The Impending Revolution in Urban Planning Practice: Intelligent and automated, but will it be garbage in, garbage out?

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Synopsis

New technologies promise plans for new cities in months and planning permits in an instant, revolutionising the relationship between the national or provincial legal framework and more local integrated planning. Combined, they will create a revolution in urban planning, but will the outcome be “garbage in, garbage out”?

Abstract

UN population forecasts translate into a need to build three complete new cities the size of Brisbane every month for the next thirty-five years. Mostly in the massive arc stretching from northern Africa through the Middle East, and across all of Asia to Oceania.

Current planning systems struggle to produce quality plans for new urban areas at anything like that rate. Notwithstanding geographic information systems, on-line lodgement and word processing, plan making techniques and approvals processes have barely changed over the last hundred years: start with a metropolitan planning strategy, convert this to local statutory ‘land use zoning’ plans, prepare detailed master plans for new or regenerating areas and then pass these to surveyors and civil engineers for implementation (engineering design, procurement and construction). But each step takes two to five years. Typically, planning takes something like ten years from initiation to a significant level of development on the ground, but only if each plan in the chain is good enough to achieve political support and be implementable. If not twenty years is still a ‘good’ result.

After the planning is done and the infrastructure is underway the planning approvals process kicks in, a process so fraught with complexity and value judgements that development application delays are the bane of every architect and developer. In some places all aspects of urban planning and design are subservient to the statutory process, when it should be the reverse.

The one advantage of this slow grind is that it allows for extensive community, peer, political and judicial review: a net of safeguards against dangerous and inappropriate development.

However, to house an additional 3 billion people in cities by 2050 administrations seeking to manage urban development and population growth in a resource efficient and environmentally sensitive manner will increasingly turn to recent innovations that are already being deployed piecemeal around the world, e.g.:

- Daily satellite imagery;
- Drones;
- Big data, powerful algorithms and deep learning;
- Transect based planning;
- Form based codes; and
- Automated applications approvals software.

These and other technologies, if properly integrated, promise plans for new cities in months and planning permits in an instant, revolutionising the relationship between the national or provincial legal framework and more local integrated planning, but at the cost of many existing safeguards. Combined, they will create a revolution in urban planning, but will the outcome be "garbage in, garbage out"?

Keywords

urban planning, big data, transect planning, approvals software

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The Impending Revolution in Urban Planning Practice: Intelligent and automated, but will it be garbage in, garbage out?

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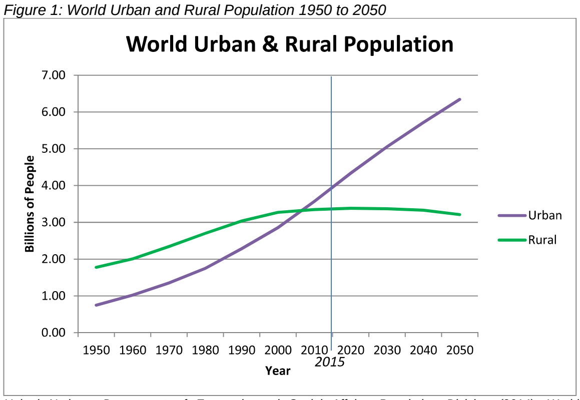
Increasing Urban Population

In 1950 three quarters of a billion people lived in large towns and cities, or 30% of the total world population of over 2.5 billion. In 2009 this had grown to 3.42 billion, just over half of a total population of over 6.8 billion. The United Nations Secretariat forecasts (see fig. 1 below) that by 2050 6.4 billion, 67% of a total of almost 9.6 billion people will live in urban areas.

Figure 1: World Urban and Rural Population 1950 to 2050



United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, custom data acquired via website July 2015 (see http://www.un.org/en/development/desa/population/)

Just over a third of that growth is expected to be in China, India and Nigeria, but the remaining two-thirds will be in the countries around those countries: a massive arc stretching from North Africa through the Middle East, across Asia and into the Pacific.

An additional 3 billion urban residents in forty years translates into a need to build a new city for a population of one million people, complete with hospitals, schools, workplaces, recreation and all the rest, at a rate of six a month, because:

1,000,000 residents x 6 cities x 12 months x 40 years = 3,080,000,000 residents

However, planners are more used to dealing with rates of growth than global population totals. From this perspective, an increase in urban population from 2009 to 2050 of 3.42 billion to 6.4 billion is a compounded annual increase of 1.54%, because:

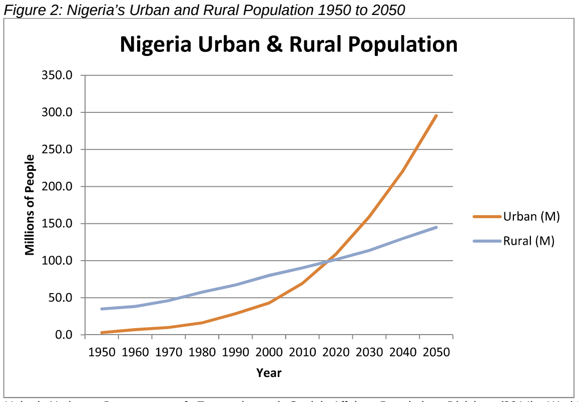
$$6,400,000,000 = 3,420,000,000 \times 1.0154^{41}$$

1.54% doesn't sound too difficult as a planning task, but of course it is envisaged that this growth will mostly happen in the rural areas of the world, not the already urbanised 'west'.

In Nigeria, for example (see fig. 2), the urban population growth from 2010 to 2050 is forecast to be 3.69% p.a., which is a much harder planning task. This is shown graphically at figure 2 and can be demonstrated mathematically as:

$$295,500,000 = 69,400,000 \times 1.0369^{40}$$

Figure 2: Nigeria's Urban and Rural Population 1950 to 2050



United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, custom data acquired via website July 2015 (see http://www.un.org/en/development/desa/population/)

Similarly, the total, national growth over the same period is forecast by the United Nations' Population Division at 2.57% and the rural sector at 1.19%. However, the rural growth will mostly be absorbed in incremental village expansion, the need to house the additional 226.1 million city dwellers, as expressed mathematically below, will be the main task.

295,500,000 – 69,400,000 = 226,100,000 residents
1,000,000 residents x 5.6525 cities x 40 years = 226,100,000 residents

One city of one million people, fully built and completed in 15 years is a very difficult task, so is planning and building five to six such cities each year for forty years in a country such as Nigeria an impossibility? Firstly, giving up is not an option, secondly the calculation above is a simplification, much of the growth will be incremental to existing cities, cities that have an existing governance and private enterprise capability to manage and deliver urban growth, but clearly it is still a massive task, and at the same time we have to manage and maintain the existing urbanism. There is also an ongoing requirement to replan to rectify past errors, to rebuild what was destroyed by war or natural disaster, and to replace that which can no longer be used, or which is no longer loved. As a consequence the figures above are a minimum. We should not be surprised if local demand assessments are fractionally higher, perhaps an additional five percent or more.

So, if giving up is not an option, current planning administrations that currently struggle to produce plans for new urban areas at anything like the rate required will need to implement efficiencies of at least one order of magnitude. What previously took ten years will need to be done in one. So, if currently it takes something like ten years from the initial instruction to identify to commencing construction on the ground then it will need to be achieved in twelve months instead.

The "3S" menace: scale, speed, and scarcity of means

"Let's start with the global challenge of urbanization. It's a fact that people are moving towards cities. and even if counterintuitive, it's good news. Evidence shows that people are better off in cities. But there's a problem that I would call the "3S" menace: The scale, speed, and scarcity of means with which we will have to respond to this phenomenon has no precedence in history. For you to have an idea, out of the three billion people living in cities today, one billion are under the line of poverty. By 2030, out of the five billion people that will be living in cities, two billion are going to be under the line of poverty. That means that we will have to build a one million-person city per week with 10,000 dollars per family during the next 15 years. A one million-person city per week with 10,000 dollars per family. **If we don't solve this equation, it is not that people will stop coming to cities. They will come anyhow, but they will live in slums, favelas and informal settlements**." [my emphasis]

Alejandro Arevena

Clearly this is a '3S Problem' as defined by Chilean architect Alejandro Arevena: a problem that is simultaneously large scale, requires a speedy response and must be dealt with by individuals or teams suffering a scarcity of means (see text box above and his TED Talk: *My architectural philosophy? Bring the community into the process*, posted Nov 2014), but it would be good if it was that simple, there are also climate change and technological innovation to consider as well.

Environmental Push Factors

It is neither my position nor my expertise to make any pronouncement on climate change, but it is my responsibility as an urban planner to assess how we should respond. So what should we respond to?

Firstly, it is clear that it is a global issue. The leaders of the world's nations and/or their relevant ministers will not be converging in Paris in November 2015 just for two weeks of theatre and sightseeing. "France will be hosting and presiding the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21/CMP11), otherwise known as 'Paris 2015' from November 30th to December 11th. COP21 will be a crucial conference, as it needs to achieve a new international agreement on the climate, applicable to all countries, with the aim of keeping global warming below 2°C." (COP21, 2 August 2015: http://www.cop21.gouv.fr/en/cop21-cmp11/what-cop21-cmp11)

Secondly, there are already reports (see text box below) of the impact of sea level rise on low lying islands, such as the Sunderbans, a vast archipelago in the delta region of the Bay of Bengal, partly in India and partly in Bangladesh.

Sea Level Rise in the Sundarbans

In a study conducted in 2012, the Zoological Society of London (ZSL) found out that the Sunderban coast was retreating up to 200 meters in a year.

Researchers from the School of Oceanographic Studies, Jadavpur University, estimated the annual rise in sea level to be 8mm in 2010. It had doubled from 3.14 mm recorded in 2000. The rising sea levels had also submerged around 7500 ha of forest areas. This, coupled with around 1.5°C rise in surface water temperatures and increased levels of salinity have posed a problem for the survival of the indigenous flora and fauna.

Loss of the mangrove forest will result in the loss of the protective biological shield against cyclones and tsunamis. This may put the surrounding coastal communities at high risk. Moreover, the submergence of land mass have rendered up to 6000 families homeless and around 70,000 people are immediately threatened with the same. This is causing the flight of human capital to the mainland, about 13% in the decade of 2000-2010.

A 2015 ethnographic study, conducted by a team of researchers from Heiderberg university in Germany, found a crisis brewing in the Sunderbans. The study contended that poor planning on the part of the India and Bangladesh governments coupled with natural ecological changes were forcing the flight of human capital from the region.

Already, Lohachara Island and New Moore Island/South Talpatti Island have disappeared under the sea, and Ghoramara Island is half submerged.

(Wikipedia 2 August 2015: *Sundarbans: 9. Climate change impact*)

Other island nations, such as the Maldives are also affected. The Intergovernmental Panel on Climate Change's 2007 report predicted the upper limit of the sea level rises will be 59 centimetres (23 in) by 2100, which means that most of the Maldive's 200 inhabited islands may need to be abandoned. (Wikipedia 2 August 2015, *Maldives: 3.2 Climate*)

Former Maldivian president Mohamed Nasheed, has stated, "If carbon emissions were to stop today, the planet would not see a difference for 60 to 70 years." "If carbon emissions continue at the rate they are climbing today, my country will be underwater in seven years."

Finally, the United Nations Higher Commission for Refugees commissioned a report on this issue. Its key findings are listed in the text box below.

Effects of climate change on human migration and displacement

- Climate change is already contributing to displacement and migration. Although economic and political factors are the dominant drivers of displacement and migration today, climate change is already having a detectable effect.
- The breakdown of ecosystem-dependent livelihoods is likely to remain the premier driver of long-term migration during the next two to three decades. Climate change will exacerbate this situation unless vulnerable populations, especially the poorest, are assisted in building climate-resilient livelihoods.
- Disasters continue to be a major driver of shorter-term displacement and migration. As climate change increases the frequency and intensity of natural hazards such as cyclones, floods, and droughts, the number of temporarily displaced people will rise. This will be especially true in countries that fail to invest now in disaster risk reduction and where the official response to disasters is limited.
- Seasonal migration already plays an important part in many families' struggle to deal with environmental change. This is likely to become even more common, as is the practice of migrating from place to place in search of ecosystems that can still support rural livelihoods.
- Glacier melt will affect major agricultural systems in Asia. As the storage capacity of glaciers declines, short-term flood risks increase. This will be followed by decreasing water flows in the medium- and long-term. Both consequences of glacier melt would threaten food production in some of the world's most densely populated regions.
- Sea level rise will worsen saline intrusions, inundation, storm surges, erosion, and other coastal hazards. The threat is particularly grave vis-à-vis island communities. There is strong evidence that the impacts of climate change will devastate subsistence and commercial agriculture on many small islands.
- In the densely populated Ganges, Mekong, and Nile River deltas, a sea level rise of 1 meter could affect 23.5 million people and reduce the land currently under intensive agriculture by at least 1.5 million hectares. A sea level rise of 2 meters would impact an additional 10.8 million people and render at least 969 thousand more hectares of agricultural land unproductive.
- Many people won't be able to flee far enough to adequately avoid the negative impacts of climate change—unless they receive support. Migration requires resources (including financial, social, and political capital) that the most vulnerable populations frequently don't have. Case studies indicate that poorer environmental migrants can find their destinations as precarious as the places they left behind.

(Dr Koko Warner, Dr Charles Erhart & ors: In search of shelter - Mapping the effects of climate change on human migration and displacement, United Nations University Institute for Environment and Human Security & ors, Nov 2009)

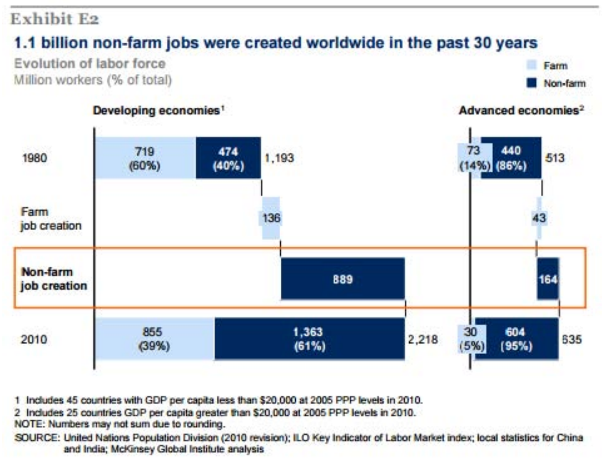
The report does not calculate the numerical effect of sea level rise, but it refers to a study by the International Organisation for Migration (Brown, Oli. 2008. *Migration and Climate Change.* International Organization for Migration: Research Series No. 31. Geneva: IOM) that estimates "IOM takes the middle road with an estimate of 200 million environmentally-induced migrants by 2050." as being 'middle of the road'. That's an additional 200 million-person cities required by 2050!

Economic Pull Factors

As I discuss later, technological innovation may give us some tools to help us in the response to these problems, but it must also be recognised that it is one of the contributing factors. Simply put, climate change is pushing people to the cities at the same time that technological innovation is pulling them in.

McKinsey's have calculated that in the thirty years from 1980 to 2010 1.1 billion new jobs were created in the non-farm sector, 900 million of these in developing economies, as demonstrated in exhibit E2 from that report reproduced below as figure 3.

Figure 3: The growth of urban jobs from 1980 to 2010.



(Dobbs, Richard & others, *The World at Work: Jobs, pay and skills for 3.5 Billion people, for* McKinsey Global Institute June 2012)

The report then goes on to detail massive skill gaps that will only be able to be solved by improving education standards, something that is only likely to happen with increased urbanisation.

The Situation

It is clear that Franklin's Law is as true today as when the great man first coined it: "If the poor folks are happier at home than they can be abroad, they will not be lightly prevailed with to cross the ocean." (Benjamin Franklin quoted at p 46 Zolberg, Aristide R., *A Nation by Design: Immigration Policy in the Fashioning of America*, Russell Sage Foundation.)

In summary, global population is increasing rapidly, environmental change, along with corrupt governments and conflicts in some parts of the world, are pushing poor people to migrate to already successful urban areas, while the employment growth in urban areas is pulling people towards those areas. This has led many countries to engage in urbanisation programs, notably India and China.

China's story is well known, "In 1978, less than 20 percent of China's population lived in cities; now the share is more than half. … China's urbanization is projected to reach about 70 percent—some 1 billion people—by 2030." (p3 *Urban China - Toward Efficient, Inclusive, and Sustainable Urbanization*, World Bank, 2014). With a strong, centralised government and an efficient public sector, China has implemented this plan without an unseemly rush to the cities, and has therefore averted the development of shanty towns, urban slums and the like.

However, India's urban slums are legendary, and nothing will stop the migration, so the strategy there is about improvement, as promoted in Indian Prime Minister Narendra Modi's vision of 100 smart cities (see fig. 4).

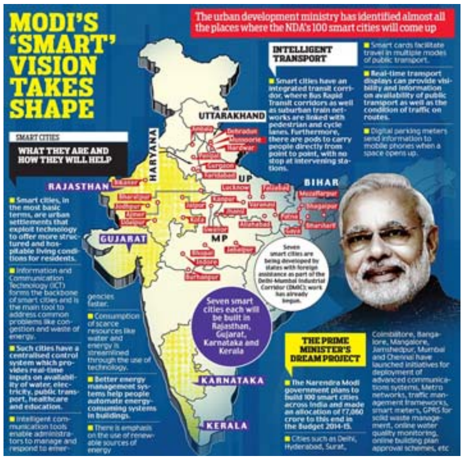


Figure 4: 100 smart cities for India

(Vikram, Kumar *Modi's vision of 'smart cities' takes shape as government commits to delivering first three hubs by 2019*. Mail Online India, 29 August 2014)

Wherever urbanisation occurs it usually leads to improved incomes, better education, particularly for girls, and subsequently falling birth rates and generally an improved quality of life. Which are all good outcomes, but they depend upon governments managing the process to minimise the bad outcomes: slums, sickness, fires, crime, riots, political instability and so on. To do this we, the urban planners and designers, need to help our governments by providing effective plans and then to administer them efficiently, in an environment where the task is of a massive scale, where it must be done at unprecedented speed and where, as always, there will be a scarcity of resources. All of these circumstances mean that a revolution in urban planning is now a necessity.

To achieve this we will be forced to adopt new technologies while ensuring that we make best use of our usually scarce resources.

Technological Innovation and Urban Planning

Whether or not humanity is approaching a knowledge singularity, it is clear that discovery and innovation are proceeding at a very rapid pace. So rapid that in preparing this paper I was aware of relevant new understandings, philosophic and scientific, and technologies at least weekly. Most of this information comes via digital media and informative television such as TED Talks and the BBC's *Click* program. The information technology journals are too difficult to follow for the layman, and there are too many of them to manage, while the professional planning journals seem not to be interested. I can see no solution to the dilemma of coping with the quantity of knowledge other than the development of a new specialisation within the profession, the urban planning technologist.

So what would an urban planning technologist be expert in? In order to give some structure to this analysis, I have grouped the items as follows:

- Technological innovation in satellite photography;
- Remote sensing and data;
- Technological innovation in the planning process; and
- The application of technological innovation in urban planning.

Technological Innovation in Satellite Photography

At the global level Google Earth has put aerial photography onto everyone's desktop, laptop, tablet and smart phone, but the resolution ranges from 15 metres per pixel for most areas of land to 150 millimetres per pixel in some frequently viewed urban areas and it is updated sporadically, every few years or so. It is very useful for virtual site visits or quick comparisons of places, but for more detailed purposes the in-house geographic information systems (GIS) are much more useful. Except of course that GIS is updated on a transaction basis, usually tentatively when something is approved and then permanently when the 'as built' drawings are received. Changes outside of this process are not recorded. These include illegal building works, minor structures that do not require approval, the growth and decline of vegetation, parking occupancy, increase and decrease of water bodies, and many other things. What if daily aerial photography was available? What if it was in infra-red as well as the normal spectrum?

The San Francisco based company *Planet Labs* was founded in 2010 as *Cosmogia Inc*. and its progress since then, according to Wikipedia is:

- April 2013, successfully launched two demonstration CubeSats, Dove 1 and Dove 2;
- November 2013, Dove 3 and Dove 4 were launched.

- June 2013, it announced plans for Flock-1, a constellation of 28 very small (4kg and 10x10x30 cm in size) Earth-observing satellites to provide daily imagery with a resolution of 3–5 m (9–15 feet);
- February 2014, Flock-1 CubeSats were successfully deployed from the International Space Station;
- May 2015, Planet Labs had raised a total amount of $183 million in venture capital financing;
- July 2015, Planet Labs acquired BlackBridge and its RapidEye constellation. BlackBridge was a German geospatial information provider focused on assisting in management decision-making through services based on their own Earth observation imagery. The company operated a five satellite constellation producing 5 meter resolution imagery over 4 million km² in 5-band color imagery every day.

Note that there is 149 million km2 of land on the surface of this planet, so 4 million km² every day equates to a refresh every 35 days. Planet Labs' has announced that it is working towards a flock of 131 satellites very soon. These will give whole earth coverage with good resolution in 5-bands and will be updated daily.

But the above is at only 3 to 5 metre accuracy, planners, and particularly urban designers need a much higher level of accuracy. This is where high precision computer modelling comes in. *GeoSim* (http://www.geosimcities.com/#02) has taken 14 sq km of Vancouver to 1cm per pixel and $^{+}$/.10 cm precision by using aerial photography and a LIDAR equipped car that stops every 20 m to take a complete scan. Uses include utility analysis, development visualisation, virtual visits for real estate marketing and on-line shopping, energy consumption, flood mapping, traffic forecasting, etc, etc. Their on-line simulation of flood waters entering the city is worth watching.

There are even more accurate digitisations than that. *Urban Circus* has modelled Melbourne's CBD to building information modelling (BIM) accuracy, that's $^{+}$/.5 mm, as shown in figure 5, below.

Figure 5: Melbourne Central Business District as a composite building information model

Image courtesy of Urban Circus <http://www.urbancircus.com.au/>

All technologies come with a cost in both time and money, but the trend is clearly towards every built structure and its natural landscape being able to be modelled to a precise level of detail. The issue is not cost, but how best to use it.

Finally, camera equipped, remote controlled, quadcopters, otherwise known as civilian drones, are now almost ubiquitous. Their utility in capturing aerial video as part of a planning tour is clear, but in this role they are probably a supplement to the frequent satellite photography and fine grained digital models discussed above.

Remote Sensing and Data

Along with the mapping of terrain and structures, more and more information is being stored on computers, but there are two important drivers that will make this useful to urban planners. The first is the rise in sensors and the second the increasing proficiency of machine learning.

Sensors are anything that can record data and transmit it in digital form to a computer. As well as satellite photography discussed above, these include weather stations, financial transactions, metadata about telephone calls, data from electricity grids, self-driving cars, customer preference data from on-line shopping, etc, etc. The mass of seemingly unrelated data is way too large to be processed by specific software routines devised by humans, it is a job for semi-intelligent machines.

“Machine learning is a branch of artificial intelligence, which itself is a branch of computer science. The general idea is that instead of instructing a computer what to do, we are going to simply throw data at the problem and tell the computer to figure it out for itself.” (Kenneth Cukier: *Big data is better data* TED Talks, Sep 2014.)

Stanford professor Arthur Lee Samuel (1901 – 1990) wrote the first version of the *Samuel Checkers-Playing Program,* the world's first self-learning program, in 1959. Essentially, the computer, an IBM 701, remembered what worked and didn’t and taught itself to maximise its winning opportunities. After a few improvements to the software, it was soon able to beat most amateurs and by 1970 it was good enough to challenge professionals. (https://en.wikipedia.org/wiki/Arthur_Samuel Wikipedia, 9 August 2015).

Going back to Google Earth, have you ever wondered how you can just type in an address for anywhere in the world and it will take you there? Initially Google used mapping data provided from GIS systems to create the addressing layer in their system, but this was slow and not all governments were cooperative.

Figure 6: Examples of house numbers from Google’s Street View.

379, 61, 972, 101,

26624, 98, 66, 175,

2, 2503, 205, 100

However, after their StreetView cars had taken images of most urban areas on the planet it was easy. They developed software incorporating complex algorithms that could identify the house numbers (see fig. 3) and then to read the numbers from the images. Reportedly, the software has automatically detected and transcribed close to 100 million physical street numbers at 98% accuracy, worldwide. Google engineers are reported as saying “We can transcribe all the views we have of street numbers in France in less than an hour." (http://www.technologyreview.com/view/523326/how-google-cracked-house-number-identification-in-street-view/ MIT Technology Review, posted 6 January 2014.)

So, while it might be difficult to get a planning agency to fund software that plays checkers, it would be much more likely to commission a satellite data company to give it a monthly report on actual changes to land use compared to permitted land uses, for example.

Technological Innovation in the Planning Process

Concurrent with the advances in satellite photography, sensor gathered big data and the use of machine learning to analyse that data, the geographic information systems (GIS) already established within government and local government are becoming ever more powerful in their application.

Trilogis, a specialist GIS application company in northern Italy (Chief Technical Officer, Guiseppi Conti presented at ISOCARP 2014), has developed and implemented in the Italian autonomous provinces of Trento and Polzano systems that mostly use existing GIS, to automate the planning and building application processes to the point where most of the assessment is carried out by the computer. In addition, other actions by other officers, for example utility works planned near the site of a new development, are automatically cross-notified.

There are many other innovations that space prevents me from describing. These include, but are not limited to pedshed mapping, social network mapping, comparative indexes of various kinds and so on.

The Application of Technological Innovation in Urban Planning

There is no doubt that the systems implemented by Trilogis and others will progress to the point where applications encoded in BIM formats will be assessed and approved or rejected automatically, but this opens up a question first asked of Charles Babbage, co-inventor of the Difference Engine, a mechanical calculator, in the 1820's:

> *On two occasions I have been asked, "Pray, Mr. Babbage, if you put into the machine wrong figures, will the right answers come out?"*
>
> (p. 67, Babbage, Charles: *Passages from the Life of a Philosopher*, Longman and Co. 1864.)

By the 1960's the answer to this question had been reduced to 'Garbage in, garbage out' (GIGO). In the fields of computer science and information and communications technology this refers to the fact that computers, since they operate by logical processes, will unquestioningly process unintended, even nonsensical, input data ("garbage in") and produce undesired, often nonsensical, output ("garbage out"). This leads to what I consider to be the core challenge facing senior urban planners and designers today: the development of a coherent planning philosophy and concomitant practices that can adapt and absorb the technologies described above and produce good, workable plans quickly, so that the engineers, architects and landscape architects can design and build the urbanism required for an additional three billion people by 2050.

Thankfully, I think that the New Urbanism is a coherent philosophy and set of practices that has already demonstrated an ability to produce good urban outcomes, but the process of learning this set of practices is difficult outside of north America, and of course it must not only be learnt, it also needs to be adapted both to the locale and to the technologies that have or will soon impact on our profession.

The New Urbanism

The description of a whole philosophy of planning is a task requiring many books, not just part of one paper, so I will simply discuss three key breakthroughs pioneered by the New Urbanists and leave the interested reader to inspect the 1993 Charter of the New Urbanism at http://cnu.org/who-we-are/charter-new-urbanism and then read one of any number of books about the movement (e.g. Katz, Peter: *The New Urbanism – Towards an Architecture of Community*, McGraw Hill, 1994). Of the many innovations and improvements that can be attributed to the New Urbanism, the three that I have chosen are the charrette, form based codes and the rural to urban transect.

The Charrette

"A charrette is an intensive planning session [typically five days] where citizens, designers and others collaborate on a vision for development. It provides a forum for ideas and offers the unique advantage of giving immediate feedback to the designers. More importantly, it allows everyone who participates to be a mutual author of the plan." (CNU http://cnu.org/resources/tools 10 August 2015).

Before the charrette a planning process could take many years, but following its introduction most projects that used this process properly reduced their time frame to eighteen months or even less. Typically this comprises a month to six weeks to identify the expert studies required (environment, flooding, heritage, noise, social, traffic, etc.) commission the sub-consultants and allow them two to three months to complete their studies and write their reports. Concurrently, mapping is assembled, stakeholders identified, they and the general public informed, venues booked and so on. In total this takes four to six months after which the planning is conducted in about one week, interactively with the public and stakeholders. Thereafter it takes another four to six months to refine the drawings and write up the process after which the proposed plan usually requires formal advertising and political deliberation, say a further six months.

Clearly future time savings are unlikely to be in the one week charrette that is the main part of the 'planning' element of the process. We need instead to concentrate on intelligent methods to use satellite photography and other sources of data to produce the specialist inputs into the planning process within a few weeks rather than months. Similarly, the writing and fine-drawing process needs to be automated or conducted concurrently with the charrette. Many charrettes already employ a professional illustrator and photographer during the charrette, there is no reason that professional planning report writers and planning draughtsmen cannot be included too. Finally, on-line opinion polling pushed to the community has the potential to shorten the formal approval process. Although it should be noted that no planner should accept a 51% result, anything less than 80% of the relevant community in favour probably means that the plan is suspect. In total, the use of new technologies and better management of the process has the potential to reduce plan making to less than six months, including formal approval.

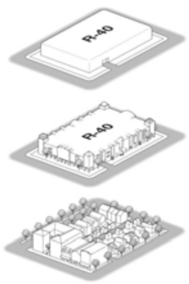
Finally, regarding charrettes, they are not for the faint-hearted, they expose the planning director to considerable professional risk, so s/he must ensure that the charrette leader and his/er team are suitably qualified and experienced (e.g. NCI certified).

Form Based Codes

Many statutory planning systems use land use as their primary organising principle and then control built form by regulations specific to particular land uses. From the town of Seaside (1981, by Andre Duany and Elizabeth Plater-Zyberk of DPZ, Miami, USA for Robert Davis) onwards the New Urbanists have instead regulated built form first and then controlled land use, as necessary, by specific regulations. This approach, in my opinion, has repeatedly demonstrated simpler regulation and better urban outcomes.

As with any statutory planning technique there is a lot of 'devil in the detail', but in essence "Form-based codes address the relationship between building facades and the public realm, the form and mass of buildings in relation to one another, and the scale and types of streets and blocks. The regulations and standards in form-based codes are presented in both words and clearly drawn diagrams and other visuals. They are keyed to a regulating plan that designates the appropriate form and scale (and therefore, character) of development, rather than only distinctions in land-use types." (CNU http://cnu.org/resources/tools 11 August 2015).

Figure 9: Illustration of typical outcomes from three coding paradigms.



Conventional Zoning
Land use, density (typically by floor area ratio), setbacks, parking requirements, maximum building heights specified.

Zoning + Design Guidelines
Land use zoning requirements as above, plus frequency of openings, surface articulation and similar cosmetic specifications.

Form-Based Codes
Built form specified, typically by street function, supported by specific build-to lines, numbers of floors, and percentage of built site frontage.

(adapted from the Form-Based Codes Institute http://formbasedcodes.org/definition, 11 August 2015)

Importantly, most aspects of a form based code have the potential to be translated into algorithms (by an urban planning technologist) that can test a digitally lodged application in a recognised BIM format, so this is certainly an area worth exploring. However, when combined with transect based planning, form based codes are even more powerful.

The Transect

The use of the transect as a framework for spanning environmental analysis, urban existing conditions analysis and to provide a descriptive framework as an integral part of an urban plan was first published in the American Planning Association Journal in 2002 (pp 245-266, Duany, Andres & Talen, Emily *Transect Planning, APA Journal, Summer 2002, Vol 68, No. 3).* I was first introduced to it by Andres himself the year that article was published. His company, DPZ were engaged by a developer to prepare a plan for a 112 hectare green fields project in the northwest corridor of metropolitan Perth known as Jindee and I was then the Executive Director for Local and Regional Planning with the Western Australian Department of Planning and Infrastructure. Jindee is still a live project and notably the website even describes the masterplan by a drop down menu listing only the shorthand for the transect elements: “T1”, “T2”, “T3”, etc. (see http://www.jindee.com.au/main.html).

Many useful images, including figures 7 and 8 below, and the latest version of SmartCode *The SmartCode v9 and Manual*, the document aligning its use to the United States context are available from the Centre for Applied Transect Studies website (see http://transect.org/index.html).

From before 2002, the transect has been used as a basis for urban survey, planning and regulation of everything from road design to hours of operation in the entertainment industry. In Al Ain we used it to better understand the structure of the city, so it is certainly also applicable to the desert cities of the gulf states.

Figure 7: European Transect – Oblique Aerial Sketch

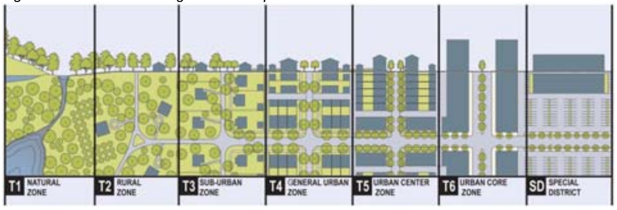
Title: Calibrated Transect Illustration
Source: Leon Krier

(Centre for Applied Transect Studies 2008)

The CNU website describes it thus: “Naturalists use a concept called the transect to describe the characteristics of ecosystems and the transition from one ecosystem to another. Andres Duany has applied this concept to human settlements, and since about 2000 this idea has permeated the thinking of new urbanists. The rural-to-urban Transect is divided into six zones: core (T6), center (T5), general urban (T4), sub-urban (T3), rural (T2), and natural (T1). The remaining category, Special District, applies to parts of the built environmental with specialty uses that do not fit into neighborhoods. Examples include power plants, airports, college campuses, and big-box power centers.

“The Transect is useful for designing and developing what Duany calls “immersive environments”: urban places in which the whole is greater than the sum of its parts. Duany Plater-Zyberk & Company describes the concept thus: ‘The Transect arranges in useful order the elements of urbanism by classifying them from rural to urban. Every urban element finds a place within its continuum. For example, a street is more urban than a road, a curb more urban than a swale, a brick wall more urban than a wooden one, and an allee of trees more urban than a cluster. Even the character of streetlights can be assigned in the Transect according to the fabrication from cast iron (most urban), extruded pipe, or wood posts (most rural).’”

Figure 8: The standard diagrammatic representation of the rural to urban transect.



(Centre for Applied Transect Studies 2008)

Physical Resources – The Planning Staff

Finally, whatever the technologies used, there will always be a need for trained urban planners and designers to apply them to the process of synthesising the situation and the analysis that we know as "plan making."

The resources applied to planning depend upon many local factors, not least of which are the relevant laws, but in my experience most of these factors can be subsumed into one constant, the size of community that one local government planer can manage if it is growing at 1% a year. Let us call this population the single planner population (SPP). For example, assume that this factor is constant for any particular state then the number of planning staff (S) will be given by the population (P) and the rate of growth, actual or desired, whichever is the greater, (R) as follows:

$$S = \frac{P \times R \times 100}{SPP}$$

So if SPP, the population that requires one local government planner to manage it effectively and efficiently if it is growing at only 1%, is 12,500 then:

$$S = (12{,}500 \times 0.01 \times 100)/12{,}500$$
$$S = 1$$

Scaling this up to a city of 1,000,000 growing at 1.5% we get a staff requirement of one hundred and twenty, as follows:

$$120 = (1{,}000{,}000 \times 0.015 \times 100)/12{,}500$$

Clearly, the same city, growing at twice the rate, requires twice the staff, because

$$240 = (1{,}000{,}000 \times 0.03 \times 100)/12{,}500$$

Finding the value of the single planner population (SPP) for any jurisdiction is simply a matter of auditing all planning organisations in that jurisdiction and taking the average (of course the audit has to normalise for consultant budgets and professional-to-support staff ratios in order to ensure an accurate comparison). As always there will be special cases and varying preferences for in-house teams over consultants, but in my experience this simple formula gives remarkably consistent results.

Unfortunately, budget makers rarely recognise that in town planning increased size and/or rate of growth creates more problems, not fewer, and therefore this ratio is constant. Cities exist because they give economies of scale, but in the planning of a city there are no economies of scale.

These same budget makers might also express a tendency to assume that technologies such as automated approvals will allow a reduction in staff. However, if this is done I am confident that the "garbage in, garbage out" rule will quickly assert itself and more planners, rather than fewer, will be required to sort out a mess that we do not have the time to deal with. It would be much more prudent to redeploy statutory planners to planning, urban design and as urban planning technologists in order to ensure that the plans that are being converted into computer algorithms are sound, and that the outputs are audited for consistency with those plans.

If there is a short-term spare capacity in planning staff then it would be wise of an agency (or group of agencies) to send them to undertake projects in less privileged jurisdictions. Revising Franklins Law slightly: "If poor people are able to move to nice towns and cities in their own countries, they will not be likely to seek refuge in ours."

Conclusions

Urban planners and designers are faced with the task of housing an additional three billion people in towns and cities by the year 2050. This is the equivalent of building six one million-person cities every month for forty years. If climate change displaces another 200 million people the task will be that much greater. It is truly one of Alejandro Arevena's "3S Problems": a problem that is simultaneously large scale, requires a speedy response and must be dealt with by individuals or teams suffering a scarcity of means.

Compounding this problem, but also demonstrating that it might be part of the solution, the developing economies are generating large scale employment in their urban areas, some 900 million jobs in the thirty years from 1980 to 2010, but most of these jobs require the level of education that only a well-designed and managed large town or a city can provide.

China, since the 1980's, and India more recently have recognised this issue and responded with massive city building or urban improvement programs, but only one-third of the additional three billion new urban dwellers are expected to be in China, India and Nigeria, the remaining two-thirds will be in the countries around those countries: a massive arc stretching from North Africa through the Middle East, across Asia and into the Pacific.

Clearly, if massive new urban areas are required very quickly, the planning process must be fast and reliable, and conducted within, or for, efficient well managed planning agencies. This requires not only the adoption of all that the new technologies have to offer, but also the development of a plan making paradigm that optimises the application of that technology in a way that produces good urbanism. In short a planning paradigm that avoids the possibility of "garbage in, garbage out".

The most significant advances in the understanding of urban areas and in the practice of producing good urban planning, and built outcomes, has been by the movement known as the New Urbanism. Three of these advances, the charrette, form based codes and transect planning are particularly relevant.

Many planners are already familiar with the two-fold improvement in efficiency that a good charrette process provides. Firstly, by shortening the plan making process through simultaneously interactive and iterative plan preparation and secondly by increasing the level of support for the plan across all stakeholders and concerned citizens, thereby shortening the approval process.

However, it is the combination of transect based planning and form based codes that, in my opinion, gives the opportunity to develop the New Urbanism further towards a systemisation that simultaneously enables localisation, which is, perhaps, the core conundrum of urban planning across the ages. Success will enable automation of the approvals process with the possibility of some eighty percent of applications being approved, almost instantaneously, on-line.

If it is feasible to shorten the plan making process and the development approvals process then perhaps we can, collectively as a profession, enable from now to the year 2050, an additional three billion people to live, learn, work and play in good, new cities and towns. Perhaps some of these cities will even stand the test of time and become the great cities of the Twenty-first Century!