The Mega Cities, The Smart Cities, The Sustainable Cities

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Introduction

Modern science dates the Agricultural Revolution to about 12,000 years ago. *Homo sapiens*, hunters and gatherers for the previous 150 thousand years more or less, began to cultivate wheat which bound them to the land due to seasonal demands of planting, nurturing, harvesting and storage of grains. Instead of roaming over large areas they began to settle into shelters and eventually into villages. The success of the new paradigm of living resulted in collective labor arrangements that led to community security and social cooperation. A logical extension of industry and commerce was development of the city which, in turn has led to innovation, invention, social advancement and, in some views, prosperity.

Social scientists, historians and anthropologists may differ as to the value of urban life to the advancement of *homo sapiens*, but the studies continue and predictions persist. What is the ultimate future of the city – will it prosper to a point of security and happiness for all, or will the city, by concentrating all its environmental and biological risks into ever more clustered areas spell the end of civilization as we know it? In short, is the city sustainable?

In fact cities have become the preferred living arrangement for a majority of the World's population, evolving into what are called Mega Cities. The marvel of the internet in this digital age with its possibilities of instant communication and immediate control of most or all functions of *homo sapiens* now in the 21st century, are expected to develop the Smart Cities for a majority of us which in turn will make urban sustainability possible a mere 12,000 years after we had begun living and working together: the Sustainable City.

The Mega Cities

A mega city is defined as an urban area of 10 million population or more. The Economist magazine's "*Pocket World in Figures,* " 2016 Edition, listed 33 mega cities of the world from Bangalore, India at 10.1 million, thirty-third on the list, to number one Tokyo, Japan at 38.0 million.

The United Nations, in *The Worlds' Cities in 2016*, reported that in 2014 54% of the world's people lived in urban areas, up from 34% in 1960. The tipping point, according to most authorities, occurred in 2007 when there were more urban dwellers than rural residents in the world: the so-called "urban millennium." The United Nations organization, DESA, predicts that by 2050 66% of the world's population will live in urban areas. Some scientists see this trend to the cities negatively for its concentration of the huddled masses and slum conditions and its

effect on the environment with concentrated air and water pollution. UN ECE reports that cities account for 80% of the world's GDP but 70% of global greenhouse gases.

Edward Glaeser, in *Triumph of the City,* claims that cities are the healthiest and richest places to live. New Yorkers (18.6 million) live longer and have a lower incidence of heart disease and cancer than other Americans, for instance. "Urban growth is a great way to reduce rural poverty," he says and "cities aren't full of poor people because cities make people poor, but because cities attract poor people with the prospect of improving their lot in life." Cities have been "the engines of innovation since Plato and Socrates," he argues and points to Florence, the site of the Renaissance and Birmingham that gave us the industrial revolution.

Alex Krieger, in *City On A Hill,* quotes two authors' opinions contrary to Glaeser's optimistic view of the cities: "(T)o the few the great city gives all, to the millions it gives annually less and less," wrote Clarence Sein in *Survey Graphic.* Steven Johnson, in *The Ghost Map* suggested that the very idea of building cities on the scale of London was a mistake citing tuberculosis, typhoid fever, infant mortality and other evils of crowding and unsanitary conditions of the city.

The 2016 World Bank Land and Poverty Conference addressed the issue. Paul Romer, an NYU professor and keynote speaker at the conference, offered his views on the role and future of the expanding cities. His main thesis was that land must be set aside for arterial work – roads, grid, infrastructure – before the expansion of the city; that land should be held until roads are needed. In other words, as he said, "Let them come and they will build it." In the early years it will be messy until water and sewer systems are built, but let people build. If corridors are protected, even bad use of the adjoining land can be retrofitted, but you can't retrofit roads over built-up areas.

Romer is especially irked by what he calls an artificial scarcity of land due to over-regulation, inflated land values and political barriers. (He doesn't like zoning.) Scarcity creates hoarding of land and inflated costs. The solution is to make land available without limit. People will not be squatters if they have the opportunity of access to land. Containment, i.e., artificial barriers to growth, is wrong.

People should be attracted to the city according to Romer. There is more potential wealth for city dwellers than in rural areas. If people leave the farm and move to the city there will be fewer people doing the farming and the income of those left behind will be greater. It is win/win according to Romer.

It should be noted that both Paul Romer and Edward Glaeser are economists, not social scientists, environmentalists, planners or politicians. Their views on the management of city growth may not be widely accepted. But their ideas are intriguing and worth thinking about as the world turns inexorably to the cities.

So, what has all this to do with the so-called "smart cities" of the future and are the smart cities sustainable?

The Smart Cities

One theory is that cities will become "smart" when their activities and responsibilities become interconnected. Traffic, parking, public transportation, public housing, public security, waste management, lighting, utilities, and so on are to become managed via the *internet of things* (IoT). There is to be real-time telemetric reporting of everything going on in the city so that everything can be timely managed according to this theory. Public safety, library use, trash pickup, street potholes and street lights will be monitored along with traffic entering and leaving urban areas with smooth and efficient intersection and parking management. Situations needing response and correction will be responded to and corrected immediately rather than at the next weekly city council meetings and eventual DPW assignment.

This scheme suggests an array of sensors and data collectors distributed throughout the city to be monitored at a central control facility from which instructions can be issued reacting to situations, as indicated. The monitoring and reacting process suggests an application of *artificial intelligence* (AI) yet to be developed on an urban scale. A key element will be in the monitoring and control of traffic. The urban Internet of Things must connect cars, trucks and buses that will also be fitted with sensors measuring location, heading and speed that can be communicated not only to a central command module but from vehicle to vehicle.

Geoffrey A. Fowler, a tech columnist for the *Washington Post*, reports that for the 2020 model year most new cars sold in the US will come with built-in Internet connections. (General Motors began connecting to OnStar services in 1996.) The category of data to be processed in this system includes vehicle location, vehicle performance and driver behavior with the intent to monitor vehicle mechanical performance, to improve safety and to help design future products and services. The aims of the automobile industry are to be integrated with the development of the smart city. All that is required for this interconnectivity is innovation in the e-industry, the political will and the acceptance and support of the public. (A current controversy rages in the U.S. between the auto industry and independent mechanics over access to the data in the many computer systems in modern cars.)

An article in *The Urban Technologists*, February 1, 2016 reported the endless conferences and reports about Smart Cities but that "very few of them tackle the issues of financing, investment and policy." The article observes that "…because Smart Cities are usually discussed as projects between technology providers, engineers, local authorities and universities the ordinary people who vote for politicians, pay taxes, buy products, use public services and make business work are not even aware of the idea let alone supportive of it."

People are, however, expressing a growing disaffection with one aspect of IoT as it is being used in the emerging smart cities. There is a growing suspicion and rejection by the public of AI devices such as image recognition software being installed on public streets to assist in crime detection and enforcement. It is not only a matter of privacy invasion, but a reported failure of the devices currently in use. High rates of miss-identification have brought the technology into serious doubt and public rejection. (Facial recognition algorithms have apparently not developed the ability to distinguish characteristics of certain racial groups dependably.)

A somewhat more implicit concern is over the provenance and use of the large amounts of personal data to be collected by e-systems in urban management, and to the extent to which all this "big data" becomes available to commercial interests and the ubiquitous "corporate intelligence." In response the European Union has adopted the General Data Protection Regulation in an attempt to keep companies from collecting and sharing personal data without an individuals' consent. In the United States, the state of California has recently passed a new Consumer Privacy Act intended to grant consumer privacy while giving consumers a process to delete their personal data from various platforms.

The more active and compelling use of the IoT and AI systems may be in the urban traffic management and control systems. The passive systems, like traffic light controls and best-route messaging to drivers will be accepted by the public with little incident or objection. However, the systems that involve direct control of cars and trucks, external to the vehicles themselves, are likely to be problematical. The most sophisticated system in the most critical of transportation units – aircraft - have proven to be subject to failure due to a variety of issues, including faulty input of situational information, system sensitivity and operator failure. All three of these "issues" contributed to the recent crashes of Boeing's 737Max aircraft resulting in 346 deaths of crew and passengers. Such failures in urban traffic control systems may amount to less dramatic events and the occasional fender-bender but public trust and reliance is sure to suffer.

As for autonomous vehicles in urban environments, the success of these systems will depend upon an exclusivity of self-controlled units on the roads and highways. A mix of driver-operated vehicles and autonomous units is a guarantee for failure. Even with flawless operating and safety systems in the autonomous vehicles (AVs), there is no algorithm capable of dealing with inattention, impatience, impetuosity or road rage of the in-control human driver. Highways and urban streets should be restricted to AV traffic and where vehicles are driven and controlled by humans AVs should be banned.

The Sustainable Cities

UN Sustainable Development Goal #11: "Make cities inclusive, safe, resilient and sustainable." For smart cities to attain sustainability there are several conditions that must be satisfied.

- The expansion of infrastructure into new neighborhoods must be anticipated and provided for; Paul Romer has called for the setting aside of land for arterial growth and utilities, for instance.
- Affordable housing for low and moderate income workers must be provided in the city and public transportation must be available to allow workers to reach centers of employment from their homes dependably and at reasonable cost.
- Privately owned and operated cars must be banned from city streets. All in-city traffic must be controlled and limited to public transportation, commercial delivery services and regulated ride-sharing services, including autonomous vehicles with no "drivers in control" at the wheel.
- All power generation must be from renewable energy sources. There is to be no more carbon-based generation of electricity whether for mechanical uses in buildings, heating or transport. The wind and sun will provide adequate power for the cities when battery

storage systems have been developed to the necessary capacity. Until then city services cannot be considered sustainable. (Nuclear power may provide the interim source of electricity generation, where politically acceptable. New systems, e.g., fuel cells, will no doubt appear in time.)

- Expansion of the city must follow carefully planned urban design allowing for appropriate density and location of residential, commercial, industrial, educational and research/development institutions.
- Commercial investment and expansion should be encouraged according to the capacity of city services and utilities.
- Public/private/partnership arrangements should be encouraged to provide financial investment and support where the ever-present shortage of public funding inhibits the expansion of public services and utilities.
- In order to be considered sustainable cities must prepare for natural events such as sea level rise (for coastal cities) earthquake occurrence (with restrictive building codes) evacuation routes (in case of massive destruction from fire or storm) and so on.
- Institutional determination is vital in order to enact the necessary policies.

The December, 2019 issue of *Civil Engineering*, a publication of the American Society of Civil Engineers, published an editorial stating that "Cities are leading the effort toward a more sustainable and resilient world …" and called for commitment to a "human-built and nature-based infrastructure that will thrive and survive in the post-climate change world." At an ASCE International Conference on Sustainable Infrastructure in November, the executive director of Global Covenant of Mayors (GCOM), a coalition of city leaders, reported that nearly 10,000 cities around the world have agreed to "do what they can to reduce their carbon footprints and build climate-change resiliency into their infrastructure projects."

The commitment of organizations like GCOM is what it will take to move us toward a world-wide development of sustainable cities but the effort will not be easy. In a new program called Global Climate City Challenge, launched by GCOM and the European Investment Bank (EIB), 145 cities in the southern hemisphere have applied for financial support for climate-change infrastructure project support. Only 20 of those provided the necessary information to secure consideration by the EIB. To date only 6 cities have received funding from EIB.

Observations

Public and political will plus institutional support will be required for the development of sustainability of the cities; there are tenacious and persistent obstacles. For instance, the UN *Atlas of the Oceans* reports that 8 of the top 10 largest cities of the world are located on the coasts of the seas and that 44% of the world's population live within 150 km of the coasts. Jeff Goodell, author of *The Water Will Come,* draws attention to a 2017 report by the US National Oceanic and Atmospheric Association that predicts global sea level rise of one to more than eight feet by 2100. According to Goodell 145 million people, globally, live at or less than 3 feet above current sea level. Faced with such a future what does sustainability of the cities mean? Does it mean relocation on a massive scale? Or does it mean a redirection of public funds away from civic concerns like education, public health, clean energy and expansion to emergency projects employing barriers, levies, gates and pumps to hold back the sea? Goodell recounts

one proposal by an American city mayor's office to raise the buildings and streets of Miami Beach by 2 feet. The U.S. Army Corps of Engineers has offered several options for multi-billion dollar storm surge barriers to protect lower Manhattan from future storms.

The problem with proposals to deal with sea level rise to protect cities *in situ* is that every physical solution can be overridden by sea level rise beyond the maximums predicted and provided for. Sea level rise will announce itself not with creeping maximum high tide levels, but with storm surges like Hurricane Sandy that struck New York City in 2012, flooding coastal residences, subways and building foundations. Following that storm major portions of the city still stood several feet above sea level, waiting for the next event.

When the sustainability argument entered the public discourse several decades ago it was used primarily in reference to ecology. Sustainability meant *the use of resources by this generation such that future generations would have adequate resources for their own needs*. What, in fact, is meant by sustainability when the concept is applied to a human invention of the scope of the megalopolis of ten million people subject not only to weather and geophysical events but to political caprice and conflicting social concepts? For the cities to attain sustainability will require more than the Internet of Things, Artificial Intelligence, renewable energy sources and control of urban transportation systems. It will require a cooperative combination of scientific, political, cultural and social effort by governments and private institutions at every level.

A related question is whether sustainability of the cities will mean a broadly distributed economic advancement for urbanites all across the socio-economic spectrum. Will the benefits of AI and IoT be felt by all segments of society, including workers whose jobs have been taken over by robots, and poor neighborhoods where affordable housing units have been upgraded by gentrification? Is disruption of the systems and activities of the cities by technological advancement a foregone conclusion we must accept in our advancement to sustainability of the cities?

In order for the mega cities to become sustainable they must first be smart, indeed.

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Biographical Notes

Robert W. Foster is a Registered Professional Surveyor and a Registered Professional Engineer (Civil) with over 50 years experience, having graduated from the University of Vermont in 1955 with a B.S. in Civil Engineering. Mr. Foster has specialized in offering professional consulting services in arbitration, dispute resolution, and litigation involving surveying and civil engineering issues. He is a past member of the Dispute Resolution Panel of Neutrals of REBA Dispute Resolution, Inc., a subsidiary of the Real Estate Bar Association of Massachusetts.

Mr. Foster is a past president of the American Congress on Surveying and Mapping and an Honorary President of the International Federation of Surveyors. He has provided professional testimony in litigation involving property disputes, appeals of permit denials, eminent domain proceedings, and professional negligence. He has testified before the United States Congress and the Massachusetts legislature on pending legislation and budgetary matters.

Mr. Foster grew up in Burlington, Vermont. Following his graduation from UVM he served for three years in the U.S. Air Force where he completed pilot training. He and his wife, Margot and their three sons relocated to Hopkinton, Massachusetts in 1959; he was employed by Schofield Brothers of Framingham, a consulting engineering company until his (semi)retirement in 1990. He may be reached at

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