# Public opinion on megaprojects over time: findings from four megaprojects in the UK

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**Abstract**

Megaprojects, due to their size, scale, and technical complexity are expensive and controversial, and how they proceed over time is a key topic of interest. This paper seeks to identify the issues surrounding changes in public opinion over time and discusses a larger question on whether such knowledge can be generalized across projects. An automated text analysis technique called 'sentiment analysis' has been used to plot trajectories for four UK megaprojects from newspaper articles. The empirical setting includes two military and two (civil) infrastructure projects, allowing the exploration of differences between the two fields as a secondary line of analysis.

## 1 Introduction

Megaprojects are defined as large-scale and complex ventures with long lifecycles, involving many public and private stakeholders, and potentially impacting millions of people (Flyvbjerg, 2014). Some examples are energy-generating facilities, infrastructure like buildings and bridges, transport and communication networks, and weapons systems. Megaprojects are typically resource-intensive and often politically controversial, generating opinion among the general publdic

because of their public and political nature (Willems and Van Dooren, 2016) and their substantive and wide-ranging impacts (Walker, 2000). At the same time, megaprojects are themselves influenced by the opinions they generate. Flyvbjerg (2014) explains how the promoters of megaprojects try to manipulate public opinion by infusing the project narrative with optimism, i.e. understating costs and overstating benefits. Sometimes, a symbolic dimension is introduced to make a more compelling narrative for the project (Sangvai, 1994; Rego et al., 2017).

The study of project narratives and understanding the relationship between projects and public opinion requires viewing projects across time, following projects as they develop and evolve. However, within the project management literature, most researchers take a snapshot view of projects rather than a long-term view. A snapshot view has two drawbacks. Firstly, such a view naturally focusses on project delivery with much less focus on stakeholders and people involved in the project and how they are affected by the changes brought about by the project (Dalcher, 2012). Secondly, a snapshot view misses out the dynamism of projects and how stakeholder engagement changes over different project stages (Aaltonen and Kujala, 2010; Di Maddaloni and Davis, 2018). In order to gain a comprehensive view of megaprojects and understand the relationship between public opinion and megaprojects, it is important to engage in long-term temporal analysis. A temporal analysis of public opinion towards projects may help in responding to the conundrum of some projects getting cancelled because of public debate and some projects being realized despite public opposition (Morris, 1985).

Moreover, stakeholder management for projects often emphasizes the local community (like Rydin et al., 2015; van den Ende and van Marrewijk, 2019) but megaprojects have wider impacts beyond local and regional economies. Studying the concerns of a more diverse public (i.e. beyond the local community) may raise issues beyond the siting of a project. The 'public' is not a micro-level agent but a macro-level abstraction and public opinion is a contested field where different narratives may dominate from time to time. This makes it important to study public management for megaprojects differently.

The aim of this paper is to conceptualize and understand changes in public opinion at the collective level over a project's lifetime. It proposes a framework for systematic study of public opinion using text-based sentiment analysis techniques, a relatively new research method that combines the richness of qualitative data with statistical methods. The empirical setting comprises of four megaprojects in the UK, each with a project history of fifteen years or more, and sentiment analysis helps to plot the trajectory of public opinion over time. Examination of the sentiment trajectory helps in identifying issues which are associated with changes in public opinion, contributing to an abiding interest in the project management literature on critical factors related to project success and failure (Pinto and Kharbanda, 1996; Flyvbjerg, 2014; Hol-

weg and Maylor, 2018). There is a larger discussion about the generalizability or context-specificity of factors which affect projects (Engwall, 2003; Dalcher, 2012) and our empirical work makes it possible for us to explore whether the issues which affect public opinion towards megaprojects are common or unique across projects.

Our empirical setting includes two military projects and two (civil) infrastructure projects, and we also take the opportunity to explore whether there are any structural differences in public opinion towards military and non-military projects. It is often claimed that military projects and policy are less well-understood by citizens (Hartley and Russett, 1992; Eckles and Schaffner, 2011), operate with secrecy and urgency (Alic, 2007), and enjoy greater public legitimacy (Nelson and Langlois, 1983). We explore civil-military differences as a secondary research interest in this paper.

The next section provides an overview of research on public opinion and project management, highlighting the existing knowledge and limitations and articulating the research questions. In 'Materials and methods', we describe our methodological framework including the empirical context and the data collection strategy. This is followed by the results and discussion of our findings. The final section summarizes and concludes.

## 2 Public opinion and megaprojects

Megaprojects are large, expensive, and technologically complex ventures involving a number of public and private stakeholders and are considered to be inherently controversial. This is attributed to the transformational nature of megaprojects, i.e. their potential for impacting millions of people (Walker, 2000; Flyvbjerg, 2014). The involvement of a number of stakeholders makes megaprojects prone to conflict as it makes the project landscape institutionally complex, bringing different institutional logics together and catalysing institutional differences (van den Ende and van Marrewijk, 2019; Matinheikki et al., 2019). According to Söderlund and Sydow (2019), projects are affected by 'pre-project politics, expectations about the future, and nested processes of parallel developments and events' (p. 263). An important aspect of project management is to understand the sources of controversy and respond to the concerns of different stakeholders at different points of time in the project lifecycle.

Public opinion can range from public support for a project to collective action against a project (Rydin et al., 2015; Liu et al., 2018). Managing stakeholder expectations is a key concern within project management as negative attitudes towards projects can affect project implementation (Olander and Landin, 2005). Esposito et al. (2020) find that protests and opposition have negative consequences for project teams (impact on costs, schedules, and reputational dam-

age). Meaningful citizen participation, involving both information dissemination as well as interactive engagement, is found to be important for creating public support for projects (Boyer, 2019).

Megaprojects are dynamic and public opinion evolves over time. Aaltonen and Kujala (2010) provide a conceptual framework arguing that stakeholder engagement does not maintain a steady-state across the project lifecycle and is affected by project characteristics like its irreversibility after a point. Di Maddaloni and Davis (2018) interview project managers and describe shifts in local community attitudes to major public infrastructure and construction projects, ranging from initial shock and opposition to eventual acceptance and understanding. Researchers have also used data from social media to understand public opinion towards a specific project and have noted changes in public opinion over time. For example, Jiang et al. (2016) present evidence of sentiment changing over a two-year period in their study of the Three Gorges project in China. Zhang et al. (2018) develop a 'social sensing' system, using data from individuals reacting to the project on social media platforms (i.e., individuals as 'sensors') to map public opinion on a major project and observe changes in sentiment over time.

## 2.1 Symbolism, optimism, and public opinion

Since public opinion towards projects can evolve over time, it is possible to conceive public opinion as a contested field for promoters and opponents of megaprojects with each group seeking to control the project narrative. In the case of megaprojects, promoters may try to infuse the project narrative with symbolism and optimism. Sangvai (1994) comments on the role of nationalism in discrediting opposition to megaprojects in India and the association of a nationalist narrative and symbolism with megaprojects has been found by researchers in different empirical settings, like Brazil (Rego et al., 2017), Australia (Steen et al., 2017), and Italy and Tajikistan (Menga, 2018).

There is a persistent argument, usually based on Hirschman (1967), that optimism, a certain level of ignorance about risks, and an emphasis on symbolism or iconography is essential for megaprojects to come into existence and deliver their potentially transformational benefits to society. At the same time, some in project management research are critical of the role of optimism in megaprojects, arguing (like Flyvbjerg, 2014) that although project planners can use optimistic cost-benefit analyses to get projects started, real challenges soon emerge, which then demands more resources and ultimately delivers the project (if at all) by overshooting initial cost estimates and time schedules.

Plotting public opinion towards megaprojects can reveal the contest between exuberant optimism and a cautious or critical approach since changes in the trajectory will indicate changes in collective public opinion. Existing research

has not sufficiently exploited new research methods to conduct such an exercise. In this paper, we propose the use of sentiment analysis, an automated text analysis technique which extracts emotions or sentiments from written documents, to plot the trajectory of public opinion over the typically long development and delivery period of megaprojects. A sentiment plot could give us insights into the tendency of public opinion to be optimistic or cautious about projects, and the analysis of project narratives could provide information on the use of symbolism.

### 2.2 Issues affecting public opinion

Plotting the progression of public opinion over time can also help in identifying critical time periods and issues which affect public opinion. Understanding the issues associated with changes in public opinion could further our knowledge of critical factors that contribute to the success or failure of projects. Such an understanding is particularly relevant for megaprojects which are inherently complex and notorious for exceeding time and budget expectations. Project management research is acutely concerned with the identification of critical factors which affect project performance (Bryson and Bromiley, 1993; Pinto and Kharbanda, 1996; Chang, 2013; Lichtenberg, 2016; Söderlund et al., 2017; Holweg and Maylor, 2018).

Researchers have warned about the context-specificity of critical factors associated with projects (Engwall, 2003; Dalcher, 2012) and there are doubts about whether critical challenges for a project can be predicted at all (Flyvbjerg et al., 2020). Megaprojects exemplify the kind of rare and improbable events termed 'Black Swans' (Taleb, 2007), suggesting that it may be impossible to anticipate risks and challenges to the project. We think that doing a comparative analysis of factors behind success and failure for a few projects can be helpful in finding out whether critical failure factors are common across projects or unique to projects. Therefore, we are also interested in comparing the issues associated with positive and negative public opinion towards projects to identify whether there are any common critical factors across projects.

## 3 Materials and methods

Many of the challenges in studying public opinion are methodological. Public opinion is an abstract concept. While surveys are a popular method of gathering public opinion, in the case of highly specific topics (like public opinion towards a particular project) over a long period of time, surveys can be prohibitively expensive, if not impossible to conduct.

In such situations, archival research is usually pursued and a number of re-

searchers have looked at media sentiment to understand prevailing public opinion (Verhoeven and Duyvendak, 2016; Metze, 2017). Mutz and Soss (1997, p. 432) describe how 'mass media coverage of an issue can serve as a surrogate for more direct expressions or solicitations of public opinion'. Habel (2012) emphasizes the reactive role of media, i.e. rather than leading public opinion, it is itself influenced by the public mood. Media outlets are an important source of information on the opinions of a variety of stakeholders, including government officials who may have oppositional views which are easier expressed to journalists (Verhoeven and Duyvendak, 2017).

Olander and Landin (2005, p. 327) describe the media as having a 'unique position' in the project process as 'they cannot really be defined as a stakeholder because they have no actual stake in the project' but nevertheless provide useful insights from a cross-section of project stakeholders. We follow a tradition of scholarship that considers sentiments expressed in media to be a valid measure of public opinion. We use articles published in national and local newspapers about megaprojects and are essentially capturing media sentiment, but given the literature tradition, the close links between the media and the wider public in a democracy, and our data collection strategy (explained later) which covers a large number and variety of publications, we consider media sentiment as synonymous to public opinion.

## 3.1 Empirical context

The UK provides an appropriate empirical context for this research as there exist both large public projects pursued by the British government, and multiple newspapers that report and comment (independently of the government) on the progress of these projects. Thus, setting this research in the UK provides rich sources of data. The projects were selected through convenience sampling among all the projects listed in the *Government Major Projects Portfolio 2019* (GMPP).

The four selected projects are: the Queen Elizabeth programme (development of two aircraft carriers for the Royal Navy), Armoured Cavalry 2025 (procurement of armoured fighting vehicles for the British Army), the Thameslink programme (purchase of trains for a commuter service running across London), and the Intercity Express programme (improvement of railway services between major cities in the UK on the East Coast line and the Great Western route). All four projects have a sufficiently long project history and have made tangible progress over time, therefore providing substantial material for analysis. Additionally, the logic of selecting these projects includes their links to the manufacturing sector of the economy, instead of services or ICT, which are considered distinct even among megaprojects (Davies and Hobday, 2005; Public Administration and Constitutional Affairs Committee, 2018, Q105). However, project selection

was not influenced by project performance. The Infrastructure and Projects Authority in the UK provides a delivery confidence rating for projects listed in the GMPP since 2013 and the selected projects have received different ratings over the years.

The empirical context makes a comparative study possible. Two of the selected projects are from the military sector (aircraft carrier and armoured vehicle) and two are public transport related infrastructure projects. This can lead to a question like 'does public opinion differ between military and civilian projects?' Existing research in public policy suggests this to be debatable. On the one hand, public opinion on military policy may be guided by national agenda, wider geopolitics, and elite narratives (Eckles and Schaffner, 2011). On the other hand, researchers have also found that the public have reasonably nuanced views on matters of defence and foreign policy, like military expenditure (Wlezien, 1995; Aldrich et al., 2006). We are not aware of any study that compares public opinion on military and civilian projects, and we are therefore interested in exploring whether there are any structural differences in public opinion, either in the trajectory over time or in the issues raised.

The projects are briefly described next.

#### 3.1.1 Queen Elizabeth porgramme (QEC)

The Queen Elizabeth programme began in 1998 when the Strategic Defence and Security Review (SDSR) announced the intention to purchase two aircraft carriers. The programme began as a competitive tender with two contractors (BAE Systems and Thales) but in January 2003, the government announced an 'alliance approach' where both Thales and BAE would be involved in the carrier development on the grounds that no single contractor would have the capacity to deliver the project on its own (House of Commons, 2003; Defence Committee, 2005, Q19-21). However, there were conflicts about the roles and responsibilities of members in the Aircraft Carrier Alliance and the manufacturing contract could only be signed in July 2008.

Work began in the next year, but several challenges emerged. The project was purposefully delayed in order to divert military expenditure towards on-going military operations in 2008 and 2009; in 2010, there were rumours about cancelling the second carrier; between 2010 and 2012, there were changes to the choice of aircraft that would fly from the ships (from F-35B to F-35 C and then back to F-35B). The first ship, HMS Queen Elizabeth, was finally commissioned in December 2017, and the second ship, HMS Prince of Wales, was commissioned in December 2019.

### 3.1.2 Armoured Cavalry 2025

In the 1980s, a programme to replace the British Army's armoured fleet was launched. Although a brief collaborative effort with the US was pursued in the 1990s, from 2003 the UK began to pursue its armoured requirement under FRES (Future Rapid Effects System). The 2003 Iraq invasion led the British Army to purchase armoured vehicles like the Mastiff and Jackal as 'urgent operational requirements' and FRES was pursued for a 'longer term requirement' (Comptroller and Auditor General, 2006, pg. 161).

In March 2010, a decision on the prime contractor (General Dynamics UK) was made for the FRES programme. The programme was later re-launched as Armoured Cavalry 2025 and the family of armoured vehicles is called 'Ajax'. In this paper, Ajax is sometimes used as a shorthand for the programme. The manufacturing contract was signed in 2014 and GD-UK began manufacturing the vehicles in a facility in Wales from 2016 (the delivery of vehicles began in 2019).

### 3.1.3 Thameslink programme

The Thameslink programme officially began in 2005 with the aim of increasing capacity and upgrading services on the Thameslink line, a north-south commuter service in London that began operations in 1988. It involved infrastructure development of stations and tracks, revised franchising of train operating services, and procurement of new trains. The invitation to tender for high-speed electric trains was issued in November 2008.

In June 2011, it was announced that Siemens had been selected as the preferred bidder for the rolling stock contract. Under the Thameslink programme, services on the Thameslink, Southern, and the Great Northern lines were merged into a single franchise which was awarded to Govia in 2014. The wider infrastructure work (e.g. station redevelopment, upgrade of signalling systems) continued during this time, even as new trains began to be introduced (from 2016). In May 2018, with the completion of station work and delivery of new rolling stock, a major revision of train timetables to increase capacity took place.

### 3.1.4 Intercity Express programme (IEP)

IEP was launched in 2005 'to examine how the current Intercity 125 High-Speed Trains, introduced between 1976 and 1982 could be replaced' (Department for Transport, 2009, para. 57). After nearly thirty years of service, there was a need to change rolling stock and the programme provided an opportunity to purchase more environmentally efficient trains. The DfT therefore sought to

buy electric trains which would be lighter and more energy efficient.

In February 2009, Agility Trains Limited (a Hitachi-led consortium) was selected as the preferred bidder, but in February 2010 the programme was paused, following an announcement by the government that procurement of new rolling stock may be shelved because of pressures on public expenditure. This period of uncertainty ended only when IEP was confirmed on 2 March 2011 with an announcement of a £5.2 billion investment programme. The programme has continued since, although introduction of new trains has been delayed due to delays in the wider electrification works.

## 3.2 Data collection

In order to search for newspaper articles on each project, the Lexis Library News database was used, which covers all major national and regional newspapers in the UK. The list of newspapers is provided in the Appendix and covers publications from across the political spectrum, including both conservative and liberal-leaning publications without discrimination. Newspaper articles for each project were found by searching for specific terms (Table 1). The search was conducted for entire calendar years (January to December). The choice of years depended on the official dates when the projects began.

Newspaper articles were manually selected for relevance and to avoid duplication. For an article to be relevant, it had to prominently and substantially discuss the project (ideally within the first 100 words of the article). Although search terms were tested with a small set of articles for relevance, there were instances where the terms captured irrelevant articles. However, refining the search terms any further led to losing potentially useful articles, and therefore the automated search was followed by manual selection.

It should be noted that selected articles do not only mean newspaper reports on events but also commentaries, editorial and op-ed pieces, and letters to editors. Van Dalen (2012) notes that the UK has a journalistic culture that values conflict and gives space to both kinds of opinions in case of controversy. This makes the data rather cacophonous, but it is beneficial for capturing diversity of opinions over time.

It may be worth clarifying why data from opinion polls (e.g. British Social Attitudes Survey, Gallup World Poll) were not used as an alternative or supplement to newspaper data. Public policy researchers are often able to exploit such survey data, but the context of this research is projects, not policy or institutions. Opinion polls also do not allow the level of granularity in time-series that newspapers do.

Table 1: Search terms usedd to collect data

| **Project name** | **Queen Elizabeth programme** | **Armoured Cavalry 2025** | **Thameslink** | **Intercity Express Programme** |
|---|---|---|---|---|
| Search terms† | "new aircraft carrier" OR "new aircraft carriers" OR "future aircraft carrier" OR "future aircraft carriers" OR "aircraft carrier alliance" OR "HMS Queen Elizabeth" OR "HMS Prince of Wales" OR "Queen Elizabeth class" | "armoured reconnaissance" OR "armoured fighting vehicles" OR "family of light armoured vehicles" OR "FRES" OR "scout specialist vehicle" OR (ajax w/p armoured) OR (ajax w/p army) | "Thameslink 2000" OR (thameslink w/p train*) OR (thameslink w/p "rolling stock") OR (thameslink w/p programme) OR "thameslink modernisation" OR (thameslink w/p upgrad*) OR (thameslink w/p contract) OR (thameslink w/p plan*) OR (thameslink w/p "project") OR (thameslink w/p Siemens) OR (thameslink w/p Bombardier) OR (thameslink w/p franchise) | ("intercity express" w/p programme) or ("inter city express" w/p programme) or "intercity 125" or "inter city 125" or "intercity 125s" or "inter city 125s" or "intercity train" or "intercity trains" or "inter city train" or "inter city trains" or "IEP" or "intercity express programme" |
| Time period | 1998 – 2019 | 1989 – 2019 | 2005 – 2019 | 2005 – 2019 |
| National newspaper (hits) | 4963 | 4093 | 4173 | 1270 |
| National newspaper (selected) | 1765 | 391 | 620 | 198 |
| Regional newspaper (hits) | 3627 | 2337 | 3307 | 2472 |
| Regional newspaper (selected) | 1212 | 203 | 664 | 657 |
| **Total (selected)** | **2977** | **594** | **1284** | **855** |

†w/p implies search terms should co-occur within the same paragraph; w/s implies search terms should co-occur in the same sentence; asterisk character is used to substitute any number of characters after the word.

## 3.3 Data analysis

In order to understand the underlying opinions and emotions from written texts, it is important to devise systematic coding strategies. Sentiment analysis refers to the 'systematic computer-based analysis of written text or speech excerpts for extracting the attitude of the author or speaker about specific topics' (Stieglitz and Dang-Xuan, 2013, p. 226). The method introduces speed and consistency to text analysis (Jiang et al., 2016; Mahadzir et al., 2016).

In this paper, we conducted sentiment analysis of newspaper articles and calculated a sentiment score for each article using the sentimentr package developed by Rinker (2017) which follows the dictionary principle for detecting sentiment in text, i.e. words are tagged according to a pre-defined dictionary or lexicon[1]. Valence shifters in front of words are also taken into account (negations like 'not', amplifications like 'really', de-amplifications like 'hardly'). This increases the accuracy of sentiment scores. The function also accounts for variance in length of text.

For meaningful analysis, we aggregated sentiment scores by month. This is in line with existing work which considers the time variable for studying public opinion towards large projects (like Jiang et al., 2016; Zhang et al., 2018). In order to detect changes in the movement of public opinion, cumulative sum of monthly averages of sentiment scores was used. Cumulative sum (cusum) was calculated in two steps – first by obtaining a normalised score ($Z$) for each month $()Z = \frac{x-\bar{x}}{\sigma}$, where $x$ is the sentiment score for that month, $\bar{x}$ is the average of monthly sentiment scores, and $\sigma$ is the standard deviation in the data), and then by adding the $Z$ value of a month with the previous sum of $Z$ values.

### 3.3.1 Validity and reliability of sentiment scores

The validity of sentiment scores as a measure of public opinion is established by using sentiment dictionaries which have been compiled from large-scale crowdsourcing projects undertaken by researchers in natural language processing. For the purposes of this research, it was also important to establish the reliability of sentiment scores against multiple human coders through inter-coder agreement. The coding task to check reliability was designed so that human coders ranked a subset of articles from high/positive opinion to low/negative opinion. The human rankings were then compared with machine ranking (based on the scores). A subset of sixty articles was drawn for each project at random (without replacement). The sixty articles were further grouped into sets of four at random. Human coders were then asked to compare four articles in a set at a time and rank them from 1 to 4, where 1 meant positive/high public opinion or

[1] Positive and negative words are given a $+1$ and $-1$ score respectively and tagged according to a combination of two dictionaries – Jockers (2017) and Hu and Liu (2004).

public approval and 4 meant negative/low public opinion or public disapproval.

Three human coders were involved – two native English speakers and the first author. The human coders worked independently of each other. The sentiment scores from sentimentr were converted into ranks and the level of agreement was calculated by using Krippendorff's alpha (Krippendorff, 1970). Alpha values over 0.67 are accepted as reliable for drawing tentative conclusions (Krippendorff, 2004) and this was met in most cases (Table 2).

Table 2: Inter-coder agreement on sentiment analysis

| **Project** | **Agreement between** | **Alpha** | **95% confidence interval** |
|---|---|---|---|
| QEC aircraft carriers (n = 2977) | sentimentr and three human coders | 0.756 | (0.699, 0.8086) |
| | three human coders | 0.756 | (0.6707, 0.8320) |
| Armoured Cavalry 2025 (n = 594) | sentimentr and three human coders | 0.738 | (0.6868, 0.7886) |
| | three human coders | 0.823 | (0.7657, 0.8740) |
| Thameslink (n = 1286) | sentimentr and three human coders | 0.626 | (0.554, 0.6935) |
| | three human coders | 0.730 | (0.6353, 0.8121) |
| Intercity Express Project (n = 887) | sentimentr and three human coders | 0.751 | (0.6946, 0.8030) |
| | three human coders | 0.832 | (0.7812, 0.8806) |

There was often little difference between inter-human agreement and that between human ranking and sentiment scores, suggesting that machine-generated sentiment scores are fairly reliable. At the same time, investigating cases of discrepancy between human rankings and sentiment scores did reveal that opinion pieces are particularly susceptible to being given a relatively higher sentiment score suggesting that sarcasm and satire cannot be interpreted by the machine well.

# 4 Results

Sentiment analysis of newspaper articles allows us to plot the trajectory of public opinion over time. Figures 1–4 provide the plot of cusum values over time for each project. The first observation from each figure is that sentiment scores fluctuate substantially over time, going through peaks and troughs. In some cases, like IEP or Ajax armoured vehicles, there seems to be a particularly significant trough, making the sentiment plot almost U or V-shaped. For the aircraft carrier and the Thameslink project, the sentiment plots do not exhibit the same behaviour and instead contain multiple peaks and troughs over the development and delivery period. It is perhaps interesting to note here that the sentiment plots do not show any structural differences between military and civilian projects.

The figures thus show that media sentiment or public opinion changes over

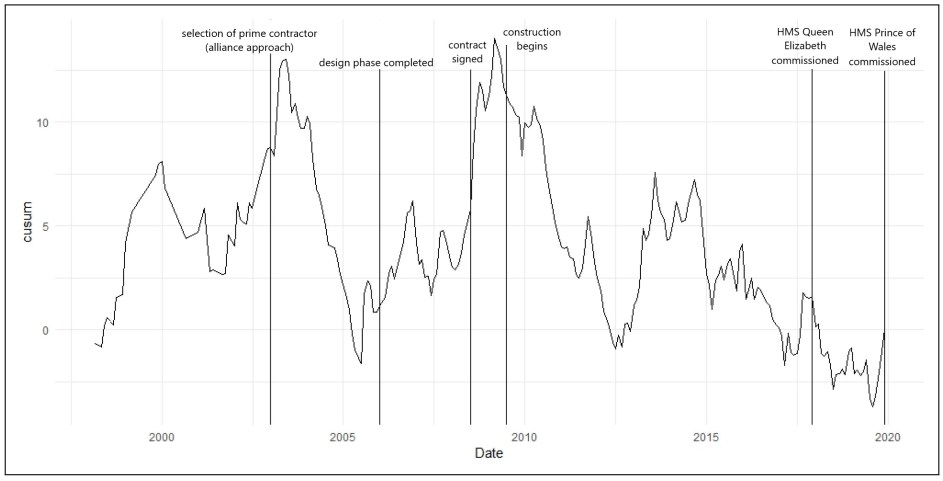


Figure 1: Sentiment scores (cumulative sum) over time (Queen Elizabeth programme)

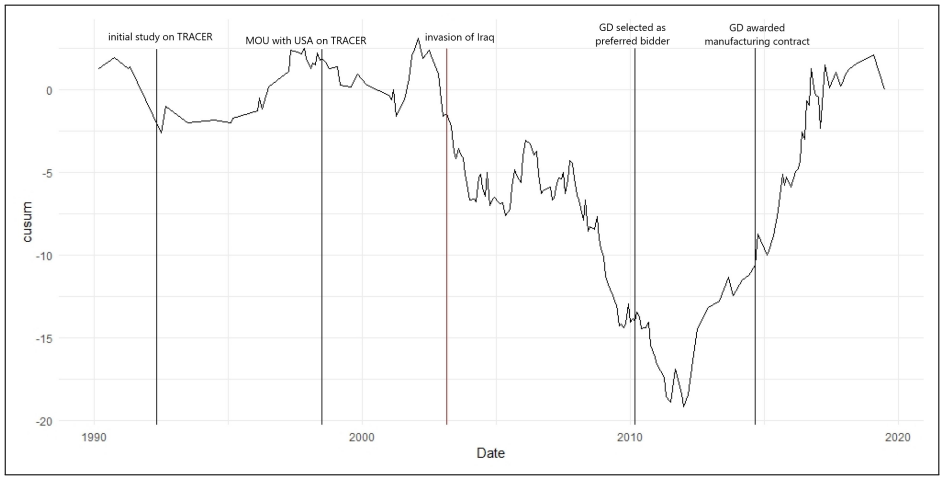


Figure 2: Sentiment scores (cumulative sum) over time (Armoured Cavalry)

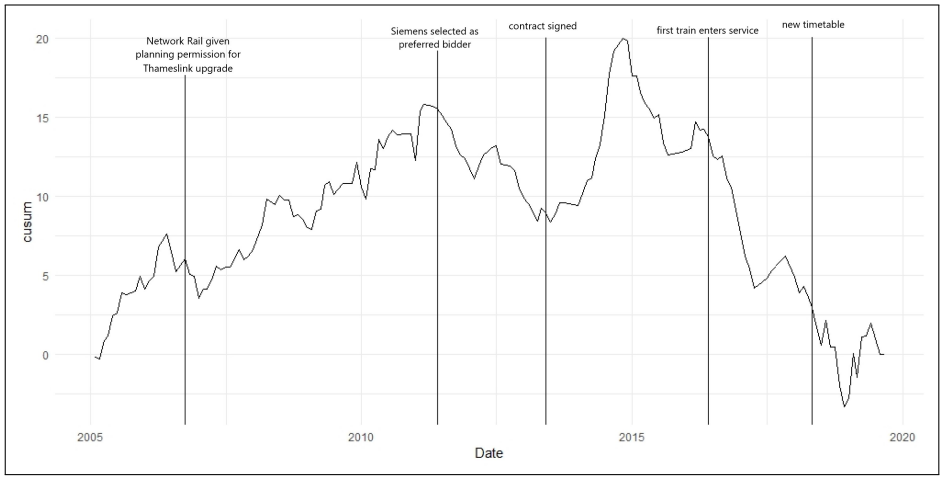


Figure 3: Sentiment scores (cumulative sum) over time (Thameslink programme)

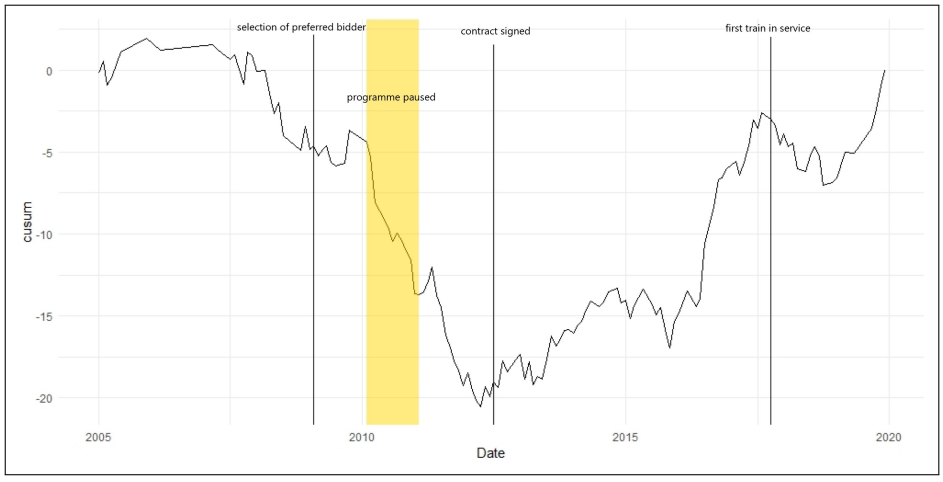


Figure 4: Sentiment scores (cumulative sum) over time (IEP)

time. The project narrative is sometimes dominated by a positive tone (and the sentiment scores rise), and at other times by a negative tone (and the sentiment scores fall). None of the four projects experience a constant level of support or opposition over time. The newspaper articles come from diverse sources – national and regional, broadsheet and tabloid, left- and right-leaning. And yet when sentiment scores from newspaper articles are aggregated over time, the scores vary substantially from one period to the next, showing that public opinion is a contested field amongst opposing points of view.

## 4.1 Characteristics of news content

The figures allude to periods of high and low sentiment for each project through the peaks and troughs in the sentiment plot, and we now focus on these periods and analyse the characteristics of news content to identify the issues that affect public opinion. In order to identify the months where sentiment scores were significantly high (or low), some selection rules were applied based on the average monthly sentiment score (i.e. sentiment score must be above the upper quartile or below the lower quartile) and the number of articles in the month (above a threshold, determined by the size of corpus). The Appendix provides further details.

Table 3 lists the issues that were found with a brief description and an exemplary headline from projects where they were found. The cells with 'n/a' denote that the issues was not found in the newspaper articles from the months under consideration for a particular project. The issues, or factors, can be further categorized according to their frequency of occurrence across projects and sectors (Table 4). The 'military' sector refers to QEC and Ajax, and 'transport' refers to Thameslink and IEP.

Table 3: Dominant stories in months of high & low public opinion

| **Type of period** | **Factor** | **Description** | **Queen Elizabeth programme (QEC)** | **Armoured Cavalry 2025 (Ajax)** | **Thameslink programme (TP)** | **Intercity Express Programme (IEP)** |
|---|---|---|---|---|---|---|
| Months with high sentiment scores, or 'good' months | contract/ subcontract award | signing of contracts or subcontracts related to the project | "MoD signals £3.9bn deal for super-carriers" (The Times, 21/05/08) | "Arms deal boost" (The Express, 22/10/14) | "Go-Ahead wins battle to run UK rail super-franchise" (The Times, 24/05/14) | "Glass maker seals major deal for North-East train building project" (The Northern Echo, 13/08/13) |
| | engineering/ manufacturing sector | job creation, regional revival or economic growth, reports on construction activities | "Clyde yards are set for lift off" (Evening Times, 03/03/09) | "Merthyr at cutting edge of Army vehicle design" (The Western Mail, 07/03/16) | n/a | "Hundreds of businesses examine Hitachi opportunities" (The Northern Echo, 27/05/11) |
| | strategic cooperation | inter-state cooperation or collaboration | n/a | "Britain poised to join European arms agency" (The Times, 11/03/96) | n/a | n/a |
| | project milestone | successful completion of a project phase | "£3bn carrier sails to base for first time" (The Daily Mirror, 17/11/19) | n/a | "Planning go-ahead for Thameslink" (The Daily Telegraph, 19/10/06) | n/a |
| | projected programme benefits | anticipated benefits of programme | n/a | n/a | "Improvements promised on the trains" (Bedford Today, 10/05/05) | "Staying optimistic about town's future" (Gloucestershire Echo, 04/01/18) |
| Months with low sentiment scores, or 'bad' months | budget cuts | pressure on departmental budget | "Navy's new carriers delayed by cash cuts" (The Daily Mail, 12/12/08) | "Armed forces face two decades of cutbacks" (The Herald, 31/05/05) | n/a | n/a |
| | cancellation fears | project uncertainty and potential for cancellation | "PM stays silent on two carrier deal" (Evening Times, 04/10/10) | n/a | n/a | "New generation trains shunted into the sidings" (Gloucestershire Echo, 01/03/10) |
| | equipment/ staffing shortages | lack of equipment or soldiers to conduct operations | "Royal Navy new aircraft carriers could be hampered by lack of personnel" (The Express, 15/03/17) | "Why our troops are fighting with equipment that isn't up to the job" (The Sunday Herald, 10/09/06) | n/a | n/a |

**Table 3 continued from previous page**

| Type of period | Factor | Description | Queen Elizabeth programme (QEC) | Armoured Cavalry 2025 (Ajax) | Thameslink programme (TP) | Intercity Express Programme (IEP) |
|---|---|---|---|---|---|---|
| | loss to British manufacturing | awarding contract to foreign firms, job losses in domestic manufacturing | n/a | "Decline in MoD orders leads to loss of 25 jobs" (Leicester Mercury, 21/11/08) | "Experts predict impact of rail job losses on city's economy" (Derby Telegraph, 17/10/11) | "We will all pay for Thameslink travesty" (The Daily Telegraph, 15/08/11) |
| | political challenges | diplomatic issues, unstable political environment | "Beijing scolds UK Defence Secretary over 'gunboat diplomacy'" (The Express, 26/02/19) | n/a | n/a | "Brexit could damage Hitachi expansion at Newton Aycliffe" (The Northern Echo, 20/05/16) |
| | project management | delays, cost overruns, and other inefficiencies of procuring department | "Cost fears over new Royal Navy carriers" (The Herald, 13/10/03) | "MOD may delay new armour project" (Western Daily Press, 11/11/03) | "Network Rail asks for an extra £8bn" (The Times, 04/07/07) | "Taxpayers will pay price if intercity trains deal hits buffers" (Yorkshire Post, 17/12/14) |
| | technical problems | technical faults in new equipment affecting users and the system | "3 people nearly drown as 200 tonnes of water leak into carrier" (The Express, 10/07/19) | "Army's new £3.5bn mini-tanks denounced as useless death traps" (The Times, 01/11/16) | "New train seats are so hard travellers told take a cushion!" (The Daily Mail, 19/02/18) | "Commuters complaining as doors fail to open on new trains" (The Western Mail, 14/02/18) |

Table 4: Frequency scale for factors

| **Number of projects where factor is found** | **Comments on specificity** | **Factors from Table 3** |
|---|---|---|
| 4 | Common to all projects | contract/ subcontract award, project management, technical problems |
| 3 | Fairly common | engineering/ manufacturing sector, loss to British manufacturing |
| 2 (from different sectors) | Shared across sectors (military & transport) | project milestone, cancellation fears, political challenges |
| 2 (from same sector) | Sector-specific (military/ transport) | projected programme benefits, budget cuts, equipment/ staffing shortages |
| 1 | Uncommon | strategic cooperation |

There are some factors which are common across the four projects and across the two sectors, suggesting some degree of universality in what constitutes good and bad news. Stories like the opening of a new factory, jobs being protected in an industry, regional economic growth and revival of the manufacturing sector, or the awarding of contracts and subcontracts can be found in months with high sentiment scores across all projects. Similarly, news of cost overruns and project delays and technical problems characterize the 'bad months', or periods with very low sentiment scores. Outsourcing or awarding contracts to foreign firms is associated with low sentiment scores, irrespective of the manufacturing sector (military projects or railway rolling stock). The presence of technical problems in all the four projects is to be expected, given the complex nature of all the projects, and it is also natural that such events will lower public sentiment.

Factors which are uncommon in the sense that they are found in only one or two of the four projects are informative on account of their specificity. Some of these issues are sector-specific: inter-state strategic cooperation is typically found in the military domain, and equipment or staffing shortages compromising operational capability is also a matter of national security. Pressures on the departmental budget ('budget cuts') are cited regarding the military projects but not transport projects. On the other hand, projected benefits of a programme feature in the months of high public opinion for transport projects only. This could be because people directly benefit from transport projects and only indirectly benefit from defence projects, making the former more apparent to the public.

## 4.2 Factors behind changes in public opinion

Besides the issues which characterize the news content during periods of positive and negative sentiment, we are also interested in the factors that occur at turning points, where a sustained rise or fall in sentiment scores changes its course. In order for a turning point to qualify for investigation, a rule on the

Table 5: Factors found during turning points

| Reasons for ... | Factor | Description | QEC | Ajax | TP | IEP | Additional notes |
|---|---|---|---|---|---|---|---|
| Rise in public opinion | Number of turning points analysed | | 9 | 7 | 1 | 8 | |
| | contract/ subcontract award | signing of contracts or subcontracts related to the project | ✓ | ✓ | ✓ | ✓ | Common to all projects |
| | engineering/ manufacturing sector | job creation, regional revival or economic growth, reports on construction activities | | ✓ | | ✓ | Shared across sectors |
| | project milestone | successful completion of a project phase | ✓ | | | ✓ | Shared across sectors |
| Fall in public opinion | Number of turning points analysed | | 11 | 11 | 5 | 6 | |
| | budget cuts | pressure on departmental budget | ✓ | ✓ | | | Military-specific |
| | cancellation fears | project uncertainty and potential for cancellation | | | | ✓ | Uncommon |
| | disrupted rail services | train cancellations due to engineering works, strikes, and technical problems with trains | | | ✓ | ✓ | Transport-specific |
| | equipment/ staffing shortages | lack of equipment or soldiers to conduct operations | ✓ | ✓ | | | Military-specific |
| | loss to British manufacturing | awarding contract to foreign firms, job losses in domestic manufacturing | | ✓ | ✓ | ✓ | Fairly common |
| | project management | delays, cost overruns, and other inefficiencies of procuring department | ✓ | ✓ | | ✓ | Fairly common |

number of articles until the next turning point was introduced so that only the times when there is a sustained rise or fall in opinion would be analysed. Since the dataset for each project differs in size, the threshold for number of articles between turning points differs as well (see Appendix/Supplementary).

Table 5 presents the factors found at the turning points for each of the four projects. Many of these factors are familiar from Table 3 except 'disrupted rail services' which has been introduced as a combination of stories making reference to the poor quality of rail service being experienced by passengers due to technical problems in the trains, timetable changes, strikes, or overrunning engineering works.

A number of observations can be made. Firstly, there are more reasons for public opinion to start falling than to start rising. A rise in public opinion is confined to stories of awarding contracts and subcontracts, achievement of project milestones (approval, completion, inauguration), and positive news about the manufacturing sector. A fall in public opinion, on the other hand, is triggered by a variety of reasons. Some of these reasons are fairly common, like delays and cost overruns, or adverse effects on British manufacturing due to international competition and outsourcing. But there are also some sector-specific

stories (budget cuts, staffing shortages, service disruption) which trigger a fall in public opinion.

Another observation from Table 5 is regarding the number of turning points analysed. When the criterion on number of articles between turning points is introduced, we note that there are more significant downward movements than upward turns for three of four projects. Public opinion appears more likely to fall than rise for major public projects which supports the sentiment analysis findings of Zhang et al. (2018) and prompts us to view the role of public opinion within project management in new ways (which we discuss next).

# 5 Discussion

Megaprojects are characterised by lengthy development and delivery periods. Some people support or oppose a project from the beginning until the end, but it is also interesting to look at the public as a collection of disparate people. We find that public opinion understood thus and expressed through multiple newspapers, changes over time – none of the four projects under consideration experience constant public adoration or opprobrium. Public opinion responds to events, announcements, news of risks, challenges, and failures. Our findings, which are relevant for project management, are discussed in two parts. The first, 'public as a barometer', discusses the characteristics of public opinion towards megaprojects and whether the public can be a barometer for project performance and contribute to project management. The second, 'Anna Karenina Principle', helps explain our ability (or lack thereof) to anticipate the issues which affect public opinion.

## 5.1 The public as a barometer

We find that the public has justifiable reactions to projects. Sentiment scores are high when project milestones are achieved. News of jobs being created locally and potential for regional economic growth is greeted positively whereas awarding contracts to firms outside the UK is greeted negatively. Project management problems (delays, cost overruns, inefficient use of resource) are factors that characterise periods of low public opinion.

Existing research on megaprojects identifies technological risks (Bryson and Bromiley, 1993; Pinto and Kharbanda, 1996), the use of lowest price bidding (Chang, 2013), and wider political challenges (Söderlund et al., 2017) as factors which adversely affect project performance. We find these issues are noted in newspapers as well, and such articles express negative sentiment. Given the essentially political nature of megaprojects (Willems and Van Dooren, 2016), it

may be beneficial to take public opinion into account and note the issues which affect people about a particular project to manage and govern megaprojects. For example, public opinion could be measured regularly during the long project development period.

The sceptical reader may argue that project managers are usually aware of risks, inefficiencies, delays, and cost overruns before the wider public (they may even be orchestrating events and press releases and sharing information selectively) and thus will derive little value from observing the rise and fall of public opinion over time. However, based on our findings, we argue that it is still important to stay in touch with public opinion because project managers and policymakers may not be able to anticipate the intensity of public emotion or reaction. For example, awarding the Thameslink contract overseas led to a very negative reaction among the British public. Newspapers often present stories in the backdrop of wider political and economic developments (see earlier reference to framing theory). In the case of megaprojects, negative media coverage may not only have implications for project managers, but also for the government and the private stakeholders involved[2].

We find some examples of symbolism in our study, particularly for the QEC aircraft carriers, where public opinion is very high (and often peaks) when the ships are launched for sea trials or commissioned into service. There is a lot of public attention on the eve of such celebrations, and the challenges of the project (those already experienced and those yet to come) are rarely addressed during such times. However, more broadly, our analysis shows that public opinion is not entirely tied to symbolism and newspapers can provide critical scrutiny and counteract over-optimism.

For example, we find that public opinion is more likely to experience sustained downward turns than rises. Zhang et al. (2018), in their study, found that negative events cause "rapid and significant decrease of sentiment value" while positive events only lead to a slow and slight increase (p. 686). In our study, even key milestones rarely sustain a positive public opinion towards the project. For the QE carriers (Figure 1), the sentiment plot peaks when the first ship is commissioned (December 2017), only to swiftly fall as a leak is discovered on the ship, and the decision to commission the ship before completion of sea trials is criticised. For the Thameslink programme (Figure 3), the new trains were criticised for being uncomfortable, and the disruption experienced due to timetable changes and delayed services dominate the narrative (2018), even when the project reaches its conclusion.

The multiple peaks and troughs of sentiment scores may thus indicate that

[2]Continuing with the example of the Thameslink contract, it is possible to find premonitions of Brexit ("Contract decision shows why we have to leave EU", *Derby Telegraph*, 30 June 2011), and anger towards private stakeholders involved ("£15m spent on train contract consultants", *Derby Telegraph*, 3 August 2011; "Top Cameron aide derailed Bombardier", *The Daily Mirror*, 6 August 2011).

while optimism could play a role in getting megaprojects started (Flyvbjerg, 2014), public opinion is wary and unforgiving, quick to become critical when problems emerge. This can be seen for both military and non-military projects. It could be argued that this quick critical response is due to teething problems associated with the roll-out of a new technical system. However, it is also possible that collective opinion and news media tend to be pessimistic, emphasising things that do not work as promised. This could suggest that collective opinion can be a source that pushes back against the optimism of the proponents of megaprojects[3].

## 5.2 The Anna Karenina principle

In our study, we observed some common factors across the four projects and the two sectors, but we also found sector-specific issues that affect public opinion. These are largely typical to the sectors themselves, like budget cuts and lack of equipment and soldiers in the military, and disruptions in service due to weather, strikes, and engineering works in rail transport. However, Table 5 suggests a difference in the commonality of issues based on the two periods (rise or fall in public opinion).

We first notice that there are fewer reasons for a rise in public opinion as compared to reasons which lead to a fall in public opinion. Secondly, the former set of reasons are more likely to be either common to all projects or shared across the two sectors. The reasons for a fall in public opinion, on the other hand, are more in number, specific to sectors, and differ in their composition from one project to the next. That factors behind a rise in public opinion are common and few in number, but factors behind a fall in public opinion are relatively unique and more numerous to list chimes with the lines in Tolstoy's novel *Anna Karenina – "all happy families are alike; each unhappy family is unhappy in its own way"*. Researchers from different fields have termed this state as the 'Anna Karenina principle' (AKP) and have used it to explain success (but more commonly, failure) in a variety of fields like animal domestication (Diamond, 1994) and ecological risk assessment (Moore, 2001). We would like to introduce the idea to public management of megaprojects.

Over the long history of the megaprojects being studied here, there are times when public opinion towards projects is high (when the public and the project are a 'happy family') as well as when public opinion is low (the public and the project are an 'unhappy family'). High public opinion is linked to the same issues across projects and across sectors, and perhaps these are necessary factors

[3]However, whether public opposition can stop megaprojects in their tracks is not clear from our data, since the four projects in our study have been completed or are nearing completion. Serious problems have been reported with the armoured vehicles during acceptance trials as recently as the summer of 2021, and the programme may be scrapped, but this is not certain at the time of writing and the data collection only goes up to the end of 2019.

for a project to be considered successful by people (for example, the project boosts the manufacturing sector, leads to contracts, and achieves milestones). However, low public opinion is associated with various issues, some of which are specific to the sector or the project. The implication of AKP in our study is that megaprojects appear distinct and different during periods of low sentiment (when projects are struggling with challenges) but during periods of public satisfaction with the project, megaprojects experience similar positive issues. There are other variations of the Anna Karenina principle, notably Aristotle's articulation in *Nicomachean Ethics*[4] and the Second law of thermodynamics[5], which also support our theorisation.

"We tend to seek easy, single-factor explanations for success, but for most important things, success requires avoiding many possible causes of failure" (Diamond, 1994, p. 4). A rise in public opinion is due to a few factors, many of which are common across projects, whereas a fall in public opinion is due to a number of factors, and some of them are specific to projects and sectors. We can attribute this to the complexity of major projects, the aforementioned 'Black Swan' characterisation, and the challenges of predicting sources of risk. Our findings contribute to this school of thinking as it shows that the composition of factors responsible for a fall in public opinion can vary from one project to the next. The presence of the Anna Karenina principle is a warning – a knowledge of critical failure factors is useful but not sufficient. Challenges come in different forms and there are many ways to fail.

# 6 Conclusion

Megaprojects are large, complex systems that seek to address the large and complex challenges we face (national security, public transportation, public health, energy provision). Although existing research acknowledges the importance of stakeholder management and involving the wider community in the development and delivery of megaprojects, there are few studies with public opinion as their central topic. Our study extends this currently small body of literature by studying public opinion on four megaprojects in the UK. To our knowledge, this is the first study that employs sentiment analysis to observe public opinion towards megaprojects over a period of fifteen years or more.

[4] "Again, one can miss the mark in many ways (since the bad belongs to the unlimited, as the Pythagoreans portrayed it, and the good to the limited), but one can get things right in only one (for which reason one is easy and the other difficult – missing the target easy, hitting it difficult). ... For good people are just good, while bad people are bad in all sorts of ways." (Aristotle, *EN*II.6, 1106a, trans. Crisp)

[5] Total entropy of an isolated system can never decrease, is constant if and only if all processes are reversible, and systems will innately move to a state of maximum entropy.

## 6.1 Contribution

The study makes five contributions to knowledge. Firstly, the analysis of newspaper articles reveals the issues which concern the citizenry about megaprojects. All four projects are associated with the manufacturing sector, a sector about which people care deeply because of the role of such projects in regional economies, particularly through the creation of skilled jobs. Public opinion rises when projects perform well and falls when a project experiences uncertainty, delays, cost overruns, and technical problems. The issues raised and associated public reactions are largely consistent with the prevailing understanding of success and failure in project management. However, the inclusion of public opinion as a measure for project performance will reaffirm the place of democratic politics in megaprojects and offer some support to the arguments made by Willems and Van Dooren (2016) about '(re)politicizing' policy on and management of public projects.

Secondly, our research finds that public opinion expressed in the media is fragile during the good times and prone to pessimism, which can perhaps make the public a potential source of resistance to the 'optimism bias' of project promoters. This finding is not as context-specific as one might assume – Zhang et al. (2018) looked at sentiment in China as expressed on social media and found negative events to have a stronger and more persistent effect on sentiment than positive events. Our empirical context (UK) is markedly different, and we study articles published in newspapers, but we too find that public opinion is more likely to experience sustained periods of decline than rise.

Thirdly, a comparison of factors that affect public opinion across different projects suggests the presence of the Anna Karenina principle – factors which lead to a rise in public opinion are few in number and often common across projects and sectors, but factors which lead to a fall in public opinion are more numerous and specific to sectors and projects. Therefore, while we may be able to predict the reasons for positive public opinion, the reasons behind negative opinion could vary from one project to the next and differ across different sectors.

Fourthly, our research design shows us the public opinion trajectories for military and (civil) infrastructure megaprojects and makes a comparison not elsewhere fully explored in megaproject research. We note that the trajectories of projects can look alike across the two sectors, indicating that sentiment plots may be project-specific but not sector-specific. Additionally, while there are some military sector-specific issues that affect public opinion, we also find some common factors across the four projects.

Finally, our research makes a valuable methodological contribution by demonstrating the use of computer-based text analysis methods such as sentiment analysis to analyse large volumes of text data. Sentiment analysis of the kind we have conducted scores newspaper articles to facilitate temporal comparisons of

collective media sentiment. Sentiment scores make it possible to identify peaks and troughs as well as turning points of opinion over time. By zooming in on the newspaper articles published at such points, it is possible to understand the issues discussed and associate the issues with both positive and negative periods.

### 6.2 Further work

In this paper, newspaper articles have been exploited in a novel manner to understand the movement of public opinion over time. While the empirical context has been the UK which has a vibrant press culture, we think the methodology can be applied to study public opinion on megaprojects in other countries.

There are some exciting directions for taking this research further. Firstly, it will be worthwhile to look more closely at project actors. From the newspaper articles, we know 'how' megaprojects are discussed (the sentiment scores) and 'why' (the factors). It will be useful to add 'who' is talking about projects and referring to certain factors (local or global stakeholders, government or independent bodies, etc.). The actors themselves – citizen groups, civil society actors, politicians – may change over time, and an interesting question could focus on how such changes or internal dynamics interact with the bystander dynamics of wider public opinion[6].

Secondly, there is potential in comparing public opinion between military and civilian projects in greater depth than has been possible here. From this study, we know that the trajectory of public opinion across military and non-military sectors can look alike, but we cannot comment on the quality of public discourse and whether it differs between the two sectors.

Finally, we believe there is scope for improvement by increasing the accuracy of sentiment scores through machine learning and artificial intelligence. Our further work in this area is likely to adopt these methods as it allows extraction of greater meaning from textual data with speed and consistency.

## 7 Appendix

### 7.1 List of newspapers surveyed through Lexis News database

#### 7.1.1 National papers

1. Daily Record and Sunday Mail

[6] We thank one of our anonymous reviewers for making this suggestion.

2. Daily Star
3. The Daily Mail and Mail on Sunday
4. The Daily Telegraph
5. The European
6. The Express
7. The Guardian
8. The Independent
9. MailOnline
10. The Mirror (The Daily Mirror and The Sunday Mirror)
11. The News of the World
12. The Observer
13. The People
14. The Sun
15. The Sunday Express
16. The Sunday Telegraph
17. The Sunday Times
18. The Times

#### 7.1.2 Regional papers

1. Aberdeen Evening Express
2. Aberdeen Press and Journal
3. Bath Chronicle
4. Belfast News Letter
5. Birmingham Evening Mail
6. Birmingham Post
7. Bristol Post
8. Coventry Evening Telegraph
9. Coventry Newspapers

10. Daily Post (North Wales)
11. Derby Telegraph
12. East Anglian Daily Times
13. Eastern Daily Press
14. Evening Chronicle (Newcastle)
15. Evening Gazette
16. Evening News (Norwich)
17. Evening Star
18. Evening Times (Glasgow)
19. Exeter Express and Echo
20. Gloucestershire Echo
21. Grimsby Telegraph
22. Hull Daily Mail
23. Johnston Press plc
24. Leeds Weekly News
25. Leicester Mercury
26. Liverpool Echo
27. Manchester Evening News
28. Northcliffe Newspapers
29. Nottingham Post
30. Regional Independent Media
31. Scotsman
32. Scunthorpe Telegraph
33. South Wales Echo
34. South Wales Evening Post
35. Sports Argus
36. Stoke the Sentinel
37. Sunday Mercury

38. Sunderland Echo
39. The Citizen Gloucester
40. The Evening Standard (London)
41. The Herald (Glasgow)
42. The Northern Echo (Newsquest Regional Press)
43. The Plymouth Herald
44. The Sunday Herald (Glasgow)
45. The Western Mail
46. Torquay Herald Express
47. UK NewsQuest Regional Press
48. Wales on Sunday
49. Western Daily Press
50. Western Morning News
51. Yorkshire Post

## 7.2 Selection criteria for Table 3

In order to select periods as 'good' or 'high' public opinion (and conversely 'bad' or 'low' public opinion), some thresholds were used for sentiment score and number of articles in the month (Table 6). The minimum number of articles was calculated by dividing the total number of articles by the total number of months.

Table 6: Criteria for selecting months

| **For a month to be included in analysis:** | **Queen Elizabeth programme** | **Armoured Cavalry 2025** | **Thameslink** | **Intercity Express Programme** |
|---|---|---|---|---|
| Average sentiment score is above the upper quartile, or | 0.108 | 0.114 | 0.077 | 0.172 |
| Average sentiment score is below the lower quartile, and | 0.029 | -0.025 | -0.025 | 0.048 |
| Number of articles is at least ($n$) ... | 12 | 3 | 8 | 5 |

Based on the selection criteria in Table 6, the following number of months and articles were analysed for their content for each project:

Table 7: Details of content analysed for Table 3

| | **Queen Elizabeth programme** | **Armoured Cavalry 2025** | **Thameslink programme** | **Intercity Express Programme** |
|---|---|---|---|---|
| **No. of months with high public opinion** | 21 | 20 | 6 | 10 |
| **Total articles** | 615 | 80 | 61 | 107 |
| **No. of months with low public opinion** | 20 | 32 | 15 | 10 |
| **Total articles** | 541 | 159 | 241 | 77 |

## 7.3 Selection criteria for Table 5

Table 8: Criteria for selecting turning points

| | **QEC** | **Ajax** | **TP** | **IEP** |
|---|---|---|---|---|
| No. of times cusum rises | 44 | 49 | 33 | 36 |
| No. of times cusum falls | 44 | 49 | 33 | 35 |
| Min. no. of articles between turning points to qualify for analysis† $(4 \times n)$ | 48 | 9 | 32 | 20 |
| Turning points analysed (rise) | 9 | 7 | 1 | 8 |
| Avg no. of articles between turning points | 96.7 | 11.42 | 51 | 35.125 |
| Turning points analysed (fall) | 11 | 11 | 5 | 6 |
| Avg no. of articles between turning points | 99.9 | 21.45 | 143.2 | 39.67 |

†For Ajax, the threshold was lowered further because of the low number of articles in the dataset

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