Monitoring social network formation and information content analysis of transport anomalies: The case of airline crashes

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Loukas Dimitriou [a, *], Constantinos Antoniou [b]

[a] Lab. for Transport Engineering, Department of Civil and Environmental Engineering, University of Cyprus, 75 Kallipoleos Str., P.O. Box 20537, 1678 Nicosia, Cyprus
[b] Chair of Transportation Systems Engineering, Department of Civil, Geo and Environmental Engineering, Technical University of Munich, Germany

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ABSTRACT

Airliners' industry corresponds to an extremely sensitive and volatile sector, especially subject to information related to flight safety. Possible negative publicity on such issues may result to sudden and abrupt fluctuations of air travel demand, accompanied with phenomena of panic or feelings of generalized insecurity. The proliferation of social media platforms that offer a direct and immediate two-way communication channel contributes to the overall information propagation related to flights security (as exposed in the recent airlines crashes) and can be viewed as a proxy of the social network formation of such paradigms. The current paper aims to offer a framework for quantitatively analyzing social network formation, based on comprehensive network metrics, valuable in cases of commercial airliners accidents. Moreover, the use of data from social media connectivity offers one more extremely valuable piece of information related to the messages that connected users exchange, mention or are exposed to. Such large datasets are quantitatively analyzed here based on methods used in content analysis, exposing valuable information on the interest of the general public (potential airliners users) of anomalies in the airline industry. The analysis is based on data from two real events (airliners' crashes), which attracted the international public interest and significantly affected air travel demand. Finally, the results are analyzed and presented in detail such as to contribute to the air demand treatment, especially in terms of optimal communication operational management in cases of crises.

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1. Introduction

Industrial accidents, especially those involving human casualties, correspond to cases that typically (and reasonably) attract the public interest. Focusing on the airline industry, among its fundamental characteristics is the extreme sensitivity and volatility related to flight safety and security (ICAO, 2014; IATA, 2014). An indication of these characteristics stands for the public interest and the associated media coverage of commercial flights accidents, while such events, although rare, typically result to major crises for this industry, with significant effects on the air transport sector and for long-haul mobility in general (Ray, 1999; Wester, 2009). Optimal operational management of such crises, especially of commercial airliners' crashes, involve a targeted (content-specific) handling of the related information channels, or at least the monitoring/awareness of the potential airliners passengers' interest and behavior (reactions) dynamics on each event.

In order to monitor the relevance and magnitude of a specific large-scale event effects, a valuable source of information nowadays stands for the social media. Social media platforms provide the means for rapidly sharing and exchanging information among the users interested in a particular event, while the surveillance of this activity offer a rich database for capturing the social network formation and for analyzing the spread of awareness. Moreover, such platforms provide valuable information on the issues that attract the interest of the social groups, since these are sharing/exchanging messages.

In this paper a methodological framework is proposed for monitoring social activity for cases of anomalies in the airline industry, namely, in cases of crashes. The analysis is focusing on two domains: (a) the social network formation, its characteristics and the main attributes that may produce valuable information for treating public interest, and (b) the analysis and identification of

* Corresponding author.
E-mail addresses: lucdimit@ucy.ac.cy (L. Dimitriou), c.antoniou@tum.de (C. Antoniou).

the most crucial piece of information that the public (and thus potential users/customers) is focusing on. For achieving the first objective, the methodological framework is based on social network analysis and its dynamics, while the second one relies on the tools and techniques of content analysis.

The application and results are based on data from two recent events/crashes with global effects, namely, the Germanwings (GWI) flight 9525 crash, which occurred on March 24, 2015 (with 150 fatalities), and the Malaysia Airlines (MAS) flight 370 crash, which occurred on March 8, 2014 (with 239 fatalities-presumed). The extent of these two events provides suitable test cases and the results offer an in-depth look on them, possibly valuable for relevant future investigations. The selection of these two events was based on the fact that these were the major, recent events at the time that the research was undertaken. Furthermore, the choice of these events is not expected to have an impact on the application of the methodology, or its results. More emphasis is given on the GWI event, as it is a more "typical" major event, in which the outcome was quickly known. On the other hand, the MAS event presents a different type of event, in which there was a prolonged period of uncertainty regarding what had happened.

The structure of the paper begins with a short background review of the social interest monitoring by data collected from social media activity. Then, the framework provided by social networks analysis is applied on the social media activity patterns 'recorded' in the occasion of these two tragic events, providing useful information on the formation, velocity and structure of these networks, while the final section provides concluding remarks. It is explicitly noted that the analysis and results provided hereinafter do not intent to interfere with consumer, user, or commercial interests of the companies that will be mentioned or cited here; on the contrary, the data used were collected by publicly available online sources, an element that highlights the applicability of the proposed analytical framework on similar occasions.

2. Background review

2.1. Social media activity as proxy to social networks formation

The physical, organization and operational structure of the airlines industry, composed by the customers, industrial partners and authorities, have been recognized as being interrelated and –thus-analyzed as a social network/system including all parts (Dimitriou et al., 2015; Kirschenbaum, 2015). The current development and widespread use of the social media can capture with relative accuracy the trends and some behavioral characteristics of the public, especially on issues that are raised in the social agenda. This cardinal assumption is used here for monitoring the reactions over a major event like a commercial airliners' crash that typically is of interest of potential air passengers, covered extensively by media and triggering significant reactions from the public. The methodological framework, used here, will follow that of social networks analysis (Carrington et al., 2005). As so, monitoring the activity on social media can capture both the pattern of the social network formation (as depicted in the structure of the connected social media users and their activity), but also on the behavior and the interest of the social media users (as depicted in the content of the shared information, comments, etc.). The datasets used here for capturing the social network formation and characteristics is based on recorded messages from Twitter® users ('Tweets') at the period of commercial airliners crashes. The extensive dataset used is subject to no preprocessing and handled as raw data reflecting the

social network structure of people interested in such events. Preliminary results are presented in the following sections.

The analysis presented in this research makes the implicit assumption that twitter network activity is a reasonable proxy to social network activity, and -taking a further leap-to human activity. While this is a complicated statement to argue, existing research has been using twitter activity as a proxy to social networks. An exploration of twitter networks geography is presented in accompanied with examination of the influence of key parameters (such as geographic distance, national and language boundaries, and –interestingly- frequency of air travel on forming social ties on Twitter (Takhteyev et al., 2012). The authors find that while Twitter is not inherently bounded by geographic limitations, a substantial share of ties lies within the same metropolitan region. In Hawelka et al. (2014) a dataset of almost a billion tweets is used to estimate mobility patterns of international travelers by country of residence, which were validated using other sources. Of course, when considering whether twitter and other on-line services are a good proxy to actual social networks, one cannot ignore the issue of equity and access to technology (Bregman et al., 2015).

Twitter has been used for several applications, including crisis management and anomaly detection. Thom et al. (2012) propose an approach for the analysis of geo-tagged twitter messages for the detection of spatio-temporal anomalies, demonstrated with applications in earthquakes, riots and hurricanes. Sakaki et al. (2010) coin the term "social sensors" to describe twitter activity that can be used to detect events in real time, in their context earthquakes. MacEachren et al. (2011) outline the use of a web-based tool of geo-tagged micro-blogging/twitter activity as an information source for crisis management. Finally, Fu et al. (2015) present an approach for traffic incident detection that (i) develops specific key-words and their association rules, (ii) extracts tweets with influential word sets and (iii) ranks and selects relevant tweets.

2.2. Content analysis in public information monitoring

Content analysis corresponds to a scientific domain that aims to analyze in both qualitative, as well as quantitative manner, the communication messages (of all kinds) such as to understand the main characteristics and thus identifying the terms/concepts that these contain, in a systematic, objective and quantitative manner. Techniques of analyzing message content have long been used for many purposes in the mass media, politics, advertisement, or other sectors (Krippendorff, 1980; Evans, 1996; Riffe and Freitag, 1997; Yale and Gilly, 1988; Neuendorf, 2002). Similarly, in reviewing intellectual work in general content analysis is used as an essential analytical tool (Guthrie et al., 2004; Duriau et al., 2007; Kim et al., 2016), but also for capturing web-based consumer satisfaction (Evans et al., 2016). However, in the transport sector, and in particular the airline industry, the use of such analytics has been limited. The impact and the quality of service in mission statements has been appraised by content analysis both for European, Japanese and US airlines (Bartkus et al., 2004), but also for a more generalized sample of international airlines (Kemp and Dwyer, 2003). Recent analysis in tourism research (Camprubí and Coromina, 2016) and in supply chain management research (Dooley, 2016), exhibits the value of content analysis in analysing extensive datasets of users responses. Focusing in the online/public information related to the airline industry, a technical content analysis has been conducted based on the official Facebook® (FB) accounts of 250 airlines, resulting in capturing important features on how they are treating FB content and connections (Grančay, 2013). Finally,