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Traffic source investigation of waste management websites: implications for institutional communication

Abstract

Effective communication is a crucial but often underestimated component of successful waste management systems. This study investigates the digital behaviour of users on waste management-related websites, with the goal of identifying the most significant online traffic sources. The research was conducted as part of a broader innovation project aimed at optimizing technological, algorithmic, and procedural elements of municipal waste management, with a dedicated focus on the communication strategies required to support these innovations. A total of 55 websites relevant to waste management — including institutional platforms, company websites, and online magazines — were identified through curated sources and AI-supported search processes.

After eliminating duplicates and incomplete entries, 42 websites were analysed using the enterprise version of Similarweb. Key metrics collected included visit volume, user behaviour, device usage, and the distribution of traffic across seven standard internet sources (e.g., direct, organic search, social, referral). The data revealed that organic search and direct access are by far the most dominant traffic sources, while email, display advertising, and paid search play marginal roles. Mobile devices accounted for the majority of access, reinforcing the need for mobile-first design. Based on these findings, a set of practical, source-specific recommendations is proposed, tailored to the needs of a public institution currently undergoing waste management reform. The results provide valuable insights not only for the analysed institution but also for other organizations seeking to improve environmental communication through data-informed digital strategy.

Key Words: waste management, traffic sources, website, internet, marketing communication.

JEL Classification: M31

Introduction

Public communication plays a pivotal role in the successful implementation of waste management infrastructure. As highlighted by Kirkman & Voulvoulis (2017), it is essential to engage the public from the earliest stages of planning. Citizens must not only accept but understand the purpose, complexity, costs, and technological aspects of new infrastructure. Scientific literacy is fundamental in this process, as it fosters meaningful public involvement in shaping decisions that directly impact their communities. Environmental awareness can be significantly influenced by the availability and quality of information. Bassi et al. (2019) demonstrate that targeted communication, particularly around themes such as ecological connectivity, increases environmental awareness. Their study further suggests that demographic variables, such as age and gender, mediate the effectiveness of such communication, emphasizing the need for differentiated outreach strategies. Modern waste management increasingly relies on information and communication technologies (ICTs) as a critical enabler of efficiency and transparency. According to Singh (2022), ICTs are essential for addressing practical issues in waste disposal, including site selection, monitoring, and recycling logistics. Similar emphasis is placed by Mazzi et al. (2020), who underline the importance of external communication within environmental management systems, particularly in the context of waste treatment. Beyond operational benefits, ICTs can contribute to cost reductions. Mousavi et al. (2023) explored the integration of spatial, identification, and data transmission technologies, alongside energy harvesting systems, and concluded that such tools not only lower operational costs but may redefine future standards in waste management systems. Likewise, Handayani et al. (2024) stress that successful implementation of waste policy requires more than technology; it also demands institutional commitment, strong internal and external communication, and optimal resource allocation. In construction sectors, ICTs have proven to support both cost efficiency and the sustainability of waste management processes. Mandíček et al. (2021) found that ICTs positively influence sustainable chain management and cost reduction in construction waste, highlighting the transferability of digital communication principles across sectors. Research indicates that consumer perception is not shaped solely by the inherent attributes of a product, but significantly by the way these attributes are communicated. A study focusing on the perceived quality revealed that while respondents initially did not consider environmental aspects important, their attitudes shifted noticeably once those aspects were explicitly highlighted through targeted marketing communication (Čarnogurský et al., 2019). Effective communication in waste management must also be audience-specific. Kala et al. (2020) developed models for selecting suitable communication traffic sources based on socio-economic categories, showing how targeted strategies improve campaign efficiency. This is consistent with findings by Kozel et al. (2019), who observed that younger age groups (under 18) can significantly influence the environmental attitudes of older generations, indicating a strong intergenerational communication dynamic. It is essential to tailor both the content and selection of communication platforms to the needs and habits of younger generations, as their online behaviour and user journey differ notably from those of older age groups (Drabik et al., 2023). Online platforms — particularly websites — remain key tools for informing the public. Repovienė & Pažėraitė (2023) found that most current web content produced by waste management institutions tends to repeat functional messages, often neglecting emotional or motivational elements

that could enhance engagement. Frempong et al. (2020) add that value co-creation — involving customers in shaping their experience — is positively influenced by firm-managed web platforms and can lead to increased electronic word-of-mouth, a critical factor in community-level environmental behaviour change. Incentivization mechanisms such as gamification are emerging as powerful tools. Daas et al. (2025) describe a mobile application that uses redeemable rewards to encourage recycling behaviour, successfully addressing low participation rates. Understanding digital traffic dynamics is essential for designing effective communication strategies. Filippou et al. (2024) concluded that three key marketing traffic sources can explain over 60% of website traffic variance, providing actionable insights for public and private waste management communicators. Their subsequent research (Filippou et al., 2025) also shows that optimizing a single marketing traffic source — such as lower-funnel campaigns — can have positive spillover effects on other traffic sources, such as branded search. Furthermore, Piccardi et al. (2021) identified Wikipedia and other external knowledge platforms as high-performing sources of website traffic, effectively acting as bridges between search engines and third-party content. Collectively, this body of literature underscores the strategic importance of communication and digital traffic sources in contemporary waste management. From participatory public planning to traffic source-level traffic optimization, successful waste management in the 21st century is increasingly as much about communicating well as it is about managing waste effectively.

1. Methods of Research

This article emerged as a natural response to the needs of a broader research and development project focused on designing technological, algorithmic, and process-level optimizations for municipal waste management systems. Within this context, the current study addresses the challenge of how to disseminate waste management-related information effectively via digital channels. It contributes to the marketing and communication part of the larger project and is considered a partial fulfillment of the broader project's objectives. The main aim of this article is to examine the most significant sources of website traffic in the field of waste management and to propose effective online channels for content distribution, tailored to the needs of a specific institution currently optimizing its waste management processes.

The article thus focuses on analysing actual user behaviour on websites related to waste management, with the goal of identifying which digital traffic sources — such as search engines, social media, or referrals — are the most effective in driving traffic. These insights will serve as a foundation for concrete recommendations aimed at improving public communication strategies in the waste management domain.

This study aims to analyse the structure and significance of online traffic sources for websites operating in the field of waste management, with the objective of informing strategic recommendations for digital communication. The methodological approach followed a structured multi-step process involving sample construction, data collection, data cleaning, and statistical analysis. The initial research phase focused on the identification of relevant websites. A total of 55 unique websites with a clear connection

to the topic of waste management were selected for analysis. The inclusion criteria required that the website either provide information on waste-related topics (e.g. educational or journalistic content), offer waste management products or services, or represent an institution engaged in the governance or coordination of waste management activities. The final sample included websites across three main categories: online magazines, commercial companies, and institutional entities. The sample was compiled from three complementary sources to ensure coverage and diversity. First, a curated list of waste management websites published by Fireart Studio was used as a foundation. Second, two iterative prompt-based queries were conducted using the ChatGPT large language model to identify additional relevant websites. The outputs from all three sources were consolidated, and duplicate entries were eliminated based on URL and content identity, resulting in the removal of one redundant item. The final dataset of 55 websites was then subjected to traffic analysis. Traffic data for each website were collected using the enterprise (paid) version of the Similarweb platform, which provides detailed web analytics and traffic source segmentation. For each domain, the following quantitative indicators were extracted and recorded in a structured spreadsheet: total number of visits, visits segmented by device type (desktop and mobile), average monthly visits, average monthly unique visitors, deduplicated audience size, average visit duration, average number of pages viewed per visit, and bounce rate. In addition to these performance metrics, a key focus of the study was on the origin of web traffic. Therefore, for each website, we recorded the estimated share of traffic attributed to the following standardized traffic sources, as defined by Similarweb: Direct traffic, Organic search, Paid search, Referral traffic, Display advertising, Social media, and Email campaigns. These categories comprehensively cover the range of primary digital traffic sources commonly used in online marketing and communication strategies.

During the data collection process, 13 websites were excluded from the analysis due to insufficient or incomplete data — specifically, 7 websites had no traffic data available across any of the measured metrics, and 6 lacked at least one of the critical variables required for comparison. The final analysed sample thus comprised 42 websites with complete and comparable traffic data. The exclusion of these websites may have influenced the overall representativeness of the dataset in several ways. First, it is likely that websites with insufficient data tend to have lower traffic volumes and limited digital engagement, which means the final analysed sample may slightly overrepresent websites with more established or better-optimized online presence. As a result, the relative strength of dominant traffic sources — such as organic search and direct traffic — could be amplified, while the variability typical of low-traffic websites (e.g., reliance on niche sources or local referrals) may be underrepresented.

Second, the removal of low-traffic websites might have affected the balance across website types (e.g., institutional vs. commercial), although care was taken to ensure diversity in the remaining sample. Nevertheless, the results should be interpreted as reflecting patterns among active and measurable websites, rather than the entire population of waste management websites. While the decision to exclude incomplete entries was made to preserve methodological consistency and comparability across metrics, future research may consider complementary qualitative or case-based

approaches to capture insights from smaller or emerging websites that fall below the detection threshold of traffic analytics tools.

Following data preparation, we conducted descriptive statistical analysis on the cleaned dataset. For each traffic source category, we calculated the mean, minimum, and maximum values of its contribution to total website traffic across the sample. These descriptive statistics allowed us to construct a relative ranking of traffic source importance, indicating which traffic sources are most and least effective in driving traffic to websites in the waste management sector. Based on this ranking and with consideration of the communication goals of public institutions engaged in waste management optimization, we developed a set of practical recommendations on which traffic sources should be prioritized to ensure effective dissemination of information to the general public.

2. Results of the Research

The table below shows the average percentage distribution of website traffic sources across all analysed waste management websites. Data were collected using Similarweb and represent the mean values for particular metrics.

Tab. 1: Average website performance metrics of waste management websites

	Total visits	Monthly visits	Monthly Unique Visitors	Deduplicated audience	Visit Duration	Pages / Visit	Bounce Rate
Average	2 775 776	231 369	140 840	122 062	00:01:42	2,60	47%

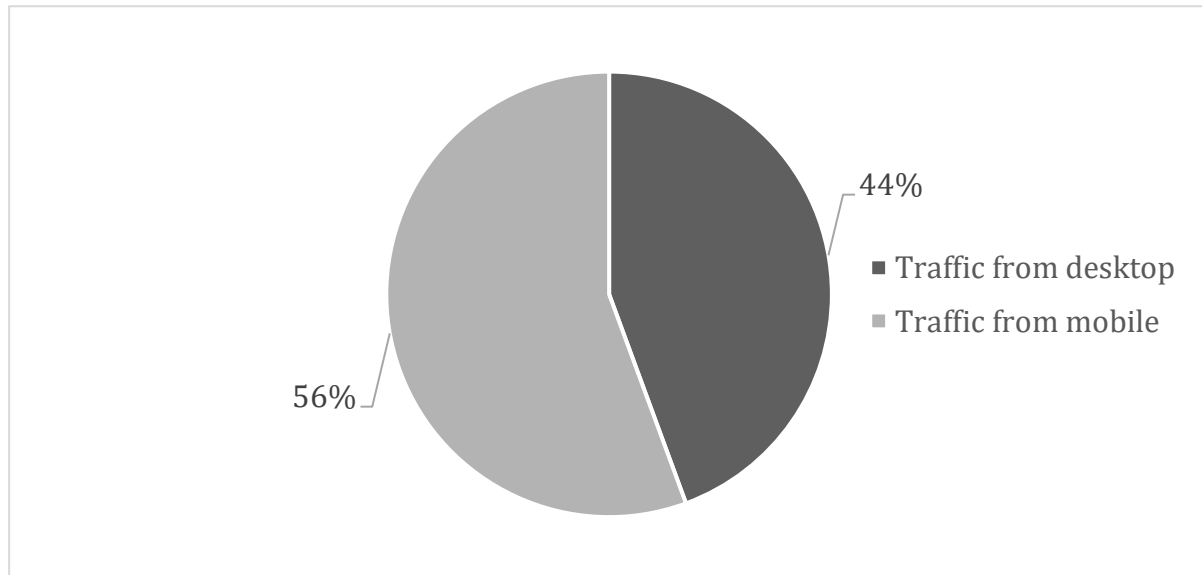
Source: authors' procession

According to the results, the most significant source of traffic is direct access, accounting on average for 38.7% of all visits. This indicates that a substantial portion of users either enter the website URL directly, use bookmarks, or arrive through offline prompts such as printed materials or branded vehicles. Organic search ranks second with 33.9%, highlighting the importance of search engine visibility and the role of non-paid search engine queries in website discovery. Other traffic sources play more marginal roles: referral traffic (10.3%) and social media (9.4%) contribute moderately, while paid search (3.2%), display advertising (2.4%), and email marketing (2.1%) show minimal impact on overall traffic. These results underscore the relevance of cost-effective, inbound-oriented strategies — such as SEO and brand recognition — in the digital outreach of waste management websites. The distribution of traffic sources as shown in the table serves as a data-driven foundation for prioritizing digital communication channels, especially for resource-constrained organizations operating in the environmental services sector.

The following chart illustrates the average distribution of website traffic by device type across all analysed waste management websites. Based on data obtained from the

Similarweb platform, two primary categories were distinguished: mobile devices and desktop computers. For each website, the share of visits originating from each device type was recorded, and the resulting percentages were averaged across the entire sample

Graph 1: Traffic share depending on device of waste management websites



Source: authors' procession

The analysis of user device preferences revealed that, on average, 56% of visitors access waste management-related websites via mobile devices, while the remaining 44% use desktop computers. This finding highlights the increasingly dominant role of mobile browsing in the context of environmental and utility-related online content. The mobile-first behavior observed in this dataset reflects broader digital consumption trends, but it also has specific implications for the waste management sector. Many users may be searching for practical, time-sensitive information — such as collection schedules, sorting instructions, or service updates — while on the move or outside the home. The convenience and immediacy offered by smartphones thus make them a preferred access point for this type of content. From a practical standpoint, this emphasizes the critical importance of mobile optimization for websites dealing with waste management communication. Websites should be fully responsive, fast-loading, and easy to navigate on smaller screens. Key information — such as dates, contact forms, recycling instructions, or search functions — should be prominently placed and easily accessible without excessive scrolling or zooming. For organizations with limited technical capacity, ensuring at least a mobile-friendly layout using established templates or CMS systems (e.g., [WordPress with responsive themes](#)) should be considered a priority. In addition, user behavior data suggests that mobile experiences should be designed with simplicity and utility in mind — prioritizing clarity over visual complexity. This trend toward mobile usage also has implications for the selection of communication channels. For example, QR codes on printed materials or containers can serve as effective bridges between offline environments and mobile digital platforms. Likewise, social media campaigns — often

consumed primarily on mobile devices — may prove more effective than traditional desktop-bound formats in reaching the public.

The following table provides an overview of the relative significance of individual traffic sources for websites dealing with waste management topics. Based on data collected through the Similarweb analytical platform, a total of seven standard traffic sources were examined. For each analysed website, the percentage share of traffic from these sources was identified, and subsequently, the average values across all websites were calculated. These averages were then used to rank the traffic sources from the most to the least significant in terms of their contribution to total website traffic. The resulting ranking offers insight into which digital channels play the most prominent role in driving users to waste management websites.

Tab. 2: List and significance of traffic sources of waste management websites

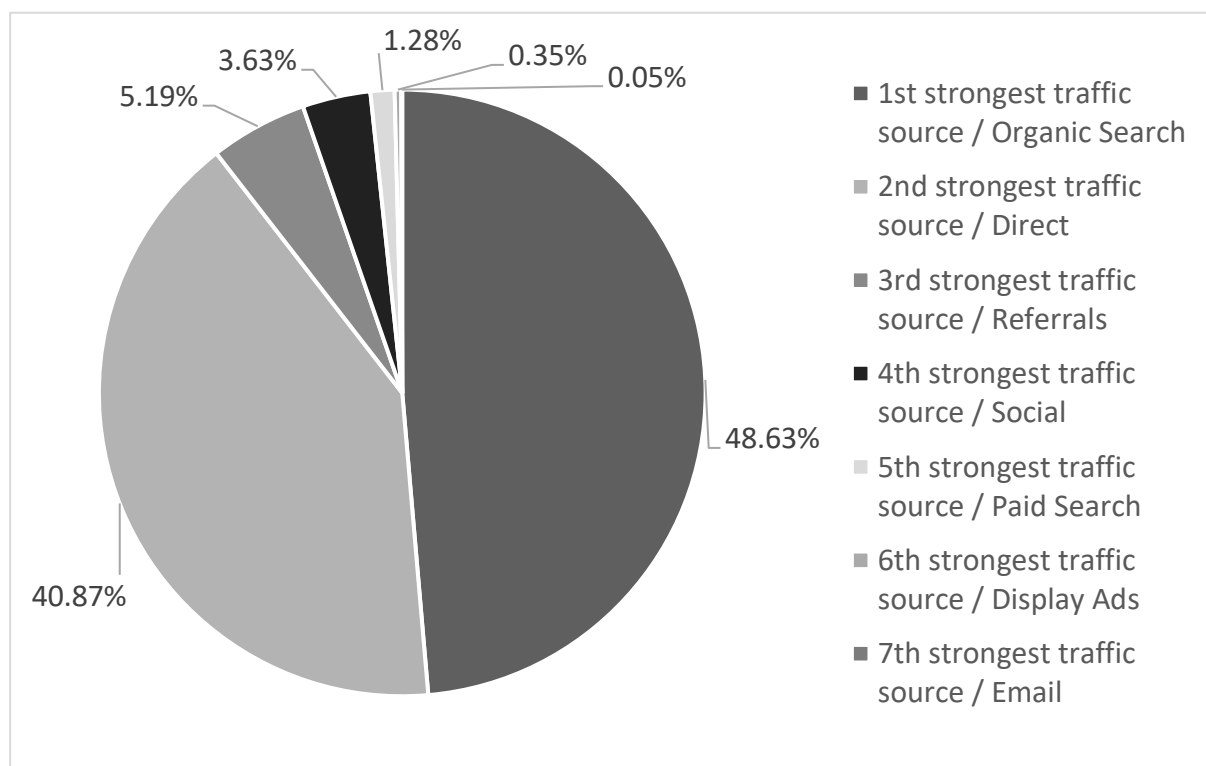
Position	Source	Percentage (average)
1st strongest traffic source	Organic Search	48,63%
2nd strongest traffic source	Direct	40,87%
3rd strongest traffic source	Referrals	5,19%
4th strongest traffic source	Social	3,63%
5th strongest traffic source	Paid Search	1,28%
6th strongest traffic source	Display Ads	0,35%
7th strongest traffic source	Email	0,05%

Source: authors' procession

The table and graph present the aggregated ranking of internet traffic sources based on their average position across all analysed websites related to waste management. Each row represents a specific type of traffic source — such as direct traffic, organic search, social media, and others — and indicates its relative strength in generating website visits within the dataset. The ranking was determined by evaluating the order of importance of each traffic source for every individual website (i.e., whether it was the first, second, third strongest source, etc.). These individual positions were then averaged across all websites that had complete data, allowing for the construction of an overall hierarchy of traffic sources. According to the results, direct traffic and organic search emerged as the two most dominant sources of visits. This suggests that users typically either access waste management websites by entering URLs directly (often as a result of strong brand awareness or offline communication), or discover them through unpaid search engine results. Referral traffic and social media also contribute significantly, whereas display

advertising, paid search, and email campaigns were generally less influential within the analysed sample.

Graph 2: Visualised significance of traffic sources of waste management websites



Source: authors' procession

3. Discussion

Beyond descriptive ranking, each of these traffic sources offers specific opportunities for strategic optimization. For waste management companies, which often operate under limited marketing budgets and in regulated environments, it is essential to focus on cost-effective communication methods and build trust through transparent public engagement. Below are tailored recommendations for each traffic source:

1) Direct Traffic can be improved through local offline campaigns that raise awareness of the company's web presence. This includes using printed materials (e.g., flyers, invoices, recycling schedules), signage on vehicles or containers, and integrating the website address into all public-facing communications. School and Kindergarten Campaigns are another option how to educate children from the early age towards waste collection, separation, and awareness, what is waste's environmental and social impact. Local campaigns, or visits can be arranged in schools. Most of kindergartens and schools are tied to the local government in Slovakia, and those are directly or indirectly owned, or operated by the same municipality, or district as the waste separation and collection entities. Such an engagement can lead not only to better awareness among children, but

also can link these to the waste management's company website, social media, etc. A basic visit by the waste management company truck, and / or associate with a short demonstration and presentation about waste separation is a highly effective option. Participation in open days, press briefings, and community events can also help drive recognition and encourage users to visit the website directly.

2) Organic Search (SEO) represents a highly cost-effective, long-term investment. Waste management companies can enhance organic visibility by creating informative content around local waste regulations, recycling tips, and service updates. Publishing regular news articles or blog posts aligned with common search queries (e.g., "how to dispose of electronics") and maintaining an accessible, mobile-friendly website structure are essential steps. Collaborating with municipalities to be featured on their official websites or digital bulletins can also improve SEO through backlinking.

3) Referral Traffic can be optimized by building relationships with local institutions, news outlets, NGOs, and environmental organizations. For example, press releases distributed to regional media can result in valuable mentions and inbound links. Being listed on municipal portals, regional directories, or public procurement databases can also enhance referral volume at minimal cost.

4) Social Media should focus on community-oriented content that reflects the company's environmental and social impact. Instead of paid promotions, firms can leverage platforms like Facebook and Instagram to share behind-the-scenes updates, respond to community questions, and document activities such as cleanup campaigns or recycling initiatives. Collaborations with local schools, civic groups, or media partnerships can further extend reach organically.

5) Paid Search and Display Ads tend to be cost-intensive and may not yield optimal return on investment for smaller waste management companies. These traffic sources should be used selectively, for example during peak service updates (holiday waste schedules) or in competitive tenders. In general, such companies should prioritize organic and relationship-based reach over paid advertising.

6) Email Campaigns may still provide value when used as part of service communications — such as reminders about pickup days, changes in service, or announcements of public events. Building a small but relevant mailing list through online sign-ups or physical interactions (e.g. during open days) can support direct, low-cost engagement with interested residents.

In summary, while large-scale advertising may be out of reach, strategic use of press relations, institutional collaboration, and community engagement can effectively enhance traffic from key sources. This cost-conscious approach aligns well with the mission-driven nature of waste management services and can yield both operational and reputational benefits.

The findings should be interpreted in light of the fact that the effectiveness and structure of digital communication are strongly influenced by contextual variables. Cultural norms,

technological infrastructure, and levels of digital literacy all shape how users interact with websites and respond to environmental topics such as waste management. In particular, preferences for specific traffic sources — such as search engines, direct access, or social media — may vary depending on local habits, digital ecosystems, and user expectations. Moreover, the perceived relevance of waste management itself, along with the public's willingness to engage with institutional communication, is often shaped by broader societal factors such as environmental awareness, trust in public institutions, and media consumption patterns. These factors can significantly differ across regions and populations, meaning that while the current study offers useful insights for designing digital strategies, its generalizability to radically different sociotechnical contexts (e.g., countries with limited internet access or different platform preferences) may be limited. Therefore, the implications derived from this research are most applicable within digitally mature environments where public institutions already maintain some level of web-based communication infrastructure

Conclusion

This study explored the digital communication landscape of waste management-related websites, with a specific focus on identifying which internet traffic sources most significantly contribute to user visits. By analysing a curated sample of 42 relevant websites through the Similarweb platform, the research revealed that the most dominant traffic sources are organic search and direct traffic, which together account for nearly 90% of total visits. These findings underscore the importance of maintaining strong search engine visibility and brand recognition, particularly for institutions operating under constrained communication budgets. The analysis also emphasized the growing dominance of mobile access, suggesting that any digital strategy in the field of waste management must prioritize mobile responsiveness and clarity of content across devices. Furthermore, less impactful traffic sources such as display ads or email campaigns were shown to play a relatively minor role in overall traffic generation — indicating that their use should be selective and purpose-driven. Based on these insights, the article offered practical, source-specific recommendations for optimizing communication strategies, particularly for public institutions currently undergoing waste management transformations. These recommendations align with broader goals of transparency, efficiency, and public engagement in the environmental services sector. In a broader sense, this research demonstrates that digital behaviour data — when interpreted appropriately — can serve as a powerful input for strategic planning in public services.

Although this study focuses on the waste management sector, the observed dominance of organic search and direct traffic as primary acquisition channels appears to be consistent with digital behaviour trends in other public service domains, such as healthcare or energy. In these sectors as well, users typically seek trustworthy information through search engines or direct access to known institutional sources. This suggests that some patterns identified in this research — particularly the importance of content accessibility, SEO optimisation, and brand trust — may be applicable across various areas of public service communication. However, sector-specific nuances, such as urgency of need or emotional framing, should be considered when translating these findings beyond the waste management context. Future research may expand this approach by including

longitudinal analysis of traffic patterns, content impact assessments, or segmentation by region and language. Moreover, integrating qualitative user feedback with traffic analytics could help develop more holistic, citizen-oriented communication strategies. Ultimately, the findings of this study are not only relevant for a single institution but contribute to a more general understanding of how digital ecosystems support — or constrain — the effectiveness of environmental communication in the 21st century.

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