

The u-City Index: Integrated planplementation of future ubiquitous cities

Andrew Macias-Diaz

(Andrew Macias-Diaz, uConnect, United Kingdom, contact: <http://u-city.in>)

1 ABSTRACT

Evolution of Information and Communication Technologies (ICT) has affected cities, government, and all type of organizations. Their adaptation is necessary for becoming competitive in a networked world. However, the pace of ICT evolution is faster than the speed of adaptation to these changes, and this difference (organizational lag) causes problems to civil servants and managers at all levels, customers and citizens (digital divide). The complexity and dynamism of city dimensions adds uncertainty and difficulty in understanding how to deal with diverse urban problems. This is a dilemma that city managers have faced since the 1990's with the rise of the Internet and that will become more complex with the rise of ubiquitous computing: u-Cities. Therefore this paper analyses issues surrounding the development of digital cities and the future u-City concept and proposes the requirements of an integrative framework, the u-City Index, for long term planning, implementation and monitoring. Grounded theory is used as main approach for gathering, analyzing and categorizing academic articles and reports to identify the requirements and form a propositional framework based on literature and previous empirical research. Moreover, international research background (500 ICT initiatives and projects), helped with additional insights on understanding and structuring digital cities and u-cities, their organizations and ICT initiatives. The study moves away from Jane Fountain (2001) technology enactment framework and extends it to a multi-organisation, multi-functional and multidimensional perspective. Additionally, the requirements will help in defining a model or framework that can be used as a tool for benchmarking by city managers and policy makers.

2 INTRODUCTION

2.1 Strategic importance of the u-City Index

Complex issues are involved in every city. This entity is dynamic and involves economic, cultural, social, political, environmental and technological areas. Moreover, in the last decades of the XXth century, with the appearance of the always evolving Information and Communication Technologies (ICT), uncertainty becomes another challenge that Society has to face and embrace. Civil servants, managers, customers, and citizens have been learning the best ways of using ICT in order to bring diverse types of benefits to Society, for example, the most common, increasing productivity, economic development and as a result wealth. However, success of ICT initiatives has been a challenge, and most of the time they don't achieve their promises resulting in a phenomena named productivity paradox. Organisations spend more time, effort and resources than the clear benefits expected they suppose to obtain. ICT doesn't help much either because initiatives that are innovative, useful or productive one year, the next year become obsolete or not trendy. Therefore is difficult understanding the city complexity when ICT has become too uncertain because its constant evolution as a result of unstoppable innovation. Without the variable of ICT, a city can be studied and managed strategically according to individual areas separately. Nevertheless, the more increasing use of ICT by all organisations and individuals within a city means that a more integrated way of understanding is necessary in order to avoid the productivity paradox. With the raise of computers, then the Internet, the need of integrated models was evident in order to make government departments work together in providing services. Now, with the raise of ubiquitous computing technologies (UCT), it is a paramount the use of integrated models as not only departments but also different organisations within the city will be involved in the delivery of services and products either in company towns -cities created as a new product and business model offering ubiquitous computing services- but more challengingly in old or contemporaneous cities. This paper explores the different concepts, including ICT, cities and their organisations that are important for the creation of the u-City Index which can help in the strategic management of a city using ICT and UCT. This conceptual study covers a range of previous literature and analyses its strengths and limitations when applying these concepts to Digital Cities and u-Cities. In this paper, u-Cities (Park, 2007; Jung et al, 2007; Misuraca, 2009; Anttiroiko, 2009) are considered a natural extension and evolution of Digital Cities. Therefore, u-Cities are analysed from a Digital City perspective when embedded within the fabric of old or current cities. Considering institutional and organisational views this approach to studying Digital Cities can also apply to company towns as the complexity in planning and implementation of ubiquitous initiatives is less than in current cities. The contribution of this paper is based on bringing another perspective to the development of u-Cities where urban planners can foresee future challenges if the next step of u-Cities is

focused on an integration into the context and infrastructure of current cities and not only remaining as company towns.

First, it looks into ICT evolution and its effects on Society, people and organisation. In this part, this paper explores the impact of technology and ICT on different human generations and their response over time. Also it looks at the effect of ICT on organisations and the concept of productivity paradigm. This approach is necessary for understanding the way “digital immigrants” have been developing products and services for “digital natives”. The second part focuses on the evolution of the city concept, the different approaches used in studying it and for performing strategic management, including planning, implementation and measurement in a city or a city-region and not only local government. This section lays out the elements necessary for strategic management as well and the different types of organisations within a city. The third part researches on the evolution of organisational issues within a city and its relation with strategic management including recent trends. It also seeks understanding on integrated assessment models and tools that can help in understanding and managing the city. The last part of this section brings concepts from section one (point 3), two (point 4) and three (point 5) for proposing and defining the requirements for strategic management of the u-Cities of the future and the characteristics that the u-City Index should have. It also discusses the shortcoming of this approach and explains futures important areas of research at organisational level.

3 ICT EVOLUTION

3.1 Drivers behind technology innovation: ICT

Society evolution has been heavily influenced by technology innovation since the Industrial Revolution. As Perez (2001, 2002a, 2002b) explains, six waves of technology have surged and they have changed the way people live by creating new products and providing new services. Technology research uses the previous waves gradually and incrementally in order to rise, mature and decline. And in this cycle that lasts around 50 years, individuals, organisations, institutions and businesses adapt their processes to the new technology. For example, the current wave of technology revolution, ICT, has modified the way people and organisations interact, either offline, online, or in an asynchronous or synchronous ways connecting more people and increasing the transactions between them.

Each wave of technology has achieved a golden age of wide prosperity. However, it is necessary the provision of resources and technical support to the community, businesses, government and institutions, in order to tackle directly the issue of improving the local level of living.

3.2 Impact of ICT on Society

Users have embraced ICT with enthusiasm and from being a few thousands in 1995, they have increased to around 1800 millions people, around 25% of the World population, in 2010 (Miniwatts Marketing Group, 2009). The Internet has been increasingly embedded in the operation of businesses, universities, research centres, NGO’s and government, therefore, users have been able to participate in different activities that have changed their level of interactivity rapidly over time, for example, one-dimensional publishing of information or reception of sales requests by email in 1997 to e-commerce or tri-dimensional augmented reality in 2010 or even the future everywhere (Greenfield, 2006). Another example, online communities, have used different types of software technology that have evolved from mail-lists and discussion forums, to dynamic portals, weblogs, chats, instant messaging, video conferencing, mobile texting, tweeter micro-blogging, Virtual Worlds and Google’s waves. Also access devices have also evolved from the first desktop computer in the 80’s to super fast, portable and multimedia enhanced devices including laptops, handhelds, i-pods, mobile telephones, tablets and computers available in Internet kiosks, cyber cafes, public libraries or within any private or public organisation. Therefore, it is not difficult to envisage the effect of ICT on our Society either in economic, social, cultural, political, or environmental terms. Academics have studied the beginning of the Internet using a technological determinism approach, however, an opposite perspective like the social strategic choice model, has been used for explaining the reasons behind the use and diffusion of these ICT innovations as well.

3.2.1 Generations

Society moulds technology according to its needs as people decide. Nevertheless, the reasons behind these decisions are based on people’s personality which is developed because human generations share a place in history and have events, images, and experiences in common. Members of a generation are profoundly affected by the personality of their peers or generation as Zemke et al (1999) argue. Technological

innovations like ICT, available as a generation matures, influence their behaviour, attitudes, and expectations because people internalise them for shaping information access and use, and ways of communicating (Oblinger and Oblinger, 2005). Thus, the understanding of future usage of technology and also decision making, needs to address the differences in human behaviour and nature derived from an evolving technology that is upgraded by each generation. Figure 1 shows the influence of technology in different past, present and future human generations.

3.2.2 Productivity paradox

Organisations have allocated big budgets for ICT, however, these investments have not obtained the benefits expected. Luftman in Vehovar and Lesjak (2007) has reported that one-third of ICT investments are wasted with no real return. In addition, there are many challenges when measuring ICT productivity within an organisation because the novelty of this type of technology. Sigala (2003) studies the ICT productivity paradox by assessing the ICT productivity impact that overcomes shortcomings such as measurement errors, redistributions of impacts, or ICT mismanagement. The author found that the introduction of ICT into poorly run firms does not increase productivity whereas the the ICT introduction into well-run firms pays-off. The reason of this success or failure is linked to the exploitation of ICT network/integration, informational and transformational capabilities and aligned with business strategy and operations. Therefore there are other factors including not only technical but also organisational and integration capabilities that needs to be considered when planning and implementing an ICT initiative in any organisation, and therefore in digital and u-Cities.

	Matures	Baby Boomers	Generation X	Net Generation	U Generation, Aml NanoBoomers	Grid Generation
Birth Dates	1900-1946	1946-1964	1965-1982	1982-1991	1991-2015	2015-?
Description	Greatest generation	Me generation	Latchkey generation	Millenials	Ambience Intelligence generation	Quantum generation
Attributes	Command and control	Optimistic, Workaholic	Independent, Skeptical	Hopeful, Determined, Digital immigrant	Highly educated, Mozart effect, Optimistic about their future, Confident, Conformed but not conformist, Peter Pan effect, Tech-dependents, Digital natives, Media-content creators	?
Likes	Respect for authority, Family, Community involvement	Responsibility, Work ethic, Can-do attitude	Freedom, Multitasking, Work-life balance	Public activism, Latest technology, Parents	Social media, Home, Techno-leisure, Ultra-connected cities, Environment and social responsibility, Brands, Living and socializing online, Seamlessness, Trust	?
Dislikes	Waste, Technology	Laziness, Turning 50	Red-tape, Hype	Anything slow, Negativity	Lies, obscurity, falsehood	?
Technology	Nylon, Acrylics, Cars, Mechanical calculators, Dial telephones, 78 rpm records	Mainframe computers, Touch-tone telephone, 33-45 rpm records	Personal computers, CD s, E-mail	Multifunctional devices, MP3's, Mobile telephone, PDA s, WWW, Multimedia, Communication-centric, Internet 1D (push)	E-appliances, On demand, Video calling, VoIP, Interoperability, Nano medicine, Ubiquitous networking, Internet 2D (share), Internet 3D (live)	Grid, Virtual Reality, Aura, Teleimmersion, Augmented reality, Photon computer, Internet 5S (feel)

Figure 1. Technology and generations. Based on : Tapscott (1999), Hanson and Hanson (2003), Hempel (2005), Oblinger and Oblinger (2005), Cahil et al (2001)

4 CITY EVOLUTION

Different ways of understanding the city, and using this knowledge for further development of it, have been used since the first village was built in ancient times.

4.1 The study of the city

Especially over the 19th century, the development of towns and cities, with the implementation of technology after the Industrial Revolution (Hall, 1992), has been influenced by the appearance of more specific theories including general systems (Low, 1982; Erkut, 1997; Taylor, 1998; Ritzer, 2000; Juniper, 2002; Coelho, and Ruth, 2006), urban systems (Marshall and Smith, 1978; Walton, 1979; Newton, 1984; Mitchell-Weaver, 1991; Boix and Trullen, 2007;), organic theories (Auster, 1990; Revetz, 2000; Rotmans and Van Asselt, 2000) or new approaches (Van Winden, 2003; 2005) in the first decade of the 21st century, and some of them have been influenced by the sustainable development agenda. The appearance of urban intelligent management (Stubbs et al, 2000) and regional systemic competitiveness (Malecki, 2007) as new advanced ways of city management have become also, at the same time, a great challenge for the city.

The study of the city has been influenced and dominated mainly by geographers or economists who look to bring in their quantitative scientific approach sometimes using single cases. However, empiricism presents many flaws because the difficulty in collecting accurate and direct data (Boix et al, 2007; van Winden and Woets, 2005), inappropriate design, or without following accurate and proven methodologies. Also, researchers analyse causes and effects isolated from other dynamic city issues. Therefore, despite all these works being theoretically and empirically interesting, this body of work taken together cannot be used to generalise as these studies lack of coherence (Wolman, 2008).

4.1.1 ICT and the city

The different policies and strategies that cities implement through local authorities and private organisations are important to increase the use of ICT's. Since 1990's, research on the different ICT's effects on cities has been carried out. Internet has evolved from being a letter-based system of communication for academic and military services to a multimedia platform that allows organisations, citizens and government to make multiple transactions independent of time and space. Studies show that implementation of citywide ICT projects has been done independently and without considering interactions with other citywide ICT systems. As a result there is a lack of coordination and therefore increased cost or failure of initiatives. Because an integrative approach on the development of ICT practices in cities doesn't exist and academic research on this topic is almost non-existent, then this becomes an area of great potential for research.

Different approaches have been used for studying the urban and ICT phenomena including sociology (Castells, 2001), urban studies (Mitchell, 1999), technical (Ishida, 2000), organisational and measurement. In the case of Digital Cities conceptualization, the focus has been on the action based approach (what industries should be supported to promote and foster urban competitiveness?), visionary approach (how the digital city future should be achieved?), taxonomic approach (what organisations or elements should the digital city have or embrace?), infrastructure approach (what ICT component should a digital city include?), virtual representation approach (what type of non-physical representation should the digital city have?), information landscape approach (what type content or information should the digital city produce?), and measurement approach (how the digital city should be monitored, measured, benchmarked and assessed? and how much information of the digital city needs analysis and collection?). Most of these approaches also apply to u-Cities (Foth, 2009) as they extend the concept Digital Cities. However, it is important to point out the differences. For example, u-Cities have been developed in the first decade of the XXIst century as company towns, entirely new. Digital Cities in the other hand have been embedded in most of the cases in the fabric of an old or current city. This is one of the challenges that urban planners need to foresee if the next step of u-Cities is their integration into the context and infrastructure of current cities. It is very different creating a new city as a product and with a fit-to-purpose business model than updating or raising an old city to these new standards, especially because this change involves a lot of complex institutional and organisational issues that even Digital Cities are still facing.

In the past, cities have been shaped by water channels, roads, or other important infrastructure (Graham and Marvin, 1996). Nowadays, ICT drives the transformation of the city partially or fully by bringing in new strategic dimensions around the technology benefits, for example, cities aspire to become a Electronic City, Digital City, Knowledge City, Innovative City, Intelligent City (Neves, 2009) or u-City (Greenfield, 2006).

4.2 Approaches to strategic management of the city

As this papers mentioned above, uncertainty and constant innovation are characteristics of the ICT wave of technology. Planning, implementation and measurement of ICT initiatives (Asgarkhani, 2006), either of products or services, and for becoming more competitive in a global market, has a long trajectory in individual companies. Therefore, the strategic management of the city needs to consider tools, techniques and methodologies that can be adapted from the private sector to public, non-for-profit and government organisations but with the challenge that they need to integrate, and be multidimensional, multifunctional and multi organisation in order to avoid the productivity paradox and failure of ICT initiatives from Digital Cities or u-Cities. In order to understand the importance of strategic management of ICT in a city, it is necessary understand the effects of failure (Misuraca, 2009), competitiveness (Heracleous, 2003) and the intertwined factors such as coherent integration of ICT, people, and processes (Gupta, 2006; University of East London, 2006)

4.2.1 Planning the long term future of the city

Planning in cities has been through different phases including simple sequential planning, rational planning, disjointed incrementalism, master plans, local development plans, collaborative planning, and recently planning support systems (Vytautas, 2004), online public participation (Yigitcanlar et al, 2003) or recently throughout participatory urbanism (Greenfield and Shepard, 2007; Myungjun and Soon-Tak, 2010). In most of the cases, this activity is lead by local government; however, these plans have been focused in the short or middle term mostly. Since 1990's cities have started using new styles for strategic management (Taylor, 1997), for example, foresight techniques for creating their future throughout long term planning (Bredenoord, 1997) and in order to achieve a competitive positioning in the global network of cities by performing a more integrated urban planning. Strategic conversation is one of the most valuable outcomes when developing city scenarios as it involves the participation of diverse actors, and also the analysis of multi dimensions, multi functions and multi organisations (Song et al, 2006); however, despite the value of this technique, very little has been researched on the important factors for transforming foresight into short and middle term plans, operational strategies, actions and using a broad number of measurements in cities.

Heracleous (1998) explains that a dialectical view of strategic thinking and strategic planning, according to two main positions on the proper meaning and interrelationship between the ideas of Henry Mintzberg and Michael Porter, should be considered in strategic management. He says that Mintzberg believes that strategic thinking and planning involve distinct thought processes, the former being creative and the latter analytical; whereas he mentioned that Porter believes that strategic thinking is achieved by utilising analytical tools. Prevalence of the analytical is detected in current strategic management of ICT initiatives implemented by government. Heracleous points out that Porter drew attention to the need to understand both the cross-sectional problem (the causes of superior performance at a given point of time), and the longitudinal problem (the dynamic process by which strategies are arrived at). Porter's contributions have tended to focus on the cross-sectional (implementation) rather than the longitudinal problem (long term planning), and in the other hand, Mitzberg's contributions have tended to focus on the longitudinal rather than the cross-sectional problem.

Considering thoughts from Mitzberg and Porter, a useful strategy tool, for analysing the present and foresee the future could have the look as shown in figure 2.

4.2.2 Implementing short and middle term plans of the city

After defining city plans, the next important step is their implementation that is achieved throughout the creation of initiatives or projects and supported with organisational capability in the form of governance, resources and actors (Waring and Wainwright, 2002; Peansupap and Walker, 2005; Anumba et al, 2006; Gajendran and Brewer, 2007; Vehovar and Lesjak, 2007); therefore, skills (Hwang, 2003), training and attitudes are important factors, and in the case of ICT, age plays also an important role on the productivity of these projects as older employees need to be retrained (Spacey et al, 2003; De Koning and Gelderblom, 2006). Knowledge and experience on ICT are vital for understanding the organisation ICT readiness, having awareness of the technology and its maturity, and the potential benefits of integration with other technologies, understanding of the business processes, managing the competitive advantage due ICT in the business environment and defining budget. ICT implementation is about people related issues of effective change management, knowledge transfer and leadership by a champion and adoption team to sell benefits and support users (Peansupap and Walker, 2006).

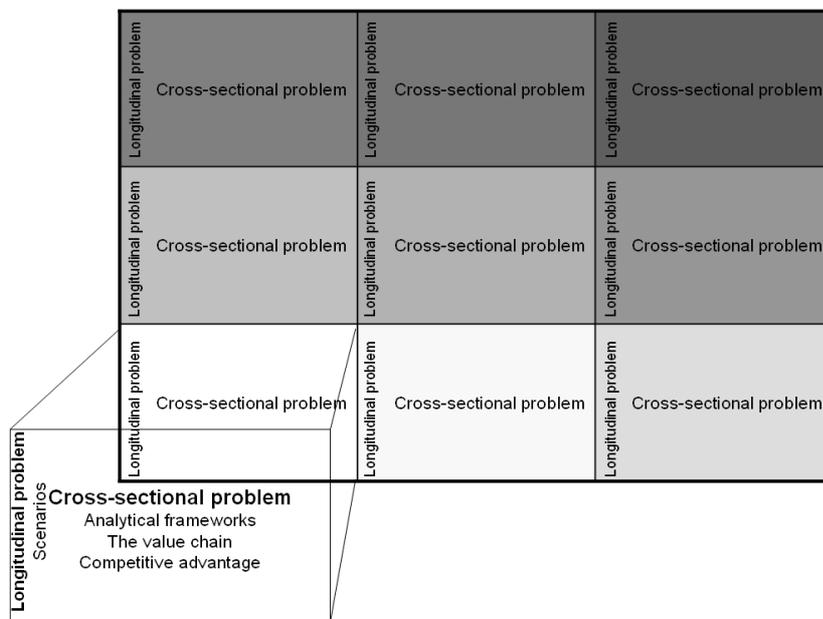


Figure 2. Tool for reducing uncertainty in strategy and policy

There are different organisational models (Winden, 2005; Klaasen et al, 2007; Weerakkody et al, 2007) for implementing ICT plans in cities including inter-city or regional networks models similar to the e-City Network in Scotland, intra-city network models as the Digital Birmingham partnership in England or Barcelona Informacio in Catalunya, single-organisation models as used by Maroussi City Council (Ergazakis et al, 2007) in Greece or other different e-government initiatives (Deakins and Dillon, 2002; Gent, 2003; Melitski, 2003; Davison et al, 2005; Ebrahim and Irani, 2005; Yoon and Chae, 2005; Beynon-Davies, 2007; Holzer and Kim, 2007) which are frequently developed by local authorities but under request and budget of a central government demands office (Weerakkody et al, 2007). In the case of ICT initiatives, standard methodologies like PRINCE are widely used by local authorities in the UK. The success of an implementation depends not only on avoiding technological lag, but more importantly reducing organisational lag in every organisation involved in the development of the Digital City or u-City. every organisation involved in the development of the Digital City or u-City.

4.2.3 Measurement of the city

Vehovar and Lesjak (2007) argue that objective measures of ICT investments (cost-benefit analysis, returns on investment, and balanced score cards) are still not very well developed and there are inconsistencies in their methodological issues, and also they are affected by the increased quality of new products/services, time lags, organisational changes, skills and education measures, innovation-related activities, age and size of the organisation, sector and international position. In addition, only one-fifth of companies, for example, apply some of these formal approaches to evaluate their ICT investments. The author analysed 500 ICT city initiatives between 2001 and 2004, and found that international, national, local institutions and city organisations, have suggested hundred of indicators for measuring ICT including usage, infrastructure, economic impact, environmental benefits, regeneration power, improvement in quality of life, crime reduction, cost and time reduction of public services, innovation, social and cultural matters amongst others. However, very few of these organisations have succeeded in providing comparable data over time and across different cities, regions or countries and considering the entire range of devices and software of the ICT industry. Also, it is important to point out that many of the results in rankings, benchmarking exercises, or awards, suffer inconsistencies, lack of clarity in methodologies and exist subjectivity in definition of ICT concepts. In many occasions the influences on measurement systems are result of political hidden agendas.

4.3 Organisations of the city

In order to study the city with integrated tools, it is necessary identifying the clusters of organisation existing within the city and normally used by the city decision makers. Mino (2001) classifies digital cities projects according to vertical sectors including urban transport, environment, education, healthcare, administration, tourism and inter-sector integration of services. In his study, Mino states challenges and roles that local authorities might take when dealing with ICT. For example, managing technical complexity of integration,

managing organisational complexity (re-engineering of public administration and processes required to introduce ICT), defining the appropriate policy and regulations to guarantee affordable and equitable services, and promoting organisational change with tight controls on public expenditure and demonstrating ICT benefits to all relevant actors. He also defines three main areas of application of digital cities, namely, economic development or regeneration, social cohesion and quality of life, and administration of the city and management of IS infrastructure. Wong et al (2007) considers different concepts of e-governance, e-democracy and e-community, and matters of e-government organisations as well. Urban competitiveness is also linked to ICT and influenced by the strategic management of ICT infrastructure (Drewe, 2006; Van Winden and Woets, 2003; Van Winden, 2003; Yoon and Chae, 2005). E-Government is also considered as an important dimension within a city (Deakins and Dillon, 2002; Melitski, 2003; Holzer and Kim, 2007).

5 ORGANISATIONAL EVOLUTION WITHIN THE CITY

5.1 From single to multiple organisations relations

Organisations within the city have a long history of doing projects independently, however, with the rise of the Information Society they have to relate to other organisations or institutions in order to innovate and use ICT more productively. Therefore, ICT becomes a driver of innovation within urban institutions and organisations in order to solve challenging problems (Johnson, 2008), and adopt a new category of policy and new style of policy development that engage in regional foresight exercises for identifying assets, undertaking collaborative processes of planning, implementation of change, and encouraging mindsets and different ways of developing ICT innovation in cities and regions (Athey et al, 2008) to foster growth (Wolfe and Bramwell, 2008).

According to Swanson (1994), Information Systems innovation means that the new ICT technology is effectively meshed with organisation design, process, strategy, and external relationships throughout the enterprise. The importance of Information Systems innovation is based on the increasing internal and external processes of computerisation within businesses, or city organisations. Mulgan and Albury (2003;2005) analyses the importance of innovation in the public sector by summarising five main types of innovation related to provision and delivery of public services and also barriers. External factors that local government managers need to pay attention are the new political environment (national government), public dissatisfaction with the quality of service, availability of IT and professional help. These are key factors that influence the early adoption of Information Systems. The internal factors involve defining local champions and increasing technological awareness in order to benefit from resource mobilisation and both are relevant in the full adoption of the innovation (Watad, 1999; Mustonen-Ollila and Lyytinen, 2004). Diverse theory and models can be used for analysing ICT innovations, including the Technology Acceptance model, Marcus's Theoretical model of adoption, Diffusion of Innovation theory and other factors (Bates et al, 2007). Fountain (2001) introduces her theory of technology enactment and argues that organisations (norm and control institutionalised by social networks and commitments) are not using the full capability of their information systems neither leverage their strategic potential because organisational actors are not aware of the potential of their technological systems or they give priority to personal interests instead of objectively seeking to exploit the technological capability fully. For this reason, the Internet and decisions regarding its use in organisations by non-technical decision-makers, is a clear example of decision-making under uncertainty due the uncertainty of technology evolution but also because the cognitive, cultural, social, rational and political logics. Schellong (2007) extended Fountain's framework by including citizens, businesses and communication, and relations between the different actors and objectives. Norris (2003) argues that in order to study IT and government, it is necessary look at innovation in organisations and socio-technical systems theory before considering Fountain's technology enactment theory. He emphasizes socio-technical systems theory because the adoption, use, and management of ICT by governmental organisations and the effects of ICT on these organisations can be examined and understood from a systems perspective.

5.1.1 Integrated assessment

Rotmans and Van Asselt (2001a) state that Integrated Assessments (IA) are useful for analysis of real world complex problems operating at different levels in time and space, and with high uncertain stakes. Rotmas and van Asselt (2000) study ways of managing evolving cities and propose an integrated approach for sustainable city planning. They use an interdisciplinary angle versus the traditional economic approach to city planning. Their dynamic model information system is focused on strategy operation and for this they use an integrated city planning tool and a participatory process. The tool helps in measuring current and future city development while considering the complex dynamics of cities. Therefore they integrate physical

infrastructure (spatial planning, housing, transport, urban water systems, waste and food, ICT), socio-cultural infrastructure, city economy and its environment. Moreover, the tool makes explicit all flows in and out within an imaginary city in relation to the existing stocks (interrelated reservoirs).

During the first decade of the XXith century diverse integrated self-assessment tools, guidelines and models for ICT strategic management have been developed by varied city and non-city related organisations. This group of management devices include the e-City Index (University of St Andrews), KnowCis (National Technological University of Athens), Digital Local Agenda (UNITAR), Council of the Future (SOCITM), Manual para el desarrollo de las Ciudades Digitales en Iberoamérica (AHCJET), Community Accelerator (Intelligent Community Forum), The e-Government Handbook for Developing Countries (InfoDev World Bank) ; however, despite the good intentions in bringing direction to cities, these tools have a lot of deficiencies as most of them focus on short and middle term implementation; therefore, they lack of strategic view of cities for the long term. Other of these tools lack of operational standardisation and are presented with a heavy technical language or without enough broadness to embrace all types of cities, allow city comparisons or more frequently focused on e-government (Yang and Rho, 2007) only. Also they are time consuming as they seek a great level of quantitative detail, are very costly, don't enhance strategic conversation in many cases, or lack of follow up actions in others and don't provide a straight forward guidance that non-technical decision makers can rely on or use easily for integration in the process of city development, for example, of civil servants, managers and directors of any city organisation; therefore if used individually, these tools are missing the strategic and operational aspects necessary for long term investments in a city. However, also complementarities exist between some of these tools as the deficiencies of one are complemented by the features of the other and vice versa.

5.1.2 The u-City Index

After analysing ICT, city and organisational issues, this paper brings these concepts and proposes a list of requirements that the u-City Index should have in order to be relevant for managers of the future ubiquitous cities from a strategic planning, implementation and measurement, or integrated planplementation perspective. With these requirements different strong strategic management devices can be developed for helping in improving the success of Digital Cities and u-Cities.

ICT view	
<p>It considers ICT and UCT uncertainty and mastery of innovation. It focuses on company towns and current cities.</p> <p>It helps in avoiding the productivity paradox.</p>	
<p>view</p> <ul style="list-style-type: none"> • It is multi dimensional – applied across different areas including waste, transport, carbon emissions, economic development, culture, health amongst others. • It is multi functional – applied to the value chain of city organisations. • It is multi organisational – applied across different organisations including local council, universities, schools, hospitals, police, businesses, and others. • It is contextualised - supporting the integration and alignment with local or regional strategy and operations. • It integrates long term planning and implementation. • It envisages different futures. • It doesn't add more work to city managers. • It facilitates strategic conversation amongst city organisations and actors. • It has a simple measurement and benchmarking system supported by evidences. 	<p>Organisational view</p> <ul style="list-style-type: none"> • It guides innovation in city organisations. • It is a proxy or complementary to other existing strategic management devices used for innovation. • It can be used for research and comparisons over time and between cities, and city organisations. • It considers the context, organisational and institutional challenges of city organisations.

Figure 3. Requirements for an integrated planplementation of future ubiquitous cities

Limitations of a city integrative approach could come from a restrictive policy and laws on privacy (Castells and Cardoso, 2005) that affect the integration of citywide projects. As this perspective differs from the current approaches to city planning, therefore will need to be improved constantly throughout empirical and focused research in order to cover all the aspects that affect a city, its organisations and citizens. A model

that reflects the requirements is needed for evaluating this new approach to city planning. This model will also have to be validated by city managers and academics.

Further research is needed considerably in the area of Digital Cities and u-Cities. After defining the framework or model of the u-City Index, a research on the impact of age and ICT knowledge and experience will open the enquiry to this new approach to understanding and managing cities. Also research has to focus on the usage of integrated assessment tools for identifying organisational or institutional factors, independently of the type of tool used, as Fountain (2001) suggested and that affect decision making.

6 CONCLUSION

This paper identified contributions from ICT, city and organisational studies for defining the requirements of the u-City Index, a model or framework for helping managers and civil servants in the strategic management of Digital Cities and the future u-Cities that can be developed in company towns but also current cities. By understanding issues of past, present and future city planning and also the nature of ICT, and its effects on innovation of organisations, this paper provides an insight on the complexity of managing cities, Digital Cities and u-Cities. At the same time, it identifies the important factors for reducing uncertainty and improving success of ICT initiatives considering the city as a unit that is multi functional, multi organisational, and multi dimensional. This conceptual study deep the understanding of application of integrated assessment tools by cities, an area that has not been researched profoundly by the academy.

7 REFERENCES

- ANTTIROIKO, A.-V. (2009) 'Urban u-community: a new dimension of urban development', *International Journal of Innovation and Regional Development*, 1, 4, 25 January, pp. 464-483.
- ANUMBA, C.E.H., Dainty, A., Ison, S., and Sergeant, A. (2006) 'Understanding structural and cultural impediments to ICT system integration: A GIS-based case study', *Engineering, Construction and Architectural Management*, 13, 6, pp. 616-633.
- ASGARKHANI, M. (2006) 'Current Trends in Strategic Management of ICTs', in *Proceedings of 2006 IEEE International Conference on Management of Innovation and Technology*, Singapore, China, 21-23 June 2006, IEEE, 1, pp. 460 – 463.
- ATHEY, G., Nathan, M., Webber, C., and Mahroum, S. (2008) 'Innovation and the city', *Innovation: Management, Policy & Practice*, 10, 2-3 Innovation and the City - Innovative Cities, October 2008, pp. 156-159
- AUSTER, M.L. (1990) 'Not without Art, but yet to Nature true: A re-evaluation of organic thought in urban planning and geography', *Australian Geographical Studies*, 28, 2, pp. 178 – 186.
- BATES, M., Manuel, S., and Oppenheim, C. (2007) 'Models of Early Adoption of ICT Innovations in Higher Education', *Ariadne*, 50, January. Available from <http://www.ariadne.ac.uk/issue50/oppenheim-et-al/> (Accessed 21 August 2009)
- BEYNON-DAVIES, P. (2007) 'Models for e-government', *Transforming Government: People, Process and Policy*, 1, 1, pp. 7-28.
- BOIX, R. And Trullén, J. (2007) 'Knowledge, networks of cities and growth in regional urban systems', *Regional Science*, 86, 4, November 2007, pp. 551-574.
- BREDENOORD J. (1997) *Planning and Managing the City of the Future*, Doctoral thesis, Technical University of Delft, The Netherlands.
- CAHILL, D., Gore, T., Macias, A., Mitchell, R., Tangvall, T., and Tussaud, P.. (2001) *e-Cities Scenario Thinking Project Report and Workbook*. Management Department, University of St Andrews. October-November 2001. Great Britain.
- CASTELLS, M. (1996) *The rise of the network society*, Oxford, Cambridge, MA. Blackwell Publishers.
- CASTELLS, M., and Cardoso, G. (2005) *The Network Society: From Knowledge to policy*, Washington DC, Johns Hopkins Center for Trans-atlantic Relations.
- COELHO, D. and Ruth, M. (2006). 'Seeking a Unified Urban Systems Theory', in Mander, U. (Ed). *The Sustainable City IV: Urban Regeneration and Sustainability*, WIT Transactions on Ecology and the Environment, 93.
- DAVISON, R.M., Wagner, C., and Ma, L.C.K. (2005) 'From government to e-government: a transition model', *Information Technology and People*, 18, 3, pp. 280-299.
- DEAKINS, E., and Dillon, S.M. (2002) 'E-government in New Zealand: the local authority perspective', *International Journal of Public Sector Management*, 15, 5, pp. 375-398.
- De KONING, J., and Gelderblom, A., (2006) 'ICT and older workers: no unwrinkled relationship', *International Journal of Manpower*, 27, 5, pp. 467-490.
- DREWE, P. (2006) 'How to assess urban competitiveness in the ICT age?', in Tremblay, D.G. and Tremblay, R. (eds), *La compétitivité urbaine à l'ère de la nouvelle économie, enjeux et défis*, Presses de l'Université du Québec, la Delta I, pp. 255-267.
- EBRAHIM, Z., and Irani, Z. (2005) 'E-government adoption: architecture and barriers', *Business Process Management Journal*, 11, 5, pp. 589-611.
- ERGAZAKIS, K., Metaxiotis, K., Psarras, J., Askounis, D. (2007) 'An integrated decision support model for a knowledge city's strategy formulation', *Journal of Knowledge Management*, 11, 5, pp. 65 – 86.
- ERKUT, G. (1997) 'The Use of Systems Thinking and System Dynamics in Urban Planning and Education', *Proceedings of 15th International System Dynamics Conference: Systems Approach to Learning and Education into the 21st Century*, Barlas, Y., Diker, Vedat G., Polat, S.(eds), Istanbul, Turkey, Bogazici University, Series Title: "Systems" Education (1) (Parallel Session), Printing Office, 1 pp. 121-126.
- FOTH, M. (Ed.) (2009). *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City*. Hershey, PA: Information Science Reference, IGI Global.

- FOUNTAIN, J. (2001) *Building the virtual state: information technology and institutional change*. Brookings Institution Press, Washington.
- GAJENDRAN, T., and Brewer, G. (2007) 'Integration of information and communication technology: Influence of the cultural environment', *Engineering, Construction and Architectural Management*, 14, 6, pp. 532-549.
- GENT, R. (2003) 'Delivering e-government – the Derbyshire experience', *VINE*, 33, 3, pp. 125-130.
- GRAHAM, S. and Marvin S. (1996) *Telecommunications and the city*, London, Routledge.
- GREENFIELD, A. (2006) *Everyware: The Dawning Age of Ubiquitous Computing*. USA. Peachpit Press.
- GREENFIELD, A. and Shepard, M. (2007) *Urban Computing and Its Discontents*, *Architecture and Situated Technologies Pamphlet 1*. USA. The Architectural League of New York.
- GUPTA, D. N. (2006) 'Strategic Management for e-Governance', in Agarwal, A., and Ramana, V. (eds), *Foundations of E-government*, Special Interest Group eGovernance, Computer Society of India, [online] Available from : <http://www.csi-sigegov.org/book1.php> (Accessed 14 August 2009)
- HALL, P. (1992) *Urban and regional planning*, London, Routledge, pp. 259.
- HANSON, R. and Hanson, J. (2003) *When Kids Are Distractible or "Hyper"*. Nurturemom. Available from : http://www.nurturemom.com/Web_store/News/adhd_news.shtml (Accessed 6 August 2009)
- HEMPEL, J. (2005) *The MySpace Generation : They live online. They buy online. They play online. Their power is growing*. Cover story. *Business Week*, December 12. Available from : http://www.businessweek.com/magazine/content/05_50/b3963001.htm (Accessed 6 August 2009)
- HERACLEOUS, L. (1998) *Strategic thinking or strategic planning?* *Long Range Planning*, June, 31, 3, pp. 481-486.
- HERACLEOUS, L. (2003) *Strategy and Organisation*. Cambridge University Press, United Kingdom.
- HOLZER, M. and Kim, S-T. (2007) *Digital Governance in Municipalities Worldwide (2007) ~ A Longitudinal Assessment of Municipal Websites Throughout the World*, National Center for Public Performance, United Nations Public Administration Network [online]. Available from <http://www.unpan.org/Library/MajorPublications/DigitalGovernanceinMunicipalitiesWorldwide/tabid/804/language/en-US/Default.aspx> (Accessed 21 August 2009)
- HWANG, G.-h. (2003) 'Information and communication technologies and changes in skills', *International Journal of Manpower*, 24, 1, pp. 60-82.
- ISHIDA, T., (2000) 'Understanding Digital Cities', *Digital Cities: Computational and Sociological Approaches*. Lecture Notes in Computer Science, 1765, pp. 7-17.
- JOHNSON, B. (2008) 'Cities, systems of innovation and economic development', *Innovation: Management, Policy & Practice*, 10, 2-3 *Innovation and the City - Innovative Cities*, October 2008, pp. 146-155
- JUNG, H.S., Baek, J.K., Jeong, C.S., Lee, Y.W., and Hong, P.D. (2007) 'Unified Ubiquitous Middleware for U-City' in *Proceedings of 2007 International Conference on Convergence Information Technology*, 21-23 November, Korea, ICCIT, IEEE, pp.2374-2379.
- JUNIPER, J. (2002) "Systems Thinking - A Post-Structuralist Critique", *Proceedings of Australian Association of Heterodox Economists Conference*, University of New South Wales, 9th December.
- KLAASEN, I., Rooij, R., and Van Schaick, J., (2007) 'NETWORK CITIES: Operationalising a Strong but Confusing Concept W20 Spatial planning and governance at the regional level', *Proceedings of European Network for Housing Research (ENHR) International Conference 2007 : Sustainable Urban Areas*, Rotterdam 25-28 June. ENHR. Available from : http://www.enhr2007rotterdam.nl/documents/W20_paper_Klaasen_Rooij_VanSchaick.pdf (Accessed 6 August 2009)
- LOW, N. (1982) 'Beyond General Systems Theory: a Constructivist Perspective', *Urban Studies*, 19, pp. 221-233.
- MALECKI, E.J. (2007) 'Cities and regions competing in the global economy: Knowledge and local development policies'. *Environment and Planning C: Government and Policy*, 25, pp. 638-654.
- MARSHALL, J., and Smith, W.R. (1978) 'The Dynamics of Growth in a regional urban system: Southern Ontario', *Canadian Geographer*, XXII, 1, pp. 1851-1971.
- MINIWATTS MARKETING GROUP (2009) *Internet Growth Statistics - Today's road to eCommerce and global trade*. Internet World Stats : Usage and population statistics. The Internet Coaching Library. Available from <http://www.internetworldstats.com/emarketing.htm> (Accessed 6 August 2009)
- MELITSKI, J. (2003) 'Capacity and E-Government Performance: An Analysis Based on Early Adopters of Internet Technologies in New Jersey', *Public Performance & Management Review*, 26, 4 (Jun., 2003), pp. 376-390.
- MINO, E. (2001) 'Analysis of Digital Cities Developments in Europe' in *Proceedings of Future Cities Symposium*, Riyadh, 10-12 November. Available from <http://www.docstoc.com/docs/2364382/Analysis-of-Digital-Cities-Developments-in-Europe> (Accessed 21 August 2009)
- MISURACA, G. C. (2009) 'e-Government 2015: exploring m-government scenarios, between ICT-driven experiments and citizen-centric implications'. *Technology Analysis & Strategic Management*, 21, 3, April 2009, pp. 407 – 424.
- MITCHELL-WEAVER, C. (1991) 'Urban Systems Theory and Third World Development : A Review', *Journal of Urban Affairs*, 13, 4, pp. 419-441.
- MITCHELL, W.J. (1999) *E-topia; It's urban life Jim, but not as we know it*, Cambridge, MIT Press.
- MULGAN, G. and Albury, D. (2003) 'Innovation in the Public Sector', Cabinet Office, The Strategy Unit, pp. 1-40. Available from <http://www.cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/pubinov2.pdf> (Accessed 20 August 2009)
- MULGAN, G. and Albury, D. (2005) 'Innovation in Public Services Literature Review', IDEa Knowledge, pp. 1-50. Available from <http://www.idea.gov.uk/idk/aio/1118552> (Accessed 20 August 2009)
- MYUNGJUN, J. and Soon-Tak, S. (2010) "U-City: New Trends of Urban Planning in Korea based on Pervasive and Ubiquitous Geotechnology and Geoinformation" *Lecture Notes in Computer Science Vol. 6016* Springer-Verlag, Berlin.
- NEVES, B. B. (2009) 'Are digital cities intelligent? The Portuguese case', *International Journal of Innovation and Regional Development*, 1, 4, 25 January, pp. 443-463.
- NEWTON, K. (1984) 'Urban Systems Theory, and Urban Policy and Expenditures in England and Wales', *European Journal of Political Research*, 12, pp. 357-369.
- NORRIS, D.F. (2003) 'Building the Virtual State... or Not? A Critical Appraisal', *Social Science Computer Review*, 21, 4, pp. 417-424.

- OBLINGER, D. G., and Oblinger, J. L. (2005) Educating the Net Generation. EDUCASE [Online]. Available from : <http://www.educause.edu/educatingthenetgen> (Accessed 6 August 2009)
- PARK, W., Jeong, W., and Cho, H. (2007) 'A Study of the Evolution of the u-City Service' in PICMET 2007 Proceedings, 5-9 August, Portland, Oregon, USA, PICMET, pp. 1141-1146.
- PEANSUPAP, V., and Walker, D. (2005) Factors affecting ICT diffusion: A case study of three large Australian construction contractors, *Engineering, Construction and Architectural Management*, 12, 1, pp. 21-37.
- PEANSUPAP, V., and Walker, D. (2006) 'Information communication technology (ICT) implementation constraints: A construction industry perspective', *Engineering, Construction and Architectural Management*, 13, 4, pp. 364-379.
- PEREZ, C. (2001) 'Technological change and opportunities for development as a moving target'. *CEPAL Review* 75, December 2001, pp. 109-130.
- PEREZ, Carlota (2002a), *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*, Edward Elgar, Cheltenham, UK
- PEREZ, Carlota (2002b), *Technological Revolutions and Techno-economic Paradigms as Framework for Designing Industrial Policy*, Lecture at the Ministry of Economic Affairs, 27 September 2002, Estonia. Available at http://www.praxis.ee/innovation/workshop/carlota_perez_slides_web.pdf and <http://www.carlotaperez.org/lecturesandvideos.html> (Accessed 6 August 2009)
- REVETZ, J. (2000) 'Integrated Assessment for Sustainability Appraisal in Cities and Regions', *Environmental Impact Assessment Review*, 20, pp. 31-64.
- RITZER, G. (2000) *The Blackwell Companion to Major Social Theorists*, Blackwell Publishers, USA
- ROTMANS J. and van Asselt M.B.A. (2000) 'Towards an integrated approach for sustainable city planning', *Journal of Multi-Criteria Decision Analysis*, 9,1-3, Special Issue: Decision Support in the Public Sector, pp. 110 – 124.
- ROTMANS J. and van Asselt M.B.A. (2001a) 'Uncertainty in Integrated Assessment Modelling: A Labyrinthic Path', *Integrated Assessment*, 2, 2, June, pp. 43-55.
- SCHELLONG, A. (2007) 'Extending the Technology Enactment Framework', PNG Working paper No PNG07-003, Program on Networked Governance, John F. Kennedy School of Government, Harvard University, pp. 1-9.
- SIGALA, M. (2003) 'The information and communication technologies productivity impact on the UK hotel sector', *International Journal of Operations and Production Management*, 23, 10, pp. 1224-1245.
- SONG, Y., Ding, C., and Knaap, G. (2006) 'Envisioning Beijing 2020 through sketches of urban scenarios', *Habitat International*, 30, 4, December, pp. 1018-1034.
- SPACEY R., Goulding, A., and Murray I. (2003) 'ICT and change in UK public libraries: does training matter?', *Library Management*, 24, 1-2, pp. 61-69.
- STUBBS, M., Lemon M., and Longhurst, P. (2000) 'Intelligent Urban Management: Learning to Manage and Managing to Learn Together for a Change', *Urban Studies*, 37, pp. 1801-1811.
- SWANSON, E. B. (1994) 'Information Systems Innovation Among Organizations', *Management Science*, 40, 9, September, pp. 1069-1092.
- TAPSCOTT, D. (1999) *Growing up Digital : The Rise of the Net Generation*. McGraw-Hill [online]. Available from : <http://www.growingupdigital.com/> (Accessed 6 August 2009)
- TAYLOR, N. (1998) *Urban planning theory since 1945*, SAGE Publications, Great Britain.
- UNIVERSITY OF EAST LONDON (2006) 'Strategies for managing ICT and its applications within colleges and universities: policy and practice'. JISC. Available from : <http://www.jisc.ac.uk/publications/documents/strategiesformanagingict.aspx> (Accessed 15 August 2009)
- VEHOVAR, V., and Lesjak, D. (2007) 'Characteristics and impacts of ICT investments: perceptions among managers', *Industrial Management & Data Systems*, 107, 4, pp. 537-550.
- VYTAUTAS, R.V. (2004) 'Chapter 2 - Urban planning, planning support and informal urban development' in *Managing informal settlements : A study using Geo-Information in Dar es Salaam, Tanzania*, ITC Dissertation No. 112, International Institute for Geo-Information Science and Earth Observation (ITC), The Netherlands. Available from http://www.itc.nl/library/Papers_2004/phd/sliuzas.pdf (Accessed 23 August 2009)
- WALTON, J. (1979) 'Book Review : From Cities to Systems : Recent Research on Latin American Urbanisation', *Latin American Research Review*, The Latin American Studies Association, 14, 1, pp. 159-169.
- WARING, T., and Wainwright, D. (2002) 'Enhancing clinical and management discourse in ICT implementation', *Journal of Management in Medicine*, 16, 2/3, pp. 133-149.
- WEERAKKODY, V., Jones, S., and Olsen, E. (2007) 'E-government: a comparison of strategies in local authorities in the UK and Norway', *International Journal of Electronic Business*, 5, 2, 2 April, pp. 141-159.
- van WINDEN, W. (2003) *Essays on Urban ICT Policies*, PhD thesis, Erasmus Universiteit Rotterdam.
- van WINDEN, W., and Woets, P. (2003) 'Local Strategic Networks and Policies in European ICT Clusters: The cases of Amsterdam, Bari, Dublin and Oulu', Paper prepared for the 15th Annual Conference of the European Association for Evolutionary Political Economy, Maastricht, The Netherlands, 7th – 10th November 2003, European Institute for Comparative Urban Research, Erasmus University Rotterdam. Available from <http://129.3.20.41/eps/urb/papers/0409/0409004.pdf> (Accessed 20 August 2009)
- van WINDEN, W. (2005) 'Municipal E-Governance Models: Comparative Analysis of European Cities', *E-government*, 4, pp. 39-42.
- WOLFE D, and Bramwell, A. (2008) 'Innovation, creativity and governance: Social dynamics of economic performance in city-regions', *Innovation: Management, Policy & Practice*, 10, 2-3 Innovation and the City - Innovative Cities, October 2008, pp. 170-182.
- WOLMAN H, (2008) 'Comparing local government systems across countries: conceptual and methodological challenges to building a field of comparative local government studies', *Environment and Planning C: Government and Policy*, 26, 1, pp. 87-103.
- WONG, K., Fearon, C., and Philip, G. (2007) 'Understanding e-government and e-governance: stakeholders, partnerships and CSR', *International Journal of Quality and Reliability Management*, 24, 9, pp. 927-943.

- YANG, K., and Rho, S-Y. (2007) 'E-Government for Better Performance: Promises, Realities, and Challenges', International Journal of Public Administration, 30, 11, September, pp. 1197-1217.
- YIGITCANLAR, T., Baum, S. W. and Stimson, R. J. (2003) 'Evaluating the potential of Queensland Australia for implementing online urban planning' in Proceedings of 2003 American Congress on Surveying and Mapping, Phoenix, Arizona, USA, 29 March - 2 April 2003
- YOON, J., and Chae, M. (2005) 'Benchmarking e-Readiness evaluation', eGov eGovonline.net. Available from <http://www.egovonline.net/articles/articledetails.asp?articleid=267&typ=Commentary> (Accessed 16 February 2009)
- ZEMKE, R., Raines, C., and Filipczak, B. (1999) Generations at Work : Managing the clash of Veterans, Boomers, Xers and Nexters in Your Workplace. AMACOM, USA.