Foreword

Unlike most scholarly texts, let us begin with some definitions. Since we are in relatively uncharted territory, it is worth a short divergence.

Webster's online dictionary defines *urban* as "of, relating to, characteristic of, or constituting a city". *Informatics*, a bit more obtuse, is "the collection, classification, storage, retrieval, and dissemination of recorded knowledge treated both as a pure and as an applied science". So how would we synthesize these terms to define *urban informatics*? One version might read "the collection, classification, storage, retrieval, and dissemination of recorded knowledge of, relating to, characteristic of, or constituting a city". This definition emphasizes information as the dominant structural aspect or reason for being—that information is literally what constitutes a city. What is left of Carthage, after all, but legends? Another possible definition for *urban informatics* is "the collection, classification, storage, retrieval, and dissemination of recorded knowledge *in* a city". This definition highlights the physical city's persistent role as a container for information-based human activity. Either way, both definitions illustrate that information processing is an age-old function of cities—as Mumford (1961) noted, writing and urbanization were more or less simultaneous historical developments.

Taking a long view of urban informatics, the simultaneous urbanization and global economic integration we are currently experiencing can best be seen as a refinement of the city as a system for information processing. In the pre-electronic era, face-to-face proximity and the clustering of functions was the most efficient means of replicating, transmitting and searching for information in social and economic networks. Over time, new tools augmented this function, but in a sense the city itself is our original and greatest information technology.

Over the last two decades, urban scholars have built a powerful case in support of the hypothesis that advances in informatics have been a powerful force driving urbanization. The literature on "global cities", most notably, argues that the centralization of high-level decision-making in a handful of global cities, augmented by information and communications technology, is how globalization is enacted. Indeed, urban informatics does play a critical role in accelerating every step of this process—from information retrieval ("what is going on in Nigeria?") to analysis and decision-making ("should we invest in more oil production?") to dissemination ("drill that well!").

But while a historical view tells us that urban informatics is not a new thing—it is as innate a part of urbanity as anything else we study, and has been used since the dawn of cities to reinforce political and economic control—there is something unique about this moment in history. It seems that after 50 years of incubating digital information technologies on the desktop, we are now at a point where they are to become inextricably woven into the everyday social and economic life of dwellers in every city on the planet. On top of the centralized informatics infrastructure of the 20th century, we are juxtaposing layers of tools for material sensing and broad, decentralized cooperation among groups.

The first big shift, the pervasive spread of sensing in urban environments is already reshaping both the day-to-day and long-term processes of urbanization. While humans still set the boundaries, more

and more of the critical life support systems of the city are instrumented to both sense and make sense of the world around them. Like Frankenstein's monster, the physical fabric of cities is waking up and becoming aware of itself.

Much of the sensing of urban settings today comes from the top-down. Congestion pricing, dynamic power grids and biometric surveillance are all examples of informatics systems that manage the status quo. But as many examples in this book describe, as sensing technology becomes more broadly diffused, it can be leveraged for disruptive uses that challenge established views of the city. For instance, inexpensive networked sensing embedded in mobile devices recasts urban dwellers as participants in an agile, dense swarm of pollution and traffic probes.

A parallel shift is the lightening-up of the informatics infrastructure, in favor of more decentralized, bottom-up frameworks. A popular metaphor for the industrial city was the machine. But if the city as machine has given way to the city as computer, what we are living in more closely resembles the messy collective capability of the Internet than a mainframe. In an ironic twist, information systems have evolved to become much like our most successful cities—open and modularized platforms on which human activity can take place—and less like master-designed utopias. In analogy form: Brasilia is to Big Blue, as Los Angeles is to Web 2.0. In a sense, by becoming more "cosmopolitan", tolerant of differences and inter-connected information systems are thriving.

This volume, then, comes along at an opportune moment—to reflect on this historic moment, and to chart both directions of change and specific principles and techniques for how to proceed into unknown territory. It conveys, I believe for the first time, the sense that we are starting to actually "see" informatics transforming cities before our eyes. When he was tearing apart New York City to make room for the automobile, power broker Robert Moses was reputed to announce, "When you operate in an overbuilt metropolis, you have to hack your way with a meat ax." But today's urban informatics effect change at the other end of the spectrum, through persuasion, surveillance, personalization and contextualization. Instead of rewriting space with a few large-scale strokes, they allow us to re-engineer an infinite number of small-scale relationships. But ubiquitous sensing is giving us the ability to sense, map and visualize these previously invisible processes.

What truly mark this volume more than any other on the topic, however, are the clear signs that scholars working in this area are developing transdisciplinary approaches to their research. In 2005, the Institute for the Future conducted a 50-year scan of future trends in science and technology for the UK government's Department of Trade and Industry (now the Department of Trade and Innovation). One of the eight high-level forecasts to emerge from this year-long effort, the idea of trandisciplinarity essentially meant that rather than putting together teams of specialists from established fields, we would see ever more young scholars seek training in multiple disciplines to develop new approaches to particularly messy or difficult problems. As author Howard Rheingold described it, "transdisciplinarity goes beyond bringing together researchers from different disciplines to work in multidisciplinary teams. It means educating researchers who can speak languages of multiple disciplines—biologists who have an understanding of mathematics, mathematicians who understand biology" (IFTF, 2006, p. 31).

The ability to easily form new communities around topics is a key driver of transdisciplinarity—historically, "*disciplines have been social as well as intellectual institutions. They've helped define what research problems and areas are important; identified who is worth knowing; rewarded innovative work; and helped allocate financial and human resources. Now though, an emerging cluster of online services offer scientists the means to find colleagues working on similar problems, irrespective of geography and institutional affiliation. Social software tools allow individuals to self-organize around common interests. Digital preprint services, wikis, and Web logs offer a spectrum of means to rapidly publish new research.*" (IFTF, 2006, p. 31).

This book is the result of just such a process unfolding, through a dialogue that without electronic sustenance would have been unlikely just a decade ago. Ten years ago, this would have been two or more separate books—one for social scientists, one for information scientists, yet another for architects and urban designers. As I sat down to write this foreword, I considered the traditional task of trying to draw out common themes from the diversity of manuscripts—until I realized that to do so would completely miss the point of what the authors have accomplished. This group of authors has stepped outside their disciplinary silos to engage in a dialogue that I suspect many will be loathe to return from.

Not having been around to experience it, as best I can from the literature, the last great burst of interest in urban informatics seems to have occurred in the late 1960s and early 1970s, about the time that computing began to be introduced on a large scale in government and business. The excitement about using computers to improve data analysis and even do predictive modeling of urban systems was widespread. In fact, my own organization, the Institute for the Future, was established in 1968 at Wesleyan College with a grant from the Ford Foundation to do computer-based urban modeling. These efforts soon fell apart, as the underestimated complexity of the effort became apparent. In a sense, the undelivered promises of that era's technocracy have driven much of the urban informatics research agenda since.

Transdisciplinarity is a beacon—instead of ignoring the input of colleagues across the table, it will be our own minds offering alternate hypotheses. Instead of blindly pursuing technological possibilities, social research is informing the definition of computational problems. The future research agenda both stated and implied by the contributions in this volume suggests decades of future work, and that is why I believe this new wave of urban informatics research will be sustained.

In conclusion, I like to think that this collaboration between urban scholars and information scientists will be more nuanced and more productive, building on the mistakes of the past collaboration. I also like to think that this will in the end result in better cities—more energy efficient, more fun, more just. The timing is certainly right. Urban planning is well into an undeclared crisis of thought leadership—despite it being one of the best avenues for dealing with global challenges like climate change and migration. Information science is poking its head out of the burrow and seeing the enormous intellectual challenge of expanding what worked on the desktop of the elites, to a diverse and mobile urban population.

It's worth speculating on the long-term impact of this developing body of research. Unlike the 20th century's urbanization, the big story by mid-century won't be the changes to the hardware. The mega-buildings of Shanghai and Dubai are just that—over-sized versions of the familiar 20th century forms borrowed from Chicago and Manhattan. Coal-fired or solar-powered, we will still be living in an energy-intensive civilization powered by electricity—billions more of us than ever.

But where we will see lots of change is in the software that shapes cities. Embedded sensing will replace a lot of human watchers and they will watch things on a frequency and scale we can barely imagine. But what will be important is how these abundant data streams provide a new ability to model and simulate very complex urban systems in real-time. Whereas today urban managers and planners react on the time cycle of a census, by mid-century real-time dashboard and predictive models will rule the trade. Already today, firms like Inrix provide fine-grained traffic forecasts for dozens of metropolitan areas in the United States.

Advances in the tools we have for "seeing" cities, from the first maps to the latest in satellite imagery, have always had major impacts on how we define problems, opportunities and aspirations. Sherman Fairchild, the father of aerial photography, described the impact of his invention (1924):

[It] shows the city with the minutest detail. It shows every structure from contractor's temporary tool-shed to skyscraper; back-yards, gardens and parks with every tree and bush visible; avenues and alleys, streets and unrecorded foot-paths; big league ball parks; water-front clubs, with their yachts and motor boats; the boardwalk of Coney Island, and crowds of people appearing like small black dots.

As Campanella (2001) describes in his history of the Fairchild Aerial Survey Company, the aerial perspective unleashed a wave of re-thinking urbanism:

If Le Corbusier was rhapsodic about the airplane's possibilities, he was shocked by what it revealed of the city. More than anything, it was the aerial view that ratified his conviction about the bankruptcy of the urban-architectural past. Rather than unfold in new light the wondrous legacy of urban civilization, the airplane supplied Corbusier with damning proof that the city of man was deeply pathological. The airplane peeled back the shrouds of the city, revealed its wrinkles and warts to Corbusier's unforgiving eye.

In essence, this new perspective granted by aerial photography rendered cities as abstract expressions of steel and concrete—malleable designs to be reworked from above by technocratic deities. The legacies of that fantasy are the planning disasters of the post-War period, costly lessons browbeaten into the minds of young urban planners today.

To use a crude analogy, if aerial photography showed us the muscular and skeletal structure of the city, the revolution in urban informatics is likely to reveal its circulatory and nervous systems. I like to call this vision the "real-time city", because for the first time we'll see cities as a whole the way biologists see a cell—instantaneously and in excruciating detail, but also alive. This is in contrast to the way astronomers see a heavenly body—as it was, some time ago, light-years in the past. And as these capabilities become more widespread, the real-time city could become a place where everyone is an amateur urban planner, using urban informatics to understand the larger impacts of their everyday decisions. That, so fundamental a shift in our perception of our own civilization, seems to be something worth working towards.

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Anthony Townsend recently joined the Institute for the Future, an independent non-profit research group based in Palo Alto, California. As a research director, he will contribute to the Institute's long-range technological forecasting programs. Prior to joining the Institute, Anthony enjoyed a brief but productive career in academia, where his research focused on the role of telecommunications in urban development and design. Between 2000 and 2004 he taught courses in geographic information systems, telematics, and urban design in two graduate schools at New York University: the Interactive Telecommunications Program in the Tisch School of the Arts, and the Urban Planning Program in the Wagner Graduate School of Public Service. During this period, he directed several major research projects funded by the National Science Foundation and Department of Homeland Security. Townsend has been a key organizer in the wireless community networking movement since 2001. He is a co-founder and advisory board member of NYCwireless, a non-profit organization that promotes community broadband initiatives using unlicensed wireless spectrum. From 2002 to 2004 he was a principal of Emenity, a successful startup company that built and manages public local wireless networks in public spaces in Lower Manhattan. Anthony's work continues to develop an international focus. He has lectured and consulted throughout Asia, Europe and North America. He lived in Korea during the summer of 2004 as a Fulbright scholar, investigating that nation's rapid development of broadband technology. Anthony holds a PhD in urban and regional planning from Massachusetts Institute of Technology, a master's in urban planning from New York University, and a BA from Rutgers University. More information at http://urban.blogs.com/