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Transportation and Smart City Imaginaries:
A Critical Analysis of Proposals for the USDOT Smart City Challenge

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Scholarly attention to the development of "smart cities" around the globe has been focused on the nature of these cities, and visions of the futures that these developments would provide for individuals, communities, and institutions. Much of the research about these information-intensive projects has been focused on the description of these cities in terms of their primary socioeconomic goals and on the influential roles in their development being played by globally active information technology firms. An important, but underexplored, focus of this research has been an examination of how local and regional governments have envisioned these projects. This article responds to that challenge through a critical analysis of proposals submitted to the U.S. Department of Transportation's (USDOT) Smart City Challenge. We associate the choice of population references used in these proposals with the socioeconomic characteristics of these cities and then examine the nature of changes made in the proposals by the seven finalists.

Keywords: smart city, transportation planning, public–private partnerships, surveillance, privacy, inequality, sociotechnical paradigm, social media

Planning for the development of technologically enabled urban spaces under the banner of "smart city initiatives" has become a global phenomenon, attracting the interest of scholars from a wide range of academic disciplines and departments. Some of this interest is economic and strategic, as universities are becoming actively engaged in the planning and implementation of these development projects, often as members of public–private partnerships (P3s). Although there have been a number of important regional initiatives, such as those begun within the European Union, the Smart City Challenge organized by the United States Department of Transportation (USDOT) provided a unique opportunity to examine how the smart city imaginaries developed among a large number of midsized American cities would incorporate concerns about information technology and its impact on inequality within "smart" urban spaces.

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Because these smart city projects have been identified, in part, on the basis of their reliance on the use of information and communication technologies (ICT), with special regard for the computational and analytical dependency on massive amounts of data generated and captured by sensors and transactional devices, this article begins with a short summary of how technological "revolutions" in the past have relied on various sociotechnical paradigms and particular kinds of epistemologies. Then, relying on a discursive analysis of 71 initial narrative proposals and seven technical proposals produced by the finalists, this article identifies substantial differences in emphasis with regard to concerns about privacy, inequality, and the well-being of population segments identified as being "underserved."

Long Waves and Sociotechnical Paradigms

Contributions to the development of economic theories regarding the long wave cycles of rapid expansion in economic growth followed by periods of slower growth have generally been attributed to elaborations made by Joseph Schumpeter to the initial contributions of Nikolai Kondratiev. Although these analyses of business cycles and their relationship to technological innovation have gone through their own cycles of interest, and abandonment by mainstream economists, Paschal Preston (2001) devoted considerable attention to the "neo-Schumpeterians" and their efforts to explain the upswings and downswings in capitalist economies in relation to new technologies that brought about growth through "creative destruction."

Carlota Perez (2009) suggested that these developments were not strictly technological, but also reflected the impact of financial innovations that supported the rapid adoption and diffusion of these technological resources throughout the economy. Perez (2013) later added a call for an increased government role in managing the integration of financial and technological innovations in support of economic expansion. She maintained that the state should "be an enabler of a shift in the balance of power from finance to production, and to change the focus from the stock market indices to the expansion of the real economy and to the increase in social wellbeing" (p. 13).

In part, Perez's views (2010) reflect those of Preston (2001), who notes the limitations of long-wave theories in that they tended to emphasize the role of technological developments while ignoring the equally important "sociotechnical paradigm"; this paradigm emphasizes the social, political, and institutional forces influencing the development of norms that shape practices in both consumption and production. Depending on one's emphasis on the technological, economic, or socio-institutional relationships governing changes within societies, a variety of temporal divisions might be used to mark significant transitions from one revolutionary phase to another.

Kondratiev long waves, which vary between 40- and 60-year cycles, are generally thought to have entered a fifth cycle around 1971. Still other periodizations emphasize industrial production, and how "cyber-physical systems" are expected to usher in the fourth industrial revolution (Schwab, 2016). This fourth revolution is a digital revolution marked by a merging of new technologies, blurring the lines among physical, digital, and biological dimensions of everyday life. At the core of these changes is the transformation of systems of production, management, and governance of populations, specifically in terms of an algorithmic ordering of the world (Campolo, Sanfilippo, Whittaker, & Crawford, 2017): how life is codified into rules and databases that are then used to "render aspects of everyday life programmable" (Kitchin, 2011, p. 945). However, unlike most of the investigations into the socioeconomic impact of technological innovations that have focused on industrial settings and relationships, our emphasis is on those outcomes that are likely to occur within the context of urban centers actively seeking to be defined as "smart cities" (Hollands, 2015).

The Emergence of "Smart Cities"

Over the last decade, urban population centers have been reimagined as smart spaces that can integrate a range of networked systems, sensors, and analytical resources to govern and manage a city's functions. These cities have been envisioned as spaces with the computational power to monitor, gain knowledge on, and adapt to both the physical architectures that comprise these spaces and the people who inhabit them (Batty et al., 2012). In part, because of its status as an emergent phenomenon, the meaning of the term *smart city* is difficult to pin down. There is not one comprehensive definition that can be applied across all the contexts in which the term is being invoked (Hollands, 2008). As some argue, this development is strategically appealing in that the promise of smart cities can often be reformulated to suit the shifting focuses of both public and private actors (Krivý, 2018). Most of the available definitions of this spatio-temporal imaginary suggest that it must ultimately be computationally enhanced, or made "smart" overall, including the economy and its governance. For many, the ability of these aspects of smartness to be measured and evaluated in support of comparative rankings of these urban centers represents both a benefit of and a risk to their development in the future (Giffinger & Gudrun, 2010).

Nearly all those definitions make reference to the generation and use of transaction-generated information (TGI). The vast amounts of data extracted from smart city devices are expected to contribute to the management of a city's numerous interconnected systems. Successful management of cities with the assistance of algorithms and artificial intelligence depends to a considerable extent on the knowledge and ability of those managers to gather, store, access, and transform massive amounts of data into practical intelligence about the past, present, and future operation of these systems. Decisions about which features of these complex systems need to be measured, and which particular measures, or metrics, are the best to be used, become increasingly difficult as more and more participants make claims on the sorts of data and intelligence they believe they will need (Zook, 2017).

The challenges that Hollands and others see on the horizon reflect some of the difficulties associated with the responsibility to balance community needs with those of business and local governments, especially when the leaders of local governments are driven by an economic imperative to "attract capital, particularly knowledge and informational capital to their city" (Hollands, 2008, p. 311). This understandable desire to derive the benefits of investments and expenditures by well-resourced firms leads city managers to enter into deals that can easily backfire, or evaporate, because "information technology capital may flow elsewhere depending upon what advantages are available to aid further capital accumulation" (Hollands, 2008, p. 314).

Observers have also pointed out that governing these spaces with coded devices and infrastructures that rely on dynamic data might result in technocratic domination and/or corporatization of governance, subjecting urban life to top-down planning and expanded surveillance (Kitchin, 2014). In addition, surveillance, profiling, and discrimination, enabled by the commodification of TGI, seem likely to "lead to highly controlling and unequal societies in which rights to privacy, confidentiality, freedom of expression and life chances are restricted” (Kitchin, Lauriault, & McArdle, 2016, p. 20).

Of particular importance in the case of smart cities, and the variety of services provided by governments or delivered by commercial firms that are subject to government regulation, are the responses of the public to the nature, quality, and availability of those services. Increasingly, in part because data derived from social media are relatively easy to collect and analyze in real time, they have become a reliable source of information for urban analysis. However, it is the use of social media data by government agencies, especially police departments, that “raises concerns that local governments might stray towards an Orwellian big brother state in which citizens are tracked and recorded” (Zook, 2017, p. 9).

Our analysis of the proposals submitted to the USDOT Smart City Challenge represents our attempt to identify similarities and differences among cities seeking to be counted among the socially and economically attractive locales. We were particularly interested in the nature of the P3s that they include within their operational core structures and the extent to which they reflect an appropriate level of concern regarding privacy and surveillance risks (Acquisti, Taylor, & Wagman, 2016; Crawford & Schultz, 2014; Privacy International, 2017) likely to be imposed on actual or potential users of these transportation-related systems. An assessment of the extent to which distributional concerns are emphasized in these proposals in general, and with regard to the seven technical proposals that often included quite substantial shifts in expressions of concern about inequality, is used to raise questions about the influence of the USDOT and that of the corporate partners providing both advice and financial support.

The USDOT Smart City Challenge

The USDOT created a research-based initiative intended to mobilize the nation’s technologically oriented leaders to consider how information and transportation-specific developments could be applied to improve the performance of urban transportation systems. The goal was to address issues of congestion, safety, and environmental impacts in ways that would support economic vitality while extending quality services to previously underserved communities.

This initiative, named “Beyond Traffic 2045: The Smart City Challenge,” initially committed up to $40 million as support for the winning city’s project. The department extended its commitment by an additional $65 million in grants to four of the seven finalists in the competition. Additional grants to cities from corporations and philanthropic organizations expanded the resource pool by more than $500 million (United States Department of Transportation [USDOT], 2017 c).

A significant aspect of these rapidly developing urban transportation projects is the central role being played by P3s, especially those that link universities with corporate and government institutions (Gabrys, 2014; Kenney, 1986). An important consideration in the evaluation of these partnerships is the extent to which these partners have quite different goals, orientations, and levels of transparency and accountability to the public (Dameri, 2017; Kitchin, 2015; Vanolo, 2014).

Concerns about the social and political characteristics of smart cities have focused on the extent to which these projects have addressed the structural problems that link access to suitable transportation with poverty, race, and economic and social inequality (Rio, 2016). Many of these concerns are associated with the altered role of the public in which citizens become sensors embedded in the environment, and/or sources of data, in addition to their roles as members of urban communities playing a part in the participatory governance that smart cities are thought to require (Gandy & Nemorin, 2019; Mattern, 2016; Ranchordás, 2019). In this capacity, smart technology can potentially be used to alter the behavior of individuals and groups instead of engaging them in dialogue: a form of governmentality through "environmental-behavioural control" (Krivý, 2018, p. 16).

In its assessment of the initial proposals, the USDOT (2016) noted that "more than 80 percent of applicants were concerned about ensuring the cybersecurity and resilience of their Smart City Infrastructure" (p. 7). In an early assessment of the nature of these concerns, Beck (2017) examined 32 of the initial applications to the Smart City Challenge, paying close attention to how these projects appeared ready to respond to these issues. Although Beck relied on dominant framings of privacy risks in terms of harms to individuals as a result of security breaches, she observed that most of the expressed concerns about security risks in the proposals were focused on mass security breaches, whereas "fewer cities addressed cyber-and physical security breaches that target individuals" (Beck, 2017, p. 41). Very little attention was apparently being paid to the risks (Levy & Barocas, 2018) that individuals and members of communities and groups were likely to face from the mining and analysis of data about their use of transportation systems (Acquisti et al., 2016).

This project emphasized the role that the gathering of TGI would play in the management of smart city transportation as envisioned by the 71 cities and urban areas that submitted proposals in response to the USDOT's invitation.[1]

Research Strategy and Results

A variety of approaches to the analysis of the terms, frames, and areas of emphasis that characterized the approaches taken by the participant cities in this competition were used. Because the purpose of our analysis differed substantially from that of communication scholars concerned with the role of the press in framing issues of public concern (D'Angelo & Kuypers, 2010; Gandy, 2017; Manheim, 2011; McCombs, 2004), we initially sought to characterize the population of contestants in terms of their use of the words that appeared most often among the proposals.

Using NVivo software to characterize the set of proposals as a whole, an initial search identified and ranked words by the frequency of their use. We noted that the terms of primary interest to us were not very popular among the competitors.[2] While "minority," "underserved," and "low-income" did not rank among the

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[1] Although 78 proposals were submitted to and considered by the USDOT, only 71 were capable of automated processing by the content analytic software that was incorporated into Adobe Acrobat Reader DC or NVivo 11 Pro.

[2] NVivo's Word Frequency Query identified and listed words, and similar words, by their count and weighted percentage, stopping at the 1,000th word in the list.

most popular thousand words, “privacy” came in at 609th. Although “elderly” did not make the list, “senior” or “seniors” came in at 777. To identify the competitors that used similar references of thematic importance, NVivo’s Word Frequency Query resource was used to link proposals on the basis of word use similarity (Figure 1).

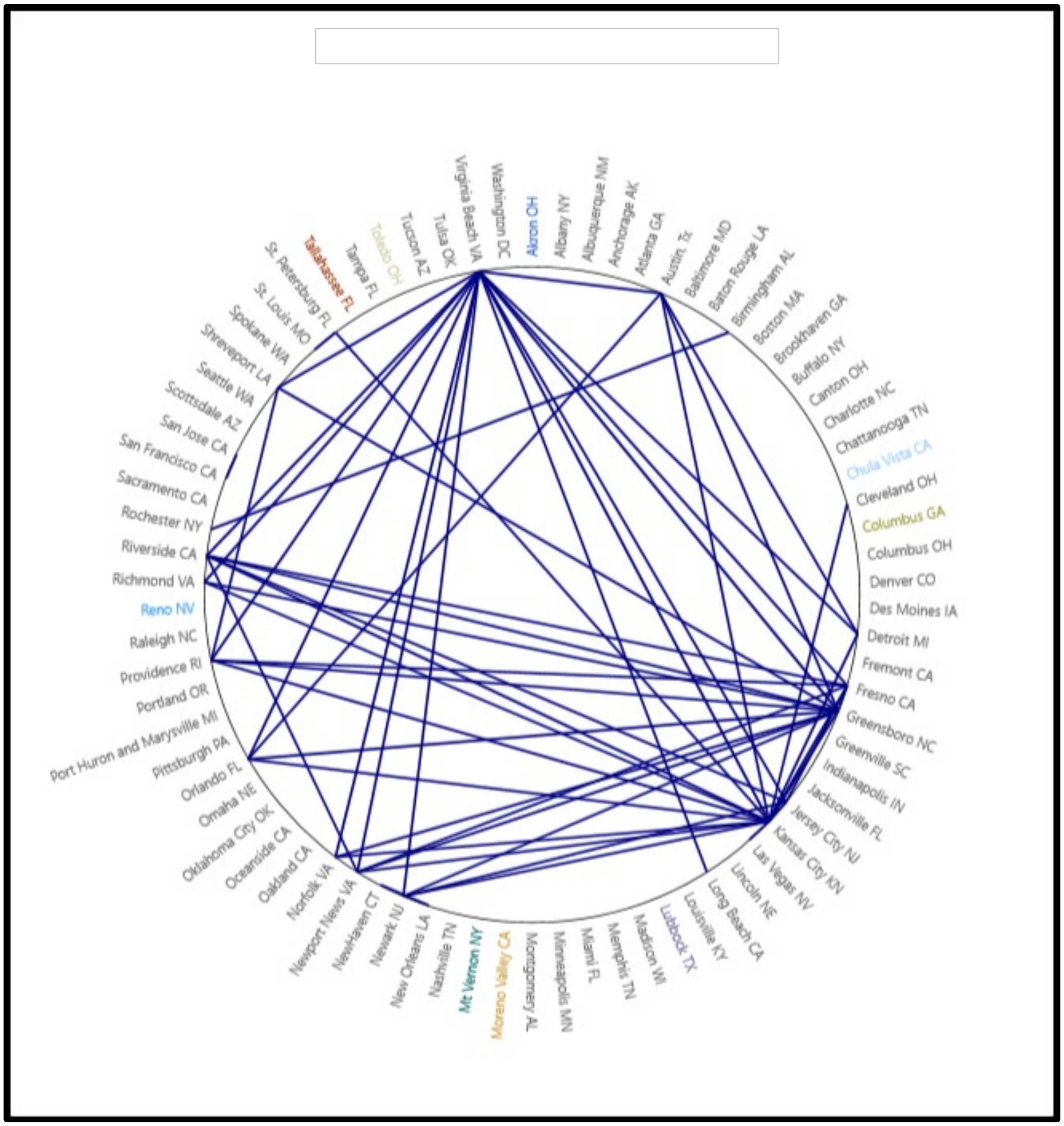

Figure 1. Relationship between proposals in terms of common word usage.

The initial proposals were not closely associated with each other, and, more critically, from our initial assumptions about the role played by terms of emphasis in the positioning of the competitors, very few of the "finalists" in the competition were in any of the more similar clusters. Kansas City's proposal was most closely linked with other proposals. Austin had links with five other cities, several of which were quite highly linked, but San Francisco was only linked with its near neighbor San Jose. None of the remaining finalists were parts of meaningfully similar clusters.

Because orientations toward privacy and an emphasis on inequality and disadvantage were among the policy-related concerns that we identified as being central to the development of smart cities within the United States, we examined how the general population of competitors conveyed their interest in these areas.

Orientations Toward Privacy

Tucson's proposal (2016) discussed privacy concerns in the context of a table describing privacy risks and their levels, and specified in general terms how the city would act to mitigate those risks. Noting that privacy represented medium-high risk, Tucson simply said that it would "develop policies and procedures to protect private individual information" (p. 13). Its plans identified a number of "data collection and privacy rights that address what data will be used, for what, and by whom" (p. 24). Boston's proposal (2016) had more to say on the subject of privacy, indicating that it would "crowd-source" the development of new standards through collaboration with its public- and private-sector partners. Boston suggested that to ensure that "data is research- and product-ready, we will implement APIs and the privacy & security policies necessary to ensure easy access and appropriate use" (p. 5). It is worth noting, however, that Boston's interests in this area seem to relate primarily to the potential for monetizing the data being generated and captured through its system.

Rochester (2016) made nearly as many references to privacy as Boston. Yet, Rochester's approach to privacy is somewhat unusual in emphasizing its relationship to the interests of consumers: "Empowerment of consumers with enhanced information to save energy, ensure privacy, and shrink bills; and improve grid security and resilience" (p. 15). Many of its privacy-related references emphasize the collaborative aspects of its partners' efforts to keep up with the challenges that privacy and security represent. Like Rochester, the proposal from Norfolk expressed great confidence in the city's ability to manage whatever problems related to privacy and security might arise. Its level of confidence seemed unwarranted, however, given its recognition that activities demanding security will only increase. Despite this, Norfolk's proposal (2016) promised that a "security plan will also be extended to fully cover all smart services used by the City, taking into account all perimeter access points to ensure proper controls and privacy are maintained" (p. 19).

New Orleans' proposal differed from Norfolk's in that it recognized a considerable number of areas of concern with regard to privacy and security, especially as they relate to data access and governance. Without claiming that the city is prepared to handle all challenges, New Orleans' proposal (2016) concluded,

> The sheer scope of data generated by a Smart City poses new challenges. Even anonymized data carries privacy implications, as highly specific conclusions can be drawn for historical location data over time. Balancing this risk with our commitment to open data for all, we will work with international data science experts to navigate this challenge as we develop our proposal. (p. 29)

Inequality or Equity Versus Disadvantage

None of the references we examined in detail considered privacy risks in terms of their distributional characteristics. However, concerns about the social consequences that may accompany the transformations likely to take place in urban centers need to be situated high on the public policy agendas being established to shape their development (Perez, 2013). Terms used in the discussion of inequality and differential access to opportunity are related to, but critically distinct from, references to poverty and its extent. There are similar, but importantly distinct, meanings associated with references to equality and equity. The terms take on a different character, for example, when they involve comparisons between neighborhoods in which levels of poverty and disadvantage vary (Chetty, Hendren, Jones, & Porter, 2018), in part on the basis of the procedures by which the distribution of resources and opportunities is determined. In recent years, scholarly and political attention has turned more explicitly toward measurement and comparisons of inequality within nations and around the globe, raising its salience as a basis for pursuing policy change (Abel & Deitz, 2019; Hacker & Pierson, 2010).

The narrative proposals were reviewed to identify and then compare how these cities presented their assessments of the character of access to transportation within their various neighborhoods, and their strategies for addressing them with assistance from the USDOT. Despite the quite dramatic increase in mass media attention to the problem of inequality in the United States and around the globe, specific references to inequality were actually quite rare among these proposals. Of 71 proposals, only 11 explicit references to inequality were found, and nearly all those references were to income inequality.

An alternative strategy, somewhat less informative than relying on references to inequality, was chosen despite the considerable differences in the interpretation of equity as a status rather than as a procedural indicator. A search for the stem "equit" was made without regard to the different uses to which it might apply (equity, equitable, inequitable, etc.). A rather dramatic increase in usage of the stem was observed and then explored in the contexts of its use within the proposals.

New Orleans' proposal used the stem some 30 times. However, only four uses of the stem were as a part of "equity," and the rest were either "equitable" or "equitably." However, the New Orleans proposal (2016) identified its first goal as a determination to "equitably increase economic opportunity to all residents through smart mobility solutions," such that it would "ensure that new technologies are distributed equitably across the entire city" (p. 7). As with other proposals, references to equity in Montgomery's proposal (2016) were associated with a recognition that "the historic legacy of inequity and separateness continues to play out in the lives of its citizens through antiquated spatial planning models, transportation infrastructure financing and the presence of a burdened criminal justice system" (p. 3). It is not surprising, given its history within the automotive industry, that the proposal from Detroit (2016) also placed concerns about "equitable mobility" high on its agenda. It noted that "making these investments in Detroit will have a significantly greater impact on equity and inclusion than they would in any other city in America due to our unique mobility challenges" (p. 3). Although the proposal noted Detroit's status in terms of car ownership, unemployment, and poverty rates, it only indirectly focused on the historic decisions that helped to produce the disparities that the city now seeks to overcome.

Frames and the Structural Character of Cities

Without directly capturing the nature of historical influences on the character of life in these cities, we sought to associate the relationship between selected terms and the socioeconomic characteristics of the cities or metropolitan areas in which they exist. Our approach to the identification of frames began with the identification of words within a list of 17 terms that were correlated with each other in terms of their inclusion within the proposal.[3]

We then evaluated the extent to which the presence of those terms within a proposal was correlated with a set of socioeconomic characteristics of those cities, emphasizing those that indicated the nature of racial and economic inequality, hardship, and segregation. Unfortunately, very few of the socioeconomic indicators that we had selected as having explanatory or predictive utility were available for all the cities participating in the competition. The most complete coverage was associated with the percentage of the population below the poverty level, and the Gini coefficient was used as a measure of inequality.[4]

We used as a criterion measure of relevance to our analytical goals the fact that the word or stem was correlated on the basis of the frequency of its appearance within the text with at least three other key terms and with at least one of several socioeconomic measures. Six terms and two indicators (% poor and Gini coefficient) met those requirements (Table 1).[5]

Table 1. Correlations Among Textual References and Economic Status.

	Behavior	Seniors	Equit-	Police	Privacy	Trust	% Poor
Seniors	0.393**						
Equit-	0.375**	−0.079					
Police	−0.164	0.051	−0.168				
Privacy	0.239*	0.016	0.173	−0.245			
Trust	0.446**	0.292*	0.113	−0.140	0.272*		
% Poor	−0.236*	−0.310**	0.080	0.045	−0.075	−0.171	
Gini	0.126	0.014	−0.048	−0.095	0.248*	0.024	0.394**

[3] Behavior, Camera, Data Sharing, Disab-, Economic Opportunity, Elderly, Equit-, Low-income, Non-Profit, Police, Privacy, Public-Private, Seniors, Sensors, Social Media, Trust, Underserved.

[4] Among the socioeconomic characteristics we considered were: White/Black Dissimilarity Indices, Neighborhood Exposure Indices (segregation), Distress Score (poverty) Black population share, 95/20 ratio (inequality).

[5] SPSS, Pearson correlation, two-tailed, * = P =.05 or less, ** = P =.01 or less.

Behavior emerged as an important term because it was significantly correlated with four other core terms and one socioeconomic indicator. Most of the significant correlations with other key terms were positive, meaning that proposals that made frequent references to behavior also made frequent references to equit, privacy, and trust.

However, we note that the correlation of references to behavior with the percent of the population identified as poor on the basis of their earning less than the poverty level is negative. This suggests that a focus on the behavior of the poor was less likely to be a part of the strategies common to those cities, despite the significant positive correlation between the Gini measure of inequality, which reflects the distribution of incomes across the entire population, and the more restrictive measure of percentage poor.

Trust was also an important term, with significant correlations with seniors and privacy, but it was not highly correlated with either of the socioeconomic indicators; this suggests that trust was more of a central framing resource rather than one associated with particular kinds of populations. Privacy was positively correlated with trust and negatively correlated with police, but it was also correlated positively with the Gini coefficient; this indicated that in communities marked by higher levels of inequality, concerns about privacy were more likely to be expressed. We note that none of the population sectors associated with particular populations at risk were linked with references to privacy, although they were correlated with trust.

Because we assumed that the frames in the proposals identified by the USDOT as the sponsor of the competition were those deemed to be representative of appropriate orientations toward the challenge as they defined it, we focused the balance of our analysis on the similarities and differences between the seven finalists, both in their initial narratives and in their subsequent technical proposals.

The Finalists

The USDOT (2017a) selected seven cities as finalists in the competition: Austin, Columbus, Denver, Kansas City, Pittsburgh, Portland, and San Francisco. These finalists received financial support and technical assistance to prepare technical proposals. Three of the seven finalists identified goals that reflected concerns about inequality, and they focused primarily on the disadvantaged or underserved. In its report on the lessons learned from the Smart City Challenge, the USDOT (2017c) divided the goals and strategies of the finalists into technological, social, and policy-oriented groups, with the concerns about inequality falling under the heading, "How We Grow Opportunity for All" (p. 14). They noted that historic racial and economic divides have been perpetuated by planning, infrastructure, and "socioeconomic policies that have isolated neighborhoods, encouraged sprawl, enabled economic segregation, and overlooked pockets of poverty" (USDOT, 2017c, p. 15).

The USDOT (2016) announced its seven finalists as part of its report on "trends and priorities from Round 1" (p. 3). It did not focus on the differences between the applicants; instead, it characterized the points of common emphasis among the proposals. It offered broad descriptions of the "unique challenges" to be addressed by three cities; one was Detroit, which indirectly referenced inequality with regard to its being an area "almost totally reliant on personal auto ownership. As a result, many Detroiters lack affordable access to mobility" (USDOT, 2016, p. 5). When the USDOT pointed out "shared mobility challenges," it included comments from Seattle's proposal, which noted the impact of gentrification "resulting in low-income residents moving further from downtown to areas where access to high frequency public transportation is weaker" (p. 6).

Because the seven finalists were selected by the USDOT, we assumed that aspects of their proposals made them stand out from the crowd, beyond the degree to which they differed from most of the other applicants in terms of their use of words. We also assumed that the USDOT would provide evaluative guidance that would be reflected in modifications of their initial proposals. We used several strategies to identify the similarities and differences between the finalists' narrative and technical proposals (Table 2).

Table 2. Change in References From Narrative to Technical Proposals.

	Behavior	Elderly	Equit-	Police	Privacy	Trust	Correlation
Austin	+3	+4	+18	+1	+1	−2	0.651
Columbus	+1	+1	0	+1	+6	0	−0.100
Denver	0	−1	+3	0	+24	0	0.658
Kansas City	+1	0	+1	+11	+8	+1	0.944
Pittsburg	−5	−2	−3	−5	−4	+1	0.210
Portland	−2	+4	−12	0	+22	+1	0.596
San Francisco	+12	−1	+60	+6	+55	+2	0.505

Using 17 terms[6] that we believed were important to understanding the orientation of smart city planners toward the populations most likely to be placed at risk as a result of increased reliance on big data analytics, we examined the changes made among the different versions of their proposals with regard to frequency of reference. The greater the positive correlation between the initial and final proposals, the less change there had been in their use of those terms. Columbus changed its proposal the most, as indicated by its negative correlation (r = −0.10). Kansas City changed the least, as reflected in the high positive correlation between its proposals (r = 0.94). The overwhelming tendency in the revision of the finalist proposals was to increase their references to our selected terms. Although Pittsburgh made relatively few changes, it actually tended to reduce the use of many of the terms that the others had increased. While Columbus made the most changes between its narrative and technical proposals, its changes were not in the terms that characterized the adjustments made in the other finalists' proposals.

The socioeconomic characteristics of the finalist cities (Table 3) do not appear to be determinative of either the use of terms in the narrative proposals or the changes observed in the technical proposals. We note that the correlation between percent poor and inequality (Gini) for the finalists' cities (r = −0.125) is quite different from that characterizing the relationships among these indicators in the narrative proposals as a whole (Table 1, r = 0.394). For example, San Francisco had the smallest proportion of its population

[6] Behavior, Camera, Data Sharing, Disab-, Economic Opportunity, Elderly, Equit-, Low-income, Non-Profit, Police, Privacy, Public-Private, Seniors, Sensors, Social Media, Trust, Underserved.

identified as poor, but it shared with Pittsburgh the highest Gini coefficient, indicating the cities' higher levels of economic inequality.

When we examined the use of the important terms in their technical proposals, we noted that San Francisco's proposal (2016) had the bulk of the equit-stemmed references (69). "Equitable" was used primarily as a description of the kinds of access that would be provided to residents. The only reference to inequities occurred early in the proposal, when the city noted, "Without innovation to meet housing and transportation inequities, the region risks its economic competitive advantage" (p. 1). Other uses of the "equit" stem included the reference by Austin's mayor: "Our city faces a confluence of mobility, equity and opportunity challenges that has plainly reached crisis levels" (Austin, 2016, p. 1). Indeed, the mayor even characterized his city as "the most economically segregated community in the country, and this segregation increases as the poor are pushed to the margins of an increasingly unaffordable city and region" (p. 1).

Table 3. Socioeconomic Characteristics of Finalists.

Finalists	% Poor	Gini
Austin	16.7	49
Columbus	20.9	49
Denver	16.4	50
Kansas City	18.3	48
Pittsburg	22.3	52
Portland	16.9	49
San Francisco	12.2	52

Without engaging in a detailed examination of the gentrification process, this highlighting of the challenges of displacement reflects an understanding of the underlying structural processes that have "forced many to move to places inaccessible to public transit and employment centers" (Austin, 2016, p. 1). The analytical framework is extended in Austin's proposal with reference to "transit deserts" that are to be understood as "not just a transportation problem; it's an equity problem" (Austin, 2016, p. 15).

The reference that emerged as a "term of art" among the finalists was the "underserved," with 82 such references occurring within these seven technical documents. San Francisco, Pittsburgh, Columbus, and Portland were the least likely to use the term, ranging from three to nine cases. "Underserved" was used primarily as a characterization of "communities" not necessarily linked geographically, but structurally. Austin's proposal (2016) did note that "outlying suburbs are developing their own concentrations of poverty, in areas where there are few services to meet the needs of the underserved" (p. 1). Austin (2016) offered a gentle criticism of traditional development strategies, noting that "scaling from well-served/developed markets to underserved markets almost always presents challenges, so we should invert the normal and start with the underserved" (p. 41).

Denver made the most dramatic expansion in its use of references to the underserved, increasing from 2 to 29. Beginning with reference to the city's commitment to addressing the problem of the underserved made by the mayor in the letter of transmission, Denver's technical proposal (2016) begins with the "alarming fact" that "up to 40 percent of Denver's residents live in underserved neighborhoods" (p. 1) and follows up with a structural analysis. It notes that these neighborhoods are "primarily in the western, northern and northeastern portions of the city, many of which are disconnected by physical barriers such as highways, railroads and rivers" (p. 1).

References to "low-income" populations were not nearly as popular among the finalists as reference to the underserved, in part because of the more limited scope of the term. The most frequent use of the term was by Portland, which increased its references from 6 to 26. Although "low-income" often appeared in comma-differentiated lists, that reference was often first in Portland's lists. Low-income communities in Portland were often characterized racially—with specific reference to African Americans—without the label of gentrification or the assignment of blame or responsibility. One reference (Portland, 2016) was made to the case in which a "traditionally African-American neighborhood, for example, experienced a 40% increase in average rent over the past 5 years. As a result, the neighborhoods best served by transit are less accessible to low-income Portlanders" (p. 3).

While references to information technologies were used throughout these proposals, references to sensors increased quite substantially between narrative and technical proposals. The greatest increase was made by Kansas City (from 23 to 69), and the smallest increases were made by Denver (from 0 to 9), Pittsburgh (from 4 to 11), and Columbus (from 0 to 13). The primary use of references to sensors was in relation to their value in providing data and information to planners and public safety agencies. Comments about their value for transportation system users were limited primarily to providing support to facilitate travel-related planning, "allowing citizens to make well-informed travel decisions" (Kansas City, 2016, p. 10). A somewhat different use of sensors was related to crime control, such as the plans being made by Kansas City (2016) to use sensor technology that would "enable an intelligent analysis through the triangulation of sounds to deliver accurate and real-time location of gun crime" (p. 4).

References to sensors were also associated with privacy. San Francisco made the most dramatic increase in references to privacy (from 1 to 56). Its approach to the challenges that it expected to come along with a massive increase in data gathering and analysis was unique in part because it planned to use 16 pilot projects that would require institutional review board approval. In describing the policies that it would evaluate, it indicated that it "will create a framework for ensuring that new data collection methods do not create unnecessary threats to privacy, i.e. the . . . ability to move throughout the City without being centrally tracked" (San Francisco, 2016, p. 54).

Portland's orientation toward privacy was also substantially increased, from eight to 30 references. Although its proposal tended to link privacy with security concerns, most of its references were reflective of service providers' interests rather than those of transportation service users. The discursive connection of privacy to users frequently emphasized the need to establish user trust—a need to convince Portlanders that they can use resources "with confidence that their privacy will be protected" (Portland, 2016, p. 57).

Despite Denver's comparatively limited reference to sensors, its technical proposal increased its references to privacy from four to 28. Most of those references were quite general, however, emphasizing system functions, as reflected in Denver's commitment to "implement privacy and security by design in the delivery of all systems while maintaining open access and interoperability for collaboration locally, regionally and nationally" (Denver, 2016, p. 32). Its approach to data sharing was one that took existing privacy policies as being suitable, except with regard to researchers. It indicated that in "the case where data includes PII or other restricted data, the City will make the data available to qualified researchers in compliance with all City privacy policies" (Denver, 2016, p. 36). Denver's orientation toward privacy is one that appears to have been shaped by a desire to facilitate access rather than to protect privacy, as this quote suggests: "In a Smart City construct, data exists in many formats, and the ability to connect data sources and integrate data as broadly as possible is paramount" (Denver, 2016, p. 53).

And the Winner Is: Columbus, Ohio

After characterizing the proposal from Columbus as a "holistic vision for how technology can help all residents move better and access opportunity" (p. 19), the USDOT (2017c) announced its selection of that city as the winner of the Smart City Challenge.

In developing our overall impression of the competition and its winning proposal, we felt that it was important to consider the kinds of adjustments that had been made in the technical proposal from Columbus. While we observed a moderate increase in the number of references being made to social media, which has been identified as playing an increasingly important role in the nature of privacy, as well as in the nature of political engagement, Columbus made only a fractional increase in its references to privacy.

In addition, the Columbus project intended to make use of the Alphabet/Google Sidewalk Labs Flow platform (Sauter, 2018) to help encourage and facilitate "health visits to be made through transportation subsidies and the linking of the trip to a 'Smart Columbus' payment card/mobile application" (Columbus, 2016, p. 32). The extensive criticism that has been focused on privacy concerns related to the Lab's proposed project in Toronto (Brauneis & Goodman, 2018) suggests the need for a much more substantial emphasis on data privacy than this proposal indicates Columbus was committed to or ready to provide.

Commentary and Conclusions

In its comments about the lessons learned from the Smart City Challenge, the USDOT (2017c) called attention to the areas in which proposals responded to a small set of common mobility challenges. The first comment listed focused on the need to "connect underserved communities to jobs" (p. 4). The second emphasized challenges related to "coordinating data collection and analysis across systems and sectors" (p. 4). Understandably, the references made to the cities' proposals to address these problems reflected the degree of emphasis they observed among the proposals. It is striking that from their perspective, only nine of the 78 proposals they reviewed initially provided much of a focus on "how we grow opportunity" (USDOT, 2017c, p. 5).

The USDOT's reflections then turned to the primary contributions made by the seven finalists with the assistance of the department, government experts, and a host of private partners. In the section on growing opportunity for all, the USDOT noted that "the seven finalists proposed over 60 unique strategies to increase access to jobs, provide training, reach underserved areas, and ensure connectivity for all"

(USDOT, 2017c, p. 15). However, because there were very few references to growing opportunity in either the narrative or technical proposals, we assume that there was actually very little pressure being applied by the department to increase the attention that would be paid to such concerns.

The USDOT (2017c) did make specific reference to Austin and its strategies designed "to reconnect residents [whom] gentrification has pushed away from downtown with new mobility options" (p. 15). Its reference to Columbus's proposal emphasized the city's plans to "reduce infant mortality . . . by creating smart corridors and smart payment projects . . . for individuals in underserved neighborhoods" (USDOT, 2017c, p. 15). Other technological innovations in the Columbus plan related to improving access to health care services by introducing an "electronic appointments and scheduling platform for doctor visits with transit tracking so that rescheduling is automated and expecting mothers need not wait weeks to reschedule appointments" (USDOT, 2017c, p. 20).

The USDOT made only a single reference to privacy in its summary document, and its emphasis was on the extent to which the finalists had come to "understand that only by building a resilient, secure privacy-driven data platforms *[sic]* will the public feel confident sharing their data" (USDOT, 2017c, p. 13). Yet, we noted that there were quite dramatic increases in references to privacy in proposals from Denver, Portland, and San Francisco. And even though such references in the Columbus technical proposal were comparatively few, they increased from zero to six. However, none of those six references was about the level of confidence that the public might feel about the nature of their data platforms. Even though the number of references to social media made by Columbus was among the highest made by the finalists, perhaps there is some comfort to be drawn from the fact that social media was seen primarily as a promotional channel rather than an instrument of surveillance or commercial exploitation.

There is also some comfort to be derived from the number of proposals that expressed concerns about, and the problems of, inequality and disadvantage, along with expressions of concern about the challenges to opportunity that are characterized as privacy risks. This is especially important in the context of rapidly developing insights about the importance of the heightened privacy risks that low-income Internet users face because of their reliance on their smartphones for most of their social media interactions (Madden, Gilman, Levy, & Marwick, 2017).

The technical proposal from San Francisco (2016) was quite different from that submitted by Columbus. Only one of the two references that Columbus (2016) made to behavior was related to efforts to assist residents in making appropriate behavioral adjustments. Its hybrid app would include "pointers for environmentally sustainable behavior" (p. 80) among the information provided to promote personal and environmental health. On the other hand, San Francisco's proposal (2016) had 16 references to behavior that included a commitment for the city to "work with the community, employ technology and pilots to shift behavior" (p. 5). It characterized its approach as a comparatively rare "demand side approach" through which it was "proposing to change user behavior at a scope and scale that is commensurate with our challenges" (San Francisco, 2016, p. 5). It even identified its efforts along with other P3s seeking to shape behavior somewhat more aggressively (Gandy & Nemorin, 2019), arguing that its "platform helps travelers make informed decisions and can nudge their travel behavior toward more sustainable travel" (San Francisco, 2016, p. 17). Many of its references were made in relation to the many research projects being developed that would help the city to understand how its projects affected travel behavior. It even associated concerns about privacy with what it characterized as "the shrinking scope of private behavior and action" (San Francisco, 2016, p. 59).

San Francisco (2016) made substantially more references to privacy than the others, and its discussion of its "privacy and security framework" included a "privacy risk model" (p. 55) that identified three primary privacy risks: (1) unauthorized access or disclosure of private information, (2) the reidentification of individuals whose data were intended to be anonymous, and (3) the "reduction in autonomy . . . posed by sensor-based data collection methods" (p. 55). Although our view is largely speculative, it seems likely that the financial and technical support that San Francisco received as a finalist expressing concern about privacy and surveillance led that city to become the first in the nation "to ban the use of facial recognition technology by the police and other city agencies" ("San Francisco Banned Facial Recognition," 2019, para. 5).

Looking Forward

Although it was possible to note the kinds of changes that have been made in the way these competitors altered their proposals, we had no generalizable basis for inferring the nature of the influence exercised by the USDOT, or by any of the corporations or foundations that provided both professional guidance and financial support, on the adjustments that were eventually made. In comparison with the difficulties that we and others faced in attempting to characterize the nature of the institutional and organizational influences on the development of smart city proposals and initiatives, we still believe that it should be possible to explore the relationship between socioeconomic and structural features of these cities and their discursive imaginaries.

Many of the proposals made reference to the status of various indicators, often in comparative terms, with rankings, or with regard to levels or rates of improvement in those measures. By treating the more frequently used references to key measures as dependent variables, comparative assessments of predictive or explanatory models would provide us with a valuable, if indirect, indicator of those factors that seem to matter more or less across cities, states, regions, and even nations as they plan for the future.

Chin's (2017) use of cluster analysis to assign 36 cities into four primary forms and 11 "micro-foundations" that facilitate comparisons between cities while identifying what she refers to as "solution sets" for planning interventions and investments in their futures represents a promising approach along these lines. It is encouraging to note that in addition to racial and ethnic status comparisons, she included measures related to poverty, such as the supply of affordable housing, the impact of gentrification, and the levels of unemployment within census regions. Although we expect that it would be something of a challenge to gather comparable data from all these cities, it would be especially useful to be able to estimate the impact of political mobilization and activism on the part of underserved and racialized community members on their city's plans for truly getting smart.

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