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The Fab City

Abstract

Today's economic, environmental, social and political crises are the result of a model that was shaped during the last 100 years. This model is based on oil processing (energy and raw materials), chain production and the creation of a global economic system. Our oil-based economy and serialised production model has allowed humanity to increase the capacity of manufacturing resources to solve its basic needs whilst investing less time and human resources and, furthermore, to generate new materials and processes for the consumption of goods and services by the masses. The spatial separation of production from consumption, and the acceleration of manufacturing processes (mainly in food), have allowed humans more time to expend in other activities. The rise of an entertainment-based society is the result: once your basic needs are met, you can use the most recent technological discoveries to consume and produce spectacle and leisure. We need to change our relationship with technology in order to achieve a more sustainable, productive and knowledge-based way of living, bringing production closer to consumption and managing our lives with more efficient and demand-based dynamics.

Keywords

smart city, smart citizen, Fab Lab, Fab City, self-sufficient city, do-it-yourself, digital fabrication, Barcelona, urbanism

A place where everything happens, or used to happen: The city

In today's society it is in cities where most human interaction takes place. Urban settlements are among the most complex systems created by mankind, and are the places where the biggest challenges of our future will happen. It is a fact that our present productive model is putting at risk the sustainability of the next generations. Although it might sound like a '70s or late '90s assertion, the sentiment remains and is becoming even more critical, and from different points of view. The technology, the resources and the administrative make-up of cities today are obsolete, and in the main continue to be based on out-dated models that encompass economic, social, political, environmental and technological perspectives. The majority of our cities function under an old industrialised model that emerged around 200 years ago in Manchester and Liverpool, with the industrial revolution. The current industrialised model relies on access to raw materials in Africa and America, cheap physical labour in Asia, and access to oil resources, mainly in the Middle East. Western societies consume food and products manufactured thousands of kilometres away from the cities we live in, which produce trash that is not being reused, and actually is being shipped thousands of kilometres away, or contaminates adjacent ecosystems.

The economic and productive model began to shape the industrialised city a couple of hundred years ago, first by establishing centres of production within the city borders, and then by absorbing the population of rural areas; people came to live in precarious conditions but were attracted by the new possibilities offered by the urban centres. Years later, production left cities and moved thousands of kilometres away from them, increasing the use of fossil fuels in the transportation of goods, levelling job opportunities and, more critically, separating knowledge of production from consumption. The result is that cities have become big factories of trash, and their subsistence depends on technology produced far away. Our cities are the physical manifestation of the consumption-based model we are living with today.

But, on the other hand, cities need technology to function and to offer their citizens the commodities to live and to satisfy their needs. The logistics of urban centres are dependent on core technological capabilities which allow them to provide services, facilitate resource distribution and resolve emergencies within their limits. Today's cities not only have to fulfil the needs of their citizens through the construction of major infrastructure such as

pipelines, fibre optic networks, public transportation and high quality public spaces; they also need to innovate and create their own technologies, and to share with other urban centres in order to construct solutions for the city, and by the city – and through its citizens.

Where is technology produced? Why?

In the medieval city, most of the productive activity happened within the city walls, which created the physical boundaries for the exchange of knowledge. The city walls served as a physical limit, which concentrated its problems but also forged solutions through the local production of goods. In this sense, we can say that the artisan work was produced in order to satisfy a local need or desire, which could then be connected with other towns or cities, in a secondary level of importance. The industrialisation of production decoupled the purpose of fabrication from its immediate reality; it scaled up into regional, national and global interests and, furthermore, to a standardised production system which finally created what we observe today: a person in Delhi uses the same microprocessor in their computer as a person in Buenos Aires, or in Cape Town or Washington, but at the same time we do not need to use the same cups, tables, toys or specific tools in China, Ukraine or Peru. In the case of a functional item this might not be important, but it becomes serious when it refers to the public lighting of a city, a public transportation system, or the furniture we use in our living rooms; most of these objects were conceived and produced for the environmental conditions and users of different places, and which are removed from the reality of those who own and use them. More critically, these objects and devices have been standardised, as if there were not different people, or different countries, with different conditions … creating an average global standard set for consumption. A universal consumption kit has been created.

A recent history of why we use what we use

If we go back to the last century, we will discover that a great deal of the technology we consume today was developed in the context of the military industry. It was this which allowed us to create most of the inventions that define our everyday life: from how and what we eat, to the way we communicate with each other, among many other simple activities. In *Sex, Bombs and Burgers,* Peter Nowak states: 'We've come to the point where it's almost impossible to separate any American-created technology from the American military. Chances are, the military has had a hand in it, and industry has been a willing partner' (2010: 12)

From Nowak's book we can understand that the most basic instincts of human nature that have instigated the development of the major advances of today's technology – the war industry, the food industry and the sex industry – have created major changes in our everyday lives, in ways that most of us are not aware of. The First and Second World Wars gave us things like the microwave oven, the hand-held camera and personal computers. Later on, the Cold War was the beginning of today's internet, when Vint Cerf and colleagues conceptualised a distributed network of connected nodes in order to maintain information flow in case of a nuclear attack on the US. Today, the internet has become the most influential recent invention for shaping the way we live, share and produce.

In *The Self-Sufficient City* ,Vicente Guallart, Chief Architect of the City of Barcelona, maintains that the 'internet has changed our lives, but has not changed our cities' (2012: 9). Guallart has developed a whole conceptual framework for how a multi-scalar approach, mainly supported by connections between ICT, urbanism and ecology, will reshape the model of our cities, just as the oil industry and serialised production did a hundred years ago. 'The information society, however, connects people to people, objects including buildings with buildings, including community so that the flow of resources between nodes occurs on a smaller scale, allowing, from the interaction of thousands of similar nodes, the "emergent" system' (Guallart, 2012: 55).

But the industrialised model is under stress, and certainly we are at a moment of transition through the creation of new tools that will redefine and shape our reality. The informational and productive tools in the hands of citizens seem to be the key players in this process, as Guallart notes: 'The regeneration of cities on the model of connected self-sufficiency only makes sense if it allows people to have more control over their lives and gives them more power, as part of a social network' (2012: 55).

There is no question about the importance of new tools for citizen-based accountability. From common tools like community radio or printed advertisement to the most recent Kickstarter projects like Formlabs (http://formlabs.com), Spark (http://www.spark.io) or Smart Citizen (http://www.smartcitizen.me), we can see that ITC is putting in the hands of people a vast access to new ways of participation in everyday life decisions. Radio, video reporting, blogging,

environmental sensing … today, as citizens, we can get access to open source tools and platforms and use them to expose irregularities and crime, share an event, create a new voice in our neighbourhood, or communicate with our community. The case of a nine-year-old student in the UK has been a recent case in point: she took pictures of her school's food and shared it on her own blog, creating awareness of the conditions of school meals. 'Martha Payne, aged nine, uploaded a picture of her lunch. Martha's blog soon began to fill with pictures and reviews of her school's food, which attracted the attention of mass audiences' (William Cook, *Daily Mail Online*, 2 October 2012).

The case of Martha is fascinating: she used a digital camera (or the one from her smartphone) and uploaded to an existing blogging platform. Now Martha is a celebrity and runs a charity programme for children in Malawi. This may be hugely enhanced by the media and by our spectator society, but at the same time it makes us think about the possibilities of the tools we have at hand today and how significant they could be if we use them to improve our living conditions. Beyond existing tools in the form of websites, apps, and other traditional tools, today's citizen participation in accountability could be exponentially changed by the introduction of 'the tools to make the tools'.

The productive city: Barcelona 5.0

Our cities import products and produce trash, tons of trash. Obsolete products, plastic packaging, cans, and rotten food end up in our trash bins (1.2 to 2 tons of food produced worldwide never gets eaten, while 870 million people are underfed), most of it never to be used again. Barcelona is one of these cities, and it wants to change that. Imagine productive neighbourhoods equipped with digital fabrication laboratories (Fab Labs) and connected with other neighbourhoods and cities throughout the world, exchanging knowledge and addressing the problems of the community, like public lighting, playgrounds, environmental conditions, energy production, food production, or even local production of needed goods such as domestic furniture or simple mobility systems; using old products as raw materials, recycling plastic to be 3D printed again, or using old electronics to produce new useful devices. Futuristic?

Fab Labs were initially created by the Center for Bits and Atoms at the Massachusetts Institute of Technology. Their success was surprising even to their creators; as Director Neil Gershenfeld observed: 'they happened as an accident'. Fab Labs started as a kit of tools and machines that CBA provided to a local community in inner-city Boston, as part of its outreach programme. Fab Labs started to spread to Ghana, Norway and India in the early 2000s, and then to Barcelona, Amsterdam and the rest of the world. Today there are around 150 labs in more than 35 countries, across continents. All Fab Labs share the same inventory of machines and processes and are connected through the internet and videoconferences, building one of the biggest networks and communities of makers in the world.

Fab Labs have a global scale, but Barcelona is forging a new model of a productive city that is based on local manufacturing enabled by the use of digital fabrication machines and processes and, more importantly, by the construction of a makers' community not only limited to Fab Labs. Antoni Vives (Deputy Mayor of the City) and Vicente Guallart (Chief Architect of the City) launched the Fab City project in the seventh Fab Lab Conference in 2011, which took place in Lima, Peru. The Fab City project came about from a discussion that took place in Boston between Vives, Guallart and Neil Gershenfeld. The discussion was basically centred on the question of productivity in cities, and how our cities today only import goods and produce trash. Informally, Guallart has named this model 'from PITO to DIDO' (PITO refers to 'product in, trash out' and DIDO refers to 'data in, data out'). Barcelona is proposing a new model for cities, based on the production within the city, recycling materials and satisfying local needs by local invention – the DIDO model, in which a majority of the imports and exports of a city will happen in terms of bytes (information) and all the atoms are handled at the local scale. This is the Fab City project: productive citizens using common tools and sharing knowledge about making and manufacturing to solve local needs and generate new businesses and educational programmes – a whole productive city.

This year Fab City's plans include the opening of two new Fab Labs in inner Barcelona: one in the district of Les Corts, one of the wealthiest neighbourhoods in the city with a highly educated population and access to commodities; the other in Nou Barris, one of the most conflicted districts, located on the city's periphery and based on a '60s development model with superblocks and with high rates of youth unemployment. Both Fab Labs will be equipped with the basic machines and tools that each Fab Lab has network-wide. It will be named 'Ateneus de Fabricació', a Catalan translation of 'fabrication athenaeum'. These two Fab Labs will be

the beginning of a city network with the objective of installing at least one athenaeum per district in the coming years. The idea of the city Fab Labs is to provide the means and tools for citizens to incubate businesses, learn new ways of production and fabricate change for their communities, in strong connection with the worldwide network of makers.

IAAC and Fab Lab Barcelona have developed projects which could be used at the scale of a micro-controller for an entire house, like the Fab Lab House, constructed in 2010 for the Solar Decathlon Europe competition, or the scale of a city or territory. The Fab City is a city-scale project that will be strongly supported by another project developed within IAAC and Fab Lab Barcelona: Valldaura self-sufficient labs, which exist on a territorial scale. Valldaura is a 130-hectare estate located 15 minutes from Barcelona city centre, inside the Collserola Metropolitan Park, the green centre of the metropolitan area. Valldaura was acquired by IAAC in 2010 and aims to develop different kinds of programmes that focus on three main principles of self-sufficiency: the production of energy, the production of goods and the production of food. Valldaura will be the incubator of new ways of production using natural and sustainable processes, and of the generation of new materials; it will allow for field tests and development of solutions for the self-sufficient city in an old monastery (Can Valldaura), but at the same time it will be connected with the world.

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Do-it-yourself is not new – Do-it-with-others is better

Steward Brand's *The Whole Earth Catalogue* (1968–1998) was released as a DIY guide for making and giving access to tools for people to develop a more self-sustainable way of living. The catalogue was updated in every issue, with how-to guides to build different devices and inventions, like water filters and solar-powered lights, to improve not only individual lives but community living. What happened with all these movements? Why did the catalogue reduce its print-run in the 1970s to finally stop altogether in 1998? The catalogue became obsolete, perhaps because it was not needed in a consumer-based world.

However, the DIY movement was far from dead after the disappearance of *The Whole Earth Catalogue* – DIY is alive today in a new way through the use of the internet and open source tools such as Instructables (http://www.instructables.com/), Makezine (http://makezine.com/) and Thingiverse (http://www.thingiverse.com/), among other platforms, which are giving people access to new tools of creation and production, not only by providing instructions on how to make a solar-powered light or a complete 3D printer, but allowing users to upload, edit and share those instructions and their knowledge of how to make things. If we link these platforms with Fab Labs (http://fab.cba.mit.edu/about/faq/), MakerSpaces (http://makerspace.com/), HackerSpaces (http://hackerspaces.org/wiki/) and other facilities for local manufacturing, then we will have an ideal mixture of the global-digital world and the local-physical one, both articulated and synchronised in order to produce solutions and satisfy needs and desires, hopefully without compromising others' needs and desires.

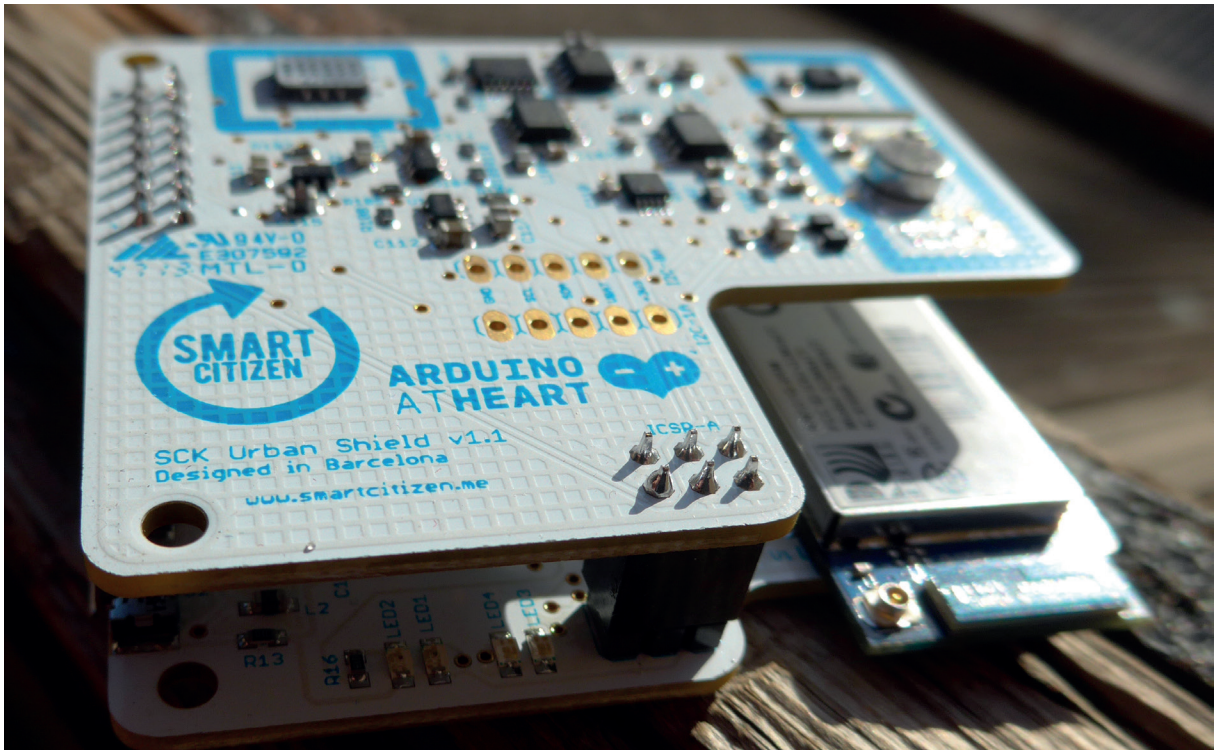
The smart citizen

In Barcelona during the last few years, the term Smart City has been in most of the mainstream forums, meetings and events, mainly connected with technology, urbanism and architecture. Barcelona hosts one of the most important forums of Smart Cities in the world – The Smart City Expo – and every year it brings to the city the biggest companies (IBM, CISCO, ABERTIS, etc.) and most important city government decision-makers internationally to discuss the new role of ICT in the development of more efficient cities. The forum is a perfect marketplace, and the term Smart City is the perfect brand to buy and sell new products related to technology and cities. But where is the citizen in this whole ecosystem of big traders, investment in infrastructure and new urban plans?

Together with a group of fellow researchers at IAAC, Fab Lab Barcelona and MID (Media Interactive Design Studio), we began raising questions with ourselves and with our students about the role of the citizen in the production of information in the city. At IAAC we run a complete studio class on Smart Cities and the role of ICT in the new urbanism. One of the main questions is: what are the tools that we have as citizens to produce information or goods in the city? In order to answer those questions we started by developing an Arduino-based kit that allows a user to capture data from the environment, which can inform us about the levels of air quality, noise, temperature, humidity, amount of light, solar radiation or radio wave exposure and can automatically upload the data to an online platform (http://www.smartcitizen.me) in order to share it and compare it with others' findings. The kit uses any domestic WiFi connection, is powered by a lithium battery and, once connected, will automatically start to push data to a server in order to share it with others. The Smart Citizen project was launched in a crowd-funding campaign using a Barcelona-based platform, Goteo (http://www.goteo.org), which supports mainly open source projects.

The Smart Citizen project achieved its campaign's goal in September 2012, raising 13,748 Euros in 80 days to produce the first 200 kits and develop the first version of the online platform. On the platform the data from the kits will be displayed and available for users to share, create visualisations, or generate triggers. Ultimately this has been developed in order to provide more tools for interaction between the citizen and the city. Less than a year later, Smart Citizen raised $68,000 in a 30-day campaign on the crowd-funding site Kickstarter, becoming a network of close to 1,000 people in the world who are capturing data and developing tools for participatory urbanism and activism.

The Smart Citizen project aims to develop a local network of data collectors not only in Barcelona but also in other cities of the world. In addition to the fact that there are several projects similar to Smart Citizen, one of its strengths is the 'localisation' of the data and the creation of a local community. The aim of the Smart Citizen project is better explained through this metaphor: make the cloud (i.e. online information and data) 'rain' in front of our homes and use both hardware and software tools to act in the city to understand it.



A new literacy

The introduction of new tools and technology in our everyday life has shaped the way we learn and what we learn. Until the '60s most of the work in an office was done without computers, course materials in universities were printed, medium-sized businesses did the accountancy by using notebooks archived on shelves. In the '70s computers became accessible to small and medium-sized businesses and organisations, requiring new skills for new tasks to perform with those new tools. Finally, in the '80s, computers became accessible to anyone; the popularisation of personal computers (PC) reached our homes. In the early '90s most of the schools in the western world introduced computers into classrooms and libraries, and learning word processors or image treatment software became part of standard educational programmes. Today's world operations depend on those new skills acquired by the new workers, leaving the machines in industry, and moving to offices in the city. As most of us know, this model of packed workplaces in front of computers is likely to be obsolete, and the 2008 crisis is just a starting point of a probable huge collapse. More and more office workers are being made redundant, and it seems that even those skills are not up-to-date anymore.

The 'first work, then rest' model also seems to be obsolete, as well the time = money equation we use to quantify and qualify what we do, how, and when. Today most of the unemployed of the world have time to spend but not the money to accompany it; the system failure resides in the fact that 'nothing moves without money'. This is a pathology which needs to be healed by the will of citizens. The internet is allowing us to have access to high quality courses in computer science, neurology, physics and electronics (i.e. EdX courses offered by MIT, Stanford and Harvard), or simple courses on how to learn the use of a tool, like how to learn to edit a movie, or to edit pictures using Photoshop, or how to program in C or Python (Codeacademy, KahnAcademy); learning is no longer necessarily connected with a formal institution – it can be achieved by anyone, anywhere, anytime, and for free. As we have learned how to use Word, Excel or Powerpoint, we will learn how to model in 3D, operate a laser cutter, or program a micro-controller. These new skills will determine our power to influence how our reality is shaped, because we will have access to the tools to do so.

Recently, a media series covered the importance of learning programming, or coding. According to the BBC, coding could be compared to learning Latin 2,000 years ago. Moreover, learning code is basically shaping a new way of thinking: 'That, really, is what it means to inhabit the coded world: to understand what it means to use these machines to think with. This is what thinking has become in the 21st century condition' (Tom Armitage, BBC-UK online, 26 December 2012). Not only coding but modelling and scanning software and tools, or any other skill that will allow us to relate both physical and digital worlds, will become mandatory in courses at schools, universities and training programs.

The next five years

'A once-shuttered warehouse is now a state-of-the art lab where new workers are mastering the 3D printing that has the potential to revolutionize the way we make almost everything' (Barack Obama, President of the United States of America in the State of the Union address. CNN, 13 February 2013, Douglas Rose, online edition).

In the above quote, President Obama is referring to 3D printing as the major boost in today's production model, but this might be too simplistic. 3D printing is the tip of the iceberg, while distributed and personal manufacturing is much more complex in essence and, at the same time, it might take several years to print fully-functional objects. Neil Gershenfeld states in a recent article in *Foreign Affairs* (2012) that 3D printing fever could be compared with media coverage for the microwave in the 1950s, which seemed to consider it as a replacement for the kitchen, while in fact although it made our lives better, we still needed the rest of the tools in a kitchen to produce complex food. Fab Labs could be compared with that kitchen, and 3D printers with microwaves; instead of food, in these labs new inventions are being produced at a faster speed than industry and university are doing today.

3D printing might not change the world itself, but it is the trigger for a major movement of which we are a part. It seems that there is a cycle in history, and the artisan, DIY practitioner or guilds are finding new tools and media to make, collaborate and produce technology. With the tools, the conditions, and the reality of life today, the human factor is the only aspect that seems to remain the same. Most of the phenomena we speak of today have been part of a previous period of history; what is really changing is the means to achieve these processes, and how we can now link things that previously had seemed incompatible.

The years to come will be transitional and critical for the construction of what may become a 'second renaissance' or a 'high tech medieval age'.

References

Armitage, T. (2012) Viewpoint: Computer code frees us to think in new ways. *BBC News*, 26 December. Available at: http://www.bbc.co.uk/news/technology-20764273.

Cook, W. (2012) Malawi One, Scotland Nil! Girl, 9, who was banned from blogging about disgusting school dinners gives thumbs up to breakfast as she visits African children. *Daily Mail Online*, 2 October. Available at: http://www.dailymail.co.uk/news/article-2211691/Martha-Payne-banned-blogging-disgusting-dinners-gives-thumbs-breakfast-visits-African-children.html.

Gershenfeld, N.A. (2005) *Fab: The Coming Revolution on Your Desktop: From Personal Computers to Personal Fabrication*. New York: Basic Books.

Gershenfeld, N.A. (2012) How to make almost anything: The digital fabrication revolution. *Foreign Affairs*, November/December. Available at: http://www.foreignaffairs.com/articles/138154/neil-gershenfeld/how-to-make-almost-anything

Guallart, V. (2012) *La Ciudad autosuficiente: Habitar en la sociedad de la información*. Barcelona: RBA Libros.

Martha Payne's blog. Available at: http://neverseconds.blogspot.com/

Mitchell, W.J (2003) *Me++: The Cyborg Self and the Networked City*. Cambridge, MA: MIT Press.

Nowak, P. (2010) *Sex, Bombs and Burgers: How War, Porn and Fast Food Created Technology As We Know It*. Toronto: Viking Canada.

Rifkin, J. (1995) *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market Era*. New York: G.P. Putnam's Sons.

Tapscott, D. (2008) *Wikinomics*. New York: Penguin.

About the author

Tomás Diez is a Venezuela-born urbanist who specialises in digital fabrication and its implications for future cities. He is the director of the FAB City project at the Institute for Advanced Architecture of Catalonia (IAAC) (http://www.iaac.net), one of the initiators of the Fab Lab Barcelona (http://www.fablabbcn.org) project, and a PhD researcher at University College London (http://www.cities.io). He holds a Bachelors in Urban Planning and Sociology from the University Simón Bolívar, a Masters in Advanced Architecture from IAAC, and a Diploma in Digital Fabrication from the Fab Academy Program at the MIT Center for Bits and Atoms (http://www.fabacademy.org), with which he works as a close collaborator in the development of the Fab Lab Network worldwide with the Fab Foundation. He is co-founder of the Smart Citizen (http://www.smartcitizen.me) project and StudioP52 (http://www.studiop52.com), both in Barcelona, and is the co-chair of FAB10, the 10th international Fab Lab conference. His research interests relate to the use of digital fabrication tools to transform reality, and how the use of new technologies can change the way people consume, produce and relate with each other in cities.