USING SOCIAL MEDIA TO UNDERSTAND STAKEHOLDERS' ENGAGEMENT IN AUTOMATIC TRAIN OPERATION MEGAPROJECT

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Abstract

The railway industry plays a central role in fostering economic growth. However, numerous challenges create constraints on its performance. Megaprojects in this sector, encompassing both digital and traditional rail initiatives, involve substantial investments, high complexity, and diverse stakeholders. This paper focuses on Automatic Train Operations (ATO) megaprojects and delves into stakeholders' attitudes, perceptions, and interests, particularly through the lens of social media. Leveraging sentiment analysis of Tweets related to the Réseau Express Métropolitain (REM) project in Montreal, the research aims to unravel public impressions and external stakeholders' perspectives. Findings reveal a notable trend of increased interest in ATO megaprojects. Public sentiment evolves dynamically based on project developments, indicating a strong correlation between public interest and project milestones. The study highlights the importance of aligning public sentiments with advancements in autonomous rail technologies. The results further underline the dynamic nature of stakeholders' needs and constraints throughout project development, emphasizing the role of effective communication with both media and citizens. Theoretical contributions focus on expanding stakeholders' theories, while practical implications suggest using natural language processing techniques to monitor external stakeholders' demands, thereby improving stakeholder management in megaprojects.

Keywords: Megaprojects; Automatic Train Operation; Social Media; Stakeholders.

1. Introduction

The pivotal role of the railway industry in promoting economic growth and facilitating commuter transportation has led to a growing demand for railway service, but factors such as outdated rolling stock, lagging technical equipment, and aging infrastructure have been identified as potential constraints on its performance (Laiton-Bonadiez et al., 2022). Consequently, the sector is undertaking various projects to solve these problems and meet the growing demands for sustainability, efficiency, reliability, and safety (Singh et al., 2021). These projects frequently leverage digital and automated technologies, such as Automatic Train Operation (ATO) (Attoh-Okine, 2014), and holds the promise of delivering equivalent benefits to traditional rail infrastructure projects while minimizing complications, but also reducing costs (Singh et al., 2021). However, in some cases, both digital (ATO) and traditional rail projects are simultaneously performed, mounting to major investments, substantial risks, high complexity, and visibility, as well as multiple stakeholders involved (Jernbanedirektoratet, 2023; REM, 2023).

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These types of projects are considered as megaprojects (Kovaka, 2005; Zhai, Xin and Cheng, 2009; Flyvberg, 2014). They imply a higher complexity due to using sophisticated technology, their impact on the environment and the multiple stakeholders involved (Pitsis et al., 2018). This complexity can lead the megaprojects to their failure (Flyvberg, 2014), since it negatively impacts decision-making behavior, strategy, governance and procurement, risk management, leadership and teams, supply chain integration and coordination, and stakeholder management and engagement (Denicol et al., 2020)

Research has focus on analyzing all the above causes, especially, stakeholders' engagement. The scope, the complexity and the uncertainty of the megaproject environment amplifies the challenge and the need to identify stakeholders and their requirements, to evaluate the effects

on stakeholders and their interconnections, and to implement suitable engagement strategies (Yang et al., 2011; Mak, Shen and Yang, 2015). Indeed, megaprojects literature emphasize that such projects are unique due to their high level of innovation and their complex physical infrastructure and stakeholder network (Invernizzi et al., 2018). They are also characterized by frequent delays and cost overruns, while delivering less benefits than initially promised (Invernizzi et al., 2018). The singularity of megaprojects consequently accentuates the imperativeness of implementing adequate stakeholder management and engagement strategies (Denicol et al., 2020).

Similarly, while conducting automation projects in the railway industry, it is of paramount importance to include stakeholders' perspectives into the implementation process in order to ensure the social acceptability of the new technology and to fully capture its benefits (Lemonnier, Adelé and Dionisio, 2023). Stakeholder management aims at identifying relevant stakeholders, determining their impact on a project, and assessing their motivations (Ward and Chapman, 2008), while stakeholder engagement encompasses the activities and outcomes of interacting with these stakeholders in an ethical and strategic way (Kajula et al., 2022). Achieving a megaproject for automatic railways thus requires pragmatic stakeholder management and engagement practices. Yet, the interest and concerns of stakeholders remains unknown, which can lead to multiple organizational and managerial challenges for railway organizations (Powell et all., 2016; Wang et al., 2016; Pattison et al., 2020; Gadmer et al., 2022).

Now, with social media, stakeholders can communicate easily with project organizations (Williams et al., 2015), while project organizations can use social media platforms to share information and milestones of the project (Ninan et al., 2019). As noted by Di Maddaloni and Davis (2017), stakeholders in local communities affected by a project are seldom included in a

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project communication plan, which can have detrimental impacts on the project outcomes and the communities. Using social media thus provide these stakeholders a platform to express their needs and expectations concerning the project (Mishra and Sharma, 2019; Lobo and Abid, 2020; Hand & Ching, 2020; Chung et al, 2023). However, the use of social media for stakeholder and project management purposes remains scarce (Ninan, 2022; Chung et al., 2023).

Therefore, the research questions of this paper are: RQ1) **How can social media messages be used to study public impression of ATO megaprojects?** RQ2*)* **Based on such analyses, what are the sentiments expressed by external stakeholders for ATO megaprojects?** More specifically, this article aims at identifying the perceived attitudes and impressions of stakeholders regarding ATO megaprojects. To do so, a sentiment analysis of Tweets regarding the *Réseau Express Métropolitain* project in Montreal using Natural Language Processing techniques with the programming language *R* was realized.

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The paper is structured as follows. Next sections provide a literature overview of related topics. Section 3 describes the research method, while section 4 presents the results. Finally, section 5 and 6 respectively discuss the results and conclude this paper.

2. Literature overview

In the following section, the literature background of this paper will be outlined. Starting with an overview of the literature on ATO user acceptance, which will be followed by stakeholder management in megaprojects and succeeded by stakeholder engagement in projects. The section is completed by outlining the use of social media analysis in transport projects.

2.1 Automatic Train Operation user acceptance

ATO stands for Automatic Train Operation, which is a broad framework with four levels of automation known as Grades of Automation (GoA) in the international standard IEC 62290-1 (IEC, 2014). Using ATO technology offers numerous potential benefits (Singh et al., 2021). It is expected to lead to a decrease in accidents and improving overall safety, among others. The deployment of automatic trains can also result in reduced operational costs for railway companies. Anticipated outcomes include a decrease in emissions and an expanded capacity for passengers, contributing to environmental and transport sustainability. Overall, these positive effects are expected to make railway services more sustainable, reliable, robust, and efficient (Singh et al., 2021; Allied Market Research, 2020).

From a passenger viewpoint, the ongoing discussion about the pros and cons of ATO is often rooted in people's perceptions of driverless trains, especially regarding safety (Fraszczyk, Brown and Duan, 2015). However, only a handful of studies have analyzed the acceptance of automatic public transport (Pakusch and Bossauer, 2017) and understanding the factors influencing public acceptance is crucial for the railroad industry to successfully embrace autonomous technology. Acceptance thus plays a pivotal role, particularly concerning regulatory approval and oversight during the development and eventual deployment of the technology (Wong, 2018). This is especially important considering that when railway users are presented a choice between a staffed autonomous mode, a traditional mode or remotely supervised mode, most of them will opt for the conventional driver-driven mode (Dong et al., 2019, Nordhoff et al., 2018, Roche-Cerasi, 2019; Wahlström, 2017; Zhu et al., 2020; Lemonnier, Adelé and Dionisio, 2023).

Transitioning to driverless trains is a complex process that involves balancing the interests of various stakeholders, including passengers, railway companies, and government agencies (Morast et al., 2023). Successfully implementing such trains necessitates meeting a wide array

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of technical, regulatory, and operational requirements. These requirements often lead to extensive interactions among the stakeholders involved, each of whom has distinct priorities and concerns. Navigating these interactions is crucial for addressing issues such as safety standards, service reliability, regulatory compliance, and public acceptances (Morast et al., 2023).

In addition to the disruptive technological aspects, another a significant challenge in the development of these advanced transport systems lies in the cost of their implementation (Jernbanedirektoratet, 2023; REM, 2023). Public transport operators and local governments face substantial financial burdens when investing in the necessary infrastructure and technology (Jernbanedirektoratet, 2023; REM, 2023). The high costs associated with developing, maintaining, and upgrading these systems can be a major deterrent in the acceptance from the public and other stakeholders (Pakusch and Bossauer, 2017). Accordingly, if the implementation of ATO is pursued by means of a megaproject, the financial burden of the involved organizations is increased, since Transport Infrastructure Projects (TIPs) usually span decades and have budgets mounting to billions of dollars (Bruzelius et al., 2002; Flyvbjerg, 2006; Locatelli, Invernizzi, and Brookes, 2017). These budgets, which are often exceeded, can negatively impact stakeholder's opinion of a megaproject (Flyvbjerg, 2012). In sum, the deployment of ATO is intrinsically linked with stakeholder management; a critical endeavor for fostering a positive public impression of a megaproject.

2.2 Megaprojects and stakeholder management

Megaprojects frequently face the threat of unpopularity and local opposition (Di Maddaloni and Davis, 2017), and according to Ward and Chapman (2008), stakeholders represent a significant source of uncertainty in large construction projects. In these

projects, uncertainties related to stakeholder entities, their assertions, and interconnections during various project phases constitute the primary stakeholder-associated uncertainties (Ward and Chapman, 2008; Mak, Shen and Yang, 2015). It is thus acknowledged that improving stakeholder management procedures is an effective way to minimize benefits shortfalls and enhance positive contributions (Di Maddaloni and Davis, 2017), but rarely are the megaproject objectives aligned with the requirements of local communities (Choudhury, 2014; Di Maddaloni and Davis, 2017).

Adding to this, in a megaproject, the needs and constraints of stakeholders are dynamic since they change as the project progresses and are expressed differently under different project conditions (Zhai, Xin and Cheng, 2009). The obvious solution would be to comply with stakeholders' demands, but this can lead to scope creep and escalation of commitments (Ninan, Mahalingam and Clegg, 2019). Furthermore, external stakeholders (stakeholders outside the project organization) can present conflicting needs and goals on the planned megaproject commitments (Ninan, Mahalingam and Clegg, 2019). External stakeholders involved in megaprojects operate across flexible boundaries, and they are often difficult to control or monitor, which exacerbates the need to identify their expectations and communicate effectively with them (Ninan, Mahalingam and Clegg, 2019). Therefore, due to its high complexity, unsuccessful stakeholder management is a major factor explaining the overall poor performance of megaprojects (Mok et al., 2015).

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Successful stakeholder management in megaprojects starts with their engagement and involvement; as shown by Arda, Esposito and Wilderom (2024), who demonstrated that the collaboration and communication between local communities, public authorities and the project owner can foster positive perceptions and convert uncertainties into informed understanding. However, unexpected events or changes in the megaproject plans can have

detrimental or positive impacts on external stakeholders' perception and opinions on the project (Morkan et al., 2023; Shenoy and Mahanty, 2024). This is especially true for external stakeholders, since megaprojects alter the way of life for residents in proximity and reshape economic dynamics in the region, consequently inducing social disturbances (Ninan and Sergeeva, 2022).

The unique stakeholder network of megaprojects (Invernizzi et al., 2018) can generate a perfect storm where resistant or doubtful stakeholders alter the project scope, leading to delays, halts, and cost overruns through coordinated efforts (Olander and Landin, 2005; Vrhovec et al., 2015; Kroh and Schultz, 2023). Nonetheless, by expressing their concerns and questioning prevailing norms (Watson et al., 2018, Kroh and Schultz, 2023), skeptical stakeholders can provide valuable input and additional perspectives (Juntunen et al., 2019; Di Maddaloni & Sabini, 2022; Kroh and Schultz, 2023). In accordance with this, organizations have an incentive to include external stakeholders in their decision-making process to mitigate the impacts of unexpected events or changes on the megaproject outcomes (Gil, 2023).

Gil (2023) illustrates that extensive literature in project management (Cleland and King, 1968; Cleland, 1986; Calvert, 1995; Miller and Lessard, 2000; Winch, 2004; Gil and Baldwin, 2013; Gil and Pinto, 2018; Gil and Fu, 2022) supports that external stakeholder, especially those affected by the project, exert control over valuable resources necessary for its progression following the primary approval. Gil (2023) also indicates that engaging external stakeholders in decision-making processes often lead to significant deviations from project goals; up to two-thirds of the cost overruns throughout a megaproject's duration can be attributed to interactions with these stakeholders (Gil and Fu, 2022). Stakeholder engagement will therefore be explored in the next subsection.

2.3 Stakeholders' engagement in projects

In project management literature, stakeholders are delineated through three primary definitions (Littau, Jujagiri and Adlbrecht, 2010; Williams, Ferdinand and Pasian, 2015). They are (1) defined as entities capable of exerting influence on or being influenced by the project (Freeman, 2010; Williams, Ferdinand and Pasian, 2015), (2) entities with a vested interest in the project's results, (3) or a combination of the aforementioned definitions (Williams, Ferdinand and Pasian, 2015).

Stakeholders are not passive actors and may dictate the project outcome, their engagement is therefore considered paramount for value creation and the overall success of a project (Bayiley and Teklu, 2016; Oppong et al, 2017; Ingvarsson, Hallin and Kier, 2023). However, stakeholders' diverging interests can lead to conflicts, adding complexity to their incorporation within the project's scope (Shi et al., 2020). Consequently, projects lead to uncertainty and complexity, which requires balancing all relations between the project and its parts, other projects, even with the organization (Aaltonen et al., 2015). This includes the way in which the projects adapt its behavior to the various stakeholders who make up its environment (Crane and Ruebottom, 2011). This perspective focuses on describing how projects identify the stakeholders who are important to them and how the latter are engaged in the process of constructing and legitimizing their actions. Bourne (2008) states that a project only can exist with the consent of its stakeholder community and the relationships with all kinds of stakeholders are essential for the project performance, as they can benefit from or adversely be affected by its activities.

Stakeholders' theories thus moved from management of stakeholders to management for stakeholders (Eskerod et Huemann, 2013; Eskerod et al., 2015) where stakeholders are

considered as actors who have the capacity to participate in a “social game” (Pasquero, 2008): they are able to formulate and carry expectations towards society, the project and the role of the project in society; they experience the consequences of the project's actions; and draw conclusions for their individual and collective behavior, they define the acceptable limits of the project; and they co-construct the systems of relationships that connect the project to its environments.

Maintaining these relationships and achieving project stakeholder engagement is nonetheless an ambitious endeavor (Ingvarsson, Hallin and Kier, 2023). Traditional approaches presuppose that stakeholders act rationally in pursuit of their interests (Floricel and Brunet, 2023). These methods involve identifying stakeholders, comprehending their interests, expectations, power dynamics, and potential actions. Subsequently, they employ time-constrained, one-way communication strategies via official channels, the press, and social media to convincingly communicate the project's benefits to them (Aaltonen, 2011; Yang, 2014; Floricel and Brunet, 2023).

Other strategies have been suggested for engaging project stakeholders (Ingvarsson, Hallin and Kier, 2023), such as the continuous planning and management of roles, responsibilities, and activities (Eskerod et al., 2015; Ingvarsson, Hallin and Kier, 2023). These strategies encompass building activities to foster stakeholder exchange (Aaltonen and Sivonen, 2009; Di Maddaloni and Davis, 2018; Lehtinen et al., 2019; Ingvarsson, Hallin and Kier, 2023), utilizing visualization techniques (Walker et al., 2008; Ingvarsson, Hallin and Kier, 2023), and implementing agile methodologies (Serrador and Pinto, 2015; Ingvarsson, Hallin and Kier, 2023). Despite these recommendations, project stakeholder engagement remains challenging (Ingvarsson, Hallin and Kier, 2023), and especially in megaprojects (Denicol et al., 2020). Indeed, it is impossible to collect and integrate all the input of stakeholders, which can create

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disappointment (Eskerod et al., 2016). The temporary and unique nature of projects exacerbates the challenges of gathering and aligning expectation (Eskerod et al., 2016). Establishing relationships with stakeholders from the start and engaging with numerous stakeholders can cause the organization to lose focus on the critical ones that provide essential resources and have the greatest influence on the project outcomes (Eskerod et al., 2016).

Social media can therefore be used to solve or mitigate these challenges (Williams et al., 2015; Ninan et al., 2019). For instance, Ninan et al. (2019) analyzed publications related to a project on Facebook and X (Twitter) and determined that posts who were resonating within the local community played an important role in making members of this community advocates for the project (Ninan, 2022). Such studies demonstrate that social media data can be used to examine stakeholders' attitudes and opinions towards the project, as well as the organization adjustment and response in face of these perspectives (Toubiana and Zietsma, 2017; Ninan, 2022). Nonetheless, the range of research for studying social media remains limited, necessitating innovative methods to perform research in project management (Drouin et al., 2013; Ninan, 2022). A cost-effective way to monitor and assess the changes in opinions from external stakeholders using social media during a megaproject development will thus be discussed in the next subsection.

2.4 Social Media and Sentiment Analysis

Some novel tools are being developed to assist in these complex endeavors, while social media has transformed project stakeholder management by introducing new opportunities and challenges (Williams et al., 2015). Notably, netnography or social media analysis allows the studies of online interactions, such as Facebook posts or X posts (Tweets). This was used by Lobo and Abid (2020) to understand the strategies used by external stakeholders to mobilize

and influence decision-making in megaprojects in London. The qualitative coding of the social media data was driven by the data itself, employing an inductive approach during the coding process. The social media content analysis spanned from 2015 to 2016 and aimed to comprehend the primary areas of concern among public stakeholder groups regarding the megaprojects. The analysis also sought to understand the ongoing campaigns and influence strategies employed during the consultation process (Lobo and Abid, 2020).

Moreover, the recent expansion of online communications offers significant potential for gaining deep insights into stakeholders' perceptions of megaprojects (Williams et al., 2015). For instance, Williams et al. (2015) analyzed stakeholder discussions about a transport megaproject in London during its front end, using social media data, i.e. X (Twitter). The discussions were structured as a network community of interest and analyzed every three months to identify key categories. These categories were then organized by the type of content shared, using inductive content analysis of Twitter profiles and tweets (Williams et al., 2015). Such endeavor is conducted by realizing a sentiment analysis, which involves classifying the sentiment polarity expressed in text and identifying the sentiment related to various aspects of a topic (Zimbra et al., 2018).

Social media sentiment analysis can be performed using Natural Language Processing techniques, which are essential for understanding and interpreting the vast amount of textual data generated on platforms like X (Twitter). These techniques involve several steps, starting with the pre-processing of text, documents, or web content to ensure the data is in a suitable format for analysis (Chaurasia et al., 2021). The first step in sentiment analysis is tokenization. This process involves splitting text into smaller units, such as words or phrases, which are easier to analyze. Next step involves the removal of stop words. By removing these words, the focus is shifted to the more meaningful content of the text, allowing for a clearer understanding

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of the sentiment being expressed (Chaurasia et al., 2021). Then, the cleaned text can be analyzed with the help of Natural Language Processing techniques. Through these techniques, social media sentiment analysis can provide valuable insights into stakeholder opinion and engagement, enabling researchers to retrieve valuable information based on the emotions and opinions expressed in social media content (Chaurasia et al., 2021).

For this paper, the aforementioned steps of a social media sentiment analysis were conducted using Natural Language Processing powered by *R* for an ATO megaproject in Montreal using X data (Tweets) in order to understand external stakeholders' engagement in the project. The methodology will be outlined in section 3.

2.5 Research Questions

The preceding literature overview revealed a research gap, which will be addressed in this subsection.

In the first subsection of this overview, it was illustrated that seldom are the studies analyzing the acceptance of automatic rail public transport. Indeed, only a few papers are presenting the factors that influence public acceptance of such mode of transport (Pakusch and Bossauer, 2017). Nonetheless, user acceptance is crucial for obtaining regulatory approval while implementing the technology (Wong, 2018) and transitioning to driverless trains is a complex process that involves balancing the interests of various stakeholders, including passengers, railway companies, and government agencies (Morast et al., 2023). Stakeholders and particularly prospective users' engagement in railway automation projects thus creates complexity since it necessitates harmonizing their expectations and constraints with the project goals (Aaltonen et al., 2015), but little is known about such exigencies. Since a project can only exist with the consent of its stakeholders (Bourne, 2008), more research is needed on

stakeholder acceptance of ATO projects. However, despite strategies such as continuous planning, agile methodologies, and visualization techniques, stakeholder engagement remains a difficult task (Ingvarsson, Hallin and Kier, 2023).

This is especially true in megaprojects, where stakeholders are a major source of uncertainty (Ward and Chapman, 2008) and where objectives are rarely aligned with the exigencies of local communities (Choudhury, 2014; Di Maddaloni and Davis, 2017). Also, changes in the megaproject plans affects external stakeholders' perception and opinions on the project (Morkan et al., 2023; Shenoy and Mahanty, 2024), consequently illustrating the dynamic nature of stakeholder exigencies and the need to include external stakeholders in the decision-making process to alleviate the effects of unexpected events on the megaproject outcomes (Gil, 2023). However, including external stakeholders in decision-making processes creates considerable fluctuations from megaproject goals, time, and budget (Gil and Fu, 2022).

In response to this challenge, social media sentiment analysis using Natural Language Processing techniques appears as a prospective solution. The research questions addressed in this paper are thus: RQ1) **How can social media messages be used to study public impression of ATO projects?** RQ2*)* **Based on such analyses, what are the sentiments expressed by external stakeholders for ATO megaprojects?** Next section will outline the methodological approach used to answer these questions.

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3. Methodology

The study focuses on conducting a sentiment analysis of tweets related to the REM (Réseau Express Métropolitain) project in Montreal. The REM is a fully automated light rail system project across the Greater Montreal. The estimated cost of the project is 7.95 billion CAD$. It should be completed in 2027 (REM, 2023). Once completed the REM will be 67 km long,

encompassing 26 stations (REM, 2023). The project was selected for this research since it is an ATO megaproject, and it's easily searchable on *X* due to its name and *Hashtag.* The project also as high visibility and arouses public and media interest in the region.

Data collection was determined to be most relevant from November 2020 to Mars 2021, since it encompasses a period crucial to understanding public and media sentiment towards the project. It was the end of the project front-end and the start of the execution. A total of approximately 5,500 tweets were collected during this timeframe, using the key works #REM, #REM MTL and #RéseauExpressMétropolitain. Tweets were collected in French and in English. The collected tweets were systematically classified into two categories: citizen and media. This categorization aimed to distinguish between public opinions expressed by individual citizens and those disseminated by media outlets. Such classification provides a nuanced perspective on how different stakeholders contribute to the sentiment landscape surrounding the REM project. To analyze sentiments, the collected tweets were exported to the *R* programming environment.

Leveraging R's capabilities, a sentiment analysis to quantify the emotional tone expressed in each tweet was conducted. A code was created, which performed the steps mentioned in subsection 2.4. This process involved the use of natural language processing techniques to assess the sentiment of a tweet and if no sentiment was identified, the program determined if it was positive or negative.

The tweets were analyzed in parallel to a timeline of the events surrounding the REM projects from November 2020 to March 2021. These events were identified in function of their media coverage and the public's reaction towards them. Such events were utilized to complement the sentiment analysis and explain the variation in sentiments from month to month. In total, 10

events were identified: two for each month of the data collection. To fortify the sentiment analysis, these events were not just considered as data points but were scrutinized as explanatory variables. Each event contributes to the contextual understanding of the fluctuations in sentiment observed over the course of the timeline. The interplay between media portrayal and public response was a focal point, shedding light on the relationship between external occurrences and the evolving sentiments expressed on social media platforms. These events are illustrated in figure 1.

The primary objective of the sentiment analysis was to illustrate the evolution of sentiments among both media and citizens throughout the various stages of the REM project. By examining sentiment trends over time, the aim was to identify patterns and fluctuations in public and media attitudes. This temporal analysis allows for a comprehensive understanding of how sentiments have changed in response to the evolving phases of the project. The findings from the sentiment analysis were then employed to analyze the fluctuations in sentiment concerning the REM project. This involved correlating sentiment trends with key milestones, events, or developments in the project's timeline. By linking sentiment changes with project evolution, the study provides insights into the dynamic interplay between public and media sentiment and the project's progress. The results are shown in the next section.

4. Results

In this section, the results based on the Tweets regarding the REM project in Montreal are presented.

Figure 1 shows the timeline of the events surrounding the REM. They are two events per month, for a total of 10. In November 2020, the unveiling of the REM trains and the cancellation of the airport station was the identified events. In December 2020, the unveiling of the new

stations and the extension of the REM to the East and North Shore were the identified events. In January 2021, the start of the tests and the beginning of the construction on the North Shore were the identified events. In February 2021, the extension of the REM on the South Shore and the East REM been deemed too risky to be undertaken were the identified events. In March 2021, the construction of a viaduct for the REM of Deux-Montagnes and the allocation of another 2.2B CAD$ to finance the REM were the identified events.

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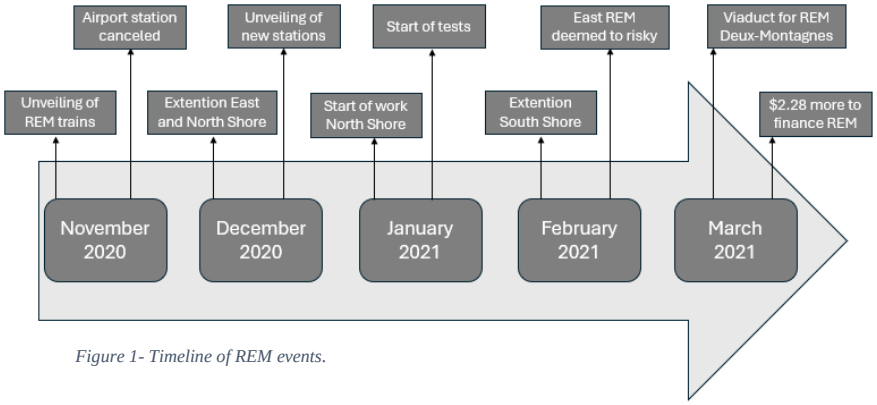


Figure 1- Timeline of REM events.

Figure 2 shows the total of tweets for both citizens and media. Citizens were much more active than the media on the social platform, as they have tweeted 3930 times, compared to 1440 times for the media. In both cases, anticipation is the most express sentiment. For the citizen, more tweets were positive and for the media, more tweets were negative.

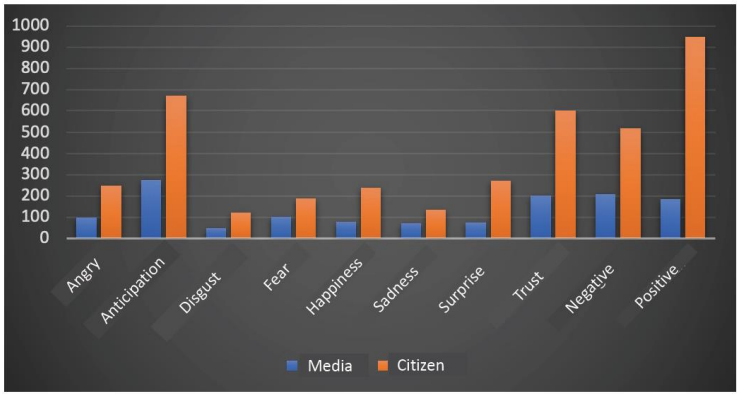


Figure 2 - Tweets total

Figure 3 shows the evolution of the sentiments expressed in the citizen's tweets. From November till February, the number of tweets is stable, and sentiments are relatively the same. However, from February till March we see a resurgence in Tweets. Most of them are positive, while anticipation is the most express sentiment, followed by trust. Based on these results, we can conclude that the extension of the REM on the South Shore and the East REM been judged to risky were the events that created the more enthusiasm for the citizens. Also, by analyzing the expressed sentiments we can figure that these events are, in general, perceived more positively by the citizens and that they trust the decisions regarding the project, which in return creates anticipation. It's noteworthy that even if the majority of the tweets are positive, hundreds of them are negative.

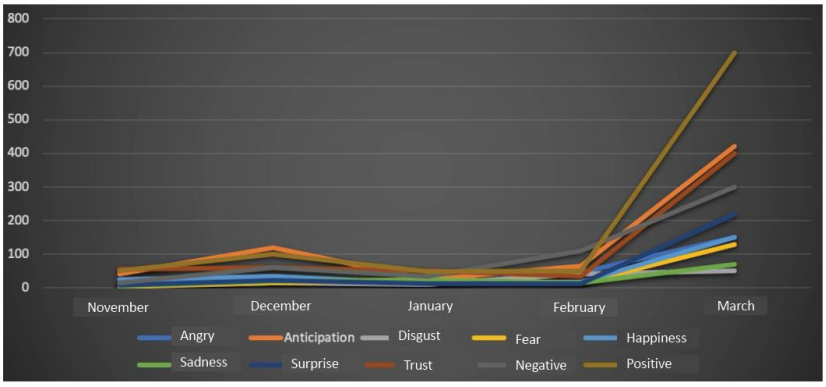
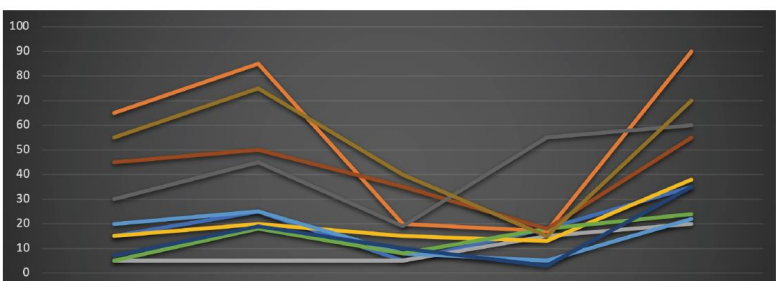


Figure 2 - Citizen's sentiment evolution

Figure 4 shows the evolution of the sentiments expressed in the media's tweets. As opposed to the citizens and as shown in the graphs, the sentiments consistently fluctuate, while the citizen sentiments are more stable. This means that medias are more sensible to all the events surrounding the REM, not just certain ones. Yet, similar to the citizens, events in February created a lot of enthusiasm in the media. The quantity of negative and positive tweets change from month-to-month until the positive one was more numerous in mid-February. At the end of this month, more tweets are positive, but negative tweets are close behind. This suggest that



the public opinion is divided regarding these events. Anticipation is the most expressed feeling, followed by thrust.

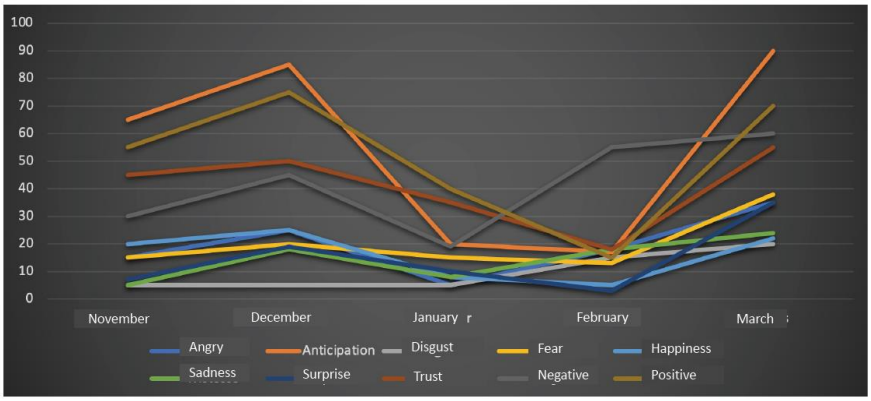


Figure 4 - Media sentiment evolution.

5. Discussion

As shown in the findings, the discernible enthusiasm for the REM project, evident in both citizen and media expressions, underscores a notable trend toward increased interest in automatic trains within the broader public (Lemonnier, Adelé and Dionisio, 2023). This aligns with and further bolsters the conclusions derived from prior research regarding the perceptions of automatic rail transport by external stakeholders (Pakusch and Bossauer, 2017). Importantly, these findings bear significant relevance in guaranteeing the secure and dependable implementation of automatic trains, emphasizing the importance of aligning public sentiments with the advancements in autonomous rail technologies (Lemonnier, Adelé and Dionisio, 2023).

Moreover, the findings reveal that public acceptance of costly projects can be significantly enhanced if prospective users clearly perceive and understand the benefits. For instance, following the announcement of the extension on the south shore, there was a notable surge in

Commenté [ART16]: I agree with your proposition for discussion. My concern is that you focus on automation train - I think we don't have specific data or twits about the automation. I wonder if this should be explained in the discussion or in the conclusions

Commenté [ART17]: This is a new elements that was not developed in the literature review - it's related to the cost to the complexity - please be sure you include it the literature review

positive tweets, with anticipation being the predominant sentiment, despite the extension requiring billions of dollars in additional investment. This builds on the research by Pakusch and Bossauer (2017) and Flyvbjerg (2006; 2012), which respectively identified cost as a primary obstacle for transport automation projects and for negative public opinions of megaprojects. Our results further suggest that this barrier can be overcome by effectively communicating the public utility and advantages of such investments. This demonstrates that transparent communication and explaining the benefits of a megaproject can help foster public support, even for expensive initiatives such as the REM.

As highlighted by Morast et al. (2023), the transition to driverless trains necessitates carefully balancing the interests of diverse stakeholders. In this context, the findings indicate that media outlets are more critical of such projects than the public. Specifically, the gap between positive and negative tweets is much narrower among media compared to citizens. In fact, media tweets are predominantly negative, whereas citizens tend to post more positive tweets. Moreover, while media sentiment fluctuates constantly, public sentiment remains relatively stable. These observations suggest that for ATO projects, organizations should prioritize providing relevant and transparent information to the media to foster public acceptance. By addressing media concerns and ensuring accurate reporting, organizations can positively influence public perception. Thus, the findings build on Morast et al. (2023) by demonstrating the importance of targeted stakeholder interactions. Specifically, they show that engaging with media is crucial due to their significant influence on public opinion, underscoring the need for strategic communication to bridge the gap between media and public sentiment.

Continuing on the theme of stakeholder engagement, the findings underscore that stakeholders are active participants whose online interactions are significantly influenced by project milestones or announced changes (Gil, 2023). This reaffirms the essential role of stakeholder

engagement in value creation and project success, as highlighted by Bayiley and Teklu (2016), Oppong et al. (2017), and Ingvarsson, Hallin, and Kier (2023). It also builds on Eskerod et al., (2016) research by providing a tool that allows project organizations to monitor and engage with external stakeholders, without losing focus on the most important stakeholders and the project goals. This tool can potentially remove the uniqueness and temporariness of a project as influencing elements for stakeholder engagement. Such approaches are answers to Drouin et al. (2013) and Ninan (2022) call to innovate project management research to grasp the full potential of social media in the domain.

Furthermore, Bourne (2008) stated that a project only exists with the consent of its stakeholders. In this case, the results illustrate that a project is a dynamic entity capable of adapting to foster stakeholder consent. This adaptability is evident in the evolution of media tweets: initially positive, they turned negative, but eventually became more positive again. This pattern indicates that stakeholder opinions can shift significantly based on how the project responds to their concerns and feedback. Consequently, the findings build on Bourne's (2008) research by suggesting that project organizations not only need to adapt to stakeholders' reactions and opinions but also can successfully do so to secure and maintain their consent. This dynamic engagement process is crucial for the sustained success and acceptance of the project, highlighting the importance of ongoing, transparent communication and responsiveness to stakeholders' needs and perceptions.

Additionally, the shift from managing stakeholders to managing for stakeholders (Eskerod & Huemann, 2013; Eskerod et al., 2015) underscores that stakeholders' express expectations regarding a project's societal role, as they directly experience its consequences (Pasquero, 2008). This dynamic is evident in the case of the REM, where citizen reactions to the February events illustrate this concept: the cancellation of the east shore extension and the confirmation

of the south shore extension elicited predominantly positive reactions from citizens. These reactions indicate that the south shore extension holds greater societal value compared to the east shore extension.

By tweeting their responses, citizens communicated their expectations and validated the recent decisions, thereby positively aligning the project with its social environment. This behavior supports Pasquero's (2008) assertion that stakeholders engage in a "social game" that defines the acceptable boundaries for a project. Consequently, with the active consideration and with frequent stakeholder feedback, organization can ensure that the project realize its goals, while aligning with societal values and norms. This approach can foster a positive relationship between the project and its environment.

For megaprojects like the REM, unforeseen events or changes can significantly impact stakeholders' perceptions and opinions (Morkan et al., 2023; Shenoy and Mahanty, 2024). This phenomenon was evident during the February events, when both media and citizens shifted their views from negative to positive. This shift underscores Gil's (2023) assertion that organizations should include external stakeholders in their decision-making processes to mitigate the impacts of changes on megaproject outcomes. The events of February thus provide a concrete example that supports the findings of Arda, Esposito, and Wilderom (2024), who suggest that effective communication between communities and project owners can foster positive perceptions and understanding of a megaproject's decisions. In this case, the decision to extend the project on the south shore while canceling the east shore extension was met with approval from citizens and medias. These findings highlight the critical importance of engaging with stakeholders and maintaining open lines of communication throughout the life cycle of a megaproject.

6. Conclusion

This section will provide answers to the research questions presented in the introduction, while highlighting the theorical and practical contributions of this research. Future research and limitations will conclude the paper.

6.1 Answers to research questions

In response to the first research question, it was demonstrated that social media messages can be effectively utilized to monitor the evolution of public sentiment surrounding a project. By collecting tweets and employing natural language processing techniques, it is possible to assess the public's perceived sentiment towards various events and developments of a project. This approach allows to track the dynamic nature of external stakeholders' opinions in real-time. Regarding the second research question, the findings indicate a significant public interest in ATO megaprojects. This interest is evident from the robust public response to project advancements and extensive media coverage. The analysis reveals that anticipation is the most expressed sentiment for these types of projects, which are generally perceived positively by the public. However, public sentiment is highly sensitive to changes in project plans, which can elicit both positive and negative reactions.

The paper thus highlights the relevance of monitoring and analyzing continuously public sentiment with the help social media. Understanding the fluctuations in public opinion in response to project milestones and changes can allow organization to better engage with stakeholders and address concerns proactively. It can potentially enhance public support and contribute to the successful implementation of ATO megaprojects.

6.2 Theorical contributions

This paper makes several theoretical contributions, particularly to the literature on public acceptance of railway automation projects, an area that remains underexplored (Pakusch and Bossauer, 2017). It confirms an increasing trend toward such projects (Lemonnier, Adelé, and Dionisio, 2023) and highlights that public opinion is generally positive. Furthermore, it demonstrates that public acceptance of costly automation projects can be enhanced when prospective users clearly perceive and understand the benefits. A key finding is the crucial role of the media as a stakeholder in fostering public acceptance. By effectively targeting media with transparent and relevant information, organizations can influence public perception positively. This paper underscores the importance of strategic communication with media outlets to align between public sentiment and project developments, emphasizing that informed and engaged stakeholders are more likely to support automation initiatives. By integrating these insights, this paper contributes to a more comprehensive framework for implementing and promoting railway automation projects, ultimately facilitating smoother adoption and better public support.

This paper contributes to theories of project stakeholder engagement. It underscores that project organizations must not only respond to stakeholders' reactions and opinions but can also successfully adapt to secure and maintain their consent (Bourne, 2008). This dynamic engagement process is essential for the sustained success and acceptance of projects, emphasizing the importance of ongoing, transparent communication and responsiveness to stakeholders' needs and perceptions.

The paper also highlights the critical role of stakeholder engagement in value creation and project success. It provides a concrete example supporting Pasquero's (2008) assertion that stakeholders participate in a "social game" that defines the acceptable boundaries for a project. By actively considering and addressing stakeholder feedback, organizations can ensure that

their projects align with societal values and norms, not just meet their objectives. This research thus illustrates that strategic stakeholder engagement is not just beneficial but necessary for achieving long-term project success and acceptance.

Finally, this paper contributes to megaproject theories by demonstrating the necessity of including external stakeholders in decision-making processes to mitigate the impacts of changes on megaproject outcomes (Gil, 2023). The findings underscore the critical importance of engaging with stakeholders and communicating with them throughout the entire lifecycle of a megaproject. By doing so, organizations can than anticipate potential issues and address concerns before they escalate. The paper thus contributes and expand the stakeholders' theories switch from management of stakeholders to management for stakeholders (Eskerod et Huemann, 2013; Eskerod et al., 2015).

6.3 Practical contributions

In terms of practical contributions, the research proposed a solution to Ninan, Mahalingam and Clegg (2019) statement that external stakeholders involved in megaprojects are difficult to control or monitor. By applying natural language processing techniques on Tweets concerning a megaproject, we can more easily monitor external stakeholders' demands and thus improve stakeholder management and the performance of megaprojects (Mok et al., 2015). In order to control the requirements of external stakeholders, organization responsible for managing megaprojects need to employ a good communication strategy using social media and communicate relevant information to the media. In brief, using social media sentiment analysis powered by natural language processing provides a cost-effective way to engage with external stakeholders without leading to scope creep or cost overruns (Gil and Fu, 2022).

6.4 Future research and limitations

Based on these results, future research should prioritize longitudinal studies to monitor and analyze shift of public opinion over the entire duration of ATO projects. This would demonstrate how attitudes are evolving from the project front-end, till its termination and operation. Despite its contributions, this research has limitations that could be solved in future research, such as using other sources of data and not just Twitter. Facebook data could be used to provide a more complete picture. While this study focuses on public and media perspective, future research should cover other relevant actors, i.e. government agencies and project organizations.

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Commenté [NO18]: add std sentence on "not statements of EU…."

Conflict of Interest and Ethical Statement

This research was conducted in accordance with the highest ethical standards. The authors have no conflicts of interest to declare.

Authors Contributions

Conceptualization, Xavier Morin; Methodology, Xavier Morin; Software, Xavier Morin; Supervision, Nils Olsson and Alejandro Romero-Torres; Validation, Xavier Morin; Writing – original draft, Xavier Morin; Writing – review & editing, Xavier Morin, Nils Olsson and Alejandro Romero-Torres.

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