Communication

Thinking about Smart Cities: The Travels of a Policy Idea that Promises a Great Deal, but So Far Has Delivered Modest Results

Amy K. Glasmeier * and Molly Nebiolo

Department of Urban Studies and Planning, Massachusetts Institute of Technology, Cambridge, MA 02139, USA; mnebiolo@butler.edu

* Correspondence: amyglas@mit.edu; Tel.: +1-617-324-6565

Abstract: This communication explores the unique challenge of contemporary urban problems and the technologies that vendors have to solve them. An acknowledged gap exists between widely referenced technologies that city managers utilize to optimize scheduled operations and those that reflect the capability of spontaneity in search of nuance–laden solutions to problems related to the reflexivity of entire systems. With regulation, the first issue type succumbs to rehearsed preparation whereas the second hinges on extemporaneous practice. One is susceptible to ready-made technology applications while the other requires systemic deconstruction and solution-seeking redesign. Research suggests that smart city vendors are expertly configured to address the former, but less adept at and even ill-configured to react to and address the latter. Departures from status quo responses to systemic problems depend on formalizing metrics that enable city monitoring and data collection to assess "smart investments", regardless of the size of the intervention, and to anticipate the need for designs that preserve the individuality of urban settings as they undergo the transformation to become "smart".

Keywords: urban development; smart city; sustainability

1. Introduction

Smart cities are the object of desire of technology corporations that seek new markets for existing products as well as simultaneously seeking, for themselves, the status of being "smart" with the hope of improving their chances of attracting economic development investment. Business consulting firms feed both of these desires by helping product businesses identify cities that are likely to yield public partners; while concurrently, these consulting organizations are creating scorecards that rank cities on their "smart qualities", thereby rendering them potential recipients of development funds. Overnight, smart cities have transitioned from being mere novelties, to serving as examples of technology application, to becoming principal targets of urban policy. According to authors such as Stephen Brown and Adriana Campelo of University of Ulster, we have entered an age where cities have taken on qualities that formerly only humans possessed [1]. Mostly self-described, the world of places declaring themselves "smart" do so to attract agents of change, hoping that name recognition will lead to investment down the road [2].

On the other hand, "greenfield" projects of new wholly planned smart cities remain few. Masdar, Abu Dhabi's smart city, remains under development. With an expected completion timescale of a decade (2006 to 2017), this living example highlights the challenges facing urban designers and engineers seeking to achieve integrated, self-regulating urban development along multiple axes, including energy, water, habitation, and transportation. Other examples of so-called "smart cities",

such as Mauritius and ReGen Village in The Netherlands, await construction, commissioning, and testing. The challenge remains to move from archetypes to standards–based systems that withstand testing and achieve replicability.

The shift from visionary Metropolis to sustainable urbanization remains the challenge posed by the world's future and expanding urban populations. Efforts underway to coalesce around the meaning of "smart city" remain inconclusive. Is this a reflection of the first arch of technology's diffusion? Currently, fragmentary thoughts of what is a smart city reflect rival topics vying for membership in the lexicon of ideas that define smart city status, their purpose, and scope. Until discourse and practice settle on a few tractable characteristics to represent durable qualities of smart city achievement (such as energy security as urban development), our efforts will remain subdued. At the core, we are seeking to solve critical issues that are overcome by the existence of smart cities. Until we achieve a consensus on what the term "smart" city defines, experiments abound will await requisite anchors in the form of norms and practices that signify the arrival and embedding of a new state of urbanism.

With pressure to be a member of the "smart city" elite, places are adding their embellishments to the definition of "smart", pushing to extend beyond just the technology of being "smart" to embody more encompassing qualities, including sustainability, no matter how ill-defined and application-specific that term is. This paper takes up from previous discussions of what the "smart city" is and builds on the emerging meanings of the newest adjectival term "sustainability" that is making its way into "intelligent city" conversations [3]. Imperatives to commercialize technologies (that are becoming synonymous with the tagline "smart city", such as sensors, autonomous vehicles, etc.), are emerging as prescribed packages of combined technologies and "smart city practices". The more amalgamating the definitions become, the more they remain aloof and unmoored from explicit goals and objectives of modern urbanization's intended beneficiaries. The unintended consequence of smart city "making" is to privilege technologies without equivalency tests that make clear what the public values are and what the basic needs are that these values seek to promote. The utility of the smart city has already morphed from being an assumed public benefit (i.e., increased efficiency, reduced cost, more efficient delivery of a variety of urban services) to exploiting recognition as a desired, new and burgeoning market niche for producers with off-the-shelf concepts and technologies. At this point, we must ask is the smart city simply a new replacement market for vendors that are otherwise facing slowing rates of growth in and competition for their traditional commercial markets, or is it a transformative conception that is leading to future and better forms of urbanization? Without greater confirmation of the medium term benefit of further investment, are we not experimenting based on vague hunches when there are equality meritorious uses of scare resources that in the immediate moment improve vital and yet more conventional concerns such as cleaner, safer better lit streets? Projects new and old are in constant competition. At the moment, the investors in smart city technologies are predominantly governments, operating at several levels of authority, all challenged by inter-jurisdictional boundary constraints. Given constraints on public sector budgets, will decision makers be reluctant to risk making investments in off-the-shelf technology products when the producers themselves are unclear about the benefits of their applications?

We contend that consulting firms are bridging the market gap between users and producers and these consulting firms have divided loyalties. Consultancy reports comprise, on the one hand, capacity scoring systems with designated "winners"—clubs that are serving as the arbiters of what smart cities are. Simultaneously, and by default, they are increasingly defining the characteristics of what constitutes a smart city. Picking winners is consequently becoming the specification system identifying the conditions that must be followed to access the pathway to becoming a smart city, irrespective of the tests to determine the efficacy, viability, and public acceptability of the relevant problems that need to be solved. In this situation, what "is" a smart city is defining what a smart city should "be", regardless of whether the valid evidence exists to support such specifications. Are we not in danger of allowing that the two ends of the problem are played off by the middle? Therefore,

does the resulting trend sever the connection between the pursuit of sustainable urbanization and the creation of smart cities?

Historically, public policy was established with primary social objectives, including quality infrastructure, available and easily accessible schools, efficient and equitable distribution of the benefits of public investments made in a fair manner (examples include distributed transportation, the supply of clean water and the availability of more jobs). Civil servants, on a daily basis, make a countless number of investment decisions about the cities they govern. Does the public not have a right to ask, "Is the currently configured smart city competition privileging those places already leading the pack, given that consulting firms are deciding what designates a city being smart, to begin with?". In addition, are decision makers not subject to the existence of a conflict of interest, given that they are being asked to make investments in private interests, whilst defining what is considered smart?

At its core, this article is about how the ordinary person benefits from this movement towards intelligence as a modality of city form and operation. Ours is not a search for bad practices; indeed, we set our task to find the elusive qualities that can inform places of the essentiality of making intelligent decisions in the face of scarce resources. In turn, that will make cities work for everyone that inhabits them.

In this communication, we examine the urban literature published over the last two years. In 2015, we published a Special Issue on "smart cities" in the *Cambridge Journal of Regions, Economy and Society*. Admittedly, while two years is a rather short period to examine change, evidence indicates that the interest in smart places has infiltrated most discussions of urbanism. Whether the term "smart city" reflects something that is truly happening or that, more simply, it reflects a newly acquired tagline adopted by urbanists to attract funders, is an open question. Access to urban-oriented development capital is quixotic. Of importance are the tradeoffs being made by cities that may forestall future investments once the smart city movement wanes.

This article includes literature that primarily captures conversations starting sometime around 2014. We continue the discussion to determine if the smart city reflects a viable urban future, taking into account its migration as a concept that is responsive to business opportunities and imperatives. Why this is important is because many communities will be left behind as the sweep of big ideas has the potential to be fully adopted in only a few privileged situations. Most places cannot possibly enjoy the benefits of smart technology unless the focus shifts to turnkey projects that are big, integrated and expensive. Given the current economic circumstances, one has to ask, is smart city development an achievable goal for numerous cities, or has it become an almost unattainable objective for most urban areas?

2. What Is a Smart City?

To this point, two themes have defined what a smart city is: a well-managed, entrepreneurial city, or a multifaceted city of all manner of conveniences. Still relevant after almost 25 years, Phil Harris [4] described the future of cities in 1992 as being, " ... the global networked city of dispersed, highly interactive economic nodes linked by massive networks of airports, highways, and communications"; this contrasts with what Rob Kitchin [5] noted in 2015, that the origins of the smart city should not be found solely in the search for technological utopias. With these two thoughts in mind, there has been a transition from creating a city whose foundations are computers and microelectronics to one where cities add technology to the already standing infrastructures to allow them to grow efficiently.

What seems to be a compelling idea on the surface—one that could produce a magnitude of advances in the sustainability of cities—is an idea that rests on a platform of questions and skepticism. The term "smart city" was originally coined sometime in the mid-1800s by writers describing newly built cities in the American West that were efficient and had strong self-governance. Even then, the term had timeless qualities long into the 20th century. The phrase was resurrected in the 1980s and once again became a commonly established term, describing urban technocracies and modern urbanization more generally [6].

In the more recent literature on smart cities, urban development and the governance of smart cities have gained importance in discussions. Albert Meijer notes in his analysis of 51 recently published articles that, in over a third of recent articles on smart cities, the smart city is not defined [5]. Nor, in most cases, is there an explicit perspective on how the smart city should be governed. Meijer, for one, highlights the serious consequence of this fragmentation in ideas, or obvious lack of a perspective on the meaning and value of smart cities. Furthermore, although there seems to be little agreement about what the smart city is, there is a general movement away from the idea of a technocracy to one that encompasses factors that a city needs in order to thrive—smart governance and smart people (human resources)—as well as smart technology.

There are still many examples linking the smart city to utopian notions of the city on the hill. Mauritius, a small island off the coast of Africa, is one example. Not only is it a tropical paradise, but the government is stable, it has "state-of-the-art infrastructure", and it is "the freest, most business-friendly country in Africa" (Smart Cities-Smart Mauritius). While it is a stable, thriving community, its plans to become a smart city through significant technological investments and energy sustainability projects are still in the planning stages. With pictures of a tropical paradise in tow and projections of future supplies of smart energy, smart governance, and smart entrepreneurship, this vision proved compelling enough to draw a global event, a world summit in 2016, to discuss its future as a smart city.

3. Numbers of Smart Cities Continue to Grow

Over 88 Smart Cities have been proposed to exist in the world by 2025, up four-fold from 22 in 2013, according to IHS Markit, the global consulting firm and its technology-centric definition of a smart city [7]. Europe and the Americas will contribute a total of 56, while the Asian Pacific will account for 32. These numbers suggest, as presently scoped, that the vast majority of the world's urban centers will remain on the sidelines as a few entrepreneurial cities tinker with elements of the emerging smart city recipe that emphasizes telecommunications, systems regulation and mobility.

With 50% of the world's population, about 4 billion people, now living in an urban environment, much is riding on the need to speed up currently glacially-paced investment in urban infrastructure innovations [7]. Given that urban population numbers will only grow, emphasizing exclusivity instead of ubiquity will undoubtedly pose serious challenges for city planners. It will take considerably longer to provide the needed infrastructure thought to accompany "smart city" development if it is built from the ground up. Fortunately, city planners are starting to recognize this risk.

As time passes and more cities become technologically efficient, they are also becoming more reactive. Cities are increasing their ability to monitor, analyze, and plan city form to improve efficiency, equity, and overall quality of life [8,9]. Not enough is being made of the benefit arising from planned upgrading of existing urban systems. Urban governments operate with substantial backlogs of deferred maintenance. Learning through adaption has the potential to build reservoirs of new knowledge that feed intermediate technology designs. Wholesale replacement of old technology for new technology represents high value opportunities for vendors, but can be very disruptive and expensive for users. Instead, should promoters of smart city technology emphasize regular maintenance and pre-programmed upgrading given that operational upkeep serves as a remarkably effective means of promoting technology diffusion?

At the moment, technology and planning are still mostly funding projects that address isolated, one-off problems. Far too few are implemented with sufficient tracking to ensure that they are sound, scalable investments. According to some, instead of implementing projects in an indirect manner, studying and investing in quantitative data collection is needed if we wish to increase the likelihood that better decision making will emerge to solve systemic problems. Problems, significant in scale and systemic in effect (indoor air pollution that exacerbates asthma and other cardiovascular problems), are noteworthy. In the absence of this magnitude of approach, one has to ask, is being smart really what will make a city better?

Shunted aside are big questions that extend considerably beyond the boundaries of a single city. For example, just reframing the question about beneficiaries of "smart city" development alters the potential magnitude of the effect. There are gaping holes in the approach of how to create or how to evolve an urban space into one that fits the mold of a smart city. Governance is one, as Meijer identifies, but there is also the way the city is being resourced, who is benefiting from the smart city, and whether or not an urban development approach emphasizing smartness produces a better city experience by and for its residents.

4. In 2016 and We Still Lack a Concrete Definition of "Smart City"

Meijer [8] (p. 5) points out a critical fact in his writing: many current sources on smart cities do not define what a smart city is, or offer agreement on what a smart city should be. The top three factors taken away from his pivotal research show that a smart city is either (1) one that uses smart technologies; (2) one that consists of "smart people"; or (3) one that engages in collaboration. After analyzing over fifty articles himself, Meijer states, "the smartness of a city refers to its ability to attract human capital and to mobilize this human capital in collaborations between the various (organized and individual) actors through the use of information and communication technologies". There is no focus on the efficiency of the city through technology nor the sustainability of the city via recycling or energy efficiency. In other papers, the term "smart city" is thrown around as a way to make a point that the end goal will make an urban environment more "modern"—almost a replica of the utopian idealisms of technocracies in the 1980s and 1990s.

Searching for the term "smart city" on the Internet yields the definition of "vision", defined as higher capacity communication and better management of a city's assets through technology applications that generate data that companies, governments, and people analyze. As noted in the previous paper, Glasmeier and Christopherson [10] suggest: "It is an urban form to be sold, resold, modified or augmented to make money". The first step to truly pursuing a smart city is to create a universal definition of such projects. Unfortunately, for now, there is still no single outline of what a smart city is and should be. Here, we are not seeking universals, but rather tangibles that can be verified and serve as performance standards.

While the definition (or lack of an exact definition) has not changed since 2014, there is one major attribute that authors almost uniformly still believe to be missing from most other papers on smart cities. A smart city should be one in which technologies facilitate the management and organization of fragmented areas of urban development—energy and urban living, for example. The smart city then is so revolutionary as to create a whole new lived experience, a new urban reality of habitation. One example of this is ReGen Village, outside of Amsterdam in The Netherlands [11]. ReGen is designed to be a sustainable village outside of Almere Center equipped to grow its food, generate its power, and to remediate its own waste through advanced technology and greenhouse ecosystems. The community looks futuristic, encased in an all-glass wall with transparent homes and floor to ceiling shelves of plants that rise three stories in height within the glass buildings. The ground is supposed to be prepared for the construction of 100 of these homes in the summer of 2016 [11]. How realistic this ideal type of habitation will be is yet to be determined. This description is not far off from the mogul-financed hermetically sealed living environment of the 1990s, Biosphere 2 (B-2), located in the high Arizona desert outside of the city of Tucson. As a living laboratory, B-2 strikes a unique pose against the cloudless desert sky, but its costly upkeep suggests we may still lack the sophisticated systems knowledge and tools to bring integrated and sustainable living to the marketplace.

5. Smart Cities Are Primate Cities and National Capitals

When comparing the top smart cities in the world, all five are either current capitals (Barcelona, New York City, London, Nice, and Singapore) or major cities that have added creative technologies to manage traffic, waste disposal, and energy efficiency [12]. Is it anything but predictable that major metropolitan areas would be the first in line to achieve smart city status? Still today there is no true

built-from-ground up and complete smart city in the world. In the first installation of this paper [10], there was no advancement in the creation of a smart city from the ground up. Greenfield projects are continually proposed. Few projects progress beyond the drawing board stage given their scale and expense. Even Masdar, initially estimated to be finished within eight years, with the beginning phase completed in 2009, has seen its completion date pushed back to 2025 or 2030. As of 2016, only 300,000 of the over 1,000,000 planned square meters of the city exist, and only 300 of the projected 50,000 city inhabitants live there as of 2016 [13–15]. All 300 are graduate students of the Masdar Institute of Science and Technology, while less than 2000 others commute to work in firms [13]. Critics lament that Masdar will never be finished, but Chris Wan, the designer of Masdar, calls the city, "part of an evolutionary process", instead of a total failure [13–15].

There are examples abound of individual buildings, streets, small neighborhoods, and transportation corridors equipped with sensing technology. Lighting is installed on a blighted corner to enhance the appeal of a gentrifying neighborhood, diminishing its situation located along a congested transportation corridor, but these are all one-off projects, rarely proposed as a package. Hence, we are still some way off of experiencing the city of the future.

"Smart city" projects are growing to enable closer scrutiny of both the terms and their physical meaning. With 51 articles drawn from various academic databases, Meijer's article makes a valiant attempt at a meta-analysis to consider how governance practices are evolving under this new urban rubric. According to his investigation, although placing the word "smart" in front of an urban project may add some degree of cache, the evidence is lacking that better management and more sustainable results necessarily follow [8]. Looking at projects, almost from the outset, skeptics worried that sensors might add data streams, but in the absence of the necessary social innovations and financial supports, residents would gain only modest rewards from such projects [16]. Looking behind the rhetoric, many of the projects that label a location a "smart city" represent activities that address more unconcealed issues (such as waste management) instead of focusing on long-term, sustainable agendas [17].

Reviewing scholarly literature explicitly linking the terms "smart city" and "sustainability", the consensus is that a smart city is an environment that is made efficient through the use of advanced technologies, and only sometimes based on principles of sustainability. There is no agreement on how to take the first steps towards the goal of becoming a smart city. A consensus on the foundations for building a smart city is still needed. Immediate issues include developing metrics to enable the monitoring and assessment of "smart investments" regardless of the size of an intervention. These must account for both technology optimization and human factors realization. Otherwise, the stream of benefits will remain ambiguous and subject to interpretation.

6. Real-Life Applications

A major problem today is not that nearly 65% of the world's population will reside in urban environments by 2025, instead, of bigger concern is that these cities will suffer from inadequate to nonexistent infrastructure systems and lack the required funds to purchase collective goods to ensure healthy environments (water, sanitation, environmental regulations) [7]. According to the United Nations World Population Prospects released in 2015, 9.7 billion people will populate the world in 2050, the majority of these citizens originating from current high-fertility zones: various parts of Africa and the Southeastern Pacific, including India [18] (p. 15). Of the top five countries expected to grow between 2045 and 2050, three are within the continent of Africa; one is in the Middle East, and one in Asia. Of the top sixteen, the United States of America is the only western country projected to grow, and that would be due to immigration rather than natural population growth [18] (p. 29). Many of these areas are already facing extreme difficulties in energy conservation and security, and greenfield sites are necessary to take care of the influx of the aging population that will take up a substantial amount of resources and attention [18] (p. 13). If millions of people will

live closely together, infrastructure must spread to frontiers that have been less desirable in the past, as these will be the spaces left [19].

There has been little to no change since 2015 in quantitative data that projects population growth and thus enables the ability to identify where the majority of the population will reside. Demographers and urbanists working for the U.N. suggest that population projections for individual nations, especially those war-torn nations that experience significant forced migrations, reflect simple straight-line projections rather than being derived from census counts. Hence, establishing that the effects of urbanization are universal in some instances may stand on shaky ground. Adding further uncertainty are changing demographics that make projections hazardous given the declining reproductive rates of most westernized countries [20].

The U.N. projects that nearly 48 countries will have a continuous decline in population growth well past 2050, marking the high importance of planning smart cities instead of fixing sites of intense urbanization after the fact [18] (p. 11). Although the implications of advanced technology and data collection within cities are beneficial and necessary, those ideals should take a back seat to the need for developing urban living conditions and energy resource systems that can sustain global south cities of the future. While there is a "domain of confusion" [8] that surrounds the key problems that a smart city should address, a major question that arises is, who are the players that have been making these decisions thus far?

7. Company and Consulting Firm Investment in Smart Cities

The private sector and non-governmental entities play crucial roles in the economic development process. Corporations produce technology, deploy it and ensure its operation. Companies work with other firms to create designs that match the needs and desires of the public sector to solve immediate problems, but also they use their talents and resources to create designs about the world of the future.

In October 2015, 37 consulting firms, which included CRISIL, McKinsey, and KPMG, were commissioned to prepare smart city plans for 88 cities in India. Little detail was offered on what the steps would be in transforming the various cities to smart city status, other than contributing funds annually to finance municipal projects. Neither were the details made explicit on how each firm was chosen to participate in the plan nor how a company was selected to work with individual cities' projects [21]. Questions abound regarding how investments will be made (the same in all cities) and whether each consulting firm will follow its prescription on how to develop these Indian municipalities into smart cities. What are the parameters of each plan and will they differ from city to city and region to region?

It is beneficial that consulting firms are focusing so heavily on smart cities because they bring a global experience to local urban problems. This oversight allows cities to avoid trying to reinvent the wheel. However, there is a danger in sequestering the process and relying on a group of global consulting firms known for converting clients' projects into company products. Cities are living things, similar and yet different if for no other reason than their site and situation being unique on the surface of the earth. More detrimental, by handing off the planning to outsiders, local capacity to plan and undertake urban management will be stunted. Problems will no doubt arise once the consultants leave the scene and local professionals are given responsibility to carry out the plan. Unless carefully monitored, consulting companies could encroach on the local prerogative of planning firms and city offices, devaluing local concerns while superimposing sterile practices as part of problem identification, analysis, and proposed solutions. An unintentional byproduct of this strategy could be the commodification of the process of urbanization, leading to a sterilization of both process and outcome. Unless deep engagement is at the core of this plan, the norm for smart cities could result in cookie cutter models and disaffected citizens. As Meijer notes when analyzing over 50 articles on smart city governance, "the idea of a 'one best city' is still quite dominant in the technological discourse about smart cities" [8].

Another enormous challenge is trying to implement smart city projects in mid-tier cities. The contracts appear to favor the largest cities despite the evidence that the process of urbanization will unfold in medium sized cities [22]. Repeatability of smaller projects could expand market potential for these midsized cities while also creating higher value in larger cities. More focus should be given to the mid-tier cities so that the optimal creation of smart cities can be fulfilled [20]. While 88 cities are projected to reach smart city status by 2050, greater energy sustainability, urban living situations, and overall population security could be achieved if attention was also given to other sized metropoles.

Overall, while the consulting firm can be a useful tool to advance the progress of smart cities throughout the world, their homogenizing influences could thwart rather than achieve the desired outcome. Instead of replicating the steps and processes in each large city, local issues and a broad range of city sizes will help create sustainable, more lively and locally grounded smart cities. Without that, projects will be in danger of failing if individualized environments, societies, and goals of places are overlooked.

8. Are Cities Being Better Resourced in the Process of Getting Smarter?

The fundamental difference between general investments in city upkeep and the improvements provided by smart city programs is the inclusion of outside actors in city programs. Smart city investments need to be checked to validate if they are actual innovations providing new tools for a city, such as the incorporation of the Internet of Things for data collection or using new technology for urban development. Standard projects such as waste and traffic management are not major stepping stones to creating or transforming a place into a smart city. They are instead deferred maintenance that would otherwise be a regular upgrading of existing services. The EU provides funds for technology implementation around transportation and energy, but it is common to find that these new technologies are supported using existing funding streams rather than augmenting local capital budgets. If one of the primary goals of a smart city is to become sustainable for the care and management of ever larger populations, then it is risky to pursue projects that ignore the need for redundancies, especially as new systems are being added [23].

The Smart Cities Initiative, a project created under President Obama to improve cities, [23] is a prime example of how intertwined the ideas of just bettering cities are with the ideas of creating a smart city through these general management programs. The Initiative states:

Every community is different, with different needs and different approaches. But communities that are making the most progress on these issues have some things in common. They don't look for a single silver bullet; instead, they bring together local government and nonprofits and businesses and teachers and parents around a shared goal [23].

The Initiative goes on to declare $160 million dollars' worth of research and leverage in over 25 technology collaborations to improve "traffic congestion, fight crime, foster economic growth, manage the effects of a changing climate, and improve the delivery of city services" [23]. The hope is that investment catalyzes the growth processes occurring in many communities to propel them forward to achieve smart city status, but the question remains of how energy security and the public sector will be funded to be sustainable. These are crucial topics that need to be addressed to achieve the status as a smart city.

9. Are Users the Winners?

Who is benefitting from smart city investment? This question remains unanswered, and it is still important when looking at the projected path of smart city development. Communities can take advantage of any upgrade or innovation of technology, but there is a general assumption that most users will be tech-savvy enough to use and benefit from more sophisticated technology contributions. Unfortunately, often, or even most of the time, that is not the case [9]. As Riggins notes, by 2020 the number of devices that are connected to the Internet of Things may be as high as 75 billion [21]. If numbers reach that high, audits are necessary to reveal how usable and accessible these technology

designs will really be for the citizens of these cities. Riggins mentions the five V's necessary to achieve the legitimate value proposition from big data—high volume, high velocity, high variety, veracity, and variability [21]. If companies are trying to propagate one-size-fits-all policies and programs, sufficient data needs to be collected and analyzed to reduce the waste of scarce resources. Also, there have been very few empirical studies conducted to reveal the potential of the Internet of Things and big data analytics. User input is needed to allow design interfaces to address the reality of what the ordinary consumer will need, and without sufficient data to outline requirements, it is almost impossible to know whether or not the citizens will optimally benefit from living in a smart city [21].

10. Is the Smart City Movement Capable of Delivering Better Urban Living?

There are many factors to consider when thinking about what "better urban living" could mean, especially when it comes to a smart city. Dotti directly states how the lack of open data on cities is urgent, and the current information should be available for all to analyze. The available information should include data on urban living in smart cities. The commercial side of the smart city movement depicts many large improvements in the way people will live: better transportation, commitment to the community, access to services and technologies, and better education. However, how can contemporary urban living be measured to determine how it can be improved? As Miimu Airaksinen emphasizes in Dotti's article, "Today we are talking quite a lot about the Internet of Things, but we should focus more on the Internet of meaningful Things" [22].

Since 2014, the Organization for Economic Cooperation and Development (OECD) has collected data multiple times a year from 34 countries hoping to produce a life satisfaction index [23]. The criteria used include access to services, civic engagement, environment, individual income, employment, and education. Even with data collected, the second big issue is how to depict these measures of smartness alongside the intangible entity of a citizen's wellbeing. Focus should not be on how long the cycle of becoming a smart city will last, but what it will mean for the people living in it. Dotti concludes that once enough information is collected and synthesized, researchers would be able to improve all of the indicators by offering new tools for policy makers [24]. As straightforward as this sounds, other things need to be considered to allow for a better depiction of urban living and well-being. For one, indicator values must be flexible enough to account for the whole picture. Without a complete spectrum of factors, it will be harder to measure more cities, since they all differ from one to the next.

Despite the absence of unifying definitions and with the limited systematic appraisal of leading smart city building practices, research by Rob Kitchin and others serves to inform discussions among urban practitioners, legislators, and individual leading technology providers as they seek to formalize elements of the developing field of smart cities. Kitchin's research on Boston suggests cities are out ahead of companies in developing grounded approaches to smart city practice. His research highlights the distance cities must travel to resolve ontological discrepancies and inter-jurisdictional disputes amid stark cultural differences to achieve smart city applications. Realistic timescales for project implementation are emerging—witness the resetting of Masdar City's extended timescale. As the adage goes, Rome was not built in a day, and surely, neither are smart greenfield cities going to be constructed in an unusual manner.

There is little immediate evidence that a coalescence of opinions is leading toward agreement about what smart cities are. Nevertheless, sub-discussions are pointing toward the key role of governance, the importance of connecting sustainability with the measures being used to denote "smart places" and the importance of specifying what the audience is for this form of urbanization. Cases are being designed based on similar patterns of investment, and their number is growing. There should soon be a sufficient number of applications of the same types of technology to conduct cross-case analysis that can then serve as a basis for performance analysis. Large data streams are being archived, and parallel data analytics are converging to allow for formal modeling of the technical consequences of these projects. We are reaching a point where performance evaluations will be possible.

We may be converging on a time where researchers can compare apples to apples. Until then, we should be modest in our claims of just what smart cities will yield.

11. Final Thoughts

Meijer writes in 2015 how the legitimacy of claims of smart city status cluster into three groups: First, outcomes; cities whose urban governance focuses on producing better results of policies in terms of wealth, health, and sustainability and the processes (those that focus on the strengthening of citizen participation and improving open forms of collaboration) [8]. The focus of the latter idea may be the best way to ensure that better urban living results. Second, smart population; the city can tap into the intelligence of resident urban actors to become a smart city, providing that the enabling conditions, including open data sources, are available to accompany improved urban living. Thus, focus should not be on strengthening the outcomes of a smart city to allow for better urban living, but instead be on collecting data on what better urban living is thought to be via its citizens and through more democratic forms of government that seek to achieve these as measurable outcomes. Third, retention of local identity; better attempts at allowing cities to preserve their individuality during development into a smart city will allow for them to keep true to what the citizens deem necessary, recognize the resource parameters necessary to remain secure, and enable more cities to succeed in becoming a smart city.

Author Contributions: This article was equal co-authored by Glasmeier and Nebiolo, research assistant at the Massachusetts Institute of Technology. The original conception of the paper was Glasmeier's, based on previously published work, written in association with Susan Christopherson, Department Head of the Department of Urban Planning and Regional Development at Cornell University. All material in this paper is original and not previously published. Nebiolo worked under the supervision of Glasmeier. Nebiolo made original intellectual contributions to the paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Brown, S.; Campelo, A. Do Cities Have Broad Shoulders? Does Motown Need a Haircut? On Urban Branding and the Personification of Place. *J. Macromark.* **2014**. [CrossRef]
2. Lyndon, M. Can Smart Growth be Codified? Miami Thinks So. Available online: https://nextcity.org/daily/entry/can-smart-growth-be-codified-miami-thinks-so (accessed on 28 October 2009).
3. Greenfield, A. *Against the Smart City: The City Is Here for You to Use Book 1*; Do Projects: New York, NY, USA, 2013.
4. Harris, P.H. The technopolis phenomenon—Smart cities, fast systems, global networks. *Behav. Sci.* **1992**, *38*, 2.
5. Kitchin, R. Making sense of smart cities: Addressing present shortcomings. *Camb. J. Reg. Econ. Soc.* **2015**, *8*, 131–136. [CrossRef]
6. Michel, J.-B.; Shen, Y.K.; Aiden, A.P.; Veres, A.; Gray, M.K.; Brockman, W.; The Google Books Team; Pickett, J.P.; Hoiberg, D.; Clancy, D.; et al. Quantitative Analysis of Culture Using Millions of Digitized Books. 2010. Available online: https://books.google.com/ngrams/graph?content=smart+city&year_start=1800&year_end=2000&corpus=15&smoothing=3&share=&direct_url=t1%3B%2Csmart%20city%3B%2Cc0 (accessed on 11 June 2016).
7. HIS. *Smart Cities to Rise Fourfold in Number from 2013 to 2025*; IHS Inc.: London, UK, 2014.
8. Meijer, A.; Bolivar, M.P.R. Governing the smart city: A review of the literature on smart urban governance. *Int. Rev. Adm. Sci.* **2015**. [CrossRef]
9. Hardy, Q. Technology Is Monitoring the Urban Landscape. *New York Times*, 20 July 2016.

10. Glasmeier, A.; Christopherson, S. Thinking about smart cities. *Camb. J. Reg. Econ. Soc.* **2015**, *8*, 3–12. [CrossRef]

11. Peters, A. This New Neighborhood Will Grow Its Own Food, Power Itself, and Handle Its Own Waste. *Fastcoexist.com*, 25 May 2016.

12. High, P. The Top Five Smart Cities in the World. 2015. Available online: http://www.forbes.com/sites/peterhigh/2015/03/09/the-top-five-smart-cities-in-the-world/#4548ad6c5a0e (accessed on 11 June 2016).

13. Goldenberg, S. Masdar's Zero-Carbon Dream Could Become World's First Green Ghost Town. 2016. Available online: https://www.theguardian.com/environment/2016/feb/16/masdars-zero-carbon-dream-could-become-worlds-first-green-ghost-town (accessed on 23 March 2016).

14. Serazio, J.R. Let's Be Smart About Intelligent Cities. *Next City*, 2 February 2011.

15. Smart Cities-Smart Mauritius-Building Intelligent, Innovative and Sustainable Cities of the Future. 2016. Available online: http://www.investmauritius.com/investment-opportunities/smart-cities.aspx (accessed on 11 June 2016).

16. Ostojic, D.R.; Bose, R.K.; Krambeck, H.; Lim, J.; Zhang, Y. *Energizing Green Cities in Southeast Asia: Applying Sustainable Urban Energy and Emissions Planning*; The World Bank: Washington, DC, USA, 2013.

17. United Nations. World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. 2015. Available online: https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf (accessed on 27 October 2016).

18. The Economist. The Paradox of Soil: Land, the Centre of the Pre-Industrial Economy, Has Returned as a Constraint on Growth. 2015. Available online: http://www.economist.com/news/briefing/21647622-land-centre-pre-industrial-economy-has-returned-constraint-growth (accessed on 27 October 2016).

19. Angel, S.; Parent, J.; Civco, D.L.; Blei, A.M. *Making Room for a Planet of Cities*; Lincoln Land Institute: Cambridge, MA, USA, 2011.

20. Cohen, B. Urban Growth in Developing Countries: A Review of Current Trends and a Caution Regarding Existing Forecasts. *World Dev.* **2004**, *32*, 23–51. [CrossRef]

21. Riggins, F.J.; Fosso Wamba, S. Research Directions on the Adoption, Usage and Impact of the Internet of Things through the Use of Big Data Analytics. In Proceedings of the 48 Hawaii International Conferences on System Sciences (HICSS), Kauai, HI, USA, 5–8 January 2015.

22. PTI. 37 consulting firms to prepare smart city plans for 88 cities. *The Economic Times-Infrastructure*, 6 October 2015.

23. Office of the Press Secretary—The White House. Fact Sheet: Administration Announces New 'Smart Cities' Initiative to Help Communities Tackle Local Challenges and Improve City Services. 2015. Available online: https://www.whitehouse.gov/the-press-office/2015/09/14/fact-sheet-administration-announces-new-smart-cities-initiative-help (accessed on 11 June 2016).

24. Dotti, G. How to Measure the Quality of Life in Smart Cities? 2016. Available online: http://phys.org/news/2016-04-quality-life-smart-cities.html (accessed on 11 June 2016).