Online stakeholder interactions in the early stage of a megaproject

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Abstract

The purpose of this paper is to examine the network structure of online stakeholder discussions in the planning stage of a UK public mega project, High Speed Rail. By providing new rail connections between London, Birmingham and Manchester, this project is highly complex as it is embedded in a network of stakeholder relationships that may support or oppose the project. Data drawn from Twitter was analyzed using Social Network Analysis and inductive analysis of user profiles and content. Findings indicate that the majority of online stakeholders oppose the project and form stable clusters. Larger clusters within this network may attempt to deploy power directly in the form of a manipulation strategy while smaller clusters may seek to ally themselves with more powerful groups, a pathway strategy. Overall, the methodology is a useful complement to existing methods and may provide real time insights into the complex, evolving discussions around mega projects.

INTRODUCTION

Mega projects, defined as projects that cost greater than 1 billion USD or 0.01% of GDP (Van Marrewijk et al. 2008), have only recently begun to attract significant attention from researchers (Hu, Chan, Le, & Jin, 2015). The most visible stream of this research examines the failure of mega projects to meet cost and benefit objectives (Flyvbjerg, 2014). Other work examines mega projects as organizational forms (Alderman & Ivory, 2007). along with specific aspects of mega project management such as scope management, site management (Rajendran & Gambatese, 2009) , and risk management(Krane, Rolstadås, & Olsson, 2010).

To date, however, the area of stakeholder engagement in mega projects has not been heavily examined. Projects establish unique social systems consisting of interactions among stakeholders (Brookes, Morton, Dainty, & Burns, 2006) to jointly negotiate objectives, develop processes and outcomes (Olander (2006). Project teams responsible for mega projects may face difficulties managing these social systems as they encompass a large heterogeneous group of stakeholders who may support or oppose the project (Wideman, 1990). In the infrastructural domain, megaprojects are often a collection of initiatives under a single framework (Campos & de Rus, 2009) that may interact with existing infrastructure and cross regional or national boundaries. Individual components may therefore be supported or opposed by differing groups of stakeholders depending on function or location. For governments, the primary sponsor of infrastructural mega projects, this creates a complex scenario that is difficult to manage as they face a number of competing interests from the political, social, cultural and technological domains (Flyvbjerg, 2014).

It is therefore necessary to explore the nature of stakeholder engagement in public mega projects.

Existing stakeholder engagement research suggests that relevant stakeholders should be appropriately informed and may provide input at the appropriate phase in the project (Friend & Hickling, 2005). This claim rests on the assumption that stakeholders have interests that may be affected by project realization activities (Rowley & Moldoveanu, 2003) and will act if these interests are negatively affected. This view promotes a somewhat idealized and simplistic perspective on stakeholders (Freeman & Evan, 1990). These individuals and organizations are embedded in a wider network (Garriga, 2009) and may have relationships with both the project organization and each other resulting in a complex scenario of competing and co operating stakeholder interests.

As projects have increased in scale and complexity, the range of stakeholders involved has seen a commensurate increase. Mega projects, in particular, have a wide range of possible stakeholders as they affect and are affected by multiple communities. To date, using conventional research methods, it has been difficult to develop insights that meet both internal and external validity requirements. Traditional qualitative methods can generate deep insights, but have been challenged as not being representative of all possible stakeholders (Margerum, 2002). In contrast, quantitative methods can claim statistical validity, but may overlook particular populations and may be weak at examining complex, evolving issues. However, recent advances in technology have provided an opportunity to examine stakeholder interactions about a particular issue at a scale that was not possible earlier. Specifically, the development of social media has encouraged individuals to share content, opinions and impressions about topics of

interest online. This trend has attracted interest from both academia and industry seeking to develop new insights about the nature of stakeholder engagement.

In this paper, we wish to examine the network of stakeholder discussions formed around a mega project in its early stage of development, using data drawn from social media . Data was obtained from Twitter, a social network, of 250,253 tweets that contained one year of interactions (November 5th 2013 to November 5th 2014) around an infrastructural mega project in the UK, High Speed Rail 2. These discussions were modelled as a network community of interest and analyzed at 3 month intervals to identify hubs which were then classified using inductive content analysis of twitter profiles and tweets by the type of content shared.

The findings indicate that at the macro level, most online users oppose the project and stakeholders form a distinct online community of interest that comprises of stable hubs of a few key users. Within these hubs there is some variation of network structure. Larger hubs were coalitions of interests while smaller hubs are based around a single issue promoted by a few individuals seeking to influence a more powerful stakeholder. These findings suggest that planners can use this approach to understand both the overall stakeholder network along with the internal configuration of stakeholder groups and support the planning of future stakeholder management strategies, improving mega project delivery.

LITERATURE REVIEW

Mega Projects sit at the nexus of technology, engineering, politics and economics and influences and is influenced by all of these factors (Giezen, 2013). Further, by changing the configuration of the built environment, infrastructural mega projects impact the environmental, social and cultural

components of the countries in which they are delivered. Due to the number of domains in which these projects are embedded they are inherently complex with high levels of structural, technical, directional and temporal complexity(Remington & Pollack, 2007). As a result, they pose a significant management challenge to the focal organization and may also face external challenges from stakeholders from each of these domains.

Previous research on Mega Projects have highlighted this complexity (de Bruijn & Leijten, 2008), identifying the challenges faced in delivering individual components (Van Der Veen & Korthals Altes, 2012) as well as the interconnections between components (Koppenjan et al. 2011) . A stream of this research focuses on the failures of mega projects to achieve cost, time and scope objectives (Priemus, 2010) along with the opposition of public stakeholders to these initiatives (Jia et al. 2011). Recent work has attributed these failures to the uncertainty experienced during planning and delivery (Flyvbjerg, 2014) and specifically to the cognitive limitations of planning teams to perceive and manage these uncertainties (Flyvberg & Molloy, 2011). Others have suggested that due to the number of interactions between stakeholders, merely scaling traditional governance mechanisms is inadequate to the task of managing complex mega projects (Sanderson, 2012). The next section provides an overview of stakeholder management research in the PM Domain.

Stakeholder Management

Stakeholders have been defined in three main ways in PM Research (Littau, Jujagiri, & Adlbrecht, 2010): 1) As entities that can influence or is influenced by the project (Freeman, 2010) or 2) As entities who have a stake from the project's outcome or 3) A combination of the first two. Researchers in this domain seek to identify stakeholders (Pinto, 1998) as this forms the

basis of developing research insights or planning interventions. Once identified, stakeholders are then characterised into possible roles such as client, customer, based on their stated interests (Cleland, 1999) In public projects, these interests can be myriad ranging from improving country reputation to minimizing environmental impact (Li, Ng, & Skitmore, 2012) . Stakeholder management can also be distinguished between the management of stakeholders and the management for stakeholders approaches (Freeman, Harrison, & Wicks, 2007). The first perspective takes a quasi economic approach to view stakeholders as direct or indirect sources of resources (Eskerod & Huemann, 2013). The focal organization should therefore seek to control stakeholders with the highest power to provide or withhold resources (Savage, Nix, Whitehead, & Blair, 1991). The management for stakeholders perspective takes a relational approach to recognize the needs, rights and legitimacy of stakeholders (Julian et al., 2008). It suggest that stakeholders without resources considered valuable by the focal organizations can still hold interests in the project that need to be considered. It is therefore important to understand not just stakeholder characteristics, but the nature of relationships between stakeholders and the effect of these relationships.

Stakeholder Characteristics

Research in this area is built on the classification schemes created to classify stakeholders as a precursor to understanding possible actions or interactions. These classification approaches are based on stakeholder attributes (Rowley & Moldoveanu, 2003) such as primary and secondary (Carroll, 1979), strategic and moral (Goodpaster, 1991) and voluntary and involuntary (Clarkson, 1995). These classification schemes, while useful, may promote a rational explanation of stakeholders that assume defined economic motives for their actions. Further, research has

indicated that even when stakeholders may be negatively affected by projects and have the power to act, they may not mobilize to secure their interests (Clarkson, 1995). Work suggests that development of an identity via group process (Klandermans, 1984) is a prerequisite for action as it enables stakeholders to articulate shared affected interests and commit to preferred outcomes (Ashforth, Harrison, & Corley, 2008). Once established, groups may strengthen bonds between members via activities and over time, develop protocols for membership. A sufficiently established group with committed members may engage in actions that are not necessarily rational in defense of members or identity (Klandermans, 1984), which can make them to an extent, unpredictable, in contrast to the classification schemes identified earlier. It is therefore necessary to examine the relationships among and between stakeholders as this may provide some insight into the nature of possible actions that they may take.

Stakeholder Relationships

Social exchange theory suggests that stakeholders will engage with a given initiative depending on their perceptions of expected impact (Bagozzi, 1975). This theory suggests that interactions between actors such as stakeholders enable the transfer or exchange of value, for example information. Stakeholder relationship structure researchers seek to understand the nature of inter and intra group relationships between and among stakeholders (Mok et al. 2014) as these relationships may provide an explanation for the nature of influence that such groups can exert. This perspective adopts methods and metrics adopted from graph theory that include the degree of dependence, the position within the network of a particular stakeholder or the pattern of information flow between stakeholders (Frooman & Murrell, 2005). Research in this area has sought to identify the types of stakeholders both within the project team and outside it, such as

clients, end users and the public (Rowlinson & Cheung, 2008). This theme recognizes the interdependence of stakeholders (Pryke, 2004) as either simple formal interactions between pairs of stakeholders such as client- customer or as a wider range of formal and informal interactions (Yang et al. 2011) . In the construction PM domain, identifying and managing relationships with and among stakeholders is considered key to project success (Olander & Landin, 2005). However, very few studies have attempted to apply this approach in practice to examine stakeholders.

This research also incorporates the effect of the environment and social context around projects. Incorporated in this work is research that seeks to identify hidden connections that may influence the outcome of the project (Missonier & Loufrani-Fedida, 2014). Specifically, with government initiated mega projects, sectors of the public can deploy pressure indirectly to more powerful stakeholders such as political parties to encourage them to change their positions (Olander & Landin, 2008).

Impact of Stakeholder Relationships

The intensity of connections among stakeholder can indicate complementary and competing interactions. Once identity is established, stakeholders may seek to increase or decrease their degree of commitment to the overall initiative, regardless of its' current status (Beringer, Jonas, & Georg Gemünden, 2012). As groups with a coherent identity and an awareness of the overall structure of relationships, stakeholders can apply influencing strategies that impact project activities and outcomes in the form of manipulation strategies (the nature of influence exerted on the focal firm) and pathway strategies (the stakeholder group who exerts influence).

Manipulation strategies can take the form of coercion and compromise strategies (Frooman & Murrell, 2003) that control the flow of resources between and among stakeholders. Coercive strategies exert influence via the threat by stakeholders to increase project costs or reduce possible project benefits. Compromise strategies attempt to do the opposite and offer increased benefits or reduced costs should the firm agree to the requirements of stakeholders. An example of this approach are withholding and usage strategies (Frooman, 1999) or threat and cooperation strategies (Savage et al., 1991). Finally, pathway strategies can apply direct or indirect forms of manipulation using an intermediary.

Aaltonen and Sivonen (2009) went beyond the opposing approaches of competition-cooperation to present a continuum of strategies ranging from Adaptation to Influence that can impact projects. In Adaptation, organizations change activities meet both the demands and regulations of external stakeholders in order to achieve project objectives. Compromising approaches require the focal organization to establish relationships with stakeholders and offer incentives in an attempt to resolve possible disputes. An avoidance strategy attempts to do the opposite by distancing the focal organization from stakeholders. Dismissal strategies deliberately ignore stakeholder demands and regulations. Finally influence strategies actively engage with stakeholders to adjust demands and regulations. These approaches however, assume that relationships are merely simple dyads. In practice, stakeholders may be linked to each other and this overall network may enable or constrain particular actions, changing the nature of impact that can occur.

Neville and Menguc (2006) incorporated some of these concepts to look at a multiplicity of stakeholder relationships in an overall network including competitive, complementary and cooperative. Differing stakeholder groups may make similar claims on the focal organization which can exert a stronger force collectively on the resources or outcomes of the project. Groups with low power may cooperate with more powerful stakeholder to increase their influence. In the context of large scale projects, these network combinations may be deployed in a number of resource and relational strategies (Aaltonen & Kujala, 2010).

Direct strategies attempt to control access to resources controlled by the stakeholder or impose conditions before these resources can be used. Indirect strategies may be used by less influential stakeholders who attempt to cooperate or form a relationship with a more powerful stakeholder to control access or impose conditions on resources. Resource building strategies attempt to gain control of resources required by the project. Coalition strategies attempt to control relationships by obtaining a central position in the overall network from which they can manage information interactions. Conflict escalation strategies stakeholders attempt increase their power by forming coalitions with groups who have complementary claims. They may also seek to recruit others to their cause by escalating the conflict, thereby attracting attention from powerful, external stakeholders. Finally stakeholders may seek public visibility and support for their claims using media.

As the focal stakeholder in public projects (Ika, Diallo, & Thuillier, 2012), governments are frequently a target of stakeholder action. Mega projects, in particular can take a long period of time and stakeholders may adopt differing strategies over the life of the project (Aaltonen & Sivonen, 2009). Stakeholders can engage in resource, reputation, conflict and communication based strategies to directly or indirectly the government or public organization charged with delivering the project (Kloppenborg, Tesch, & Manolis, 2014). From the government's perspective, they can seek to adapt, negotiate or reject stakeholder influence (Aaltonen, Kujala, Lehtonen, & Ruuska, 2010) . However, these strategies presume a relationship dyad with simplistic, deterministic action-response interactions rather than the network of interactions that characterize mega projects. As discussed earlier, stakeholders may adopt more sophisticated relational strategies to control resources, impose conditions or even to control the entire network. This complexity of potential approaches suggests that researchers need to understand the overall set of network connections to gain insight into potential stakeholder strategies in a mega project (Cook, Emerson, Gillmore, & Yamagishi, 1983).

Limitations of Existing Approaches

While the early conceptualizations of project stakeholders lent themselves to a deductive approach, as described earlier, mega projects possess a scale and complexity that make them difficult to evaluate (Diallo & Thuillier, 2005). A key challenge to researchers is that public communities are not monolithic, even though they can exist within a common geographic region (Esteves, Franks, & Vanclay, 2012) and contain can many subgroups. Since some project information is tacit and difficult to express in unambiguous terms to all stakeholders, different

subgroups may interpret information in their own terms, which can vary(Eskerod & Vaagaasar, 2014). As a result, various subgroups within the community may hold entirely different views of positive or negative mega project impacts. This raises challenges for researchers, especially when it comes to selection of appropriate research methodologies (Kidder & Fine, 1987).

Qualitative approaches enable deep exploration of the phenomenon and can build a holistic view that incorporates the views of various subgroups. However, they are resource intensive and as a result, the analysis is based on a relatively small subset of the community. The validity of these findings can therefore be called into question by project stakeholders who do not agree with the insights generated from such an approach (Reed et al., 2009). Quantitative approaches such as surveys may be able to demonstrate statistical validity (Tang & Shen, 2013). However, response rates can be relatively low and for some populations, such as the elderly, they may not accurately evaluate stakeholder perspectives (Gursoy, Kim, & Uysal, 2004). Manual content analysis of media reports can overcome some of these limitations but may be expensive and relatively slow (Dai, Bao, & Chen, 2010). However, recent developments in technology has made the collection and analysis of real time public discussions possible at a relatively low cost (Kwak, Lee, Park, & Moon, 2010). This data can be applied to evaluate the nature of stakeholder engagement with Mega Projects.

Using Social Media Communities of Interest to understand Stakeholder Engagement in Mega Projects

As previous research has indicated that mega projects spawn complex, shifting coalitions of stakeholders who are difficult to define and manage. In order to understand its nature, top down deductive methods may not be sufficient. While inductive methods can provide a deep understanding of the topic, it is difficult to apply them to the volume of stakeholders involved in mega projects. The recent growth of online communications has the potential to provide deep insights into stakeholders' perceptions of Mega Projects. Further, due to the number of individuals using these platforms, it is possible to compare a number of perspectives on the issue (Zaglia, 2013).

Firms, public and private, have attempted to create or encourage online discussions using specific platforms (Wirtz et al., 2013). These network communities have been defined by the structured social relationships created by stakeholders, customers or admirers (Muniz Jr & O'guinn, 2001). These communities are generally online (Muniz & O'Guinn, 2001) and may be small (Bagozzi & Dholakia, 2006) or large (Adjei, Noble, & Noble, 2010). Members may also share distinct values, behaviors patterns of language and signals (Muniz & O'Guinn, 2001). For this research, communities of interest (Casaló, Flavián, & Guinaliu, 2008) may provide an opportunity for understanding interactions about a developing Mega Project.

Communities of interest combine stakeholders with shared interests (Brown & Duguid, 2001) in a particular domain (Rothaermel & Sugiyama, 2001). In these communities, members learn and share knowledge about a given area (Obst, Zinkiewicz, & Smith, 2002). Larger communities can positively influence the amount of information shared and increase the benefit that individuals will gain from membership (Harwood & Garry, 2010). Similarly, group heterogeneity increases the amount information shared and the resulting benefits to members (Oliver, Marwell, & Teixeira, 1985). For Project Management research, it suggests that the scale and the composition

of the online community that discuss their opinions can shape perceptions by non visitors and hence influence public support or opposition to mega projects.

Social Network Analysis

To evaluate the nature of interactions and discussions of stakeholders in online communities of practice, Social network analysis (SNA) may be an appropriate approach. The approach has been proposed over a decade ago (Rowley, 1997) and other researchers have considered it to be a means to understand stakeholders (Scott & Lane, 2000) . In Social Network Analysis, (SNA) the focus of analysis is interactions between entities such as individuals, groups, communities, organizations or countries (Scott, 1988). Overall these interactions can be modelled as social networks that can transmit information or distribute resource between entities or coordinate activities (Latour, 2005). In SNA, these relationships or interactions are conceptualized as nodes and connectors (Hogan, Carrasco, & Wellman, 2007). Nodes represent entities while connectors are ties between nodes (Borgatti, Mehra, Brass, & Labianca, 2009).

While the study of these networks began in the 1800s, recent advances in information technology have made it easier to collect and analyse social network data. The advantages of this approach in Project Management is that it can examine the nature, extent and interactions between large numbers of stakeholders (Mohan & Paila, 2013). It can therefore be used to identify key individuals and groups within communities of interest which can then form the basis of future stakeholder management strategies.

SNA has been previously applied to understand stakeholder interactions in project teams (Mead, 2001) and larger networks around small construction (Pryke, 2004) and infrastructural (Lienert,

Schnetzer, & Ingold, 2013) projects. However, in those cases, data was collected and analysed manually. The networks were therefore based on a small sample which may result that the perspectives of some stakeholders were not captured. A notable exception is Jepsen 2013's work that was based on a corpus of emails obtained from a complex engineering project (Jepsen, 2013). It identified that Project Managers are able to maintain a central position within projects by establishing an information sharing network encompassing by intra and inter organizational actors.

Using Communities of Interest hosted on Social Media to understand Mega Projects

Social media has been defined as internet based applications that agglomerate media impressions created by individuals informed by relevant experiences (Xiang & Gretzel, 2010). They have superseded earlier platforms such as blogs for hosting online communities of interest (Kietzmann, Silvestre, McCarthy, & Pitt, 2012). For this research, the Community of Interest (COI) created on Twitter.com around a mega project (HS2) was analysed as this platform has distinct strengths for academic research (Hardin, 2014). Twitter users do not need to have direct relationships to view and interact with content (Marwick & Boyd, 2010) and COIs hosted on Twitter therefore engage a wider range of individuals than would be available in other social networks (Kwak et al 2010). This supports research in Mega Projects as it is possible for researchers to obtain a range of perspectives (Williams et al. 2015) on a given issue. A larger sample of public discussions enables analysis of subgroups within a given population, an advantage for infrastructural Mega Project research they cross several communities who may each have differing perspectives on an issue.

Research Questions

This research has been designed to explore the nature of stakeholder interactions on social media. Network position as indicated by centrality can indicate the degree of control a given actor has over stakeholders. Further, like minded stakeholders may join in clusters in which they communicate more with each other rather than with non members (R. J. Yang, Wang, & Jin, 2014).

Previous research on online networks suggests that relationships are aggregated into hubs or clusters of interactions within the network (Ma & Agarwal, 2007; Schultze & Orlikowski, 2010) where a few nodes attract most of the ties (Huberman, Romero, & Wu, 2008). While distinct hubs of this nature have been identified in previous research outside of project management (Himelboim, Smith, & Shneiderman, 2013), it is still not known if similar patterns exist when evaluating mega projects. The existence of these hubs will indicate that at a macro level, the network structure of a COI of mega project stakeholders on Twitter forms clusters or sub structures based on interest or other designations. It will therefore possible to conduct analyses based on the interests and actions of online stakeholders of the mega project, rather than working with an a priori designation that may not be appropriate for the initiative under study. The first research question is therefore:

RQ1: Does the Mega Project online Community of Interest form distinct stakeholder clusters?

Social exchange theory postulates that influential users are at the core of these clusters(Newman, 2001) and members of the social network will pay attention to their information more than

others within the cluster or other clusters. An understanding of the micro network structure within these hubs can provide additional insight into the nature of stakeholder influence in the COI network on twitter (Carrington, Scott, & Wasserman, 2005). A highly centralized network has the majority of linkages held by a small number of individuals while a less centralized one has a broader distribution. Centralized networks are valuable for forming groups and raising awareness of issues but are poor for long term collective action while decentralized structures have a diverse set of relationships that provides the resilience and the breadth of knowledge required for sustained action (Bodin & Crona, 2009) For this research, a decentralised structure indicates that the issue represented by the cluster may be sustained for the life of the mega project while centralised structures may indicate otherwise. The second research question is therefore

RQ2: What is the structure of influential users in stakeholder clusters?

While social media platforms enable peer-to-peer connections by individuals, many dominant members of Twitter are not interested members of the public, but media industry professionals or politicians with vested interests (Graeff, Stempeck, & Zuckerman, 2014). It is therefore necessary to understand the characteristics of actors with a high degree of centrality in the overall network to identify if the mega project discussions are developed and sustained by individual residents (Wu, Hofman, Mason, & Watts, 2011) or are a part of a larger framing by commercial or activist organizations (Loader, Vromen, & Xenos, 2014). Since users with a high degree of centrality exert a high degree of influence on information flow in the network, the presence of the latter may indicate that the online discussions are merely an extension of existing

lobbying efforts. If however, users with a high degree of centrality are members of the public, it could suggest that a peer to peer COI between public stakeholders was developed:

RQ3 What are the characteristics of critical stakeholders in these clusters?

While research has been conducted into the nature stakeholder coalitions in project management, this research has generally taken a cross sectional approach. Further, collection and analysis of this information has been done manually, limiting the scale of the network that could be analyzed. COIs hosted on Twitter provides us with an opportunity to collect data on the entire network over time; enabling an understanding of how the macro and micro network structure changes. It is now possible to observe and analyze stakeholder interactions at multiple points over time, enabling the development of a dynamic, processual knowledge of how coalitions evolve over time (Chinowsky & Taylor, 2012). In this way, it may be possible to identify the nature of influence that groups could deploy over the project. Over time, stakeholders may move from communicating in small groups or clusters, to create larger groups with a united identity that attempt to directly control the flow of resources or a direct manipulation strategy. Alternatively, groups may form coalitions to influence more powerful stakeholders, a pathway strategy. The research question resulting from this discussion is therefore:

RQ4: How do stakeholder groups evolve over time?

Research Setting

In order to tackle the above presented research question, a study of the Twitter.com conversations of a proposed mega project in the UK, High Speed Rail 2 (www.hs2.org.uk) . The project is designed to reduce transport times between London and the north of England via the West Midlands through providing a new railway link and associated infrastructure.

The project was designed to meet growing demand for long distance rail travel by linking 8 cities comprising of 20% of the UK's population. Further, the project intends to reduce environmental emissions and congestion on UK roads by enabling higher utilization of existing rail lines. The official approval for the project was granted in Jan 2012 and HS2 will be built in two phases starting in 2017 and ending in 2026 at an estimated cost of 42.6 billion (https://www.gov.uk/government/policies/developing-a-new-high-speed-rail-network). The first phase links London and Birmingham while the second phase comprises of two lines to Manchester and Leeds (Figure 1). Construction of the first phase is scheduled to begin in 2017 and the second phase in 2025. While the project is designed to deliver economic benefits in the form of faster transport and employment, the project is not without its critics. These rail lines will pass through a number of local government constituencies and groups in those areas have opposed the project on environmental grounds. A national group StopHS2 in emerged in 2011(StopHS2.org), who challenge the proposed economic benefits of the project, suggesting that the project will act to drain resources from the north, not catalyse it. We examined the project from November 2013 to November 2014 in which these major developments occurred:

- November 2013: A government bill authorizing construction of the line along with an environmental impact statement was deposited in the UK parliament.
- January 2014: Deadline to respond to consultation on second phase of the project

- March 2014. UK MPs voted to provide approval in principle for the project.
- April 2014 . Consultation period began where a committee of MPs reviewed requests for changes to the project from affected stakeholder groups.

  An examination of the twitter conversations around the project reveals that there has been significant growth over time. An analysis using the service Sifter (Sifter.texifier.com) reveals that in 2010 there were 100 tweets under the hashtag, 2011, 29,000, 2012, 78,000, 2013, 235,000 tweets and 2014, 251,000 tweets. This growth shows the increasing level of interest in the project as activities progress.

Methodology

Research into Mega Project Stakeholders is highly complex as perspectives at the macro (groups) and micro level interact (Baloglu & McCleary, 1999). The research design incorporated a longitudinal perspective (Pettigrew, 1997) to examine how these stakeholders engaged over time (McLeod, Doolin, & MacDonell, 2012). Figure 1 provides an overview of process:

INSERT Figure 2 Overview of the Research Process

Step 1: Identification of Community of Interest

To identify the COI, a complete archive of the term #HS2 was collected for period of one year using the service TweetArchivist, from November 5th 2013 to November 5th 2014 numbering 250,253 tweets. This service was selected as it has a limit of 16,000 tweets per day, more than

sufficient for the requirements of this research. Hashtag are used on Twitter to identify postings on twitter and form a useful way of curating discussions on a particular issue (Gechev, 2012). In this way, a complete network, rather than a sample, could be archived supporting later analysis. The collection of tweets were then filtered to identify the underlying information relationships between users in the form of 'Retweets'. While twitter has a number of possible connections such as lists, followers or following relationships, these do not necessarily represent active engagement with a given topic(Clavio & Walsh, 2013). Retweets are a deliberate response to another user's posting (Boyd, Golder, & Lotan, 2010) and as such, they represent active engagement of twitter users (Kwak et al., 2010). After filtering,144,462 retweets remained for analysis.

Step 2: Identification of Clusters

The retweets were then divided by 3 month intervals and modelled as four directed graphs using the social network analysis software Node XL. While the retweets under a hash tag indicate a COI, groups within that community may have alternate perspectives on particular issues due to demographic or other characteristics (Sparrowe, Liden, Wayne, & Kraimer, 2001). These clusters are identified as subgroups using the modularity statistic defined by nodes which have a greater degree of connectivity with each other than others (Carrington et al., 2005) hubs using the Clauset Newman-Moore clustering algorithm, selected for its ability to analyze efficiently identify subgroups in large network data sets (Clauset, Newman, & Moore, 2004). In the modularity statistic of Clauset et al (2004) 0.4 is a sufficient metric for identifying clusters and beyond 0.6, clusters do not exhibit further meaningful distinctiveness. This research will therefore use 0.4 as a basis for accepting that meaningful clusters exist and 0.6 to indicate a high degree of clustering.

Step 3: Evaluation of Subgroup Structure

Once the existence of clusters was confirmed, they were then ranked by size or the number of users assigned to each. The largest clusters in each subgroup were analysed in detail for subgroup structure using the Betweenness centrality measure. This measure indicates how many linkages a given user has with other in the network and is a measure of the importance of the user (Dugué & Perez, 2014). The proportion of users with above average betweenness centrality was used to categorize the cluster as centralized or decentralized.

Step 4: Identify Key individuals in hubs

After the subgroup structure was identified, a qualitative content analysis of key user profile descriptions on twitter and tweets was performed to provide some perspective of their HS2 discussions. Content analysis has been heavily used in research as it is a flexible approach for understanding text based discussions. As this research is exploratory, an emergent qualitative content analysis approach (Potter & Levine-Donnerstein, 1999) was deployed.

An explicit coding framework was not used since we wished to obtain a broad understanding of the twitter discussions and profile information. Since twitter content frequently contains abbreviations, contractions and image representation of concepts (Lipizzi, Iandoli, & Ramirez Marquez, 2015), an a prori coding framework may have limited the amount of insight that could have been generated from the text.

Under these conditions, an inductive approach is more appropriate as it enables flexibility in approach and interpretation (Leech & Onwuegbuzie, 2007). The profiles of the top twenty users within each cluster by degree centrality were obtained from Twitter.com and analysed to identify occupation, affiliation and location of these users. This information was used to create

an initial categorization of the stakeholder. This initial classification was confirmed by a review of tweets from the user randomly selected from within the cluster. These tweets were analysed to confirm classification of stakeholder groups. Appendix 1 provides an example of the analysis. This information was used to classify the group structure for all four COIs.

RESULTS AND ANALYSIS

Table 1 presents an overview of the four networks modelled by quarter from November 4th 2013 to November 4th 2014 . The largest network contained interactions between 9408 actors (Quarter 1) and the smallest 6233 (Quarter 3). All networks had a significant connected component that encompassed most of the verticies (>80%). Finally, the modularity statistic indicates a strong degree of modularity within all of the networks have exceeded the minimum threshold of 0.4. This factor is also persistent across all four quarters. This indicates that social media conversations form separate clusters that are distinct and can be used for later analysis.

INSERT TABLE 1: OVERVIEW OF FOUR NETWORKS

For each network, the cluster structure was reviewed. The top 5 clusters were selected for later analysis as they contained a majority of accounts and interactions (Table 2).

INSERT TABLE 2 HERE

For example in Network 1, the top 5 clusters accounted for 6043 of 9408 accounts. Further, the top 2 consisted of 4177 accounts, over 40% of the overall network. Social exchange theory suggests that influential individuals tend to have higher than average betweenness centrality.

Within each of these clusters, the number of accounts that have above average betweenness centrality were identified and used to identify relatively centralized clusters with few influential users vs decentralized clusters with many influential users. Figure 2 presents an example based on network 1. Clusters demonstrated 8-10% of accounts with above average centrality with the exception of cluster 4 which had a 4% of accounts with above average centrality.

INSERT FIGURE 3 HERE

Stakeholder characteristics were evaluated by a content analysis of the twitter profiles and tweets of the top 20 accounts in each cluster , defined as accounts with a high degree centrality in each network. An example of the classification is presented in Table 4. The following was observed in each network:

1) Group 1 were anti HS2 activists whose accounts were used to tweet information and opinions opposing the project for primarily cost reasons
2) Group 2 were a combination of official government forces on HS2 and pro HS2 activists who presented information on the benefits of the project
3) Group 3 were a combination of anti HS2 accounts who opposed the project on environmental and grounds
4) Group 4 were a number of activists from a political party UKIP, who shared information against the project and their rationale for cancelling the project

5) Group 5 were activists who were opposed to the project as the funding could be used for a better purpose such as ,upgrading existing rail networks or high speed broadband in rural areas.

Table 1 ,2 and 3 shows that at the groups showed a good degree of separation at the onset and over time became more distinct. Modularity increased from .49 to .59 and the degree of group interconnections reduced. Finally, the key accounts classified by betweenness centrality remained relatively stable, X% of top ten accounts were still there one year later. Overall, this indicates that groups did not change significantly over the year of existence.

DISCUSSION AND CONCLUSION

The findings of this research makes a number of academic contributions to the Mega Project literature. It is the first illustration of the dynamics of stakeholder engagement using SNA of narratives taken from social media, an approach which has not been applied in Project Management. It extends the research of Missonier and Loufrani-Fedida (2014) to provide empirical validation of stakeholder interactions.

RQ1: Does the Mega Project online COI form distinct stakeholder clusters?

The findings indicate that HS2 tweeters formed coherent and distinct groups on twitter. Further, these groups were stable and showed an increase in stability over time. These finding echo earlier research in marketing and politics that online COIs form distinct groups (Bozdag et al 2014). While earlier views of the internet assumed that exposure to a wide range of information would ensure robust debate and participation by a greater number of stakeholders (Wellman et

al., 1996), individuals purposely filter their information sources to those that support their pre existing beliefs and interests(Gibson & McAllister, 2014).

Online groups will therefore be composed of clusters of individuals who share similar interests and will not change them over time. This property may be of value to researchers seeking to understand online stakeholders as coherent groups enable the visualization of previously hidden and theorised connections among stakeholders. In this way, it is now possible to gain additional insights into stakeholder interests and the possible approach to deploying power. For example larger clusters may attempt to deploy power directly in the form of a manipulation strategy while smaller clusters may seek to ally themselves with more powerful groups, a pathway strategy. This is a useful complement to existing qualitative and quantitative analytical approaches as it enables quantification and visualization of the interactions overall network. This enables mega project researchers and practitioners to design strategies based on a holistic knowledge of both interests and the configuration of relationships.

RQ2: What is the structure of influential users in stakeholder clusters?

Within each COI, there were similar group structures. Groups 1-3 and 5 were relatively decentralized with 10% of actors having higher than average betweenness centrality while Group 4 had a higher degree of centralization. For the earlier groups, a relatively decentralized structure suggests that power is distributed in those clusters. Stakeholders may therefore consult others within the group before attempting to engage in stakeholder action. For the latter, a centralized structure suggests that the lead individual may drive initiatives. This illustration of network structures within clusters is an extension to existing theory. Current work has identified inter group interactions that may drive particular stakeholder strategies. However, little work has

been directed to understand intra group network structures and the possible influence of these structures on stakeholder action. This work suggests that groups may vary in their own internal network configuration and these configurations may influence the approach to managing resources, activities or relationships. Since little research has examined the network structure of subgroups within an overall stakeholder network, this finding may be a useful insight for mega project research. It suggests that the existing multiplicity of network actions by stakeholders can be extended from inter group interaction to intra group interactions. Groups may undergo a distinct set of coordination and identity development process before emerging as a coherent cluster that engages in stakeholder interactions. Additional research in this area may be useful to identify additional modes by which stakeholders can exert influence in projects.

RQ3 What are the characteristics of critical stakeholders in these clusters?

An examination of the twitter profiles and tweet content showed that both support and opposition exhibited varying perspectives. Supporters for the project touted the benefits and sought to extend the project. Opposition to the project had cost, ideological (environmental) and political reasons. While the supporters attempted to defend the project on it's own terms and benefits, opposing stakeholders attempted to link to a larger cause to engage or influence more potentially powerful stakeholders such as environmental or political groups to provide support. This supports previous research on conflict in mega projects as work suggests that benefits accrue nationally, but costs, and hence opposition can occur locally(Gibson & McAllister, 2014). In an attempt to exert more influence on the outcome of the project, this opposition is seeking to increase the influence of their claim by attempting to appeal to more power stakeholders. This conflict escalation strategy can attract the attention of more powerful stakeholders who can influence the legislative framework of HS2 that was then under discussion during the period of

study (2013-2014). Ironically, an attempt to appease these very different stakeholders will result in the very maladaptation that plague mega projects (Flyvbjerg, 2009).

RQ4: How do stakeholder groups evolve over time?

Further, the stability of groups in online COIs over a year indicates that users engaged in these conversations have strengthened their intra cluster relationships, suggesting the development of a coherent identity. As a result, they can now engage in sustained action and can be resistant to information that does not match their pre existing beliefs. Since most of these stakeholders are against the projects, this indicates that the project team will need to consider alternate approaches to explaining benefits of HS2 before construction or face opposition. However, since there were a relatively few number of hubs, it suggests that a targeted strategy for communicating may be able to create an open dialogue between participants.

Overall, the methodology is a useful complement to other approaches to understanding stakeholders. For PM research, the findings indicate that data from social networks such as Twitter can be used to understand stakeholders as they form coherent groups for analysis. The SNA approach can enable the development of exploratory insights as it is possible to understand emergent patterns of interactions within the dataset.

The use of an online COI approach enables low cost, rapid analysis of current narratives. Existing methods force stakeholders to choose between low cost variable or expensive process approaches. The former utilizes a series of predefined measures that are applied to evaluate Mega Project elements using quantitative approaches to identify the presence and quantum of impacts. The latter allows deep exploration of attitudes and relationships over time and can

provide deeper insights. Use of social media data combined with existing approaches can build an overall understanding of mega project stakeholders that integrates interests, interactions and characteristics which can form a stronger basis for planning management strategies.

Further, data can be collected before, during and after the Mega Project, not just at fixed points, facilitating a longitudinal analysis. Since the number of individuals posting on social media about a mega project is high, providing a broad insight into a range of stakeholder perspectives. The approach also limits the effects of researcher biases as conversations from social networks are conducted without the influence or encouragement of researchers. Finally unlike existing qualitative and quantitative methods, data collection and analysis is done using commonly available software tools. This increased access to the data and analysis tools align with the current trend for improved access to public data. Opening the research process also enables Mega Project organizers to leverage a diverse community of interested personnel to improve data analysis. Finally, over time, these datasets help build an evidence based approach around Mega Project evaluation that links theory and practices. Data from a number of Projects can be integrated and analyzed to build valid measures of impact that are derived from stakeholder discourse.

While twitter is an open network, it does face limitations as it does not have the broad demographic reach of Facebook. However, future work can repeat this study on other social networks to see if similar network structures and topic interests exist. Further, while the patterns observed in the topic hashtag were stable over the period of study, it would be interesting to see how they change over the life of the project. Finally, Twitter text content is a challenge to analyze and interpret since the platform limits postings to 140 characters (Dann, 2010). Users therefore deploy a number of non verbal tools such as text based images or emoji along with

links to sources with additional data. By combining tweet content with profile data, the research was able to classify clusters. However, future research repeated on platform without those limitations may be able to perform more sophisticated quantitative and qualitative content analysis that can provide insights that may not be obtained from twitter.

FIGURE 1: HS2 ROUTE

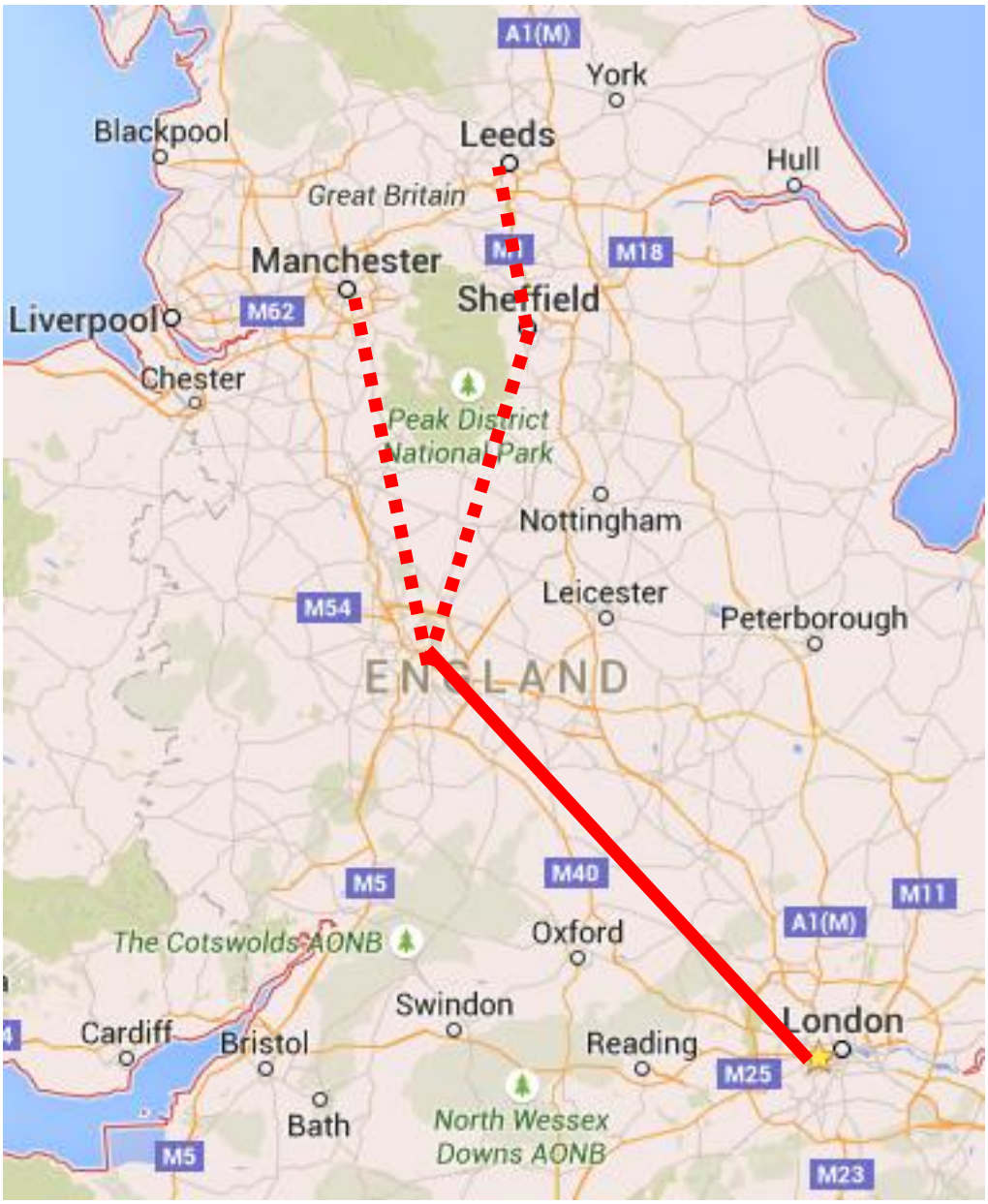


FIGURE 2: RESEARCH PROCESS OVERVIEW

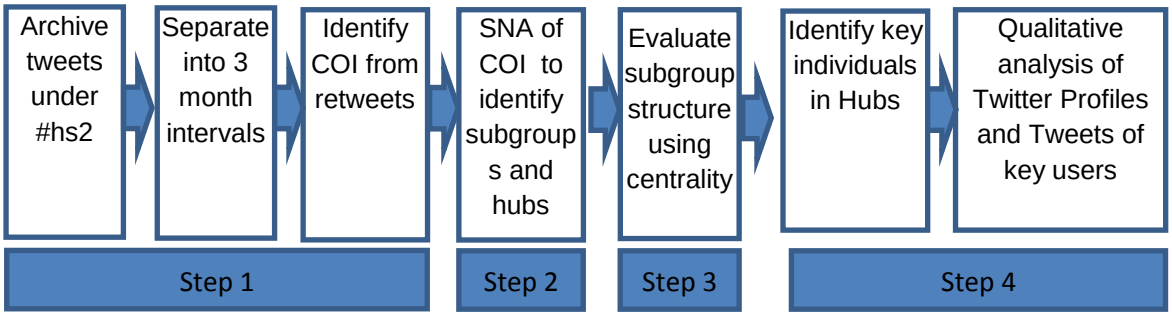


TABLE 1: Overview of Four Networks

File Name	Vertices	Unique Edges	Maximum Vertices in a Connected Component	Maximum Edges in a Connected Component	Maximum Geodesic Distance (Diameter)	Average Geodesic Distance	Modularity
Quarter 1	9408	25737	8702	25264	12	3.833571	0.484933
Quarter 2	8269	21503	7590	20990	10	3.9544	0.481922
Quarter 3	6233	14375	5679	14012	11	4.046157	0.518005
Quarter 4	6847	14197	6107	13555	11	4.111235	0.581667

TABLE 2: GROUP INTERCONNECTIONS

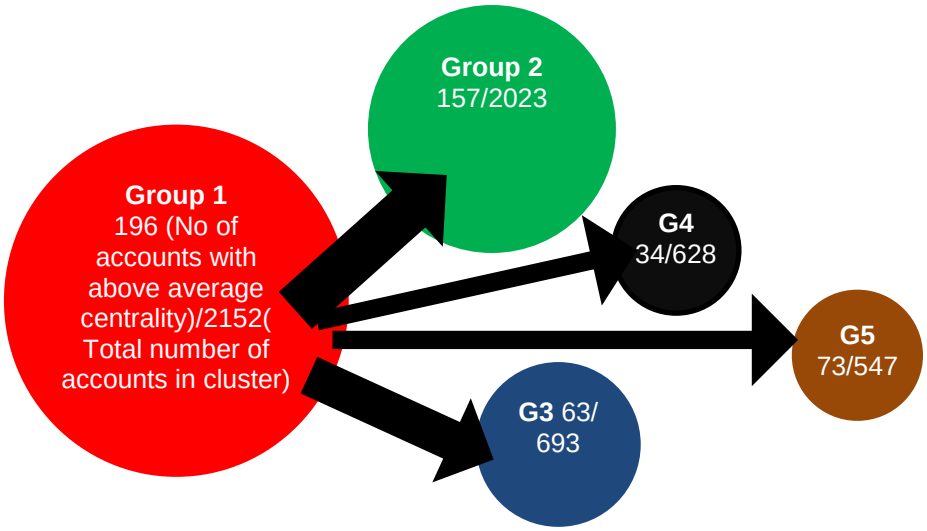
Network 1 Group Interconnections			Network 4 Group Interconnections		
From	To	Connections	From	To	Connections
G1	G2	346	G1	G2	109
G1	G3	663	G1	G3	357
G1	G4	211	G1	G4	225
G1	G5	405	G1	G5	18
G2	G1	131	G2	G1	41
G2	G3	16	G2	G3	9
G2	G4	5	G2	G4	7
G2	G5	6	G2	G5	3
G3	G1	495	G3	G1	237
G3	G2	31	G3	G2	9
G3	G4	14	G3	G4	38
G3	G5	26	G3	G5	21
G4	G1	142	G4	G1	182
G4	G2	6	G4	G2	7
G4	G3	12	G4	G3	26
G4	G5	9	G4	G5	4
G5	G1	387	G5	G1	27
G5	G2	16	G5	G2	17
G5	G3	49	G5	G3	24
G5	G4	9	G5	G4	14

TABLE 3

QUARTER 1			QUARTER 4		
Group	Twitter Account	Betweenness Centrality	Group	Twitter Account	Betweenness Centrality
G1	HS2DeadDuck	8316958	G1	Outoftweet123	5544184
G1	mcahs2	7939017	G1	NicholasBatty	3874948
G1	Outoftweet123	5160295	G1	Smotyndu	2526243
G1	JohnSensible	3899218	G1	JohnSensible	1994442
G1	stophs2	2823808	G1	stophs2	1607010
G1	gpn01	2662442	G1	Joerukin	1557709
G1	misrouted	2296639	G1	Jrjasrichy	1502796
G1	CherylGillanMP	2101164	G1	Misrouted	1233052
G1	norm1037	2049444	G1	norm1037	1158378
G1	gordyfin	1961325	G1	ZapHS2	1108305
G2	transportgovuk	8185210	G2	PaulBigland1	7530701
G2	PaulBigland1	7690697	G2	transportgovuk	1885305
G2	HS2ltd	3789454	G2	20MilesMore	1571975
G2	Number10gov	2328536	G2	HsrLiverpool	846851.3
G2	David_Cameron	1529560	G2	Vincecable	619785.6
G2	GoHS2	924862.4	G2	ManchesterKurt	598588.5
G2	RIBA	724353.7	G2	BusinessinDN	558366.1
G2	cynicalkind	722593.9	G2	HS2ltd	544828.1
G2	iansderbyshire	663517.2	G2	business_bham	517818.7
G2	ENGfocus	655627.3	G2	Scraptvtax	442115.3
G3	RichardWellings	3811919	G3	RichardWellings	2402429
G3	Trev_Forrester	2140608	G3	UKIPDB	1397713
G3	_Chris_Adams	959202.4	G3	Geezajay2013	750382.8
G3	DavidCoburnUKip	811789.6	G3	UKIPNigel	641021.8
G3	UKIP	526096.8	G3	CheaperThanHS2	443982.8
G3	BBCLeeds	437417.7	G3	Mike_Fabricant	329421.7
G3	igeldard	393511.8	G3	GeorgeK989	269434.2
G3	Garyw_	362914.4	G3	nero4166	233232.4
G3	OHwinsAgain	211865.3	G3	GoldenOldieC	226694
G3	Nigel_Farage	194324.6	G3	Cornishview	209764.5
G4	WoodlandTrust	8852620	G4	HS2__FACTS	5271173
G4	_BCT_	156146.6	G4	IanCampbell_	244771.2

G4	naturesgreat	144709.9	G4	A2Mac	221774.1
G4	CountryfileMag	104509.1	G4	scott45yes	183151.8
G4	charliemoores	96208.92	G4	ukschizophrenic	137854.6
G4	Imthenicenurse	87476.12	G4	dinogreycat	112256.4
G4	Juleslhoward	87371.29	G4	MirfinBoukouris	84064.2
G4	Butsurelynot	70076.39	G4	costofcameron	78718.53
G4	Alexends	69843.46	G4	DrCliffordHodge	75141.03
G4	DenzpDp	60939.16	G4	trabasack	65830.33
G5	NicholasBatty	3693484	G5	rog_ukip	3004310
G5	Mikebutcher	631854.4	G5	Wispame	114748.2
G5	MagsNews	408098.2	G5	steve_hume	97624
G5	Ianrmillard	337936.7	G5	willowbrookwolf	13017.29
G5	Trabasack	274283.4	G5	Teuchtermac	12210
G5	Avitusparta	246060.9	G5	Bizbrokerse	11683.02
G5	JohnEdwards33	193411.6	G5	Pinesbloke	11683.02
G5	Tamworthherald	187378.6	G5	Brawn_Brains	9215.731
G5	Oqoco	159158.1	G5	PDT10	9041.265

FIGURE 3: EXAMPLE NETWORK STRUCTURE



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Appendix 1: Key user cleassification

Account Name	Twitter Profile	Example Tweets	Tweet Meaning	Account Classification	Perspective	Reason
@mcahs2	Mid Cheshire action group against #HS2 £50 billion Gravy Train for vested interests. £3000 per working family household	Despite the massive PR budget and lobbying #hs2 supporters (and there aren't many) have not won the argument http://t.…	HS2 proposed benefits will not be realized	Action Group	Anti HS2	HS2 will not deliver proposed benefits
		ch4 news about Spain.Spent billions on Fast trains + redevelopment. Had Short term construction boom but now over 50% youth une…	HS2 will not deliver long term benefits			
@JohnSensible	Tweeting against the insanity of HS2 and the politicians and vested interests who support it. I don't endorse any particular political party.	@20MilesMore. #Liverpool already is. Wasting £50bn+ will not help. We need trams, light rail and better rail coonectivity…	Investment should be spent on local transport services	Member of public	Anti HS2	Money is better spent elsewhere
		@WarringtonHS2 Don't forget @HelenJonesMP there's #NoVotesForUWithHS2! Please oppose #HS2 now.	Threat to withhold vote from MP if they support HS2			

Account Name	Twitter Profile	Example Tweets	Tweet Meaning	Account Classification	Perspective	Reason
PaulBigland1	Photographer, writer, journalist, traveller, lover of life.Tweets for free (much to some people's chagrin). Blocked by a Shadow SoS for posing awkward questions	We can't afford #hs2? The cost is spread over 18yrs at less than 0.17% of GDP! We can't afford NOT to build HS2!	Economic benefits of HS2	Media	Pro HS2	Project has long term benefits to UK
		1,754 deaths on UK roads in 2012. Since 1981 French High-Speed TGVs have carried 2 billion pax without a fatality. We nee…	Safety benefits of HS2			
@cynicalkind	Apolitical, like curate's eggs, travel, and beetroot.(can't sing)	@NicholasBatty don't worry, 1 or 1 million, it's the MPs that count & make the decisions @PaulBigland1 #hs2	Highlight importance of MPs in HS2 approvals	Member of Public	Pro HS2	Project should deliver economic benefits
		"@cybrum: £10billion worth of contracts up for grabs on #HS2 new North-South railway." Welcome employment opportunities	Employment benefits of HS2			

Account Name	Twitter Profile	Example Tweets	Tweet Meaning	Account Classification	Perspective	Reason
@igeldard	#Libertarian in the UK tweeting global news on civil liberty, national security, UK/US politics and the EU. RTs ≠ endorsement	Good @WoodlandTrust presentation about how #HS2 affects ancient woodlands here http://t.co/6Fv997zD1W #N02HS2 #StopHS2	HS2 will damage environment	Member of Public	Anti HS2	Negative Environmental impact
		#HS2 is a blueprint to ruin land and lives http://t.co/nAeDe7MgVt	HS2 will damage environment			
@Cornishview	Ex Civil Engineer, Happy to live in Cornwall, fed up with politicians. Sad that public are been conned about AGW	@5WrightStuff #HS2 at £50 Billion just ridiculous! Money far better spent on improving current rail infrastructure and re…	Investment should be spent on local transport services	Member of Public	Anti HS2	HS2 will weaken existing transport network
		#HS2 will take £18m from SW economy.#HS2 will mean worse traditional rail services in North- worst thought #EU scheme ever.	HS2 will take resources from traditional services			

Account Name	Twitter Profile	Example Tweets	Tweet Meaning	Account Classification	Perspective	Reason
@dinogreycat	Aging hippy in an ouzo haze trying to fugure it all out.	Women refused cancer drugs because it's expensive. Look we have to save money so a few well off people can get to Manchest…	HS2 will take resources from Health Services	Member of Public	Anti HS2	HS2 will not deliver benefits
		#r4today #hs2 is a vanity project. Most of the proposed jobs will be temporary,Where will the quoted extra 20k per day pas…	HS2 will not deliver financial benefits			
@rog_ukip	QPR FC season ticket holder / NHS supporter / UKIP member / Catholic / Vegan.	India are spending £45 million to get to Mars. The UK are spending £60 billion to get to Birmingham. #HS2	HS2 funding is better spent elsewhere	Member of Public, Political Affilation	Anti HS2	HS2 is a waste of funding
NicholasBatty	Comms, broadband, PR and cheese	@NicholasBatty : Cameron's 'Hard-working families Paying huge price 4 bogus #HS2 http://t.co/EGdBi8GL7d via @YouTube High Speed 2 - The G…	HS2 will not deliver benefits	Media	Anti HS2	HS2 will not deliver benefits

Account Name	Twitter Profile	Example Tweets	Tweet Meaning	Account Classification	Perspective	Reason
		@NicholasBatty : UKIP trending high during High Speed Two Twitter storm. Time to scrap #HS2 @David_Cameron UKIP are outwitting you! #STOP…	Support for anti HS2 Political party			