Monitoring event attendance using a combination of traditional and advanced surveying tools

Monitoraggio della partecipazione agli eventi tramite la combinazione di strumenti tradizionali e nuove tecnologie

Mauro Ferrante, Amit Birenboim, Anna Maria Milito, Stefano De Cantis

Abstract This paper will describe the research stages and tools used for monitoring participants' attendance at the European Researchers' Night, held in Palermo in September 2017. A combination of traditional survey instruments and new technologies was effected in order to analyse participants' behaviour during the event. The results derived from these different data sources were also integrated and analysed in order to evaluate the success of the event from social and economic points of view. Data relating to participants' mobility during the event will be described and clusters of participants proposed, based on their mobility behaviour.

Abstract *Il presente articolo descrive le fasi della ricerca e gli strumenti utilizzati per lo studio del comportamento dei visitatori alla Notte Europea dei Ricercatori, svoltasi a Palermo nel Settembre 2017. Viene proposta l'integrazione di strumenti di rilevazione tradizionali con l'utilizzo di nuove tecnologie per lo studio del comportamento dei visitatori durante l'evento. I dati derivanti dall'integrazione di più fonti informative sono stati analizzati al fine di valutare il successo dell'iniziativa dal punto di vista economico e sociale. Vengono inoltre descritti i dati relativi alla mobilità dei vistatori e vengono proposti dei cluster di partecipanti sulla base del loro comportamento in termini di mobilità.*

Key words: Event behaviour, GPS technologies, mobility, event management

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1 Introduction

The monitoring and measurement of participant attendance at events is particularly relevant for a number of reasons. Beyond providing information to organisers and sponsors regarding the popularity of an event, it is a fundamental prerequisite for measuring the economic, social and environmental impacts of events [1]. Given these premises, the aim of this work is to describe the various research stages, the survey instruments used, and the main results of a survey performed during the European Researchers' Night, held in Palermo in September 2017. An integration of traditional survey instruments and new technologies was implemented, the aim of which was to collect information regarding the event attendance. Data relating to the participants' profile and their behaviour during the event were collected and analysed in order to characterize participants' behaviour, motivation, and satisfaction during the event. The results are of relevance for both sponsors and organisers alike for planning and management similar initiatives in the future.

2 Data and Methods

On the occasion of the second edition of the *Sharper* European Researchers' Night project, a research team from the University of Palermo planned a survey during the event, the aim of which was to monitor and evaluate participants attendance, behaviour and satisfaction at the event. This event is supported by the European Commission as a part of the Marie Skłodowska- Curie actions and funded by the Horizon 2020 programme, a stated aim of which is to boost the careers of researchers. The survey made use of an integration of several survey tools, including: i) an infra-red beam counter; ii) a questionnaire distributed at the beginning of the event (the *opening questionnaire*); iii) a smartphone App 'Sensometer'; iv) GPS devices and v) a questionnaire distributed at the close of the event (the *closing questionnaire*).

There was no charge to enter the event. In order to measure the number of participants attending the event, an infra-red beam counter was placed in the main entrance of the Botanical Garden, the main venue, to count the total number of those entering and exiting during the event. This information were used to monitor the smooth running of the event and to obtain ex-post information useful for sampling purposes. The opening questionnaire was administered to a sample of participants and aimed at collecting information regarding participants' profile, motivation and expectations. This sample was selected according to a pseudo-systematic procedure, with a sampling interval of 1 every 20 participants joining the event. It was requested that every sampled participant download and use a smartphone app 'Sensometer'. The app collected information on participants' mobility during the event and it enabled pictures of the most 'liked' aspects of the event to be sent to the research team. A sub-sample of participants also received a GPS device which collected more accurate information on participants' mobility during the event. In order to easily recognize each sampled unit at the end of the visit, a numbered badge was provided

to each participant. At the end of the visit, every sampled participant was asked to return the GPS device (where given), and to answer a closing questionnaire. The aim of the latter was to: collect post-visit information relating to satisfaction of the visit, the intention to revisit, the intention to recommend the event to friends and relatives, and a question relating to the willingness to pay for similar events in the future. Finally, the impact of the event on the participants' opinion of the University of Palermo was evaluated by means of pre-visit and a post-visit questions. In order to analyse the results, the data obtained from the various survey instruments used (two questionnaires, the smartphone app, and GPS devices) and data quality evaluation were merged. The GPS trajectories of participants were compared and participant clusters were created which were based on the similarities of their trajectories. A Dynamic Time Warping (DTW) algorithm was used to measure the distance among trajectories. This is an algorithm for measuring distance between two temporal sequences, and it was applied to obtain a distance between GPS tracking [4]. The major advantage of DTW over Euclidean distance is its ability to take into account the stretching and compression of sequences. As a result, this method produces a distance-like metric, which is independent of the velocity of the two temporal sequences. The DTW algorithm remaps the time indexes of two series X and Y to produce series of the same length T, which are termed warping curves $\phi(k) = (\phi_x(k), \phi_y(k))$ with $k = (1, \ldots, T)$. The monotonicity of the warping curve is usually imposed as a constraint in order to preserve time ordering. The DTW distance can, therefore, be defined as the minimum Euclidean distance between each warping curve:

$$DTW = min_{\phi} \sum_{k=1}^{T} d(\phi_x(k), \phi_y(k))$$

However, when comparing alignments between time series of different lengths, it is usually appropriate to manage an average per-step distance along the warping curve. Therefore, the DTW distance is divided by the number of steps of the warping curve T [3]. Having obtained the distance matrix among the trajectories, in order to segment participants in relation to their behaviour, an average linkage hierarchical clustering was implemented [2]. More peculiarly, an agglomerative approach was used by initially assigning each observation to its own cluster, then by computing the similarity between each cluster and recursively joining the two most similar.

3 Results

The fact that there was one entrance to the event (Fig. 1a) facilitated the use of an infra-red beam counter, which counted the number of participants attending the event: a total of 1,815 entrances and 1,819 exits were recorded throughout the period 18:30 to 00:00. Regrettably, the device malfunctioned for 16.4 minutes, representing 5% of the total time recorded (332 minutes). By considering the difference between numbers of exits and entrances, it is possible to determine the number of people

attending the event over time. The number of people attending the event in a 10 minute time interval is reported in Fig. 1b. A peak of attendance was observed at around 22:00, and, at 23:00 (the time when the event officially closes), more than 400 people were still present until midnight when the event closed its doors. Table 1 reports the descriptive statistics for the main variables, which were collected from the opening and closing questionnaires. The majority of participants were young, well-educated and residing in Palermo. Approximately 20% of participants interviewed were returnees with a relatively high share of participants (62%) agreeing to download the mobile app. The majority of participants expressed a high degree of satisfaction with the event, many of whom felt they could recommend the event to friends and relatives. A positive impact of the event on the opinion of the University of Palermo was observed, with 44.1% of participants interviewed declaring an improvement in their opinion after the event.

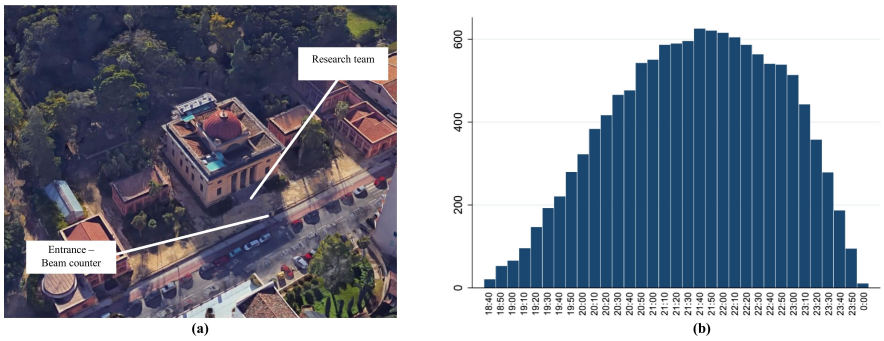

Fig. 1 Event site and survey setting (a), and number of people attending the event at 10 minutes time interval (b)

In terms of participants' behaviour at the event, a comparison of the results obtained from the mobile app and GPS devices demonstrated clearly better performances for the latter compared to the former. Indeed, the low quality of the data collected with smartphone app (missed observations, many observations with the same coordinates, irregular data collection time interval, etc.) led the authors of this paper only to analyse GPS tracking, albeit from a limited number of participants (approximately 20). After the pre-processing of GPS tracking data, the degree of similarities between each pair of trajectories was measured with the DTW algorithm. The implementation of hierarchical clustering and visual examinations of clusters of trajectories, led us to choose four clusters. Patterns of participants' mobility belonging to each cluster are reported in Fig. 2, in which the height of each polygon is proportional to the average time spent in each cell, and the colour is related to the number of participants in each cell. Differences among the identified mobility cluster patterns may be highlighted. Cluster 4 comprises those participants who had did not remain for long at the event. They made short stops at the various event sites, with little or no deviation from the circular area around the main build-

ing in the Botanical Garden. These participants spent about 1 hour at the event, and their trajectories were on average 1.7 kilometres length. Participants belonging to cluster 3 remained the longest at the event (about 2 hours) and walked the most (2.7 kilometres). The height of these polygons highlights the many stops made at several sites in the event. Similar considerations can be made for clusters 1 and 2, although their trajectories differ among each other.

Table 1 Opening and ending questionnaires: descriptive statistics (n=101).

Variable	**Categories**	%	**Variable**	**Categories**	%
Gender	Male	32.0	Took part to	Yes	20.8
	Female	68.0	last year's night?	No	79.2
Place of	Palermo	81.2	Willingness to	Yes	62.0
Residence	Other	18.8	use mobile app	No	38.0
Age	18-25	30.7	Company type	Partner/spouse	37.6
	26-35	20.8		Parents	3.0
	36-45	25.7		Children	25.7
	46 or more	22.8		Friends/relatives	54.5
Job type	Student	36.6	Opinion about	Very good	8.9
	School teacher	14.9	the University	Good	40.6
	University	4.0	before	Neither	44.6
	Freelance	24.8	the event	Bad	3.0
	Other	19.8		Very bad	3.0
Main	Visit to friends/relatives	19.8	Degree of	Low	5.4
motivation	Interest for the event	71.3	satisfaction	Medium	38.7
	Other	8.9		High	55.9
Education	Mid-school	5.0	Opinion about	Improved	44.1
	High-school	39.6	the University	Remained equal	53.8
	Bachelor	47.5	after the event	Got worse	2.2
	Master or Ph.D.	7.9	Willingness to	Yes	97.8
			recommend	Don't know	2.2

4 Conclusion

Events are often used strategically to contribute to the economic development of a region. The monitoring of events is particularly useful when evaluating their cultural, social, economic and environmental impact. Furthermore, it is helpful for event managers to obtain information relating to where, when and how activities take place, and the degree of satisfaction of these experiences. The monitoring of participants' space-time behaviour can, therefore, be said to be critical to supply management. Consequently, the development and implementation of new data collection tools and methods is particularly relevant for the sustainable management

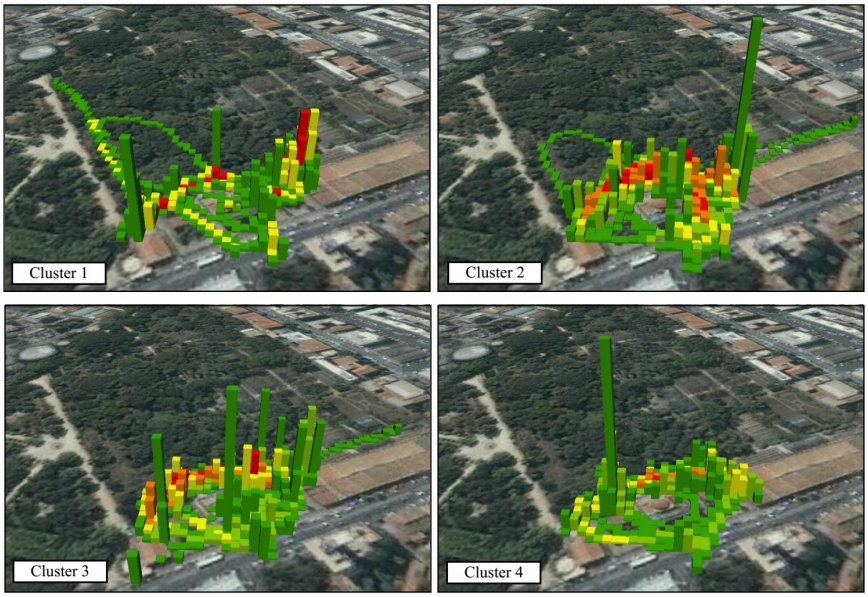

Fig. 2 Patterns of trajectories of clusters of participants

of events. The empirical application presented in this paper highlights the potential deriving from new data collection tools (e.g. GPS devices, electronic counters, etc.) for monitoring and analysing event attendance. The single entry-exit point allowed for the implementation of the presented survey strategy, a discussion on potential solutions in open events, in terms of sampling strategies and counting procedures, represents a clear research line. Moreover, an analysis of participants' characteristics as potential determinants of their behaviour at events represents an important topic for future research. An improved knowledge of participants' behaviour at events may be useful for the implementation of event management policy.

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