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Novel Research Practices

An exploratory study of the use of social media to assess benefits realization in transport infrastructure projects

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ABSTRACT

Infrastructure projects such as metro rails are being increasingly built in busy cities mainly to improve mobility and reduce congestion. However, assessment of benefits realized from these projects is complex. One reason for this is that promoters of these projects often misrepresent the projects' benefits to get them approved. Although some benefits from infrastructure projects can be measured using economic data, such data are insufficient for measuring social benefits. This article reports on an exploratory study on how social media could provide an opportunity to evaluate benefits qualitatively by analyzing tweets from metro rail projects in India and Australia. Although the analysis of tweets from these projects indicated that citizens who use these transport facilities report benefits, they do not seem to use the same terms as the project's promoters to describe these benefits. The article concludes with some suggestions on how social media can supplement current methods used in evaluating benefits from transport projects.

1. Introduction

Due to global trends such as urbanization, there is an increasing need for the delivery and maintenance of transport infrastructure, such as roads, railways and metro rails. These kinds of endeavors are typically organized and managed as transport infrastructure projects (Volden and Samset, 2017). Transport infrastructure projects have at least two characteristics that make them especially interesting. First, the scale of these types of projects tends to be very large and the delivered infrastructure is designed to be in use for several decades. The value created in these kinds of projects is realized over an extended period of time and, consequently, the overall project success is difficult to evaluate completely when the projects are completed but not yet fully used. Second, transport infrastructure projects are of interest not only to internal stakeholders such as the project supplier (e.g., contractors) and client (e.g., government agencies responsible for infrastructure delivery), but also to the people who use the delivered infrastructure. One important stakeholder group to be considered in evaluating benefits is citizens who are the future users of the transport infrastructure. In this article, we focus on the citizens' viewpoint of transport infrastructure projects and the benefits that they derive from them.

Guided by their long lifecycle and high interest in the eyes of multiple stakeholders, we study transport infrastructure projects as vehicles for defining, creating and delivering value (Laursen and Svejvig, 2016; Martinsuo et al., 2019a,b). According to this viewpoint of value creation, the goal of a project is to deliver desirable outcomes. These desirable outcomes can be achieved when utilizing the outputs delivered by the project (e.g., Zwikael and Smyrk, 2012). The value creation viewpoint challenges the perspectives of the earlier literature, where the goal of a project was often defined as the delivery of a predefined output and the achievement of this goal was mainly assessed by the cost-time-quality/scope 'iron triangle' objectives (e.g., Atkinson, 1999). Projects were then considered successful if they met these goals.

One way to assess value creation is to measure the value realized from these projects that flows from the project to its stakeholders (Zwikael and Smyrk, 2012). Linking this idea to transport infrastructure projects, citizens are critical targets of value flows, because they are not only the users of the delivered transport infrastructure, but are also

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affected by the transport infrastructure projects in various other ways. Demonstrating this critical role of citizens, recent studies have demonstrated how citizens can exert influence on transport infrastructure projects in various ways (van den Ende and van Marrewjik, 2019; Vuorinen and Martinsuo, 2019).

The benefits from a transport infrastructure project are typically evaluated before, during and after project implementation. These pre-project, mid-term and post-project evaluations focus on topics such as value for money and funding decisions, assessment of project progress and assessment of project success, respectively. Although the viewpoint of the citizens is implicitly present in, for example, value-for-money assessments (e.g., Volden, 2019), their voice is seldom heard directly. However, if the main goal of a project is to deliver flows of value to stakeholders (Zwikael and Smyrk, 2012), is it not important that we listen to the stakeholders themselves?

Although citizens can, especially in collaboration, have strong influence on projects (Aaltonen and Kujala, 2016; Vuorinen and Martinsuo, 2019), their capacity for making their voices heard is limited by their peripheral location in stakeholder maps. However, a critical avenue for individual citizens to be heard is social media, which has become widely used in recent times to be able to express opinions publicly. There is a wide range of research evidence of people, especially customers, having major effects on organizations through social media (Alalwan et al., 2017; Salo, 2017). Recently, the interest in the role of social media in project management has grown as well. However, the potential of social media for assessing value creation in projects has remained largely unstudied. To address this knowledge gap, we set the following objective to be addressed in this article:

To investigate the potential of social media for evaluating benefits derived from transport infrastructure projects after they are put into operation.

To address this objective, we studied value creation in two transport metro rail projects – one in Australia and the other in India – by evaluating opinions expressed through social media. We use the term 'benefits' (to represent value) in the research objective, as project benefits management is a recognized process both in the project management research and in project management guidelines and standards published by organizations such as the PMI (Project Management Institute) and OGC (Office of Government Commerce, UK). 'Benefits' is the term often included in business cases for a project to be funded.

This article is structured as follows. First, we analyze recent literature on value creation in infrastructure projects, the assessment of project benefits and the role of social media in project management. Then, we present the methods used for an empirical study of metro rail projects in India and Australia. This is followed by the empirical findings and discussion of the contributions. Finally, we provide our conclusions and recommendations for using social media to assess value creation in projects.

2. Literature review

2.1. Value creation in infrastructure projects

As discussed in the introduction, we view projects as vehicles for defining, creating and delivering value (Laursen and Svejvig, 2016; Martinsuo et al., 2019a,b), and consider the desirable outcomes of a project (i.e., the goals of a project) as flows of value from the project to the stakeholders (Zwikael and Smyrk, 2012). To set the scene for this review, Table 1 summarizes recent empirical studies on value creation in infrastructure projects. This list is limited to empirical studies that have focused on infrastructure projects and considered value as the worth of a project (Martinsuo et al., 2019a,b), or as benefits for the stakeholders (Zwikael and Smyrk, 2012), instead of other perspectives as value related to ethical and moral considerations (Martinsuo et al., 2019a,b) or beliefs (Martinsuo, 2020).

Three observations can be made based on Table 1 and the broader literature on value creation in projects (e.g., Laursen and Svejvig, 2016). First, value in projects is not a unidimensional concept but extends to multiple interrelated dimensions. The multidimensionality of value is demonstrated in studies referred to in Table 1 (Kivilä et al., 2017; Liu et al., 2019; Martinsuo et al., 2019a,b; Vuorinen and Martinsuo, 2019) as well as in studies published on value creation in other types of projects (e.g., Ahola et al., 2008; Ang et al., 2016; Green and Sergeeva, 2019; Martinsuo, 2019; Martinsuo et al., 2018).

Second, recent empirical studies illustrate the importance of stakeholder considerations in value creation. Martinsuo et al. (2019a,b) demonstrated how stakeholders shape value at the project's front end, and the case studies of van den Ende and van Marrewijk (2019) and Vuorinen and Martinsuo (2019) illustrate how the perceived (especially negative) value of a project can drive stakeholders to seek influence on

Table 1
Recent empirical studies on value creation in infrastructure projects.

Article	Context and method	Key findings for this study
Kivilä et al., 2017	Context: Transport infrastructure projects Method: A qualitative single-case study	- Focus on the project implementation phase and sustainability as a dimension of value. - A holistic control package with control mechanisms for different dimensions of sustainability.
Liu et al. (2019)	Context: Infrastructure development programs Method: Action research, single case	- Focus on value co-creation at the program front end. - Client's intended value (value-for-firm) was competing with market partner's values. - Three sets of values (value-in-use) as results of value co-creation: commercial, intellectual and collaborative values.
Martinsuo et al. (2019)	Context: Transport infrastructure projects Method: A qualitative multiple-case study	- Focus on the stakeholders' framing of value at the project front end. Framing of value relates to project funding decisions. - Three dimensions of value: financial, social and comparative values. - Positive and negative dimensions of value, and four themes of lifecycle-oriented framing of value: uncertainties, timing of cost and benefits realization, project relations and external sponsorship.
van den Ende and van Marrewijk (2019)	Context: Transport infrastructure projects Method: A qualitative, longitudinal two-case study	- Focus on community resistance to large subway projects. - An institutional theory perspective to understanding project actors' responses to community resistance. - Community resistance prompted institutional work by project actors to socially (re)construct the projects in pursuit of legitimacy.
Vuorinen and Martinsuo, 2019	Context: Transport infrastructure projects Method: A qualitative multiple-case study	- Focus on the stakeholders' influence efforts during project implementation. - Stakeholders' value perceptions explain the stakeholder influence strategies utilized. - Three dimensions of value: environmental and social value, financial value and systemic value. - Four stakeholder influence strategies in transport infrastructure projects differentiated according to their different value priorities.

projects. Liu et al. (2018) discuss similar findings in the context of major construction projects.

In summary, the recent empirical studies have focused mostly on the front end of a project (Liu et al., 2019; Martinsuo et al., 2019a,b) or its implementation phase (Kivilä et al., 2017; van den Ende and van Marrewijk, 2019; Vuorinen and Martinsuo, 2019). Less attention has been placed on the value created in the project operations phase. Thus, this stream of literature reviewed provides few answers to the question of assessing value creation at the operations phase.

2.2. Project benefits assessment

Different review methods are an established element of both project management guidelines and textbooks, and scientific research to review projects. In this section, the discussion will follow the lifecycle of a project in two parts: pre- and mid-project reviews, and post-project reviews.

2.2.1. Pre- and mid-project reviews

The most established pre-project reviews acknowledging project value creation are cost-benefit analyses (CBAs) and benefits management. CBA is a method for measuring the project's "value for money" by assessing the relationship between resources invested in a project (i.e., "the money"), and the benefits that can be achieved from the project (i.e., "the value") (Volden, 2019). More precisely, the aim of a CBA is to compute the net present value (NPV) of a project or several competing project alternatives (Volden, 2019). Regarding value creation, the key aspect of CBA is the inclusion of both financial and non-financial benefits in the analysis; in other words, the aim of CBA is to be comprehensive in terms of coverage of a project's impacts (Sager, 2013). There are various challenges in CBA, or in value-for-money assessment in general, such as measurement problems (Sager, 2013; Volden, 2019) and appraisal optimism (Flyvbjerg, 2009; Volden, 2019). Despite the possible shortcomings, different versions of value-for-money assessments are in use for project appraisal around the world (Volden and Samset, 2017), especially for public sector projects (Volden, 2019).

Benefits management is a stream of literature with strong roots in the information system projects literature (e.g., Breese et al., 2015; Coombs, 2015). Regarding pre-project reviews and value creation, a critical element of benefits management is the definition of target benefits (Zwikael et al., 2018). Target benefits can be defined as "those benefits set prior to project commencement which the project funder seeks thorough an investment in a project" (Zwikael et al., 2018, p. 650); in other words, target benefits are the desirable flows of value resulting from the project (see Zwikael and Smyrk, 2012). Although defining target benefits is not a guarantee of benefits being realized (e.g., Coombs, 2015), setting effective target benefits has been argued to support project investment decisions (Zwikael et al., 2018).

Especially in large projects, such as transport infrastructure projects, there is typically a project governance model or a project management methodology (e.g., PMI, 2017) in place. While conducting pre-project reviews, a typical consideration in these kinds of models is the assessment of a business case. Regarding mid-project reviews – that is, reviews during project implementation – project management methodologies or governance models often include some types of performance review (PMI, 2017), stage-gate model (e.g., Narayanan and DeFillippi, 2012), or similar. However, typically these kinds of mid-project reviews are mostly concerned with project performance; for example, this is the case with performance review in the PMBOK model (PMI, 2017) or in earned value analysis (e.g., Kwak and SciencesGeorge, 2012).

2.2.2. Post-project reviews

In the benefits management literature, the post-project phase is labeled as benefits realization or benefits realization management (BRM) (e.g., Coombs, 2015; Zwikael, 2016). The BRM literature discusses the linkages between BRM and project success (Serra and Kunc, 2015) and the inhibitors and facilitators of benefits realization (Coombs, 2015). The core message of this stream of literature is that benefits are not realized automatically; instead, benefits realization must be managed and promoted actively. For example, project sponsors may have an important role in promoting benefits realization (Breese et al., 2015). However, this stream of literature has paid less attention to *assessing* the delivery of project benefits.

After a project's completion, most project management guidelines or methodologies include some sort of a post-project review (e.g., PMI, 2017). The assessment of value creation is included in some of these assessments as well. An illustrative example is the UK-based OGC Gateway Process (Klakegg et al., 2008). Tailored versions of the Gateway Process have been introduced in various other countries; for example, in Australia (Xu et al., 2013). The core idea of the Gateway Process is the independent review of major projects and programs at key points of their lifecycles (Klakegg et al., 2008). Regarding post-project benefits assessment, main reviews include "Review 4: Readiness for service" (OGC, 2007a), and "Review 5: Operational review and benefits realization" (OGC, 2007b). Regarding benefits management, the key question of these reviews is the delivery of the expected benefits, with respect to the original business case (OGC, 2007a, 2007b).

However, the traditional method of evaluating projects using methods used in project management reviews has come under criticism in an article evaluating megaproject success (Fahri, Biesenthal, Pollack and Sankaran, 2015). These authors suggest that post-project evaluation should benefit from using ideas from the evaluation literature (Mathison, 2004; Vedung, 2010).

2.3. Social media in project management

One of the most significant developments enabled by the internet is the advent of social media. In February 2019, it was estimated that 72% of the American public use some type of social media (Pew Research Center, 2019). Of these American users of social media, 74% use Facebook daily (Pew Research Center, 2019). Social media has also spread very fast; compared to the most recent 72% estimate, just ten years before in April 2009 only 36% of the American public used social media (Pew Research Center, 2019).

Social media is increasingly adopted by companies and studied by scholars as well. However, there is a dearth of research on social media in project management. The published studies combining social media and project management have focused on topics such as improved project learning through social media (Rosa et al., 2016; Winter and Chaves, 2017), better intra-project communication or collaboration through social media (Kanagarajoo et al., 2019; Zhang et al., 2018), and social media as a platform for branding (Ninan et al., 2019) or managing external stakeholders (Ninan et al., 2020) in megaprojects. Although the number of studies is still low, the combined message of this early research seems to indicate several possibilities for utilizing social media in project management (see also Hysa and Spalek, 2019).

In contrast to project management, social media has received more scholarly attention in the fields of general management, especially in marketing and sales. This is illustrated by a few review articles published on the topic (Alalwan et al., 2017; Andzulis et al., 2012; Salo, 2017). Electronic word of mouth (e-WOM) has more reach and influence than traditional word of mouth (Alalwan et al., 2017; Salo, 2017). In other words, social media enables the general public to share opinions about products, firms and services quickly and easily. In a similar vein, customers use social media as a source for information when making purchasing decisions (Erkan and Evans, 2018; Powers et al., 2012) and, consequently, companies invest more and more on strategic marketing in social media (Alalwan et al., 2017; Salo, 2017).

The rationale behind this study is the broader application of social media in marketing and sales. In particular, whether customers using transport infrastructure, such as metro rail, actively shared opinions about the benefits derived from these projects using social media. The

focus of this study is in the operations phase of the infrastructure since that is when the public can express their satisfaction or otherwise with what has been delivered.

The following research questions were formulated to be addressed in this article:

RQ1: How can social media be used to evaluate the benefits derived from transport infrastructure projects after they are put into operation?

RQ2: What are the implications of using social media for evaluating benefits derived from transport infrastructure projects after they are put into operation?

3. Method

3.1. Research strategy

The philosophical underpinning for this study is interpretivism. In particular, we looked for meanings from the perception of social reality constructed by citizens as expressed in social media. We designed this study as a multiple case study. Case studies are useful to study a phenomenon in depth within a context to retain the holistic and meaningful characteristics of real-life events (Yin, 2014). Case studies are particularly useful to study a phenomenon that focuses on contemporary events and where the researchers have no control over the behavior of the informants (Yin, 2014, p. 9). We studied two purposefully sampled cases, which were completed over the past two years in two different countries, to give us an opportunity to have cross-case analysis and also because multiple cases are analogous to multiple experiments (Eisenhardt, 1989). Eisenhardt and Graebner (2007) noted that the findings from multiple case studies are better grounded, more accurate and more generalizable than single-case research. Multiple case studies also help us not to misjudge the representativeness of events that occur within a single case (Tversky and Kahneman, 1989).

We chose to study metro rail projects in Chennai (India) and Sydney (Australia) for two theoretical reasons. First, both projects were in operational phase and hence would help us evaluate the benefits. Second, both projects had social media presence and activities, thereby enabling us to use social media for evaluating the benefits. We now present a brief overview of these projects.

3.2. Case description

Chennai Metro Phase-1 is a rapid transport system serving the city of Chennai in Tamil Nadu, India. Chennai is the fourth largest city in India and the largest in South India. The network is managed by the Chennai Metro Rail Limited (CMRL), a joint venture with equal equity holding between the Government of India and Government of Tamil Nadu. The Chennai metro rail project's phase one started in June 2009 with an estimated cost of USD 2.2 billion and was fully commissioned on February 10, 2019. The project covers 45.1 km, has 32 stations and operates on two lines – the green and the red. The green line connects Chennai Central railway station to St. Thomas Mount station via the central bus terminal called Chennai Mofussil Bus Terminus (CMBT). The red line connects Chennai International Airport to Washermanpet. The two lines intersect at Alandur station and Chennai Central railway station where passengers can switch between the lines. The phase has both elevated and underground sections with the majority being underground sections (55%).

The project was proposed as the answer to the traffic demands of a rapidly growing city. There was rapid urbanization in the city, which resulted in an increase in privately owned vehicles, road congestion and consequent air quality problems. The project was also aimed at providing interconnectivity with existing public networks including buses, suburban trains and MRTS, and an ecofriendly alternative to existing modes of transport. Thus, the project was conceived with multiple objectives, such as boosting the economic growth of the city and reducing pollution. The mission statement published before the start of the project was: "*We shall provide a safe, fast, reliable, accessible, convenient, comfortable, efficient and affordable public transport service preferred by all in a sustainable manner*" (https://chennaimetrorail.org/mission-vision/).

The Sydney Metro Northwest is a rapid transit link to the northwestern suburbs of Sydney in New South Wales, Australia. The link is managed by Transport for NSW through its Sydney Metro agency and it connects the suburbs of Rouse Hill and Chatswood via Castle Hill and Epping. The link, which includes the Epping to Chatswood Rail Link, opened to service on May 26, 2019, with Metro Northwest Line services running on the link between Tallawong and Chatswood. The project involved 15 km of new tunnels.

The business case for Sydney Metro Northwest caters for the challenges in growth in employment, population and dwellings, ongoing economic productivity and liveability (the quality of life residents enjoy in their neighborhoods, workplaces and cities) as Sydney continues to develop. Sydney's population is forecast to increase from 4.3 million people to 6.2 million people in 2036. Driven by population growth, employment in Sydney is expected to increase from its current level of 2.1 million workers to 3.1 million by 2036. This employment and population growth will require increased transport capacity, to ensure continued growth in productivity and to sustain Sydney's liveability. Rail network demand is expected to increase by 41 per cent by 2026, with the growth in demand for rail travel into the CBD expected to increase by 31 per cent by 2026. The number of people travelling to the Sydney city center each day is forecast to grow to 775,000 by 2031. The metro provides a fast transport link for suburbs experiencing significant growth in north-west region of Sydney to CBD.

A comparison of the Chennai metro rail project and the Sydney metro rail project is consolidated in Table 2.

3.3. Data collection

Data were collected through tweets from the Sydney and Chennai metros. For data collection from Twitter, we used Python and the Twitter Search Application Programming Interface (API) to retrieve tweets. Twitter provides a search API for the public to search their database with user-defined keywords and time range. The API returns 500 records for each call, and a program written in Python was executed to recursively retrieve tweets containing the keywords. The keywords are the titles of two projects, i.e. "Chennai Metro" and "Sydney Metro". It is acknowledged that some tweets would not be retrieved if they discussed the two projects without using the keywords. No duplicates were observed on checking the unique ID of each tweet, and the collected data were stored as a comma-separated values (CSV) file.

We collected the tweets for a 90-day period (as this was an

Table 2
Comparison between the cases.

	Chennai metro rail	Sydney metro rail
Track length	45.1 kms	36
Number of stations	32	13
Number of lines	2	2
Construction commenced	June 2009	June 2014
Operational commenced	February 10, 2019	May 26, 2019
Cost of the project	2.2 b USD	5.9 b USD (8.3 b AUD)
Objective of the project	To provide a safe, fast, reliable, accessible, convenient, comfortable, efficient and affordable public transport service preferred by all in a sustainable manner	To deliver a 21st century state-of-the art service that provides easy and fast connections to people and places across the city and suburbs, with an enviable, reliable and affordable service worthy of Sydney's great future.

exploratory study) from July 1, 2019 to September 30, 2019, during which both the metro rail projects were operational. The selected period of study enables us to retrieve tweets relevant for the research objective, i.e., whether the conceptualized benefits during planning phase were realized during the operation phase.

There were 1064 tweets relating to the Chennai metro rail project and 5960 tweets relating to the Sydney metro rail project during the study period. All the tweets were in English. Even though the local language of Chennai is Tamil, we found the tweets in English representative of the total discourses around the project as Chennai is one of the largest English-speaking cities in India.

3.4. Data analysis

We used content analysis and open coding of the tweets collected to understand what each tweet conveyed. We went through each tweet and looked at the meaning/message of the tweet. We focused on the contextual meaning of the text (McTavish and Pirro, 1990) rather than merely ranking message variables based on the frequency with which they occurred. For example, a tweet that read "Thank god for @cmrlofficial I reached from Teynampet to Central in less than 15 min #ChennaiMetro" was coded as 'travel time saved', even though the tweet did not have the words 'time' or 'saved'. The process was very iterative and we took multiple readings of the tweets as some categories are often not obvious until the second or third reading (Steger, 2007), due to the focus on content and meaning. We employed manual coding as automatic methods could create a barrier to understanding (Kozinets et al., 2014).

To enhance the rigor of our approach to data analysis, first, we conducted an exploratory coding to understand the different categories of tweets extracted. Along with tweets of benefits of the metro rail project, there were also negative tweets, interest group tweets, and operational issues tweets. The coding structure along with sample tweets for our initial analysis is given in Table 3. We then organized the tweets of benefit realization into first order observations and then assembled them into a more structured aggregate dimensions of benefits. This was done by collapsing or clustering the first order observations that seemed to share some unifying benefits. The results of the benefits of Chennai metro rail project and the Sydney metro rail project are presented in Tables 4 and 5 respectively.

Table 3
Exploratory coding of all tweets.

First order exploratory codes	Aggregate category	Tweet example
Travel time saved Customer satisfaction Well-connected network	Benefits	"Chennai metro line from the airport to the high court is awesome if a lawyer is flying in for a case. Comfy, economical and speedy. Seen nothing comparable in any other metro." (Aug 1, 2019)
Inconvenience due to Construction High ticket prices No mobile connectivity in underground stretches	Negative Tweets	"Wow!! Finally after ten years! #Chennai's iconic #MtRoad aka #AnnaSalai near LIC buildings is now open for two-way traffic. Stretches of road were closed for (@cmrlofficial) #chennai metro work back in 2008? Now one straight road 4 m Munro statue to RajBhawan. Skip #ExpressAvenue" (29 Sept 2019)
Demolition of buildings Green roads than dusty metro station buildings and viaducts	Interest group tweets	"We, poor people are cursing u how dare u could demolish>1000 Buildings? - Message to unnecessary Chennai metro rail phase 2 crew! Ask sorry to poor & Ban the construction" (29 Sept 2019)
Complaints about doors Non-functional facilities Lack of parking Lack of connecting buses	Operational issues tweets	"the USB points in car 0501 don t work FYI" (September 15, 2019)

4. Results

4.1. Findings from Chennai metro

The content analysis of the social media posts helped us to understand the types of benefits perceived by the public during the operational phase of the metro.

The tweets provided an understanding of the user's perception of the benefits they derived from the project. There were opinions that the metro rail was fast as it beats traffic and saves travel time. These instances were personal stories in which the users gave descriptive accounts of how the metro rail project helped them save time. Examples are highlighted below:

> *"My husband and I took the Chennai metro rail from Meenambakam to Anna Nagar last weekend, and I must say I am impressed. It is so much better than finding a Uber/Ola, waiting for it, and getting through the traffic. @cmrlofficial*" (a tweet dated 27 Sept 2019).

> *"Encourage public transport! 340 KM will surely make a lot of difference – more time at home and less time on the roads. Hi to chennai metro"* (1 Sept 2019).

The users of the Chennai Metro rail project also highlighted the cleanliness of the metro as shown in the tweets below:

> *"Annanagar to Airport, Chennai Metro costs only Rs 50, whereas ola/uber costs anywhere between 450 to 750. Metro is clean and punctual. You need not explain the driver in Tamil [local language in the city] …. and knowing your destination a Metro driver will not cancel the trip"* (18 Sept 2019).

> *"Chennai best metro, best people unlike BMRCL [acronym for the metro rail project of Bengaluru, a nearby city] most inefficient. Chennai metro station speaks for itself unlike ugly Bengaluru metro stations"* (11 Sept 2019).

Table 4
Data Structure of benefits of Chennai Metro Rail.

First Order Observations	Aggregate Dimensions	Tweet Example
Fast transport Time saving Getting through traffic	Travel time saved	"Uncluttering myself inside the Chennai Metro Rail. It took just an hour to go all around my beloved Chennai! #metroride" (23 Sept 2019)
Connectivity Convenient Accessible Efficient	Well-connected network	"@ChennaiMetRail Amazing work connecting the city! No Chennai citizen could have asked for more! Super convenient access to the airport! Looking forward to using it more regularly!" (30 Sept 2019)
Safe Air-conditioned Comfort Cleanliness of the metro Best metro rail	Enhanced customer satisfaction	"Used Chennai metro for first time today. Well built and clean. Stations modelled on Singapore (layout etc.). Makes me fall in love with the city more. Indeed makes life better. Well done!" (July 10, 2019)
Aesthetics of the metro stations	City landscape	"First time travelling in Chennai Metro … Service Platforms looks like Abroad." (Aug 5, 2019)
Minimizing pollution Conserving water through innovations	Social benefits	"@chennaimetro has been running in full capacity for the past week. No place to sit. Not complaining. Happy that the service is being opted by many of us & thereby helping in minimizing pollution". (Aug 20, 2019)

Table 5
Data Structure of benefits of Sydney Metro Rail.

First Order Observations	Aggregate Dimensions	Tweet Example
Fast Time saving	Travel time saved	"On the other side of the fence I'm actually having no problems and it's faster than the bus for me" (Aug 1, 2019)
Impressive first experience Fun pretending they were the driver in the driverless trains Cleanliness Quiet	Enhanced customer satisfaction	"New, Sydney Metro driverless trains …. New experience. Pretty impressed, gotta say." (July 11, 2019)
Aesthetics of the metro stations	City landscape	"There is so much new infrastructure and development happening within the CBD. Sydney's Pitt Street Station will become the city's newest landmark with a $463 million contract awarded to build the new metro railway station and the buildings above it. #sydneyproperty #cityliving" (24 Sept 2019)
More housing choices Better access to services	Social benefits	"Grand Cherrybrook home is just a quick walk to Sydney metro northwest" (July 12, 2019)

Other tweets also showed that the transport system is convenient, accessible and safe. The users stated that the trains are air-conditioned, without rush and offer quick rides. Some indicative tweets are below:

"Cab ride Chennai airport to T-nagar showed 55 minutes travel. So took the #chennaimetro for the first time. Easy access from arrival to metro station. Self-ticketing kiosk. Trains at multiple intervals. Air-conditioned, no rush, clean quick ride. Reached in 19 minutes. Underrated" (20 Aug 2019).

"@ChennaiMetRail Amazing work connecting the city! No Chennai citizen could have asked for more! Super convenient access to the airport! Looking forward to using it more regularly! #chennai #chennaimetro" (30 Sept 2019).

"Yes, of course. It's getting there. It's visible in office as there are many of us who leave our cars at the station and take the Metro. So many people exercising this option that safe and convenient and clean" (20 Aug 2019).

However, there was some dissent among the commuters regarding the cost of the metro rail services. People criticized the high cost of the fares and complained that the common people cannot afford the services. Some indicative tweets are below:

"Volumes should be the mantra & increased patronage will automatically bring in more revenue & help in bridging gap btw cost & income. urban public transport should not be subsidized but under bogey of market dynamics should not made costly like Chennai metro, Bengaluru Volvo buses" (30 Sept 2019).

"I do not understand what you mean by improving mass transit. Chennai metro is an improved mass transit system but no point having it if people can't afford it. The section of society that Chennai suburban system [another mass rapid train system operational in the city] serves are happy with the services" (25 Sept 2019).

The benefits of using the Chennai Metro rail as seen from the social media comments by the users were speed, accessibility, and convenience. When compared with the mission statement of the project highlighted earlier, i.e. "*We shall provide a safe, fast, reliable, accessible, convenient, comfortable, efficient and affordable public transport service preferred by all in a sustainable manner*," the tweets provided an indication that several planned benefits were perceived to be met. It was thus qualitatively evident that most of the planned benefits were realized during the operational phase. However, the tweets also pointed to the lack of affordability of the metro rail as they included complaints about the cost of the fares. Thus, the project failed to deliver on the benefit of affordable public transport as the users complained about the cost of the fares. It is to be noted that the community did not use the same terms in their tweets to describe the benefits as the project promoters used in their mission statement.

4.2. Findings from Sydney Metro

There were some tweets describing commuters' impressive first experience of riding the Metro, such as:

"Having my first Sydney #metro experience. So far very impressed." (3 July 2019)

"First ride in @SydneyMetro, wow, very clean and on time" (10 July 2019)

"Loving the @SydneyMetro first time on it." (11 July 2019).

Some users explained specifically why they were satisfied with the Metro as shown in the tweets below:

"Insanely fast mobile speed on the @SydneyMetro [a speed test result by Ookla]" (23 Aug 2019) and a reply on the same day *"That's crazily fast. Is that underground?";*

"First day, first ride on board Sydney metro from Kellyville to Chatswood. What's so great about it.? Oh boy these Sydney metro coaches were 'MADE IN INDIA'. I conceited telling this to co passengers. Superb finish, excellent acceleration, extremely quiet" (a retweet on 4 July 2019).

Another benefit of the Sydney Metro Project confirmed by the tweets is the aesthetics of the metro stations. Many users would start their days by sharing photos of the stations on Twitter, such as

"*Our beautiful Sydney Metro. @SydneyMetro @TransportforNSW*" (a tweet with three photos on 29 September 2019)

"*A #beautiful morning and a beautiful #metro station. @SydneyMetro #thebestmetro*" (a tweet with a photo on July 9, 2019).

Some users had fun on the driverless Sydney Metro, pretending they were the driver or a proton beam while the train travelled through a tunnel.

"Almost six months in, people still love pretending to be the driver on @SydneyMetro #SydneyMetro" (a tweet on 19 September 2019,

"Pretending I'm a proton beam on the #sydneymetro" (a tweet on 6 August 2019).

Besides transport benefits such as travel time saved, enhanced customer satisfaction, and enabling network growth, there was also evidence for other benefits like increased economic activity, jobs, more housing choice, and better access to services. For instance, a tweet stated that

"With the opening of the Sydney Metro North West line, the hills are well and truly alive!" (See "*My story from last night's #sydneyweekender featuring the new North West Metro and a gem of a restaurant tucked away in Baulkham Hills* [a link to an article on sydneyweekender.com.au on riding the Sydney Metro to Quoi Dining]", a tweet dated 9 Sept 2019).

The opening of the Metro also brought an opportunity to provide more choice of housing and more affordable housing along with the metro line, as evident from the announcement tweet issued by Landcom

"*Landcom and Sydney Metro will deliver up to 55 dwellings reserved for Affordable Rental Housing to accommodate workers on low to moderate incomes at the Sydney Metro Tallawong station precinct*" (26 Aug 2019).

In addition, more development opportunities for business service providers were seen through some tweets such as

"*Construction of a new international fresh food marketplace and underground Sydney Metro link at Castle Towers is underway – with dozens of new specialty stores and food outlets expected to open by Christmas*" (7 Sept 2019).

On the other hand, the operation of the Metro was found to be not always perfect. A series of disruptions to services marred the first few months of operation caused by some teething problems like train doors sometimes closed too quickly to allow passengers get on and off. There were, in fact, many complaint tweets about the train doors, such as

"@SydneyMetro Your 15 second door opening is stupid and dangerous. People cannot get off the train in the fifteen seconds. Fix it before people get hurt" (16 Sept 2019).

A typical example is an incident where a distraught mother was separated from her two-year-old boy when the new driverless train took off from a station before she could get on board

"*Latest fiasco with Sydney Metro driverless trains. Mother trying to get on with baby in pram, doors shut 2yr old on train by itself. Mother frantic as she is left behind on the platform*" (24 Aug 2019).

Other users have complained about non-functioning facilities such as train display, USB point, air conditioning, thermometer, escalator, as well as a lack of parking and connecting buses.

5. Discussions

Based on the empirical findings in the Chennai and Sydney metro projects, the next sections describe the answers to the research questions and contributions to literature. The discussion is divided into two parts: the potential of using social media for assessing benefit realization; and the contributions of this study to the literature on value creation in projects.

5.1. The potential of using social media for assessing benefits realization

5.1.1. Discussing project benefit realization through social media

As reported in the results section of this article, we found some evidence of the benefits delivered by Chennai and Sydney metro rail projects reported by citizens in their tweets. In the case of the Chennai metro rail, it was observed that benefits such as speed, accessibility, and convenience were discussed by the citizens during the operational phase. Similarly, the Sydney metro rail's benefits such as enhanced customer satisfaction, increased transport capacity, and time saving were mentioned by users. A few personal and organizational stories also indicated increased economic activities, more housing choice, and better accessibility to business services.

The personal descriptions in the tweets provide authenticity to the benefits claimed. The true-to-life and meaningful stories enabled through the qualitative data (Sandelowski, 1986) provide credibility that the benefits of the project were realized. We also noted that the benefits could not be quantified and evaluated. This is because of some of the issues of evaluating social media data as explained below.

5.1.2. Predominance of negative tweets

In both Chennai and Sydney metro rail projects, we also noticed several tweets that represented some negative perception of the project. This echoed the literature that people are often more vocal about criticism than praise (Park, 2015; Golbeck, 2016).

In the case of the Chennai metro rail project, the community complained about different aspects of the project such as its unaffordability, poor design, etc. It was also seen that the community had fun at the expense of the Chennai metro rail project often trolling the project as highlighted in the tweets below:

"#chennaimetro floors n pavements are a design disaster. Rain wet, they can kill you if u r not a pro at moonwalking." (17 Aug 2019)

"@cmrlofficial Chennai metro rail services is getting worse day by day … you people are charging high but the service is very poor,.. there is no AC most of the metro stations. Stations are deep underground, customers are literally suffocating" (6 Sept 2019)

"Besides serving as a means of transportation, #ChennaiMetro has given thousands of pillars for political parties / film industry to stick their posters!" (25 Aug 2019)

In the case of the Sydney metro rail project, besides complaints about specific facilities such as USB points, air conditioning, thermometers and escalators, the most common complaints were about train delays:

"@SydneyMetro without fail every time I catch the train from Rouse Hill there are huge delays at each stop. Once again I'm stuck between stations and late for work with no update on when we'll get moving again." (14 Sept 2019).

"@SydneyMetro what's the delay this morning? We are waiting at norwest station for last 10mins with no updates or announcements" (20 Aug 2019).

Our findings resonate with those of Albrecht (2006), who notes that controversial ideas get more traction in online forums.

5.1.3. Presence of interest groups

Interest groups are stakeholders such as lobby groups or activists who have a vested interest in the project and pressurize decision makers to get their preferred outcome in the project (Henisz and Zelner, 2006). The presence of interest groups resulted in most of the tweets about the metro rail project being negative. These interest groups are very vocal on the social media platform, often echoing their interests through similarly worded tweets.

In the case of the Chennai metro rail, it was seen that the interest groups repeated keywords such as 'unnecessary', '1000 buildings destroyed' and 'ban construction', as highlighted in the tweets below:

"Indian Officials are worthless! Idiotic crew of Chennai metro rail phase 2 destroyed many buildings (>1000), now shopkeeper are in trouble! Ban const. Immediately" (13 Sept 2019).

"Indian govt. officials are graduated but no common sense! They'r constructing unnecessary Chennai metro rail phase 2 in narrow roads and they destroyed more than 1000 buildings!" (12 Sept 2019).

"Poor people in trouble – INDIAN people should come front! UNNECESSARY Chennai metro rail phase 2 Idiots demolished>1000Building. They should ask sorry to poor & BAN this UNNECESSARY construction" (30 Sept 2019).

In the case of the Sydney metro rail, repeated tweets were seen mostly when the original one was issued by a blue verified Twitter account. In *The Sydney Morning Herald* newspaper, for instance, one of the news articles titled "Your trains are broken again: Sydney Metro delays expected after train mechanical issue" was retweeted many times. Another example is the tweet shared by a *10 News First* television service reporter on reinstating the Hills Bus Service that had been cut as a result of the Metro:

"Hundreds in Hills Shire of Sydney are meeting to call on Transport Min @AndrewConstance to reinstate #Hillsbus services that have been cut as

a result of new @SydneyMetro 10,000 + signatures on 2 petitions. They claim no consultation or notice before cuts @10NewsFirstSyd #nswpol" (4 August 2019).

These repeated tweets make quantitative analysis of benefits quite challenging as a few words are repeated many times by the interest groups. The predominance of negative tweets and the presence of interest groups result in the benefits being overshadowed in automated data analysis. As discussed earlier, the benefits were more personal and often had different personal stories, which would be missed in automated coding of data from social media.

5.1.4. Identifying and improving operational issues

The predominance of negative tweets and the presence of interest groups limits the possibilities for assessing value creation through social media. However, there were many tweets highlighting the operational issues of the metro rail project. The community were very vocal about the day-to-day issues of the metro rail such as below:

"Crazy. @chennaimetro rail's doors didn't open when it stopped @Pachaiyappas metro station, at around 11am today, putting the passengers to hardships. What's happening?" (2 Sept 2019).

"What's happening with #chennaimetro we have been trying to reach koyembedu metro station from nanganallur, but there have been improper information saying not to board trains continuously!! #metrotrains #metrotrainchennai #cmrlofficial" (A tweet dated 28 Aug 2019).

An interesting observation regarding those complaints is that social media can play a role in service requests. People may complain on social media because they feel they are not being seen or heard through the official channel provided by the service provider or because they would like to get attention from others. It then becomes useful for service providers to handle requests or complaints on social media. A tweet dated July 31, 2019 stating "*@SydneyMetro Please clean N5432 carriage upper deck #trains #sydney"* with a photo of the situation was responded to on the same day with "*Thanks for bringing this to our attention. It has been passed onto our cleaning team."*

There were also multiple suggestions from the users, such as increasing the frequency of trains, reducing fares to increase number of rides, etc. In some cases, people commended the positive changes carried out following comments from users:

"@cmrlofficial can you pls increase the frequency of trains during peak hours? All the coaches are running double the capacity. It's right time for increasing the frequency. Thank you. @RailMinIndia #Chennai #chennaimetro" (19 Aug 2019).

"Thanks to @ChennaiMetRail service for being introduced the #metrofeedertaxiservice at very low cost. Great service to the customers. Thanks again #chennaimetro." (24 Aug 2019).

Similar suggestion tweets were observed in the Sydney Metro project on specific issues:

"Replying to @SydneyMetro: Can't see a suggestion or plan here yet from Metro to convert the new car parks along SMNW to free parking only for Opal account holders making a linked bona fide Opal fared public transport trip. Otherwise it's big $$ for the day in the car park. That will help." (27 September 2019).

"Hi @SydneyMetro Just a suggestion. How about announcements on the trains about using all the doors on the train when getting on and off. Too many people try and use the same doors to exit at Epping and don't realize/care there is so little time to get on and off." (9 July 2019).

One of the advantages of social media, as noted by Srivastava and Pandey (2013) in the context of e-commerce, is its ability to connect customers and organizations and as a platform to scan customers' comments and concern. Even in the context of infrastructure projects, social media provides an efficient platform for the users of the project to raise operational concerns and for the project organization to respond to them.

5.2. Contributions to the literature on value creation in infrastructure projects

The main goal of this article was to study the potential of social media for assessing value creation in transport infrastructure projects. However, this study makes a few contributions to the broader literature on value creation in infrastructure projects as well.

The citizens discussed different kinds of benefits in social media. This is in line with several studies that have emphasized the multidimensional nature of value in infrastructure projects (Kivilä et al., 2017; Liu et al., 2019; Martinsuo et al., 2019a,b; Vuorinen and Martinsuo, 2019). The nature of the social media discussion, for example the presence of interest groups, also illustrates the subjectivity of value (e.g., Ang et al., 2016; Green and Sergeeva, 2019). In other words, different stakeholders, in this case citizens, can perceive and value and express these perceptions quite differently. Taken together, the multidimensionality and subjectivity of values set additional challenges for assessing value creation in infrastructure projects.

Finally, most of the studies on value creation in infrastructure projects have focused on the front end or implementation phases of infrastructure projects. This study contributes to the existing literature by studying value creation in the operation phase of infrastructure projects.

6. Limitations and ideas for future research

This study focused on projects from Chennai and Sydney and used a manual scan of the tweets. We suggest similar research in different transport infrastructure projects across countries. We only studied tweets in a 90-day period in both the projects. While this duration was adequate for the exploratory purpose of this article, the continuous monitoring of these messages could provide an idea of change of public perception over time. Also, the research team used Twitter as single source for sentiment analysis. The limitation also includes the use of only Twitter data as no single source can cover entire demographics. We suggest expanding the social media sites to include Facebook, Instagram, WeChat, Tumblr, etc. to cover wider demographics. Another limitation of this study using social media data is the poor representativeness of the data. Social media users only include people who have substantial technical knowledge, digital familiarity, and a willingness to engage online (Ninan, 2020).

Our approach to data analysis worked as the number of tweets were just sufficient for a manual scan. If the number of tweets is large, a manual analysis is time consuming and prone to error. We suggest expanding the scope to include artificial intelligence (AI) and machine learning (ML) models to conduct sentiment analysis. Future research could explore this avenue.

Thus, in order to operationalize this research for use by transport agencies we need ingestion of messages from popular social media sites of the day; aggregation of the data into a common format for real-time coding and sentiment analysis; creation of dashboards for use by operational teams to respond to issues. Additional research can be undertaken to potentially standardize the coding of operational issues by using larger data sets over extended horizons and machine learning and engaging transport agencies in a pilot study.

7. Conclusions

This study focused on the potential of social media for assessing benefit realization in transport infrastructure projects. Some evidence of the benefits delivered by Chennai and Sydney metro rail projects were reported by citizens in their tweets. However, the predominance of negative tweets and the presence of interest groups make the

quantitative evaluation of benefits quite challenging as the tweets related to benefits are overshadowed. We suggest that transport agencies can use social media as an additional way of studying public perception about benefits derived besides their existing benefit realization assessments. We also found that social media can be a useful tool for transport agencies to monitor operational issues, such as problems, delays or other sources of stakeholder dissatisfaction.

We also noticed that the terminology used by the public to describe perceived benefits was different from the terminology used by the project sponsors to describe benefits expected from the project in their business case or mission statement. For example, in the case of the Chennai Metro, one of the objectives was 'fast' services, which was echoed by the users in the form of 'savings in time,' 'beating traffic' and other less catchy words. This confirms the criticism of strategic misrepresentation of large public projects to get them funded (Flyvbjerg, 2006) as sponsors do not use the language used by stakeholders such as citizens to justify spending on a project but terms that appeal to the political system. The findings from this study could also contribute to our evolving understanding of what project success means (Judgev and Müller, 2005). Our research also support the recent calls for the use of mass media in stakeholder engagement of megaprojects in the planning and operation stages (Ninan et al., 2020; Cuppen et al., 2016; Flyvbjerg, 2012).

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