Mapping Communication Patterns of Transit Agencies on Social Media

Subasish Das, Ph.D.[1]

[1]Civil Engineering, Ingram School of Engineering, Texas State Univ., San Marcos, TX.
ORCID: https://orcid.org/0000-0002-1671-2753. Email: subasish@txstate.edu

ABSTRACT

Social media networks, like X (formerly Twitter), emerged as a revolutionary means of communication, drastically changing how information is disseminated. This study attempted to synthesize the current state of social media usage by transit agencies, accomplishing three primary tasks: (1) conducting a comprehensive review of agencies' social media practices, (2) surveying and analyzing representative United States agencies to understand their social media usage, and (3) performing text mining on selected agencies' archived tweets. Notably, the study revealed that the COVID-19 pandemic has significantly impacted information-sharing patterns among transit agencies. The text network analysis indicated that the information shared was primarily related to services, alerts, delays, detours, and promotional offers, such as free rides. However, more recent discussions have started to include evolving topics like equity and disability-related issues. By understanding these insights, agencies can better plan and develop strategies to leverage social media effectively in their operations and communication with the public.

INTRODUCTION

In the digital age, the meteoric rise of social media platforms has revolutionized how individuals and organizations connect and disseminate information across the globe. From Twitter (now titled X), Facebook, and Telegram to Instagram, TikTok, YouTube, Vimeo, and Twitch, as well as professional networking sites like LinkedIn, social media has ushered the world into a new era of interconnectedness. With its profound impact on the user community, social media has not only transformed personal interactions but also spurred companies, including transit agencies, to leverage these platforms as powerful communication channels. In recent years, transportation agencies have undergone a radical shift in their approach to social media utilization. Recognizing its potential, they actively employ social media as direct marketing and public relations channels, engaging with both existing and potential riders. Moreover, these platforms serve as valuable tools for collecting passenger data and feedback, allowing agencies to personalize their services and foster cooperation and customer-driven innovation.

The aim of our study was to examine the social media usage patterns of transit agencies in the United States and Canada. To achieve this, we embarked on three crucial tasks. Firstly, we conducted an extensive review of the existing literature on social media usage by transit agencies. Secondly, we conducted a nationwide survey to comprehensively understand how social media is employed in terms of timely updates and crisis information, public education and awareness, public engagement, transit promotion, and support in achieving organizational goals.

Finally, we collected and analyzed archived tweets (now called posts) from select case study transit agencies to gain insights into their information-sharing patterns. The findings of our study

bear significant implications for policy and decision-making concerning social media usage by transit agencies. By understanding and optimizing their presence on these platforms, agencies can effectively connect with their customers, market their services and products, enhance client satisfaction, build a strong brand image, and foster equity in public transportation. In an era where online interactions are increasingly central to daily life, our research seeks to empower transit agencies in their quest for seamless communication and improved service delivery through the dynamic realm of social media.

LITERATURE REVIEW

Our primary focus was on examining recent studies regarding the utilization of social media by transit agencies. The literature review encompassed a comprehensive analysis of scientific articles and reports that shed light on best practices and lessons learned from these agencies' experiences with social media. This review not only included studies from the United States but also incorporated relevant international literature to gain a holistic understanding of social media usage in the transit sector.

Collecting Feedback and Sharing Information

Social media use in transportation agencies can take on various forms, including informational, participatory, collaborative, or interactional approaches. Liu and Ban (2017) discussed transit agencies primarily utilize social media to provide information to riders and gather feedback in the form of complaints, comments, and service requests. As a result, Choudhury (2013) emphasized a growing need to implement advanced technological strategies to collect more accurate rider information and effectively reach their target audiences. Watkins et al. (2015) suggested that transportation professionals, including policymakers, marketers, customer service managers, operations, maintenance managers, and safety and security personnel, can benefit from using customized toolkits to systematically collect customer feedback. The advancement of technologies and the widespread use of social media have led to a significant preference among riders around the world for receiving transportation information, such as fares and promotions, through these platforms. Notably, Crawford (2013) found that passengers are willing to pay more for rides booked through smartphone applications due to the time-saving convenience it offers.

Ferreira et al. (2017) proposed innovative solutions like OneRide, that have emerged to seamlessly integrate social media platforms with payment and route planning sites, further enhancing the overall user experience. Additionally, Ma et al. (2017) introduced the MOBility ANAlyzer (MOBANA) framework, designed to provide real-time integrated information from various sources, classify texts, and filter information from tweets, ensuring relevant and accurate data is delivered to riders. Beyond routine functions, the role of social media platforms for transport agencies extends to critical situations, such as disaster response. Chan and Schofer (2014) mentioned that during events like Hurricane Sandy, transit agencies in New York effectively utilized Twitter communications to disseminate vital information to users, ensuring their safety and well-being during the crisis. Furthermore, Mahmood et al. (2017) developed algorithms capable of detecting locations affected by violence and informing bus riders in real time via Twitter, showcasing the potential of social media in enhancing passenger safety and security.

Public Engagement and Transit Promotion

Schweitzer (2014) highlighted that understanding user engagement on social media is crucial for agencies as it influences rider sentiment, cognitive involvement, and communication behavior. Hanifin (2014) examined the social media practices of transit agencies, highlighting their significance as a determinant of agencies' success. Posting user status messages on popular platforms like Twitter and Facebook and engaging with them directly can naturally foster positive sentiment among users (Schweitzer, 2014; Osorio Arjona et al., 2021). Zhang et al. (2019) underlined that with user-generated metrics such as likes, comments, and shares becoming essential for measuring public engagement, sentiment analysis, topic modeling, text mining, opinion mining, and deep learning frameworks are being applied across various domains, including traffic agencies, to gather public opinions and understand patterns of thinking. Osorio Arjona et al. (2021) utilized tweet-per-topic index-based sentiment analysis to comprehend rider feedback and reasons for dissatisfaction and Haghighi et al. (2018) integrated topic modeling to combine social media analysis results with customer satisfaction surveys. El-Diraby et al. (2019) assessed user politeness, Das and Al-Zubaidi (2021) categorized tweets' sentiment as positive or negative, and Kim et al. (2019) classified feedback based on service areas such as cleanliness, mobility, or timeliness using deep learning frameworks. Additionally, Casas and Delmelle (2017) identified riders' leading concerns related to public transportation, such as transit infrastructure, safety, and fellow passenger behavior. Qi and Costin (2019) had a practical insight from sentiment analysis, which was that rider dissatisfaction increases during delays and breakdowns, revealing valuable user habits.

The extraction of information on social media behavior and engagement using advanced methods is a burgeoning field with immense potential for enhancing transit promotion. Recent studies have extensively explored rider behavior and effective communication strategies to attract more riders. For example, Shafer and Macary (2018) found that young people prefer receiving transit information through social media rather than targeted messaging. Qualitative studies indicate that younger individuals, such as millennials or those under 24 years old, favor public transportation over personal vehicles (Shafer and Macary 2018; Yang and Cherry 2016). Consequently, Delbosc and Currie (2015) noted that targeting young adults through social media can lead to increased travel frequency. Blumenberg and Taylor (2018) examined how technological and social changes influence millennials' travel behavior, with younger audiences turning to social media influencers. Abellera and Panangadan (2016) mentioned that transit agencies can identify influencers whose audiences align with their target markets and collaborate accordingly. Bregman (2012) suggested that aligning social media networks with specific transportation uses can further enhance the success of social media promotion campaigns. Additionally, Dau-Ngo et al. (2013) discussed involving the public through social networking platforms during the planning stages of transit projects can be effective, bringing together collective user voices to generate innovative ideas.

Support and Influence Organizational Goals

The integration of social media data into transit agency operations has opened up new possibilities for optimizing services, engaging with riders, and improving communication strategies. By leveraging the diverse capabilities of social media platforms, agencies can enhance their overall efficiency, customer satisfaction, and public engagement in the ever-evolving

landscape of transportation. Gkiotsalitis and Stathopoulos (2016) utilized mobility data derived from social media platforms, agencies have optimized transit vehicle timings and routes and Zhang et al. (2016) extracted valuable rider information. Studies by Ni et al. (2016) and Zhang et al. (2016) introduced algorithms capable of predicting both planned traffic events, such as high passenger flow during large public gatherings based on hashtags, and unplanned events like road crashes. By tapping into crowd-based perception and social media data, two studies (Chandra et al., 2020; Imran et al., 2015) suggested that agencies can gain insights into potential riders' travel mode choices, enabling them to strategically influence and alter travel mode preferences. The effective information-sharing practices by transit agencies on social media have proven crucial for successful communication, particularly during busy traffic schedules, as exemplified during the 2014 Commonwealth Games (Cottrill et al., 2017). Kaufman (2014) emphasized the necessity of co-monitoring systems to establish a strong and rapid line of communication between transit agencies and riders.

Different social networking platforms offer transit agencies diverse tools to continuously serve and engage their users based on unique characteristics and features. Platforms like Facebook helps in building communities, directing people to the agency's website, disseminating information, and raising awareness. Bregman and Watkins (2013) highlighted that real-time messaging apps such as Twitter and Instagram facilitate interactions with existing riders and promote events. Platforms like YouTube, Vimeo, Flickr, and Pinterest enable agencies to engage more vividly with riders through rich media content. Nikolaidou and Papaioannou (2018) investigated the appropriate use of social media platforms according to their distinct features and recommended the most effective platforms for each purpose. For example, Foursquare, being a location-based service, proves useful for identifying mobility patterns and trip purposes. Transit agencies can benefit from incorporating various tools for training transit authorities. Liu et al. (2019) developed a toolbox for integrating general transit feed specification (GTFS) data and social media data to assess performance, identify areas requiring infrastructure improvements, and evaluate network effectiveness. Additionally, Weisenford et al. (2018) highlighted social media to train transit authorities for quick access to information, creating a more interactive and dynamic community of learners, and reaching a mass audience.

Existing Challenges and Future Directions for the Transit Agencies

In surveyed agencies, the management of social media pages is often divided among staff members instead of employing dedicated full-time staff. Liu et al. (2016) noted that one of the common limitations observed in these agencies is the lack of well-defined goals and metrics to effectively assess the performance of their social media endeavors. Bjerkan and Øvstedal (2020) suggested barriers to accessibility, such as the need for high-contrast texts and screen-readable websites for better comprehension and readability, must be tackled. In the realm of social media practices, transportation researchers and practitioners have provided valuable recommendations based on surveys and analysis. Howard (2019) suggested policy changes that could enhance communication with riders and, in turn, benefit the agency's reputation. The author also highlighted the efficiency of Twitter as a platform for customer service. Bregman and Watkins (2013) emphasized how social media can play a role in providing equitable information despite language barriers, accessibility challenges, and the digital divide. Stewart and Cochrane (2018) presented the benefits of digital practices adopted by Novo Rail in Sydney, showcasing their own mobile app named NovoView, which can serve as an effective strategy for other agencies.

The literature review demonstrates a significant increase in research interest in social media usage by transportation agencies in recent years. However, there is a pressing need to synthesize the most up-to-date practices, address existing challenges, and explore prospects in this domain. The current study undertakes a comprehensive approach to meet this need by identifying best practices, existing problems, and potential areas for future development in the use of social media by transportation agencies. By doing so, it aims to provide valuable insights and guidance to the transportation industry for harnessing the potential of social media effectively and efficiently.

METHODOLOGY

Survey Design

To gain a deeper understanding of how transit agencies engage with social media, we undertook the development of an online survey questionnaire that covered various crucial sections, including social media platforms, agency considerations, challenges and barriers faced, lessons learned, and future needs. Through this comprehensive survey, we aimed to gather valuable insights into the social media strategies and practices adopted by transit agencies. The survey was carefully crafted to explore the social media structure of these agencies, delving into important aspects such as the specific platforms they utilize, the amount of time and resources invested by staff members for social media usage, and the frequency at which they employ social media for different purposes. Additionally, we sought to understand how these agencies measure the outcomes of their social media programs and how their policies are designed to cater to the needs of both users and employees.

To ensure a diverse pool of respondents, we distributed the survey request via email to 75 North American and Canadian transit agencies, which were selected based on regional location and relative size or service coverage. Our efforts in curating a varied mix of respondents led to participation from 60 agencies, resulting in an impressive response rate of 80%. However, we had to exclude 13 incomplete submissions from the analysis. Ultimately, we analyzed 47 complete responses, each representing distinct transit agencies. Notably, in one case, two personnel from the same agency submitted responses, providing an even more comprehensive outlook on that agency's social media engagement. Through this robust and diverse sample, we aimed to obtain a comprehensive understanding of the social media practices, challenges, and future needs of transit agencies. The data collected from the survey will serve as a valuable resource for examining the current state of social media usage in the transit sector, identifying successful strategies, and formulating recommendations to enhance social media engagement for improved communication, service delivery, and customer satisfaction.

Twitter Mining

Twitter mining, also known as Twitter data mining or Twitter analytics, is a specialized form of text mining that focuses on extracting valuable insights and patterns from the vast amount of data generated on the Twitter platform. With millions of users posting tweets daily, Twitter serves as a valuable source of real-time information and opinions on various topics, making it a goldmine for researchers, businesses, and analysts. The process of Twitter mining involves

collecting and preprocessing tweets, which may include filtering by keywords, hashtags, or user profiles of interest. NLP techniques are then employed to analyze the text.

We selected seven case study agencies for Twitter data mining. These case studies are a representative sample of ridership, agency type, and social media network size (for example, by follower counts). Table 1 provides information on some social media metrics of these agencies.

Table 1. Social Media Metrics of the Case Study Agencies

Agencies	Twitter Handle	Followers	Tweets	Retweets	Likes	Replies
San Francisco Bay Area Rapid Transit District (BART)	@SFBART	316,100[1]	36,689	169,613	559,456	49,442
Miami-Dade Transit	@iridemdt	13,900	35,388	11,079	17,177	7,040
CyRide	@cyride	2,048	1,602	805	1,448	97
Transit Authority of Northern Kentucky (TANK)	@tankbus	442	475	365	1,038	56
Central Midlands Regional Transit Authority (The COMET)	@catchthecomet	1,082	2,336	1,810	2,554	305
Capital Metro	@capmetroatx	24,900	24,906	31,772	47,897	10,276
Halifax Transit	@hfxtransit	59,100	16,901	34,935	35,780	11,152

Note: [1]Tweets are collected till June 30, 2021 (from the start date of each of the Twitter handles).

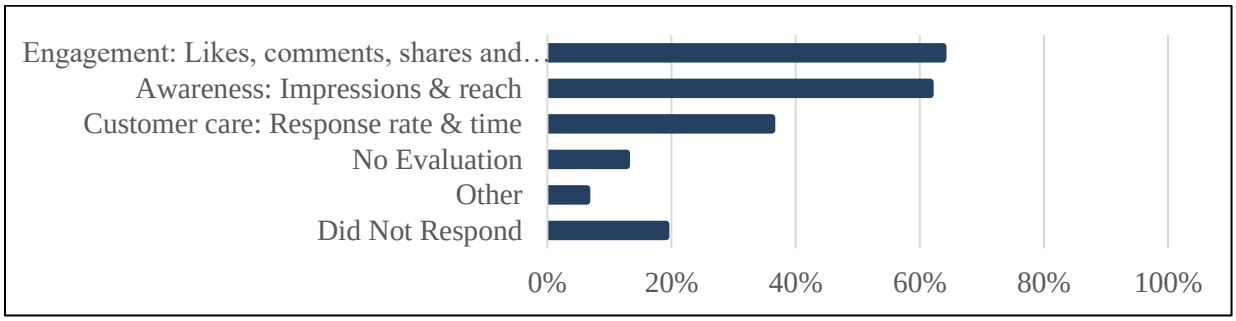
RESULTS AND DISCUSSIONS

Survey Results

The survey measured how often the transit agencies used social media for sharing specific information. We found that transit agencies use social media to share real-time service information (40.43%), general service information (25.53%), and promote their agencies (10.64%) several times a day. There is a tendency among the agencies to match the type of content with the social media platforms they use. For example, 66% of the agencies share real-

time service alerts through Twitter. For meeting and event notices, feature stories, and agency promotion, Facebook is preferred by transit agencies. Both Twitter and Facebook are frequently used by agencies for service information, emergency alert and crisis information, agency news and projects, press releases, and statements. Similarly, Facebook and Twitter are the most popular platforms for reaching all target segments including regular riders, occasional riders, student or young adults, seniors, people with disabilities, low-income communities, minorities, agency employees, and external stakeholders. For reaching young adults or students, most of the agencies almost equally use Facebook (59.6%), Twitter (57.4%), and Instagram (57.4%).

With regards to measuring social media metrics, our survey results indicated that more than half of the transit agencies relied on users' engagement (63.8%) estimated by likes, comments, shares, and clicks, followed by awareness (61.7%), which was measured through impressions and reach, and customer care success (38.1%), measured by response rates and time (Figure 1). Some of the survey respondents also reported engaging Facebook Insights (53.2%), Twitter Analytics (44.7%), Hootsuite (25.5%), and Sprout Social (19.2%) for analyzing their social media usage.



Note: Multiple responses were allowed. Responses are expressed as a percentage of total participating agencies (N=47).

Figure 1. Common social media metrics measured by the surveyed agencies

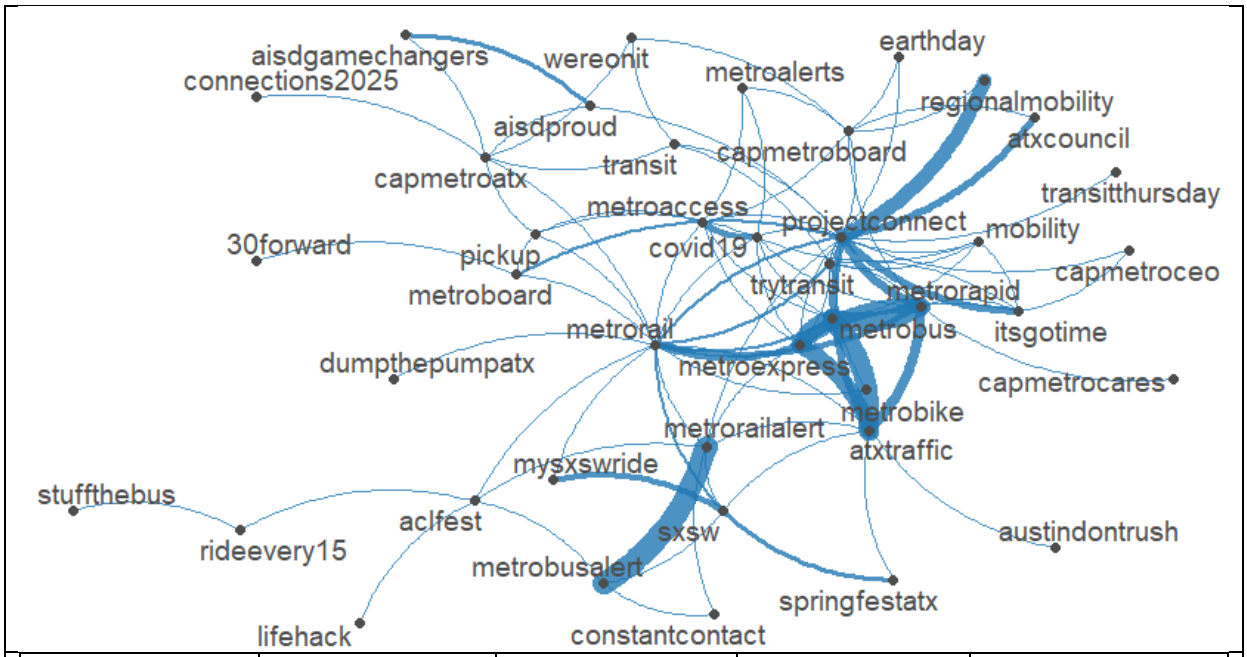
Results from Text Mining

We collected around 118,000 tweets generated by the seven case study transit agencies. By executing these preprocessing steps, the data is transformed into a 'clean text' format, which is ready for further analysis and mining of valuable insights from the Twitter dataset.

Text network of hashtags

Figure 2 shows the next network of hashtags in the case study of transit agencies' official tweets. The top ten most frequently used hashtags in the case study transit agencies' official tweets include '#metroexpress,' '#metrorapid,' '#metrorailalert,' '#metrobus,' '#regionalmobility,' '#trytransit,' '#mysxswride,' '#atxcouncil,' '#itsgotime,' and 'atxtraffic.' These hashtags are highly relevant and frequently utilized in the transit agencies' social media communication. Visual analysis of the hashtag network shows that certain hashtags like '#trytransit,' '#metrorapid,' '#covid19,' '#metrorail,' '#metroaccess,' and '#projectconnect' appear to be closely interconnected and central to the network. In contrast, hashtags like '#stuffthebus,' '#rideevery15,' '#lifehack,' and '#austindontrush' appear to be further away from the center and less connected to the rest of

the hashtags. Several wide edges are observed between certain hashtags, indicating stronger associations or frequent co-occurrences. For example, there are wide edges between 'metrorailalert' and 'metrobusalert,' 'metrorapid' and 'metrobike,' and 'projectconnect' and 'regionalmobility,' among others. The hashtag 'metrobus' shows multiple wide edges with other hashtags such as 'metrorail,' 'metroexpress,' and 'metrorapid,' suggesting frequent usage and connections between these transit-related terms. The analysis highlights the importance of using specific agency or locality-related hashtags (e.g., #atxtraffic, #mysxswride, #austindontrush) to provide more specific and targeted information for a particular transit agency or city, as opposed to generic hashtags like '#metrorail' that do not offer specific agency context.



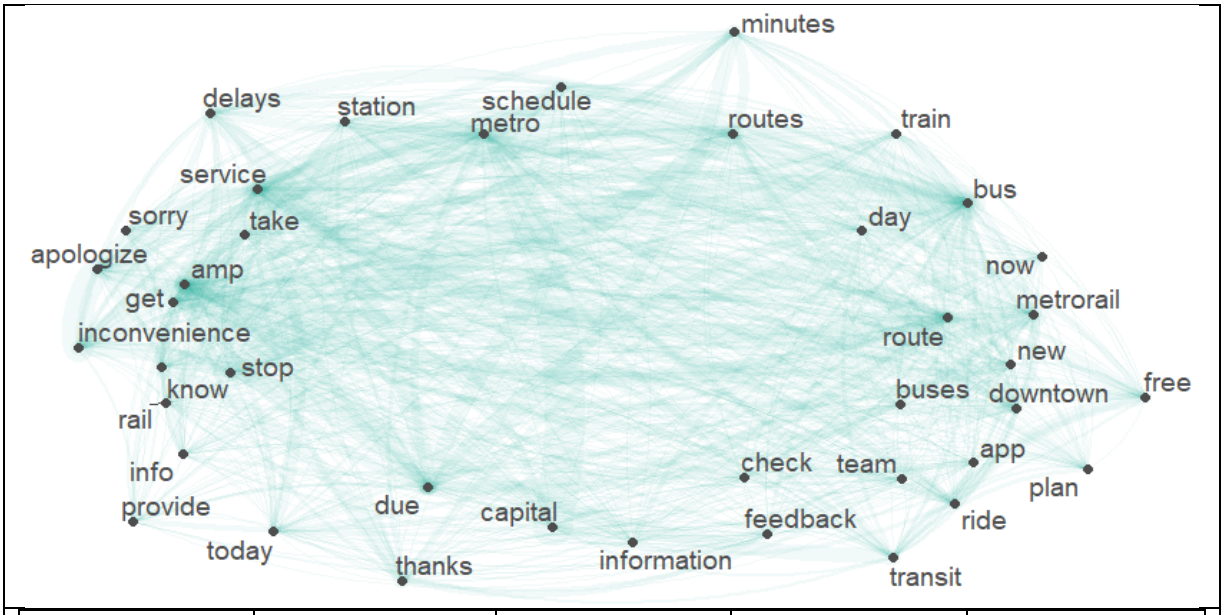
#metroexpress	#metrorapid	#metrorailalert	#metrobus	#regionalmobility
198	160	90	89	51
#trytransit	#mysxswride	#atxcouncil	#itsgottime	#atxtraffic
31	29	28	28	27

Figure 2. Hashtags in case study transit agencies' official tweets

Text network of top keywords

The text network in Figure 3 provides a comprehensive overview of the keywords transit agencies frequently use in their official tweets, highlighting both common themes and specific topics of interest. The top ten most frequently used words include 'route,' 'inconvenience,' 'stop,' 'service,' 'metrorail,' 'get,' 'minutes,' 'due,' 'delays,' and 'new.' These words reflect the major themes and topics that transit agencies frequently communicate with their audience. Notably, there are no words located near the center of the graph, indicating that there is no single dominant keyword or central theme that consistently appears in the tweets. Instead, the most frequent words are distributed across the graph, suggesting a diverse range of topics covered in the tweets. Some words, such as 'minutes' and 'free,' appear visibly further outside the network compared to others. This suggests that these words are less frequently used, but when they are

used, they stand out as distinct and important keywords. A comparison with Figure 2, which depicts the hashtag network, shows that the hashtag '#metrorail' also appears as a top feature in the word network. However, there are content differences between the two networks. Figure 2 focuses more on specific types of transit, such as '#metroexpress,' '#metrorapid,' '#metrorailalert,' and '#metrobus,' while Figure 3 focuses more on general details about transit, such as 'route,' 'inconvenience,' 'stop,' and 'service.' The diverse distribution of words indicates the wide range of information and updates shared with the audience, ensuring a comprehensive communication strategy for transit agencies.



Route	Inconvenience	Stop	Service	Metrorail
6165	5313	4991	4868	3903
Get	Minutes	Due	Delays	New
3447	3175	3114	3067	3015

Figure 3. Top 40 most frequent words in case study transit agencies' official tweets

Text clusters of top keywords

The analysis of text clusters developed using the official tweets of transit agencies is presented in Figure 4. Notably, Cluster 4 constitutes the largest proportion, accounting for 37.9% of the tweets. Cluster 1 seems to center around tweets thanking and being grateful for those using the services of the transit agencies, including keywords such as 'thanks', 'please', 'service', and 'feedback'. Cluster 2, however, seems to center around the transit agencies apologizing to consumers for delays, including keywords such as 'delay', 'inconvenience', 'apologize', 'experiencing', and 'minutes'. Cluster 3 seems to be more community and service-focused, with keywords such as 'transit', 'community', 'service', 'project', 'connect', and 'public'. Finally, Cluster 4 seems to be focused on different services offered by these agencies, including keywords such as 'service', 'bus', 'ride', 'metro', 'routes', 'apps', and 'transit'. Overall, the analysis of tweet clusters from transit agencies' official accounts reveals a diverse social media communication strategy.

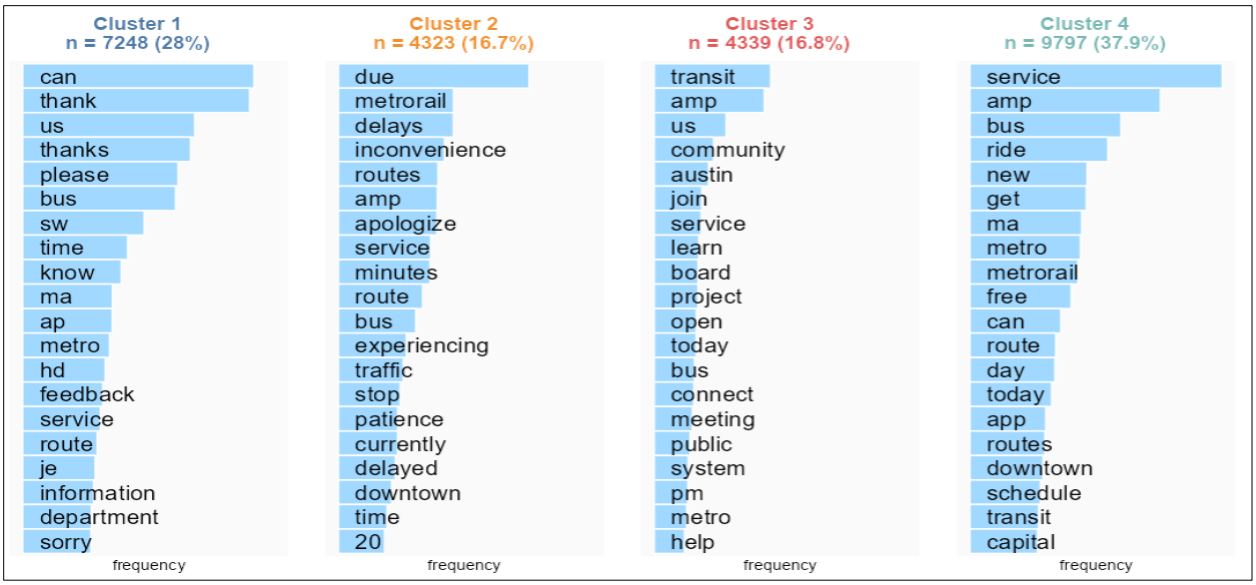


Figure 4. Four text clusters from the transit agencies' official tweets

CONCLUSIONS

The global reach of popular social networking sites is astounding. It is said that social media marketing is the biggest shift since the industrial revolution. Almost every business, organization, and agency have an official identity in social media. Transit agencies have been using social media as a regular tool to share information and understand public sentiments and attitudes toward their services. There is a need for synthesizing the amount of work conducted on this issue. This study has three unique contributions: 1) it performed a thorough review of the social media usage by the agencies, 2) it completed and analyzed a survey on the representative agencies to understand their social media usage, and 3) it performed text mining on the archived tweets of selected agencies.

However, the study has certain limitations. Social media data can suffer from sampling biases and under-representation of specific groups, which might affect the survey's interpretation. The lack of defining target groups, such as minorities or young adults, could have potentially skewed responses. Additionally, the study's focus on certain considerations or goals might limit a broader understanding of the impact factors involved. While acknowledging the study's limitations, this study design was deliberately broad to encompass a global perspective. By conducting a thorough review of social media usage, analyzing representative agency surveys, and employing text mining techniques, this study has generated multifaceted insights. This study's strength lies in its ability to capture diverse strategies and challenges faced by transit agencies worldwide. These insights, even within the study's defined scope, offer substantial knowledge about the evolving landscape of social media within transit contexts. Furthermore, the current study's limitations serve as valuable signposts for future, more targeted research endeavors, making our analysis a foundational step towards more nuanced investigations in this field.

Furthermore, the ever-evolving nature of social media platforms necessitates careful interpretation of the study's findings within a specific timeline. Future studies should consider the dynamic nature of social media and how it influences transit-related issues, such as pandemic

responses, handling misinformation, promoting environmental benefits, ensuring equity, fare reduction initiatives, and safety and livability improvements. Future studies can focus more on social media to convey transit-related issues, such as pandemic responses, misinformation handling, environmental benefits, equity, fare reductions, safety, and livability improvements, as social media platforms grow.

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