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Leiming Zhao

University of Nebraska - Lincoln, leimingzh@gmail.com

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Social Media Communication by Local Governments and Its Implications
for Urban Planning

by

Leiming Zhao

A THESIS

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Social Media Communication by Local Governments and Its Implications for Urban Planning

Leiming Zhao, MCRP

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Adviser: Zhenghong Tang

Abstract: Social media has altered traditional communication and enriched traditional social networks. In addition to its use for personal communication and business marketing, social media has also been proved to be a valuable tool for urban planners and managers. However, there are relatively few studies about how social media communication may inform the design of urban master plans. The objectives of the thesis are to understand how the city governments have used social media to engage with the general public on urban planning issues, and assess if social media contents can be used to inform urban planning. The 10 top digital cities with mid-range population size rated by the Center for Digital Government (CDG) were selected as study sites. A combination of statistical analyses and manual topic classification were used to reveal the patterns of the social media discussion. The outputs were then compared with the comprehensive plans of these cities. The results showed that (1) social media contents encompass a broad range of planning issues, and have been used as supplemental information to improve the comprehensive plans; (2) there is no statistical difference between Facebook and Twitter discussion on planning issues percentage-wise; (3) Overall, the comprehensive plan provides more detailed and structured visions and strategies to address planning issues compared with fragmented social media discussion.

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Chapter I

Introduction

1.1 Background

A vast array of web-based social media services has burgeoned in the recent decade, including such examples as blogs, microblogs (e.g., Twitter), social sharing services (e.g., YouTube, Flickr), discussion forums, collaborative editing tools (e.g., Wiki), and social networking services (e.g. Facebook) (Hansen et al., 2010). Well-known social media sites such as Facebook, Twitter and YouTube have become increasingly popular and acceptable means, in which global Internet users can easily connect each other and share up-to-date information and real-time contents in a virtual world. As of June of 2018, the registered active users on Facebook and Twitter are over 2.23 billion and 68 million monthly active users, respectively (Statista, 2018). Defined as Internet-based applications that build on the conceptual and technological framework of Web 2.0, social media allows the rapid dissemination and exchange of user-generated information (Kaplan and Haenlein, 2010). These modern communicating trends have not only cultivated a massive public preference for the quick and real-time communication, but also have boosted a series of invisible products, including question feedback, news updating and techniques innovation.

Social media has altered traditional communication and enriched traditional social networks. People can make friends with each other and learn about news and exchange ideas through such platforms as Facebook, YouTube and Twitter. Social media has had revolutionary influence on public relations in business world (Hoffman and Fodor, 2010). Social media can affect a firm's reputation, sales and even survival. In a cyberspace of society, people can communicate or

comment freely regarding their experiences or ratings of the businesses. The traditional resorts to press announcements or public relationship managers seem minimal because firms have either no chance or right to alter publicly posted comments on the social media (Kaplan and Haenlein, 2010).

In addition to its use for personal communication and business marketing, social media has also been proved to be a valuable tool for urban planners and managers. The adoption of social networking tools contributes to the paradigm shifts in planning methods and practices, such as the Urban Planning 2.0 (Anttiroiko, 2012). The adoption of social media by local governments can improve urban planning and management via various avenues, such as:

- (1) Augmenting information sharing and promoting community participation in decision making of urban affairs (Evans-Cowley, 2010; Fredricks and Foth, 2013; Kleinhans et al., 2015) by reaching out to historically difficult to reach, as well as new, segments of our society.
- (2) Improving the understanding of social dynamics and problems of a city, such as behavior and mobility patterns (Liu et al., 2014, CIVITAS, 2015), land uses (Frias-Martinez et al., 2012), social inequity (Shelton et al., 2015) and unemployment (Llorente et al., 2015).
- (3) Enhancing the preparedness and responses to urban emergency events (Xu et al., 2016).

The primary drivers of employing social media by the governments can be attributed to the active government engagement and widespread use of social media in the daily lives of many people. Its inception can be dated back to the periods of President Clinton and President Bush, when several projects related to social media were engaged in to promote an effective and

efficient government (Bertot et al., 2010). The Presidential Memorandum on Transparency and Open Government, issued on January 21, 2009, stipulates that government should be transparent, participatory and collaborative (Lux Wigand, 2011). Key objectives of such practices include greater efficiency, deeper transparency, higher service quality and more public participation (Sandoval-Almazan and Gil-Garcia, 2012). Another important force under this new communication paradigm is the widespread use of social media by citizens, businesses and non-profit organizations. The vast number of social media users makes the open access to government information and services through social media necessary and indispensable. Further, social media can serve not only as channels of information collection and services by the government, but also the platform to allow information exchange between government entities and to enable public participation in the decision-making processes of important urban affairs (Sandoval-Almazan and Gil-Garcia, 2012). It helps extend government services, solicit new ideas, improve decision-making and problem-solving (Bertot et al., 2012), reduce miscommunication, information asymmetry between the government and the public, and increase the information flows and public trust. Since the inception of the social media, the governments have been increasingly relying on social media to establish open platforms of public participation on critical urban issues, and improve interaction between more transparent governments and public voices.

Historically, unidirectional information flow and data sharing characterized how the government websites interacted with the public in its early stage (Sandoval-Almazan and Gil-Garcia, 2012). That is, a website created the contents and its users only consumed it (Agichtein et al., 2008). The use of social media in government administration has substantially increased in the last decades. The integration of social media and Web 2.0 technology in the government

websites not only provides new avenues for the interaction and collaboration within a network of government and non-government actors, but also fosters a two-way communication paradigm among governments and publics. Accordingly, the roles of web users have changed from content consumers to generators and deliverers with the rise of social media (Park and Cho, 2011). The direction of information exchange and the level of networking and interaction among social media users separate it from the traditional media (Park and Cho, 2009). In addition to improved communication dynamics, social media provides a more cost-effective means to enable public engagement for both governments and the public. On the one hand, social media and Web 2.0 tools can easily be integrated into existing government websites. On the other hand, they allow citizens easily to switch among different platforms when dealing with multiple government entities, since the social media are not proprietary to any government entity or single website.

Researching and evaluating the quality of social media communication by local governments is essential to improve their continual usage and advance public engagement in critical urban issues. Federal and state governments tend to pioneer in the application of such new information technology (Lux Wigand, 2011; Sandoval-Almazan and Gil-Garcia, 2012). Up to now, social media applications have been widely applied in the federal executive branch of government (Mergel, 2013). Table 1 shows the social media channels used by the federal government agencies and departments. The roles of social media, as interactive planning and communication tools, have been growingly recognized by local authorities and decision makers in many cities of the United States. As a result, our society has witnessed widespread adoption of social media channels by local governments.

Table 1 Channels of social media in Federal Governments

Agency	Facebook Channel	YouTube Channel	Twitter Channel
General Services Administration	www.facebook.com/USAgov	www.youtube.com/USGovernment	https://twitter.com/USAgov
White House	www.facebook.com/WhiteHouse	www.youtube.com/user/whitehouse	https://twitter.com/whitehouse
National Aeronautics and Space Administration	www.facebook.com/NASA	www.youtube.com/NASATelevision	https://twitter.com/NASA
Centers for Disease Control	www.facebook.com/CDC	www.youtube.com/user/CDCStreamingHealth	https://twitter.com/CDCgov
Department of State	www.facebook.com/usdos	www.youtube.com/user/statevideo	https://twitter.com/StateDept
Department of Health and Human Services	www.hhs.gov/facebook/	www.youtube.com/user/USGOVHHS	https://twitter.com/hhs.gov
Census Bureau	www.facebook.com/uscensusbureau	www.youtube.com/uscensusbureau	https://twitter.com/uscensusbureau

However, existing studies on how social media can or has been applied in urban planning have been relatively limited. Although a few papers (e.g., Evans-Cowley, 2010; Evans-Cowley and Griffin, 2011; Kleinhans et al., 2015) provide excellent insights on this topic, very few studies have examined how social media have been used to communicate key planning issues that may better inform the design of urban master plans.

1.2 Research Question and Objectives

Since a majority of U.S. citizens are serviced by local governments and many administrative functions and services are provided at the local level (Huang, 2006), it is imperative to better understand the application of social media in local governments. Especially, there are relatively few studies about how social media communication can inform urban planning issues. The research question that needs to be answered in this study is **how social media used by local governments may help inform urban planning?** It is hypothesized that word of mouth

discussion on social media platforms used by local planning departments contains information that may be used to better inform city planning.

The objectives of the thesis are to: (1) understand how the city governments have used social media to engage with the general public on urban planning issues; and (2) assess if social media contents can be used to better inform urban planning. This thesis is expected to provide unique perspectives on social media communication and its implications for urban planning in U.S. cities.

Chapter II

Methodology

2.1 Study Cities

This research focuses on the top digital cities rated by the Center for Digital Government (CDG) based on their 2016 Digital Cities Survey (see the link at <http://www.govtech.com/dc/digital-cities/Digital-Cities-Survey-2016-Winners-Announced.html>). According to CDG, these cities have been “using technology to improve citizen services, enhance transparency and encourage citizen engagement.” There were a total of 50 cities selected under 5 population categories (i.e., 500,000 or more, 250,000~499,999, 125,000~249,999, 75,000~124,999, and 75,000 or less). To test my proposed methodology, this study selects the top 10 cities under the 250,000~499,999 population category, including Virginia Beach, VA; Kansas City, MO; Pittsburgh, PA; Greensboro, NC; Riverside, CA; Long Beach, CA; Sacramento, CA; Cincinnati, OH; Henderson, NV; and Omaha, NE. Cities with mid-range population was selected, because the cities with a smaller population base may not present significant social media footprints, but those mega-cities with very large population may present very high spatial and demographic heterogeneity on concerned issues. For example, the identified planning issues on social media pages of the City of New York may not well represent the voices from those residents from the less representative boroughs. Table 2 shows the estimated population of each of the ten case study cities in 2015 according to the U.S. Census Bureau. Figure 1 shows the locations of these cities, of which four are situated in the western states, three in the central, and another three in the eastern coastal states.

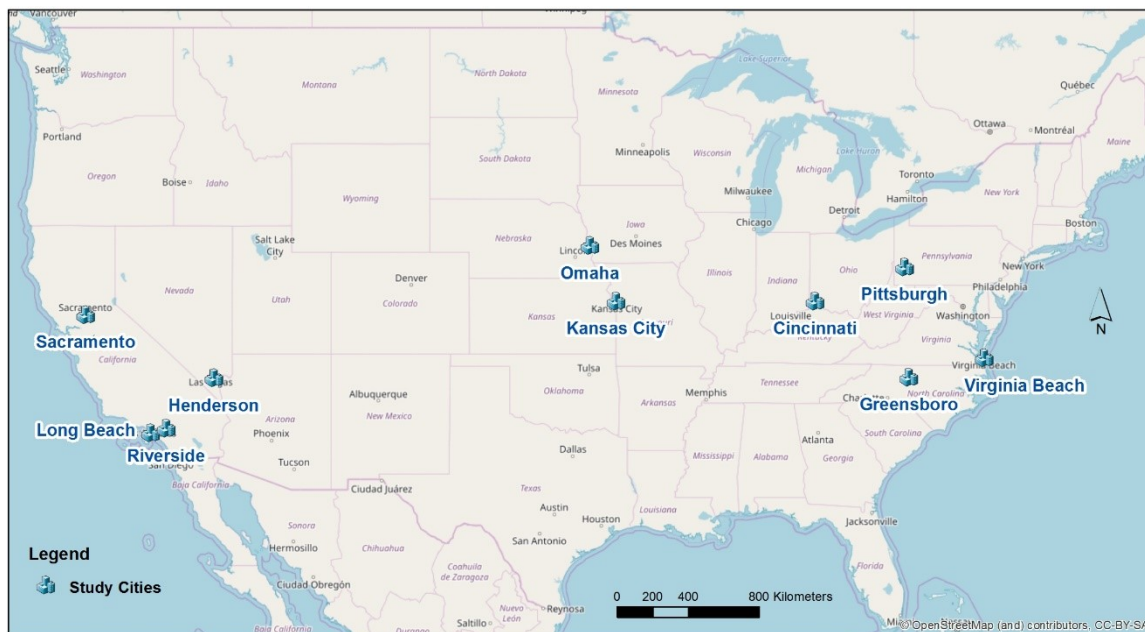


Figure 1 Locations of 10 Cities in this Study

Table 2 Selected Cities and Their Estimated Population in 2015

City	2015 Population
Virginia Beach, VA	452,745
Kansas City, MO	475,378
Pittsburgh, PA	304,391
Greensboro, NC	285,342
Riverside, CA	322,424
Long Beach, CA	474,140
Sacramento, CA	490,712
Cincinnati, OH	298,550
Henderson, NV	285,667
Omaha, NE	443,885

2.2 Methods

This study employs a **three-part analysis**, including (1) a review of social media applications used by local governments, (2) an assessment of social media contents on planning issues in selected cities, and (3) an examination of whether social media may help better inform the development of local plans.

2.2.1 Review of Social Media Applications Used by Local Governments

To address the first objective, the website of the urban and regional planning department in each city was inspected to collect all available social media platforms. The number, types and user statistics of social media channels listed in these channels were downloaded and tabulated. In the case of a city without social media channels from the planning department, I used the social media pages listed on the city's general government website, such as the mayor's social media page. For example, the planning department of Omaha does not have their own social media pages, so I selected the mayor's social media channels as the study subjects for Omaha, which were solely listed on the main government website.

With a wide range of social media, such as blogs, microblogs, RSS feeds, video and photo sharing, podcasting, social networking sites, people or groups can create, organize, edit, comment on, combine, and share information (Lux Wigand, 2011). Through a preliminary study, it was found that a large variety of social media channels have been used for public engagement by local governments. For example, the City of New York has used Facebook, Twitter, LinkedIn, Instagram, Flickr, YouTube, Foursquare and Tumblr as their official social media channels. The number, types and user statistics of social media channels could serve an indicator

of the breath of avenues that local governments use to engage with their citizens on planning issues.

2.2.2 Assessment of Social Media Contents for Urban Planning

To address the second objective, the social media contents for each city were evaluated. Due to the diversity of the social media channels, only contents from Facebook and Twitter were considered, as they are the dominant social media channels widely used by local governments and citizens.

Quantitative and qualitative analyses of the contents from both social media channels were conducted. First, the contents of Facebook and Twitter from these cities were downloaded using NVivo Plus®, the social science analytical software, and exported into M.S. Excel format for manual interpretation and classification. Then, each Facebook post and Twitter tweet were interpreted and classified into 13 general categories of planning topics, including transportation, infrastructure, housing, zoning, crime and safety, economic development and jobs, disasters and hazards, education, public participation, environmental and public health, events and recreation, waste and recycling, and comprehensive plans. These topics were determined based on a detailed examination of Facebook and Twitter posts and a few online sources, such as McGill School of Urban Planning (2018) and UAA (2018). These 13 categories represent the frequently discussed planning topics occurring in social media discussion. Meanwhile, it is acknowledged that not all planning topics were mentioned in the social media discussion, such as social injustice and immigration. I contend that these planning categories can well cover the social media contents through my interpretation. Those social media contents irrelevant to these planning topics were excluded from the analyses. The number of posts/tweets and corresponded percentages for each category were summarized as a table. Third, the hashtags and words with top frequency on the

Facebook and Twitter pages up to April 30, 2018 were selected and plotted as word clouds using NVivo. These top words, representing the popular topics in social media conversations, may contain the updated information on planning issues. Lastly, to understand if Facebook and Twitter exhibit different patterns of planning-related discussion, I used IBM SPSS v12 to conduct the t-test and Wilcoxon rank-sum test. The Wilcoxon rank-sum test is a nonparametric alternative to the two-sample t-test, and it is based solely on the order of the observations from the two samples (Wild and Seber, 2000).

2.2.3 Comparison of Social Media Data and Planning Documents

In general, it is unclear if the social media contents from planning-related social media platforms may be used to improve the development of urban comprehensive plans. As social media can reflect the citizens' ideas and perceptions on concurrent issues, it is expected that gaps exist between the social media discussion on planning topics and the planning documents that were not updated as often. In the analysis, the results from social media data analytics were compared with each city's development master plan to examine if any prominent issue identified in the social media discussion was missing in the planning documents. Furthermore, emerging planning issues not well addressed by the planning documents were analyzed and summarized. The hyperlinks directing to each city's comprehensive plans and social media sites are available in Table 3. The urban master plans were downloaded during the period of April 21-30, 2018.

Table 3 Data Sources for the Social Media Sites and Comprehensive Plans of 10 Cities in Focus

City	Planning documents	Facebook	Twitter	YouTube
Virginia Beach, VA	https://www.vbgov.com/government/departments/planning/2016ComprehensivePlan/Pages/Comprehensive%20Plan.aspx	https://www.facebook.com/CityofVaBeach	https://twitter.com/cityofva beach	https://www.youtube.com/user/VirginiaBeachTV
Kansas City, MO	http://kcmo.gov/planning/comprehensive-plan/	https://www.facebook.com/EconomicDevelopmentCorporationKCMO/?fref=ts	https://twitter.com/edckc	https://www.youtube.com/channel/UCm83DhMIPtXCMH18CbrcGCg/videos
Pittsburgh, PA	http://pittsburghpa.gov/dcp/CompPlanPGH	https://www.facebook.com/city.of.pittsburgh/	https://twitter.com/citypgh?lang=en	https://www.youtube.com/channel/UC-YfIv9wvBjGT3LMxo9hLoQ
Greensboro, NC	https://www.greensboro-nc.gov/home/showdocument?id=20549	https://www.facebook.com/cityofgreensboro	https://twitter.com/greensborocity	https://www.youtube.com/user/CityofGreensboroNC
Riverside, CA	http://www.riversideca.gov/planning/gp2025program/general-plan.asp	https://www.facebook.com/CityofRiverside	https://twitter.com/riversidecagov	https://www.youtube.com/cityofriverside
Long Beach, CA	http://www.lbds.info/planning/	https://www.facebook.com/LongBeachBuilds	https://twitter.com/LongBeachBuilds	https://www.youtube.com/user/LBDSVideos
Sacramento, CA	http://www.cityofsacramento.org/Community-Development/Resources/Online-Library/2035-General-Plan	https://www.facebook.com/TheCityofSacramento/	https://twitter.com/theCityofSac	https://www.youtube.com/user/TheCityofSacramento
Cincinnati, OH	http://www.cincinnati-oh.gov/planning/planning-cincinnati/	https://www.facebook.com/CincyPlanning/	https://twitter.com/cityofcincy	N/A
Henderson, NV	http://www.cityofhenderson.com/community-development/planning-commission/planning-commission-overview	https://www.facebook.com/cityofhenderson	https://twitter.com/cityofhenderson	https://www.youtube.com/user/cityofhenderson
Omaha, NE	https://urbanplanning.cityofomaha.org/omaha-master-plan	https://mayors-office.cityofomaha.org	https://twitter.com/Jean_Stothert	N/A

Chapter III

Results

3.1 Overview of Social Media Platforms and Contents Used by Local Governments

Social media platforms and corresponding discussion contents in the 10 selected cities are shown as follows.

3.1.1 Social Media Platforms

Table 4 shows the names and number of social media platforms used by these 10 cities. Overall, the social media platforms adopted by ten cities are dominated by Facebook, Twitter and YouTube, which are the most popular social networking, microblog and video sharing social media sites in U.S. The number of platforms ranges from 2 to 5, indicating varying efforts of these governments to expand social media channels for interactions with the public.

Table 4 Social Media Platforms Adopted by Ten Cities

City	Social Media Platforms	Variety
Virginia Beach, VA	Facebook, Twitter, YouTube, LinkedIn, Flickr	5
Kansas City, MO	Facebook, Twitter	2
Pittsburgh, PA	Facebook, Twitter, YouTube	3
Greensboro, NC	Facebook, Twitter, YouTube, Instagram	4
Riverside, CA	Facebook, Twitter, YouTube, Instagram	4
Long Beach, CA	Facebook, Twitter, YouTube, Instagram	4
Sacramento, CA	Facebook, Twitter, YouTube	3
Cincinnati, OH	Facebook, Twitter	2
Henderson, NV	Facebook, Twitter, YouTube, Instagram	3
Omaha, NE	Facebook, Twitter	2

Virginia Beach has the largest number of platforms, but Kansas City, Cincinnati and Omaha the least. Geographically, cities in the east and west coastal states used more diverse platforms than those in the central states.

3.1.2 Social Media Contents

The Facebook posts and tweets downloaded from the social media channels were inspected and coded based on 13 general topics related to urban planning issues, including transportation, infrastructure, housing, zoning, crime and safety, economic development and jobs, disasters and hazards, education, public participation, environmental and public health, events and recreation, waste and recycling, and comprehensive plan. Table 5 shows a list of the categories and corresponding nominal scores used to code the posts from Facebook and Twitter.

Table 5 Discussion Topics on the Social Media Websites (Facebook and Twitter)

Category	Label
transportation	1
infrastructure	2
housing	3
zoning	4
crime and safety	5
economic development and jobs	6
disasters and hazards	7
education	8
public participation	9
environmental and public health	10
events and recreation	11
waste and recycling	12
comprehensive plan	13

An examination of all downloaded Facebook and Twitter contents resulted in the frequency of posts/tweets corresponding to each category of planning topics. Table 6 and Table 8 summarize the classification of the Facebook and Twitter contents. Table 7 and Table 9 show the lists of top-three planning topics from Facebook and Twitter, respectively, for the 10 cities.

For Facebook discussion in most cities, events and recreation (#11) and public participation (#9) are the most frequently discussed on Facebook. Events and recreation is the most frequent topic in almost all of these cities except Long Beach and Henderson. It is noted that the numbers in the tables and figures exclude those discussion irrelevant to the 13 planning related topics.

Table 6 Frequency of Facebook Posts Regarding 13 Planning Topics

City	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Virginia Beach, VA	573	216	58	320	391	372	479	125	703	209	1730	84	81	5342
Kansas City, MO	48	331	0	7	10	604	0	7	285	26	827	1	52	2828
Pittsburgh, PA	34	12	4	4	30	36	13	27	125	29	479	18	97	1355
Greensboro, NC	66	70	2	336	95	25	12	135	167	100	938	80	116	2927
Riverside, CA	124	89	48	167	198	265	84	332	731	346	1022	48	141	5163
Long Beach, CA	262	70	50	146	113	519	149	138	852	255	298	85	211	3408
Sacramento, CA	200	49	18	6	51	82	37	15	216	93	520	20	22	2675
Cincinnati, OH	31	28	21	27	5	33	3	11	150	6	212	2	46	716
Henderson, NV	103	68	15	86	310	39	98	264	43	1092	40	10	103	3970
Omaha, NE	66	75	28	34	99	129	64	80	214	84	319	74	42	1597

Table 7 Top-3 Planning Topics on Facebook in Each of 10 Selected Cities

City	Top-3 Topics
Virginia Beach, VA	Events and Recreation; Public Participation; Transportation
Kansas City, MO	Events and Recreation; Economic Development and Jobs; Infrastructure
Pittsburgh, PA	Events and Recreation; Public Participation; Comprehensive Plan
Greensboro, NC	Events and Recreation; Zoning; Public Participation
Riverside, CA	Events and Recreation; Public Participation; Environmental and Public Health
Long Beach, CA	Public Participation; Economic Development and Jobs; Events and Recreation
Sacramento, CA	Events and Recreation; Public Participation; Transportation
Cincinnati, OH	Events and Recreation; Public Participation; Comprehensive Plan
Henderson, NV	Environmental and Public Health; Crime and Safety; Education
Omaha, NE	Events and Recreation; Public Participation; Economic Development and Jobs

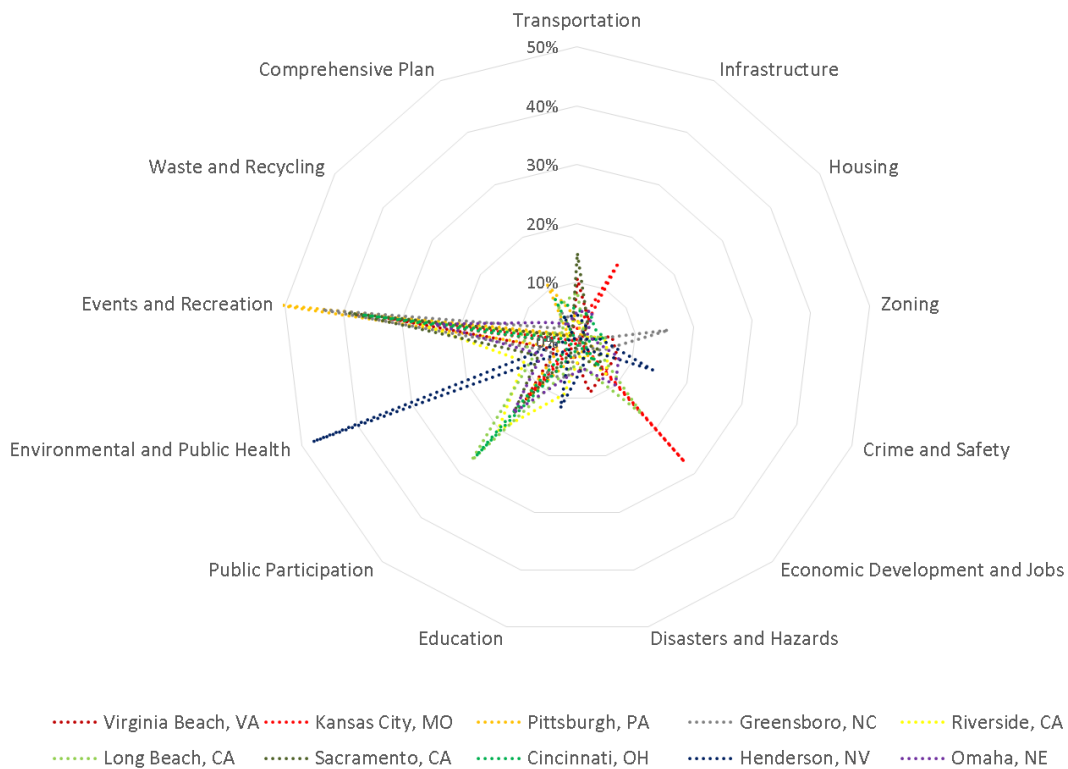


Figure 2 Spider Chart Representing the Frequency of Facebook Posts on Different Planning Topics

A visualization of the percentage of different planning topics in the Facebook posts is shown in Figure 2. Events and recreation and public participation are clearly the most

frequent topics, but Environmental and public health has been intensively discussed in Henderson, and Economic development and jobs is a planning topic in Kansas City.

For Twitter discussion in most cities, events and recreation (#11) is the most frequently discussed on Twitter except for Virginia Beach and Kansas City. Public participation ranks as the second or third frequent planning topic in 8 cities. In a cross-comparison of Table 7 and Table 9, the most frequent topics under different social media platforms, i.e., Facebook and Twitter, exhibit variation, although events and recreation is the most frequent topic. It is noted that the numbers in the tables and figures exclude those tweets irrelevant to the 13 planning topics.

Table 8 Frequency of Tweets Regarding 13 Planning Topics

City	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Virginia Beach, VA	298	10	91	453	328	131	387	107	74	234	405	130	169	3202
Kansas City, MO	34	78	8	146	7	29	1	2	210	4	197	6	190	1338
Pittsburgh, PA	115	94	57	123	139	194	7	84	594	75	675	22	156	2740
Greensboro, NC	66	51	29	202	206	134	58	17	723	102	995	24	52	3222
Riverside, CA	33	98	2	354	64	95	154	15	459	116	1058	10	32	3239
Long Beach, CA	45	63	72	92	62	31	22	8	236	58	320	31	97	1539
Sacramento, CA	62	62	22	255	162	264	85	64	97	349	691	113	332	3227
Cincinnati, OH	194	97	41	35	19	70	17	19	138	12	345	8	108	1337
Henderson, NV	123	69	76	108	363	289	41	91	296	62	912	30	109	3234
Omaha, NE	137	50	5	53	233	90	24	46	234	74	331	62	44	2111

Table 9 Top-3 Planning Topics on Twitter in Each of 10 Selected Cities

City	Top-3 Topics
Virginia Beach, VA	Zoning; Disasters and Hazards; Events and Recreation
Kansas City, MO	Public Participation; Events and Recreation; Comprehensive Plan
Pittsburgh, PA	Events and Recreation; Public Participation; Economic Development and Jobs
Greensboro, NC	Events and Recreation; Public Participation; Crime and Safety
Riverside, CA	Events and Recreation; Public Participation; Zoning
Long Beach, CA	Events and Recreation; Public Participation; Comprehensive Plan
Sacramento, CA	Events and Recreation; Environmental and Public Health; Comprehensive Plan
Cincinnati, OH	Events and Recreation; Transportation; Public Participation
Henderson, NV	Events and Recreation; Crime and Safety; Public Participation
Omaha, NE	Events and Recreation; Public Participation; Crime and Safety

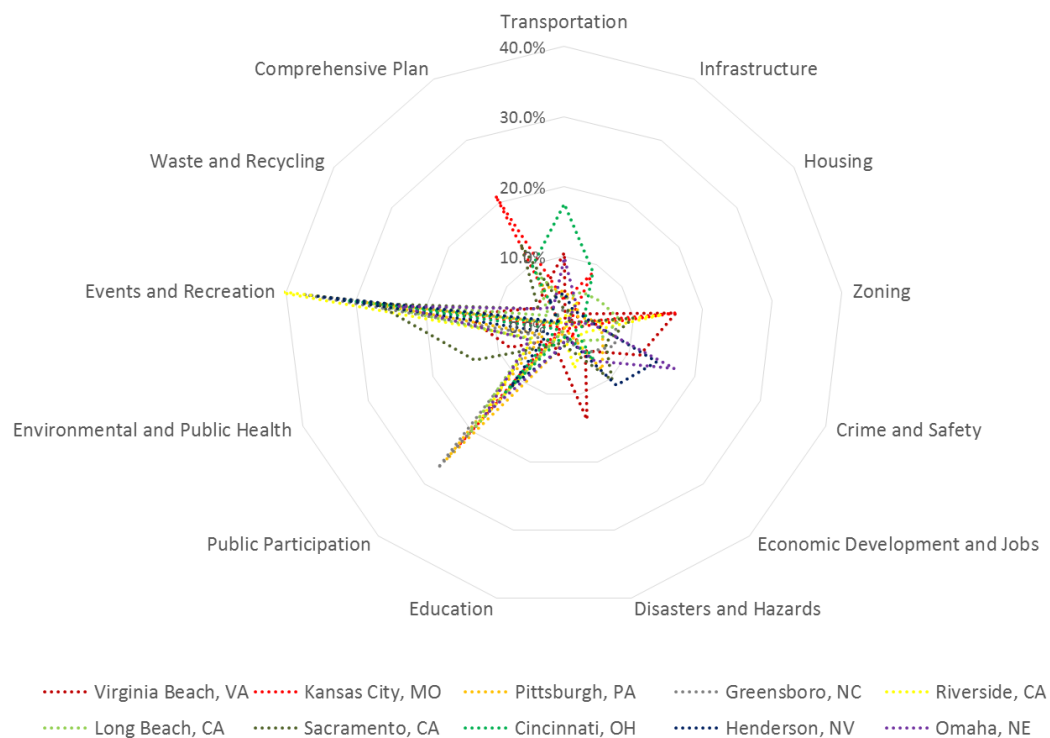


Figure 3 Spider Map Representing the Frequency of Tweets on Different Planning Topics

A visualization of the percentage of different planning topics in the tweets is shown in Figure 3. Events and recreation and public participation are still the most frequent topics, but the discussion topics are more diverse than those in Facebook posts. For example, transportation, zoning, crime and safety, and disasters and hazards are more frequently mentioned.

3.2 Comparison between Social Media Platforms

In this study, the classification of different planning topics from Facebook and Twitter is a critical step of the analysis. The spider charts (Figure 2 and Figure 3) show that the patterns have similarity but exhibit variation. To understand if the patterns of planning topics are statistically different percentage wise, I employed both t-test and Wilcoxon rank-sum test. The results are shown in Table 10 and Table 11.

Table 10 Statistical Comparison between Facebook and Twitter Posts Based on t-Test

	<i>t Stat</i>	<i>t Critical one-tail</i>	<i>t Critical two-tail</i>	<i>Significance</i>
<i>Virginia Beach, VA</i>	3.28E-16	1.724718	2.085963	no
<i>Kansas City, MO</i>	-2.1E-16	1.717144	2.073873	no
<i>Pittsburgh, PA</i>	0	1.724718	2.085963	no
<i>Greensboro, NC</i>	0	1.710882	2.063899	no
<i>Riverside, CA</i>	2.24E-16	1.720743	2.079614	no
<i>Long Beach, CA</i>	0	1.710882	2.063899	no
<i>Sacramento, CA</i>	2.48E-16	1.720743	2.079614	no
<i>Cincinnati, OH</i>	-4.5E-16	1.713872	2.068658	no
<i>Henderson, NV</i>	-2E-16	1.717144	2.073873	no
<i>Omaha, NE</i>	3.38E-16	1.710882	2.063899	no

Table 11 Statistical Comparison between Facebook and Twitter Posts Based on Wilcoxon Rank-Sum Test

	<i>W Stat</i>	<i>W Critical</i>	<i>Significance</i>
<i>Virginia Beach, VA</i>	188	136	no
<i>Kansas City, MO</i>	191	136	no
<i>Pittsburgh, PA</i>	197	136	no
<i>Greensboro, NC</i>	167	136	no
<i>Riverside, CA</i>	156	136	no
<i>Long Beach, CA</i>	173	136	no
<i>Sacramento, CA</i>	189	136	no
<i>Cincinnati, OH</i>	186	136	no
<i>Henderson, NV</i>	184	136	no
<i>Omaha, NE</i>	166	136	no

Both tables indicate that there is no significant difference in Facebook and Twitter data in these ten cities.

3.3 Assessment of Social Media Contents for Urban Planning

By analyzing the word frequency in all of the Facebook and Twitter posts, specific popularly discussed issues under each planning topic were extracted using NVivo software.

The results from the examination of social media contents were compared with the cities' comprehensive plans. The focus is placed on (1) whether social media may better inform the plan, and (2) identification of any discrepancy between concerned issues in social media discussion and the comprehensive plan.

3.3.1 Virginia Beach, VA

Based on the high-frequency words, the summary of these issue related to the planning topics from Facebook and Twitter is shown in Table 12 and Table 13 respectively.

Table 12 Top Facebook Discussion Issues under Each Planning Topic in Virginia Beach

Planning Topics	Specific Issues
Transportation	Traffic, location, centers, driving, roads
Infrastructure	Roads, bridge, water, library
Housing	Housing
Zoning	Centers, area,
Crime and safety	Police, emergency, public,
Economic development and jobs	Works
Disasters and hazards	Hurricanes, storms, floods
Education	School
Public participation	Community, councils programs, Vbgov, departments, weeks, likes, public, offices
Environmental and public health	Water
Events and recreation	Open, recreational, parks, events, shows
Waste and recycling	
Comprehensive plan	Plan

Table 13 Top Twitter Discussion Issues under Each Planning Topic in Virginia Beach

Planning Topics	Specific Issues
Transportation	Traffic, closings
Infrastructure	Road, bridge, using
Housing	Family, homes
Zoning	Centers, area
Crime and safety	Emergency, safe, vbpd*, check
Economic development and jobs	Works
Disasters and hazards	Floods, storm, disaster, hurricanes, winds, flood
Education	School
Public participation	Thanks, community, City, join, new, helps, followers
Environmental and public health	Water
Events and recreation	Parks, tonight, Amp**, open, closings
Waste and recycling	
Comprehensive plan	Plan

* vbpd - *Virginia Beach Police Department*; ** Amp - *Amphitheater*

Almost all planning topics were covered in the social media discussion in Virginia Beach. In particular, as a coastal city, it is vulnerable to floods and natural disasters such as tropical storms and hurricanes. Thus, it is found that these are among the top frequently discussed issues. We found no high-frequency word associated with waste and recycling.

Through a review of the City of Virginia Beach's Comprehensive Plan, I found that the plan covers the topics discussed on social media overall. Most parts of the plan focus on the details of strategic growth areas, such as parks and open spaces. A citywide transportation plan includes the planned roadways and transit networks. Environmental stewardship framework tackles potential solutions to disasters and hazards as well as environmental and public health (with a focus on water quality). The plan also deals with more opportunities for better education and expanded economic development. However, crime and safety and waste and recycling, although being briefly mentioned in the plan, lack detailed actionable measures for potential improvement. I contend that the plan may be enhanced by extra information to deal with how to improve crime and safety, as well as waste and recycling.

Furthermore, it is noted that green infrastructure has been extensively discussed in the comprehensive plan, but no such information was found in the social media discussion. More information on green infrastructure may be shared with the general public to enhance its awareness.

3.3.2 Kansas City, MO

Based on the high-frequency words, the summary of top planning issues from Facebook and Twitter is shown in Table 14 and Table 15 respectively. Almost all

planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with crime and safety and waste and recycling on Facebook and none concerning disasters and hazards, crime and safety, education, environmental and public health, and waste and recycling on Twitter.

Table 14 Top Facebook Discussion Issues under Each Planning Topic in Kansas City

Planning Topics	Specific Issues
Transportation	streets
Infrastructure	Buildings, streets, construction, improvement
Housing	Apartment
Zoning	Centers, area, downtown, locations
Crime and safety	
Economic development and jobs	Jobs, company, entrepreneur, economic
Disasters and hazards	Winters
Education	Learn, read, works, technology
Public participation	Community, council, mayor, announcement
Environmental and public health	Water
Events and recreation	Events, parks, historic
Waste and recycling	
Comprehensive plan	Downtown

Table 15 Top Twitter Discussion Issues under Each Planning Topic in Kansas City

Planning Topics	Specific Issues
Transportation	Streetcar, bike, nextrailkc
Infrastructure	Buildings, midtown, projects, preserving
Housing	Housing
Zoning	Zoning, area,
Crime and safety	
Economic development and jobs	Development, works
Disasters and hazards	
Education	
Public participation	Community, neighborhood, public, join
Environmental and public health	Creeks
Events and recreation	Parks, event, amp, historic
Waste and recycling	
Comprehensive plan	City plans, commission

Kansas City's Forging Our Comprehensive Urban Strategy (FOCUS) comprehensive plan spans over 1200 pages, covering a broad range of topics organized as "FOCUS Building Blocks". As shown in its plan's voluminous information, the city actively shares the neighborhood information to its citizens and encourages public participation in various planning issues. The plan tackles a broad range of planning topics, from the transit system, affordable housing, competitive economy to the construction of parks, walking/biking trails and other recreational facilities, and health care facilities for the community. Also, some topics that were not covered in the social media discussion are included in the FOCUS plan, such as waste and recycling and crimes. In particular, little discussion on crime on social media may be attributed to the current low crime rates in Kansas City. Thus, crime is likely not to be a major concern to the city's residents, as the plan mentions that people "find Kansas City attractive for its low crime rate". The city also actively seeks to protect the water quality in rivers, streams, creeks and aquifers and air quality in the urban area.

Only one minor topic not covered in the comprehensive plan of Kansas City is streetcar, a popular free-to-ride transit system in downtown Kansas City. Although discussed on Twitter, no information is available about the current conditions and future plan of this popular transit system in the plan. This topic may be added to the future plan.

3.3.3 Pittsburgh, PA

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 16 and The City of Pittsburgh's comprehensive plan includes Cultural Heritage and Historic Preservation Plan and Open

Space, Parks, and Recreation Plan published in 2012 and 2013, which are available on the city's website. Through my review, I found that the comprehensive plan mainly focuses on the built environment.

Overall, most of the topics discussed on social media have been addressed in the plan. For example, to address the safety concerns, the Crime Prevention Through Environmental Design (CPTED) is introduced in the City's design review process and Urban Design Manual for new construction. The city strives to foster a sense of citywide community to strengthen the neighborhood identities and public participation. However, recycling was not discussed in both social media and the city's plan. Only the reduction of waste construction materials by reusing the historic and existing buildings is discussed. The City of Pittsburgh's 311 Response Center was frequently mentioned in social media, but its roles in providing services to the citizens and tourists were not available in the comprehensive plan.

Table 17 respectively. Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with crime and safety, environmental and public health, and waste and recycling on Facebook, and none concerning disasters and hazards, crime and safety, education, and waste and recycling on Twitter.

Table 16 Top Facebook Discussion Issues under Each Planning Topic in Pittsburgh

Planning Topics	Specific Issues
Transportation	Street
Infrastructure	
Housing	residents
Zoning	Block, downtown
Crime and safety	Safety
Economic development and jobs	Work, business

Disasters and hazards	
Education	Students, learn, young, read
Public participation	Community, government, thanks, join, leadership, volunteer
Environmental and public health	
Events and recreation	Event, visit
Waste and recycling	
Comprehensive plan	

The City of Pittsburgh’s comprehensive plan includes Cultural Heritage and Historic Preservation Plan and Open Space, Parks, and Recreation Plan published in 2012 and 2013, which are available on the city’s website. Through my review, I found that the comprehensive plan mainly focuses on the built environment.

Overall, most of the topics discussed on social media have been addressed in the plan. For example, to address the safety concerns, the Crime Prevention Through Environmental Design (CPTED) is introduced in the City's design review process and Urban Design Manual for new construction. The city strives to foster a sense of citywide community to strengthen the neighborhood identities and public participation. However, recycling was not discussed in both social media and the city’s plan. Only the reduction of waste construction materials by reusing the historic and existing buildings is discussed. The City of Pittsburgh’s 311 Response Center was frequently mentioned in social media, but its roles in providing services to the citizens and tourists were not available in the comprehensive plan.

Table 17 Top Twitter Discussion Issues under Each Planning Topic in Pittsburgh

Planning Topics	Specific Issues
Transportation	Street
Infrastructure	downtown
Housing	House, Plan Build Live
Zoning	Neighborhood, urban, district
Crime and safety	public safety

Economic development and jobs	Market, workshop, work, business
Disasters and hazards	snow
Education	
Public participation	Community, join, thanks, announce, mayor, public, pgh311
Environmental and public health	
Events and recreation	Park, event, amp
Waste and recycling	
Comprehensive plan	Downtown

3.3.4 Greensboro, NC

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 18 and Table 19 respectively. Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with housing on Facebook, and none concerning transportation, housing, and disasters and hazards on Twitter.

The City of Greensboro's comprehensive plan encompasses almost all important issues that have been discussed on social media. The plan lists fragmented growth, pollution, loss of open space, traffic congestion, unbalanced investment patterns, fiscal and environmental stress as critical challenges to life quality and economy viability in the city. For example, the greenway network, as a planning priority, has been particularly highlighted in the tweets (#downtowngreenway). The housing related issues, such as affordable housing and convenient access to community services, were comprehensively planned in a section of the plan. Libraries are highlighted as critical public facilities and services for education in the plan, which is rare among plans in other cities.

Table 18 Top Facebook Discussion Issues under Each Planning Topic in Greensboro

Planning Topics	Specific Issues
-----------------	-----------------

Transportation	Streets, roads
Infrastructure	Roads
Housing	
Zoning	Centers, area, open
Crime and safety	Policing
Economic development and jobs	Works, jobs
Disasters and hazards	Fires
Education	Schools, library
Public participation	Community, closings, joining, participation, joining,
Environmental and public health	Food, water, lake
Events and recreation	Recreation, events, parks, festivals, lake
Waste and recycling	Recycling
Comprehensive plan	Downtown

The only identified discrepancy is the use of a mobile app launched by the city, namely GSO Collects app, for trash and recycling pickup. The application of this emerging technology is not part of the plan. Further, the strategies to cope with flooding are linked to the inappropriate development within the floodplain instead of in a context of weather disasters, such as hurricanes. The recent disaster caused by Hurricane Florence has been reflected on the most recent social media discussion (but our social media data analysis is only included up to May 2018).

Table 19 Top Twitter Discussion Issues under Each Planning Topic in Greensboro

Planning Topics	Specific Issues
Transportation	
Infrastructure	Downtown greenway, library
Housing	
Zoning	center
Crime and safety	Police
Economic development and jobs	Works
Disasters and hazards	
Education	Schools
Public participation	Join, community, thanks, council, hosting, resolution
Environmental and public health	Lake,
Events and recreation	Parks, events, garden, closings, fun, game, arts, amp, lake

Waste and recycling Comprehensive plan	Recycling Downtown
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3.3.5 Riverside, CA

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 20 and Table 21 respectively. Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with housing, environmental and public health, and waste and recycling, and none concerning crime and safety, environmental and public health, and disasters and hazards on Twitter.

With a publicly agreed vision on the future of the city (“good home ownership and well-paying jobs”), the General Plan 2025 of Riverside laid out the plan by multiple elements, including land use and urban design, housing, public safety, education, arts and culture, air quality, noise, public facilities, open space conservation and historic preservation.

Table 20 Top Facebook Discussion Issues under Each Planning Topic in Riverside

Planning Topics	Specific Issues
Transportation	streets
Infrastructure	walks, avenue (university avenue), library, museum
Housing	
Zoning	Local, centers, downtown
Crime and safety	police
Economic development and jobs	Works, openings
Disasters and hazards	Fires
Education	Schools, library, university
Public participation	Community, joins, participation, neighborhoods, department, informed
Environmental and public health	
Events and recreation	Park, events , tickets, weekend, visits, fun, openings

Waste and recycling
Comprehensive plan

Table 21 Top Twitter Discussion Issues under Each Planning Topic in Riverside

Planning Topics	Specific Issues
Transportation	Airport kral
Infrastructure	Service
Housing	Living
Zoning	Center, downtown
Crime and safety	
Economic development and jobs	Grow riverside
Disasters and hazards	
Education	School, students
Public participation	Community, join, mayor, sharing, mayor, sharing
Environmental and public health	
Events and recreation	Fun, park, event, conference, amp, festival, artsgreat, celebrate
Waste and recycling	
Comprehensive plan	

Compared with many other cities, Riverside focuses on land use and infrastructure development within the existing city's limit instead of the development at the cost of encroaching on the natural and agricultural landscape in its outskirts. Most of the efforts on infrastructure, housing and zoning focus on the better use of existing urban areas. It has highly detailed housing and public safety plans for affordable, safe and quality living in the city. It also focuses on creating economic development opportunities of highly skilled and well paid employment for all members in the community. For recreation, residents are offered parks, numerous trails and vast open space. It sets the learning community as the goal of its Education Element, for not only young kids but also elder citizens.

However, compared with the general plan, the social media missed some critical planning topics, such as housing, environmental health, waste and recycling, comprehensive plan, which have been well addressed in the general plan.

3.3.6 Long Beach, CA

Table 22 Top Facebook Discussion Issues under Each Planning Topic in Long Beach

Planning Topics	Specific Issues
Transportation	Freeway, biking
Infrastructure	Streets, airport, services, construction
Housing	
Zoning	Centers, area
Crime and safety	Police, safety
Economic development and jobs	Works
Disasters and hazards	
Education	Library, learn
Public participation	Public, informed, community, residents, thanks
Environmental and public health	Improving
Events and recreation	Parks, recreational, visiting, inviting
Waste and recycling	
Comprehensive plan	Plans

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in **Error! Not a valid bookmark self-reference.** and

Table 23 respectively. Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with housing, disasters and hazards, and waste and recycling, and none concerning zoning, environmental and public health, and waste and recycling on Twitter.

Table 23 Top Twitter Discussion Issues under Each Planning Topic in Long Beach

Planning Topics	Specific Issues
Transportation	streets
Infrastructure	Downtown, airport, clean
Housing	Housing, building
Zoning	
Crime and safety	safety
Economic development and jobs	Works, workshop,
Disasters and hazards	youth
Education	Learn, library, librarian
Public participation	community, help, join, neighborhood, public, leadership, council, volunteer
Environmental and public health	
Events and recreation	Amp, parks, celebrate, Trees, event, plating
Waste and recycling	
Comprehensive plan	Plan

Similar to Riverside, the general plan of Long Beach is also organized as multiple element reports, including historic preservation, open space, housing, air quality, mobility, land use, seismic safety, local coastal program, noise, public safety, conservation, and scenic routes. In the comprehensive plan, it states that transportation has been improved to address an increased demand. Infrastructure and housing have been developed in order to accommodate the rapid population growth since the early 20th century. Education was highlighted as a pivotal support for the economy as well as historic preservation in Long Beach. However, the plan does not include the waste and recycling topic (with only water recycling mentioned). Compared with the general plans from other cities, many elements in the general plan are highly aged, some of which can be dated back to 1970s (Figure 4). Thus, it is not surprising that modern planning issues may not be well incorporated into the planning process.

General Plan Element	Year of Adoption
Historic Preservation Element	2010
Open Space	2002
Housing Element	2014
Air Quality: Part 1 & Part 2	1996
Mobility Element	2013
Land Use: Part 1, Part 2 & Map	1989
Seismic Safety	1988
Local Coastal Program (LCP)	1980
Noise	1975
Public Safety	1975
Conservation	1973
Scenic Routes Element	1975
General Plan Maps & Descriptions	1989

Figure 4 The General Plan Elements for Long Beach, CA

The Facebook and Twitter contents from Long Beach, CA also missed many topics, such as disaster and hazards, environmental and public health, and waste and recycling. Crimes and public safety is frequently mentioned in social media, but was addressed in the public safety element published in 1975.

3.3.7 Sacramento, CA

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 24 and Table 25 respectively. Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with crime and safety, disasters and hazards, education and waste and recycling, and none regarding education on Twitter.

Table 24 Top Facebook Discussion Issues under Each Planning Topic in Sacramento

Planning Topics	Specific Issues
Transportation	Streets,

Infrastructure	Downtown, service, utilities, building, animal (shelter)
Housing	Residents, housings,
Zoning	Location, placing, district, centers, regions, area
Crime and safety	
Economic development and jobs	
Disasters and hazards	
Education	
Public participation	Public, informed, council, join, improve, biking, likes
Environmental and public health	Waters, river
Events and recreation	Parks, events, providing, celebrate,
Waste and recycling	
Comprehensive plan	Plans

Table 25 Top Twitter Discussion Issues under Each Planning Topic in Sacramento

Planning Topics	Specific Issues
Transportation	Streets, traffic
Infrastructure	Downtown, service, station
Housing	housing
Zoning	Area, centers
Crime and safety	Sac police
Economic development and jobs	Works, busy,
Disasters and hazards	Rains, cooling, storm
Education	
Public participation	Mayor, community, public, seeing, thanks
Environmental and public health	Animal, river,
Events and recreation	Amp, national holidays, events, celebrate
Waste and recycling	sacrecycle
Comprehensive plan	Plans

Aiming at being the most livable city in America, the City of Sacramento's 2030

General Plan covers all 13 categories of planning topics. The city's economy is expected to stay strong nationally and globally. A large range of jobs will be provided in all industry sectors, including small and local business. Neighborhoods are planned to be walkable with tree canopy and plenty of housing choices. Sacramento will extend the network of roadways, bridges, mass transit, bikeways, pedestrian trails, and sidewalks in

this region. International airport, high-speed passenger rail will help people travel to other regions in or beyond California. Some of the activities in the plan’s guiding vision require public participation: culture and ethnic diversity celebration, and historic and cultural resources protection. The health and well-being of the community are promoted. In particular, the long-term safety of its citizens is highlighted: To protect residents from crimes, a suite of strategies such as land use and developments strategies, public awareness, and policing programs are promoted. Recycling construction materials and water conservation measures are included in the plan. Social media, in aggregate, cover almost all of the topics except education. But, Twitter discussion covers broader topics than Facebook posts. About five topics were not well discussed in the Facebook posts.

3.3.8 Cincinnati, OH

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 26 and Table 27 respectively. The development of the current Plan Cincinnati involves broad stakeholder involvement from almost all ages. Public participation plays a key role in the process of Plan Cincinnati. Instead of a traditional elements-based structure, the plan adopts an innovative structure that integrates 12 original planning elements into 5 Initiative Areas (i.e., Compete, Connect, Live, Sustain, and Collaborate) in correspondence with the city’s planning visions and policies. This unique structure enhances the cross-connections and synergy among different planning elements. In this plan, all of the planning topics from social media are included.

Table 26 Top Facebook Discussion Issues under Each Planning Topic in Cincinnati

Planning Topics	Specific Issues
-----------------	-----------------

Transportation	Streets,
Infrastructure	Floor, avenue,
Housing	Housing
Zoning	Urban, central, district, zoning, places, Walnut (Hills neighborhood)
Crime and safety	
Economic development and jobs	Works, market workshop,
Disasters and hazards	
Education	University
Public participation	Facebook, commission, survey money, community, council, neighborhood, department, informed
Environmental and public health	
Events and recreation	Award, project, bikes, tonight
Waste and recycling	
Comprehensive plan	Planning, comprehensive, plans

Table 27 Top Twitter Discussion Issues under Each Planning Topic in Cincinnati

Planning Topics	Specific Issues
Transportation	Streets, transit,
Infrastructure	Downtown, retail,
Housing	House,
Zoning	Central, place, zoning, urban
Crime and safety	
Economic development and jobs	Workshop, business, Plan Build Live*
Disasters and hazards	
Education	
Public participation	Neighborhood, join
Environmental and public health	
Events and recreation	Park, open, event,
Waste and recycling	
Comprehensive plan	Plan, comprehensive

* Plan Build Live project is designed to transform the development process for the City of Cincinnati's residents, communities, businesses and property owners. The project will evaluate and rewrite Cincinnati's complex development regulations into a smooth process to make development and redevelopment easier.

Many planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with crime and safety, disasters and hazards, and waste and recycling, and none regarding disasters and hazards, education, Environmental and public health, and waste and recycling on Twitter. Comparatively, for example, the plan includes hazard recovery programs such as Neighborhood Stabilization

Program (NSP) and Neighborhood Enhancement Program (NEP), and Crime Prevention through Environmental Design (CPTED). It also deals with waste and recycling problems, which require the participation from public and related organization.

3.3.9 Henderson, NV

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 28 and Table 29 respectively.

Table 28 Top Facebook Discussion Issues under Each Planning Topic in Henderson

Planning Topics	Specific Issues
Transportation	Road
Infrastructure	Pool, service,
Housing	Living area
Zoning	Area, centers
Crime and safety	
Economic development and jobs	
Disasters and hazards	Fire, emergency
Education	Schools, learn
Public participation	Henderson, city, cityofhenderson, community, hendersonnv, informed
Environmental and public health	(Lawn) watering
Events and recreation	events, parks, recreation, trails, recreational, Open, celebration, performs, festival, parade, activities, ticketprovide, music, happenings*
Waste and recycling	
Comprehensive plan	

*Henderson Happenings is a website that promotes local events happening in the city.

Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with crime and safety, economic development and jobs, environmental and public health, waste and recycling, and comprehensive plan, and none regarding zoning, waste and recycling, and comprehensive plan on Twitter.

Table 29 Top Twitter Discussion Issues under Each Planning Topic in Henderson

Planning Topics	Specific Issues
Transportation	Drivers, streets
Infrastructure	Rec, services
Housing	Family, residents
Zoning	
Crime and safety	Police, arrested, safety
Economic development and jobs	Works, jobs
Disasters and hazards	Fire,
Education	Schools, learn
Public participation	Henderson, city, mayor, councils, @city of henderson, thanks, info, public
Environmental and public health	Water
Events and recreation	Amp, park, shows, festivities
Waste and recycling	
Comprehensive plan	

The comprehensive plan of Henderson aims to provide guidance for sustainable development, identify goals, objectives and strategies to better integrate housing, transportation and jobs, and ultimately improve quality of life and economic competitiveness. The city views transportation as a key process to balance jobs and housing and locates business, housing and schools closer to lower living costs. Regarding zoning, the plan promotes the development of employment centers connected with public transit systems that support the nexus between economic development, education and various amenities. In order to maintain quality education, it suggests expanding safe routes to school and improving the environment and safety around schools. The only missing piece in its plan is recycling. Overall, social media discussion involves most of the planning topics, except zoning, waste and recycling, and comprehensive plan that were not well covered.

3.3.10 Omaha, NE

Based on the high-frequency words, the summary of issues related to top planning topics from Facebook and Twitter is shown in Table 30 and Table 26 respectively.

Almost all planning topics were covered in the social media discussion. However, I did not find high-frequency words associated with environmental and public health, and comprehensive plan, and none regarding environmental and public health on Twitter.

Table 30 Top Facebook Discussion Issues under Each Planning Topic in Omaha

Planning Topics	Specific Issues
Transportation	Street
Infrastructure	Service
Housing	Buildings, development, budgets
Zoning	Area
Crime and safety	Police, safety
Economic development and jobs	Works
Disasters and hazards	Fire, firefighters, snow
Education	School
Public participation	Omaha, city, office, thank, mayor, department, community, city of omaha, informed, council
Environmental and public health	
Events and recreation	Parks, opens
Waste and recycling	Waste
Comprehensive plan	

The comprehensive plan adopted by the City of Omaha is organized as 9 elements. This plan concerns all factors that are linked with the quality life in Omaha, including urban form and design, housing and community development, environment, infrastructure and public service. To address the increased traffic congestion, Omaha will continue promoting transportation efficiency. Infrastructure related to public service, sewer, park and recreation is planned. Resource consumption and waste generation are among the foci of urban environment element. Regarding the economic and land use

development, Omaha will promote redevelopment to provide a broader range of employment, retail, service and housing opportunities within central city areas identified as having the greatest needs. Meanwhile, tremendous efforts will be focused on upgrading existing central city infrastructure in order to accommodate economic and community development. Omaha announces that local education systems should promote educational excellence at all levels. Overall, both plans and social media have good agreement on the covered planning categories.

Table 31 Top Twitter Discussion Issues under Each Planning Topic in Omaha

Planning Topics	Specific Issues
Transportation	Streets
Infrastructure	Service, budget
Housing	Family
Zoning	Center
Crime and safety	Policing, crime, officers
Economic development and jobs	Jobs, works
Disasters and hazards	Fire
Education	Library
Public participation	Vote, join, helps, department, neighborhood, taxpayer
Environmental and public health	
Events and recreation	Parks, holiday, weekend, memorial, closings
Waste and recycling	Waste
Comprehensive plan	Plans

However, the social media data show public safety is among one of the frequently discussed topics, but this information is missing in the elements of its plan. Also, the plan for education mainly surrounds the facilities and infrastructure, but lacks information on other ‘software’ supports, such as the training of teachers and the roles of universities. Although this plan was drafted through collaboration with local citizens, the plan can be

further enhanced by including more information on public participation on various critical planning issues as suggested by the social media data.

3.3.11 Social Media Contents on City Plans

Examples of social media contents on urban plans are summarized in Table 32 for those 10 cities. The results show that social media discussion on the city plans was more relevant to the announcements than detailed discussion. Thus, the information in this planning category may not help advance the design of comprehensive plans.

Table 32 Social Media Contents Concerning City Plans

City	Example posts relevant to city plans
Virginia Beach, VA	We would like to hear your thoughts on our strategic plan to end homelessness. Learn more at https://t.co/4qIM4Faxsh
Kansas City, MO	A new Area Plan for Shoal Creek Valley is in the works. Visit KCMO's virtual town hall to give your ideas
Pittsburgh, PA	@PLANPGH release draft EcoInnovation plan for Uptown / West Oakland
Greensboro, NC	RT @GreensboroEDBS: The City is seeking firms to assist in developing a Cultural Arts Master Plan. Info and link to RFP at: https://t.co/5Q
Riverside, CA	A new plan to guide future land use, mobility, open space & community design in the Northside area is now underway! https://t.co/SxWODGNAoD
Long Beach, CA	Mark your calendars! Southeast Area Specific Plan (SEASP) draft documents to go before the PC for review on May 4! https://t.co/2zdoFBL0z7
Sacramento, CA	Sacramento's Downtown Specific Plan: How would you shape it? https://t.co/qtzdlZEwgF https://t.co/7Dz7nLyZgX
Cincinnati, OH	RT @jdeatrck: @CincyPlanning wins the big one: 2014 Daniel Burnham Award for Comprehensive Plan for Plan Cincinnati- Great Work!
Henderson, NV	Mayor Debra March unveils her 100 day plan. Focus on Community Safety, Economic Development, Transparency, Education!
Omaha, NE	For the last nine months, we have been working on a 3-year strategic plan and now, at the end of the year, we are... http://t.co/WCbHJ7iHJo

Chapter IV

Discussion

4.1 Multi-city Comparison

Overall, both social media discussion and the comprehensive plans in these 10 cities have reasonable agreement. However, the comparison also shows that:

(1) Social media can serve as supplemental information to improve the comprehensive plans of some cities as shown in Table 33. For example, it is found that social media discussion related to new technologies and infrastructures, such as mobile apps used in Greensboro and streetcars in Kansas City, was not included in both cities' comprehensive plans. Concerns about public safety were not addressed in the current comprehensive plan of Omaha.

Table 33 Latitudinal Comparison of Discrepancies between the Social Media and Comprehensive Plans in 10 Cities

City	Mentioned in social media but not well tackled in the plan	Other areas for improvement in the plan
Virginia Beach, VA	crime and safety	waste and recycling
Kansas City, MO	streetcar	N/A
Pittsburgh, PA	N/A	recycling
Greensboro, NC	GSO Collects app for trash and recycling	hurricane disaster
Riverside, CA	N/A	N/A
Long Beach, CA	N/A	outdated for many elements
Sacramento, CA	N/A	N/A
Cincinnati, OH	N/A	N/A
Henderson, NV	N/A	recycling
Omaha, NE	crime and safety	education, public participation

(2) Overall, the comprehensive plans provide more detailed and structured visions and strategies to address urban planning issues compared with fragmented social discussion. These plans differ in their approaches and foci widely. But, it is interesting to note that none of the comprehensive plans recognize the potential values of social media to improve public participation in the design of the comprehensive plans. Most of current social media platforms are still dominated by one-way information flow instead of two-way exchange between the government and the public.

4.2 The Implications to Planning Research

One of the major challenges to modern urban planning is to address the discrepancies between the relatively slow-paced planning process and ever-increasing emerging planning issues. Adams (1994) viewed urban planning as interventions in the development process of a city. However, it is often observed that the urban plans fall behind the development of a city, an awkward reality that is witnessed in the City of Long Beach, where some planning elements were developed almost 30 years ago. A plan should be updated with appropriate frequency to timely reflect the common interests and values from a broad spectrum of citizens including those historically disadvantaged. The conventional master plan, with few exceptions, often fails to integrate the interests from the disadvantageous groups, such as the poor, aged, women and youth (United Nations Human Settlements Programme, 2016). But, local knowledge can improve planning for communities facing the most serious environmental and health risks (Corburn, 2003). Therefore, a better engagement with the citizens via social media may help bridge the discrepancy and enhance the planners-public interactions, as well as information exchange.

In the most recent decade, social media has become one of the important tools for urban planning, including urban informatics (Prieto et al., 2015), and citizen-planner engagement (Evans-Cowley and Hollander, 2010; Foth et al., 2011; Kleinhans et al., 2015). For urban informatics, the ever-increasing amount of data generated by Location Based Social Networks (LBSN), such as Twitter and Flickr, indicates the mobility behaviors of their inhabitants and provides the planners with spatially and temporally detailed information that may be used to tackle traffic issues. This work coincides with the recent planning revolution of ‘smart cities’ or ‘smart infrastructure’. For the citizen-planner engagement, social media provides new opportunities and platforms for gathering ideas, concerns, and values in a timely manner. As planners increasingly play a mediating role between experts, policy makers, and various publics, they need to learn new manners of assimilating the local knowledge embedded in the tradition and daily lives of communities where they work (Corburn, 2003). However, little research has been conducted to understand if and how the social media contents may inform the development of planning documents for a city. This research has proved that social media contains planning related conversations, which can help improve the planning documents in a few study cities.

This research reveals both strengths and weaknesses of social media as potential data sources for planning documents. The strengths include that (1) social media reflects concurrent information from the public concerning issues around the cities, (2) it is widely available and cost-effective in many cases (as demonstrated in this thesis); and (3) it can be developed into a platform for frequent interactions, exchange and dialogues on critical planning issues between the planners and the citizens. The weaknesses include

that (1) the information is highly unstructured and needs more quantitative and qualitative data syntheses (as shown in this study), (2) social media may only represent the public perception of certain social groups who frequently use digital devices, but does not reflect those historically disadvantaged and subject to digital divide, and (3) a complacency of solely relying on the ‘push strategy’ to cause one-way information communication (Kleinhans et al., 2015) instead of two-way interactions. The urban planners should maximize its strengths and be careful with the weaknesses.

To advance the use of social media for better development of urban plans, the current plan structure may need innovation or a departure from the convention. As it is difficult to update the comprehensive plans frequently, given limited resources, a new model of urban plan design may be adopted. For example, the design may be structured with a static portion and a dynamic part that could be used to represent the emerging topics collected from social media. The plan could be updated with a few intermediate releases between major updates. Emerging design modes, such as cross-connection of planning elements adopted by City of Pittsburgh, may be adapted to better integrate the information from social media.

4.3 Limitations

There are a few limitations to note in this study. First, the Facebook and Twitter posts were analyzed via human interpretations that may be subject to uncertainties, especially when the posts may fit into more than one category. In the classification scheme, only one category was assigned to each social media post. Second, it has been found that social media contents under analyses mainly stem from the governments instead of the general public. This may be due to two potential causes: (1) a strategy of limiting or

avoiding potential inappropriate or off-topic comments (Chawla, 2015); (2) the complacency of relying on the ‘push strategy’ for information sharing with the public (Kleinhans et al., 2015). Thus, the social media contents may represent the planning issues more from the governmental perspectives rather than public opinions. Third, many high-frequency words extracted from this study may have diverse meanings under different contexts. For example, the “park” may be referred to as a recreational open space, or as “parking” under transportation planning.

Chapter V

Conclusions

I found that social media discussion encompasses a broad range of planning issues, from infrastructure, housing, and education to public participation, crimes & safety, and environmental health. For both Facebook and Twitter discussions in most cities, events and recreation and public participation are the most frequently discussed topics. Overall, both social media discussion and the comprehensive plans in these 10 cities have reasonable agreement. Through statistical analyses, I found that percentage-wise the planning related discussions on Facebook and Twitter is in similar patterns statistically, although the detailed topics are slightly different.

Social media may complement the traditional planning process and content, although it exhibits various strengths and weaknesses. Social media can quickly reflect the most current planning issues of concerned to the general public. This thesis specifically answered the research question “how social media used by local governments can help inform urban planning”, and confirmed the hypothesis “word of mouth discussion on social media platforms used by local governments contains information that may be used to better inform city planning”. Specifically, I contend that:

(1) Social media can be used as timely and supplemental information sources to improve the comprehensive plans in some cities. For example, it was found that social media discussion related to new technologies and infrastructures, such as mobile apps used in Greensboro and streetcars in Kansas City, was not included the

cities' comprehensive plans. Concerns about public safety were not addressed in the current comprehensive plan of Omaha.

(2) Since planning documents are updated with relatively low frequency, emerging planning issues captured by concurrent social media discussion may be integrated into the planning documents and available as intermediate updates between major releases of planning documents.

This research has proved that social media contains planning related conversations, which can help improve the planning documents in the study cities. The results reveal both strengths and weaknesses of social media as potential data sources for planning documents. The strengths include the currency of the information, broad data availability with low costs, and serving as a platform for public engagement. The weaknesses include the representatives of the social media for public perception, unstructured and challenging data volumes, and a tendency of solely relying on the 'push strategy' for communication. The urban planners should maximize the strengths and avoid the weaknesses.

The thesis also identified a few important facts through a coding scheme of social media conversations and interpretation of the planning documents, such as:

(1) There is no statistical difference between Facebook and Twitter discussion on planning issues percentage-wise. But, the results show some specific differences in the specific topics, represented by high frequency words.

(2) Overall, the comprehensive plan provides more detailed and structured vision and strategies to address urban planning issues compared with fragmented social

discussion. Meanwhile, it is observed that these plans differ in their approaches and foci widely. But, it is interesting to note that none of the comprehensive plans recognizes the potential values of social media as an avenue of public participation in the planning process. Most of current social media platforms are largely dominated by one-way information flow instead of two-way exchange between the governments and the public.

Of course, a few uncertainties exist in this study. The data sources of social media communication on urban planning issues may not represent the true perceptions from a broader scope of local citizens. The recent political debates on the potential bias of social media towards conservative groups partially exemplify this potential representative issue. Social media may represent the voices from a relatively narrow audience who use social media and are actively engaged with urban affairs. Another uncertainty is related to data sources. Not all of the cities host social media channels by their planning departments (e.g., Pittsburgh, PA, Riverside, CA, and Omaha, NE). Thus, their government's official or Mayor's office Facebook and Twitter pages were used instead, if the planning departments' social media channels were not available. Furthermore, social media data are still subject to constant change as information flows, and thus the results may be subject to change in the future time periods.

Future work may include an investigation of the following topics: (1) what factors may help explain the differences in popular planning topics among those cities; (2) how local planners perceive social media as opportunities to improve the planning process; and (3) a sentiment analysis will help reveal if certain planning topic or social media post

may be positively or negatively perceived. The work may be potentially achieved through statistical correlation analyses, mail surveys, and machine learning methods.

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