ARTICLE IN PRESS
TFS-18683; No of Pages 12
Technological Forecasting & Social Change xxx (2016) xxx–xxx
Contents lists available at ScienceDirect
Technological Forecasting & Social Change

Real Time Spatial Delphi: Fast convergence of experts' opinions on the territory

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ARTICLE INFO

Article history:
Received 9 June 2016
Received in revised form 8 August 2016
Accepted 28 September 2016
Available online xxxx

Keywords:
Spatial Delphi
Real-Time Delphi
Geo-consensus

ABSTRACT

Considering the advantages of the online consultation methodologies and the potential of WebGIS technology, we introduce a novel real-time Delphi technique, which exploits the features of two existing methods: Real Time Delphi and Spatial Delphi. This new technique, called Real Time Spatial Delphi, preserves most of the advantages of both methods, minimizes the disadvantages, and develops new potential. A panel of experts, suitably chosen according to the application, answers a geo-questionnaire by placing points on an online interactive map and presenting written arguments. The system automatically calculates and displays a circle representing the convergence of the opinions, which shrinks and moves in real-time. The final result is the delimitation of an area most suitable for a given action or for the occurrence of a future event and is immediately usable for decision support and/or spatial scenario building without any processing. We applied this technique to the zoning of street prostitution in Italy and identified several areas inside five municipalities where the zoning was considered most appropriate by the experts. This new Delphi method represents an innovative way of eliciting experts' opinions regarding a simple and intuitive platform, which is potentially applicable to a very broad spectrum of forecast/decision making issues.

1. Introduction

The Rand Corporation (Santa Monica, California) developed the *Delphi method* in the 1950s with the aim of achieving a convergence of opinions across members of a panel of experts to forecast the impact of technology on warfare (Dalkey and Helmer, 1963; Linstone and Turoff, 1975). It is an iterative method with a number of iterations called *rounds*, in which each member of the panel anonymously replies to a questionnaire and subsequently receives feedback regarding the responses of the group. At each round, the experts are invited to revise their judgments in light of the feedback, producing, at least in principle, a progressive reduction of the range of answers and the consequent convergence of opinions. It is commonly recognized that the Delphi method makes better use of group interaction (Rowe et al., 1991), particularly compared with the face-to-face conference methods (Riggs, 1983).

Currently, the method is still broadly in use, generally in a decision-making context and/or a forecasting framework. Delphi has been so widely used that it is considered the foundation of a large variety of methods. During the last half century, several authors have developed a series of Delphi-derived methods; thus, to build a methodological framework for the method we propose in this paper, we present a brief historical overview, citing the most important methods.

In 1970, Murray Turoff proposed the *Policy Delphi* (Turoff, 1970), which is consensus-oriented and used for the analysis of public policies. A different version, called *Public Delphi*, is based on the participation of citizens. Soon after the *Mini Delphi* (Gustafson et al., 1973; Van de Ven and Delbecq, 1974) also known as Estimate-Talk-Estimate (ETE) was proposed, a technique that speeds up the procedure, as it is applied for face to face meetings.

In 1974, the theoretical foundations of the *Markov-Delphi* were laid by De Groot (1974). Chatterjee (1975) studied an alternative solution, based on variable weights, and Marbach (1975) proposed the adoption of weights that minimize the overall variance of the evaluations.

In 1975, David A. Ford proposed the *Shang method* (Ford, 1975), in which some characteristics of the Delphi method are kept but the trouble of asking to rephrase the evaluations at each round is eliminated. In the same year, the Nominal Group Technique was proposed, a problem-solving process that includes the identification of a problem, the generation of a solution and the final decision (Delbecq et al., 1975). In 1979, the *Decision Delphi* was born (Rauch, 1979), a variant oriented to coordinate the decision-making processes of different actors. The *Abacus-Delphi* method was developed in the 1980s and uses the logic of the colors of the Abacus, as defined by François de Régnier (Chapuy et al., 1990; Régnier, 1989).

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http://dx.doi.org/10.1016/j.techfore.2016.09.029
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Please cite this article as: Di Zio, S., et al., Real Time Spatial Delphi: Fast convergence of experts' opinions on the territory, Technol. Forecast. Soc. Change (2016), http://dx.doi.org/10.1016/j.techfore.2016.09.029

In 2006, Theodore J. Gordon and Adam Pease proposed the *Real Time Delphi* (RTD). This method is a computerized Delphi and does not provide for subsequent rounds, therefore leading to a greater efficiency in terms of execution time (Gordon, 2009; Gordon and Pease, 2006).

A recent innovation is the *Spatial Delphi* (Di Zio and Pacinelli, 2011), suitable when the decision problem involves the choice of a place where a future event may happen. This method replaces some of the basic features of the conventional Delphi with analogues that are "spatial". The last of these Delphi-like methods is the *Spatial Shang* (Di Zio and Staniscia, 2014), a modified version of the Shang method applicable, such as the Spatial Delphi, when consultations and consequent decisions concern matters of geographical location. Nevertheless, both these methods have sequential rounds, while the method that we propose in this paper is roundless.

However, why do all these methods exist? What is the best among them? It is obvious that each method has advantages and disadvantages such that we cannot choose a method that is best of all. In fact, each has some peculiarities that make it more suitable for particular situations. Therefore, a good research question, half a century after the invention of Delphi, could be:

Is it possible to develop a new method by combining some of the existing ones to make the most of their advantages?

Independently of Delphi, we have observed a remarkable development of the online consultation methods over the last decade because they allow for collecting large amounts of data in a short time and for reaching people anywhere on the globe. Moreover, the use of Geographic Information Systems (GIS), especially those that use web technologies (WebGIS), is becoming increasingly widespread. Currently, we see an exponential growth of geographic data because knowing where something happens, or where something could happen, is of fundamental importance for making decisions. As stated by Longley et al. (2005), "everything that happens, happens somewhere".

Considering the advantages of the online consultation technologies and within the scope of the methods dealing with WebGIS technology, we consider if it is possible to develop a novel Delphi method that exploits the features of other existing methods. To this end, we focus on the Spatial Delphi and Real Time Delphi; the possibility of integrating them into one new method has interesting implications, both from a methodological and practical point of view. From the examination of the theoretical backgrounds and the applications found in the literature, it is possible to combine the advantages of both methods, minimizing the disadvantages.

In the following, we will develop a method that arises from bringing together the logic of the Real Time Delphi, which is *roundless* (Gordon, 2009), and the potential of the Spatial Delphi in the management of geographical problems. Consequently, we call it the *Real Time Spatial Delphi* (RTSD) method, with which it is possible to consult experts on issues related to the territory in an efficient, real-time way, with very short times and low costs. The main product of a RTSD study is the delimitation of one (or more) area(s) on the territory that, according to the convergence of the opinions of a panel of experts, is most suitable for a given action or for the occurrence of a future event. Therefore, the results are immediately usable for decision support and/or spatial scenario building without any further processing.

The RTSD is based on a WebGIS interface, with a series of tools and functionalities that make it adaptable to a very large number of applications. The web platform is part of a larger project, called Geospatial System of Collective Intelligence (Castillo Rosas et al., 2015a,b), and designed to support the decision-making process in geographic complex scenarios.

The main goals of this paper are to present the RTSD method, discuss its potentials and show an application.

Among some of the applications made in this initial testing phase of the system, we will present a study on the issue of zoning of street prostitution in a district of five municipalities in the Abruzzo region (Italy).

The remainder of the paper is organized as follows: after a comparison between the Real Time Delphi and the Spatial Delphi (Section 2), in Section 3, we illustrate the Real Time Spatial Delphi, while Section 4 outlines the application to the zoning of street prostitution. In Section 5, we present the results, and in Section 6, we conclude with a brief discussion.

2. The Real Time Delphi and the Spatial Delphi compared

In this section, we describe the main characteristics of the Real Time Delphi and the Spatial Delphi to highlight their strengths and weaknesses. From this comparative analysis will arise the methodological assumptions of the method that we propose, i.e., the Real Time Spatial Delphi.

Since the early years of use of the Delphi method, despite its potential, it has emerged that the procedure is time-consuming and costly. Consequently, there were many attempts to use the Internet to speed up the Delphi process and reduce costs. Murray Turoff conducted an early experiment by linking experts in a network (Turoff, 1972); later, he designed a Social Decision Support System to allow a large group of people to vote and interact dynamically (Turoff et al., 2002).

Important studies were conducted in Finland, resulting - in 2008 - in a system called *eDelfoi*. Significantly, in 2006, Theodore J. Gordon and Adam Pease developed the Real Time Delphi (Gordon and Pease, 2006), first as an open source program and then improved and largely used by the Millennium Project (a non-profit global participatory futures research think tank).

In a RTD, each expert of a panel anonymously answers questions in an online questionnaire. For each question, he/she can also give written arguments and then, whenever he/she considers it appropriate, comes back to the study, seeing his/her original inputs. If in the meantime other experts have responded, some group statistics (i.e., number of responses, average, median or interquartile range) are displayed next to each question and new judgments and comments can be provided, in the light of the statistical synthesis of the group responses and the arguments. The experts can repeat the process, reassessing and adjusting their responses, as often as they want (Gordon, 2009; Gordon and Pease, 2006).

The primary innovation of the RTD is the absence of repeated rounds (*roundless*) because the statistical synthesis is calculated automatically and displayed in real time. This reduces the overall time frame normally required to conduct this type of study, producing high efficiency in terms of time and cost needed to perform the analysis. With this system, experts are not forced to respond a fixed number of times and at preset time intervals, as in the conventional Delphi. Moreover, they are not compelled to complete the entire questionnaire in one sitting (Gordon, 2009; Gordon and Pease, 2006). The number and locations of participants are various, and through the interface of the questionnaire, you can include hyperlinks to reference material to allow the respondents to retrieve supporting information online while completing the questionnaire.

It has been empirically demonstrated that the final results of a RTD are not significantly different from the results of a conventional Delphi (Gnatzy et al., 2011); therefore, the particular features of the RTD do not affect the results. Finally, a considerable advantage is that the boxes in which the experts can type comments for their own answers and consult the reasons of others are interactive.

We now turn to the main features of the Spatial Delphi (SD). The founding idea of this method is that in Delphi applications, the geographic element has been too often underestimated; nevertheless, many decision/forecast problems are related, in some way, to the territory. With the SD, the convergence of the opinions of a panel of experts regarding a little portion of the territory can be achieved according to the Delphi logic (Di Zio and Pacinelli, 2011). The authors of the Spatial Delphi method indicated three particular contexts in which it can be used: 1) in the present, when the problem involves choosing an optimal

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site to place goods or services or to act for specific interventions; 2) when the research issue regards the prediction of where a future event will most likely occur; and 3) for collecting experts' judgments regarding the search for underground materials, such as in mining, archaeology or oilfield search (Di Zio and Pacinelli, 2011).

After defining the research problem and building the panel, in the first round, the experts are asked to locate a point (called an *opinion point*) on a map, denoting the place more suitable for the specific research problem, e.g., the location where the occurrence of a future event is more likely. The map can be on paper or digital. The result of the first round is a cloud of points on the map; over this cloud, the administrator constructs a circle, containing 50% of the opinion points provided by the panel. In this way, the circle is analogous, on the space, to the interquartile range. In the second round, each expert again receives the same map with the addition of the circle and is asked to locate a new opinion point, trying to stay inside the circle. Anyone wishing to place an opinion point not inside the circle can do it but must provide a written explanation. After collecting the second cloud of points, a new circle is calculated and, as in the conventional Delphi, the procedure is repeated a certain number of rounds. If the experts converge, in each round the circle becomes smaller and smaller until finally achieving a *final circle* small enough to consider that convergence has been achieved.

The positioning of a point on a map is quick and intuitive, i.e., it does not force the participant to conduct complex reasoning regarding the question(s) asked, as occurs in a classical questionnaire. The method is easily accessible and understandable, even for a non-specialized audience (we are all used to reading and interpreting a map, even kids), which shortens the total time of the survey and also reduces the problem of drop-out (Di Zio and Pacinelli, 2011). In this method, the computation of a measure of the convergence of the opinions is easy and intuitive, e.g., the ratio between the area of the final circle and the total area under study (Di Zio and Pacinelli, 2011). Additionally, the interpretation of the results is very simple and does not require any type of statistical processing, unlike all the other versions of the Delphi method.

By its nature, the problem of the choice of the response scales (dichotomous scales, rating scales, semantic differential scales) and that of the number of response categories (three-point scales, five-point scales, etc.) are not present in this method. Once the research problem is defined, the requested action is always the same, i.e., "please, put a point on the map…". Together with the main map, the experts can also receive supporting materials and, where appropriate, other maps of the same area with different themes, which help in making choices (Di Zio and Pacinelli, 2011).

While recognizing the numerous advantages of the two methods described above, note that there are also several weaknesses (Table 1). For each new application, the Real Time Delphi has to be programmed with all its details (questions, scales, images, hyperlinks, response categories, windows for comments, etc.). Therefore, the time and endeavors required for the preparation of a survey are not negligible and require specific skills. Although in recent years the system has been greatly improved, for an expert who uses it for the first time, it is not easy to respond. Difficulties can arise in the interpretation of the group statistics (because not everyone is familiar with averages, medians and quartiles), in understanding the research questions and in interpreting the scales used for each question. When designing a RTD survey, as for any type of survey, a number of subjective choices are necessary, which could affect the results. We refer to the choice of the response scales (dichotomous scales, rating scales, semantic differential scales, etc.) and to the choice of the number of response categories for each scale. Note that the problem of drop-out is still present, although lower than in the conventional Delphi (Gnatzy et al., 2011). Finally, Real Time Delphi is not well suited for handling issues related to territory.

Let's now consider the weaknesses of the Spatial Delphi. Like the conventional Delphi, it consists of a certain number of rounds; it takes a long time to perform, and the participants are forced to respond in any round and within the predetermined temporal intervals. The Spatial Delphi is based on a "frozen" map, namely, not interactive, whether on paper or digital; the research team must fix the type, scale and extent of the map a priori. In other words, GIS is used only by the research team to prepare the materials, while the panel of experts works on still images. This is a limitation because respondents are not allowed to change the map (e.g., from a satellite map to street map) or explore the study area by moving the map or zooming in on it. Any supporting material (other maps, documents, etc.) must be given separately, e.g., attached

Table 1
Strengths and weaknesses of the Real Time Delphi and the Spatial Delphi in comparison.

	Real Time Delphi	Spatial Delphi
Strengths	• Absence of repeated rounds; • Simultaneous computation and delivery of participant responses; • Possibility of using a large number of participants; • High efficiency with regard to the time frame needed to perform the analysis; • Applicability to a vast range of forecast/decision making issues; • Any type of supporting material, including documents and hyperlinks, can be used; • Low realization costs (compared to the classical Delphi); • The interventions of the facilitator are few; • Experts are not forced to respond to a fixed number of times and at preset time intervals; • Respondent are not compelled to complete the entire questionnaire in one working session; • Interactive boxes for the comments and the reasons.	• Very suitable for handling issues related to the territory; • Ease in understanding the research questions; • Easy and fast in responding, even for those who have never participated in a Delphi (i.e., simply putting a point on a map); • Ease in the interpretation of the group synthesis; • The problem of drop-out is reduced; • The interventions of the facilitator are few; • Ease regarding the computation of measures of the convergence of the opinions; • Interpretation of the results is very simple and does not require statistical processing; • The problem of subjective choices of the response scales and the response categories is not present; • Each new application does not require specific skills, e.g., programming software.
Weaknesses	• Not suitable for spatial issues; • For each application, the system has to be programmed with all its details; • The preparation of a survey requires specific skills (e.g., programming software) • For an expert who uses the system for the first time, it is not easy to respond; • Subjective choice of the response scale for each question; • Subjective choice of the number of response categories for each question; • The problem of drop-out is still present, although lower than in the conventional Delphi;	• Not suitable for non-spatial issues; • Consists of a certain number of rounds; • Experts are forced to respond in any round and within the preset temporal intervals; • Subjective choice of the type, scale and extent of the map; • Any supporting material must be given separately; • The number of supporting maps and documents is necessarily limited; • The task of the facilitator is laborious; • For each application, the maps must be specially built; • Significant implementation and realization costs; • The boxes for the written arguments are external with respect to the map and not interactive.

to an email that is sent to experts; inevitably, the number of maps and documents is limited. Although less than in the conventional Delphi, the task of the facilitator is still laborious (sending questionnaires and materials, collecting points, calculating circles of convergence, constructing maps with circles, etc.). Even if the preparation of a survey is easy because it does not require special skills (e.g., programming software), the base map must be prepared again for each survey. For each new application, all the necessary material must be equipped; therefore, the time and costs required for the preparation are considerable. Another disadvantage is that all the boxes for written comments are external with respect to the map and, above all, are not interactive, as in the Real Time Delphi; this can discourage participants from giving arguments or continuing the survey until the end (Table 1).

Finally, we must stress that while RTD is not well suited for geographical issues, conversely, SD is unsuitable for handling issues that are not related to the territory.

As an overview, Table 1 summarizes the strengths and weaknesses of the two methods.

At this point, note that some shortcomings of the Real Time Delphi can be overcome by the Spatial Delphi and vice versa. From this consideration, the idea to develop a new method, which exploits the advantages of both, minimizing as much as possible the disadvantages, was born. We call this method the *Real Time Spatial Delphi*.

3. The Real Time Spatial Delphi

Spatial Decision Support Systems (SDSSs) aim at helping decision-makers solve complex problems related to a geographical space (Jankowski et al., 1997; Sugumaran and Degroote, 2011) and very often are systems based on the technology of Geographic Information Systems (GIS). However, SDSSs imply the use of tools and methods of spatial analysis that are executed by a single individual user. A different approach is that of Group Spatial Decision Support Systems (GSDSSs), which, instead, are based on the collaboration of a group of people, often experts (Armstrong, 1994). In this family of systems fits the Geospatial System of Collective Intelligence, called SIGIC based on its Spanish acronym (SIstema Geoespacial de Inteligencia Colectiva) (Castillo Rosas et al., 2015a,b). It is a set of hardware, software, procedures, data, and people whose purpose is to support the decision-making process in geographic complex scenarios, mainly regarding the planning, organization and/or use of resources in a territory and is based on the consultation of groups of experts.

The Geospatial System of Collective Intelligence system is based on the methodology of the Spatial Delphi (Di Zio and Pacinelli, 2011), as well as the Vector Consensus model (Monguet et al., 2012). The system can store and display documents, pictures, videos, reports, maps and any other material useful for understanding the research problem and objectives to be achieved. It was designed to accommodate for different group consultation methods and different GIS data formats (points, lines, polygons). Moreover, it can also be programmed to handle simple questions, as in a classic online questionnaire.

The SIGIC platform (v. 1.0) is based on the GETSDI Geoportal Open-Source Software (v. 3.0), a platform developed in JavaScript and PHP, which incorporates tools and functions based on OpenLayers, ExtJS, GeoExt and Proj4js. The Real-Time functions are developed with the Socket.IO Server and Node.JS. All the other methods and functionalities implemented on the SIGIC platform, are programmed and personalized by the authors with JavaScript, PHP, ExtJS, Postgresql and PostGis, as well as other API services like Google Maps, OpenWeatherMap, OpenStreetMap, Panoramio, Tweeter, Wikipedia and WebGL Earth. A free example is available at http://sigic.net/thesis.

The first method implemented on this platform is the Real Time Spatial Delphi, which is based on opinion points, as for the Spatial Delphi. However, unlike the Spatial Delphi method, there are no rounds and the Delphi procedure develops in real time, just as in the Real Time Delphi (Gordon, 2009; Gordon and Pease, 2006).

Once the research problem is defined, the experts receive the credentials to access the system and can immediately start providing opinion points through a WebGIS interface. According to the study, a number of questions - n - appear next to the map, each with a different color; appropriate buttons allow each expert to locate the opinion points on the map, one for each question. These n points represent, according to the assessment of the expert, the places more suitable for the problem under study. After the positioning of each point, a dialog box opens, in which it is possible to write reasons for that choice. The first expert of the group, who starts the survey, sees on the map one circle for each question, which we call the *initial circles*, covering the entire area related to the question. If, for example, the study area includes two towns ($n = 2$), there are two initial circles, each covering the corresponding town. After at least two opinion points for each town are given, the initial circles automatically reduce (or expand) and move, according to the algorithm of the Spatial Delphi method (Di Zio and Pacinelli, 2011).

There is a window that opens when the expert gives an argument, displaying a series of information regarding the history of the points given until that moment. More precisely, for each point, there is: the argument, the date, the time, the diameter and area of the circle, and a marker (Fig. 1). The marker (a rectangle) is a consensus indicator; it is green (light grey rectangles in Fig. 1) if the point was positioned inside the circle of convergence (indicating consensus) or red (dark grey rectangles in Fig. 1) if the point was located outside (indicating dissent). Thus, the experts can see a list of useful data, in chronological order, regarding the whole process of consultation and convergence, providing tangible support in making his/her choice. This system is perfectly in line with the Real Time Delphi because each expert can see (anonymously) the statistical synthesis and arguments of the other experts and can answer as many times as desired, changing his/her opinions as often as necessary.

In addition to the circle of convergence and the feedback, experts can use a number of WebGIS tools to move the map, zoom in and out, measure distance and areas (top bar on Fig. 1) or visualize different types of maps, such as street maps, satellite images, land use, and so on (left panel of Fig. 1). Presently, the system is programmed with three different languages (Spanish, English and Italian), and other languages will be loaded shortly."

At the end of the consultation, the system produces two types of results: *geographical* results and *non-geographical* results. For each question, the main geographical result is a *final circle*, which, if the experts converge, is small enough to represent a solution to the research problem. The n final circles depicted on the map are understandable by anyone and thus are immediately usable for decision support or for spatial scenario building, without any further processing. Other geographical data are all the sequences of the opinion points and the sequences of the circles. Also very important are the arguments given by the experts, which, together with a number of statistical data, constitute the non-geographical product of a survey.

Once the survey ends, having the size of the initial circle and that of the final circle, we can construct, for each question, some measures of the convergence of the "spatial" opinions, namely, some quantitative indices of the consensus among the experts, which we can now call *geo-consensus*.

The simplest measure is the area of the final circle (or the diameter) because the smaller the circle, the greater the geo-consensus. We denote the area as M_1. A limit of this indicator is that it is an absolute measure because it does not consider the extension of the study area.

If the study region is an administrative area (e.g., a municipality), a simple relative measure can be derived from the ratio between the area of the final circle and the surface of the study area. We call it M_2:

$$M_2 = 1 - \frac{FC}{S}$$

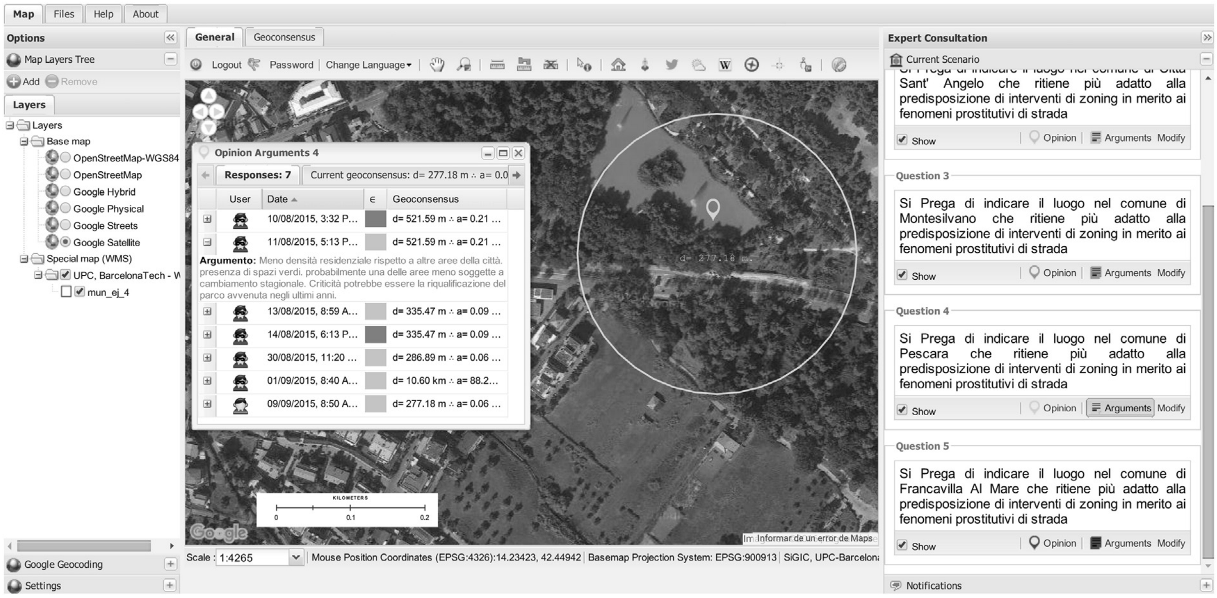

Fig. 1. A screenshot of the web interface.

where *FC* is the area of the final circle and *S* is the surface of the administrative unit. The closer this measure comes to 1, the smaller the final circle is compared to the surface of the administrative unit, therefore indicating a high degree of geo-consensus.

Another relative measure of the convergence (especially useful when the study area is not limited by borders) is the percentage of the area of the final circle with respect to the initial one. We call this indicator M_3:

$$M_3 = \frac{FC}{IC} \cdot 100$$

where *IC* is the area of the initial circle. If M_3 is closer to 0, the final circle is small compared to the surface area of the initial one, therefore signifying a high geo-consensus. The higher the value of M_3 (the maximum is 100), the lower the degree of convergence among the participants.

Some authors consider the use of consensus as a sole stopping criterion for a Delphi application a mistake (von der Gracht, 2012). In fact, there is a substantial difference between "consensus" and "stability" because in Delphi, it is first important to check for stability; only after does it make sense to verify whether there is consensus. Group stability is achieved only when the results of two subsequent Delphi rounds are not significantly different (von der Gracht, 2012). Thus, a good stopping criterion is the group stability achievement (Dajani et al., 1979; Scheibe et al., 1975; von der Gracht, 2012). Dajani et al. (1979) specified that in the case of stability, there may be consensus, majority, or plurality of views.

By using the dates of the opinion points and the corresponding diameters of the circles, for each question of the survey, we have a time series that gives information regarding the speed and magnitude of the geo-consensus, as well as group stability. In our method, stability will be deemed attained when a time series becomes stable (namely, when the trend assumes an asymptotic horizontal behavior), i.e., when the size of the circle varies less than a value that is reasonably small and chosen subjectively.

The final circles on the map, the arguments, the measures of convergence and the time series of the circles are the results (geographical and non-geographical) of the system and constitute a significant amount of useful information for decision support and/or scenario building.

The system is being tested in different areas of the world and for different topics. To date, here are the surveys that have been carried out:

- Location of monitoring sites for HIV screening tests for pregnant women (Esmeraldas, Ecuador);
- Location of points for blood collection (Cuenca, Ecuador);
- Environmental planning and management at a scientific station (Pedro Vicente Maldonado, Ecuador);
- Infrastructure and services planning (Tremp-Montsec Basin, Spain);
- Environmental Impact Assessment of wind energy (Mexico);
- Zoning of street prostitution (Abruzzo, Italy);

In this paper, we present the application to the zoning of street prostitution in Italy (see Section 4).

3.1. Strengths and weaknesses of the method

We now discuss the strengths and weaknesses of the Real Time Spatial Delphi, specifically by comparing it to the RTD and SD.

Many of the advantages of the RTSD are the same as those of the Real Time Delphi, as discussed in Section 2 (see also Table 2), and concern the fact that it is a web system, fully automatic and interactive. To these we must add the strengths inherited from the Spatial Delphi (Table 2).

Furthermore, we must add the inherent advantages of this novel method (Table 2). First, the study map is not "frozen", but being a WebGIS, the scale and extent are modifiable in real time, which produces great flexibility and the immediate availability of numerous spatial information. The expert can instantly consult a number of different supporting map layers, e.g., street maps, satellite images, land use, and so on (Fig. 1). Once a number of those maps are uploaded to the platform, they can be used for any type of application. Measurements of the history consensus and stability have good potential, especially if shown on the screen during the consultation. The window containing information regarding the history of the points (arguments, date, time, diameter and area of the circle, and colored markers) provides information in real time that the expert can use for his/her choices (Fig. 1). We have already observed that the boxes for the written arguments appear automatically on the map, greatly facilitating the respondent. Finally, any "non-spatial" questions can be implemented directly on the map.

Table 2
Strengths and weaknesses of the Real Time Spatial Delphi.

Strengths inherited from the Real Time Delphi
• Absence of repeated rounds;
• Simultaneous computation and delivery of participant responses;
• Possibility of a large number of participants;
• High efficiency with regard to the time frame needed to perform the analysis;
• Any type of supporting material can be included;
• Low realization costs (compared to the classical Delphi);
• The task of the facilitator is easy;
• Experts are not forced to respond a fixed number of times and at preset time intervals;
• Respondents are not compelled to complete the entire questionnaire in one working session.
Strengths inherited from the Spatial Delphi
• Very suitable for handling issues related to the territory;
• Ease in understanding the research questions;
• Easy and fast in responding (simply locating points on a WebGIS interface);
• The drop-out rate is very low;
• Easy computation of measures of the convergence of the opinions;
• The interpretation of the results is simple and does not require statistical processing;
• The problems of the choice of the response scales and response categories are not present;
• For each new application, only few modifications are necessary.
Further strengths
• The scale and extent of the map are modifiable in real time;
• The expert can instantly consult a number of different supporting GIS map layers;
• The maps present in the system can be used for any application;
• New instruments for measuring the history consensus and stability;
• Special windows display information regarding the history of the opinion points;
• The boxes for giving arguments appear on the map, facilitating the respondent;
• "Non-spatial" questions can be implemented on the map.
Weaknesses
• The problem of drop-out is still present, although lower than in the conventional Delphi;
• The system does not detect clusters of opinion points;
• The preparation of a survey requires specific skills.

This makes the RTSD suitable for both spatial and non-spatial problems and therefore applicable to a huge range of forecast/decision making issues, thus building a bridge between the Real Time Delphi and the Spatial Delphi.

The list of advantages makes the RTSD better than its two "parent" methods, but this does not mean that there are no disadvantages. Although lower than in the conventional Delphi, the problem of drop-out is still present. We have observed that in a study area, it is possible to provide as many initial circles (n) as the places to be searched and that, at the end of the survey, the final circles are necessarily n. However, this number is subjectively chosen and, above all, will remain fixed during the survey. It can happen, however, during the consultation, which on the map emerges a number of clusters of points greater than n, indicating that the number of suitable places chosen by the experts is greater than that initially predicted. In this eventuality, the most likely result is that one of the n initial circles will not become small enough, as if there was no geo-consensus, while, in truth, there is a convergence but in two or more areas inside the initial circle. Therefore, a future development could be to program the system to detect the formation of clusters, e.g., by using a threshold distance, and automatically create a variable number of circles of convergence as the survey goes on.

Finally, in the list of weaknesses, note that the preparation of a new survey requires specific programming skills, which makes the preparatory phase rather difficult (Table 2).

4. An application for the zoning of street prostitution

4.1. The zoning of street prostitution

The term *zoning* is used to indicate a policy approach that tends to tolerate street prostitution restricted within an urban area. However, it does not indicate what sort of sex work nor what degree of toleration. In some cases, zoning means restricting prostitutes to industrial areas; in others, zoning means toleration, from the police and/or from the municipal council, in a specific area. Thus, the term zoning has different meanings in different contexts (van Doorninck and Campbell, 2006).

"There is a constant and direct interaction between the form of an urban aggregate, and the lifestyle of its inhabitants, interaction that is built through the image of the city" (Lynch, 1960). The organized space, in which different units of society are located, has for each individual two important functions, which create stability in social relationships: that of the construction of identity and that of socialization. This is how *space* turns into a *place*, able to differentiate and characterize the actions of the individual, reinforce its symbolic capacity and transform the symbols in cultural values. This is opposed to the concept of "non-place", coined by Marc Augè to refer to contemporary urban degeneration, which involves the emergence of spaces devoid of identity, memory and stimuli for socializing, i.e., spaces that do not have enough relevance to be considered as "places" (Augé, 1992).

In the 1930s, the scholars of the Chicago School dwelled a long time on the connection and mutual influence of space on the formation of both the identity and behavior of individuals (Melossi, 2008). From these considerations, in recent years, a need was felt for a redefinition of the competences among the various levels of governance; in fact, the so-called *Spatial Welfare* has taken hold. A new perspective stresses the need to change the focus of social interventions from the target categories to the place of manifestation of the phenomena, following a holistic and multidisciplinary approach (Castelli, 2011).

In this methodological context fits the practice of street prostitution, a social phenomenon that characterizes the streets of many contemporary urban settings. Thus, in our approach, zoning is an intervention that aims to relocate the practice of prostitution in areas characterized by low population density, the presence of law enforcement and social workers. It is a methodology of harm reduction: it increases the effectiveness of actions aimed at the welfare of citizens and prostitutes. It has the objectives of promoting a more peaceful coexistence between the citizens and the phenomenon of prostitution and ensuring safety conditions (Castelli, 2012). It is a model of intervention that encourages networking among local services, social workers, cultural mediators, law enforcement, prefecture, hospitals and citizens. It is a practical and effective collaboration for the exchange of good practice, tools and methodologies to sign memoranda of understanding and joint projects (Castelli, 2014).

In this context, it is first important to detect the areas in which street prostitution occurs, and then it is crucial to identify specific "islets" in which to divert the sex workers.

In Europe, there are many countries that have applied zoning, such as Belgium, Denmark, France, Italy, Poland, Spain and the UK. These states have a common approach, tending to avoid the legalization of prostitution but moving towards a decriminalization with containment (Havelkova, 2009).

In Italy, there are very few cases of zoning, which occur only in some major cities, such as Rome, Milan, Venice and Naples, with none in Pescara; here, we propose a RTSD application in the district of this small town.

4.2. The use of the Real Time Spatial Delphi for zoning: an application on the Adriatic coast

"Zoning should not stand alone but be part of a multi-layered strategy to address street sex work" (van Doorninck and Campbell, 2006). In other words, zoning is a complex process involving many stakeholders, but the primary phase of finding a suitable place in the territory is crucial and very delicate. The Real Time Spatial Delphi can be of great utility because it allows for finding one or more areas shared by a group of experts, which are the final result of a spatial process of convergence of opinions.

Fig. 2. The study area.

The non-profit organization "On The Road", based in Pescara (Italy), is working on the possibility to realize interventions of zoning of prostitution to improve the policies of the governance of the territory. The area of interest covers five neighboring municipalities (Fig. 2) along the Adriatic coast in the Abruzzo region (Italy): Silvi, Città Sant'Angelo, Montesilvano, Pescara and Francavilla al Mare. These are mainly small towns where, on the streets close to the coastline, the phenomenon of prostitution, especially in the summer, is very present and produces significant social conflicts, as well as problems related to crime and drug dealing.

Silvi (approximately 15,500 inhabitants, 20.63 sq. km) and Città Sant'Angelo (approximately 15,000 inhabitants, 62.02 sq. km) are the two less populous villages of this area, located further north. Silvi, once a fishing village, also thrives on sea tourism, and it is quite far from Pescara. Città Sant'Angelo is mainly inland and its urban center, an ancient medieval settlement, is located on a hill, approximately 7 km away from the sea. Its particularity is that despite its large territory, the coastline is only 700 m (see Fig. 2).

Heading south, one arrives at Montesilvano, a relatively more populous village (approximately 53,500 inhabitants in 23.57 sq. km) that thrives mainly on tourism and trade. It extends between the Adriatic Sea and the hills and contains an area with a high presence of hotels, which receives a continuous flow of people both for tourism and business. Next is Pescara, the most populous city in the Abruzzo region and capital of the homonym province, with a surface area of 34.36 sq. km and approximately 121,000 inhabitants. The nerve center of the entire coast of the Abruzzo region, Pescara is a major tourist destination in Italy and is a university town, with a commercial port, a leisure port and an airport. This city is certainly the one with major problems associated with crime, prostitution and drug dealing.

Finally, most southern is Francavilla al Mare (approximately 25,400 inhabitants and a surface area of 23.09 sq. km), with an economy based mainly on tourism and fishing.

Although these are five different municipalities, urban development and seaside tourism make this stretch of the Adriatic coast (approximately 27 km) an area homogeneous in terms of socio-economic features and problems related to the phenomenon of prostitution.

In August 2015, we developed an application of the Real Time Spatial Delphi with the aim of identifying five areas, one for each municipality, as the most suitable for the application of zoning. To this end, we organized a panel by contacting nine experts with different specializations and skills. Specifically, the panel included a chair and two managers of non-profit organizations, a therapeutic community operator, a police officer and four social workers. In addition to the knowledge of the phenomenon of prostitution and the methodology of zoning, the essential conditions to be included in the panel were an excellent knowledge and work experiences in the study area. The experts were first contacted personally; then, after agreeing to participate in the survey, they received an email containing the invitation letter and the credentials to access the SIGIC platform.

The experts responded to the Real Time Spatial Delphi questionnaire by placing opinion points inside each municipality. During a couple of weeks, they returned often to the study, placing more and more points together with written arguments. The five questions - one for each municipality - appeared next to the map (see Fig. 3), with the buttons "Opinion" and "Arguments" having the same color of the corresponding circle to facilitate the giving of answers. For example, for Pescara, the question was: "Please, indicate the place in the town of Pescara you deem suitable for interventions of zoning regarding the phenomenon of street prostitution."

On the platform, we included base maps from Google Maps API (Satellite, Roadmap, Terrain and Hybrid) and from OpenStreetMap API (OpenStreetMap), as well as a layer of the five municipal boundaries from ISTAT (the Italian Institute of Statistics). By using this last layer, the five initial circles were set to cover each corresponding municipal territory.

During the exercise, we sent two intermediate reminder e-mails to stimulate the experts to provide other points.

5. Results

Among the nine experts contacted for the survey, seven answered the RTSD questionnaire, giving a total of 98 opinion points. Also very interesting was the high number of arguments given by the experts, i.e., 80.

The exercise started on August 7, 2015 and was closed on September 9, when stability was achieved for all the municipalities (see Section 5.1). Note that in Italy, August is a holiday month; thus, from August 15 to August 30, all experts interrupted the survey, meaning that the actual duration of the exercise amounted to only 19 days. Therefore,

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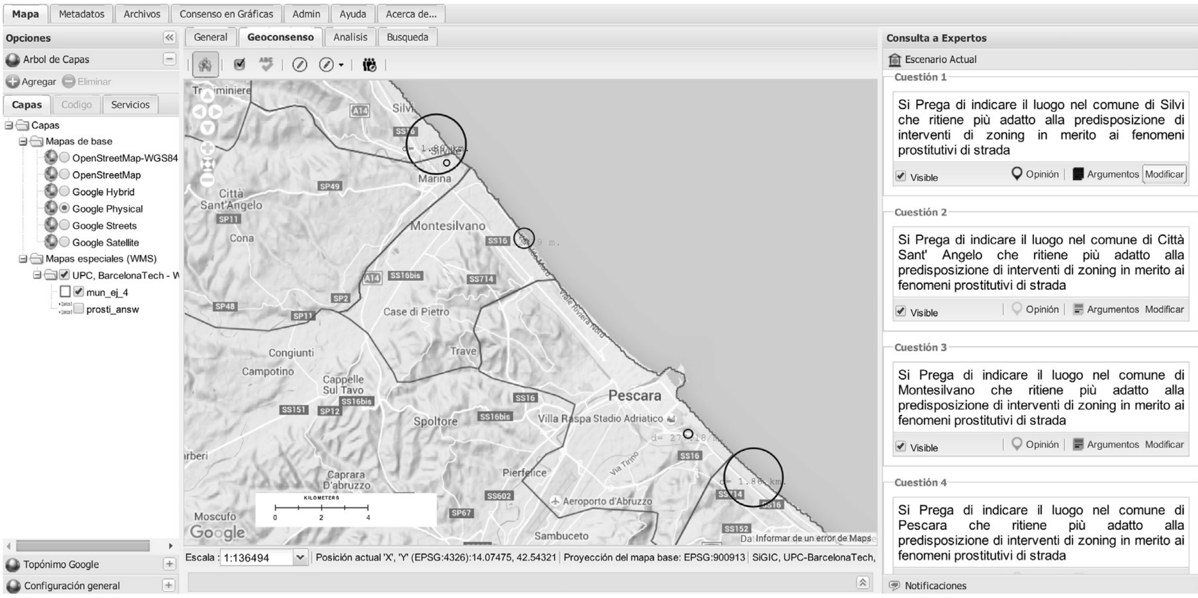

Fig. 3. Geographical results of the study on prostitution.

the experts were very active, not only with respect to providing opinion points but also to motivating their choices in a conscious and responsible way.

In Table 3, we report the main non-geographical results; for each municipality, we have the surface area of the town, area of the initial circle, area of the final circle (M_1), relative measures of convergence M_2 and M_3, total number of opinion points given, and average number of points per expert. This last measure indicates how much debate or how much interest there was among the experts when assessing that municipality.

For Città Sant'Angelo, Montesilvano and Pescara, the experts reached a consensus, given that the index M_2 was always greater than 0.98 and M_3 was always less than 1%. On the contrary, for Silvi and Francavilla al Mare, a convergence of opinions could not be considered reached (M_1 being greater than 2.7 sq. km, M_2 being less than 0.89 and M_3 being greater than 4.5%). This is also evident by looking at the map (Fig. 3) containing the final circles, namely, the geographical results.

In principle, experts indicated the opinion points by taking into account the areas where street prostitution is pervasive while also considering some particular features that make the zoning feasible, such as zones far from highly populated centers and far from the presence of tourists or degraded areas in need of rehabilitation. From the analysis of the comments of the experts (non-geographical results), we can extrapolate important information to interpret the results.

The highest convergence of opinions occurred for the municipality of Città Sant'Angelo ($M_2 = 0.9996$, $M_3 = 0.02\%$), with a final circle of only 2.7 ha (Table 3), completely on land. Because, as mentioned above, in the study area, the prostitution concentrates along the coastline, the result of the RTSD is a small area just behind the shore (Fig. 3). Many experts commented on their choice, saying that it is “an area isolated from the rest of the urban context, which might be particularly suitable for zoning. The customers might reach this area without fear and there would be no impact with the residents.” Other interesting comments referred to the activities of drug dealing present in this zone. With an intervention of zoning, the presence of law enforcement “would curb the phenomena of drug dealing” by also “eliminating the connections between prostitution and drugs trafficking”.

The second municipality in terms of geo-consensus was Pescara ($M_2 = 0.9983$, $M_3 = 0.07\%$), with a final circle of 6 ha (Table 3), completely inland (Fig. 3). The resulting area is located in a zone of the city far from downtown and with low population density. Furthermore, this zone is slightly inland, a few hundred meters from the coast; this is consistent with the fact that Pescara has a coastline with high population density and a considerable tourist flow (especially in summer). Thus, it is an area not near the coast (frequented by tourists) but close to it and far from homes. Here is one of the comments of the experts: “This area is currently already affected by the phenomenon. It has already made an impact on city life, which partly citizenship has learned to absorb. Making here intervention of zoning […], it would create a space not too much inside but not too far from the urban tissue, an area where to exercise the prostitution activities safely.”

The third city in which there was a good convergence of opinions was Montesilvano ($M_2 = 0.9867$, $M_3 = 0.76\%$). The final circle was 31.4 ha (Table 3), but note that it was located halfway between the sea and the mainland; therefore, the area available for a possible intervention of zoning is smaller (Fig. 3). This is an area with low population density between the coast and the urban fabric, situated in a part of the city with great passage of people both for holidays and for conferences. It is a small strip of land less than 100 m wide covered with pine trees; therefore, it is well hidden during the night from traffic and the walks of tourists. The experts said that “this area of Montesilvano could accommodate in full the dynamics of prostitution, which instead at present affect the whole coast and the streets around the park.”

Table 3
Some non-geographical results of the study on prostitution.

Municipality	Area (km^2)	Initial circle (km^2)	Final circle (km^2) M_1	M_2	M_3	No. of points	Average points
Silvi	20.630	62.180	2.809	0.8638	4.52%	19	2.71
Città Sant'Angelo	62.020	162.860	0.027	0.9996	0.02%	24	3.43
Montesilvano	23.570	41.396	0.314	0.9867	0.76%	23	3.29
Pescara	34.360	88.247	0.060	0.9983	0.07%	16	2.29
Francavilla al Mare	23.090	60.545	2.722	0.8821	4.50%	16	2.29

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Additionally, “a zoning here could clean the territory from deviant elements that intersect with prostitution.”

As stated before, in Francavilla al Mare, geo-consensus has not been reached ($M_2 = 0.8821$, $M_3 = 4.50\%$). The final circle was rather huge, covering a surface of 272.2 ha (Table 3), even though, as in Montesilvano, the circle was approximately halfway between the sea and the mainland (Fig. 3). The reading of the arguments of the experts reveals a possible explanation for the lack of geo-consensus. The coast is characterized by two main streets that run parallel to each other, one just along the beach and the other approximately 200 m inland. Panelists argued that at present, the prostitution is concentrated along these streets, which are highly frequented by tourists, in a strip of land of approximately 5.5 km. The participants placed their opinion points inside this strip but in different zones, which were distant from each other. Therefore, the lack of consensus in Francavilla al Mare is due to the presence of a huge area suitable for zoning; thus, it is difficult to choose a single point. To verify this interpretation, we interviewed one of the experts of the panel. He confirmed that “it is the conformity of the territory (a long, narrow strip of land) that makes difficult the identification of a specific area in which to practice zoning.” Indeed, he said, “street prostitution in this city is not concentrated in specific areas but spreads along the coastline, and this disorients in wanting to identify a specific area in which to practice zoning”.

The municipality where geo-consensus was the lowest was Silvi ($M_2 = 0.8638$, $M_3 = 4.52\%$). The final circle covered a huge area of 280.9 ha (Table 3), though a part of it extended to the sea and another part intruded upon the territory of Città Sant'Angelo (Fig. 3). Here again, the arguments of the experts were very valuable and helped us to understand why a consensus was not reached. Prostitution in this town is very dynamic and, in recent years, has constantly changed, from the streets to the apartments, from female prostitution to that of males and transsexuals, from the exploitation of prostitution to drug dealing, up to the management of entire neighborhoods by criminal organizations. To date, prostitution is practiced mainly in apartments, i.e., there is a scarcity of street prostitution. The experts have remained steadfast on some locations, giving many different reasons to justify their opinion points. Here is a summary of these reasons: “A seafront area because Silvi has above all a summer life”; “A non-place, or area to be reclaimed, slightly degraded and bad lighting”; “Area inhabited by immigrants”; “Rather isolated area, with a high perception of risk”; “Green area immersed in a highly populated district”; “Area strongly characterized by conflicts and complaints from residents”; “Industrial area, […] with poor light and low urbanization”.

Thus, if street prostitution is minimal, what should the main features of an area be to implement zoning?

Most likely, each expert focused on different aspects (seafront, degradation, lighting, immigration, perception of risk, green areas, urbanization, industrialization), and because it is impossible to have all these features in the same place in Silvi, this produced a huge final circle. Thus, in the case of Silvi, an important reflection emerges: the true problem is not the lack of consensus on “where” to implement zoning; rather, when prostitution is particularly indoors, there is still no agreement among experts regarding “what” is the suitable urban context for implementing this practice. Surely, prostitution and zoning are complex issues that go beyond the present study, but in our opinion, the case of Silvi provides interesting insights for future research. Additionally, for Silvi, we interviewed one of the experts, asking for his point of view regarding these results. The comment was that “Silvi is a village where the police practiced a strong repression of the street prostitution. As a consequence, to date there is a strong incidence of indoor prostitution, and a very little presence of street prostitution”. Therefore, “there is not a strong need for interventions of zoning”, which has probably led the experts to have doubts when indicating the best place for this practice. We can say that if the result is a lack of geo-consensus, the true conclusion is that in a particular village, zoning is not of primary importance.

Another important reflection arises from exploring the spatial distribution of the opinion points. In Silvi, while the majority of opinion points are located near the coastline, there is a small group of points towards the inland, approximately 3 km from the sea. This means that during the consultation, two clusters of points arose; unfortunately, the system is not programmed to manage more than one cluster for each municipality (see Section 3.1). This is another explanation for the failure to reach consensus.

As observed above, for Francavilla al Mare and Silvi, consensus has not been reached, but we have found that useful conclusions can be deduced from the arguments of the experts and from the analysis of the spatial distribution of the points. In fact, in Delphi studies, as recognized by various authors (Scheibe et al., 1975; von der Gracht, 2012), the absence of consensus is, from the viewpoint of data interpretation, as important as the presence of it.

By visualizing all the circles of convergence of an area (another geographical result), it is possible to obtain graphical information regarding the entire convergence process, which leads to the final circle. In fact, the circle of convergence shrinks during the survey but also moves, indicating how the experts have modified their preferences regarding the territory. For example, consider the case of Montesilvano (Fig. 4). Here, the circle moved rapidly along the coastline and remained more or less in the same area while reducing its size. However, in the case of Silvi (not in the figure), the circle jumped from one place to another, never decreasing under a certain dimension.

5.1. Consensus and stability

The whole study was concluded only after stability was achieved for all five municipalities. As observed above, an administrator can visualize the time series of the dimensions of the circles (non-geographical results), which give information regarding stability and the speed and magnitude of geo-consensus. In Fig. 5a − e, we have five time series (one for each village), with the number of days from the beginning of the survey on the horizontal axis and the diameter of the circles on the vertical axis.

The more the sequence of points approaches the horizontal axis, the greater the geo-consensus, because the circle becomes smaller. Looking at the five graphs, it is quite evident that for Silvi (Fig. 5a) and Francavilla al Mare (Fig. 5e), there is no consensus because the diameters of the circles do not drop below approximately 1.8 km. Instead, for the other municipalities, the consensus is evident, confirming the previous analysis (see Table 3).

Moreover, we can now also see the speed of the convergence. For example, in Città Sant'Angelo and Pescara, the consensus was very fast because the points on the graph were already close to the horizontal axis by the fifth/sixth day of the survey (Fig. 5b and d). In Montesilvano, the dynamic was different because the circle had a sharp reduction on the fourth day, reaching a minimum on the sixth and seventh days and then slightly rising again. Finally, for Silvi and Francavilla al Mare, the reduction of the size of the circle was slower, confirming the indecision of the panel due to the reasons discussed in the previous section.

From these graphs, it is also evident that there was a period during which there were no evaluations. From the tenth to the twenty-fourth day, there is a “hole” in all five time series, which, as said before, corresponds to two weeks of summer vacation.

Lastly, from the trend of each time series, we have information regarding the stability. Observing the last points of each sequence, we note how these are aligned, being substantially parallel to the horizontal axis, meaning that the size of the circle has stabilized. This occurred for all five towns, regardless whether consensus was reached. We can affirm that for all five municipalities, we achieved group stability, given that the variation of the diameter of two subsequent circles was less than 0.5%. This is, of course, an arbitrary threshold, but it is objectively very low. Stability was achieved after only 8 days for Silvi and Montesilvano and after 24 days for the other municipalities. More

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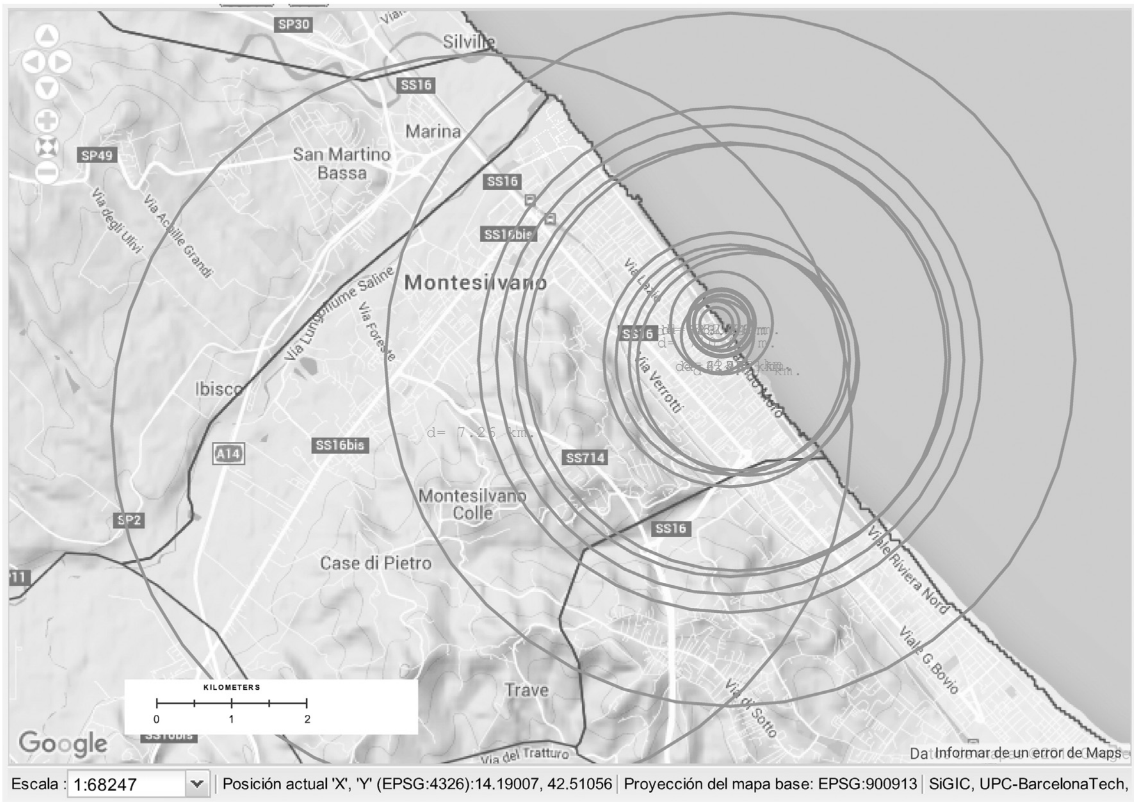

Fig. 4. View of all the circles for Montesilvano.

technically, by taking the last 5 points of each series and fitting a regression line to them, the estimated regression coefficient also offers information regarding the stability (the closer to zero, the greater the stability). For all five series, we obtained a regression coefficient of less than 0.003.

6. Concluding remarks

We have observed the development of a novel Delphi method, called Real Time Spatial Delphi (RTSD), resulting from the combination of two other methods - Real Time Delphi and Spatial Delphi - from which many advantages are inherited. The potential of the Real Time Delphi, especially in terms of execution speed, have been combined with the particular capability of the Spatial Delphi to address geographical issues. Moreover, the RTSD has its own capabilities, derived from the use of WebGIS technology.

With this new Delphi technique, it is possible to consult experts regarding a broad range of issues (geographical and non-geographical) in an efficient, real-time way, with very short times and low costs. The main result consists simply of circles on a map; thus, it is very easy to interpret and can be used without any further processing. The Real Time Spatial Delphi promotes geo-consensus in a spatial decision-making process, in complex situations with high uncertainty, or in circumstances of scarce or insufficient data that impede the application of quantitative methodologies.

The main contribution of this paper to the present literature is the addition of another piece to the large family of Delphi methods. The RTSD responds to the increasingly strong need for fast consultation methods that are intuitive, with easily treatable results, and immediately useable for decision support. In the existing literature, the Real Time Spatial Delphi constitutes a bridge linking the world of online questionnaires, the family of Group Spatial Decision Support Systems and that of WebGIS, where users can add items to a digital interactive map. This method also covers some of the open questions posed by the authors of the Spatial Delphi (Di Zio and Pacinelli, 2011), such as the management of different maps, the capability to interact with a map and the automatic calculation of the circles of convergence. Furthermore, because the platform can be programmed to have both spatial and non-spatial questions, the system offers a versatile instrument that can be used for a very wide range of possible applications.

The description of the web platform and the application presented in this paper have allowed us to explore some of the potential uses of this new method.

We have analyzed in detail the strengths and weaknesses of the method, and we have observed that the RTSD retains many of the strengths of the two methods from which it is derived, minimizing the disadvantages and itself having new strengths. The large amount of data stored during a survey allows for the calculation of a number of measures for geo-consensus and stability, and the results are both geographical (circles of geo-consensus and clusters of points) and non-geographical (the comments of the experts, the measures of geo-consensus and the time series of the size of the circles).

Of course, some weaknesses have also been identified, e.g., the system does not automatically detect spontaneous clusters of opinion points.

There are a number of possible future developments of the system. Regarding convergence, we are studying the opportunity to visualize in real time a relative measure of convergence, e.g., the percentage of the area of the circle with respect to the surface of the study area. From a technical point of view, this is very simple, but it will be important to understand if, from a methodological point of view, this could bring benefits and additional support to the experts.

Even if in this system the stability could be explored with greater detail, e.g., by developing a robust statistical test, our analysis of the time series of the dimensions of the circles is an easy and practical way to check for the stability and to define a stopping criterion of the survey.

At the present, all the opinion points have the same importance, but it could be useful in a future version ask the panelists to state also the

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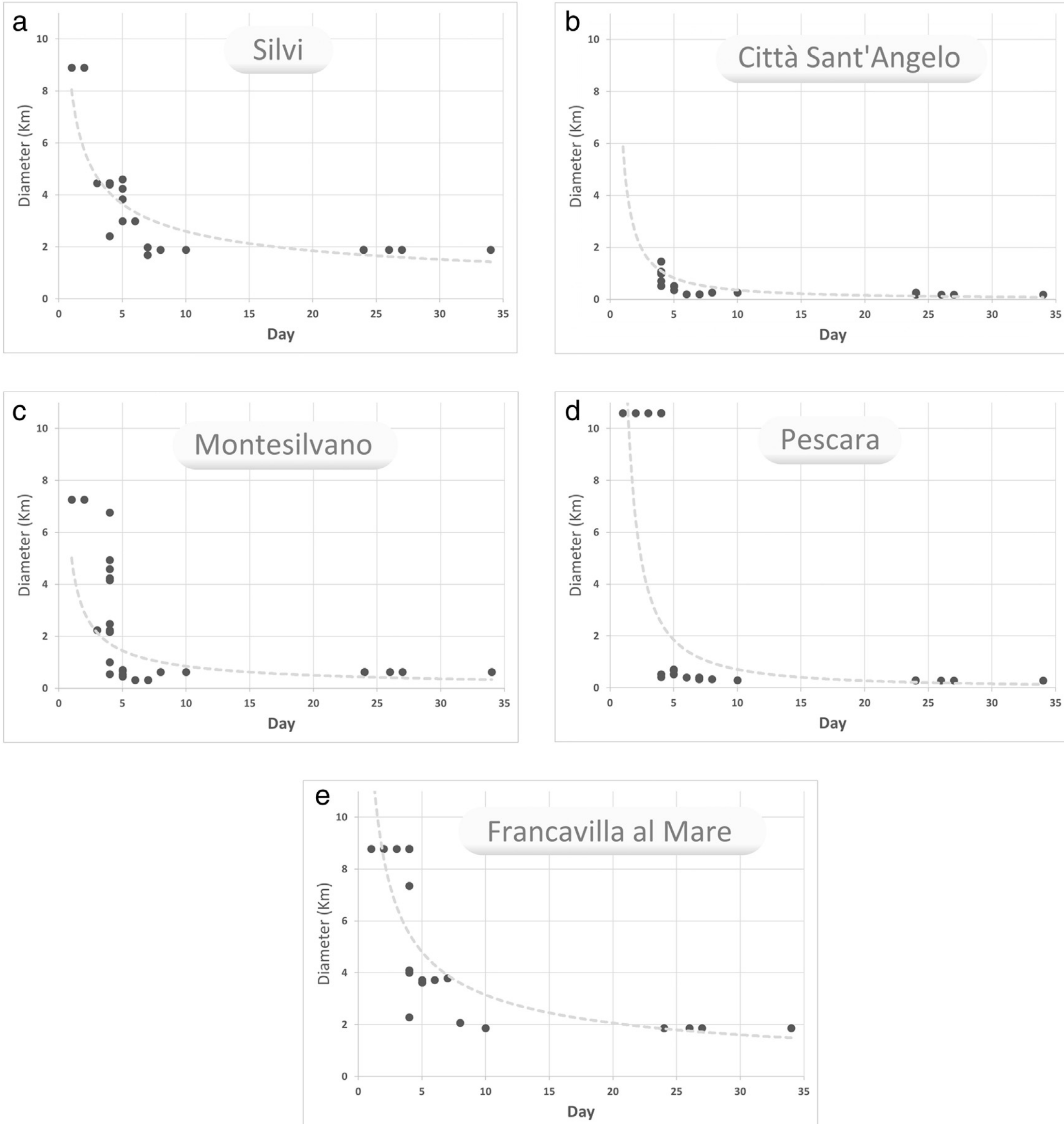

Fig. 5. Time series of the size of the circles.

strength of their suggested locations. In that way, each point will have a weight, and the weights could be used in the algorithm which computes the circles of convergence.

Thanks to the application to the zoning of street prostitution, we have observed that it would be interesting to develop an algorithm that automatically identifies the formation of clusters of points. In this way, the convergence of spatial opinions would no longer be caged inside a single circle but would be free to be expressed with respect to the territory as the experts provide their assessments. Having clusters of opinion points, it would be also possible to study the covariates of the respondents (genders, ages, regions, employment, etc.). In that case, the results of interest would be, for example, that males concentrate in a place and females in another place, or that young people prefer an area and older people a different area.

Regarding the SIGIC platform, research is currently underway to implement the Spatial Shang (Di Zio and Staniscia, 2014), following the logic of the Real Time Delphi; this will lead to the creation of a method that we'll call *Real Time Spatial Shang*. In this case, instead of circles, the experts will interact with rectangles on the map. Additionally, we believe that the web platform is easily adaptable to other types of Delphi, such as the Policy Delphi (Turoff, 1970) and the Public Delphi.

As the method becomes more widely used, there may be further applications. Consider for example: architecture, landscape gardening, war games, pinpointing points of origin and potential courses of epidemics, location of future crimes, location of computer hackers, planetary exploration, etc.

Another possible evolution of the system could involve taking into account the third dimension in space. In that case, the circle would become a sphere of convergence. For example, a 3D spatial application could respond to the following questions: where in a building is the safest when a fire occurs? Which are the best underground places, impervious to water and other intrusions, for long-term storage of nuclear waste?

Note that even when a consensus is not reached, the system provides very useful information for decision-making or scenario building. In the application to the zoning of street prostitution, we have observed that the analysis of the comments of the experts provides valuable material for decision support, regardless of the achievement of convergence. For example, in the case of Silvi, we did not achieve geo-consensus, but the various arguments are useful for a debate to define the characteristics of a place suitable for the zoning of street prostitution. From the analysis of the arguments, it also emerged that the lack of consensus in Silvi and Francavilla al Mare is due to different reasons.

While in Francavilla al Mare, the suitable sites are many and are located on a long strip of land, in Silvi, the scarce presence of street prostitution makes it difficult to find the best place for zoning. These considerations put the RTSD in line with the prevailing view in the literature, according to which consensus is not the main objective of Delphi studies; rather, “it is often where consensus is not evident that the interesting and important issues emerge” (Rowe and Wright, 2011).

After the survey, we interviewed one of the experts to ask him for an opinion regarding the use and usefulness of the RTSD system. His comment is as follows: “The innovative contribution of the use of the system results to be the substantial acceleration of the first step of the zoning: experts of this issue could, in fact, express their preference about the identification of a specific area in an immediate way, by following a simple online procedure. This passage has so speed up and considerably reduced the timeframe, that would certainly been longer, to organize and give life to negotiating tables and meetings, in order to reach a sustainable decision in respect of the various interests at stake. Moreover, it was possible to have clear and immediate visualization of the convergence of the opinions of the experts in real-time.”

Now, the results of the application will be given to the local authorities; if they decide to apply the zoning in Pescara and its surroundings, they will obtain decision support regarding the most appropriate places for this practice.

In conclusion, the RTSD is a new Delphi method that is also a new way of eliciting experts' opinions in a dynamic, modern and real-time form and on a simple and intuitive platform, making it potentially applicable to a very broad spectrum of forecast/decision making issues. We can include the SIGIC system in the context of *neogeography*, a new concept that refers to new geography (Turner, 2006), as non-expert users employ geographic techniques and tools, to achieve consensus in a decision support framework. It can be used, with appropriate adaptation, in various relevant areas related to the complexity of geographical space, such as the environment, security and defense, natural hazards, civil protection, health, education, energy, communications, commerce, development and spatial planning. Because the main result simply consists of circles on a map, it can be used as decision support and/or for spatial scenario building without any further processing.

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