both the smart city debate and to piecemeal accounts of technology. The paper focuses on Britain and the experience of digital innovation up to the summer of 2019 but refers to the international literature on matters of principle and theory.

The pervasive growth of digital technology is recognised in the World Cities Report by UN-Habitat (2016, p. 42). Moreover, practice in Britain is of particular interest owing to the government's expressed aims to be at the forefront of innovation in the use of data and artificial intelligence (HMG

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2017, pp. 36-37) and the existence of a series of related initiatives organised through Innovate UK and its predecessor the Technology Strategy Board and through the continuing work of Future Cities Catapult (now the Connected Places Catapult) first established in 2012. [1] It is topical, in this context, to prepare an analytical framework that goes beyond specific examples of technology and helps in the interpretation of events and responses.

The main research question, derived from socio-technical theory (Fountain, 2004: Greenhalgh & Stones, 2010: Orlikowski & Scott, 2008), is to determine what happens when governments try to innovate and change planning practice with the help of digital technology and new forms of data analytics. Once the analytical framework is specified, two further questions become apparent. Do these frameworks suggest that digital technologies will lead to radical changes or otherwise influence the culture of planning practice? Do they suggest that technological innovation will influence forms of democratic accountability?

Preparing an analytical framework means that theory is the main framing device, rather than, as in previous accounts either the statutory town planning framework and its various stages (Burgess and Quinio, 2018; Future Cities Catapult, 2016a) or a classification of different types of geographic information (Laurini 2017). Preparing an analytical framework also means a review of the literature, including official documents and the many examples of digital experimentation available online. The analysis is not just based on a desktop analysis. The author has attended smart city and innovation events and discussed the various issues with those seeking to implement digital innovation at both a national and local level (this latter with practitioners in three local authorities based in Yorkshire, the Midlands, and London). For reasons of anonymity, the details of the events and discussions are not revealed, however.

The account comprises four sections. The first section 'Background: From the smart city to socio-technical pragmatics' summarises the context, explains why existing 'smart city' conceptualisations are flawed or limited, provides relevant historical parallels and goes on to the explain how an alternative framework might be constructed from existing socio-technical approaches. The subsequent sections explain the implications of the main alternative frameworks, namely actor-network theory and strong structuration theory and then bring the two frameworks together.

2. BACKGROUND: FROM THE SMART CITY TO SOCIO-TECHNICAL PRAGMATICS

To an extent, the use of digital technology in urban planning has already been conceptualised as a movement towards 'smart cities,' smart eco-cities and in a few cases towards 'living labs'- experimental projects intended to provide an understanding of how urban forms, building designs and associated behaviours influence consumption patterns (Voytenko et al., 2016). The smart city has been the dominant storytelling device of companies and the European Commission and has attracted the greatest attention. IBM popularised the term 'smart city' in a marketing campaign started in 2009 (Söderström et al., 2014). In the same year, the term was taken up by the European Commission. [2] It has subsequently become a 'buzzword' in summarising the potential uses of technology (Laurini, 2017, p. xiv).

2.1. The Smart City Debate

The widespread use of the term 'smart city' disguises its limitations as an analytical device. The origins of the term as a promotional device pose a methodological problem as it means that the debate is as much about discourse as about technology or its actual use. Partly for this reason, the term has also generated highly polarised assessments. For some, digital technology provides the infrastructure for open government (Laurini, 2017)- a means of increasing the learning capacity of democratic government (Caragliu et al., 2011) and of creating new forms of digital citizenship (Joss et al., 2017).

Other accounts, whilst asserting its potential, see the smart city as a work in progress and examine the factors that facilitate or limit learning abilities (for example Nam et al., 2011).

In contrast, others have conceptualised smart city technologies as an aspect of a new type of 'society of control' as elaborated by Deleuze (1992). According to the smart city critics, the society of control rests on new surveillance technologies, promotes control as an end in itself (Krivy, 2016) and involves damaging side effects such as a loss of privacy, the promotion of technocratic decision making and a bias in favour of technological business interests (Halpern et al., 2013; Kitchin et al., 2017). Cugurullo (2018) goes further and compares smart cities and scientific eco-cities to Mary Shelley's Frankenstein. In the smart city, as in the body of Frankenstein, technological innovation has gone out of control. The individual parts work but the body fails collectively.

A clarification is necessary. To an extent, the smart city debate has gone ahead of spatial planning practice. Sources of information in planning practice still rely heavily on analogue documentation derived from written statements, maps and drawings and are not machine readable.[3] In 2016, the Head of Projects of the FCC stated, 'innovation is sparse, with few places adopting digital and data driven techniques across all elements of the planning process.' (FCC, 2016a, p. 1). The key words are 'across all elements of the planning process.' Excluding generic office software, planners use a variety of software tools- geographic information systems, computer-aided design, and graphic design software tools. Other specialist modelling tools are available in fields such as transport, project viability and environmental impact assessment and are commonly used by consultants. However, all these have either been developed for related professions or are not fully integrated within a robust operational framework.

The smart city debate is, therefore, mostly about emergent technologies and future directions. For the critics of smart technologies, the debate is also more about a trend in the context in which digital technologies are used, away from public planning and public accountability towards a reliance on private finance and private developers. From the time that the first modelling and systems approaches were advocated by Chadwick (1971) and McLoughlin (1969), spatial planning has itself changed away from a large-scale, comprehensive approach. Disillusion with the results of modern town planning of the preceding period (from about 1945 to 1970), the emergence of entrepreneurial local government from about 1980 and the emergence of a diverse 'postmodern' cultural sensibility have all led to a more piecemeal, more market-based and less ambitious style of intervention. For critics, the smart city is an extension of the previous trends, with yet more emphasis on local entrepreneurialism, a shift from the control of development to the control of how public spaces are used (Kitchin, 2014) and an emphasis on short-term experimentation rather than a commitment to the future (Cowley and Caprotti, 2018). The critique of the smart city therefore adopts a structural model of society in which local practice reflects market-based, neoliberal trends and policy assumptions (Cardullo and Kitchen, 2019: Grossi, & Pianezzi, 2017).

2.2. Older Debates and Parallels

The smart city critique is, in any case, sometimes extreme. To give an example: Cugurullo's reference to Frankenstein is a reference to a Romantic novel of the type that arose in early 19th century Europe and that was deeply suspicious of the 'unnatural' tendencies represented by advances in science, technology and the newly emerging industrial cities. Romanticism later inspired the possibility of ideal urban spaces and ideal urban forms (Peer, 2011), whilst also carrying the seeds of anti-urbanism (Glass, 2013) and a refusal to accept the city as a force for progress. Extreme critiques of the smart city risk the same error. They condemn the smart city without also recognising the potential benefits.

Further, it is misleading to suggest that the workings of spatial planning practice reflect those of a new type of 'society of control.' This latter is a post-disciplinary society in which enforcement action and punishment have become downgraded in favour of the automatic adjustment of behaviour in response to signals or indicators or changes in the context in which behaviour takes place. In contrast, environmental regulation, including the exercise of planning control still involves the possibility

of enforcement action, with fines, the compulsory demolition of buildings and even imprisonment in extreme cases (Harris, 2011). The physical context of cities- its terrain, layout and quality- still matters, perhaps even more as is demonstrated by the experience of 'Living Labs' and the pressure of environmental movements.

Conversely, if theorists other than Deleuze (1992) are consulted, it is possible to find precedents and parallels to the 'society of control.' Mannheim (1971, pp. 274-310), the founder of rational planning theory, wrote at length about how governments control human behaviour of all types and in doing so drew extensively on the sociological writings of the period from about 1900 to 1940. Planning for Mannheim (p. 193) is the 'control of controls.' Further, partly in opposition to Mannheim, the fear of technocratic government and technocratic decision-making was recurrent throughout 20th century social theory (Gunnell, 1982). For Ellul (1967, p. 174), for example, self-sustaining 'techniques,' derived from science, rationalism and bureaucracy, 'subvert democracy' and 'create a new aristocracy' of technical experts. Technique is not the same as technology. For Ellul, however, techniques operate within the context of a technological society that itself subverts democracy.

Technology is therefore Janus-faced (Arnold, 2003; Gunnell, 1982). Janus was the Roman god who looked both ways, who was the door keeper for beginnings and endings and who could open or shut the door to heaven.[4] Technology is a doorway to ideal cities and to collective learning. Equally, it is a doorway to control and to technocracy. Moreover, technology does not necessarily lead in one direction rather than another, but instead interacts with the intentions of actors and its context. Analytical frameworks need to have similar characteristics. Rather than adopt a theoretical or analytical position that favours one outcome rather than another, technology demands a framework that simultaneously looks in multiple directions.

2.3. Pragmatic Alternatives: 'Technology in Use,' Networks and Practice

How might such an analytical framework be constructed? One approach, represented by Douay (2016), is to envisage different ideal types that represent different possibilities in the organisation and aims of spatial planning. Douai (2016) treats the neoliberal, privatised smart city as one possibility, but points to three other directions- a revival of rational planning based on the use of models; citizen planning in the search for alternative urban forms and, finally, a more collaborative practice that is similar to citizen planning but more strategic and more based on evidence.

The four ideal types are an example of how digital technologies lead in different directions at the same time. However, they jump from commercial platforms such as Über to the public sector, without considering the distinctiveness of commercial and governmental agencies. In addition, the selection of ideal types is not grounded in a tradition of ideas. Without that grounding, it becomes impossible to work out how they have been generated.

Another way is to develop a framework from the extensive socio-technical literature that has emerged to study the implications of technology in organisations and institutions. Organisations may be defined as a set of roles intended to undertake a particular purpose, notably to provide a service or product. Institutions may also provide a service or product but, in addition, they generate rules of conduct (Fountain, 2004, p. 11). The organisation/ institution distinction is blurred, however and both organisations and institutions are involved in urban governance, understood as the process of governing and managing urban areas.

Socio-technical studies have their own history but are significant for the emergence of mixed, pragmatic approaches best summarised as 'technology in practice' and that involve a recognition of the processes in which technology interacts with actors and practices and with the 'objective' material realities on which decision-making is based (Orlikowski & Scott, 2008). As such, technology in practice draws on two particular varieties of theory: first, those concerned with the way in which technology and practice come together in a dialectic of resistance and accommodation, leading in turn to entanglement or 'mangling' (Orlikowski, 2005): and second, those concerned with the social shaping of technology in design and in use (Bijker 1995: Fountain, 2004).

As an extension of both entanglement and social shaping approaches, Greenhalgh and Stones (2010) have articulated a framework that joins so-called 'actor-network theory' (Callon, 1986; Latour, 2005; Law, 1992) and institutional theory in an approach called 'strong structuration.' The resulting combination of actor-network and structuration theory is of established value in health service innovation (Doolin, 2016: Greenhalgh, & Stones, 2010) in studies of the uptake of technological innovation (Mead et al., 2018) and in business management. including accounting (Englund and Gerdin, 2014).

The terminology of strong structuration requires a brief clarification. Structuration theory, as commonly associated with Giddens (1984), is about how social structure is formed and reformed through everyday social practice in a repeated interaction between agency and structure. Structuration theory therefore, offers a multi-level approach that recognises individual action and local diversity whilst also admitting the influence of power relations and non-local, historical, economic and other forces. Strong structuration theory as developed by Stones (2005) is an applied, more empirical extension, more concerned with the analysis of social processes and events at particular times and places.

Pragmatic theories have, with good reason, been independently applied to spatial planning. Pragmatism and spatial planning have an affinity to one another, certainly since the abandonment of large-scale blueprints in the 1970s and 1980s (Goodchild, 2017, pp. 137-146). Likewise, structuration and actor-network theories have been applied to spatial planning. Healey (1999, p. 114; 2007) has advocated concepts of structuration, as specified by Giddens, as a philosophical foundation for planning theory. Weise et al. (2017) have outlined a closely related approach to understand how to adapt digital technologies for civic groups. Further Savini (2019) has used institutional theory to understand planning practice in terms of different types of norms, values and responsibilities, namely those dealing with operational aspects (who does what), with collective values and with the creation of added land value. In relation to actor-network theory, Rydin and Tate (2006) have argued that this offers a 'relational approach and posits a radical symmetry between social and material actors.' Further, Boelens (2010) has used a modified actor-network theory to conceptualise the relationship between planning practice and place.

In spatial planning, existing applications of structuration and actor-network theory consider the two theories separately, rather than together. The application of structuration theory is, moreover, generally based on Giddens rather than the later, more applied version of 'strong structuration.' The differences are not insuperable, however. Given their established use in other fields, similar pragmatic approaches deserve to be elaborated and applied in the study of digital innovation in spatial planning.

3. ACTOR-NETWORK THEORY: BLURRING THE DISTINCTIONS

Applying actor-network and structuration theory together presupposes that they are first delineated separately. While structuration, strong structuration and actor-network theory all recognise networks as means of holding society together, actor-network theory is distinctive, as the accounts by Boelens (2010) and Rydin and Tate (2006) recognise, through the inclusion of non-human elements. The networks themselves are created through a repeated process of translation- a term that is used in actor-network theory in both its common sense meaning and with a more abstract meaning of mediation where the activities of one element (human or non-human) have a material effect on others (Latour, 1994). Technology mediates between people and objects and between people and nature in hybrid combination of elements that are in turned linked by networks. Mediation means, moreover, that technology has the potential to change meaning or to select different aspects of meaning. Moreover, the distinction between human and non-human elements becomes blurred, so suggesting in some accounts the otherwise unusual term 'actant,' rather than 'actor.'

Strictly speaking, digital technology is commonly an exercise in 'remediation' rather than simple mediation as it builds on and reworks older images and older forms of expression, presenting these

in new ways. Bolter and Grusin (2000, pp. 14-15) suggest that 'remediation' comprises a double overlapping process of 'immediacy' (or transparency) that attempts to make the viewer or reader forget about the medium, and 'hypermediacy' that draws attention to the medium and makes the viewer aware of its workings and of changes to the object being viewed. The distinction between, mediation and remediation does not alter the logic of actor-network theory.

3.1. Innovation Processes and Pathways

Digital technology is engineered and manufactured. As such, innovation does not take place through the 'moments of translation' model as identified by Callon (1986) and repeated by Boelens (2010) as a model for spatial planning. Instead, innovation takes place through a hybrid internal/ external model (Heeks & Stanforth, 2007). In this, innovation depends on the ability of a project to generate a combination of three necessary conditions: an internal (or local) support network, an external (or global) support network capable of providing resources and finally a point of passage between the local and external network (Law and Callon, 1988). The external support networks are based in government and commercial organisations, the implication being that innovation will be guided by policy priorities, the size of the potential market and the assessment of that market by commercial entities.

The forces involved in innovation are not new and not specific to digital technology. The study by Law and Callon is based on the development of a cancelled military aircraft in the late 1950s and early 1960s. Recent government initiatives, including policies to promote open data, have placed more emphasis on the promotion of private start-ups and the private sector (Bates, 2012).

Processes of innovation mean that tools and technologies have their intended use and their intended beneficiary 'inscribed' (Latour, 1992) within them as a function of design. Technology therefore guides action even when the designer is absent. The potential beneficiaries depend in part on the field of application. In relation to the technology used in spatial planning, so-called 'Plan-Tech,'[5] variations in the intended use and variations in the intended beneficiaries suggest three overlapping types of innovation and three overlapping pathways to innovation:

- 'Prop-tech,' mainly comprising digital maps and some artificial intelligence (AI) procedures where the intended beneficiaries are infrastructure system operators and developers;
- 'Civic-tech,' mainly comprising multimedia and digital interaction opportunities where the intended beneficiaries are local groups and citizens and where technology involves explicit issues of local democracy and public education;
- 'Project-tech' comprising information platforms, where the intended beneficiaries arise from the workings of the planning process itself.

3.2. Prop-Tech

A concern with 'Prop-tech' flows, in part, from national policy priorities as for example reflected in a statement in the election manifesto of the Conservative government elected in 2017 'to release massive value from our land' (Conservative Party, 2017). In addition, the same concern flows from the way local authorities and developers have a shared interest in saving the number of working days involved in determining planning applications. Compared to elsewhere in Europe, the planning system in Britain is discretionary in character, meaning that it favours specific 'material considerations,' rather than fixed land use zoning maps (Stead and Nadin, 2014). In this context, it has made much sense to provide better information for property owners, property professionals and developers so as to encourage planning applications that are simultaneously viable and acceptable.

The result has been a series of online maps and online software that represents a city according to the requirements of an operator or developer (a transportation agency, a real estate company, a water provider and so on). Various initiatives are underway, the most extensive of which is the Community

Apparatus Data Vault system (Vault for short) that applies to Scotland and that covers electricity cables, gas pipes, oil pipes. communications networks and water and sewage facilities. [6] Industry uses the system on a routine basis (FCC, 2017a, p. 37). It is unclear, however, as to the extent to which the Vault leads to greater efficiency as developers and infrastructure operators are still required to undertake independent searches to assess the accuracy of the information. Access to the database is restricted for security reasons. (FCC, 2017b, pp. 11-12).

Another, closely related type of innovation is to map designated areas, sites and buildings (for example listed buildings). Various examples exist. Some are based on subscription such as 'Howard' covering policies and sites in Greater London [7] and a private/ public collaboration called 'Land Insight' that involves the United Kingdom map making agency, Ordnance Survey and is distinctive by virtue of the inclusion of information on property boundaries and valuation. [8] Others have been developed in-house by local authorities and offer public access. Examples include those of Sheffield City Council [9] and Manchester City Region. [10]

Placing information on a map does not in itself specify which factors and which constraints are more important or relevant to a specific case. In addition, maps showing the location of infrastructure say little about the capacity of that infrastructure to absorb additional demand. Digital mapping serves mostly to narrow down choices in the selection of sites, prior to more detailed work. However, narrowing down the choices may be sufficient from the developers' viewpoint in reducing the risk of abortive work.

Detailed design and layout considerations are typically considered during the process of applying for planning permission. The national Planning Portal, the product of an earlier phase of government sponsored innovation, was privatised in March 2015 and is now a joint venture between the UK Government and a private company, Terraquest.[11] Terraquest is not a monopoly provider, however. Local authorities can use different software systems and they can promote innovation with commercial partners, according to local requirements and priorities.

Ensuring that planning applications are valid in terms of their information coverage has been a focus of recent innovations to the planning portal and similar local procedures. In Milton Keynes, for example, the local authority is working with a commercial software specialist to include a digital 'chatbox' into online planning applications so as to provide a virtual planning assistant who responds to questions from the developer. Reports suggest that the automatic question and answer procedures in Milton Keynes have saved the time of 'real' planning officers. [12] The next step is to use artificial intelligence systems that can create hypermediated assessments of reality, highlighting constraints on relatively simple applications such as those involving extensions to domestic buildings. [13] The application of AI is limited, however, by the discretionary character of the planning system. AI depends on the existence of rules and the rules as they currently exist are both very varied and subject to omissions.

3.3. Civic-Tech

The distinction between 'prop-tech' and 'civic-tech' is not absolute. Digital mapping exercises that, for example, provide information about site ownership or the location of protected buildings and sites are relevant to community campaigns and to local pressure groups such as Civic Societies. In addition, visualisation technologies such as VuCIty can help all parties. [14] This latter contains updated digital models of London and six other English cities and is able to show how future development proposals fit into their context.

Civic-Tech is nevertheless distinct on its emphasis on the use of information for the benefit of the local community, as defined by the local community. 'Civic-tech' means, in part, an acceptance of the 'wisdom of crowds (Surowiecki 2014), the principle that the 'many are smarter than the few.' Civic-tech means, therefore, enabling citizens to resolve problems and participate in decision-making. It also means, though this receives less attention, providing a voice to those who are seldom heard.

The apps and software designed specifically for planning practice are mostly intended to allow citizens to post comments on proposals. The assumption is therefore of a reactive 'call and response' model of consultation. Commercial examples include 'Stickyworld' [15] or Participatr. [16] The use of these and other similar software is not well documented. However, even a cursory examination suggests that routine exercises of consultation in development management and plan making stop at posting proposals and applications on a website (and, addition, posting notices in the street), without the use of supplementary software. There are, moreover, no published examples of software that has sought to facilitate community plan making, along the lines of the Localism Act, 2011.

Other software is available in a form that is close to, but not integrated into planning practice. Open access software 'StoryMaps' is relevant to the documentation of local history and heritage and could be used, therefore, in conservation campaigns. [17] Further, the website 'FixMyStreet' offers a very simple procedure to allow residents to report environmental nuisances. [18]

The call and response model of consultation may be defended on the grounds that members of the public are generally not interested in spatial planning in itself and need to understand proposals as relevant to their interests or lives. Compared to the experience of generic 'Community Awareness Panels' advocated in the technology programmes of the European Commission [19] and used in an independent local initiative at Mons in Belgium (Pouleur et al., 2018), call and response may generate a larger response. On the other hand, it is arguable whether the call and response method allows much scope for vision, for alternatives or for public education.

Actor-network theory is strongly prescriptive in relation to public accountability and democracy. Callon (1998, 2012), suggests for example, that conventional forms of democratic control are not well suited to scientific and highly technical questions and that, in any case, science and technology commonly tend to generate uncertainty- uncertainty about the assumptions of analysis, uncertainty about data projections and uncertainty about impacts according to different experts. Instead, Callon argues for new concepts and forms of 'technical democracy' of which three forms are conceivable- instruction, debate and co-production, with latter going beyond the typical concerns of current planning practice. Likewise, Law (2016) writing separately and jointly with Ruppert (2016, p. 156) use pre-Romantic, Baroque aesthetic analogies to argue that data analytics should promote public understanding by showing the world as heterogeneous, 'alive' and 'in motion.'

Technical democracy is not, in any case, a complete departure from the past or from pre-digital methods of public education and debate. Co-production implies consensus building exercises and the use of focus groups, juries and other in person, meeting-based rather as well as online methods. The wisdom of the crowd' is mostly about the response of multiple individuals. Co-production in contrast requires collective decisions. Focus groups and other group consultation exercises may nevertheless still be enriched by the use of a range of digital simulations and visualisations. In addition, as a complementary measure, Ylipulli and Luusua (2019) have argued for the use of public libraries as a means of promoting digital skills and bridging the divide between those who possess and know how to use digital technologies and others. It is easy to see how public libraries could become digital resource centres for urban and environmental education, though in Britain, any such extension would also require public investment.

Actor-network theory highlights, in addition, the significance of data limitations and the often-mundane ways in which analytical techniques, mapping techniques influence or limit the process of translation between elements in networks and therefore the outcomes. Some relevant information, for example local patterns of carbon use or energy use are either unavailable or difficult to obtain. Analysis may also take the form of opaque 'black-boxes' where the inputs and outputs are known, but where the conversion stages and processes are either unknown or obscured. Black-boxing hinders public debate and local politics, though different groups are likely to try to 'open up' the contents, to reveal their assumptions and limitations (Rydin et al., 2018).

A further complication exists in that black boxing is sometimes based on an economic rationale, rather than scientific complexity, as consultants seek to protect their market position through

withholding the algorithms applied to data. Governmental open data programmes have not extended to software. A further result is to increase costs for local authorities (Ambrose et al., 2015; FCC 2016b, 12). Commercial interests can also limit data availability in other ways. The privatisation of the Planning Portal has limited the amount of detailed information that can be extracted from planning applications at a national level.

Yet opaque and closed decision-making is not confined to the use of technology. Local authority planning departments and developers may enter into confidential discussions at an early stage before proposals are publicised. They may also hide behind the complexity of professional language as the supporters of digitisation have noted. [20] Most likely, therefore, the tension between confidentiality and openness will persist.

3.4. Project-Tech

The methods of Plan-tech are, in general, distinct from and, in the case of hypermediated images and scenarios, they are also more technically demanding than design-based simulation methods such as building information modelling. These latter are generally intended to co-ordinate building work, so improving quality and avoiding errors. Apart from conservation work, Building Information Modelling requires too much precision to be easily incorporated into spatial planning exercises, at least not before the granting of planning permission (FCC, 2018). Spatial planning must in contrast cope with various types of uncertainties- not just scientific uncertainties such as variations in economic and population forecasts but the unpredictability of market-based development, and variations in values and interests between different groups.

The specific requirements of the planning system have led Future Cities Catapult to call for commercial partners in the development of a 'planning information model' capable of linking all the different elements in planning practice (FCC, 2018). The same requirements suggest a case for 'project-tech' software to support the creation of a planning project, as defined by Healey (2007, p. 23) as an exercise in 'shaping, to some degree, the socio-spatial dynamics of urban areas, through explicit attention to spatial organisation and place qualities.' Put slightly differently, a 'planning project,' is a statement of political intentions expressed in spatial terms and supported by scenarios and visions- a hybrid between a programme of action and a worked out design for the future (Merlin and Choay 1996, 648).

A planning project assumes a territory, a neighbourhood or a district or a city. Within that territory, urban space comprises a 'collective' (Latour, 1993, p. 4) or 'assemblage' (Deleuze and Guattari, 1987, p. 36) of technological networks and other elements (Latour and Hermant, 2006), some of which are invisible and that may conflict, overlap, interact or merely coexist with one another. The digital equivalent of an assemblage is a platform prepared in a way that allows the synthesis and unification of data sets from multiple sources and that permits an understanding of the different relationships and dependencies. Such a platform depends, in turn, on 'semantic interoperability' and the existence of semantic data structures capable of bridging multiple interests, perceptions and parties (Chun et al., 2010). Semantic data structures list data separately from meaning and also specify links between different data sets in the form of a relational graph.

As applied to urban planning, the international literature includes examples whereby semantic databases have been used to organise information for urban and environmental 'observatories.' They have been used to represent issues of interest to different parties in environmental evaluation (Métral et al., 2007); to illustrate the interrelation of the different domains involved in the evaluation of CO2 emissions (Madrazo et al., 2012); and, more broadly, to reflect the viewpoints of different publics (de Sède-Marceau, 2011). Moreover, it is only a short step from monitoring trends and relationships to projecting those trends into the future and so providing scenarios for use in planning. [21]

Digital observatories and integrated data structures are still inscribed technologies. However, the inscription is derived, at least in principle, from the long-term implications of trends as they relate to another. Projecting trends and preparing scenarios for a neighbourhood would, for example,

provide the basis for the co-production of project plans. However, the development of the technology is unlikely to occur through a reliance on commercial partners alone, as the technology is still demanding and arguably even more importantly, all the interested parties would have to accept the use of the same place-based platform- a precondition that could probably only be achieved through governmental action. Commercial innovation in digital technologies involves sectoral innovation of the type characteristic of innovation in manufacturing. Sectoral innovation is not well suited as a means of promoting an integrated approach to place-making.

4. STRONG STRUCTURATION: CONTINUITY AND RESISTANCE

A criticism of actor-network theory is that it has a 'flat ontology,' in which 'there is neither the global or local, but only networks of translation that extend and multiply without hierarchy' (Harris, 2005, p. 173). The lack of hierarchy means, in turn, that actor-network theory lacks a recognition of inequalities in power between different stakeholders and actors. Strong structuration corrects that limitation, whilst conversely saying little about the direct characteristics of the material world or of technology itself (the contribution of actor-network theory).

4.1. Practice and Professionalism

Both structuration and strong structuration theory use the concept of 'practice' as a bridge between the individual and society. Concepts of practice are, moreover, well adapted to a consideration of technology as a tool to facilitate specific tasks and in the case of information technology as a means of acquiring, preserving and transferring formal knowledge. However, the implications of technology are conditional on other aspects of practice, for example as listed by Schatzki (2002, p. 77)- the practical understandings and skills of staff; the 'routines, procedures and rules' that codify the use of technology and finally the 'teleoaffective structures' that define the range of ends, means or 'mission' appropriate to a specific situation.

Reference to 'teleoaffective structures' is, amongst other things, a reference to the rationale and values, including professional norms of the organisational network in which practice takes place. The concept of 'teleoaffective structure,' in turn, implies a distinction between types of organisation, notably between those in the private and public sectors. The analysis of governmental institutions is the main theme of Fountain (2004) who suggests that these have a momentum that promotes continuity and limits the extent of change. The context is different from the sometimes-disruptive application of technology in the business world.

Continuity of practice may be illustrated by the continuity of methods. For example, land supply analysis has long been a central task in spatial planning and, before the advent of digital technologies, was undertaken in part by means of the visual evaluation of a "sieve map"- a single map upon which numerous areal distributions are shown superimposed and in which each overlap contains information about which areas should be included or excluded (Batey, 2017). The method originated in attempts to work out plans for a growing population in the 1940s and was endorsed by Keeble (1969, p. 31) in a widely read textbook as 'a most useful means of analysing and summarising survey data.' Keeble also, however, noted that the sieve 'map creates formidable presentation problems'- problems that are greatly eased through digital visualisation and digital mapping. 'Prop-Tech' mapping presentations and technologies therefore have continuities with the past.

Continuity of practice can also cover radical planning exercises. The radical architecture platform 'Concrete Action' is the best documented example (FCC, 2016a, p. 47). Its rationale is moreover explained in a lengthy online interview with its initiators, recorded in 2015. [22]

Exactly because information about development proposals is technical and scattered, online platforms and non-technical explanations linked to those platforms can help local people grasp the implications. 'Concrete Action' was established as a means of reminding built environment professionals of their ethical and political responsibilities. However, the initiators of 'Concrete

Action went beyond assembling publicly available information to encouraging professionals to disclose confidential information so that local communities could be warned in advance. Disclosing confidential information is a risky process both for professionals and the website owners. Perhaps for this reason, the site is currently under reconstruction and seems to have been so since 2018. The builders of the site suggest in any case that they need to remain in the background of local campaigns in order to promote the effectiveness of those campaigns.

'Concrete Action' was mostly about the political aspects of professionalism and was very ambiguous in its relation to the usual interpretation of professional ethics. A commitment to social justice and grassroots action goes beyond the usually accepted scope of professional ethics as stated in the UK in the Code of Practice of the Royal Town Planning Institute (RTPI). [23] In addition, the example of 'Concrete Action shows how different ethical principles may conflict with one another. The disclosure of confidential information would probably be defined as unprofessional by most employers. The example of 'Concrete Action' is nevertheless instructive in revealing how professional identity, the ethics and values associated with professional identity and understandings of power relationships influence practice- considerations that are more easily conceptualised through structuration and strong structuration rather than through actor-network theory.

Case studies of the National Health Service in England by Greenhalgh et al. (2014), and Greenhalgh and Stones (2010) reveal a simpler example of how professional identity influences the acceptance or otherwise of new digital technologies. In these studies, professionalism was mostly about a commitment to standards of effective service delivery. When apparently unreliable and untrustworthy digital technologies were imposed on practitioners, the commitment to effective service delivery caused numerous complaints and organisational conflict. The commitment and sense of professionalism extended moreover to all members of staff within the organisation, including relatively junior office staff. To avoid conflict, practitioners have to have confidence in the reliability and usability of technology.

4.2. Bureaucracy, Centralisation and Decentralisation

Technology as 'enacted' within government is more specific in use than its potential might suggest (Fountain, 2004) and is also more specific and standardised than is implied by the inscription of technology as understood in actor-network theory. Within the broad parameters of rules and political control, governments look to cost reduction (of time, staffing, travel), to cost effectiveness and as part of this to the standardisation of data, operating procedures and business processes.

In other words, governmental authorities focus on technologies that are 'instrumental' in meeting a specific purpose rather than technologies that clarify the context and inform a wider public debate. Instrumental digitisation favours a reliance on evidence, but in a narrow, unreflexive form as Davoudi (2006) and Wong (1998) have noted of earlier episodes of evidence-based policy making. The implicit situated frame of meaning is one in which the role of local government is defined as dealing solely with implementing means as defined by statutory frameworks. The result is a bureaucratic form of professionalism, which entails a refusal to question ends and the values that inform these (Greenhalgh et al., 2014; Weber, 1978).

The limited character of recent innovations as enacted in spatial planning in Britain is most easily demonstrated by the omissions. For example, there is a lack of attempts to use consultation exercises to provide a better understanding of who says what, showing the influence of age, social class, neighbourhood location on the comments that citizens make about proposals. In addition, no systematic attempt has been made by government agencies to develop district-wide or neighbourhood-wide indicators of sustainable development, even though sustainable development defines the aims of the planning system as stated in the National Planning Policy Framework for England. [24] 'Living Labs' have remained purely experimental, with no attempt to bring their methods or their lessons into the mainstream.

Instrumentality means cost effectiveness as a continuous background feature in government. However, the emphasis on cost effectiveness varies. The analysis of Fountain (2004) was based on US Federal initiatives in about the year 2000 in the context of a global fashion for 'New Public Management,' a loose set of initiatives intended to increase the efficiency, accountability and performance of public services, in part through contracting out and the greater use of markets.

Similar pressures to improve the performance of public services were also apparent in local government in England at about the same time (Morphet, 2003). Complaints about the complexity and slowness of UK town planning have been and remain particularly sharp (HLSC, 2016, p. 37). Recent austerity programmes and reductions in profession planning staff (by about 15% in England between 2006 and 2016 [NAO 2019, 41]) have made cost management- doing more with less- even more a priority. Digitisation offers a potential way of increasing efficiency without contracting services out to private providers. Moreover, the loss of planning staff means that digitisation can be promoted as a means of reducing the workload and encouraging professional creativity.[25] Professional resistance may therefore minimised in current circumstances.

Taken literally, strong structuration involves a linear, vertical, centrally directed programme of innovation in which officials at different levels in a bureaucracy respond to new technologies as these are introduced. Central direction reduces the variety of software that employees and clients are likely to encounter and also facilitates communication. Central direction assumes, however, that innovation has reached a stage of 'closure' (Bijker, 1995, pp. 87-88) where alternatives and variations can be disregarded. It is unclear whether digitisation has reached this stage in spatial planning, with at present in the words of one reviewer 'so much innovation going on' (PWC, 2018, p. 16).

As yet, central government has avoided a strongly directive role and has mostly acted through issuing advice and providing selective innovation grants (for example for open data) and, in addition, through using a semi-independent agency- Connected Places (formerly Future Cities) Catapult as a means of linking all the different agencies involved including the private sector. Local authorities have been encouraged to use technologies best suited to their local circumstances, with the result, for example, that the online policy and planning maps prepared by English local authorities are all different to one another. Variations in presentation create additional costs for developers and infrastructure providers working across local authority boundaries. It is possible, therefore, that standardised presentation frameworks may be introduced in the future.

Standardisation of presentation does not necessarily promote central control in relation to the policy content, though much depends on the level of detail in the standardised requirements. Fountain (2004) suggests that, in general, digital technologies are neutral in terms of centralisation and decentralisation. Online information and improved analytical technology mean that, in principle, staff at low level positions have the ability to make decisions based on the rules and standards inscribed in the software (p. 38). Equally, the same factors allow more control from the centre, the result being that the two tendencies cancel each other.

In contrast, Greenhalgh et al. (2014), developing ideas from Giddens (1990) argue that expert systems have a centralising effect. An expert system is a task-specific programme that 'contains sufficient relevant knowledge about objects, situations, and courses of action to imitate or replicate the reasoning processes of human experts' (Witlox 2005). For Greenhalgh et al. (2014, p. 212):

expert systems, using technology to encode information and store formal knowledge, have an inherent tendency to 'empty out' the content of local interactions because the technical knowledge they contain is assumed to have validity independently of any particular interaction and to have the authority to override situational contingencies.

Expert systems exert control remotely from over distance in a way that seeks to remove (or at least, radically attenuate) the discretion of local decision-making.

The apparent centralising tendency of expert systems is itself disputed. Ortolano and Perman (2012, p. 6) give examples of expert systems that help practitioners and others to work through legal and administrative procedures and eliminate errors. Current innovations in automatic question and answer systems in development control are an example of this type of initiative.

In any case, the implications of expert systems are complicated by the way that spatial planning deals with multiple aims and values and multiple and sometimes conflicting interest groups in an information field whose boundaries are commonly poorly defined. Digital technologies in spatial planning must therefore generally be understood as decision support rather than decision making systems of which expert systems are an example. Nevertheless, the very complexity of spatial planning suggests, as Witlox (2005) has argued, that decision support may include elements of knowledge-based (expert) systems to predict and therefore to clarify the implications of initial decisions or particular aspects of practice. The outcome depends on the interaction between the technology and the circumstances in which it is designed and used.

4.3. Systems Conflict/Social Conflict

Socio-technical conceptualisations have generally sought to study the introduction of single technologies in specific contexts. Applied to spatial planning, multiple technologies co-exist with multiple stakeholders and multiple places. Moreover, processes of resistance, accommodation and entanglement operate within a three-way relationship between institutional actors, digital technologies and proposals about the future shape of places.

The reference to place raises, in a new way, the relationship between the social and material worlds. Structuration theory, as presented by Giddens (1984, p. 25), proposes a dual analytical focus and in doing so makes a distinction between social structure and social system. In its original form, structuration theory is unhelpful, however, as it ignores the material world and also conceptualises social systems as homeostatic (p. 27), that is to say with their constituent parts as self-regulating and in equilibrium. Once conceived as homeostatic, the possibility of change and the need for planning disappear. Most recent conceptualisations of systems conceive of these as involving a state of 'far from equilibrium' (Batty, 2017), either balancing order and chaos (Innes and Booher, 1999, p. 22) or in multiple transitions from one state to another (Batty, 2018).

The distinction between social system and social structure does not have to involve equilibrium. Lockwood (1964) and Archer (1996) offer an alternative interpretation of the distinction between systems integration and social integration, as well as between two parallel states of social conflict and systems conflict. The social conflict, system conflict distinction arose in the writings of Lockwood in an effort to clarify the relation between politics and, in particular, class-based politics and the workings of the money economy. Social integration and by extension its opposite social conflict are personal and involve groups, social structures and social practices, whereas systems integration and systems conflict are impersonal. They are also to an extent independent. For example, a country could have a relatively equal distribution of income and a relatively homogeneous population but an unbalanced, precarious economy (or *vice versa*). However, they are also linked. A systemic crisis in the economy is likely for example to lead to new social tensions.

The same distinction may, in addition, be generalised to the relationship between social and political process and any impersonal system, whether the property and labour markets or traffic flows or the environmental factors linked to the quality of life. The distinction rests on the different ontologies that are appropriate to different phenomena (Archer, 1996). Some aspects of the use of technology are best examined through ontological assumptions that favour material causes and the operation of a system of interconnected elements. Other aspects favour an ontology that reveals the subjective experience of actors and the qualities of a place (Naess, 2016). The former is positivist in its emphasis on 'facts,' observations and measurements, but generally involves a middle element- a quantitative model- between reality and theory. The latter involves the experiences and views of different individuals and groups and requires qualitative research and consultation procedures.

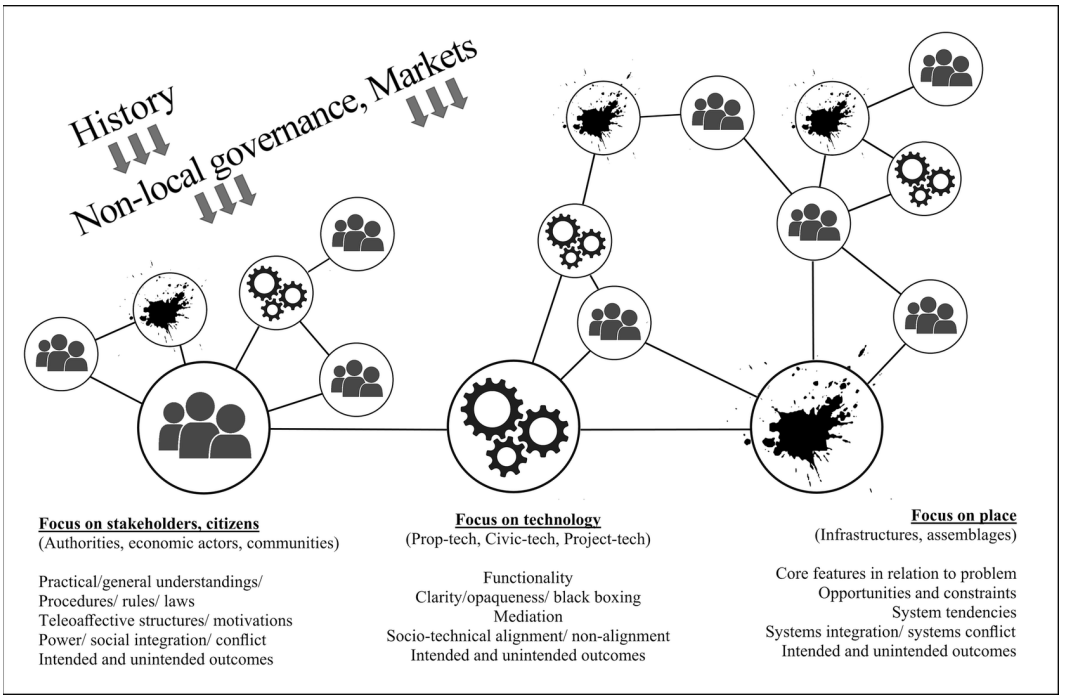
To give an example (Goodchild et al., 2018): a river basin is an integrated system whose behaviour is determined by local patterns of relief and rainfall. The river basin may complement and support human activities, whilst operating in a disruptive, damaging way at the time of drought or extreme rainfall events. All this is about system integration and system conflict. However, managing the risk of drought or flood immediately raises questions of social integration, subjective place attachment and conflict in relation to who loses, who gains and how much it will cost. Systems management and systems conflict proceed alongside the more political process of environmental management, place management and urban planning to the point that they become entangled with one another. Over time, events caused by the material system, the river, alter the networks of different actors involved in land use planning and environmental management, influence the planning process and engineering work specified in planning documents and these in turn influence the river.

In the entanglement of the river, communities and local authorities, digital models act as a mediating tool that seeks to predict, communicate and visualise the implications of different weather conditions and remedial measures. Digital technology is commonly introduced to promote efficiency in government (Fountain, 2004) The time savings are only about the exchange of information or in the case of artificial intelligence about the creation of alternatives, rather than the political aspects of socio-technical governance. More information and the possibility to work out alternatives may even reduce the ability of decision-makers to reach 'closure' in favour of a single course of action. Systems conflict and social conflict, though entangled, are not identical. Moreover, speeding up systems analysis and forecasting does not necessarily lead to speedier political decision-making.

5. ILLUSTRATING THE FRAMEWORK

Taking strong structuration and actor-network theory together, Figure 1 shows a field of three main elements- stakeholders and citizens, technology and finally place.

Figure 1. Spatial planning as socio-technical governance



In addition, Figure 1 shows history, governments and markets in the background as broader, non-local forces that restructure practices and networks over time. Governments are able, to some extent, to change field structures, as was also recognised by Mannheim (1971). The notion of planning as the control of controls- a notion shared in different ways by Mannheim, the systems approaches of Chadwick (1971) and McLoughlin (1969) and the smart city critique of Krivy (2016) is impractical, however. The field is an active network. It is an arena where different actors jockey for position and where, in any case, the relative power of different actors- say the local planning authority and developers- may vary over time. Moreover, non-local governance and market processes would likewise comprise fields and are, therefore, not easy to co-ordinate.

For strong structuration theory (Greenhalgh and Stones, 2010; Stones, 2005, p. 94), Figure 1 would represent a 'position-practice network in which individual and institutional agency interact with wider forces. Position constitutes the relation between one element and another. Practice defines what people do and say within their role and network. For Latour (1993, p. 120), in contrast, networks emerge and are constructed rather than fixed and may be discontinuous in time and space. Latour's interpretation is better suited to urban and place-based networks rather than the more clearly defined organisational networks that are the basis of strong structuration. However, local government has predefined roles and responsibilities- hence the use of a hybrid conception.

Actor-network and strong social structuration theory work together partly because they contain parallel concepts. Inscription (actor-network theory) and enactment (institutional/ structuration theory) both suggest that technology in use is more narrowly defined than in principle. Hybridity (actor-network theory) and entanglement (institutional/ structuration theory) both suggest that the distinction between human and technological factors are blurred. In addition, both theories draw attention to the details of organization, the relevant actors (including actors as things), practices and specific situations whilst also recognising the influences and constraints of non-local factors. Viewed in this way, the duality of structure and action emerge alongside one another in a single framework.

For the sake of simplicity, the analysis of actor-actants as stakeholders is summarised in Figure 1 mostly under the aspects of practice as specified by Schatzki (2002). Strong structuration theory is recognised through the reference to power. Otherwise the elements come from actor-network theory, from the interpretations of actor-network theory by Rydin et al. (2018) and Boelens (2010) and from the system/ social distinction of Lockwood (1964) and Archer (1996). All the main types of elements (stakeholders and citizens, technology and place) are likely to generate a combination of expected and unexpected outcomes, as is a basic assumption of pragmatic approaches to research and policy making.

The likelihood of unexpected as well expected outcomes implies in turn the need for evaluation and as part of this a research agenda to evaluate who gains and who loses from technology and by what mechanisms. Research would therefore aim to reveal the beneficiaries by effect as well as by intent. In planning theory, albeit from a different philosophical perspective, Flyvbjerg (2004) has already suggested a focus on the winners and losers of planning policies and has also argued for the case study method to do so. The difference in socio-technical analysis, especially where influenced by actor-network theory, is that the analysis of losers and winners would also consider the role of digital technologies in determining that impact and the impact on the non-human (rivers and eco-systems) as well as the human environment.

Some qualifications and clarifications are necessary. The diagram is a map of possibilities, a means of imagining relationships. Some aspects might deserve more detailed scrutiny to reveal further levels of networks, variations in institutional interests, technologies and types of place. The entanglement and blurring of different elements also mean that aspects of planning occur under more than one heading. For example, housing is likely to appear as an issue under all three headings- as an impersonal system of supply and demand, as statistical projections and scenarios and as stakeholders such as developers, users and communities.

In any case, the diagram cannot be applied as a research device in its entirety, as it would be impractical to observe all actions, interactions and entanglements simultaneously (Schatzki, 2005). The number of actors and interested parties- land owners, concerned residents, developers, pressure groups, public agencies, environmental experts and so on- involved in large-scale development and strategic planning is commonly very large. An overview will suffice as, for example, in studies that focus on the relation between governmental processes, their associated discourses and the use of technology. The point is to reveal the logic of each of the main elements and to analyse processes of accommodation and resistance as these occur.

6. CONCLUSION

The digitalisation of spatial planning involves a combination of technological change and a changing policy and historical context. Moreover, the analysis of practice has to be undertaken against a background in which theory itself is changing. As this study has shown, recent socio-technical studies have placed more emphasis on practice/ position networks of power than when Healey (1999) started to apply structuration theory to planning and have also enabled the material world, including technology to be incorporated in the analysis in a way that has not been fully undertaken in the past.

This paper started by asking the question: 'what happens when governments try to innovate and change planning practice with the help of digital technology and new forms of data analytics.' The answer is apparently simple. Structuration theory suggests that digital technology generally becomes absorbed within an existing institutional and legal framework and has been generally been implemented with a view to make existing practice more efficient and cost effective rather than to disrupt practice. Disruption is avoided because this itself causes conflict and inefficiencies as revealed in the case studies undertaken by Greenhalgh et al. (2014) of the National Health Service. Given current tendencies, therefore, digital technology is unlikely to be a force for an immediate, short-term dramatic change in working practices or culture. Actor-network theory emphasises the ease of innovation in relation to the external networks represented by government and the market. The implication is therefore that the method of financing and the terms on which the finance is made available have a direct influence on the form of the technology. Incremental change is again the likely outcome.

Nevertheless, the effort and sunk costs put into information technologies and the added value associated with relevant, good quality data will surely start to have an effect, raising questions about public access to data and how to reconcile public and private interests. Planning depends on the public availability and sharing of information. Innovation strategies such as have been pursued in the UK and intended to promote commercial software development inevitably limits the availability of that information. From the viewpoint of public planning, therefore, it might be best to reinvigorate drives towards open data and, in addition, to extend open data drives to the software that converts data into meaningful information- for example about development potential or the environmental impact. However, resolving issues of data availability and public data will almost certainly require political intervention and a change in policy emphasis and funding priorities rather than technological solutions.

It is not new to say that digital technologies raise questions about the accountability of technology companies and the relation between the private and public sectors. The smart city critique has similar implications. Where socio-technical approaches have added analytical value is through a focus on 'the intersection between users, contexts and technologies' (Mead et al., 2018), so combining observations about general tendencies and policies with the detailed workings of planning practice.

The detailed workings of planning practice are, moreover, significant in their own right. In part, the issue is staff time. For example, once a local planning authority or other agency has invested in a smart expert system, question and answer platform to inform and guide developers, it may become more difficult to justify giving face to face advice to developers. In addition, the issue is professional discretion, local autonomy and standardisation. Smart question and answer platforms and other expert systems mostly involve the operational norms of practice (Savini, 2019)- that is to say who does what

in what circumstances. However, the operational norms are especially sensitive as they provide the routines of the workplace and define the foundation of professionalism (Greenhalgh et al., 2014).

As part of the redefinition of spatial planning, digital technologies enable, at least in principle, the preparation of multiple visions and scenarios at different spatial scales and using different growth and sustainability assumptions. In doing this, digital technology favours a multiplicity of data-based planning projects, rather than a single land use plan and so raises a question about the relation between multiple project plans and the planning system. Contrary to the smart city critique (Cowley & Caprotti, 2018), the preparation of project plans is not in itself inconsistent with the idea of planning in its various forms- either as the preparation of spatial arrangements (land use, street and building layouts) or as understood by Mannheim (1971, p. 53) as a means of providing insights. Both the immediacy of the present and the hypermediacy of longer-term scenarios may be incorporated into digital technology (Bolter and Grusin, 2000). More significant is how immediate, short-term processes and long-term visions are related to one another and related to representations of urban space and, in addition, how and when citizens groups are involved in the processes of plan and project preparation. Any shift away from conventional local plans would therefore require careful consideration.

The direction of change is towards an 'information-driven' or 'data-driven' planning system, one in which the role of planners is more about checking the validity of informational inputs, visualisations and scenarios rather than making value-based judgements. Older critiques of evidenced-based planning suggest a tendency towards a narrow, instrumental approach that ignores public education (Davoudi, 2006; Wong, 1998). Actor-network theory, in contrast, suggests that uncertainties about predicted outcomes, forecasts and evaluations, will lead to renewed pressures in favour of technical democracy, including public education, debate and co-production (Callon, 2012). Digital technologies offer new ways in which planning authorities and agencies can work with private developers and promote economic development, as is another theme of the smart critique. Working with private developers does not mean that local residents or other interested parties will accept the resulting proposals. Digital technologies also offer new means for campaigning groups to disseminate knowledge, organise themselves and open-up black boxes, to use the language of actor-network theory.

In this context, rather than proceeding directly from data to plans within existing local governance arrangements, it might be better to establish local data observatories and to persevere and extend public involvement initiatives. The further development of 'Project Tech' would be a priority to do this. Another complementary possibility as suggested by Ylipulli, and Luusua (2019) might be to invest in public libraries or some other local facility. Another would be to provide funds to local groups to help understand complex models, for example about the behaviour of river systems. Such investment again requires a political commitment. Digital technology remains Janus-faced, repeating in new forms the many divisions and debates of the past, between property and community, between centralisation and decentralisation and between technocracy and democracy. Exactly because it is Janus-faced, moreover, pragmatic socio-technical evaluation is necessary.

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ENDNOTES

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