MAPPING URBANISM

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INTRODUCTION

For over five years I have developed the seminar Mapping Urbanism, teaching it to architecture students at Carnegie Mellon's Pittsburgh, Pennsylvania campus and the general student body at Carnegie Mellon's Doha, Qatar campus. In both locations, students of various disciplines and backgrounds have engaged in learning about diverse cities and the multitude of social, economic and political influences that shape the built environment, as well as how to produce mappings that relate to the city. Urbanism is examined through such seminal texts as *Learning from Las Vegas* and *Delirious New York*; information design is studied through the lens of Edward Tufte and Richard Saul Wurman; and interactive visualizations are introduced from the likes of Brian McGrath and Ben Fry.

MAPPING URBANISM FRAMEWORK

Curriculum and Sequence

The first few weeks of the seminar are dedicated to learning the interdisciplinary tools of mapmaking and information design. These tools are then applied to the urban condition. A series of different city typologies (the global city, the shrinking city, the growing city and the megalopolis) are studied, each for a three-week module. The first week and a half focuses on a U.S. city and correlating text, and the second week and a half focuses on a non-U.S. city and correlating text (Figure 1). For example, the typology of the megalopolis is taught by learning about the Northeast Corridor of the U.S. in the context of Constantinos Doxiadis', *Ekistics: An Introduction to the Science of Human Settlements*, followed by learning about China's Pearl River Delta through the urban research compiled in Harvard Design School's *Project on the City 1: The Great Leap Forward*.

Reading excerpts from these texts serve as an introduction to the city and its correlating typology. For example, New York City is studied by introducing the evolution of the skyscraper through a reading from Rem Koolhaas' *Delirious New York.* Through the lens of the text and its rich drawings and maps, the representations of the city and their effect on reality can be seen in examples such as the "1909 Theorem," a cartoon drawn by A.G. Walker and published in *Life* magazine showing "The skyscraper as utopian device," to Hugh

Figure 1. Typologies, cities, and correlating texts studied in the seminar Mapping Urbanism

Ferriss' "Drawing for the Set-Back of Buildings" which influenced the 1916 Zoning Law – one of the first grand urban rules. [6]

Lectures focus on the social, economic and political influences on city development. To continue with the example of New York, urban development is examined through a chronological sequence of maps, from the patchwork of the *Castello Plan of New Amsterdam in 1660*, to the intensely rigorous gridiron plan of the *Commissioners' Plan of 1811*, to the sectional *Map and Profile of the Erie Canal* and the infrastructural network created when it opened in 1825.[7] Socio-economic and political influences on the city are introduced through films, such as viewing the movement of the masses in *Manhatta* and hearing the bottom-up versus the top-down planning debates of Jane Jacobs and Robert Moses in the *New York* PBS documentary series.[8] Interactive web projects, such as Brian McGrath's Manhattan Timeformations, show the proliferation of skyscraper districts in regard to era and geography.[9]

Concise reading response papers attempt to hone students' analytical skills. Requirements include providing a brief introduction to the

book and its author or editor, critical inquiry in regard to the city and associated urban issues, and the selection and analysis of key visual representations within the assigned reading excerpt.

This initial inquiry is followed by a group presentation on each city, where students are responsible for the gathering of key data of the city of study. This exercise is designed for the presenting group to deliver an overview of the given city, in numbers, drawings, and photographs. Numbers required include population, area, density, population growth rate, GDP per capita, literacy rates by gender, infant and mortality rates, and age, ethnic and religious breakdowns. Maps are required at both the scale of the city (or metropolitan region), and at the scale of an urban public space. City-scale map work includes outlining the legal city boundary, the metro region, the city growth over time, the identification of major neighborhoods and outdoor public spaces. Public space map work includes drawing the plan of the space with surrounding buildings and infrastructure. Photographs, with multiple zooms and vantage points, are intended to reveal everyday urbanism.

Finally, each city examination culminates in an individual graphic assignment that requires the synthesis of the data provided in the student presentations into the design of a compelling mapping visualization. Mappings are intended to be poetic and informative, revealing something previously unseen in regard to urbanism and the built environment.

INTERDISCIPLINARY TOOLS USED TO CREATE MAPPING VISUALIZATIONS

Learning the Tools

At the start of the seminar the very notion of mapping is unpacked, including the history and principles of mapmaking, and the fundamentals of information design. A diversity of mapping techniques and a multitude of examples of information design are introduced and analyzed.

Mapmaking

By looking at various world maps over time, one can glean an understanding of how maps reveal biases, dependent on the mapmaker's cultural background and world views. James Corner, in the "Agency of Mapping," expands upon the fundamentals of mapping, outlining how methods of traditional cartography might begin to inform new experimental and creative mappings.[10]

In the seminar, maps are examined as both aesthetic objects and as informational tools. Importantly, the mapping of both fundamental concepts of space, as outlined by Heidegger, is emphasized – quantitative or measurable, and qualitative or experiential.[11] However, for purposes of the seminar, there is a distinct focus on mapping as it relates to the visual representation of the city, or more specially, urbanism.
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Information Design

The guiding principles of information design are studied through the writings of Edward Tufte, referred to as the "da Vinci of data" by *The New York Times*.[12] The chapters "Micro Macro Information," and "Layering and Separation," in his book *Envisioning Information* contain a diverse range of rich visuals that are well aligned with the spatial representations undertaken by an architect. Additionally, another important work of information design, Charles Joseph Minard's graphic details of Napoleon's fateful Russian Campaign of 1812, is highlighted in Tufte's book, *The Visual Display of Quantitative Information*. Tufte remarks that this mapping "may well be the best statistical graphic ever drawn," as it synthesizes many variables: the number of people, their geographical location and direction of movement, as well as time and importantly, temperature (Figure 2).[13]
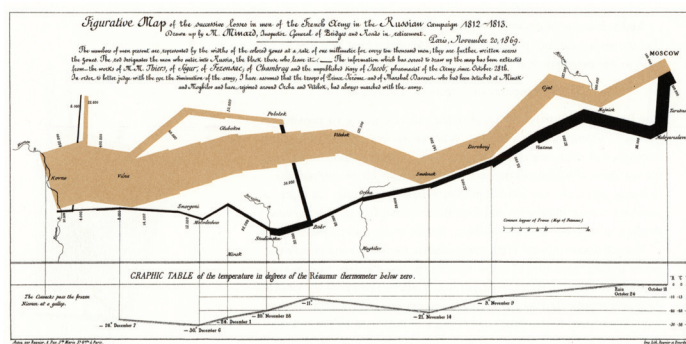

Figure 2. "*Tableaux Graphiques et Cartes Figuratives de M. Minard, 1845-1869*" by Charles Joseph Minard.

Today a vast amount of data is now easily accessible via the internet. However, it is important to recognize that only through the careful parsing of data does information result. As Richard Saul Wurman, designer, author and thinker about information design (and, incidentally, founder of the TED conferences) remarks in his book *Information Anxiety 2,*

> The great Information Age is really an explosion of data. To deal with the increasing onslaught of data, it is imperative to distinguish between the two; information is that which leads to understanding.[14]

Contemporary precedents of information design used throughout the course include those in the Transparency section of *Good* magazine, described as "a graphic exploration of the data that surrounds us," covering politics, education, environment, cities and transportation.[15] Online blogs, such as "Radical Cartography" and "Visualizing Complexity" provide additional sources of inspiration.[16] Fundamentals of graphic design are reinforced throughout the course including use of the grid, in *Making and Breaking the Grid* by Timothy Samara; consideration of type, in *Thinking with Type* by Ellen Lupton; and "The Do's and Don'ts of Presenting Data, Facts and Figures" in *The Wall Street Guide to Information Graphics* by Dona M. Wong.[17]

Interactive Graphics

Interactive precedents provide a learning experience focused on the comparison of spatial and statistical data. Two examples focused on global issues affecting urbanism include the Gapminder project by Hans Rosling and the 19.20.21 project by Richard Saul Wurman.[18] Alternative spatial representations have been the focus of MIT's SENSEable City Lab since 2004, with new institutional laboratories focused on spatial visualizations proliferating across the globe.[19]

APPLYING THE TOOLS TO THE CITY: SOCIETY AND SPACE

The interdisciplinary tools are applied to the city in an effort to examine both society and space. Introductory conceptual mapping assignments, such as drawing one's route from home to school, assist in the initial exploration of mapping urbanism through the documentation of social and spatial observations. As Robert A.M. Stern affirmed, "Urbanism is about human life." [20] Students are required to complete mappings focused on *people*, by using any of the following three methods: 1) survey; 2) observation, or behavioral mapping; or 3) statistics. These methods can be used individually, or in conjunction with one another through either the use of traditional fieldwork techniques or remote data mining. The methods can be used singularly, or in conjunction with one another through either the use of traditional fieldwork techniques or remote data mining.

Traditional Fieldwork

Learning about traditional fieldwork techniques and mappings that document the urban condition provide useful fundamentals for all students. These include the diagrams of Kevin Lynch in *The Image of the City* and the work of William Whyte, whose observational time-lapse photography and charts in *The Social Life of Small Urban Spaces* can be used to empirically document factors that contribute to the successful design of urban spaces.[21]
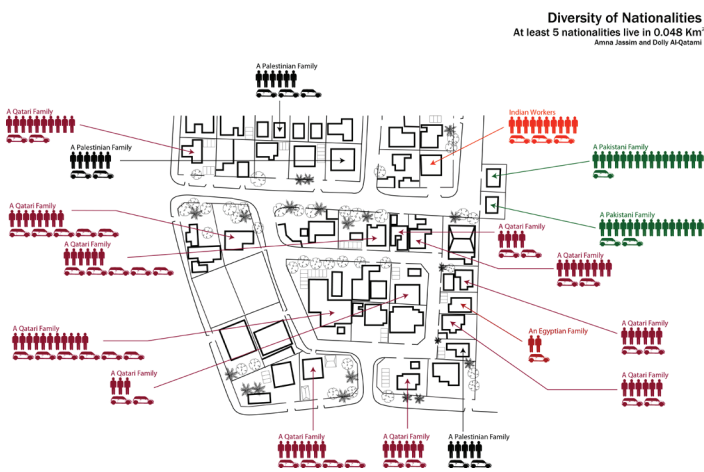
An example of a course project utilizing traditional fieldwork techniques can be seen in this investigation of a residential neighborhood in Doha, Qatar. Two Carnegie Mellon Qatar business students were drawn to the neighborhood by what they perceived as a diverse and unusual residential fabric. By conducting a door-to-door survey, they determined the nationality of each household, as well as the number

Figure 3. Diversity of Nationalities in Doha, Qatar, Amna Jassim and Dolly Al-Qatami, Mapping Urbanism, Carnegie Mellon Qatar, Spring 2009.
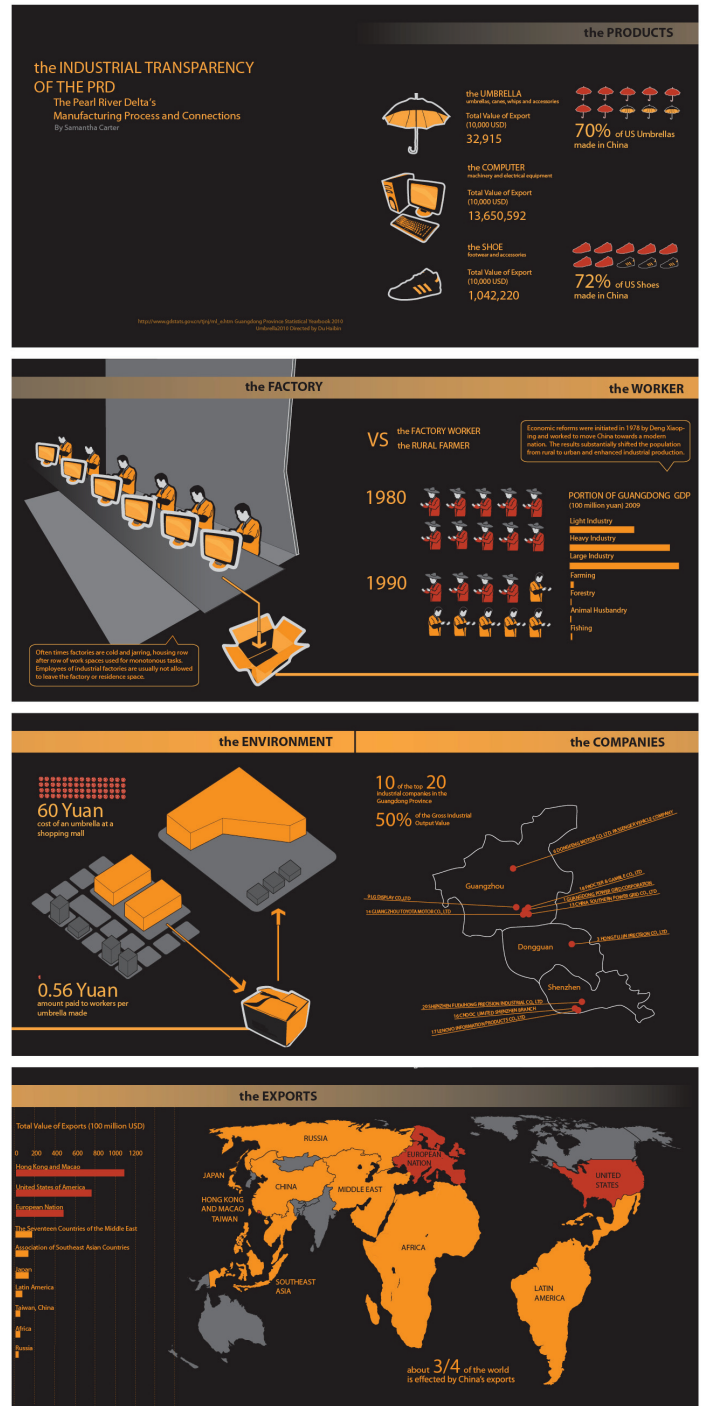
Figure 4. "The Industrial Transparency of the Pearl River Delta," Samantha Carter, Mapping Urbanism, Carnegie Mellon Pittsburgh, Fall 2010

of people and cars associated with each household. The experience was a unique and memorable one for them, and the resulting graphic reveals a meaningful glimpse into life in Doha (Figure 3).

Remote Data Mining

In contrast, "remote data mining' focuses on online data collection rather than traditional fieldwork methods. GIS is perhaps the best example of remote data mining. Increasingly, comparative mappings utilizing GIS data are made available to the public, allowing for increased transparency. For example, *The New York Times* project "Mapping America: Every City, Every Block" allows one to examine data from the Census Bureau's American Community Survey, based on samples from 2005-2009 Race and Ethnicity, Income, Housing and Families and Education.[22]

A fifth-year architecture student at Carnegie Mellon Pittsburgh utilized government data from the Guangdong Province Statistical Yearbook in order to examine the multi-scalar network resulting from the fact that 70% of all umbrellas sold in the US are made in China, as highlighted in a course viewing of the film *Umbrella*.[23]

LEARNING OUTCOMES

While the Mapping Urbanism seminar is taught on both the Pittsburgh and Doha campuses, the learning outcomes remain the same. At the culmination of the course, it is expected that learning outcomes include new knowledge of urban history and urban theory, as well as new skills in urban representation.

Regarding urban history, the course serves to introduce the discipline and practice of urban design and to provide a critical overview of the work of urban designers historically, and in today's context, and to impress upon students an understanding of pressing global issues such as population growth, human migration patterns, ecological impact, and the role of architects, urban designers and planners in this context.

As for urban theory, students are taught to analyze diverse writings and critiques in regard to urbanization, to understand economic, social, and political influences on city evolution, and to identify and analyze urban elements and typologies and understand their role in the larger urban context.

Finally, students gain skills in urban design research, analysis, and representation. Students, whether they are business majors who may work in the real estate market, engineering majors working on infrastructural projects, or architecture majors working on the design of a singular urban site, learn to look at the multi-scalar site, and graphically analyze and communicate complex urban issues.

Throughout the seminar, analog and digital mapping skills go hand in hand, building upon one another over the course of the semester, through a series of graphic assignments that require students to produce sketches and storyboards, to workshops that provide software instruction in Adobe Photoshop and Illustrator. The correlation of GIS with census data yields comparative demographic information. Mobile computing paired with Google Maps has begun to be used to yield innovative and informative visualizations.

The most successful projects are those that are both poetic and informative. Assessment is based equally on both graphics and content. Successful mappings are those that are creative, aesthetically pleasing and portray not only socio-cultural competency, but also unseen or hidden patterns, connections or comparisons.

FINDINGS

Over the years, I have uncovered a series of findings, both on behalf of my students and myself as their instructor. I have found that the students' foci and priorities shift depending on the locale and student groups. Students in Pittsburgh, for example, are keen to examine issues of urban development and environmental sustainability, while in Doha, the students expand the notion to include social justice and cultural sustainability as well. This can be attributed in part to culture on both the macro and micro level: architecture students in the shrinking city of Pittsburgh view the world through a different lens than business students in the rapidly growing city of Doha.

While I've enjoyed continually designing and teaching this course, in recent years I have questioned its efficacy, due to three key issues: 1) the proliferation of data visualizations available on the web and the inability of students to limit time looking in favor of time doing or testing, 2) the limitations of a static two-dimensional image, and 3) the challenges in convincing students that mappings can serve as not only analytical tools but also design tools.

INNOVATIVE DEVELOPMENTS

As a practicing architect and an urban designer as well as a researcher and academic, I strive to keep an equal footing in both the profession and the academy so that my teaching, research and practice inform each other. Happily, I've begun to take cues from these other aspects of my life to begin to reinvigorate the course. In the past year, my research team and I have begun to experiment with methods to address some of these issues. These techniques aim to avoid the above-mentioned pitfalls by returning to the basics (hand drawing analogue techniques) and by harnessing the power of data collection through more advanced visualization tools.

Analogue techniques

Our current research is focused on the architecture and urbanism of Doha, one of the world's fastest growing, and least examined, cities. When our research first commenced in 2006, we sought to understand the development of the road network, the sea and air ports, the landfill additions, and of course, the buildings. Little existed in regard to concise mappings of the urban growth of the

city over time. We manually drew our own series of maps based on the British aerial surveys of Qatar taken on a biannual basis, from the late 1940s to the early 1980s.[24]

As our research progresses, we have further analyzed Doha's urban form and structure to tease out speculative projects. Through the analysis work, we've rediscovered the merits of hand drawing as an age-old means of understanding. Basic figure ground drawings and morphological and typological reduction diagrams yield great clarity, providing the basis, and often genesis, of design work.

Mapping visualizations

To fully understand the meteoric growth of Doha, one must understand the complexity of Qatar's demographics. Our attempts to design two-dimensional informational graphics using the Qatar 2010 Population Census information fell short of revealing the demographic complexity of the country. The use of the Parallel Sets plugin with a javascript data visualization library called Data Driven Documents (D3) allowed for the sorting and rearranging of nationality, gender and occupation (Figure 5).[25] The resultant graphic reveals profound correlations. In Qatar, Qataris make up only one fifth of the total population. Of the total population, there are three men for every one woman. Expatriate males working in the construction sector account for 34% of the total working population.
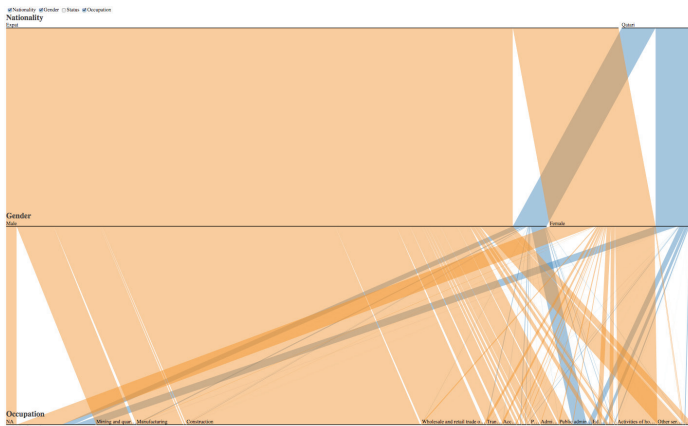

Figure 5. An interactive graphic examining the demographics of Qatar, created by Carnegie Mellon Qatar research team members Kristina Ricco and Spencer Gregson.

Interactive Web Applications

Part of a larger ongoing research project on the physical growth of Doha over time, 4dDoha: Buildings is an educational web-based application that focuses on the city's architecture across the decades. Combining research, graphic design, and interaction design, the iPad app allows users to sift through the data via a series of filters, while recording the users' choices on a projected map. One can view over thirty architecturally significant buildings designed

for Doha, sorting the information into different eras, by location in the city, by programmatic function, by architectural style or by its current condition.[26] Together, these buildings weave a coherent narrative of the city's past, present and future.

CONCLUSION

In 2005 when I began developing the Mapping Urbanism course, little existed in terms of informational design or data visualizations. Today, there is no shortage of precedents or programs. Many of these tools can be utilized in the field of architecture to advance research-based design, allowing further engagement in complex, multidisciplinary design projects. I look forward to integrating the above-mentioned methods into the course over the coming year, in an attempt to further cultivate a wide array of verbal, written, and graphic skills.

Throughout the seminar, the curriculum aims to advance students' knowledge about the connections between architecture, the city and society, including the urgent global challenges affecting the built environment. Students learn about other cities, their own city, and themselves. Whether in Pittsburgh or in Doha, students acquire new ways of seeing, portraying and designing the city. It is the hope that the course better prepares students to become actively engaged in the global built environment.

COURSE READINGS

New York City
Rem Koolhaas. "The Double Life of Utopia: The Skyscraper," and "The Skyscraper Theorists," *Delirious New York.* New York: The Monacelli Press, 1994, pp. 82-131.

Paris
Simon Sadler. "The Naked City: Realities of Design and Space Laid Bare," *The Situationist City*. Cambridge, Massachusetts: The MIT Press, 1999, pp. 15-61.

Detroit
Jerry Herron. "Three Meditations on the Ruins of Detroit," *Stalking Detroit*, ed. Georgia Daskalakis, Charles Waldheim and Jason Young. Barcelona: Actar, 2001, pp. 33-41.

Dan Hoffman. "The Best the World Has to Offer," *Stalking Detroit*, ed. Georgia Daskalakis, Charles Waldheim and Jason Young. Barcelona: Actar, 2001, pp. 42-47.

Patrick Schumacher and Christian Rogner, "After Ford," *Stalking Detroit*, ed. Georgia Daskalakis, Charles Waldheim and Jason Young. Barcelona: Actar, 2001, pp. 48-56.

Manchester, England
Ekle Beyer et al., ed. *Atlas of Shrinking Cities*. Ostfildern, Germany: Hatje Cantz Publishers, 2006.

Las Vegas

Robert Venturi, Denise Scott Brown and Steven Izenour. *Learning from Las Vegas.* Cambridge, Massachusetts: The MIT Press, 1972, pp. 18-45.

Gulf Cities (Abu Dhabi, Dubai & Doha)

"City Statistics," *Volume 23: Al Manakh 2,* ed. Archis, AMO, C-Lab, Pink Tank & NAi. Amsterdam: Archis, 2010, pp. 16-41.

Rami el Samahy and Kelly Hutzell. "Closing the Gap," *Volume 23: Al Manakh 2,* ed. Archis, AMO, C-Lab, Pink Tank & NAi. Amsterdam: Archis, 2010, pp. 184-190.

U.S. Northeast Corridor

Constantinos A. Doxiadis. *Ekistics: An Introduction to the Science of Human Settlements,* London: Hutchinson, 1968.

Pearl River Delta, China

Judy Chung Chuihua et al. *Project on the City 1: Great Leap Forward,* New York: Taschen, 2002.

ENDNOTES

1   For example, while the business world capitalized on a new trend based on a systematic design process, "Architects, the standard-bearers of professional design, are virtually nonexistent in discussions about design thinking." Mark Lamster, "Business Philosophy? On the virtues – and perils –of design thinking," *Architect*, July 8, 2010, accessed May 18, 2012, http:// www.architectmagazine.com/ business/ business-philosophy.aspx. Similarly, Jeffrey Inaba and Rory Hyde discuss the notion that architects are largely absent in the dialogue about Smart Cities, while technology companies and policy makers have successfully converged in the making of the City 2.0. "Jeffrey Inaba," (Urbanists Talk. Netherlands Architecture Institute Auditorium, Rotterdam. May 3, 2012), http://en.nai.nl/content/ 1135751/ archive. Lecture and dialogue: http://vimeo.com/ 43889521.

2   For example, "7 Billion," *National Geographic*, accessed July 17, 2012, http://ngm.nationalgeographic.com/7-billion

3   With some exceptions – the groundbreaking 2007 exhibit "Design for the Other 90%," the Cooper Hewitt National Design Museum in New York became one of the first museums to showcase humanitarian work by architects – a profound exhibit, in an era focused conversely on the work of starchitects. In the "Design with the Other 90%: CITIES," the exhibition series evolves to "examine the complex issues arising from unprecedented urban growth." Opened in 2011 at the United Nations Headquarters, it brought the importance of 'public good' design to the doorstep of decision makers. "Design with the Other 90%," Smithsonian Cooper-Hewitt, National Design Museum, accessed May 20, 2012, http://www.designother90.org/.

4   Bjarke Ingals recently called for "proactive and progressive architects," as well as "provocation," and "public participation." Bjarke Ingals. (Keynote. ACSA International Conference. Centre de Cultura Contemporània de Barcelona, Spain, June 20, 2012).

5   Andrea Kahn, as my professor at Columbia's MSAUD program, first introduced me to the notion of multiscalar urban sites and their "dynamic," "porous" and "messy" nature, as further outlined in her essay, "Defining Urban Sites," *Site Matters: Design Concepts, Histories, and Strategies,* Carol J. Burns and Andrea Kahn, ed., (New York: Routledge, 2005), 281-294.

6   Rem Koolhaas. *Delirious New York,* (New York: The Monacelli Press, 1994), 82-131.

7   John Wolcott Adams and I.N. Phelps Stokes, *Redraft of the Castello Plan New Amsterdam in 1660,* (New-York Historical Society Library, Maps Collection, 1916).
     William Bridges*, Commissioners' Plan of 1811*, (New York: New York Public Library, 1811).
     Map and profile of the Erie Canal, (Albany, New York, E. and E. Hosford, 1825).

8   *Manhatta,* Directed by Paul Strand and Charles Sheeler. (1921; New York: Museum of Modern Art, Aperture Foundation Inc., Paul Strand Archive).
     New York, 8 DVDs. Directed by Ric Burns. (1999; New York: Pbs Paramount, 2004).

9   "Manhattan Timeformations," McGrath, Brian, accessed May 18, 2012, http://www.manhattantimeformations.org

10   James Corner. "The Agency of Mapping: Speculation, Critique and Invention," *Mappings.* Dennis Cosgrove, ed., (London: Reaktion Books, 1999).

11   Martin Heidegger, *Poetry, Language, Thought*, (New York: Harper & Row, 1971).

12   Shapley, Deborah. "The da Vinci of Data." *The New York Times,* March 30, 1998.

13   Edward Tufte. "Micro Macro Information," and "Layering and Separation," *Envisioning Information*, (Cheshire, CT: Graphics Press, 1990), 37-66, and *The Visual Display of Quantitative Information*, (Cheshire, Connecticut: Graphics Press, 2001), 41.

14   Richard Saul Wurman. *Information Anxiety 2.* (Indianapolis, Indiana: Que, 2001), 19.
     For further insight into the work of Kevin Lynch and Edward Tufte, see Nadia Amoroso. "Graphic Integrity and Mapping Complexity: The Works of Lynch, Wurman & Tufte," *The Exposed City: Mapping the Urban Invisibles,* (London: Routledge, 2010), 41-67.

15   "Transparency," Good magazine, accessed May 18, 2012, http:// www.good.is/departments/ transparency

16   "Radical Cartography," Bill Rankin, accessed May 18, 2012, http:// www.radicalcartography.net/
     "Visualizing Complexity," Manuel Lima, accessed May 18, 2012, http://www.visualcomplexity.com/vc/

17   Timothy Samara. *Making and Breaking the Grid*, (Beverly, Massachusetts: Rockport, 2005).
     Ellen Lupton. *Thinking with Type,* (Princeton: Princeton Architectural Press, 2007).
     Donna Wong. *The Wall Street Journal Guide to Information Graphics: The Do's and Don'ts of Presenting Data, Facts and Figures,* (New York: W.W. Norton & Company, 2010)

18   "Gapminder," Hans Rosling, accessed May 18, 2012, http://www.gapminder.org
     "19.20.21," Richard Saul Wurman, accessed May 18, 2012, http://www.192021.org

19   There has been the proliferation of not only new think tanks, such as Columbia University's Spatial Information Design Lab, but also those associated with professional practices, such as Vision Arc, operating in parallel to Toshiko Mori's architectural practice, and even new programs, such as the MRes in Advanced Spatial Analysis and Visualization at the Center for Advanced Spatial Analysis, The Bartlett, University College London.
     Karen Cilento. "We Are Here Now / Spatial Information Design Lab / Columbia University," *ArchDaily* (March 30, 2012): accessed May 22, 2012, http://www.archdaily.com/222024
     Mimi Zeigler. "Systems Thinking," *Architect.* (April 27, 2011): accessed May 18, 2012, http://www.architectmagazine.com/ research/systems-thinking.aspx
     The Bartlett Centre for Advanced Spatial Analysis, University College London, accessed July 19, 2012. http://www.bartlett.ucl.ac.uk/ casa/programmes/postgraduate/mres-advanced-spatial-analysis-visualisation. Incidentally, the online blog "Digital Urban" written by Dr Andrew Hudson-Smith, Director of the Centre for Advanced Spatial Analysis, The Bartlett, University College London, provides

information and tutorials focused on the spatial and data analysis of the built environment.

20   Robert A. M Stern. "Urbanism is About Human Life," in *The State of Architecture at the Beginning of the 21ˢᵗ Century*, ed. Bernard Tschumi and Irene Cheng, (New York: The Monacelli Press, 2003), 20.

21   Kevin Lynch. *The Image of the City*, (Cambridge, Massachusetts: The MIT Press, 1960).
     William H. Whyte. *The Social Life of Small Urban Spaces*, (New York: Project for Public Spaces Inc., 2001).

22   Matthew Bloch, Shan Carter and Alan McLean. "Mapping America: Every City, Every Block," *The New York Times*, accessed July 18, 2012, http://projects.nytimes.com/census/2010/explorer

23   *Umbrella* or *San*. Directed by Du Haibin. (2007; New York: Icarus Films, 2008).

24   Rami el Samahy and Kelly Hutzell. "Scenes and Speculations from an Emerging City," http://www.4ddoha.com/projects/SAS-Doha-Architecture/

25   Ibid.
     The interactive visualization utilizes data sets from the "Qatar 2010 Population and Housing Census," Qatar Statistics Authority, accessed July 18, 2012, http://www.qsa.gov.qa/QatarCensus/

26   Rami el Samahy and Kelly Hutzell. "4dDoha: Buildings," http://4ddoha.com/collection/