2011

From Bricks and Mortar to Mega-Bytes and Mega-Pixels: The Changing Landscape of the Impact of Technology and Innovation on Urban Development

Patricia E. Salkin
Touro Law Center, psalkin@tourolaw.edu

Recommended Citation
42/43 Urb. Law. 11 (2011-2012)

From Bricks and Mortar to Mega-Bytes and Mega-Pixels: The Changing Landscape of the Impact of Technology and Innovation on Urban Development

Patricia E. Salkin*

AS MEMBERS OF THE ACADEMY PAUSE TO HONOR the magnificent achievements of our colleague Julian Juergensmeyer, it is appropriate to consider how technology has impacted the practice of urban development law over the span of Julian's career. The following short comparison puts the rapid pace of technological advancements in perspective: In 1963 Julian earned his law degree and the typical mode of telephonic communication was a touch-tone phone. Today, cell phones have become the more widely used method of communication, at least among the younger generations, with the speed of 3G and 4G networks competing for customer satisfaction. In 1963, the government implemented a system of zip codes for postal delivery. Today, people have email addresses to receive and send mail much more efficiently. In 1963 the pull-tab can was invented. Today, with the assistance of recycling technology there are deposits on cans and bottles and many have been removed from the solid waste stream. In 1963 the population of the United States was roughly 190,000,000 and today it is over 308,000,000. The cost of living has also significantly increased. For example, the average price of a home in 1963 was $3160, and the price tag today is about $232,880, creating serious housing affordability challenges. In addition, the average cost of a new car in 1963 was $3223 and a gallon of gas to fuel it was about 29 cents. Today, the average cost of a new car is $27,958 and the cost of an average gallon of gasoline is $2.73. While the merits of the social, economic and political costs and benefits of technology are subject to debate, it is clear that the technological innovations of the

*Patricia E. Salkin is the Raymond & Ella Smith Distinguished Professor of Law, Associate Dean and Director of the Government Law Center at Albany Law School. The author is grateful for the research assistance of Albany Law School students Zoran Kujulis, Robin Wheeler, and Alison Cohn, as well as staff attorney Amy Lavine.

last 50 years, from the creation of the internet to the development of computer technology, a multitude of advancements that resulted from exploration of space, and countless other scientific discoveries related to, among other things, energy and genetics, have affected nearly every facet of our everyday lives and its impact on urban development is no exception.

In considering some of the significant challenges in urban development planning and law over the last 60 years, it is apparent that many of the issues followed various technological innovations. For example, in the 1950s, most Americans did not own a car, but by 2008, most Americans owned 1.1 cars. Undoubtedly the Federal Highway Act of 1956 had a lot to do with the desire to own a car, but the automotive technology made it financially within the reach of many Americans. This increase in car ownership and vehicle miles traveled led to rapid suburbanization and sprawl resulting in myriad new land use regulatory techniques to deal with the growth of shopping malls, drive-thru establishments, big box retail, impervious asphalt parking lots and other issues.

Information is a key to enabling innovation. Technological advances have made new information in different formats available to urban planners, policymakers and lawyers. For example, satellite images of the Earth taken by NASA's Landsat program for the last several decades have allowed researchers to study and track changes on the Earth's surface caused by natural events and the growth of human cities and societies.[1] These satellite views of the planet have also enabled software companies like Google to provide accurate digital mapping software to everyday computer users, and this in turn has allowed members of the public to view their communities in ways previously impossible.[2] United States military technology, such as the Global Positioning System (GPS),[3] which has become available to civilian users, has changed the way people navigate and survey the land around them. The growth of the internet, and its ability to foster communication and provide people everywhere with easy access to vast amounts of information, has allowed for greater public participation in government. Greater public involvement in local government in areas such as zoning and planning

1. *See* Nat'l Aeronautics & Space Admin., Landsat Then and Now (Nov. 18, 2010), http://landsat.gsfc.nasa.gov/about/index.html.

2. *See* Google Maps, http://maps.google.com/ (last visited Nov. 23, 2010); Google Earth, http://earth.google.com/ (last visited Nov. 23, 2010); Mashable, Google Maps: 100+ Best Tools and Mashups, http://mashable.com/2009/01/08/google-maps-mashups-tools/ (last visited Nov. 23, 2010).

3. *See* Global Positioning System, http://www.gps.gov/ (last visited Nov. 23, 2010).

ensures that the development of urban communities will better represent the interests of its residents.

This essay discusses the impact of a number of significant technological advancements on the field of urban planning and development.

I. Elevator and Steel Technologies and Their Impact on Urban Architecture and Density

Skyscrapers were made possible due to the invention of the elevator and advances in steel manufacturing.[4] Together, these inventions completely changed the landscape of cities, and allowed for the concentration of business, residence, finance, and industry within the confines of a city.[5]

The first elevators were simple mechanisms to transport freight and construction materials, and have existed at least since the time of the Egyptians.[6] Hydraulic and then electric passenger elevators, in use since the mid-nineteenth century, made it practicable to construct buildings of increasing height.[7] Advances in elevator technology, to allow automatic

4. RODNEY CARLISLE, SCIENTIFIC AMERICAN INVENTIONS AND DISCOVERIES 223 (2004); Jean Gottman, *Why the Skyscraper*, 56 GEOGRAPHICAL REV. 190, 191 (1966) ("The multistoried building of considerable height was made possible by a remarkable contraption, the passenger elevator"); Nick Paumgarten, *Up and then Down*, NEW YORKER, Apr. 21, 2008, *available at* http://www.newyorker.com/reporting/2008/04/21/080421fa_fact_paumgarten?currentPage=all.

> Two things make tall buildings possible: the steel frame and the safety elevator. The elevator, underrated and overlooked, is to the city what paper is to reading and gunpowder is to war. Without the elevator, there would be no verticality, no density, and, without these, none of the urban advantages of energy efficiency, economic productivity, and cultural ferment. The population of the earth would ooze out over its surface, like an oil slick, and we would spend even more time stuck in traffic or on trains, traversing a vast carapace of concrete.

Id.

5. *See* sources cited *supra* note 4.

6. *See* CARLISLE, *supra* note 4 at 223; JAMES HENRY BREASTED, A HISTORY OF EGYPT: FROM THE EARLIEST TIMES TO THE PERSIAN CONQUEST 8, 18 (1905), *available at* http://books.google.com/books?id=OtyBAAAAIAAJ&printsec=frontcover&client=safari&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false; Paumgarten, *supra* note 4; Elevator World, The Elevator Museum Timeline, http://www.theelevatormuseum.org/timeline.php (last visited Nov. 23, 2010).

7. *See* CARLISLE, *supra* note 4, at 223 (explaining that prior to the introduction of the passenger elevator, few buildings were taller than five or six stories); JOSEPH J. KOROM, JR., THE AMERICAN SKYSCRAPER, 1850-1940: A CELEBRATION OF HEIGHT 62-66 (2008), *available at* http://books.google.com/books?hl=en&lr=&id=JVzYO1TyZ6AC&oi=fnd&pg=PA6&dq=THE+AMERICAN+SKYSCRAPER&ots=yi9vA_C5sj&sig=NNe8Iki6FKtY2HVEFn8uVufGU0Y#v=onepage&q&f=false; Gottman, *supra* note 4, at 191.

> The first elevators were hydraulic, and their rise was limited by the physical laws of the pressure of the water column. An elevator could be lifted by hydraulic force to a height of eighteen or twenty stories, but not much more than that, especially in the nineteenth century. To be liberated from this ceiling, architecture needed the electric

service, were accompanied by architectural and materials innovations that permitted structures to be built higher than simple masonry would permit.[8]

More recently, advanced steel fabrication techniques have made steel stronger, lighter, easier to shape, more corrosion-resistant, and longer lasting,[9] and innovations in reinforced concrete have increased its compressive strength more than three times.[10] Elevators, however, continue to be a significant limit on building height. If there are too many elevators, the ratio of elevator space to habitable building space becomes economically unfeasible, but too few elevators will annoy building users and lower a building's value.[11] The sky lobby was introduced in 1973 in the World Trade Center as a sort of express transfer station, to facilitate the efficiency of vertical travel and reduce the need for additional elevator banks.[12] Smart elevators, using "destination dispatch" systems, have also helped to improve elevator efficiency in recent years by coordinating passengers' desired floors and limiting the number of stops made by any given car.[13]

Skyscrapers and high-rise buildings have brought changes to urban planning and development law over the last half-century, allowing property to be developed at higher densities and reshaping the character of downtown commercial districts. Cities have responded to the

elevator, which made its appearance about 1887. From then on, the height to which people could be lifted mechanically was no longer restricted by physical laws, and the sky became the limit.

Id.

8. *See* KOROM, JR., *supra* note 7, at 131-235 (discussing early structural techniques for constructing tall buildings); Gottman, *supra* note 4, at 191; Georgette C. Poindexter, *Light, Air, or Manhattanization?: Communal Aesthetics in Zoning Central City Real Estate Development*, 78 B.U. L. REV. 445, 452-53 (1998).

9. *See* Am. Iron & Steel Inst., The New Steel: Feel the Strength 1, http://www.steel.org/AM/Template.cfm?Section=Fact_Sheets4&CONTENTID=25996&TEMPLATE=/CM/ContentDisplay.cfm (last visited Jan. 28, 2011).

10. *See* Blaine Brownell, *The Age of Concrete*, N.Y. TIMES, Mar. 12, 2010, at A19, *available at* http://www.nytimes.com/2010/03/13/opinion/13brownell.html?scp=1&sq=skyscraper%20residential&st=cse (discussing the Burj Khalifa, the world's current tallest building, which was constructed with reinforced concrete rather than steel).

11. *See* Paumgarten, *supra* note 4; Roger Hawkins, *Elevator Core Areas: a Comparison With Existing Structures and Those of the Future*, ELEVATOR WORLD, Oct. 28, 1998, *available at* http://www.elevator-world.com/magazine/archive01/9811-002.html-ssi.

12. *See* Paumgarten, *supra* note 4. Sky lobbies have also been proposed with special air pressure controls to allow people to use vertical transportation more quickly without hurting their ear drums. *See* James Gleick, *Vertical Reality*, N.Y. TIMES, Oct. 27, 1996, *available at* http://www.nytimes.com/1996/10/27/magazine/vertical-reality.html?pagewanted=1.

13. *See* Paumgarten, *supra* note 4.

technological advances allowing for ever-higher buildings in different ways, with different results. In Washington, D.C., for example, building height limits enacted in 1910 have remained mostly unchanged.[14] The result of limiting building space in the downtown area has been to push development toward suburban areas in Maryland and Virginia, where tall office and residential towers are permitted.[15] Regulations enacted in San Francisco were intended to promote smaller, tapered towers, with light-colored exteriors, interesting surfaces, and sculpted rooftops.[16] Chicago, taking another approach, has no height limit for buildings. It restricts bulk through the use of floor area ratios, and permits density bonuses for development amenities such as arcades, setbacks, and plazas.[17]

II. Transportation: The Automobile and Public Transportation Systems

Although suburban and exurban land use patterns are not completely dependent on personal automobiles and extensive road networks, the growth of America's car culture "has fundamentally restructured the pattern of everyday life in the United States."[18] This growth has been due not only to advances in vehicles[19] and materials technology,[20] but also to extensive federal investments in transportation infrastructure, most notably through the Federal-Aid Highway Act of 1956.[21]

By 2008, Americans owned 246 million cars.[22] The prevalence of the personal automobile led to a suite of suburban innovations in the latter

14. *See* Poindexter, *supra* note 8, at 454-55.
15. *See id.*
16. *See id* at 458-60. San Francisco's regulations also sought to confine skyscraper construction to certain districts. *See id.*
17. *See id.* at 463-65.
18. KENNETH T. JACKSON, CRABGRASS FRONTIER: THE SUBURBANIZATION OF THE UNITED STATES 247-48 (1985).
19. *See, e.g.*, Simon Marks, *Designing Cars for Low-Carbon Chic*, N.Y. TIMES, Jul. 9, 2008, *available at* http://www.nytimes.com/2008/07/09/business/worldbusiness/09greencar.html.
20. *See* U.S. Dep't of Transp., Technologies: Highways for LIFE, http://www.fhwa.dot.gov/hfl/technologies.cfm (last visited Nov. 23, 2010).
21. *See* Pub. L. No. 84-627, 70 Stat. 374 (1956); JACKSON, *supra* note 18, at 248-51; Richard F. Weingroff, U.S. Dep't of Transp., Federal-Aid Highway Act: Creating the Interstate System, http://www.fhwa.dot.gov/infrastructure/rw96e.cfm (last visited Nov. 23, 2010).
22. *See* Martin Mittelstaedt, *U.S. Car Ownership Shifts Into Reverse*, GLOBE & MAIL, Jan. 4, 2010, http://www.theglobeandmail.com/news/world/us-car-ownership-shifts-into-reverse/article1418860/.

part of the twentieth century, among them the shopping mall[23] and the drive-thru establishment—not just fast food restaurants, but also banks, liquor stores, and pharmacies.[24] Drive-thrus have become the subject of various zoning regulations, including formula-business restrictions[25] and outright bans.[26] Big box stores, another creature of the car culture, have also spurred the development of new sorts of zoning laws, such as retail store size caps, architectural and design requirements, franchise architecture and formula business restrictions, vacant store ordinances, and economic impact review requirements.[27] The increasing number of cars on the roads has also required an increasing number of parking spaces, and parking requirements have become one of the most important (and controversial) aspects of zoning.[28]

As it has become less expensive and more convenient to live farther from one's place of employment,[29] increased car ownership and usage have also led to changes in the distribution of urban, suburban, and rural land uses. This, in turn, led to the formation of various land use movements, such as smart growth and new urbanism, which were intended to curb sprawl and inefficient land use patterns.[30]

Automotive technology and other transit innovations will surely continue to shape land use and planning laws. As alternative energy vehicles become more common, regulations will be necessary for new alternative energy fueling stations. Planners will also be able to take advantage of the data made available through connected car networks and GPS.[31]

23. *See* JACKSON, *supra* note 18, at 257-61 (describing the evolution of the shopping center from early shopping strips to enclosed, climate controlled malls, and then to regional malls).

24. *See* Tom Vanderbilt, *We're Thru: Has the American Romance With the Drive-thru Gone Sour?*, SLATE, Dec. 11, 2009, http://www.slate.com/id/2238094/?from=rss.

25. *See* AMERICAN LAW OF ZONING § 18:68 (5th ed. 2010); Patricia E. Salkin, *Municipal Regulation of Formula Businesses: Creating and Protecting Communities*, 58 CASE W. RES. L. REV. 1251 (2008).

26. *See, e.g.*, Canada.com, Drive-thru Ban Mulled by Cities (June 24, 2008), http://www.canada.com/windsorstar/news/story.html?id=7240472a-ba6b-44f1-a115-1586a384d824.

27. *See* Salkin, *supra* note 25, at 1251.

28. *See* Michael Lewyn & Shane Cralle, *Planners Gone Wild: The Overregulation of Parking*, 33 WM. MITCHELL L. REV. 613 (2007).

29. But note, this trend may be changing. *See* Mittelstaedt, *supra* note 22.

30. *See, e.g.*, James A. Kushner, *Smart Growth, New Urbanism and Diversity: Progressive Planning Movements in America and Their Impact on Poor and Minority Ethnic Populations*, 21 UCLA J. ENVTL. L. & POL'Y 45 (2002).

31. *See The Connected Car: Cars Are Becoming More Connected, Both to Remote Systems for Navigation and Information, and to Each Other*, ECONOMIST, June 4, 2009, *available at* http://www.economist.com/node/13725743.

III. Green Building

Green building is a recent planning approach changing the face of contemporary development. The idea of "green building" began to form in the early 1990s after the American Institute of Architects (AIA) formed the Committee on the Environment.[32] The green building concept seeks to create structures which are environmentally responsible and resource-efficient throughout the life span of the building.[33] It focuses on using recycled building materials, energy efficiency, and reducing waste contributing to environmental degradation.[34] It also seeks to minimize the built environment's impact on human health by using clean forms of energy and development processes.[35]

Technologies that improve energy efficiency are at the heart of the green building initiative. Some of these energy efficient building techniques, such as passive solar design,[36] are by no means modern technological innovations. However, new energy efficient appliances, materials, and monitoring systems have proliferated in recent years. On-site renewable energy generators have also become more common as the technology has progressed and become more affordable.[37] These green building techniques have been standardized, to an extent, by the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, and the Energy Star rating system.[38] LEED and Energy Star requirements, in turn, have been included in many municipalities' zoning and building codes. Additional green building requirements, such as white/green roofs and water-efficient landscaping have been included as distinct requirements in some municipalities' zoning and building codes.[39]

32. *See* U.S. Envtl. Prot. Agency, Green Building Basic Information, http://www.epa.gov/greenbuilding/pubs/about.htm (last visited Nov. 23, 2010).
33. *See id.*
34. *See id.*
35. *See id.*
36. *See* Borimir Jordan & John Perlin, *Solar Energy Use and Litigation in Ancient Times*, 1 SOLAR L. REP. 583 (1979).
37. *See* U.S. Envtl. Prot. Agency, Greening EPA: Onsite Renewable Technologies, http://www.epa.gov/greeningepa/energy/renewtech.htm (last visited Nov. 23, 2010).
38. *See* Patricia E. Salkin, *Sustainability and Land Use Planning; Greening State and Local Land Use Plans and Regulations to Address Climate Change Challenges and Preserve Resources for Future Generations*, 34 WM. & MARY ENVTL. L. & POL'Y REV. 121, 155-62. However, municipal officials must be mindful of the variety of certifications and the legal and policy issues involved with directly mandating certain third-party standards in legislation.
39. *See id.* at 167-70.

IV. Geographic Information Systems (GIS)

Geographic Information Systems (GIS), which represent the grouping of databases and cartography, have proliferated along with the increased power and usability of computers, allowing governments, corporations, and other users to convert large amounts of data into specialized visual representations.[40] Originally developed in the 1960s,[41] GIS technology did not become widely adopted until computing power became faster and less expensive in the late 1980s and early 1990s.[42]

GIS has many commercial and government applications,[43] but it has been particularly useful to urban planners and land use decision makers because of its ability to provide new ways of analyzing geographic information. Local governments, for example, have integrated GIS with their land use review processes to streamline approvals, track projects, perform joint project analyses, produce more accurate maps, reduce the time needed to complete mapping tasks, and reduce redundant datasets.[44] It has been used to more efficiently manage street, water and sewer infrastructure,[45] and to help identify park locations and improve-

40. *See* Peter H. Lewis, *The Executive Computer; When Maps Are Tied to Data Bases*, N.Y. TIMES, May 28, 1989, at 10, *available at* http://www.nytimes.com/1989/05/28/business/the-executive-computer-when-maps-are-tied-to-data-bases.html?pagewanted=all; U.S. Geological Survey, Geographic Information Systems, http://egsc.usgs.gov/isb/pubs/gis_poster/ (last visited Nov. 23, 2010).

41. *See, e.g.*, David M. Mark et al., The GIS History Project (1996), http://www.ncgia.buffalo.edu/gishist/bar_harbor.html. Although it is unclear where and when exactly GIS first were started, it is undoubted that the Harvard Laboratory for Computer Graphics and Spatial Analysis has played an instrumental role in the development of GIS. *See id.* Beginning in 1965, planners, geographers, mathematicians, computer scientists, and experts from other fields converged at the Harvard laboratory to rethink thematic mapping, spatial analysis, and what is now called Geographic Information Systems. *See id.* The main force behind the project was Howard Fisher, who had studied architecture at the Harvard Graduate School of Design. *See id.* Fisher later conceived of an improved computer mapping program that he called SYMAP, which would later become the foundation for much of the Laboratory's work combining grid based databases and cartography into productive and usable computer programs. *See id.* Apart from SYMAP, other Harvard software programs which were equally important in the developing field of GIS and spatial data analysis were CALFORM (late 1960s), SYMVU (late 1960s), GRID (late 1960s), POLYVRT (early 1970s) and ODYSSEY (mid 1970s). *See* Nicholas R. Chrisman, History of the Harvard Laboratory for Computer Graphics: a Poster Exhibit, http://isites.harvard.edu/fs/docs/icb.topic39008.files/History_LCG.pdf (last visited Jan. 10, 2011).

42. *See* Lewis, *supra* note 40 (describing GIS as "a relatively new offshoot of a larger universe of computer systems called automated mapping/facilities management, which have been used for many years on mainframe computers.").

43. *See* ESRI, GEOGRAPHY MATTERS 4-7 (2008), *available at* http://www.gis.com/sites/default/files/docs/whatisgis/geographymatters.pdf; Mark et al., *supra* note 41.

44. *See* ESRI, GIS SOLUTIONS FOR COMMUNITY DEVELOPMENT 3-4 (2002), *available at* http://www.esri.com/library/brochures/pdfs/gis-sols-for-commdev.pdf.

45. *See* Scott Dompke, *City Nears Full GIS Implementation*, 124 PUB. WORKS 36 (1993). Bloomington's GIS feasibility study indicated that over a 15 year period, GIS

ments based on the geographic distribution of existing parks, natural resources, and socio-demographic characteristics.[46] Through the digitization of maps, GIS programs have also led to cost reductions in map printing.[47] GIS has also been used for such diverse planning research as measuring crime rates in the vicinity of public housing developments,[48] determining the location of "food deserts,"[49] and analyzing the effects of Census counts of prisoners on legislative redistricting and vote dilution.[50]

Today, GIS is no longer a niche field accessible only by experts, but is becoming more widely available through web-based tools.[51] State and local governments, recognizing that GIS can be used to facilitate services to residents and businesses, have begun to devise interactive tools. In Las Vegas, for example, a resident can find a city park for an event by selecting desired features on the city's website; the website returns matching park options with links to Google Maps.[52] Utah's state website reads visitors' IP addresses and then coordinates them with

technology could save the city as much as 25% of the $350,000 annual costs it incurred in its use of mapped and related geographic records. *See id.* The study also found that public services could be enhanced by increasing the speed and quality of personnel response to customer complaints. *See id.* GIS would also act as a cohesive mechanism to help plan, coordinate, and manage infrastructure operations, maintenance, and improvements. *See id.* GIS would work to establish a common, centralized geographic information processing tool that would avoid the anticipated proliferation of separate departmental solutions. *See id.*

46. *See* Bob Lee & Alan Graefe, *GIS: A Tool to Locate New Park and Recreation Services: New Technology Can Help Park and Recreation Managers Learn More About Their Park Users*, BNET, Oct. 2004, http://findarticles.com/p/articles/mi_m1145/is_10_39/ai_n6335483/?tag=content;col1. GIS use in outdoor recreation focuses on resource location and statistical analyses of measuring how far away parks are from local populations, while its use in urban parks and recreation focuses on the allocation of facilities, service planning and issues of how accessible the parks are and the socio-economic disparity of those placements. *See id.*

47. *See* Lewis, *supra* note 40.

48. *See* U.S. DEP'T OF HOUS. & URBAN DEV., A GUIDEBOOK FOR MEASURING CRIME IN PUBLIC HOUSING WITH GEOGRAPHIC INFORMATION SYSTEMS (1999), *available at* http://www.huduser.org/Publications/doc/crimegis.doc; Robert A. Hyatt, Measuring Crime in the Vicinity of Public Housing with GIS (1999), http://proceedings.esri.com/library/userconf/proc99/proceed/papers/pap124/p124.htm.

49. *See* ESRI, GIS Helps Provide Answers to Public Health Concerns in the City of London, Ontario: Inner-City Population Living in a "Food Desert," http://www.esri.com/news/arcnews/winter0809articles/inner-city-population.html (last visited Nov. 23, 2010).

50. *See* Prison Policy Initiative, Further research and methodology discussion on Importing Constituents: Prisoners and Political Clout in New York (Jan. 2005), http://www.prisonpolicy.org/importing/further.html.

51. *See* Tod Newcombe, *Gov. 2.0 Summit: GIS the Big Winner in Push for Open Government (analysis)*, GOV'T TECH., Sept. 11, 2009, http://www.govtech.com/gt/722260.

52. *See* Chad Vander Veen, *Web-Based Mapping Tools Help Governments Transform GIS Into New Services*, GOV'T TECH., Feb. 5, 2008, http://www.govtech.com/gt/241047?id=241047&topic=117676&full=1&story_pg=4.

links relevant to their physical location, providing local information such as public meeting schedules and maps of nearby parks, libraries, and schools.[53] A number of cities, including San Francisco, New York, Washington, D.C., and Seattle have released their GIS data to the public so that citizen programmers can develop user applications.[54]

Urban planning and development law continues to evolve to address myriad issues presented by the use and misuse of GIS.[55]

V. Landsat and Satellite Map Data

For nearly the last three decades, NASA's Landsat satellites have been providing high-resolution multispectral data on a global scale, and have created a unique data record of the Earth's land surface.[56] This portrait of the Earth's surface has been used in various ways to achieve an improved understanding of the Earth's land surface and the impact of humans on the environment.[57] The development of the Landsat program was a spinoff from the United States lunar program when NASA scientists realized the significance of viewing the Earth from space.[58] In 1972, NASA launched the first Landsat satellite dedicated to mapping natural and cultural resources on land and ocean surfaces.[59] Since its inception, the images and information provided by the Landsat program have been used in a variety of ways. In the fields of land use and mapping specifically, Landsat data has been used to classify land uses, monitor urban growth, aid in regional planning and in mapping transportation networks, as well as providing information to facilitate transportation and power transmission routes.[60]

Satellite imaging has been used to inform land use and planning policies in a number of ways. For example, Landsat data was used to map

53. *See* Andy Opsahl, *Utah CTO David Fletcher on the State's Use of Geo-IP Technology*, GOV'T TECH., Nov. 23, 2009, http://www.govtech.com/gt/733909.

54. *See* Andy Opsahl, *Seattle Announces Open Data Web Site*, GOV'T TECH., Mar. 1, 2010, http://www.govtech.com/gt/747646?topic=117676. However, controversy surrounds questions of whether the government can charge higher fees for spatially stored information than for other print formats. *See* Henry H. Perritt, Jr., *Should Local Government Sell Local Spatial Databases Through State Monopolies?*, 35 JURIMETRICS J. 449 (1995).

55. *See* PATRICIA E. SALKIN, NEW YORK ZONING LAW & PRACTICE § 36A (4th ed. 2009); Jeremy H. Speich, *The Legal Implications of Geographical Information Systems (GIS)*, 11 ALB. L.J. SCI. & TECH. 359 (2001).

56. GIS Development, Mapping GIS Milestones: 1970-1980, http://www.gisdevelopment.net/history/1970-1980.htm (last visited Nov. 23, 2010).

57. *See id.*

58. *See id.*

59. *See id.*

60. *See* Nat'l Aeronautics & Space Admin., *supra* note 1.

the growth of the Washington D.C. metropolitan area over time, and it was found that greater Washington expanded at a rate of 8.5 square miles per year with notably higher growth during the late 1980s, a trend that followed the regional and national economy.[61] The researchers also found distinct variations in the efficiency of land use among neighboring counties in Maryland and Virginia, in part reflecting the land use policies of those jurisdictions.[62] Satellite data has also been used to predict various urban growth scenarios for the Washington D.C. region over the next two decades, allowing planners to evaluate strategies for forest and agricultural land preservation.[63] Aside from just providing visualizations of sprawl over time, satellite data from Landsat and NASA's Ikonos satellite have provided information about impervious surfaces that is invaluable to planners and agencies involved in water quality monitoring, and it is less expensive than aerial photography.[64] In one research study, satellite images were used to demonstrate a link between rapid city-growth and rainfall patterns, and to assess compliance with an international treaty to protect wetlands.[65] In Dane County, Wisconsin, GIS information was used to provide more accurate information about open space and other land uses, and to facilitate public participation through land use training workshops.[66]

VI. Online Mapping: Google Earth, Google Maps, etc.

In 2000, NASA sponsored the creation of a mosaic of satellite images of the Earth, and the base maps thereby created were used for Google Earth,[67] which was launched in June 2005.[68] While Google Earth op-

61. *See* Jeffrey G. Masek, NASA, Monitoring Urban Growth, http://landsat.gsfc.nasa.gov/about/Application2.4.html (last visited Nov. 23, 2010).

62. *See id.*

63. *See* Nat'l Aeronautics & Space Admin., NASA Uses a "SLEUTH" to Predict Urban Land Use (July 7, 2004), http://www.nasa.gov/vision/earth/environment/SLEUTH1.html.

64. *See* Nat'l Aeronautics & Space Admin., Visible Earth: Map of Paved Surfaces (June 8, 2006), http://visibleearth.nasa.gov/view_rec.php?id=1792.

65. *See* Jesse Boyett Anderson, *Satellite Images Reveal Link Between Urban Growth, Changing Rainfall Patterns*, STANFORD U. NEWS, July 2, 2007, http://news-service.stanford.edu/news/2007/july11/seto-071107.html.

66. *See* Steve Ventura et al., GIS-Enhanced Land Use Planning in Dane County, Wisconsin, http://www.ncgia.ucsb.edu/varenius/ppgis/papers/ventura.html (last visited Nov. 23, 2010).

67. *See* Laura Rocchio, Nat'l Aeronautics & Space Admin., Landsat Data Base Map for Google Earth (Apr. 26, 2006), http://landsat.gsfc.nasa.gov/news/news-archive/dyk_0002.html.

68. *See* Google, Google Milestones, http://www.google.com/corporate/milestones.html (last visited Nov. 23, 2010). Google Earth is a satellite imagery-based mapping

erates as an independent computer program, its satellite images were combined with Google Maps, which was also launched in 2005. Google Maps, like GIS, also draws on independent data sets to provide information like addresses, directions, traffic information, and subway stations. Unlike GIS, however, Google Maps allows individual internet users to contribute information in real time by linking to photos and videos and writing reviews. The Street View feature, which combines street level photographs with Google Earth's satellite images and maps was introduced in April 2008.[69] This user-friendly, publically available technology suggests new opportunities for greater public interest and participation in urban planning and design.

VII. Global Positioning Systems

Global Positioning System (GPS)[70] technology is rapidly being introduced in different technological devices, ranging from car navigation systems to mobile phones, dog collars, and exercise wristwatches.[71] The proliferation of GPS data generated by these devices has been coordinated with GIS maps and is now being used for a variety of municipal and planning purposes. In South Windsor, Connecticut, for example, GPS-enabled phones are deployed with municipal crews to track such services as snow removal, sidewalk inspections, zoning enforcement, and leaf removal.[72] The technology allows the town's public works department to more efficiently manage these services and the information it generates is also available to residents over the town's website.[73] Municipal governments have also started to experiment with the possibilities of GPS "crowdsourcing." One such service is See Click Fix,[74]

service combining 3D buildings and terrain with mapping capabilities and Google search. *See id.*

69. *See id.*

70. GPS is a satellite-based system that tracks a user's position and velocity. *See* Peter H. Dana, University of Colorado at Boulder, Global Positioning System Overview (May 1, 2000), http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html. GPS was developed in 1973 by the Department of Defense, it was made commercially available in the 1980s, and the system reached full 24-satellite capability in 1993. *See id.* The system is still funded and controlled by the Department of Defense. *See id.;* Daniel Kleppner, The Global Positioning System: The Role of Atomic Clocks, Beyond Discovery, http://www.beyonddiscovery.org/content/view.page.asp?I=1275 (last visited Nov. 23, 2010).

71. *See* Jessica Lipowski, *Consumers Buy Into GPS; Future Looks Bright for Navigational Tech*, WASH. TIMES, Aug. 4, 2008, at B01.

72. *See* Blackberry, Inc., *Tracking Efficiency*, GOV'T TECH., Dec. 1, 2008, http://www.govtech.com/gt/case_study/579002.

73. *See id.*

74. *See* Seeclickfix, http://www.seeclickfix.com/ (last visited Nov. 24, 2010).

which allows people to report potholes, graffiti, and crime by uploading photos from their mobile phones.[75] Locational information is automatically attached to the images, and local governments that team with the company receive the information directly.[76] Aesthetic preservation goals can be better achieved with this type of information sharing.

VIII. Personal Computers, Mobile Communications, and the Internet

The invention of the transistor in 1947[77] and the silicon chip in 1961[78] allowed the modern computer to develop.[79] The personal computer has been one of the most important technological innovations in human history, allowing information to be stored and manipulated in volumes and at speeds never before possible. Combined with the internet, which was invented in 1957 and matured in the 1990s,[80] the computer has become an extraordinary feat of human innovation. Largely as a result of the proliferation of home computers, the number of home occupations or home-based businesses has significantly increased, leading to a need to modernize zoning ordinances and regulations addressing these uses.[81] The flexible work schedules enabled by telecommuting have also enabled people to live farther outside of the city limits without the hassle of daily commutes, impacting sprawl and further suburbanization.

Mobile phone technology, which was developed in the 1970s, has provided an important complement to the personal computer and the in-

75. *See id.*

76. *See* Thomas MacMillan, *See, Click, Fix Potholes*, NEW HAVEN INDEP., Mar. 11, 2010, *available at* http://newhavenindependent.org/index.php/archives/entry/see_click_fix_potholes/id_24408; NPR Radio Broadcast: All Things Considered: Using GPS to Tag Potholes (Mar. 5, 2010), *available at* http://www.wbur.org/npr/124371598; Twin Cities Daily Planet, There's a warning for that! (Mar. 11, 2010), http://www.tcdailyplanet.net/news/2010/03/11/theres-warning.

77. *See* TIME 100: Builders & Titans-20th Century Technology, Transistor, http://205.188.238.181/time/time100/builder/tech_supp/transistor.html (last visited Nov. 24, 2010).

78. *See* CNN.com, Silicon Chip 'Most Influential Invention' (Dec. 31, 2004), http://www.cnn.com/2004/TECH/12/27/explorers.silicon/index.html.

79. *See id.;* STEPHEN BENNINGTON ET AL., GREAT INVENTIONS THAT SHAPED THE WORLD (2003).

80. *See* Claire Suddath, *That Viral Thing: A Brief History of the Internet*, TIME, Jan. 28, 2009, *available at* http://www.time.com/time/arts/article/0,8599,1874608,00.html.

81. *See* PATRICIA E. SALKIN, AM. PLANNING ASS'N, MODERNIZING ZONING FOR HOME OCCUPATIONS 2-4 (2006), *available at* http://www.planning.org/zoningpractice/2006/pdf/sep.pdf; Robin Wheeler, *Zoning for Home-Based Businesses in New York*, 10 GOV'T L. ONLINE 1, 2 (2009), *available at* http://www.governmentlaw.org/files/Zoning_for_Home-Based_Businesses_In_New_York.pdf.

ternet.[82] The "Model T of mobiles," the Motorola DynaTAC 8000X was released in 1983, and since then the cell phone has become ubiquitous—unless you consider that they are now being replaced by "smart" phones that combine cell phone technology with internet, computing, GPS, and various other technologies.[83]

New communications technologies provided by cell phones and web-based applications, such as texting, email, and video conferencing, have contributed to a massive reworking of human relationships, and have influenced urban planning immensely. In one sense, they have contributed to sprawl by allowing people to more easily work from remote locations and allowing businesses to operate with only "virtual" storefronts. However, new media and communications technologies have had far fewer impacts on the physical form of human development than earlier innovations like the car and the elevator produced. "What's different about the information age that has been ushered in by personal computers, mobile phones and the Internet is its ability to reshape the social organization of cities and empower everyday citizens with the knowledge and tools to actively participate in the policy, planning and management of cities."[84]

The most basic change in urban planning and local government administration brought about by these innovations has been the rise of the government website. Today, nearly all state and local governments, and many government agencies and authorities, have their own websites. Government transparency has increased dramatically because of these websites. While in the past, a member of the public might have visited a public office or library, or combed through fine-print newspaper notices, today government websites have given immediate access to laws, regulations, hearing schedules, reports, and various other government information.

82. In 1978, a 2000–customer, 2100-square-mile cellular telephone system called the Advanced Mobile Phone Service was built, demonstrating the technological feasibility and affordability of cellular service. *See* ROGER SMITH, INVENTIONS AND INVENTORS 172-76 (2001). Cell phone technology works by establishing small coverage areas called "cells," each of which is served by low-power transmitter-receivers. *See id.* When a person leaves the coverage of one cell, the call is switched to the antenna and channels of an adjacent cell, and the conversation is automatically transferred and continues without interruption. *See id.* Computers control the call-transfer process. *See id.* The result is the ability of people to keep in touch with others at all times. *See id.*

83. *See* Mat Honan, *From Brick to Slick: A History of Mobile Phones*, WIRED, Feb. 23, 2009, http://www.wired.com/gadgets/gadgetreviews/multimedia/2009/02/gallery_cell_phone_history?slide=1&slideView=2.

84. Christina Madera, *The Future of Cities in the Internet Era*, NEXT AM. CITY, Feb. 15, 2010, http://americancity.org/columns/entry/2066/.

Government websites have also led to new forms of government-public interactions.[85] Some government entities and officials have established blogs,[86] photo and video sharing accounts,[87] and social networking accounts.[88] In February 2010, California adopted an official social media policy to encourage agencies to use tools like Twitter and Facebook to promote communication and transparency.[89] The policy creates training requirements for state employees who have access to social media sites, and it outlines ways to avoid unnecessary functions and security threats.[90] In Minneapolis, residents can sign up to receive email and text message snow alerts,[91] and in Manor, Texas, the city has deployed special barcodes that can be read by camera phones and that provide location-specific information such as event schedules or park regulations.[92] Portland, Oregon, launched an open source design contest in March 2010, for "CivicApps"—software designed "to showcase regional open data and promote collaboration between citizens and government . . . [and] that address[es] civic issues and benefit[s] the greater Portland community."[93] The city released a variety of government data

85. *See* Sarah H. McGuire, *Land Use Planning and Online Social Networks: Public Participation and Web 2.0 Technology*, 33 ZONING & PLAN. L. REP. 1, 1 (2010).

86. *See, e.g.*, City of Evanston Blog, http://www.cityofevanston.org/blog/ (last visited Nov. 24, 2010); L.A. Council Dist. 13, Eric Garcetti Blog, http://cd13.lacity.org/ (last visited Nov. 24, 2010).

87. *See, e.g.*, YouTube, Cory Booker: Moving Newark Forward, http://www.youtube.com/user/CoryBookerdotcom (last visited Nov. 24, 2010); YouTube, Official Atlanta Beltline Channel, http://www.youtube.com/user/beltlineatl (last visited Nov. 24, 2010).

88. *See*, Kim Hart, *Firms Take to the Tweetable Business Model*, WASH. POST, Mar. 9, 2009, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/03/08/AR2009030801531.html?hpid=sec-tech; Facebook, OpenAustin, http://www.facebook.com/group.php?gid=90275885408 (last visited Nov. 24, 2010); Twitter, Cory Booker, http://twitter.com/Corybooker (last visited Nov. 24, 2010).

89. *See* Karen Wilkenson, *California CIO Issues Use Policy for Facebook, YouTube, and Other Social Media*, GOV'T TECH., Feb. 26, 2010, http://www.govtech.com/gt/articles/747525. Social networking sites, such as Facebook, MySpace and Twitter, began to launch in 1997. *See* Danah M. Boyd & Nicole B. Ellison, *Social Networking Sites: Definition, History, and Scholarship*, J. COMPUTER-MEDIATED COMM., 2007, http://jcmc.indiana.edu/vol13/issue1/boyd.ellison.html. These sites "allow individuals to construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system." *Id.*

90. *See* Wilkenson, *supra* note 89.

91. *See* City of Minneapolis, Email and Text Message Snow Alerts, http://www.ci.minneapolis.mn.us/snow/esubscribe.asp (last visited Nov. 24, 2010).

92. *See* Christian Madera, *How Smaller Cities and Towns can Begin to Benefit From New Media*, NEXT AM. CITY, Mar. 3, 2010, http://americancity.org/columns/entry/2098/.

93. Office of the Mayor Sam Adams, City of Portland Launches CivicApps Design Contest (Mar. 17, 2010), http://civicapps.org/press/city-portland-launches-civicapps-design-contest.

to facilitate the contest, including information on crime, building permits, parks, transportation, and liquor license applications.[94]

Other on-line tools are more tailored to planning and development purposes. Ideas for Seattle, for example, is a web-based program that allows residents to contribute their ideas for the city and vote on ideas already submitted.[95] Manor, Texas, also has an interactive crowd sourcing website; the city incentivizes participation by awarding points for contributions, and then reviewing suggestions that receive a certain number of points.[96] San Jose has recently used a wiki website to enhance its city planning process.[97] The website included a 19-question survey intended to extract information from participants to help guide officials in developing the Envision San Jose 2040 plan. It also allowed residents to post photos of San Jose sites that they like or dislike, and discussion boards allowed discourse among contributors.[98] Tools like these let local governments target constituencies—like younger people and people with inconvenient work schedules—who might otherwise not attend in-person planning meetings or hearings. Similar collaborative, new media tools have been developed to engage citizens in the budget process.[99]

While on-line projects like these offer innovative ways to interact with the community and facilitate collaborative approaches to planning and other government functions, governments must still be aware of the "digital divide." In March 2010, the Federal Communications Commission announced a ten-year plan to provide broadband access to the nearly 100 million Americans who do not yet have high speed internet connections.[100] The lack of internet access is a serious problem, especially because it disproportionately impacts minorities, the elderly, the less-educated, and the less-wealthy.[101] Some local governments have taken steps of their own accord to bridge the digital divide. When Minneapolis decided to create a city-wide Wi-Fi network, it included in

94. *See id.*

95. *See* Ideas for Seattle, http://www.ideasforseattle.org (last visited Nov. 24, 2010).

96. *See* Madera, *supra* note 92.

97. *See* Chad Vander Veen, *San Jose, Calif.'s Wikiplanning Project on Course*, GOV'T TECH., Dec. 28, 2009, http://www.govtech.com/gt/719878.

98. *See id.*

99. *See* Christian Madera, *New Media Tools for Balancing Public Budgets*, NEXT AM. CITY, Feb. 25, 2010, http://americancity.org/columns/entry/2084/.

100. *See* Juliana Greunwald, *Groups Hopeful Broadband Plan Will Narrow Divide*, NAT'L J., Mar. 18, 2009, http://techdailydose.nationaljournal.com/2010/03/groups-hopeful-broadband-plan.php.

101. *See id.*

its request for proposals a requirement that the winning service provider take steps to address the digital divide.[102] The city council also authorized the formation of a Digital Inclusion Task Force to work with the community to assess the community's digital needs and develop a proposal for a community benefits agreement.[103] The vendor contract ultimately included a $500,000 fund for digital inclusion and provisions for advertising revenues to be added to the upfront amount, as well as subsidized internet services for more than 100 community groups and nonprofits and a guarantee of network neutrality.[104]

IX. Conclusion

Technology has enabled urban planners and developers to change skylines and landscapes, it has fostered greater public participation in the process and it has enhanced our knowledge of geographic and environmental data to better inform decision making. It has also, however, served as an enabler for sprawl and the resulting inefficient use of finite natural resources. Technological advances in the area of urban planning, design and development have also challenged lawyers to become more conversant with the technology as both users and with respect to other overlapping areas of law including, but not limited to, intellectual property rights (including copyright) and privacy.

102. *See* Cmty. Benefits Blog, Minneapolis Digital Inclusion CBA (Jan. 30, 2008), http://communitybenefits.blogspot.com/2008/01/minneapolis-digital-inclusion-cba.html.
103. *Id.*
104. *See id.*