Editorial

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The digital transformation of planning

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The digital computer was invented just prior to and during the Second World War in at least three different places: Germany, the United States and Great Britain. The idea that we could represent different phenomena using the binary code, by arranging and switching various things (or bits) on and off, had been around for centuries but during the 1920s and 1930s, the idea gained momentum. The vacuum tube had become key to the development of circuitry in a range of electrical devices from radio to the telephone network and early digital computers availed themselves of this technology. The war effort in these countries rapidly spurred on these developments with the Manhattan project and the code cracking effort at Bletchley Park, providing the momentum for the first large-scale digital computation which continued apace once the war ended.

There were at least three developments working in parallel that led to the continued development of digital computers. The notion that such machines could represent a multitude of problems was encapsulated in the concept of the computer as a 'universal machine', an idea that was writ-large in the writings of the early philosophers of computation and artificial intelligence such as Alan Turing, John von Neuman and Vannevar Bush (Dyson, 2012; Eames and Eames, 1973). The second development relates to the technology of switching. Vacuum tubes were notoriously unstable and had to be continually replaced and the effort to find an alternative led to the transistor invented at Bell Labs just after the war in 1948. This device that could enable rapid and perfect switching took the world by storm and it led to the whole process of miniaturisation in silicon that has spread computers everywhere. Eighty years later, it shows little sign of stopping. It is the essence of Moore's Law which loosely suggests that computation is getting faster, its capacity is doubling and its hardware is halving in cost every 18 months and has been ever since Moore (1965) coined his famous law.

With the slow realisation that computers are 'universal machines' and their embedding into almost everything we do as a human race, the way we organise ourselves socially is beginning to change. This is what we refer to here as the third development – the digital transformation, a wave of change as deeply rooted as anything we have ever experienced to date, and one that is affecting all aspects of society. It is this that we will explore with respect to planning in this editorial. Almost as soon as computers left the scientific labs in which they were spawned in the immediate post war years, they began to be commercialised for large-scale transactions processing, while the first computers were used in local government in the early 1950s for the mundane tasks of accounting in finance and data storage. In Britain, the first reported applications in urban planning took place in Coventry largely for data processing involving census-related data (Gilfoyle and Thorpe, 2004) while in more

avant-garde fashion, various planning agencies began to pick up on the use of computers in enabling numerical models of land use location and traffic to be constructed. As early as 1955, various large-scale transportation studies, particularly in Detroit and Chicago, were using such models to enable future traffic, the impact of new highways and the decentralisation of economic activities from the core of American cities to be understood and forecast. By the mid-1960s, these developments had come to Britain.

In planning, the 1960s saw a sea change in how we could develop a hierarchy of plans at different scales organised from the top-down which incorporated ideas about how cities could be made more efficient and more equitable. The systems approach focussed on ways in which we could articulate these ideas supporting such efforts with computers and the information that enabled planners to organise the planning system into a comprehensive set of physical instruments. To an extent, this was the fruition of at least half a century of thinking about how one might reorganise cities in systematic ways that would lead to a better quality of life. We would be remiss to suggest that computers came to be widely applied during these years for most of the high-profile examples were demonstration projects, one-off attempts at demonstrating what was possible. In fact, it took until the 1980s for the population census to be automated using computers and it was not until the 1990s that the ordnance survey moved in earnest towards digital mapping. In the 1960s, GIS was a long way in the future and the brief love affair with computers, models and surveys ended almost as soon as it began for all kinds of operational reasons about the difficulties of pursuing such activities in practice. It would take a shift in hardware and software for such activities to even approach the requirements for the most rudimentary automation to take place.

Yet, this shift was already in the works as Moore's Law continued to generate ever smaller computers that by the mid-to-late-1970s were becoming personal, scaled down in size to be operated by individuals who could not only use them for applications but who could operate them for any purpose, joining them together and developing all kinds of new ways of networking them. In short, as soon as the computer became small enough to be networked, there was a massive explosion of connectivity and the first transmission of data between remote places became possible. Much of this did not touch planning but the personal computer did begin to feature in applications in the 1980s largely through the fact that as computers became personal, graphics became central not only to what could be computed but also to the ways in which one could interact with them. Out of such developments came automation of the most basic kind. Computer cartography, computer-aided visualisation using programs such as AutoCad, and thence GIS which added basic functionality in spatial analysis to mapping all led to quite widespread applications which were packaged in forms that were immediately useful to planners in practice. These were not models per se but basic ways of representing the form of cities through data that could be visualised, and it quickly led to desktop applications becoming widely accessible to planning practice.

To an extent, the development of personal computers demonstrated the power of the universal machine as numerical processing no longer was the dominant use. Graphics in terms of everything from maps to games and music too represented the cutting edge and once the internet became widely available after the invention of the World Wide Web in 1990, all the rudiments for a connected society were in place. Yet, computation was still regarded as being something that was rather separate from most other activities in society. Networking began in the 1950s with computer terminals connected to main frame machines which were able to time share programs. But it was not until the 1970s and 1980s that networks came into their own and only when local area networks converged with the ARPANET to form the internet did remote processing for personal computer users become a reality with email and thence web pages.

By the millennium, all the rudiments were in place to automate many functions of everyday life, but it required further miniaturisation to reach the point some 15 years ago when the idea of 'smart' places and 'smart' buildings to really catch on. But before we discuss this as it is key to digital transformation, it is worth saying something about the different eras of digital computation until we reach this time. Computers initially were close to those who actually built them and the operation of main frames as they were called until the 1960s, perhaps beyond, was a collaboration between programmers who were often users and those who knew how the machine worked and could be operated. This began to change as the personal computer developed, and by the early 1980s, a new cohort of operators, often those who could hack the operating systems of their own computers, emerged. Main frames moved to spawn mini computers in the 1970s and then these merged into workstations, while the PC also became more powerful. By the mid-1990s, the state of the art was based on PC-workstations that generally meant the biggest computers came to be reserved for specialist tasks or for very large-scale data processing. The convergence of all these computers was also hastened at the most individual level as handheld devices began to merge with machines that had graphics interfaces extending the domain of such devices from the telephone to many routine computing applications.

The millennium really does mark a major transition to a society based on many computable devices from the phone to the supercomputer but also with the embedding of computers into the very fabric of society itself. Some regard the launching of the *iPhone* in 2007 as being the threshold, but during this decade, this embedding of sensors which were computable, as well as the development of mobile sensing through smart phones, became the basis for a fully digital society. We have only just embarked on this journey but what it means is that this marks a sea change in how we use computers. Prior to this era which we can loosely call the age of the smart city (Batty, 2020), computers were mainly used to support plan-making functions, although data and information had become central to the operation of the routine planning system as well. This is best seen in planning skills which in the year 2000 were still organised around spatial representation through GIS and CAD, forecasting models from transportation to housing, the development of web pages to communicate ideas that might be organised digitally such as database access and the development of a national infrastructure for the archiving and transmission of data.

During the half century when computers developed to reach the point at which they really started to become embedded in organisations, cities, economies and many of the institutional structures of modern life, there was little recognition that the tools that had been fashioned to deal with computable aspects of planning cities could also be part and parcel of the very cities that planning sought to address. In short, computation became part of the problem of planning the city and the notion that the same computers used to explore and forecast the future were being deeply embedded into the city itself has generated a strange kind of recursion. This has slowly crept up on us, although there are now many stakeholders who have little sense of the armoury of tools still used to fashion plans but do have a view of the smart city which essentially is short term where management of the daily urban system merges into very local change in time and space. In short, the smart city has emerged alongside the array of computer tools used to plan that same city and the way in which computers are able to represent themselves as universal machines confounds this digital transformation in ways that make the current picture of where information technologies are headed confusing and as ever, highly unpredictable (Batty and Hudson-Smith, 2007).

What is rapidly happening which is core to this transformation is that the organisations which define the structure of contemporary societies are becoming digital in a way that now dominates their form and function. This not only goes for cities where we see organisations

which run the obvious physical functions such as transport but also retailing, housing and other markets as well as public services, being automated. Entire industries are thus becoming platforms based on internet technologies. Computers are simply one element of this transformation where the way those who operate such organisations through different forms of network (which we tend to call collectively 'the internet') are defining a new form of urbanism, called 'platform urbanism' by Barns (2020) amongst others. Platform urbanism is a kind of capitalism that puts data and connectivity at the heart of the problem of planning in the age of the smart city, rather than focussing on traditional functions such as the production and consumption of particular products, notwithstanding that such functions still remain core to the city itself. Examples are widespread from Google and Apple to Airbnb, Uber and the emerging array of such organisations that are proliferating in many if not most industries. These are all based on the provision of digital platforms that enable others to produce and consume, to share ideas and resources across much wider markets and urban spaces than at any time hitherto.

Currently we are beginning a review of digitisation in planning which will attempt to grapple with the ambiguities, challenges, conflicts and overlapping ideas that now pervade the way planning is responding to these rapidly changing themes. The taskforce for digital planning we are setting up (www.digital4planning.com) is in its infancy but we need such an initiative to provide a comprehensive statement of how planning is able to relate to these many themes that now define the 'digital'. These need to be mobilised to provide coherent and comprehensive ways to develop better plans for better cities while at the same time engaging in developing a deeper understanding of how cities are changing. The smart city where new digital tools are changing our management of the short term and the kind of urban science that defines our longer term focus on how the city works, are two sides of the same coin but alongside this, the idea of platform urbanism is weaving its way through the digital transformation.

We see this initiative as also drawing together what is a relatively fragmented and no longer a particularly comprehensive response to the problems of our cities (and regions and countryside of course). From its heyday in the 1950s and 1960s where the concern was strategic and visionary, planning as an activity is now dominated by the small scale, by the control of development which is largely related to the development industry. Many of its functions simply play lip service to the grand challenges of our times such as climate change, aging, social segregation, housing quality and affordability, as well as mobility. Digitalisation in planning is not simply about automating the planning system, although this is necessarily an obvious and largely incontestable quest. So far, we have not discussed in detail how the planning system and our conceptions of planning have changed in the 70 years since the digital computer emerged from the science labs of The Second World War. But this was the period when planning reached is heyday only to decline, as its functions were stripped away by the bureaucracies that established themselves in government seeking to deal with localism, pouring scorn on attempts to think strategically and negating the bigger picture (Batty, 1987). The time does now seem right, however, for a reinvigoration of the planning vision and the digital transformation is likely to be key to this. So the initiative noted above will attempt to map out the salient and all-important characteristics of planning as it might develop in the future, supported of course by the requisite digital tools and approaches.

We do not have time to sketch out here the configuration of topics, perspectives, skills and methods that define the digital transformation in planning for this is an endless list of issues that are all woven into one another. And it is something that needs to be reflected upon at more length. There are many new ideas ranging from platform urbanism to digital

twins, from big data to machine learning, from communications media which engage the very substance of planning itself through the web and social media, all of which contribute to the wider focus. I have written about many of these in previous editorials in this journal and will continue to do so but at this time, we urgently need to take stock so that we can see the range of possibilities that the digital world offers planning in perspective. This is not simply a plea for planning to engage in using more digital tools, it is a plea for attempting to see how we can make sense of the way our societies through our focus on cities, are being automated. It is also about how the very problems that we need to address digitally and the methods we use to do so are being influenced by new forms of transformation that will continue to challenge our abilities to make sense of our cities in a time of ever faster change in the very technologies we need to use.

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