

The volunteered geographic information in cadastre: perspectives and citizens' motivations over potential participation in mapping

Sofia Basiouka · Chryssy Potsiou

Published online: 22 August 2013
© Springer Science+Business Media Dordrecht 2013

Abstract The volunteered geographic information was introduced in 2007 and was first applied in navigation and mapping purposes. Currently, it has been applied in various fields and has been used for various purposes. The paper focuses on the potential of integrating crowdsourcing techniques in the compilation procedure of cadastral maps. This research aims to investigate the intention of citizens over the specific perspective in a theoretical approach and to analyze the results of the first experiment carried out in Greece. The main aim of the research investigates on citizens' intentions, motivations' analysis and in depth evaluation of the current official cadastral process. The research examined a wide range of participants of various ages and educational background composing an unbiased sample in Greece. A questionnaire was compiled and distributed to more than 250 volunteers. The volunteers were mainly questioned about their intention to participate in cadastral mapping and the potential motivations behind their participation. The research was carried out by filling out anonymous questionnaires in an online platform, adopting the exponential non—discriminative snowball sampling methodology. The research first focused on (a) raising awareness and exploring volunteers' availability and their familiarity with the new technologies; (b) identifying the reasons which would lead them to

participate in cadastral mapping; and (c) volunteers' opinions about the efficiency of the official traditional cadastral surveying procedure.

Keywords Volunteered geographic information · Crowdsourcing · Cadastre · Motivations

Introduction

“Where historically a professional cartographer might use conventional packages of GIS, compare Mercator versus Mollweide projections, and resolve land disputes, a new geographer uses a mapping API like Google Maps, talks about GPX versus KML and geotags his photos to make a map of his summer vacations.” Turner (2006). Smartphone expansion and APIs that can be downloaded and used on them have also played a critical role in this direction. Neogeography is the term that was given by Turner (2006) to express the specific phenomenon; Goodchild (2007) gave a different term and named it volunteered geographic information (VGI). Already large numbers of individual citizens without formal qualifications and experience, whose results may be uncertain, have obvious impacts on GIS which turns from official agencies to volunteers. Budhathoki et al. (2008) correlated the relationships between mapping agencies and users in the past and now indicating how the forms have changed. Not many years before, the

S. Basiouka (✉) · C. Potsiou
National Technical University of Athens, Athens, Greece
e-mail: s.basiouka@gmail.com

geospatial market was limited among agencies and enterprises in a strict model of two where the passive role was assigned to the users. Currently, the limits between users and agencies are indistinguishable. The main innovation is what Flanagan and Metzger (2008) have posed as volunteers' credibility defining the quality of data and users' trustiness.

Taking into account that each dataset "fits for purpose" and meets specific requirements and users' expectations (Coote and Rachman 2008), various applications have been launched during the last 5 years based on crowdsourcing techniques. The main fact is that volunteers' motivations vary and depend on the nature and importance of the applications. Navigation, leisure, and crisis management are the principle aspects which were developed with the aid of VGI based on various citizens' requirements.

When Steve Coast founded OpenStreetMap (OSM) by using UCL server for storing data in 2004, he probably didn't expect its expansion. There was a great need for free geospatial data not restricted by copyrights and other conventional limitations. OSM is the first dynamic map which was enhanced with the aid of volunteers for navigation purposes under the Creative Commons protocol. It was spread all over the world counting more than 805,000 users and 3 trillion uploaded GPS points at the time of writing (OpenStreetMap (2012). Haklay et al. (2010) did an in-depth research of number of volunteers in comparison to data accuracy using Linu's Law.

Crisis management is another field which was rapidly affected by VGI. The 2010 Haiti earthquake is a representative example of a sudden event which motivated volunteers to participate in order to rescue humans and support official aid in a clear, altruistic and humanitarian framework. The Libyan crisis and the earthquake and tsunami in Japan were also mapped with social media support and VGI software.

Leisure has evolved due to Smartphones' expansion which has offered easy and quick access to all social media from every part of the planet which can be connected to internet. According to Gartner (2012), 472 million smartphones were sold corresponding to 31 % of mobile communication devices sales. Among the most popular applications in social media are foursquare and flickr which were the first spatial applications that launched spatial check in users' placement and photograph sharing, respectively. Facebook and Instagram, in an effort to be expanded

into the geospatial market, introduced checks of places and photographs as well. It is not irrelevant that Instagram's spatial tagging is powered by foursquare and the whole application was bought by Facebook for a 1 billion dollars in a deal that was finalized last April (Inc 2012). Entertainment and social engagement are among the obvious motivations which activate volunteers in these applications.

Land administration is the newest field among the above and its evolution with VGI practices is just beginning. Although there are numerous publications concerning various aspects of land administration, the potential for crowdsourcing techniques in land administration is only lately discussed. Laarakker and de Vries (2011) offered a theoretical framework for an open cadastre by interviewing experts in LinkedIn in a way to identify their motivations which are far from altruistic. Basiouka and Potsiou (2012a) did the first practical cadastral mapping experiment by creating draft cadastral maps with crowdsourcing techniques and comparing this procedure with the traditional cadastral survey procedure. Volunteers' motivations to participate in that first experiment targeted bypassing bureaucracy and unblocking the property market in an area where the market was blocked for more than 12 years due to various problems in the cadastral survey. McLaren (2011) did a research in land administration systems and crowdsourcing techniques with the sudden expansion of smartphones focusing on the unmapped areas and the great number of unregistered parcels worldwide.

The main result indicates that volunteers' incentives vary a lot. All these "crowdsourcing" activities may be characterized as attractive in terms of participation as well as connection. However, the most important incentive may be the benefits that will be gained from the completion of the VGI projects. As Maron (2010) has admitted, while talking about crowdsourcing in crisis management, emergency cases constitute "an engineering problem in the most extreme environment." Is the current economic crisis considered to be an emergency case for Greece and Europe? Is the lack of cadastre in Greece considered to be an engineering problem in the most extreme economic environment? Is the fast and low cost compilation of an updated draft cadastre at a nationwide level expected to serve as a tool to support administration and facilitate economic growth? What do people really think?

The motivations behind the volunteered geographic information science

During recent years many researchers have tried to understand the participants' incentives for volunteerism. Although the VGI phenomenon is relatively recent and its' parameters have not been analyzed in depth, there are numerous publications which describe citizens' motivations towards volunteerism generally. Clary and Miller (1986), Clary and Orenstein (1991), Penner and Finkelstein (1998) are among the very first studies which figured out the motivations of volunteerism in general. The research sets its origins in the 1970s and was extended in many cases and scientific fields proclaiming the great interest of the researchers.

Publications over the motivations of volunteers

Volunteerism as a movement, and as self expression, has impelled researchers to carry out various studies over specific issues. The studies can be divided into three main categories according to their content: "volunteerism" in general, "volunteerism in GIS" and "targeted Volunteerism in specific geographic applications". The main innovation of this specific research is the focus on the motivations of volunteers in the field of cadastre by incorporating common reasons and creating new ones. This is the first research which explores theoretically the motivations of citizens towards a volunteered governmental project.

Before VGI became a trend, a research concerning volunteerism in general shed light upon the phenomenon. Papadakis et al. (2004) did a research based on questionnaires among volunteers and non-volunteers, males and females and service-oriented and non-service oriented majors in their motivations to volunteer. Their research was focused on a six-parameter volunteer inventory function (VFI) by performing a series of t tests: altruism, career, understanding, social, enhancement, and protection which was first launched by Clary et al. (1998). The results indicated that Values, Understanding and Enhancement were assigned significantly to female than male and those who had volunteered at some point in their life than the others. Many studies were based on the specific model and numerous publications have been carried out evaluating its outcomes. When Goodchild first

introduced the term "VGI" in public (2007) he did the very first approach to identify the motivations of Volunteers manipulating Geographic Information Issues by presenting two fundamental factors. The first one is based on the self—promotion that an individual hopes to gain from the participation in the project. It is remarkable that after the creation of the Mapchester—mapping of the city of Manchester over a weekend by volunteers—the majority of the people asked for feedback of how much they had done (Perkins and Dodge 2008). The second reason may derive from a personal satisfaction. Everyone feels satisfied for contributing to the completeness of such an ambitious effort. Tulloch (2008) considers also that achieving a higher level of empowerment may be a considerable reason for participating in VGI projects such as the OSM.

Another aspect that is posed by Sieber (2007) concerns activism which in fact is a significant worry according to her. It's unclear how one moves from a visualization environment to an active one. Various digital applications have proved the specific claim.

Haklay and Budhathoki (2010) gave an overview of the main motivations that can activate volunteers to participate: fun, recognition, money, unique ethos, reciprocity and instrumentality are notable among the most common factors given in relevant studies. Instrumentality means that volunteers can serve an aim and reciprocity means that volunteers can act positively in a positive aim. Both factors inspired the research of VGI in cadastre as a useful field of application.

The most recent research was carried out by Coleman (2010), who also posed his own list of factors by dividing them in positive/constructive and negative factors. In the positive factors, he listed altruism, professional or personal interest, intellectual stimulation, protection of a personal investment, social reward, personal reputation, self expression opportunity and pride of place. Among the negative factors, he listed mischief, social, economic or political agenda and malice/criminal intent. In another research Coleman et al. (2009), he divided volunteers in five categories based on their knowledge and background. Thus, a volunteer can be neophyte, interested amateur, expert amateur, expert professional or expert authority and may be get involved in various crowdsourcing actions based on his capabilities.

The framework of the research

The main questions which were posed during the design of the research were focused on the model that should be adopted; the content of the questionnaire; and the sample of the research. The researchers decided to adopt an evolved VFI model containing four main categories which fitted to the purpose of the research. The questionnaire was divided into four main sections and the sample was selected by using the exponential non—discriminative snowball sampling methodology.

The nature of the research

This research has combined many and different aspects of each previous research, mentioned in 2.1., especially in manners of structure and content. The VFI model includes six main functions which were used for the development of the questionnaire: the Values function, the Career function, the Understanding function, the Social function, the Enhancement function and the Protective function. For the current research the VFI was simplified in four main categories expressing the main reasons for participation in a cadastral mapping (Fig. 1). The values function expresses altruism and was named as “altruistic reason”. The career function contains the career reasons as the title suggests. The understanding function which includes skills practicing was merged with the career function. social function was also merged with enhancement function and protective function incorporating social awareness, relaxation, personal satisfaction and self promotion. These three categories were generally named as personal reasons. A new category was also created containing targeted, specialized reasons. A four-dimensional framework of theoretically approaching the volunteers’ motivations was created by the researchers in an effort to concentrate, simplify and fit the VFI (Clary et al. 1998) model to the requirements of a targeted research for a governmental VGI project.

The four categories were filled with motivations that were posed by the researchers of the publications above or were created by the researchers in aspects of the study’s nature. Among the most important factors that have been taken into consideration in all publications are those that can be divided primarily into two main categories: altruistic and egoistic motivations.

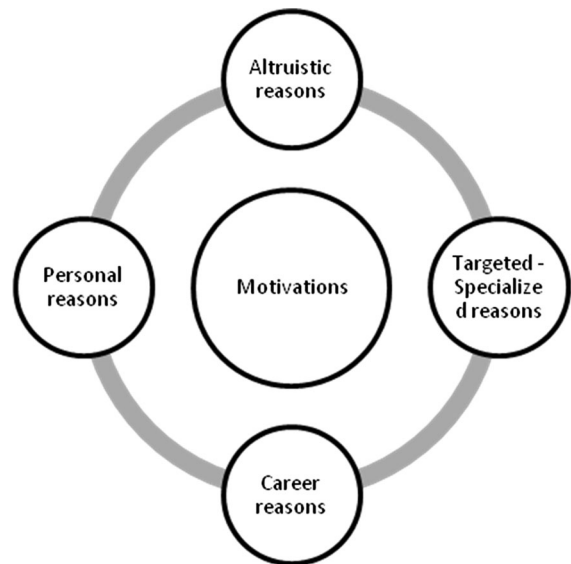


Fig. 1 Four—dimension model over volunteers’ motivations

The motivations for participating in cadastral mapping are given below.

- a. Altruistic motivation as a contribution to society which means to assist in any manner without any claim for exchange.
- b. Targeted and specialized questions on cadastral process. The volunteers were asked about their willingness to participate for cost and time elimination, for collection of accurate spatial data free of charge and about the lack of spatial data in the area of interest.
- c. Career reasons such as career investment and technical specialization on the specific field.
- d. Personal reasons and more specifically: personal satisfaction, relaxation, self promotion and introduction to social networks.

The content of the research

A questionnaire was designed by the authors and completed by 250 individuals in an online form supported by Google platform. It was divided into four main sections consisting of general, special and personal questions.

The first section consists of general technical questions in a way to figure out the familiarity of the citizens with the technical aspects; use of pc, broadband internet, cell phones with internet connection,

use of social media such as facebook, linkedin, etc. and use of dynamic maps. As MacLaren (2011) has emphasised, the expansion of Smartphones with the aid of GPS have given a great assist to crowdsourcing techniques.

The second section is focused on the willingness of citizens to participate voluntarily in cadastral mapping and the potential motivations which could lead them towards this direction.

The third section figures out how citizens perceive the hellenic cadastre (HC). How cautious and aware they are about its necessity, role, cost, funding and perspectives.

The last section includes personal questions concerning the gender, age, educational background and the potential professional connection of the citizen with the cadastre.

The questionnaire was designed according to closed format questions so that the respondents' answers could be restricted in specified boundaries in a way to easily categorize the different replies and export classified statistics. The questionnaires that are filled with open-end format questions are more time consuming, it is hard to categorize the replies and some questions may remain unanswerable. The main categories of closed—end questions that were posed are closed-end dichotomous questions, closed-end likert questions and closed—end scale questions.

The main questions are given in the text box in Fig. 2:

The sample of the research

The sample was selected by using the exponential non—discriminative snowball sampling methodology and covered a wide range of age and educational background spread in all Greek jurisdictions including urban areas, the capital city of Athens and rural areas as well. The questionnaire was shared by the researchers among undergraduate students of the School of Rural and Survey Engineering, staff occupied in Public Sector and Private Sector, Engineers (16 % of the total sample), Colleagues, neighbors and a wide range of people filling the social environment of the researchers (Fig. 3). This type of sampling technique works like chain referral. The exponential non—discriminative snowball sampling methodology was adopted due to its advantages. It is a quick,

inexpensive and efficient methodology which allows researchers to reach populations that are difficult to sample.

Objectives of the research and analysis of its results

The aim of the research

The main idea of the project is simple and is based in three main points; creating row cadastral maps with the aid of the owners—volunteers, eliminating the time of the official process and minimizing the costs. The aim of the research was to identify the interest of citizens towards a potential participation in cadastral mapping. The main objectives of the study were focused on citizens' opinion over the official cadastral process; to identify the motivations which could activate them to participate voluntarily in mapping and how acquaint are they with the idea of the volunteerism and the new technologies. The area of application is localized in Greece and the experiment is focused on cadastral procedures. However the main idea behind the experiment can be extended in many applications of land administration worldwide taking into account local distinctiveness and needs.

The research was carried out from May 2011 to December 2011 in a 6 months period of collecting opinions and responses anonymously, and from January 2012 to June 2012 when data was edited and results were evaluated. The period during which the research took place is extremely important taking into consideration that Greece has asked financial support from International Monetary Fund (IMF) while this study asks from citizens to participate voluntarily in a governmental project. Meanwhile, the unemployment rate reached 24.4 % in June 2012 up from 23.1 % in May 2012 which increased 6.3 % since May 2011 (Eurostat 2012). In the same period, Greece has accepted a 4-year SDR \$23.8 billion (about €18 billion) arrangement by the Executive Board of the International Monetary Fund. According to the Annex of IMF (2012a) the recent economic developments are worrying. “Since 2009, Greece has been unwinding fiscal and external imbalances, but through deep recession. Real GDP has declined by more than 13 percent since 2009. Private investment led the downturn in 2009, while public retrenchment started only in 2010” (IMF 2012b). It is clear that Greece is under a

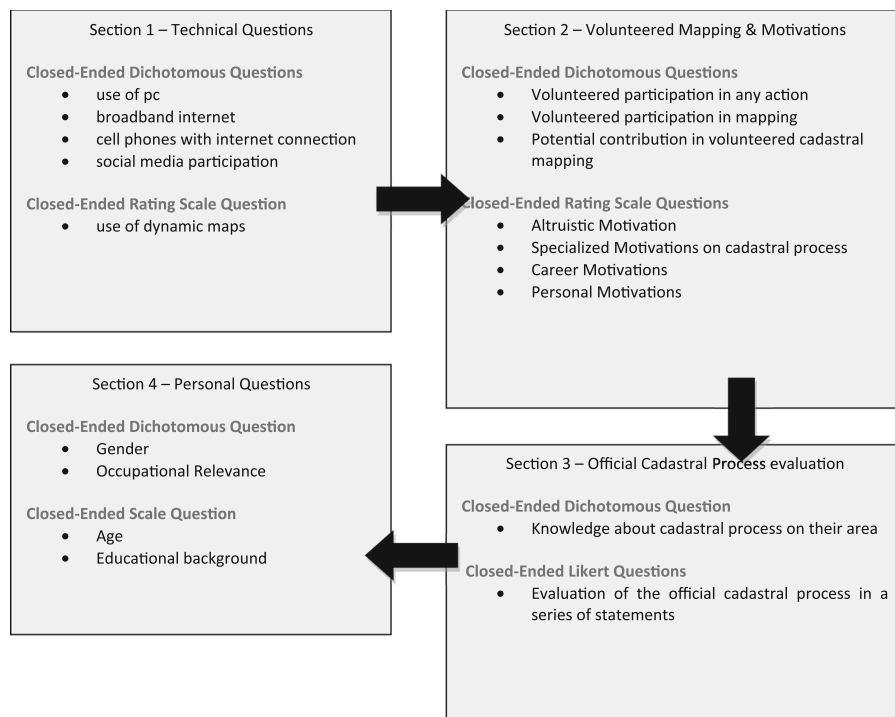
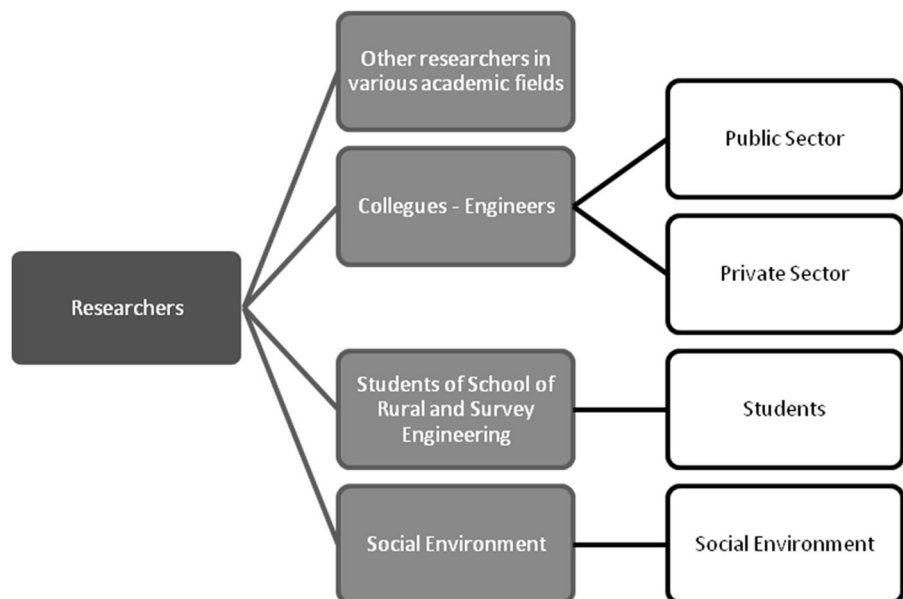


Fig. 2 The structure and the content of the questionnaire

Fig. 3 The exponential non—discriminative snowball sampling of the research



crucial financial situation close to an economic disaster which affects not only social coherence but also citizens’ trustiness over governmental projects and actions.

When the HC project started in 1995 few could predict how long it would last and how much money would be spend. The cadastral surveys have been carried out in 340 regions all over the country while 95

Cadastral Offices have already begun operations in these regions (Basiouka and Potsiou 2012a). The responsible agency for the HC project is KTIMA-TOLOGIO SA (KT). According to a previous research the total cost of the KT project until now has reached 340 M € while only 6.4 % (8,400 km²) of the total area has been completed and 6,800,000 property rights which in percentage is 17 % (Basiouka and Potsiou 2012b), while there are serious doubts that the project will be finished by 2020 as planned. However, with the Greek economy at such crisis, there is an urgent need for an updated land administration tool to support fair taxation and property markets.

The research is carried out so that an alternative plan to be proposed. The official cadastral survey includes the following stages (Basiouka and Potsiou 2012a):

- Declarations are submitted to the cadastral survey offices by the right holders and the registration of the declared rights is introduced in a digital database. During the submission right holders are expected to identify their properties on digital images on the screen. However, in several rural areas this is proved to be very difficult for them.
- The draft cadastral tables and diagrams are then formed based on the data that has been collected from the submitted declarations according to what the right holders have identified on the digital images, and has been processed by lawyers and surveyors.
- The draft cadastral data is suspended at the cadastral survey offices for a two-month period and dispatch of extracts is sent to the right holders for their information and acceptance.
- Objections or applications for correction of a cadastral registration are submitted and forwarded to independent administrative committees, depending on the case, by whoever has a legal right. According to KT about 340 rural areas that have been surveyed during the first phase of the project suffer by significant errors (of 40–50 %). Errors refer to the *location*, *shape* and *boundaries* of the land parcels. Errors are also noticed at the *records of the cadastral tables* where properties are recorded to belong to “unknown owners”.
- The cadastral data must then be reformed after the examination of the objections and the correction claims and the final cadastral tables and diagrams

are formed. These registrations are called Initial Registrations and they constitute the first registration in the HC.

However, in the areas with great percentage of errors this process lasted more than 12 years blocking the market and creating problems to the local economies; now, after a long period of evaluation of the errors, the whole areas need to be resurveyed. The main objective for introducing crowdsourcing techniques in cadastral data collection is to activate local citizens and right holders, as these are the ones who know the existing situation in the field (tenure and boundaries) better, in order to provide more accurate and cheaper draft cadastral maps and to shorten the duration of the procedure especially in rural areas.

Volunteers for the recording of spatial cadastral information

The scope of the research is to introduce citizens in a generally new idea of voluntarily manipulate spatial data for land administration purposes and more especially cadastre. The main differentiation of all previous studies that were focused of volunteers' motivations is that the specific is focused on the specified field of cadastre. In fact, a governmental land administrative project is characterized by a few aspects. First of all, cadastral mapping is targeted in volunteers—owners adopting the statement that no one knows the local area better than the residents. The whole project is based on the aid provided by the local people. The Mapchester was created within a weekend (Perkins and Dodge 2008). The whole effort was based on the residents' aid. Seeger (2008) notices that a volunteer offers valid information only if he is local or part of the community. Secondly, previous practical research has shown that owners face more specialized incentives in cadastral mapping than simply mapping such as eliminating time and cost of the process and bypass the preliminary phase of indicating the boundaries of their property on LSO orthophotos. (Basiouka and Potsiou 2012a, b). Thirdly, the quality of the specific producing maps “fits for purpose” so for the time being the research is centered in the preliminary phase of the official procedure. Any corrections will be done by surveyors in next phases.

Who can be a volunteer and how can contribute in cadastral mapping? These were the two main

questions that were answered by filling the questionnaire which was based on citizens' participation adopting the exponential non—discriminative snow-ball sampling methodology. Everyone who owns a property and knows its boundaries can participate in creating row cadastral maps. The questionnaire was delivered with a note explaining the purpose of the research and its aim. The receivers were informed about the meaning of volunteered geographic information and the successful example of OSM. The questionnaire was spread online, however the exact number of receivers is unknown due to the nature of the methodology that was adopted and let the receivers to pass it to other receivers. The questionnaire was answered by 250 individuals in total.

Citizens who live abroad were asked to participate in the research covering the 2.5 % of the total sample so that the answers will vary based on the external incentives. The percentage of women was higher than men; 145 women and 105 men participated on the experiment. The majority of the sample was among volunteers 18–30 years old in an effort to approach those who are more familiar with new technologies (Fig. 4). The sample in all other age categories was eliminated progressively.

Technical responses and dynamic maps

The research was firstly focused on technical aspects in order to identify the citizens' familiarity with the new technologies. According to Pultar et al. (2009) the transition from static to dynamic GIS maps is essential especially if it is taken into account that real world geographic objects are changing through time. It was, however, Peterson (1997) who first recognized the dynamic maps' success where users' actions are responded in real time by a map server. The first part

of the Survey is an introductory in Geographic Information before the participants are asked about the specialized section of VGI.

It is remarkable that in the first section, the majority answered positively. All who were asked have a pc and 96 % of them have a broadband connection while 60 % of them retain an account in social media pages and have a GPS proving the great increase which has been mentioned in the last broad band report of the observatory for the Greek Information Society (2011).

The extreme majority, 94 %, also answered positively in the use of online maps. Between the six most common maps in Greece (Google Maps, Bing, OpenStreetMap, DriveMe Terra and Navigation.gr Maps) the table below indicates that Google is the leader in use and preference far beyond its competitors. The specific maps were chosen among numerous others, not only because they are popular but also because they have not been derived by mashup maps. The spatial data used in each map is primordial and were not derived from different sources.

Table 1 summarizes to which extent the sample uses these online maps.

Greeks are willing to participate in VGI governmental cadastral mapping projects

Starting the second section of the research, the respondents were asked if they have ever participated voluntarily in any action, if they have especially participated in mapping and if they would potentially participate voluntarily in cadastral mapping. In neutral numbers, 56 % of the sample has never participated voluntarily in any action. Only 3 % of the participants have voluntarily participated in mapping and 51 % of the sample is positive in cadastral mapping although it's a totally new activity for them.

Fig. 4 The age and the educational background of the sample

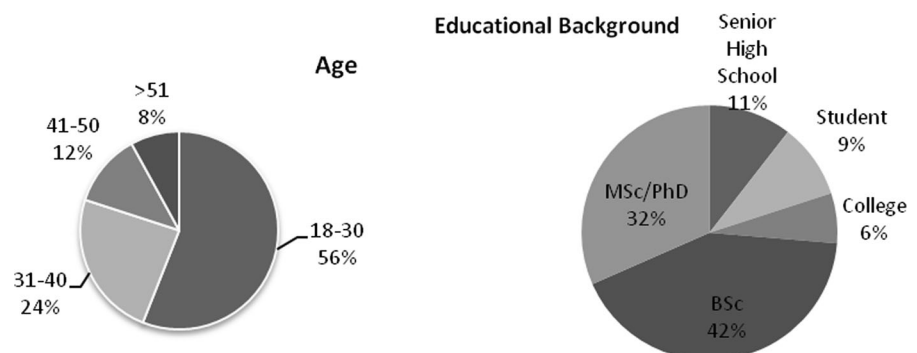


Table 1 Extend of use of specific dynamic maps

	Google maps (%)	Bing maps (%)	OpenStreetMap (%)	DriveMe Maps (%)	Terra maps (%)	Navigation.gr (%)
Not at all	1	81	86	56	91	75
To little extent	7	6	5	10	1	13
To some extent	20	6	4	16	4	6
To a large extent	24	5	3	11	3	4
To very large extent	49	1	3	7	1	3

The results indicate a positive trend towards cadastral mapping which is increased among the citizens who have already participated in an action or project voluntarily. All these citizens have already adopted a culture of contribution and 55 % of them could participate potentially in cadastral mapping. The percentage is encouraging if it is taken into account that the majority were volunteers in Olympic Games 2004 which was the most important national goal of the last 20 years before Greece turns into great economic depression. However, the most impressive is the percentage of experts who are willing to participate in cadastral mapping. Almost, 77 % of surveyors, GIS specialists and cartographers, generally young, are positive in participatory mapping potentially (Fig. 5). The specific results prove not only the proposal of experts volunteers as team leaders in targeted volunteered actions (Basiouka and Potsiou 2012b) but also verify Adlington's (2011) claims who has mentioned that in East Central Asia region the World Bank Land Administration Management projects have succeeded in the greatest land reform the world has ever seen because they have been guided by experts who were open to help without being stuck to traditional methods and high levels of accuracy, and were willing to be practical and meet the needs of the society. The results were constant between men and women although a gradual elimination of interest was mentioned in accordance to age growth.

The motivations behind the participation in cadastral mapping

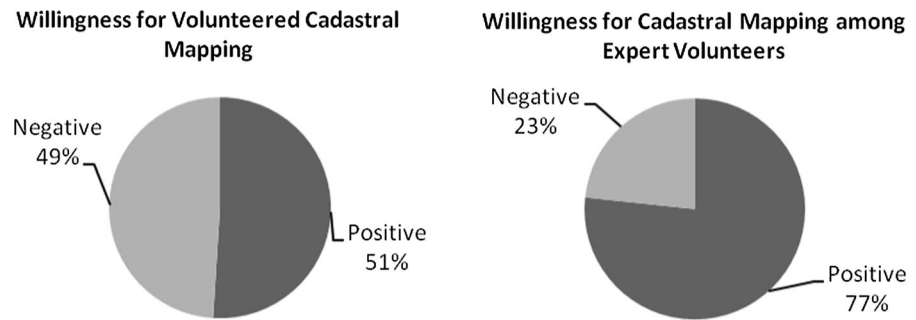
All previous researches have primarily focused on altruistic aspects (Coleman et al. 2009; Papadakis et al. 2004; Haklay and Budhathoki 2010). As Clary and Miller (1986) first underlined, altruism affects positively the length of service offered by Volunteers.

Altruism was the first main category that was also evaluated in the current research. The given answers were encouraging as the 63 % of the participants would participate in a large or very large extent as a manner of contribution to society. Only 4 % of the sample was totally negative in cadastral mapping for the specific purpose.

Clary et al. (1998) have reported that volunteers who receive benefits are more willing to participate in voluntary projects. The study indicated that the volunteers were willing to participate in contributory cadastral mapping in order to speed up the official process 32 % to some extent and 30 % to a large extent and minimize its cost 26 % to large extent and 22 % to very large extent. It is also remarkable that in the four categories the responses “to a large extent” and “to very large extent” surpasses 48 % which means that all four cases present importance for the citizens (Table 2).

The table summarizes the targeted responses below.

Regarding career reasons, the results are controversial indicating the real socio-economical situation of Greece. The majority (35 %, “not at all”) considers that participating in a governmental VGI project is not the proper way of career advancement. On the contrary, one out of four participants supports the opposite; participating in such a VGI project could broaden the horizons for gaining a relevant position. The citizens are divided into two main categories based on the secureness that they receive by their career field. However, participation is considered as a great opportunity for gaining technical knowledge in the specific field (60 %) and for developing practical skills over it. It is clear that the levels of unemployment have increased citizens' interest in new fields. As Clary et al. (1998) have summarized, career reasons are those that could activate volunteers to work in a scientific field that they might prefer.

Fig. 5 Willingness for cadastral mapping**Table 2** Volunteers' responses in specified questions over cadastral mapping

	Quicken the official process (%)	Minimize the cost of the official procedure (%)	Acquiring free geospatial data (%)	Fill the gap of reliable geospatial data (%)
Not at all	8	14	14	10
To little extend	8	16	8	16
To some extend	32	24	24	24
To a large extend	30	26	31	29
To very large extend	22	22	24	20

Among the personal reasons which were considered in the questionnaire, the predominant is the personal satisfaction where one out of three volunteers might contribute to a large extent. However, it is notable that volunteers might not contribute in cadastral mapping for all the other personal reasons which were given in the survey. Incentives such as stress elimination, self promotion and introduction in social networks leave them negligent. Not surprisingly, if it is taken into consideration that a targeted participatory mapping has to serve specialized needs. In all these personal cases the majority, which varied between 43 and 63 %, answered negatively in a perspective of participation forced by the specific motivations. Thus, it is clear that a targeted research like this which is focused on a specific aim cannot be advanced by general personal motivations. The results are summarized in the chart below (Fig. 6).

The graph summarizes to a large extent what volunteers support. In other words, what would potentially motivate them (Fig. 7).

In the last section of the questionnaire, the citizens were asked specialized issues over the official cadastral process and land administration generally. The questionnaire indicated that participants recognize the value of an accurate land administration system as a sign of a civilized society which protects public and

private ownership in a framework of fair taxation, and support of property markets and development.

It is notable that 47 % of the citizens who answered the questionnaire support unconditionally this concept, while 78 % of the sample is positive to this statement; cadastre will protect ownership (1). Furthermore, eight out of ten citizens agree that the existence of cadastre will eliminate squatting on state land, will solve all controversies of land ownership, while guaranteeing private properties (2). 66 % of citizens also believe that when the compilation phase is complete the economy will start benefitting (3) and more specifically 60 % of them agree that there is a need for accelerating the compilation procedure (4). The concern is lower in aspects like fair taxation; only one out of three citizens thinks that Cadastre will bring fair taxation due to limited trust at the political system (5); 43 % of citizens characterize the official process as time consuming and expensive (6), while 37 % of the sample thinks that Cadastre is created for taxation purposes (7). It is remarkable that four out of ten have neither positive nor negative reaction in these two last statements indicating ignorance over the subject.

The graph summarizes the given answers of the sample in very large extent of agreement to this section (Fig. 8).

Fig. 6 Volunteers' personal motivations

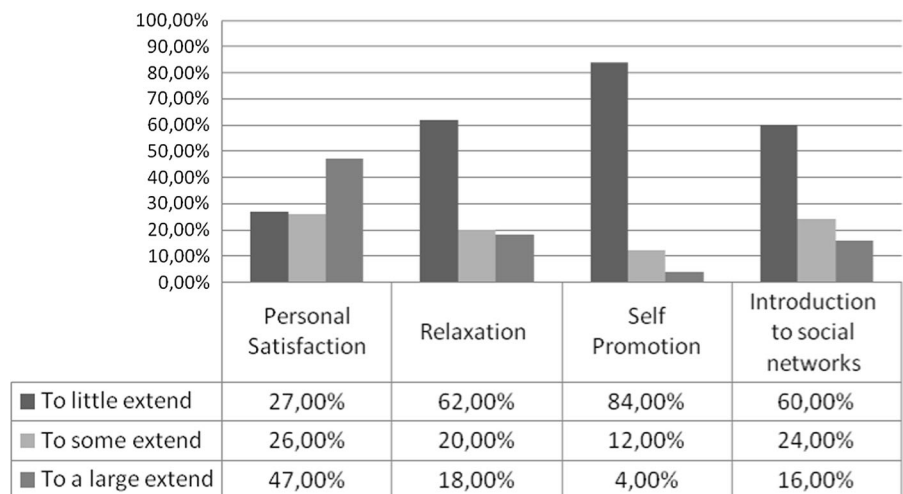
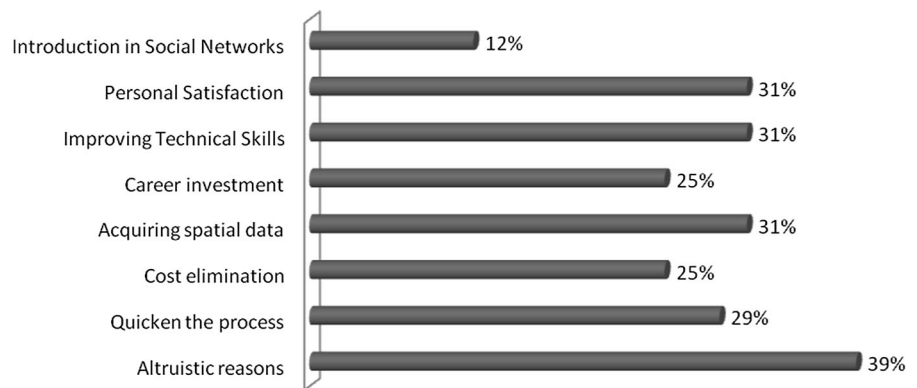


Fig. 7 Volunteers' summarized motivations



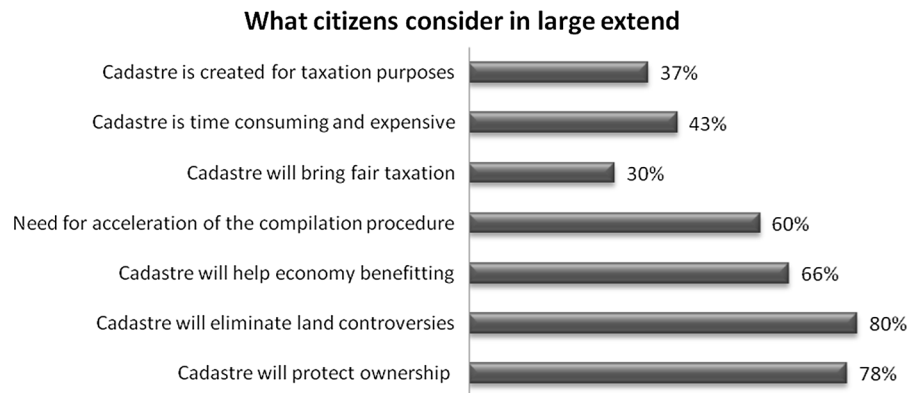
Discussion

It is clear that motivations of volunteers vary a great deal depending on the nature of the project. Also, volunteers may contribute in the same research motivated by various incentives. However, it is encouraging that among the principle motivations are altruism and the care for improving the official process. Although, Greece is in a difficult economic situation which primary affects society, the fundamental motivations are focused on the general improvement of land administration and cadastral processes. Participants recognize the need for an accurate land administration system as a tool for ownership protection and property market.

As the practical experiment proved (Basiouka and Potsiou 2012a) and Laarakker and de Vries (2011) approached theoretically, targeted reasons are found behind their participation. Elimination of time and

cost are the fundamental causes. Researchers' experience indicated that the theoretical approach differentiates slightly from the practical one. Participants' need for transactions and elimination of registration fees can be positive factors, speaking practically. Participant's desire to help society is the principal incentive, theoretically. Their positive recognition of the utility of a cadastral system was in contrast to their suspiciousness towards the official procedures which turns them from being reluctant to potential participants in mapping.

Although participants were quite divided into two main categories in either participating voluntarily on mapping or not, the majority was positive towards this direction. The percentage of positive answers was significantly higher among the younger participants, the citizens who had a previous voluntary experience, people that don't work in the public sector and do not have guaranteed job positions and

Fig. 8 What citizens consider in large extend**Table 3** Summary results of the survey

No great differentiation between men and women in terms of potential participation

Young participants were found more willing to potentially participate in a cadastral survey than elderly participants

The participants who answered negatively in participatory mapping were those who have never participated voluntarily in any action, and find the whole process time consuming and incomprehensible

Three out of four surveyors and GIS experts are positive in potential cadastral mapping

the experts such as engineers, surveyors and GIS analysts.

The Table 3 indicates the most predominant results of the survey.

Conclusions

This experiment was the first attempt to raise awareness among Greek citizens about the new possibilities that current technology provides. Respondents to the survey were positive to the concept of voluntary contribution to cadastral mapping under governmental guidance if strong incentives will be offered and a project's severity will be guaranteed. A more abstract concept of citizen participation might be a motivation toward a transformation of malfunctioning official administration. The official procedure for cadastral mapping may not yet be replaced as a universal public approval has not yet been achieved, but crowdsourcing methods should be implemented supplementary in a way to create low-cost draft cadastral maps within a short time. Such draft maps may be used for several purposes such as parcel inventory and property taxation until a more comprehensive cadastral project is completed.

It is clear that VGI is not the ultimate solution to all geospatial data updating and maintenance challenges

faced by mapping organizations. However, there is a growing agreement that it potentially represents one important channel for such updates, and one that needs to be investigated, prototyped and introduced in a reasonable, informed manner. A new era has come in which cadastres and their maintenance and up-dating worldwide may be based on open source techniques. The technological revolution in data acquisition and distribution through crowdsourcing methods proclaims that practical advances may be made; such progress is advantageous and inevitable.

Acknowledgments Acknowledgements to all those who have completed the questionnaire and offered their advices towards the specific research.

References

- Adlington, G. (2011). Rise or Fall of the Cadastre Empire? In: *Proceedings of FIG International Symposium Cadastre* (vol 2).
- Basiouka, S., & Potsiou, C. (2012a). VGI in cadastre: A Greek experiment to investigate the potential of crowd sourcing techniques in cadastral mapping. *Survey Review*, 44(325), 153–161.
- Basiouka, S., Potsiou, C. (2012b). Improving cadastral survey procedures using crowd sourcing techniques". *Coordinates Magazine* vol. VIII, issue 10, 20–26.
- Budhathoki, N., Bruce, B., & Nedovic-Budic, Z. (2008). Re-conceptualising the role of the user of spatial data infrastructure. *GeoJournal*, 72(3), 149–160.

- Clary, E. G., & Miller, J. (1986). Socialization and situational influences on sustained altruism. *Child Development*, 1358–1369.
- Clary, E. G., & Orenstein, L. (1991). The amount and effectiveness of Help: The relationship of motives and abilities to helping behavior. *Personality and Social Psychology Bulletin*, 17(1), 58–64.
- Clary, E. G., Snyder, M., Ridge, R. D., Copeland, J., Stukas, A. A., Haugen, J., et al. (1998). Understanding and assessing the motivations of volunteers: A functional approach. *Journal of personality and social psychology*, 74(6), 1516.
- Coleman, D. J., Georgiadou, Y., & Labonte, J. (2009). Volunteered geographic information: The nature and motivation of producers. *International Journal of Spatial Data Infrastructures Research*, 4(1), 332–358.
- Coleman D. J. (2010). Volunteered geographic information in spatial data infrastructure: An early look at opportunities and constraints. In: *Proceedings GSDI 12 World Conference*.
- Coote, A., Rachman, L. (2008). Neogeographic data quality—is it an issue?. In: *Proceedings of Annual Conference of the Association for Geographic Information, AGI*.
- Flanagin, A. J., & Metzger, M. (2008). The credibility of volunteered geographic information. *GeoJournal*, 72(3), 137–148.
- Goodchild, M. F. (2007). Citizens as sensors: The world of volunteered geography. *GeoJournal*, 69(4), 211–221.
- Haklay, M. M., Basiouka, S., Antoniou, V., & Ather, A. (2010). How many volunteers does it take to map an area well? The validity of linus' law to volunteered geographic information. *The Cartographic Journal*, 47(4), 315–322.
- Haklay, M.M, Budhathoki, N. (2010). OpenStreetMap—Overview and Motivational Factors. In: *Proceedings of communication au Horizon Infrastructure Challenge Theme Day, Université de Nottingham*.
- Laarakker, P., & de, Vries, W. T. (2011). www.opencadastre.org: Exploring potential avenues and concerns. In: *Proceedings of the FIG working week*, p. 16.
- McLaren, R., & McLaren, R. (2011). *Crowdsourcing support of land administration: A new, collaborative partnership between citizens and land professionals*. UK: Royal Institution of Chartered Surveyors (RICS). 32.
- Papadakis, K., Griffen, T and Frater, J. (2004). Understanding volunteers' motivations. In: *Proceedings of the 2004 north eastern recreation research symposium*, pp. 321–326.
- Penner, L. A., & Finkelstein, M. A. (1998). Dispositional and structural determinants of volunteerism. *Journal of Personality and Social Psychology*, 74(2), 525–537.
- Perkins, C., & Dodge, M. (2008). The potential of the user-generated cartography: a case study of the OpenStreetMap project and Mapchester mapping party. *North West Geography*, 8(1), 19–31.
- Peterson, M. (1997). Trends in internet map use. In: *Proceedings of 18th international cartographic conference, ICA*, pp.1635–1642.
- Pultar, E., Raubal, M., Cova, T., & Goodchild, M. (2009). Dynamic GIS case studies: Wildfire evacuation and volunteered geographic information. *Transactions in GIS*, 13(1), 85–104.
- Seeger, C. (2008). The role of facilitated volunteered geographic information in the landscape planning and site design process. *GeoJournal*, 72(3), 199–213.
- Sieber, R. (2007). *Geoweb for social change*. <http://www.ncgia.ucsb.edu/projects/vgi/supp.html>. Accessed 01 Sep 2012.
- Tulloch, D. L. (2008). Is VGI participation? From vernal pools to video games. *GeoJournal*, 72(3–4), 161–171.
- Turner, J.A. (2006). *Introduction to Neogeography*. Short Cuts, O'Reilly Media, ISBN: 978-0-596-52995.

Online resources

- Eurostat. (2012). *Unemployment Statistics* (online). Available at http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Unemployment_statistics. Accessed Sep 2012.
- Gartner. (2012). *Gartner says worldwide sales of mobile phones declined 2 percent in first quarter of 2012; previous year-over-year decline occurred in second quarter of 2009*. <http://www.gartner.com/it/page.jsp?id=2017015>. Accessed Sep 2012.
- Inc. (2012). *Deal of the Year: Facebook buys instagram* (online). Available at <http://www.inc.com/nicole-carter-eric-markowitz/facebook-buys-instagram-for-1-billion.html>. Accessed Sep 2012.
- IMF. (2012a). *ANNEX recent economic developments* (online). Available at <http://www.imf.org/external/np/sec/pr/2012/pr1285.htm#TopOfPage>. Accessed Sep 2012.
- IMF. (2012b). *IMF Board Approves €28 Billion Loan for Greece*. IMF Survey online (online). Available at <http://www.imf.org/external/pubs/ft/survey/so/2012/CAR031512B.htm>. Accessed Sep 2012.
- Maron, M. (2010). *OpenStreetMap. A disaster waiting to happen* (online). Available at <http://www.slideshare.net/mikelmaron/openstreetmap-a-disaster-waiting-to-happen>. Accessed Oct 2010.
- Observatory for the Greek Information Society. (2011). *12th broadband report* (online). Available at <http://www.observatory.gr/page/default.asp?la=1&id=2101&pk=442&return=183> Accessed Oct 2012.
- OpenStreetMap. (2012) *OpenStreetMap Statistics* (online). Available at http://www.openstreetmap.org/stats/data_stats.html.