

# Mobility in the Feed: Assessing Facebook Communication and Public Engagement in European Cities

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**Abstract.** Facebook has become an essential channel for communicating urban mobility issues, allowing cities and transport agencies to share updates, promote initiatives, and engage directly with citizens. This study examines how eleven European cities use Facebook to inform and interact with the public on transport-related matters. Data from 30 official municipal and transport authority pages were analyzed, focusing on posts filtered through mobility-related keywords. Four indices were designed to assess online communication performance: the User Engagement Metric Index (UMEI), which captures reactions and comments; the Transport Content Activity Index (TCAI), reflecting the intensity of mobility-related content; the Public Sentiment Alignment Score (PSAS), capturing the overall sentiment tone of transport-related posts and the Reaction Sentiment Profile Index (RSPI) reflecting the audience's emotional response to transport-related communication. All indices were standardized to enable comparison between pages and cities. The results reveal clear differences in communication patterns and audience responsiveness, linked to factors such as population size, transport system complexity, and national trends in social media use. The study offers insights into how city characteristics influence digital engagement and proposes a structured approach for improving Facebook communication strategies in urban mobility planning.

**Keywords:** Sentiment analysis, Public Engagement, Sustainable Mobility, Data Analytics, Digital Strategies

## 1 Introduction

Promoting sustainable urban transport is important for addressing the environmental, social, and economic challenges faced by current cities. The transition to more sustainable mobility patterns, particularly through the increased use of public transport, active

modes, and shared mobility, plays a key role in achieving climate-neutral cities, reducing greenhouse gas emissions, and managing the negative impacts of road transport such as congestion, air pollution, and noise. However, to achieve this, it is critical to understand how citizens and public authorities interpret, engage with and interact with transport systems, while also ensuring that these interactions lead to improved user satisfaction and overall service effectiveness.

Traditionally, public perception of mobility services has been assessed through large-scale surveys, interviews, and focus groups. While these methods are valuable, they are also costly, time-consuming, and limited in scope and frequency while often capturing a static picture rather than ongoing public sentiment, making it difficult for authorities to respond quickly to shifting attitudes or emerging issues.

In recent years, social media has emerged as a valuable source of public opinion and behavioral insight in urban contexts. Platforms like Facebook and X allow users to spontaneously express views, experiences, and frustrations related to transport services in real time. Compared to traditional methods, social media offers large volumes of unprompted feedback that can be mined continuously and at relatively low cost. Studies have suggested that social media posts may provide more immediate expressions of user satisfaction or dissatisfaction, especially when users perceive these platforms as informal and accessible channels for public (Balbi et al., 2018; Yang et al., 2020; Nikolaidou et al., 2024).

In the field of transport research, social media has been increasingly used to monitor mobility patterns, track disruptions, and assess public sentiment toward specific policies or services (e.g., Cottrill et al., 2017; Zayet et al., 2021; Mathews et al., 2022). These applications highlight the potential of social media to complement traditional methods and provide richer, more dynamic understandings of public attitudes toward mobility systems. Yet, most existing studies either focus on specific events (e.g., strikes, delays, or emergencies) or analyze data from a single city, limiting generalizability.

The aim of this study is to assess social media performance related to mobility communication across multiple European cities by introducing a structured and quantifiable method. By analyzing Facebook activity from official accounts managed by municipalities and transport operators, the study develops and applies four composite indices to evaluate user engagement, content activity, and sentiment. These indices allow for cross-city comparisons and are interpreted considering contextual factors such as city size, public transport system complexity, and social media adoption rates. This approach not only provides insights into how cities perform digitally in the mobility domain but also offers a methodological blueprint for evaluating and improving online communication strategies aimed at promoting sustainable urban transport.

The structure of the paper is as follows: Section 2 reviews the background and related literature. Section 3 presents the methodological approach, covering data collection and the development of performance indices. Section 4 discusses the results, including index-based comparisons across cities and their relationship to city characteristics. Section 5 concludes with key findings and implications for urban transport communication.

## 2 Theoretical background

In recent years, social media has emerged as a pivotal platform for urban mobility communication, enabling municipalities and transport operators to disseminate information, engage with the public, and gather feedback. The interactive nature of social media platforms allows for real-time communication, fostering a two-way dialogue between service providers and users, which is essential for promoting sustainable transport options and enhancing user satisfaction.

Studies have highlighted the significant impact of social media communication on transportation behavior. For instance, increased social media activity correlates with higher usage of public and sustainable transportation modes, such as subways and bicycle-sharing systems, while private car usage tends to decrease (Martinez-de-Ibarreta et al., 2024). This suggests that effective social media strategies can influence public transport adoption and support environmental goals.

Moreover, social media platforms serve as valuable tools for collecting unprompted user feedback, offering insights into public sentiment and experiences. This user-generated content can inform service improvements and policy decisions, providing a cost-effective alternative to traditional survey methods (Karatsoli & Nathanail, 2023).

The integration of social media analytics into urban mobility planning allows for a more responsive and adaptive approach to transport management. By leveraging data from platforms like Facebook, authorities can monitor public reactions to service changes, identify areas of concern, and implement timely interventions to address issues.

In summary, social media plays a crucial role in urban mobility communication by facilitating information dissemination, enhancing public engagement, and providing actionable insights through user feedback (Karatsoli & Nathanail, 2021). Its strategic use can contribute to more sustainable and user-centered urban transport systems.

The growth of social media, accommodating billions of users, has prompted various stakeholders in the transport and mobility sector to develop social media mining methodologies, such as public opinion mapping and research, with the aim of extracting valuable insights and data-driven decisions. A user-friendly, zero-cost, collaborative datalake, capable of launching social media (Facebook, X and TripAdvisor) crawlers, storing and manipulating collected social media content in tailored designed data repositories, while providing straightforward built-in filtering and analysis tools (including NLP and NER) to transform aggregated information into insightful charts and analytics, is provided by Deligiannis et al. (2020).

## 3 Methodological approach

This section outlines the approach followed to collect, process, and analyze transport-related Facebook data from the eleven European cities (Antwerp, Barreiro, Bologna, Gdynia, Heraklion, Las Palmas, Rouen, Sibenik, Tallinn, Valladolid, Zilina). These cities share different characteristics in terms of mobility, demographics and user engage-

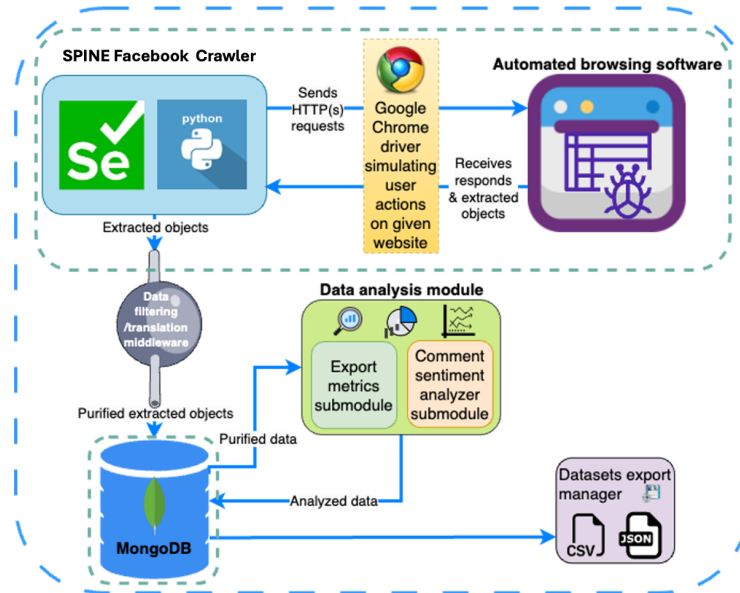
ment in social media. The aim was to convert the unstructured collected data into structured insights that can support evidence-based decision-making in urban transport communication and public engagement strategies. The analysis focused on Facebook activity from accounts linked to municipalities and public transport operators in nine European cities.

### 3.1 Data collection and preparation

To analyze public engagement and sentiment with urban mobility content on social media, a dataset was compiled based on 30 Facebook accounts linked to municipalities (12 accounts) and public transport operators (18 accounts) in eleven European cities. The selection of Facebook accounts was based on their role in providing transport-related information at the city level. This includes official accounts of public transport operators, municipal entities, or affiliated organizations that actively communicate mobility-related content. In cases where no dedicated official account was available, alternative pages used in practice for transport communication were considered (i.e. Sibebnik, Valladolid). These accounts were selected based on a keyword-based filtering process to ensure that transport-related content was retained. Data was collected using a custom scraping pipeline that extracted content, ensuring coverage of user generated as well as shared communication.

Each post was associated with several metadata insights, including the number of post reactions (Like, Love, Care, and Wow, Sad and Angry), along with sentiment polarity and subjectivity scores (Matthew & Varghese, 2023) calculated through natural language processing tools (Vasiliev, 2020). The collected dataset also included account-level metadata such as the number of followers, total posts, and inactivity periods. All metrics were carefully organized to enable normalization, aggregation, and multi-dimensional interpretation across accounts and cities.

As mentioned earlier, social media platforms, including Facebook, host a vast amount of user-generated content that reflects people's preferences and experiences. In our case, accounts of transportation companies and municipalities were identified as valuable sources of information for assessing users' transportation experiences. To this end, an additional pipeline for collecting and analyzing data from Facebook was developed. This pipeline consists of 3 main steps (see **Fig. 1**): (i) data collection: automated collection of posts from the target accounts, (ii) data preparation: cleaning and preparation of data for analysis, and (iii) data analysis and visualization. The following sections describe each stage in detail.



**Fig. 1.** The Facebook data collection and analysis system architecture.

**Data Collection:** Facebook is a platform with hundreds of millions of active users generating content daily. This calls for an automated method of collecting data, since manual effort would be a labor-intensive and tedious procedure. The large volume of data has also affected the adopted strategies for rendering content on screen, with a large share of accessible data being dynamically loaded to promote scalability. These requirements, in combination with the time and resource restrictions coming with the use of the official Facebook API, highlighted the Selenium framework and Python as the best candidates for this data collection task. In more detail, Selenium was configured to log in the platform via the Chrome browser, visit 30 Facebook accounts of municipalities and transportation companies, scroll throughout the uploaded content and collect posts, as well as their comments, that had been uploaded within the time frame 01/01/2022 – 30/06/2023. For each account, the crawler collected the account name, description, national origin, links to external sources, date of joining Facebook and a list of target post URLs. Similarly, for each post, the upload date, post text (including emojis, mentions, and hashtags), and the of post reactions were gathered. After iteratively loading the replies, the crawler also extracted the text and corresponding engagement metrics (-reactions) for each reply. Collected data were stored in the form of documents in a MongoDB database. The data collection process resulted in 9.573 posts, which can be exported and distributed via JSON or CSV files. Finally, it is worth highlighting that the data was collected solely for academic research purposes and exclusively publicly available content was targeted, with no intent to infringe on user privacy or exploit the platform commercially. Efforts were made to minimize impact on the platform and to ensure compliance with ethical research standards, while no personally identifiable information violating GDPR regulation was either collected or stored in the database.

**Data Preparation:** The goal of the data collection task was to gather and analyze user-generated replies to transportation-related posts. However, since the selected Facebook accounts span across different European countries, users' content may be produced in various languages. Therefore, it was deemed necessary to translate all posts and replies into English using the Deep Translator Python framework (Baccouri, 2020). This framework parsed the text, detected the source language with a certain level of confidence and translated it into English, excluding non-text content (e.g., emojis) from the translation process. In addition to overcoming the language barrier, the analysis should focus solely on posts related to transportation. This was achieved by filtering out posts that contained no transportation-related keywords (e.g., public transportation, traffic, mobility).

**Data Analysis and Visualization:** The objective of assessing users' experiences and opinions based on the collected social media data was approached from three different but complementary directions: (i) analyzing the activity of the target accounts, (ii) measuring community engagement with the uploaded content, and (iii) evaluating the sentiment expressed in user replies. Regarding activity, metrics such as the average number of daily posts and the average interval between consecutive posts were calculated. Community engagement was assessed by analyzing the number of reactions (Like, Love, Care, and Wow, Sad and Angry) and replies, while sentiment analysis, employed the SpaCy NLP ecosystem. This framework applied rule-based sentiment analysis to the textual data and provided four outputs: (i) Polarity: a decimal between -1 and 1 indicating sentiment from negative to positive; (ii) Subjectivity: a decimal between 0 and 1 reflecting the degree of personal opinion versus objectivity; (iii) Sentiment Assessments: a list of detected terms along with their associated polarity and subjectivity scores; and (iv) trigrams: sequences of adjacent words. The polarity and subjectivity metrics were used to assess the emotional state of posts' replies and, in combination with the measurements, contributed to acquiring an account-specific estimation of users' response to transportation-related content.

### 3.2 Index development

Four indices were developed to convert a large and diverse set of engagement and sentiment metrics into interpretable results. These indices serve as quantitative representations of different dimensions of Facebook-based transport communication: public engagement, content activity, and alignment with user sentiment.

The first index, **User Engagement Metric Index (UMEI)**, quantifies the degree of interaction a post generates from users. It aggregates the average number of comments per post, the average number of reactions per post, the average number of reactions to posts' comment section, as these are key indicators of how well transport-related content reaches and affects the audiences. Each of these four metrics is converted into a standardized z-score and then rescaled from 0 to 10.

$$\text{UMEI} = 1/3 \times (z_{\text{comments}} + z_{\text{reactions}} + z_{\text{reactionstocomments}}) \quad (1)$$

The second index, **Transport Content Activity Index (TCAI)**, measures the proportion of posts that include transport-related keywords. It is designed to reflect the degree of thematic focus that the account places on transport issues, highlighting whether communication efforts are aligned with mobility topics.

$$\text{TCAI} = 1/2 \times (z_{\text{keyword\_proportion}} + z_{\text{posts\_per\_day}}) \quad (2)$$

The third index, **Public Sentiment Alignment Score (PSAS)**, evaluates the overall tone and subjectivity of the transport-related posts. Higher polarity values reflect more positive perceptions, while subjectivity indicates whether the posts represent facts or personal opinions. This index captures how public reactions align with the messaging tone of the account.

$$\text{PSAS} = 1/2 \times (z_{\text{polarity}} + z_{\text{subjectivity}}) \quad (3)$$

The fourth index, **Reaction Sentiment Profile Index (RSPI)** reflects the audience's emotional response to an account's communication. The index quantifies the balance between positive vs negative emotional reactions to the posts of each account. Positive reactions included Like, Love, Care, and Wow, while negative reactions included Sad and Angry. The Haha reaction was excluded from the sentiment balance calculation, as it can reflect either amusement or sarcasm depending on the context.

$$\text{RSPI} = z[(\text{Positive} - \text{Negative}) / (\text{Positive} + \text{Negative})] \text{ Reactions} \quad (4)$$

To enable cross-variable comparability, each z-score is rescaled to a [0, 10] range using the following transformation:

$$\text{Score\_scaled} = (z - z_{\text{min}}) / (z_{\text{max}} - z_{\text{min}}) \times 10 \quad (5)$$

This approach avoids any bias by the different metric scales and allows all index components to contribute equally. The resulting indices allow direct interpretation, where higher scores indicate stronger engagement, higher content activity, or more positive public sentiment in relation to urban transport.

## 4 Results and City-Level Comparisons

This section presents the main findings of the analysis across the selected European cities. It highlights key differences in social media performance and explores possible factors that help explain these variations. The results are structured to allow both individual account evaluation and city-level comparison. Differences in communication roles (e.g., municipalities vs. transport operators) and the number of active accounts per city may influence comparability across cities and are acknowledged as a limitation of the approach.

#### 4.1 Index-Based Assessment of Social Media Performance

The four transport-related indexes, UMEI, TCAI, PSAS and RSPI were calculated for each one of the Facebook accounts. These indexes were then aggregated for each one of the eleven selected European cities, covering metrics such as average number of reactions, comments and sentiment.

Table 1 summarizes the normalized index values by Facebook accounts (M: Municipality account; PT: Public Transport operator)

To facilitate interpretability, index scores ranging from 0 to 10 were categorized into three qualitative performance levels: low (0–3.3), moderate (3.4–6.6), and high (6.7–10). These intervals, although evenly distributed, serve as indicative thresholds to support comparative analysis rather than classifications. However, when describing a city’s performance as “strong” in a particular index, this assessment is made relative to the distribution of all cities’ scores rather than against the maximum theoretical value of 10.

In terms of UMEI, the strongest results are observed for CP- Comboios de Portugal (PT) and Comune di Bologna (M), both reaching the highest scores in the sample. High engagement is also reported for NMBS (PT), Tallinna Linnatransport (PT), and De Lijn (PT). In contrast, accounts such as AUVASA (PT), City of Tallinn (M), and Slim naar Antwerpen (M) show very low engagement values, suggesting limited user interaction on their posts.

Regarding transport content activity (TCAI), De Lijn (PT) stands out clearly, with the highest activity score, followed by CP-Comboios de Portugal (PT) and TCB-Transportes Coletivos do Barreiro (PT). Several municipal pages remain moderate, while City of Gdynia (M) and City of Žilina (M) record very low TCAI values, indicating minimal transport-related posting intensity.

For sentiment alignment (PSAS), the most positive and subjective tone is found in City of Gdynia (M), which reaches the maximum score. High PSAS values are also recorded for City of Šibenik (M) and CP-Comboios de Portugal (PT). Lower sentiment scores are observed for Carris Metropolitana (PT) and Gradski parking d.o.o. Šibenik (PT), indicating a more neutral or less emotionally framed communication style.

Finally, RSPI captures audience emotional response through reactions. Very high values are observed for AUVASA (PT), GLOBAL (PT), Guaguas Municipales (PT), and City of Šibenik (M), indicating a strongly positive reaction balance. In contrast, Mobilna Gdynia (M) records the lowest possible RSPI score (0.00), signalling an unusually unfavourable reaction profile compared to the other accounts. Low RSPI scores are also found for Carris Metropolitana (PT) and PKA company (PT)

**Table 1.** Index scores of the Facebook accounts and the seven European cities.

Account	M/PT	UMEI	TCAI	PSAS	RSPI	City
Slim naar Antwerpen	M	0,85	5,59	4,32	8,98	Antwerp
De Lijn	PT	4,10	9,82	6,21	7,11	

Account	M/PT	UMEI	TCAI	PSAS	RSPI	City
NMBS	PT	5,02	6,00	4,77	7,91	
City of Tallinn	M	0,42	1,64	6,08	9,17	Tallinn
Tallinna Linnatransport	PT	4,97	4,64	6,79	9,44	
Comune di Bologna	M	6,30	3,95	6,18	6,17	Bologna
Servizio Ferroviario	PT	2,00	7,54	4,48	3,28	
Metropolitano Bologna						
SFMBBO						
TPER (Transporto Passeggeri Emilia- Romagna) (TPB- Bologna)	PT	1,04	4,02	4,04	8,02	
MEX – Marconi Express	PT	0,78	3,81	3,83	8,23	
Ayuntamiento de Las Palmas de Gran Canaria.	M	1,73	2,94	4,54	8,61	Las Palmas
GLOBAL	PT	3,09	3,76	5,18	9,99	
Guaguas Municipales	PT	1,33	6,44	4,86	9,79	
City of Gdynia	M	4,01	1,27	10,00	9,76	Gdynia
Mobilna Gdynia	M	3,31	3,88	3,54	0,00	
PKA company	PT	1,01	2,10	6,73	3,10	
PKP Szybka Kolej Miejska w Trójmieście	PT	2,55	4,96	3,90	8,40	
City of Sibenik	M	0,91	2,30	9,12	9,85	Sibenik
Gradski parking d.o.o. Šibenik	PT	0,48	4,56	2,94	9,18	
Municipality of heraklion	M	1,88	4,84	4,79	8,88	Heraklion
Ayuntamiento de Valladolid	M	1,69	3,35	4,74	8,47	Valladolid
AUVASA	PT	0,11	1,58	4,23	10,00	
Município Do Barreiro	M	1,08	3,16	4,27	9,87	Barreiro
TCB – Transportes Coletivos do Barreiro	PT	0,68	7,59	3,95	9,48	
Carris Metropolitana	PT	3,33	5,53	2,32	2,48	
CP – Comboios de Portugal	PT	6,37	8,08	7,38	9,50	
Fertagus	PT	2,96	5,22	4,74	6,43	
City of Zilina	M	5,18	0,91	4,39	8,11	Zilina
DPMZ	PT	0,66	4,92	5,50	9,15	

Account	M/PT	UMEI	TCAI	PSAS	RSPI	City
Métropole Rouen Normandie	M	2,02	7,06	4,86	7,23	Rouen
Réseau Astuce	PT	1,49	5,69	6,20	6,91	

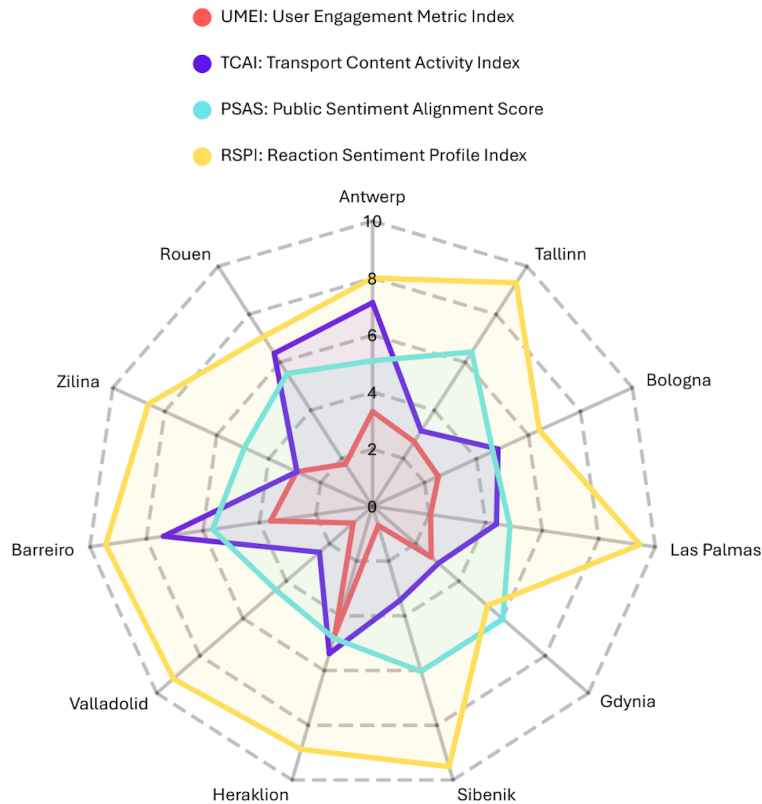
At the city level, the aggregated indices provide a comparative view of how different urban contexts perform across the four dimensions of Facebook communication. The following radar chart (**Fig. 2**) summarizes these scores and highlights clear cross-city differences in communication patterns and public reactions. City-level indicators are computed by averaging values across all selected accounts within each city, aiming to capture the overall communication profile rather than individual provider performance.

Antwerp presents a strong and relatively balanced profile, combining high transport-related activity (TCAI = 7.14) with solid engagement (UMEI = 3.32) and moderate sentiment alignment (PSAS = 5.10). Its RSPI score (8.00) further suggests that the audience response to transport-related communication is largely positive. Barreiro stands out as one of the strongest cases in transport-focused communication (TCAI = 7.39), while also maintaining relatively high engagement (UMEI = 3.61) and strong audience reaction patterns (RSPI = 9.44), indicating a consistent and well-received mobility communication strategy.

In contrast, several cities show a clear dominance of the audience reaction component. Las Palmas, Tallinn, Sibenik, Valladolid, and Zilina all exhibit very high RSPI values (above 8.6 in most cases), suggesting that posts tend to trigger overwhelmingly positive reactions. This is particularly visible in Las Palmas (RSPI = 9.46) and Sibenik (RSPI = 9.51), even though both cities record low overall engagement levels (UMEI = 2.05 and 0.70 respectively). This indicates that, although interaction volume may remain limited, the emotional tone of user reactions is consistently favourable.

Regarding the text-based sentiment indicator (PSAS), Tallinn (PSAS = 6.43) records the highest score, followed by Gdynia (PSAS = 6.04) and Sibenik (PSAS = 6.03). This suggests that in these cases the transport-related Facebook content is framed in a more positive and subjective tone. At the same time, Gdynia shows an interesting imbalance, combining strong PSAS with the lowest RSPI among all cities (RSPI = 5.32), indicating a potential gap between the positive framing of content and the way it is emotionally received by users.

Overall, the index-based comparison confirms that cities differ substantially in their Facebook communication profiles. While some cities combine activity, engagement, and positive reactions in a more coherent way (e.g., Antwerp, Barreiro), others appear to achieve a strong reaction profile despite low engagement volumes (e.g., Sibenik, Valladolid). These findings underline the value of using multiple indices, as reliance on activity or engagement metrics alone would overlook important aspects of how transport communication is perceived by audiences across cities. Differences observed in specific cases (e.g., Heraklion) may be related to local communication practices and varying levels of user engagement.



**Fig. 2.** The four indexes across eleven European cities.

The next section explores these aspects in more detail, aiming to contextualize the observed index scores by relating them to key city characteristics. This additional analysis helps to clarify whether strong social media performance is a function of communication effort alone, or if it also reflects broader urban and mobility system conditions.

#### 4.2 City Characteristics and Their Impact on Social Media Scores

To explore potential factors behind the observed differences three contextual factors were considered: population size, the complexity of the public transport (PT) system, and social media usage levels at the national scale (Table 2). **Population size** was selected as a representative metric of urban density and potential audience reach. Data from official statistical sources revealed that the cities in the study vary significantly in size, from Rouen with approximately 113,000 residents (INSEE, 2021) to Antwerp with around 540,000 (Statbel, 2023). These differences could have an impact on the expected level of public engagement, and the communication needs of local authorities and transport operators. **Public transport complexity** was evaluated based on the

availability of multimodal options such as bus, tram, metro, and rail. Cities like Antwerp, Bologna, Gdynia, and Tallinn offer integrated systems combining multiple modes (Multimodal -Advanced), while Las Palmas, Rouen, and Valladolid primarily rely on bus networks (Bus based- Basic). The classification was derived from each city's public transport portals and verified through local mobility reports (e.g., Tallinna Transpordiamet, 2023; Bologna Urban Transport Plan, 2021). To account for the broader digital environment in which these Facebook accounts operate, national-level social media usage was included. These percentages, representing the proportion of internet users who actively use social media, were obtained from DataReportal's 2024 Digital Global Overview. Estonia, for instance, showed a relatively high social media penetration rate of 75%, while France and Italy had lower levels around 58%, possibly affecting the base level of user engagement expected in those contexts.

These three contextual characteristics were compared against the aggregated Facebook index scores (UMEI, TCAI, PSAS, RSPI) to identify potential patterns (**Table 2**). Overall, larger cities with advanced PT systems, such as Antwerp and Tallinn, tend to present more consistent mobility communication outcomes, including moderate-to-high engagement and stronger content activity, suggesting that complex multimodal systems and larger populations may create stronger demand for systematic transport-related updates and a broader base for interaction. By contrast, smaller cities with basic PT systems, such as Sibenik, record very low engagement (UMEI = 0.70), indicating limited reach and interaction in contexts where both the potential audience and transport system complexity are reduced.

At the same time, the results show that structural context does not fully determine performance. Heraklion, despite a basic PT system and medium population size, records the highest engagement (UMEI = 4.68), indicating that smaller-scale systems can still generate strong public interaction when digital communication is effectively mobilised. A similar pattern is observed in Rouen, where a small population and basic PT system coexist with a high transport activity score (TCAI = 6.37), suggesting that even bus-based systems can sustain frequent and mobility-focused communication when active use of Facebook is prioritised.

Finally, national social media penetration appears to shape the wider digital context in which accounts operate. Cities in countries with high social media usage, such as Tallinn (Estonia, 75%), Sibenik (Croatia, 75%), and Zilina (Slovakia, 78%), generally achieve strong sentiment-related outcomes (PSAS and/or RSPI), supporting the expectation that a more digitally engaged population may increase responsiveness and emotional interaction on Facebook. In contrast, cities in countries with lower social media usage levels, such as Bologna (Italy, 58%) and Rouen (France, 58%), show comparatively moderate engagement and reaction profiles, indicating a potentially narrower baseline of platform participation.

**Table 2.** Index scores of the Facebook accounts and the eleven European cities

City	Population (approx.)	PT complexity	Social media usage (%internet users – country level)	UMEI	TCAI	PSAS	RSPI
Antwerp	540,000	Advanced	67% (Belgium)	3.32	714	5.10	8.00
Barreiro	78,000	Advanced	74% (Portugal)	3.61	7.39	5.66	9.44
Bologna	390,000	Advanced	58% (Italy)	2.53	4.83	4.63	6.42
Heraklion	179,000	Basic	69% (Greece)	4.68	5.38	4.82	8.88
Gdynia	246,000	Advanced	71% (Poland)	2.72	3.05	6.04	5.32
Las Palmas	381,000	Basic	73% (Spain)	2.05	4.38	4.86	9.46
Rouen	113,000	Basic	58% (France)	1.76	6.37	5.53	7.07
Sibenik	43,000	Basic	75% (Croatia)	0.70	3.43	6.03	9.51
Tallinn	440,000	Advanced	75% (Estonia)	2.69	3.14	6.43	9.31
Valadolid	298,000	Basic	73% (Spain)	0.90	2.46	4.48	9.23
Zilina	83,000	Advanced	78% (Slovakia)	2.92	2.91	4.94	8.63

## 5 Conclusions

This paper proposed a simple but structured way to assess how municipalities and public transport operators use Facebook to communicate mobility-related topics. Four indices were used to capture key dimensions of performance: UMEI (engagement), TCAI (transport content activity), PSAS (sentiment in published content), and RSPI (audience emotional response based on reaction types). Together, they allow a more balanced reading of social media performance than relying only on follower counts or raw engagement totals.

The results point to clear differences between cities. In general, cities with larger populations and more complex PT systems appear to have a stronger need and incentive to maintain more systematic mobility communication, which is reflected in more stable index profiles in cases such as Antwerp and Tallinn. At the same time, the findings show that context does not fully determine performance: Heraklion, for example,

achieves high engagement despite a basic system, suggesting that active communication practices can compensate for smaller scale or lower transport complexity.

A strong contribution of the Facebook analysis is the inclusion of RSPI. In several cities (e.g., Sibenik and Valladolid), engagement levels are low, but the reaction profile is overwhelmingly positive. This suggests that on Facebook, mobility information can be well received even if it does not generate extensive interaction. In contrast, cases such as Gdynia show that positive sentiment in posted content does not always align with how users respond emotionally, highlighting the value of keeping text-based sentiment (PSAS) and reaction-based sentiment (RSPI) separate.

There are also limitations that need to be acknowledged. First, this study focuses only on Facebook, and results should not be interpreted as representative of cities' overall digital communication capacity. Second, the analysis relies on aggregated account indicators, meaning that it cannot explain which post types (e.g., service updates, disruptions, campaigns, visuals, videos) drive engagement and reactions. Third, sentiment-related measures are inevitably imperfect: polarity and subjectivity depend on NLP tools and may miss irony or local language nuance. Finally, reaction types are useful as behavioural signals, but they remain context-sensitive, which is why ambiguous reactions such as "Haha" were excluded from RSPI.

Future research could build on this work in several directions. A clear next step is a post-level analysis that considers content formats and platform reach, rather than only account-level averages. A second direction is to expand to other platforms and compare communication patterns across channels. Finally, linking social media scores with mobility indicators (e.g., disruptions, ridership changes, complaints, satisfaction surveys) would strengthen the policy relevance and help clarify whether strong digital performance is associated with real improvements in mobility service delivery and public trust.

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