

## Keeping the BGT up-to-date:

*Volunteered geographic information, a serious option?*



**GIMA Master thesis**

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## Abstract

Volunteered Geographic Information (VGI) is often suggested by academics for governments to keep their geo-information better up-to-date. But in contrast to corporate and open VGI platforms, mature governmental VGI platforms are generally lacking. This research investigates if VGI could be a successful option to keep a Dutch topographical dataset, the Basisregistratie Grootchalige Topografie (BGT), up-to-date. The focus of this research is on the social sides of VGI: are governments willing to adopt VGI and are there volunteers willing to deliver this data and why (not)?

Surveys among both groups showed that VGI is a very viable option. Both groups were positive about the usefulness of crowdsourcing. The volunteers showed that they are mostly intrinsically motivated to contribute, due to altruism, learning, self need and especially fun and local knowledge. Extrinsic motivations were less strongly found. Both results are in line with previous VGI research about contributor's motivations.

In contrast to indications from literature, governments were positive about crowdsourcing. There were some reservations, such as doubt about the VGI quality, the revenues and the amount of volunteers, but these were less strongly present than expected. The prevailing image about governments seemed to be too pessimistic and a successful adoption of VGI is certainly feasible on a short term.

There are thus good indications that there will be volunteers to contribute and governments are much less reserved as expected. VGI could thus be a useful instrument for keeping the BGT better up-to-date.

## Acknowledgements

Like volunteered geographic information (VGI) this research could not have taken place without a willing and supporting crowd. First of all, I want to thank all respondents who filled in the surveys. With more than hundred respondents per survey, the response was higher than expected. Especially the high number of response from the source holders (200!) was surprising and gave the research and the results a great boost. In this light, I would like to thank the SVB-BGT for sending an e-mail to all source holders. Without this e-mail, the generated response would be much less.

Furthermore, I would like to thank all organizations which were enthusiastic to discuss the idea of VGI: ProRail, Provincie Overijssel, Dataland, Bram van Hove, Ministerie van Infrastructuur en Milieu and the Kadaster. The enthusiasm of the first two organizations has learned me a lot of the underlying processes of creating the BGT. Dataland and Bram van Hove shed an interesting new light on the research and the way governments work. With the openness and positive attitude of the Ministerie van Infrastructuur en Milieu and the Kadaster, I gained a lot of knowledge about the current feedback processes and current issues. The Kadaster was furthermore very transparent in the results of their conducted crowdsource projects, which were very informative to better understand the practical implications of VGI.

Of course, I would also like to thank my friends and family which showed a lot of support during this research. Thanks to my fellow thesis writing friends at the university of Utrecht, the writing process was a lot more fun than expected. Furthermore I would really like to thank my girlfriend, Jessy, who did not only show a lot of support, but also gave very useful critical comments on my research.

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*Jaap-Willem Sjoukema*

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## 1. Introduction

2015 will be an important year for many Dutch public organizations. At the start of 2016 they have to deliver the BGT, the Basisregistratie Grootchalige Topografie (Key Register Large Scale Topography). This is a very detailed digital map of the Netherlands, which should be usable on a scale between 1:500 and 1:5000 (see figure 1). Many public organizations on national, regional and local level are involved in delivering the 'parts' which are necessary to create this map and are called 'bronhouders' ('source holders'<sup>1</sup>). There are seven different types of source holders: municipalities, provinces, water boards, Rijkswaterstaat (water and road infrastructure), Ministry of Defense, Ministry of Economic Affairs and ProRail (rail infrastructure): In total, there are almost 450 source holders. It is obligatory for each of these source holders to have the BGT put in place before the start of 2016 and thereafter they should keep their parts of the 'puzzle' up-to-date (Ministerie van Infrastructuur en Milieu, 2012; BGT-web, 2014; Geonovum, 2014a; see also textbox 1).



Figure 1 Exemplary screenshot of the BGT-dataset of Leiden viewed in PDOK (PDOK, 2014).

Although the majority of the source holders is now busy with the realization of the BGT, it will be wise to start thinking about keeping the BGT up-to-date. The predecessor of the BGT, the GBKN, had known backlogs in its contemporariness. Especially data of rural areas was not always up-to-date, despite the obligation to refresh it every year. Ironically, these errors were mainly found when the transition to the BGT started (SVB-BGT, 2014).

The backlogs are not very surprising. Change detection is a time intensive and costly job. Nowadays, most of the changes are detected with detailed aerial photographs, which are very precisely manually checked on even the smallest changes. The update interval is, due to the high costs of labor and aerial photography, in most cases just once a year, while real-time GIS is becoming more and more important (Goodchild, 2011). Governmental maps are also in many cases less up-to-date than those of commercial digital map providers, which challenges the position of governmental maps (Coleman, 2013; see figure 2):

*“[G]overnment topographic mapping products in most countries are not “authoritative” by any practical definition. Far from it. They are typically out of date, possibly inconsistent, and usually the victims of diminishing maintenance budgets (Coleman, 2013, p. 259-260).”*

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<sup>1</sup> Actually there is not an official translation for the word 'bronhouder' yet, as it also a made up word in Dutch. 'Source holder' is a quite literary translations, but most often used in fellow thesis research. However, some refer to 'bronhouders' as 'custodians' in their research.



Keeping the BGT up-to-date with the conventional methods is thus a time intensive, cost consuming job with a too low update interval for modern demands. Luckily there is an important development in geo-information in the form of Volunteered Geographic Information (VGI).

## 1.1. Volunteered Geographic Information

Volunteered Geographic Information<sup>2</sup> (VGI) emerges through

*‘the widespread engagement of large numbers of private citizens, often with little in the way of formal qualifications, in the creation of geographic information, a function that for centuries has been reserved to official agencies (Goodchild, 2007, p. 212).’*

Citizens are nowadays technically enabled with the functionalities of Web 2.0 to create user-generated content and GPS to locate yourself. VGI has therefore attracted many users and applications (Goodchild, 2007; McDougall, 2009).

For the GI-community, VGI-data has major advantages. Society has more eyes and ears than even the largest organizations. Furthermore, because VGI is done on a voluntary basis, *‘it is far cheaper than any alternative, and its products are almost invariably available to all (Goodchild, 2007, p. 220).’*

A notable VGI example is OpenStreetMap<sup>3</sup> (OSM), which is *‘frequently cited as one of the most successful VGI projects within the GIScience community (Budhathoki, 2010, p. 61).’* OpenStreetMap is a community of voluntary online mappers, which contribute and maintain geographic data all over the world. Basically everyone can use and produce OpenStreetMap data. Thanks to its large and growing community, OSM has surprised the GI-community because it *‘has shown that VGI can reach very good spatial quality (Haklay, 2010, p. 701).’*

Furthermore, OpenStreetMap is continuously updated in contrast to many official maps of the Netherlands (see figure 2). This sparked initiatives as OpenTopo<sup>4</sup>, which is a mash-up of data from OpenStreetMap and open data from several Dutch organizations. The goal of this project is to create a topographic map which is more up-to-date than the one from the Dutch cadaster (Kadaster), while retaining the experience of topographic maps from the cadaster (Imergis, 2014).

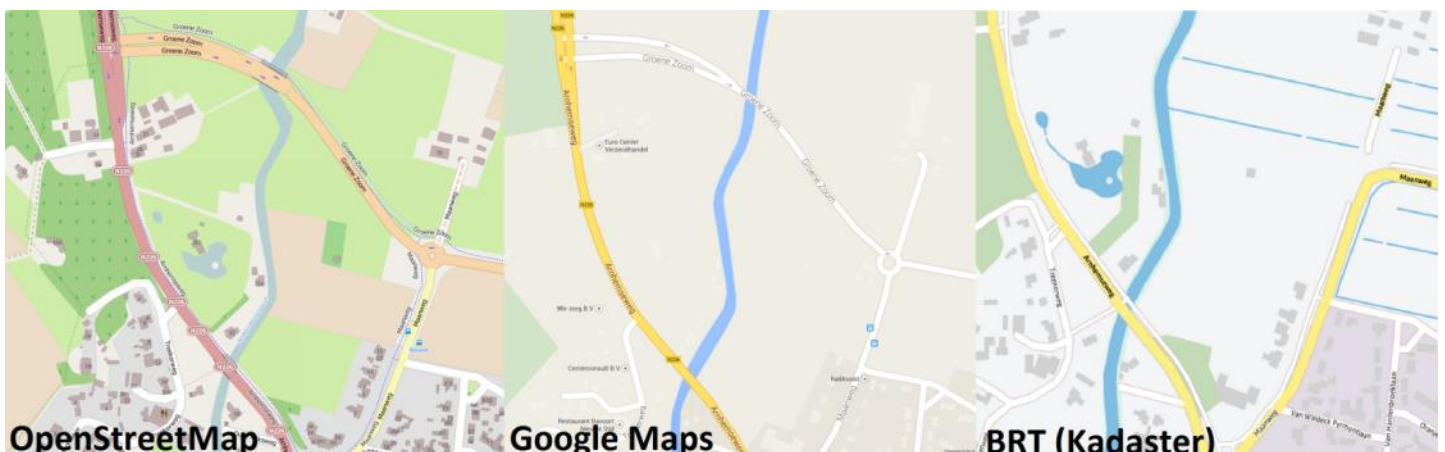


Figure 2 Comparison between OSM (open VGI), Google Maps (corporate VGI) and the BRT: the national topographic map of the Netherlands. There are major differences in the level of detail. Most strikingly however, is the absence of a road in the BRT (see textbox 1). The road opened up in September 2013 and a year later (31-10-2014) it still has not appeared (viewed in PDOK, 2014).

<sup>2</sup> Also sometimes called ‘neogeography’, ‘GIS 2.0’, ‘wiki-mapping’, ‘crowd-sourced GI’ or ‘geoweb’ (Elwood, 2010). In this thesis I will use the term volunteered geographic information (VGI) as proposed by Goodchild (2007).

<sup>3</sup> <http://www.openstreetmap.com>

<sup>4</sup> <http://www.opentopo.nl/>

### ***Textbox 1: The Dutch key registers and the role of the BGT***

The BGT is part of the Dutch key register system. This system will be implemented in order to make all Dutch governments better organized and efficient. Furthermore this system provides that all key registers are exchangeable between governmental organizations. In the future, all key registers will be linked together, which makes information exchange even more efficient.

It will be too exhaustive to explain all 12 key registers and their relations. But it is important to understand the place of the BGT and its relation to other (geographical) key registers. The BGT will be related to three key registers:

- BAG (Basisregistratie Adressen en Gebouwen): This is the key register for addresses and buildings (premises). This key register contains the geometry of all premises in the Netherlands which will be used as input for the BGT.
- BRT (Basisregistratie Topografie): This relative of the BGT contains the topography on a less detailed level as the BGT (from 1:5000). The BGT will be used as input for the BRT. At this moment, the BRT is already 'finished', so we could already learn from processes behind the BRT (see also textbox 2 and 3)
- BRK (Basisregistratie Kadaster): This key register contains the geometry and information of parcels, such as ownership and mortgages. This key register will use the BGT as input.

It is important to know that source holders have a legal responsibility to keep the quality of their key registers high. Because of the linkages between the key registers, errors in the BGT could indirectly translate themselves to mistakes in the level of property taxes or wrongly granted permits. This could influence the attitude of source holders towards VGI negatively. However, the BGT has less 'power' in these cases than for example the BAG or BRK (E-overheid, 2014).

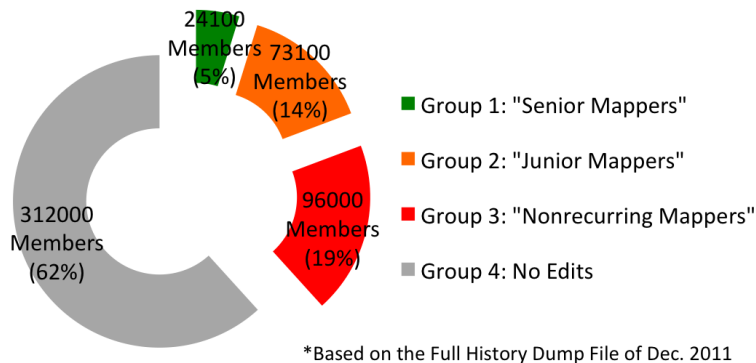
But VGI has not only positive aspects, there are also drawbacks identifiable. For example, Haklay (2010) does not only find that the quality of OpenStreetMap is in certain areas quite good, but also that it is quite weak in other areas. Especially less densely populated areas are of less quality than the densely populated areas. VGI produces thus '*heterogeneous*' quality. Furthermore, he points out the importance of good source material: especially London is quite well mapped, but this is thanks to the high resolution aerial images Yahoo provided for this area (Haklay, 2010). It is a known issue in the GI-world that providers of aerial photography are not really eager to give an open-data license. Furthermore, Goodchild (2007) points out certain dangers and annoyances on the internet, which can also happen to VGI such as spam, viruses and denial-of-service attacks (Goodchild, 2007).

Next to these '*dangers*' and the '*heterogeneous*' quality issues of VGI, we also must keep in mind that there should be willing volunteers to contribute. OpenStreetMap has a quite large and active community in absolute numbers, but as you can see in figure 3, only a small share of the total amount of the members are active editors. This supports Haklay's (2014a) first assertion on crowd-sourced geographic information, namely that

***“you can be supported by a huge crowd for a very short time, or by few for a long time, but you can't have a huge crowd all of the time (unless data collection is passive (Haklay, 2014a)).”***

According to Neis & Zipf (2012), around 2% of the OSM contributors come from the Netherlands. When we multiply this percentage with the active senior and junior mappers of figure 3 (97200

mappers), we get around 1950 active Dutch contributors<sup>5</sup>. Compared to all inhabitants of the Netherlands ( $\pm 17$  million), this is a relatively small share. However, it will probably be for the BGT hard to match. In contrary to OSM where the data is made with the help of volunteers, the BGT data is already produced by professionals. A VGI platform would only facilitate users to update this data. Volunteers have thus less freedom and it is the question if volunteers are willing to contribute with these limitations.



**Figure 3** Distribution of registered members based on their node contributions at December 2011 (Neis & Zipf, 2012).

## 1.2. VGI within the government

On the other hand, are governments willing enough to give VGI a place within their geo-information supply? Public organizations are not always very positively described when it comes to geo-information and innovations: *‘Historical bureaucratic structures [such as public sector agencies,] carry with them a significant “organisational inertia” which is reinforced by departmental silo structures, traditional public service systems and an increasingly complex legislative framework that is difficult to change (McDougall, 2009, p. 2).’* *‘[F]ailures often evolve from visionary middle-level and frontline public servants’ attempts to innovate. Their attempts often end up in a process of incrementally “groping along” the hurdles of bureaucracy before fading away entirely (Vonk et al., 2007, p. 745).’*

While many commercial organizations like TomTom and Google Maps have embraced VGI as update source (see also paragraph 2.2.3), the slow innovating nature of many governments affects the quick adoption of VGI. Despite the number of scientific articles that highlighted the benefits of VGI for governments (for example Coleman, 2013; Dobson, 2013; Johnson & Sieber, 2013), there are little examples of mature VGI implementations found in governmental organizations. There even seems to be an aversion against VGI, as Johnson & Sieber noted:

*“Across many different types of government, we have repeatedly seen a resistance to the acceptance and use of VGI (Johnson & Sieber, 2013, p. 68).”*

Despite the criticism towards governments, there are some Dutch (semi-)governmental organizations experimenting with VGI. For example, the Dutch cadaster (Kadaster) did in 2011 a pilot project for monitoring border markers with help of the crowd (Kadaster, 2012). In 2013 they held a pilot for keeping another Dutch key register, the Basisregistratie Topografie (BRT), up-to-date with the help of volunteers. The latter project was quite successful (Grus, 2014; see textbox 3), which made the Kadaster decide to launch an official VGI platform at December 2014.

The latter project may sound similar like the proposed solution for keeping the BGT up-to-date, but the BGT is on a whole different scale. The BRT has only one source holder, the Kadaster, which

<sup>5</sup> Of course, this is just an estimation and serves as indication. The real number of active Dutch contributors could be higher or lower.

can make the decision whether to approve VGI or not. For the BGT there are 403 municipalities, 24 water boards, 12 provinces and 4 national organizations involved as source holders. Each of them can have a different opinion on the question if it is acceptable to allow VGI.

### 1.3. The research

In order to fully understand if VGI can be successfully applied on the BGT, two groups need to be studied. First, a majority of the [source holders](#) should see the potential and use of VGI. They could be attracted by the positive aspects of it: it is cheap, fast and it has - especially in densely populated areas - quite a good potential coverage. However, there also drawbacks of VGI identifiable such as intentional and unintentional errors and the heterogeneous quality, which make it probably not reliable enough as the only source for updating the BGT. Furthermore, many public organizations are known to be quite reserved in their attitudes towards innovations.

The other group which is necessary to understand, are the [potential volunteers](#) and their motivations. Despite the fact that the '*network of human sensors has over 6 billion components* (Goodchild, 2007, p. 217)', in practice even the most successful VGI projects such as OpenStreetMap cannot succeed in attracting and engaging a large community for active contributing.

The [nature of the BGT](#) should therefore also be kept in mind as context: In contrast to OSM, the BGT will be a complete map of the Netherlands, which shifts the focus from 'map making' to 'map updating'. On the other hand, you could say that due to the mature status of OSM-data in the Netherlands, OSM in the Netherlands is nowadays also more about updating. Still, the freedom OSM offers to fix errors yourself, would probably not be allowed for the BGT, because of the high quality and reliability that the BGT must offer.

But there are also aspects of the BGT in favor of VGI: The Dutch government has already agreed that the BGT should be 'open data' (Geonovum, 2014b). Therefore it is much better accessible for the crowd than its predecessor, the GBKN, which had its backlogs. Thanks to this accessibility, it will probably be viewed much more and thanks to its quality, level of detail and reliability, it will probably become much more used (see textbox 2).

#### ***Textbox 2: Effects of open data***

By making GI data free and accessible it is assumable that there will be more users. However, it is unknown for many governmental organizations who the users and what the effects of open data are. As put in an interview by an employee of the Ministry of Infrastructure and Environment: '*We are actually creating a semi-finished product and dump it on the streets. What will happen with it? We simply don't know...*'

Bregt et al. (2014) studied the effects of opening up the BRT, the small scale key register Topography (see also textbox 1). These effects were mainly positive: the share of commercial and private users has increased considerably. Also the number of downloads increased from 675 each four months in 2011 to 4932 downloads in the first quarter of 2014. The number of views of the BRT base map as WMS service is even more impressive: 114.625.773. However, there must be said that this is the standard base map in the Dutch geoportal PDOK. But also the WMS services of the Top10NL, a detailed topographic dataset derived from the BRT, attracted almost 3 million views in the first quarter of 2014 (Bregt et al., 2014).

It is assumable that the BGT will attract easily an equal number of views as the Top10NL, because the dataset is highly anticipated within the Dutch GI-world. Opening up the BRT turns out to be very successful in terms of use by society. And the more views of a dataset, the better VGI would work.

Incorporating VGI within the BGT has clearly its pros and cons. A successful incorporation is mainly dependent on the opinions and motivations of the contributors and public organizations. This research will therefore investigate the social sides of VGI in order to fulfill the research aim which is:

*‘To investigate if volunteered geographic information could be a successful option for keeping the BGT up-to-date.’*

Like said before, two important human sides can be distinguished. These are the VGI adopters, the source holders, and the (potential) VGI contributors. Therefore, the following two research questions are formulated:

- 1. Are the Dutch BGT source holders willing to use VGI as source for updating the BGT and why (not)?*
- 2. Are there potential volunteers willing to contribute VGI as source for updating the BGT and why (not)?*

Of course, the answers to these two questions will be much more nuanced than a simple yes or no. Most likely there are proponents and opponents of using VGI for the BGT with good arguments for and against. The aim of this research is not only to get insight into these arguments, but also to explore the underlying motives.

The technical feasibility of VGI for the BGT is not an aspect of this research. This is because there are already many successful VGI platforms up and running in the world. Furthermore, the government is developing a system to communicate feedback between different source holder organizations. While this is not (yet) accessible for all citizens, it shows that the BGT standard will be open for external feedback (E-overheid, 2014). This does not automatically mean that the technical implementation of VGI would be easy, but it will certainly be feasible.

The focus on this research on the social side is, because VGI is highly dependent on humans. The best designed VGI system would become pointless, when there are no motivated users. Nevertheless, it is wise to keep the technical feasibility in mind when researching the two groups, because they could be of influence on the motivations to adopt or contribute.

The research questions are summarized in figure 4.

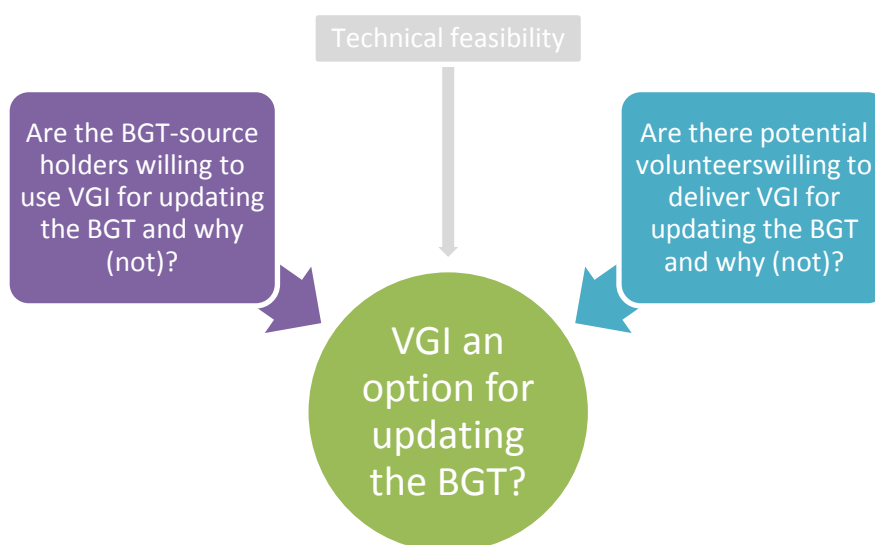


Figure 4 The two formulated research question and research aim.

The subject of this research is specific to the Dutch GI-context and quite practical. However, this does not mean that the answers to these questions are not interesting for the scientific community. Many scientific VGI studies have their focus on OSM or emergency response, but motivations to contribute to governmental VGI are never really explored. The reason therefore could be the simple fact that there are hardly any examples of mature governmental VGI projects. The reason why these projects do not exist, is never systematically investigated. This is not surprising, because in many countries the production of GI-data is centralized in one National Mapping Agency.

The decentralized nature of the BGT with its many source holders, is an unique opportunity to study the willingness to adopt VGI among a broad range of public organizations in a quantitative manner. Due to the specific Dutch context, the answers cannot be generalized to other national contexts. This does not mean the answers are of no scientific value, the answers can be very informative for understanding the nature of VGI.

## 1.4. Report structure

To subtract and connect to the leading scientific ideas about VGI adoption and contribution, the next chapter, 'VGI Theories' will explore these. These theories will lead to a conceptual framework. Chapter 3 will describe the necessary research methods to test the conceptual framework. The results of the conducted empirical research will be described in chapter 4 thereafter. Chapter 5 will discuss the main findings and critically review them. The report will end with a conclusion, chapter 6. Appendices are added to gain better insight in the conducted surveys and the generated response.

## 1.5. Summary

- Governments seem to have problems with keeping their geo-data up-to-date. Therefore, Volunteered Geographic Information (VGI) could be put to use as it proved to be cheap, quick and can result in a good spatial quality.
- VGI has also drawbacks: the quality is heterogeneous and could generate spam and other abuses. Furthermore, it is very dependent on an active crowd.
- Therefore, this research studies if governments are willing to adopt VGI and volunteers want to contribute VGI. Also the underlying motives will be studied.



## 2. VGI Theories

Before jumping into an empirical research, it is important to investigate existing scientific literature on the described two social sides of Volunteered Geographic Information (VGI): the contributors and the adopters. This chapter will therefore evaluate both sides with the help of scientific literature in order to come up with a conceptual framework.

### 2.1. VGI contributors

Many scientists have described a romantic view of VGI, for example calling it the '*socialization and democratization of GIS*' (Jones et al., 2012). Of course, in theory is every citizen with access to a computer and internet a potential VGI-contributor. However, in practice, it becomes clear that not everyone is motivated to contribute. According to Nielsen (2006), 90% of the users of online communities and social media do not contribute (so-called 'lurkers'). 9% does occasionally contributes and 1% contributes actively. For Wikipedia this 'participation inequality' is even bigger: 99,8% is a lurker (see figure 5; Nielsen, 2006). Who are the persons of these small minorities and what moves them to contribute, especially in the case of VGI?

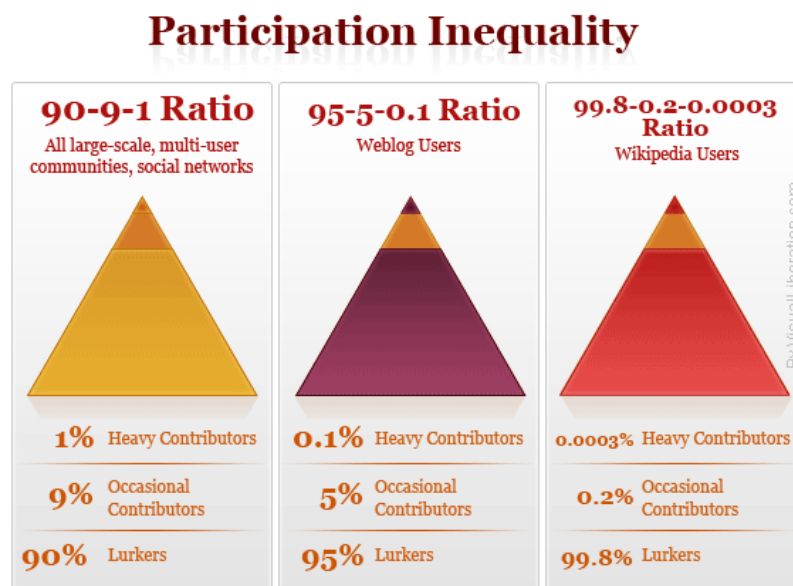


Figure 5 Participation inequality of online communities and social networks (Kinko, 2011).

Budhathoki (2010) discovered that most OpenStreetMap (OSM) contributors '*are young adult males living in Europe.*' Two third were between the age of 20 and 40 and only 2,7% of the respondents was female. Furthermore, he found that the majority of the contributors are employees (61,2%), mostly employed in the commercial sector (71,6%). A large share had also contributed to other 'open' projects such as Wikipedia (71,5%) and open-source software projects (60,3%). They are in general highly educated, with 78,0% having a college/university degree or higher, and very interesting: 49,5% has - to some degree - experience with GIS. This indicates that the OSM community does not solely exist of non-professionals, but on the contrary, GI-users form an important share of all contributors (Budhathoki, 2010).

Neis and Zipf (2012) found that most members of OSM do not add anything at all or do not recur (see figure 3). This is in line with Haklay's (2014a) first assertion on VGI that long-lasting active contributors are relatively scarce in continuous VGI projects. In 2008, 10% of the OpenStreetMap-members added data every month. This percentage dropped to 3% in 2011, but thanks to the

growth in memberships, the absolute number has grown. However, it becomes apparent that OSM does not have a lasting appeal to all members (Neis & Zipf, 2012).

Schmidt et al. (2013) investigated the reason why people do not want to contribute to OSM (anymore). They find that the most important reasons for not contributing are too less time, the completeness of data, forgetting about it and too complex editing (see figure 6; Schmidt et al. 2013). While other reasons mentioned are more specific to the semantics of OSM, the before mentioned reasons are possibly also the largest barriers for contributing to the BGT and VGI in general.

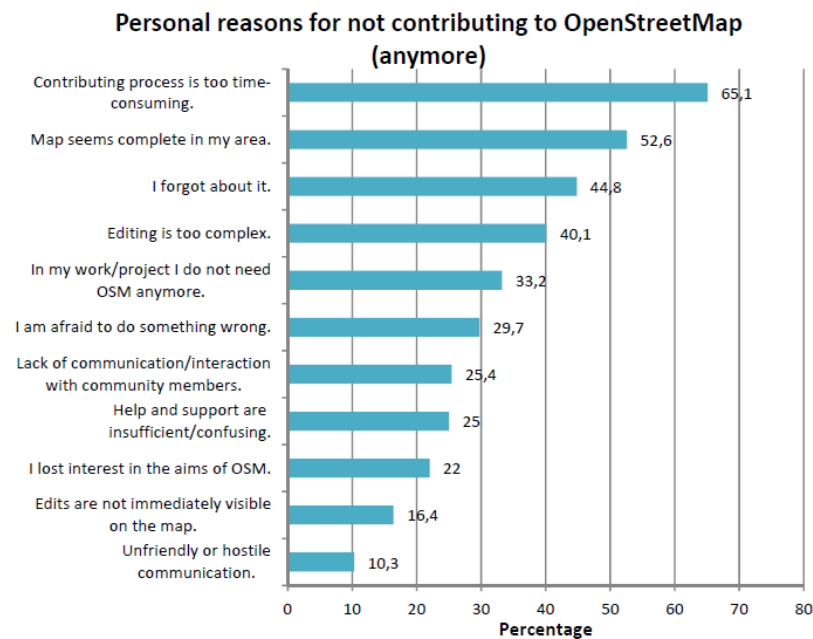


Figure 6 Reasons for not contributing to OpenStreetMap (anymore) according to a study conducted by Schmidt et al. (2013).

However, failing to retain all contributors should not be seen as failure of the VGI project. According to Coleman (2013) come in many crowdsource projects the majority of the contributions from non-recurring contributors. However, in order to keep the quality high, there should be a long-serving and dedicated group to assess and refine these contributions (Coleman, 2013).

Gaining a long-serving and dedicated group is of course not easy to accomplish. The reasons Smith et al. identified may arise from a lack of (a sustaining) motivation. As put by Coleman et al. (2010):

*“The longer-term sustainability of a VGI initiative depends upon its inherent ability to appeal to one or (hopefully) several important key motivators of its contributors (Coleman et al., 2010, p. 390).”*

Motivated users are the key in successful VGI projects. But why are some people motivated to contribute and how can VGI become more appealing?

### 2.1.1. Motivations to contribute

Coleman et al. (2010) found from scientific research on Wikipedia and Open Source Software communities, eight motivations to contribute to such projects: *Altruism, Profession or Personal Interest, Intellectual Stimulation, Protection or enhancement of a personal investment, Social Reward, Enhanced Personal Reputation, Outlet for creative & independent self-expression & Pride of Place*. Except for ‘Outlet for creative & independent self-expression’ they identified these motivators at least once in one of their three case studies. The *Altruism, Profession or Personal Interest* and *Intellectual Stimulation* motivations, were present all three cases (Coleman et al., 2010).



Budhathoki (2010) performed a more grounded qualitative and quantitative study on motivations to contribute to OpenStreetMap. In his qualitative research he found nine important motivations to contribute: *Self need, Anti-corporate sentiment, Expectancy of reciprocity, Visual power of maps, Outdoor entertainment, Pride of local knowledge, Concerns of larger issues, Learning and Monetary*. These findings were qualitatively tested. A factor analysis on the results indicated seven motivational constructs: *Learning, Instrumentality of local knowledge, monetary, social/show off, altruism, project goal and self need* (Budhathoki, 2010). These constructs are to some extent, all comparable with the indicated motivators by Coleman et al. (2010). Table 1 highlights the similarities and differences and furthermore indicates which were the more present findings of both authors.

**Table 1 Comparison between motivations Coleman et al. (2010) and Budhathoki (2010) found for contributing VGI.**

Motivation	Comparable to some extent with	Coleman (1)	Budhathoki (2)
Altruism (1)	Altruism (2)	Strong	Strong
Profession or Personal Interest (1)	Monetary (2)	Very Strong	Weak
Intellectual Stimulation (1)	Learning (2)	Strong	Strong
Social Reward (1)	Social/show off (2)	Limited	Limited
Enhanced Personal Reputation (1)	Social/show off (2)	Limited	Limited
Pride of Place (1)	Instrumentality of local knowledge (2)	Normal	Strong
Protection or enhancement of a personal investment (1)	Self need (2)	Weak	Normal
Project goal (2)			Very strong

The biggest differences are found at the least comparable motivations: Profession or personal interest compared to monetary motivations. The reason lies probably in the much broader explanation of the first, while second focuses solely on professional and commercial motives. However, the rest of the motivations seem to correspond quite well. According to these studies, the most present motivations to contribute to VGI are altruism, intellectual stimulation and learning, interest, local knowledge and commitment with the project goal. Monetary and social motivations seem to be not really important. However, we should not forget that the research populations existed of active contributors. For potential contributors could these motivations still play a vital role. Steinmann et al. (2013) for example find that:

*“social motives may be the most influential factors on gender imbalance in UGC [user-generated content] platforms. OSM and GMM [Google Map maker] which are the platforms hardly contributed to by females (OSM 3%, GMM 2%) both lack social aspects (Steinmann et al., 2013).”*

Not only between genders can motivations differ, Budhathoki (2010) also looked at the difference between ‘serious mappers’ and ‘casual mappers’. It seems that serious mappers are significantly more motivated by local knowledge, learning and monetary rewards (Budhathoki, 2010).

### 2.1.2. Extrinsic motivations

An interesting new trend, is the creation of games for VGI data collection, so-called ‘gamification’. Except for monetary and social motivations, all identified significant motivations are intrinsic motivations. *“Intrinsic motivations reflect a genuine interest in or enjoyment of an action for its own*

sake, reflecting the natural human ability to learn and assimilate (Odobashić et al., 2013, p. 330).” Extrinsic motivations on the other hand, are motivations which are sparked from the outside, such as (monetary) rewards or punishments.

With gamification, extrinsic motivations can be introduced which can improve the engagement of volunteers with the system (Odobashić et al., 2013). As put by Zichermann (2010)

*“[G]ames are the only force in the known universe that can get people to take actions against their self-interest, in a predictable way, without using force (Zichermann, 2010, in: Odobashić et al., 2013, p. 335)”*

A test with a serious iPad game revealed that the quality of collected land cover data with this game was 74% of the time correct, compared to 93% via ‘normal’ crowdsourcing. The game scored thus lower, but when the two data sources were combined they represented very reliable information. Gamification could thus be used to a certain extent to make the VGI experience more fun and engaging. But because the focus does not lie on quality but on fun, more errors could slip in (Sturn et al., 2013).

A less fancy, less fun, but certainly not a less important rewarding and motivating system is the recognition and use of the contributed VGI data. Contributors want to hear a ‘thank you’ when they contributed and they want to see their contribution being used as soon as possible. This seems very logical, however, especially for governments, this can be very difficult. A known example is the experience of the United States Geological Survey’s (USGS) pioneer program: The National Map Corps (Coleman et al., 2010).

## 2.2. VGI adoption by governments

The USGS let volunteers “Adopt-a-Map” to identify and annotate topographic map corrections and updates. Despite the 3000 enthusiastic volunteers, the work of volunteers was rarely used because of the lengthy revision cycle of the topographic maps. There were no internal resources available to act on these notifications. Also the large amount of submitted GPS updates could not be processed, which created a 16-month backlog. Many volunteers left the program and the program was suspended in 2008 (Coleman et al., 2010).

The experiences of the National Maps Corps illustrate that VGI is not per se resource reducing. Also Johnson & Sieber (2013) identified financial and human resource costs of adopting VGI for governmental organizations. The financial costs mainly arise from the software and the services necessary to create a system which could gather VGI data. While these systems can be applied almost for free (e.g. OpenLayers or Google Maps API), gaining the necessary programming skills for installment, maintenance and refreshing can be time-consuming and costly. Furthermore, people have to be trained to gather, analyze and respond to VGI. Also the existing workflow and organizational processes need to change to incorporate VGI in an efficient manner, something what did not really happen at USGS (Johnson & Sieber, 2013). Quick implementations, as recommended by Coleman et al. (2010), require that there should be a person who will check the contribution on a frequent basis.

Coleman (2013) therefore suggest that public organizations should move from a coverage-based to a feature-based updating model. Many mapping organizations are working tile-based (see figure 7 & textbox 3): Aerial images are thoroughly checked for changes and when the area is done, they shift to another area. Because there are no resources available to check the country at once, backlogs always arise, but the quality will be more or less homogeneous per tile. With a feature-based updating model incorporating VGI, the whole country is monitored at once and update cycles can be sped up. (Coleman, 2013). The major drawback of this system is of course that differences in actuality arise not only between tiles, but also within each tile. People have to accept *‘that such*

volunteered information will be “perpetually unfinished” (Coleman, 2013).’ Luckily, because of the local nature of the BGT will many source holders work feature based instead of tile based, which will probably smoothen an eventual implementation of VGI.

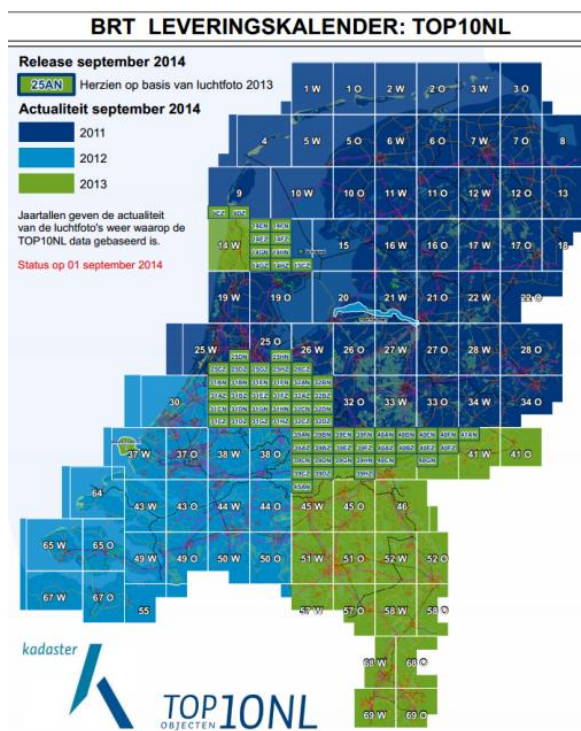


Figure 7 Contemporariness of the topographic data of the Netherlands, September 2014 (Kadaster, 2014).

### Textbox 3: Crowdsourcing within the Dutch cadaster

In order to prevent backlogs in their topographic data (BRT), the Dutch cadaster tries to speed up their tile based revision cycle. At this moment, they have grown to a two-years revision cycle (see figure 7) and the ambition is to grow to a one-year revision cycle in the future. Fitting in this ambition and in order to provide an easily accessible error report system to the ‘general public’, the Kadaster conducted a crowdsource pilot. On beforehand, it was only possible and even obligatory for governments to report an error and these errors were only approved when they were not applicable on a recently adjusted area. With other words: if they would fit their tile-based revision cycle.

For the crowdsource project, these two conditions were neglected and everyone was able to place everywhere a remark on a digital topographic map. This proofed to be a highly successful development: in the two months the pilot was held, 384 error reports came in. In the previous years with the traditional error report system, this were on average 16 reports per year. Of all reports 66% was approved, 2% under consideration, 20% was stored until new (aerial) images became available, 11% was rejected. The rejections were namely based on internal regulations of which contributors were unaware. Also the need for aerial imagery to check the contributions will slow down the potential of crowdsourcing. Both are important threats, which can demotivate volunteers as Coleman (2013) showed. (Source: Grus, 2014 and interviews with Kadaster)

#### 2.2.1. Trusting VGI quality

Maybe one of the biggest challenges to overcome for governments is accepting that non-experts can contribute and the quality of the data can fluctuate per area. Scientists, like Haklay (2010), have proven that VGI data can be quite accurate in certain areas and with a lot of contributors, errors will

be detected and corrected (Coleman, 2013). But in contrast to VGI, official mapping organizations have the obligation to be always reliable and quality fluctuations are generally not accepted.

*“This mismatch between VGI as a product of often unknown provenance with a variable degree of data quality should be considered as a significant barrier for government adoption of VGI (Johnson & Sieber, 2013, p. 74).”*

This quote implies that especially the uncertainty of VGI quality is one of the main issues. Johnson & Sieber (2013) find that the *perceived quality* is probably more important than the actual quality. Use of negative terminology for describing VGI, like ‘informal data source’, ‘non-experts’ and ‘hobby’, can negatively influence the consideration of VGI data.

Also they experienced substantial criticism from governments when they used Google Maps. The public servants found several inaccuracies and mislabeled roads and names in Google Maps. However, when Johnson & Sieber showed that the governmental data contained the same errors, their perception changed more positively. This positive view was further enhanced by showing that suggested changes in Google Maps were handled within weeks, while it took the government much longer (Johnson & Sieber, 2013).

However, research by Parker et al. (2014) did not find a difference in perceived trust. On the contrary, when they told people that a mash-up was a combination of VGI and professional data, users had a more positive feeling about how up-to-date the data was. According to the researcher this can be caused by the fact that VGI expanded the quantity of information. The quantity of information seemed to be more important in determining the quality of data than the actual data source (Parker et al., 2014).

The difference between the research of Johnson & Sieber (2013) and that of Parker et al. (2014) is likely caused by a difference in research population. The first research is conducted with GI-professionals which have to adopt VGI, while the latter was performed with a more or less ‘general’ public. It is assumable that the attitude of GI-professionals towards VGI is with more suspicion, while the general public could perhaps be too naïve.

### 2.2.2. Improving trust

The trust in VGI can be further improved by assessing its contributors. By assessing contributors, governments can get insight in the credibility and reliability of their contributions. Furthermore, with identification of the users governments could better protect themselves from mischief, malice and/or criminal intent (Coleman, 2010). This has of course ‘*a risk of alienating or otherwise reducing participation, either because participants want to be anonymous or have difficulty navigating extra layers of technology* (Johnson & Sieber, 2013, p. 73).’ Systems which assess contributions based on spatial-temporal aspects are therefore studied (Coleman, 2013).

Some have described VGI and participatory GIS as ‘*the democratization of GIS* (e.g. Goodchild, 2007; Weber et al., 2010),’ but assessing contributors and their contributions, raises the question how democratic VGI actually is. GIS has certainly become better accessible for non-professionals, but in every VGI project there is a certain hierarchy. Boulton (2010) describes three stages in the context of the Google Map Maker community, a VGI initiative from Google for updating Google Maps. These are: (1) *the stranger/enemy*, (2) *the semi-permanent-resident alien* and (3) *the citizen*.

The first stage exists of newcomers who are not accepted by the community yet. They are viewed with suspicion whether they are enemies or not and their contributions are always moderated. The second stage exists of users with a more established reputation, because they made more time and/or contributions within the community. Their contributions can be added with minimal moderation or none at all. However, they are unlikely to ever attain full citizenship, the third stage. “*This inner sanctum is an exclusive space in which the constitution (Terms of Service) is modified on a whim, from which members can be removed to taste, and to which financial reward accrues* (Boulton, 2010, p. 3).” In the case of Google, this is the paid Google Maps staff.

This hierarchy will probably be more present in corporate VGI than open VGI, but of course also in open VGI there is an hierarchy between newcomers and more experienced mappers (OpenStreetMap Wiki, 2014; OpenStreetMap forum, 2014). If VGI becomes implemented in the update process of the BGT, it is logical that the source holders will have more power than the contributors, because of their professional and juridical responsibility. In this sense, governmental VGI will be more like a variant of corporate VGI, where paid experts will assess the contributions. It is therefore important to understand the workflow of corporate VGI.

### 2.2.3. Corporate VGI

Unfortunately there is much less written about corporate VGI compared to OSM, but luckily did Dobson (2013) explore some of these VGI initiatives in his study about compiling navigational databases. It is important to understand that no map database is solely based on VGI<sup>6</sup>. But for many companies such as TomTom and Google, became VGI a very important source for keeping their maps up-to-date (Dobson, 2013).

Especially in the case of Google Maps, probably the most used online map database in the world, plays crowdsourcing a dominant role. The original created map of the United States was mainly constructed from authoritative data sources (figure 8; Dobson, 2013). In 2008, three years after the launch of Google Maps, Google Map Maker was initiated. This enabled the crowd to add user-generated content. Originally Map Maker was intended to map countries where authoritative databases were not available to Google (Friedman, 2011). After realizing the potential of the crowd, Google provided Map Maker also for countries of which it did have authoritative sources. Because of the popularity of Google Maps this was a huge success and it made crowdsourced content the most important source for updating Google Maps (see figure 9; Friedman, 2011; Dobson, 2013).



Figure 8 The designed update sources for Google Maps in order of importance (larger= more important; Dobson, 2013).

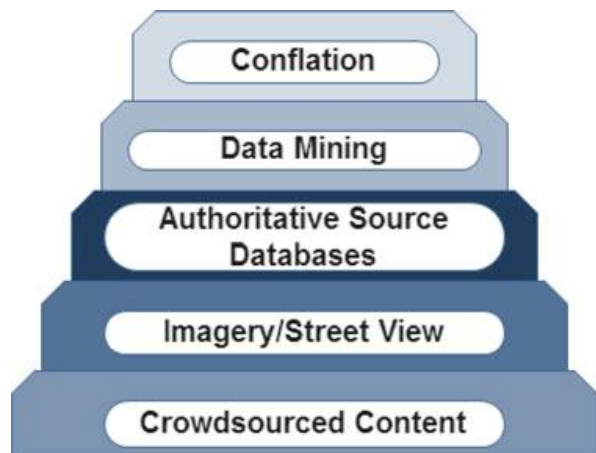


Figure 9 The current update sources for Google Maps in order of appearance (Dobson, 2013).

However, we should not generalize the benefits Google created towards all VGI corporate initiatives, because *'Google benefits from its enormous reach and its popularity as a search engine. (...) It is the classic case of more eyes to reduce error, and Google can attract more of these than any other commercial map database provider'* (Dobson, 2013, p. 323). However, there are certainly advantages of corporate VGI compared to open VGI systems like OSM.

The cause of these advantages is the simple reason that there is more at stake for corporate map database providers. Therefore they guide the VGI-initiatives with more budget and direction. As explained before, VGI creates heterogeneous quality, which is not desirable. A commercial party could assign extra budget to places which are of less interest to the crowd to equalize the quality.

<sup>6</sup> Even in OSM open data from governments is imported.



Furthermore they can put up marketing and editorial teams which ensure that the data meets the customer needs. Open projects, like OpenStreetMap, lack necessary standardization and effective quality control (Dobson, 2013): this becomes especially clear in the way how diverse the metadata of similar objects can be ‘tagged’ (Taginfo, 2015). Dobson (2013) therefore critically concludes that:

*‘Two of the supposed advantages of crowdsourced data compilation systems are that they have no formal management structure (or the associated expenses) and that they lack an overarching business structure. The lack of both may, in fact, be a limitation when applied to map compilation (Dobson, 2013, p. 318).’*

But there are also disadvantages of corporate VGI identifiable. Corporate VGI platforms mostly limit the edit possibilities, claim the ownership of your contributions and restrict the use of their database (Dobson, 2013). Google Map Maker therefore gained quite some criticism from OSM volunteers and the founder of OSM, Steve Coast (Korevaar, 2008). It is also no surprise that Budhathoki (2010) found anti-corporate sentiment as one of the motivations to contribute to OSM in its qualitative analysis: *‘Many contributors are concerned about the growing corporatization of geospatial data and the potential consequences to the access and use of these data (Budhatoki, 2010, p. 64)’*.

Because the BGT is open data it will be hard to predict if a VGI initiative will provoke ‘anti-government sentiment’. The BGT would probably fall between both groups: It will probably be not as open as OpenStreetMap, but in contrast to Google Maps will the BGT be open data. Perhaps it will therefore combine the best of both VGI worlds.

#### 2.2.4. Recommendations

For a successful incorporation of VGI within a public organization, Johnson & Sieber (2013) recommend public organizations to (1) formalize the VGI collection process with a focus on data quality, control and verification; (2) increase collaboration between governments in order to facilitate the cross-scale nature of VGI and save costs; (3) investigate VGI’s participation potential to generate communication and communities. Coleman (2013) recommends public organizations to set clear goals why they want to use VGI and keep in mind that:

*“VGI is not the ultimate solution to all geospatial data updating and maintenance challenges now faced by mapping organizations. However, there is growing agreement that it represents one important channel of such updates—one that needs to be investigated, prototyped, and introduced in a reasonable, informed manner (Coleman, 2013, p. 260).”*

Also Dobson (2013) stresses the importance of mixed compilation techniques in order to use the benefits of VGI without giving the negative aspects of VGI too much space. VGI will then not necessarily be resource reducing, but probably resource increasing: current work processes would not change, they are only extended. However, the benefits up-to-date geo-information could generate and the relatively cheap nature of crowdsourcing to accomplish this, would probably overshadow this sore point easily.

### 2.3. Summary

This chapter showed the motivations of volunteers to contribute and the struggles of governments to adopt VGI. Both dynamics proofed to be quite complex as they are influenced by many factors. Figure 10 shows the main influences to contribute.

- Intrinsic motivations, such as altruism, learning, local knowledge, interest and engagement with the project proofed to be main motivators for contributing VGI. Self

need and social motivations were found less strong, but still can play an important role, especially when personal characteristics such as gender were taken into account.

- Also other patterns in personal characteristics and background emerged, which revealed that volunteers were mostly high-educated employed young adults of which around 50% has GIS knowledge. However, these characteristics can be very specific to OSM contributors and should not be projected too much on all VGI-contributors.
- Extrinsic motivations are less present than intrinsic motivations, but by giving monetary or virtual rewards, they could be an extra incentive to contribute. The actual implementation of a contribution was also an important motivator.
- There are also barriers and constraints identifiable which prevent people from (continuing) contributing. These incorporate personal aspects such as a lack of time or 'forgetting', as well as VGI(-system) aspects such as people thinking the data is already complete and people fearing the complex systems.

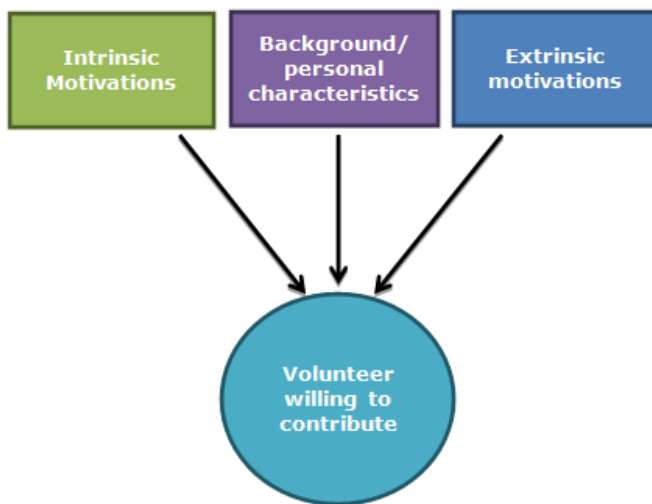


Figure 10 Schematic motivational framework for volunteers to contribute to a VGI project.

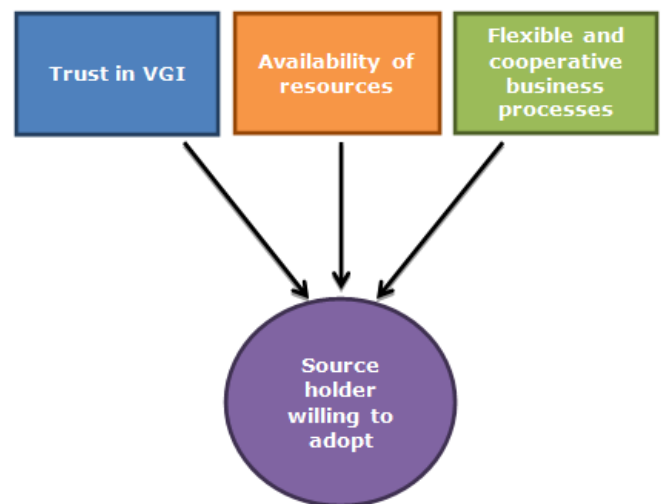


Figure 11 Schematic adoption framework for governments to adopt VGI.

When studying VGI adoption by governments, a constant struggle between the reliability and flexibility of VGI is noticeable. Before governments can become successful in adopting VGI, they have to change three things:

- they have to trust VGI;
- make resources available to adopt VGI;
- change their business processes to a more flexible and cooperative manner.

When these conditions are fulfilled, a government is likely to adopt VGI successfully (figure 11). This is easier said than done, but there are ways to facilitate these changes.

- Trust in VGI can be achieved by gaining a better perception of it, assessing the contributors and their contributions and formalizing the contribution process.
- Resources can be made available by more cooperation (e.g. nation-wide development of VGI system instead of local) and a collective awareness that VGI is an important source keeping governmental data up-to-date.
- Flexibility can be achieved by using a feature-based updating model methods with higher update frequencies.

### 3. Methodology

When we combine figure 4, 10 & 11, we get the conceptual framework of this research as shown below in figure 12. This model will guide the empirical research. To assess which factors are most influential, this research will largely have a quantitative approach. This is also done to find relationships between personal and governmental characteristics and their attitude towards VGI.

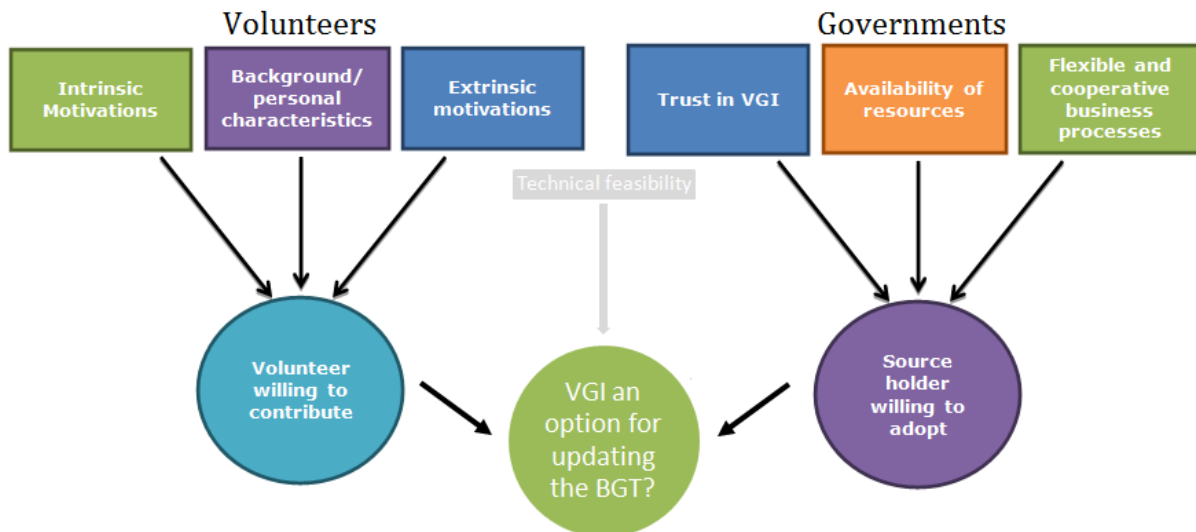


Figure 12 Conceptual model derived from the previous literature study.

The above described conceptual model is not necessarily (completely) correct. The literature study in the previous chapter had its limitations: At the volunteer side, much information was derived from OpenStreetMap studies, but OSM does not automatically equals VGI (Haklay, 2014b). There are many reasons to see OSM as a VGI project on its own, with its own dynamics and patterns, which cannot be generalized to another VGI project.

Also differences in motivations can be found between different cultures. Subramanyam & Xia (2008) for example find that North Americans are more driven by intrinsic motivations than Chinese and Indian people in Open Source Software development projects. It is unknown by which motivations the Dutch are mostly affected.

At the government side, there is a lack of qualitative and quantitative studies. The studies discussed were more based on experiences of scientists, instead of empirically grounded methods. This research will therefore probably be the first to thoroughly analyze the opinions of governments as VGI adopters. Because a scientific qualitative research is lacking, there is a risk that some influential factors are missed. In order to gain a better insight in the opinions of source holders towards VGI, there are also some additional interviews and discussion groups conducted (see paragraph 3.3).

#### 3.1. Research population

In order to test the assumptions of the conceptual model, a quantitative research is done. It will not be surprising that we therefore need two research populations: potential volunteers and BGT source holders. Two surveys were therefore set up, one to study the motivations of volunteers to contribute and one to study the adoption by source holders. To reach as many respondents as possible, self-completion surveys were used, both online and offline. This paragraph will elaborate on how the response was gathered, paragraph 3.2 will discuss the creation of the surveys.



### 3.1.1. Volunteers<sup>7</sup>

Every Dutch citizen is a potential volunteer. The BGT will be open data, thus everyone has also access to the data. However, it is unknown how the BGT will develop when it will be fully realized. It can become a mainstream data source like Google Maps or it can be a very specialized data source, mainly used by GI-professionals and governments. It is likely that in either way the 'early adopters' of the BGT will be the existing GI-community which consists of companies, NGO's, educational institutions and of course other public organizations. They will have a higher awareness of the BGT than an 'average' citizen and will be easier to research.

Also VGI communities like the OSM community could be potential contributors: Another key register, the BAG, which exists of the geometry of every building in the Netherlands, is also imported in OpenStreetMap. Such collaborations may contribute to the exchange of knowledge where physical changes have happened.

The research population for the volunteers therefore exists of GI-students, -professionals and existing OSM-contributors. This has as unfortunate consequence that the responses are being biased towards the GI-community. However, studying the motivations for 'average' citizens would require a whole different research approach, like an experiment. This was not viable giving the time and money constraints of this research.

Another difficulty is reaching these potential volunteers: there are multiple calls posted on various GI-related LinkedIn and Facebook groups. However, people can choose for themselves if they would like to respond to these calls. It is possible that people with more affinity or interest with the subject will respond more to the survey. Also it excludes people who are not (very) active in these social media groups.

Also an e-mail has been send to current GI-students which further influences the respondent division. This can also be clearly seen in the age division of the volunteer sample (see paragraph 4.1.1. or appendix C). A link has been posted to the Dutch OSM discussion board too, which could also bias the sample towards more crowd-'aware' volunteers. Furthermore, the offline survey is used on the GI conference GeoBuzz. When analyzing the volunteer results, these drawbacks should always be kept in mind. This research has thus absolutely no random sample.

### 3.1.2. Source holders

In contrary to the group potential volunteers, it is clear who the source holders are: There are 403 municipalities, 24 water boards, 12 provinces and 4 national organizations involved as source holders. However, this is in theory, in practice there are multiple organizations who are cooperating with each other in the realization and creation of the BGT. At the other side, each source holder consists actually of several involved individuals, who all have an opinion about how the organization should develop itself. It is easier to collect those opinions, instead of forcing organizations to formulate an official 'opinion' which cost them more effort. Furthermore it will be unclear to the research how the official opinion was formulated.

The source holders are approached via various ways. Like the volunteer survey, a call has been placed in the LinkedIn BGT group with a link to the online survey. Also on Geobuzz some offline surveys were handed over. However it did not attract enough responses and therefore the assistance of the SVB-BGT was asked, the overarching BGT foundation. This organization sent the survey to all contact persons of the BGT, which luckily did generate a lot of response.

Also two interviews were done with source holders. The interviewees did fill in a survey first, before the interview started (see paragraph 3.3).

The sampling of the research population was thus not completely random, some had more opportunities to fill in the survey than others. However, because every source holder had a chance

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<sup>7</sup> In order to provide a quicker reading experience, one survey is called the 'source holder' survey and one survey is called the 'volunteer' survey. A more accurate name of the latter would be 'potential volunteer' survey because a respondent can indicate that he/she does not want to contribute.

to fill in the survey and the largest share of response was generated by the direct e-mail, the source holder sample would be more robust than the volunteer sample. This is further enhanced by the relatively high number of respondents (see paragraph 4.1.2.).

### 3.2. Survey

There are thus two surveys created for the two groups, which were both held online and offline. According to Bryman (2012) are the effects of mixing online and offline negligible, but the researcher should always take these into account. Positive effects of online surveys is that in most cases people will respond more elaborate to 'open' questions. A negative aspect is that online surveys are more 'anonymous' and therefore also more open to spam, abuse or duplicate response by the same user (Bryman, 2012).

ThesisTools (2015) is used as online survey software package. This online software package was chosen because it was free, without limitations and allowed more advanced options for questions in order to imitate the offline version as good as possible. However, it also had some drawbacks: the design of the system looked like it came from the early days of the internet and there was no control to check if the responses came from the same IP-address. While the abuse of filling in the survey several times would probably be scarce, it could lead to distortions in the response.

In order to prevent scaring off potential respondents, both surveys were designed to be as short as possible, while retaining the necessary questions to test the conceptual model. Furthermore, a minimal amount of personal characteristics is asked.

Because the conceptual model in combination with the chosen method, can mainly be tested by measuring the opinions of the respondents, the survey's main components existed of statements. With the help of a 5 point Likert scale, people answered to which degree they agree with the proposed statements. This goes from 'Fully disagree' to 'Disagree', 'Neutral', 'Agree', 'Fully Agree'.

Because the research population are Dutch citizens, the surveys are held in Dutch. The translation from English written academic literature to practical Dutch and from Dutch back to English could cause misinterpretations. Nuances could get lost or words with slightly different meanings could influence the response dramatically. Also the translation from science to operational questions is always difficult. VGI has been named 'crowdsourcing' in the surveys, because this is a more common used term. However, it is also much broader than VGI. This is not necessarily a problem, because VGI has many relationships with other crowdsource projects like Wikipedia and open source projects (Coleman et al., 2010).

Setting up both surveys proofed to be hard. For example, people should be explained what crowdsourcing is, but this is difficult to explain without biasing people. Furthermore, the order of questions was difficult to determine. Especially the question about which kind of VGI system respondents would prefer, was difficult to place. When putting the question at the start of the survey, respondents would fill in the survey with their system in mind. This is no problem if the response per system was treated separately. However, it was unclear how many response the surveys would generate. Therefore there was chosen to put the question about the system behind the statements, in order to steer respondents as little as possible.

But this had clearly its drawbacks too: some people reacted that they thought that crowdsourcing would automatically imply that users could directly modify the BGT. They were not aware that error reporting with picking points on a map was also an option. Some therefore said that they replied negative to the statements, while they are actually proponents of using the crowd to report errors.

Furthermore, the surveys could generate socially desired response. For example, it would be socially desirable to react positively on the statement about 'altruism' (important to help other people). Also source holders could react more positive than they actually are, in order to try to keep up with the other source holders. Of course, there is stated in the introduction of both surveys that all responses would be handled confidential, thus there would be no need for this.

The last thing one should keep in mind is that the surveys are all asking questions about the future. There is not yet a VGI system so people do not really know what motivates them, only what appeals to them. There is no obligation to do what you stated in this survey. People are probably more reserved in their opinions when they have to commit to their answers. The responses should be used as indication and we should avoid attaching too much value to it.

### 3.2.1. Common part

Both surveys contained next to a target group specific part, also some common questions in order to compare the attitude of both groups towards VGI. The common questions include two kind of questions: questions about personal characteristics and VGI-specific questions.

The personal and background questions measured gender, age, GI-experience and if the respondent ever contributed to or used a crowdsource project. This in order to measure how much experience a respondent has with crowdsource projects and to test if this has any influence on the attitude of a person towards crowdsourcing.

Other personal characteristics which emerged from Budhathoki's (2010) research like education level and their profession are thus not asked. On the one hand, this is done to prevent scaring off respondents with asking too much personal questions. On the other hand, the research populations of both groups are mostly GI-professionals which makes it assumable that they are mostly highly educated anyway. However, neglecting more detailed personal characteristics could have a danger of excluding information which could be of underlying importance.

The VGI-specific questions try to measure the perception of an user towards crowdsourcing: what does a user think about the usefulness, trustworthiness and currency VGI would deliver. Do they think that there would be enough volunteers to contribute?

Furthermore a question about the desired update interval of the BGT is proposed to both groups as well as the ideal VGI system. Also a question is proposed to give an estimation of the (un)intentional errors contributions would contain. This could help determining the level of trust in VGI quality by a respondent in more detail.

### 3.2.2. Volunteer specific part

According to the academic literature, the most strongly present intrinsic motivations were altruism, local knowledge, intellectual stimulation and learning, self need, profession or personal interest and commitment with the project goal (Coleman, 2010; Budhathoki, 2010). The latter two motivations were not included in the survey, because the research population only includes persons with a profession or personal interest. There is also no clear project goal compared to OSM. Fun was a finding in the study of Budhathoki (2010), but for unclear reasons this motivation evaporated in his further analyses. Because fun seemed an important motivation, it is included in this survey.

Extrinsic motivations that are measured are social contacts, commercial interest, monetary rewards and the implementation of the contribution. There is chosen to use some motivations in this research, even if they were not very present in literature, such as monetary rewards and social motivations. The reason lies in the fact that the previous literature studies were namely conducted among active volunteers and not among potential volunteers. Some statements are borrowed partly from the quantitative study of Budhathoki (2010), however most of his statements have a too large focus on OSM.

The most important barriers and constraints Schmidt et al. (2013) found for not contributing to OSM (anymore) will also be translated into questions. These are too less time and the completeness of data. The fear of a complex system is indirectly included in the question about which system users would prefer and the time-consuming statement. Forgetting was also an important constraint, but it is impossible to measure if respondents would forget to contribute in the future. The questions of the volunteer survey are included in appendix A.

### 3.2.3. Source holder specific part

The other survey measures the willingness of source holders to adopt VGI and more specifically try to find confirmations of the identified hurdles for adoption. These were a distrust of VGI, unavailability of resources and an inflexible organizational culture.

Trust will be measured largely in the general part of the survey. However, two extra questions are asked in order to measure the necessity of identifying and assessing contributors, which could improve trust according to the literature. Therefore also the need to be anonymous is asked in the volunteer survey.

The availability of resources will be measured on the one hand by available statistics about absolute and relative height of the municipal budgets. On the other hand the respondent will be asked how he/she thinks of the availability of human, financial, technology and knowledge resources. The municipal budgets are of course only applicable on the municipalities. A certain precaution should also be made, because it is unknown how much of the budget would really go to the geo-information department.

Flexibility and cooperative business processes of an organization are hard to measure with quantitative measurements. Everyone can have a different feeling whether their organization is flexible or not. Furthermore, because the BGT would require a more flexible and feature based approach anyway. Therefore is asked about openness towards innovations as this could be a good indicator of the organizational culture. If an organization is open to innovations, it also needs to be flexible in their business processes. Also about the cooperativeness between GI-departments is asked in the survey. The question is perhaps also a bit redundant because cooperation is almost obligatory for the BGT, but source holders may vary to which degree they agree with this statement. The source holder survey is included in appendix B.

### 3.3. Additional interviews

Additional interviews and discussion groups are conducted with governmental organizations which have either experience with VGI or have practical knowledge about the workflow of the BGT and municipalities. Also two source holder organizations were questioned. The interviews and discussion groups were exploratory and therefore had no formal topic list. Table 2 shows the organizations asked and the subject of the conversation. In total there have been seven interviews/discussions.

**Table 2 The additional interviews/discussions per organization and their subjects.**

Organization	Reason to discuss
<b>Bram van Hoeve (self-employed)</b>	To gain knowledge about the necessity of citizen participation and the role of topographic data for spatial planners
<b>Dataland</b>	To gain knowledge about the processes within and between municipalities.
<b>Kadaster (Apeldoorn)</b>	To gain knowledge about the current BRT crowdsource project.
<b>Kadaster (Zwolle)</b>	To gain knowledge about another crowdsource project which used volunteers with GPS devices. Also to gain knowledge about the update process of the Top10NL.
<b>Ministerie van Infrastructuur en Milieu</b>	To discuss their ideas about a BGT feedback system and the necessity of a crowdsource system.
<b>ProRail</b>	To gain knowledge about the processes within this source holder and discuss the necessity of crowdsourcing.
<b>Provincie Overijssel</b>	To gain knowledge about the processes within this source holder and discuss the necessity of crowdsourcing.

### 3.4. Analysis

To thoroughly analyze the results of both surveys, statistical analyses have been conducted. The largest share of the analysis will exist of descriptive statistics. Because both research samples are not completely random, it is scientifically incorrect to make generalizations for the whole population. However, because it is an exploratory and indicative research, some exploratory statistical tests are calculated. These could give directions for future research. Furthermore, the responses are verified and discussed with help from the previous found literature research.

A large share of both surveys existed of Likert scales. There is an ongoing discussion whether to use Likert scales as ordinal or interval data (for example Jamieson, 2004 versus Norman, 2010). Technically are Likert items ordinal data, because there are no clear intervals between for example 'neutral' and 'agree'. However in many scientific articles they are treated as interval data anyway, because it will enlarge the possibilities of statistical tests one can conduct.

In order to avoid involvement in this ongoing discussion, there has been chosen to play it safe, especially because the research samples are not completely random. Therefore, non-parametric and parametric statistical tests are conducted (Statistics Café, 2011). In most cases this did not lead to any difference in the significance level. Only when calculating correlation matrices, it leads to a difference in the strength of relationship. This difference was in most cases also small.

The statistical analyses are conducted with help of the statistical software package SPSS.

### 3.5. Summary

- To test the conceptual model, two surveys are conducted. One is targeted at potential volunteers and one is targeted at source holders.
- The (potential) volunteer research population consisted mainly of GI-specialists, because these are probably the 'early adopters' of VGI for the BGT. They were reached via social media groups.
- There is chosen to allow multiple responses per source holder, because each organization exists of multiple BGT-employees. Additional interviews are conducted to gain more knowledge of the processes within and between governments.
- Because both research populations are not random, statistical analyses should be taken with precaution. However, because the results can be of use for further research, some tests are conducted.

## 4. Results

This chapter explores and discusses the results of the two conducted surveys. In appendix C and D are the results of both surveys included. This chapter will highlight the most interesting results and will compare these with findings in the literature. First, the characteristics of both response groups will be discussed. Thereafter, the specific survey results for each research group will be discussed.

### 4.1. Response and characteristics

Before drawing conclusions from both surveys, it is important to gain knowledge of the response group and their characteristics. This paragraph will firstly discuss the volunteer sample and thereafter the source holder sample.

#### 4.1.1. Volunteers

In total, 133 persons responded to the volunteer survey. In 25 cases the paper version was answered and in 108 cases the online version. In 16 cases, only the first page of the online survey was filled in (12% of the questions). These surveys were excluded from further analysis, because they did not participate in the in-depth part of the survey. In total 117 valid cases remained. Because sometimes questions were skipped by some of the respondents, the real number of response may vary per question.

78,6 % of the volunteers is male and thus only 21,4% is female. This is not surprising, due to the fact that the existing GI-field and also VGI-projects as OpenStreetMap are mainly dominated by men. The youngest respondent is 22 years old and the oldest 64. The average age is 37,52. While the range fits the working population of the Netherlands, relatively more responses came from young respondents: 51,4% of the respondents is 35 or younger.

The reason lies most likely in the fact that the student population could be more directly approached than other target groups, which could made them fill in the survey more frequent than other groups. However, because there is not asked about the occupation of the respondent it cannot be proven that these respondents are mostly students. Another explanation could for example be that young persons have more affinity with the subject or are more active on social media like LinkedIn where the survey was posted.

Due to the relatively large number of young respondents (see paragraph 4.4.4), the question about GI-experience is polarized into two categories: 42,5% of the respondents state that they have 1 till 5 years of GI-experience, 37,2% of the respondents have more than 10 years of experience. 'Some experience' is chosen by 12,4%, 8,0% chose for 6-10 years of experience.

Highly remarkable is the experience with crowdsource projects: 47,9% of the volunteers state that they have contributed to a crowdsource project. This is a much higher share than expected, especially when we compare this to the participation inequality ratios of Nielsen (2006) which indicated that just a small share of crowdsource project users, actually contributes (mostly less than 10%; see figure 5). This unexpected division warns us that the volunteer sample is clearly not an 'average' research sample in terms of contribution. It is likely that people with more affinity with crowdsourcing responded more to the call to fill in the survey, than people who never did something with it.

Also the majority of the respondents (89,7%) say they did have used crowdsourced data in the past. We cannot state that the other 10,3% never used crowdsourced data: they could have used it without being aware. Therefore, these two questions are more or less indicators about how 'aware' people are about the use of crowdsource projects. It is important to keep this in mind when analyzing the results and drawing conclusions.

The most named crowdsource applications by the volunteers are OpenStreetMap (34 persons contributed; 77 persons used) and Wikipedia (14 contributed; 77 used). This is not surprising



because these are probably the best known examples in the GI-field and they were also named in the question as example. While there were 25 different projects named as contributed and 34 different projects were named as used, the small share or even absence of corporate VGI platforms is remarkable. Google Maps was only named twice as contributed and used. Navigation companies like TomTom were not even mentioned.

It could be that people are usually unaware that these databases consist (partly) of crowdsourced data. These companies market their maps less as 'crowdsourced' compared to open initiatives like Wikipedia or OpenStreetMap which state this on their homepages (Wikipedia, 2015; OpenStreetMap, 2015). Another reason could be that the formulation of the survey questions influenced people to think more about 'open' instead of 'corporate' crowdsourced projects. More research to confirm these presumptions is necessary.

#### 4.1.2. Source holders

The source holder survey was filled in 216 times. In 11 cases it was filled in on paper and the other 205 times online. Six surveys were excluded from the analysis because they did not come from a source holder or other governmental organization<sup>8</sup>. Furthermore, 10 respondents filled in only the first 16% of the survey (first page), these cases were also excluded from the analysis. In total, 200 valid cases remained.

The source holder sample is even more dominated by males than the volunteer sample: 89,6% is male. While the source holder sample has also a nice fitting range in age distribution (24 is the youngest, 64 the oldest), the younger age group, 35 and younger, is relatively small (10,9%). This is not surprising because it is known that the average age of governmental employees is quite high (44,0) compared to other types of organizations (Centraal Bureau voor de Statistiek, 2015). However, the average age of the source holder sample is even higher with 46,9.

The majority of the source holders has also more than 10 years of experience with GI (71,9%), which is likely caused by the relatively older age of this sample. Most respondents also have quite some power within their organization: 61,0% percent of the respondents state that they have a coordinating/decision making role<sup>9</sup> and 55,0% say they have a managing role.

Compared to the volunteer sample, the source holder sample is less crowd-'aware'. Slightly more than three quarters of the respondents (76,5%) say they never contributed to a crowdsourced initiative. More than one-third of the respondents (36,0%) say they never used data from a crowdsourced initiative. The most named projects contributed to are OpenStreetMap (27), Wikipedia (8) and Google Maps (5). The most named used projects are OpenStreetMap (78), Wikipedia (72) and OpenSource Software/QGIS (19; 12). Google Maps stays behind with 4 times named as used. Of course, the same underlying motives why corporate crowdsourced platforms are not named that many times, may be applicable as explained before. Their relative absence remains remarkable.

Just 9,5% of the respondents say that their organization did launch a crowdsourced project. Unfortunately in the survey was not asked what kind of crowdsourced projects the organization started and therefore it is unknown if this project was VGI related.

Table 3 shows the response per source holder type compared to the 'real' distribution. As can be seen, the distribution follows in general the 'real' distribution: The largest chunk exists of municipalities, with smaller shares for the other organization types. When we compare the percentages of the 'real' distribution with the response distribution, it becomes clear that the

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<sup>8</sup> Intentionally the survey was meant only for source holders. However in three cases people from national organizations which are busy with the BGT, but formerly not a source holder, filled in the survey. These cases were not excluded from analysis, because they have an important say in the decision making about the BGT.

<sup>9</sup> Quite some respondents in the 'other' category stated that they were the project managers of the BGT in their organization. These respondents are reclassified to the 'coordinating/decision making role', because they fulfill a role on one of the highest levels.

Table 3 Comparison between the 'real' distribution and response.

	Real	Real (%)	Response	Response (%)
<b>Municipalities</b>	403	90,2%	153	77%
<b>Water boards</b>	24	5,4%	14	7%
<b>Provinces</b>	12	2,7%	16	8%
<b>National Government</b>	4	0,9%	5	3%
<b>Other source holder</b>	4	0,9%	12	6%
	447		200	

municipalities are underrepresented despite the large share, while the other organization types, water boards, provinces, national governments and other source holders, are overrepresented.

The reason why lies probably in the fact that the 'real' distribution exists of organizations, while the surveys were filled in by the GI-staff of these organizations. Furthermore are the 'province' and 'other source holder' category overrepresented, due to extra face-to-face discussions with the province of Overijssel (province) and ProRail (other source holder). In both cases almost the whole BGT-team did respond to the survey.

We can therefore not test on the representativeness of the sample and generalizations about the whole population should be avoided. However, due to the large size of sample and the fact that the majority of the respondents is still from a municipality, it is unlikely that opinions of the whole population would differ much with this sample.

Figure 13 shows a map with the locations of the respondents per organization type. As can be seen, also geographically are the source holders quite well distributed.

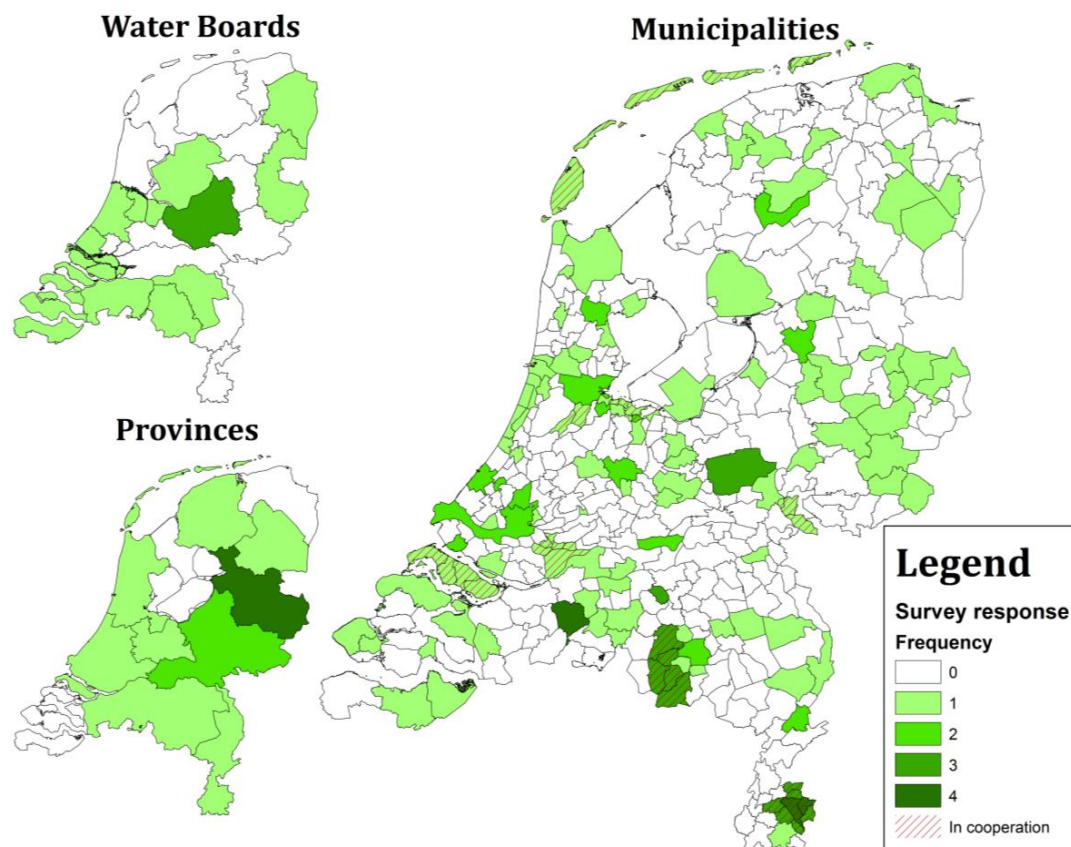


Figure 13 Geographical distribution of the respondents and their organizational areas. The national source holders are not included in this map.



### 4.1.3. Summary

- The response to the surveys was high. In total there were 117 useful volunteer surveys and 200 useful source holder surveys filled in.
- Most volunteer respondents were young, male and did have experience with other crowdsourcing projects. We must avoid drawing hard conclusions about volunteers on the basis of this sample, because this is probably not an average reflection for all potential volunteers.
- The source holder sample did show some similarities on the basis of average age and actual division of source holder organizations, but this cannot be tested. The source holder sample is therefore quite robust, but again we should avoid generalizations towards all source holders.

## 4.2. Source holders vs. volunteers

Maybe one of the most important questions of both surveys was the question if the respondent would think that crowdsourcing would be useful for the BGT. Figure 14 shows the division between source holders and volunteers to this statement (in percentages). Most respondents of both surveys agree with the statement. There does not seem to be a huge difference between source holders and volunteers. Source holders are only a bit more reserved and use the neutral option more, while the volunteers use the extreme response categories relatively more (fully agree/disagree). Also a Mann-Whitney and student's t-test both indicate that we could not assume that the populations differ significantly in their opinion (Mann-Whitney sig. 0,079 > 0,050, t-test sig. 0,338 > 0,050). This is interesting because from literature it would be assumable that governmental organizations would be more reticent.

One of the main reservations for government would be that they do not trust the data (quality). Figure 15 shows the distribution on the statement that crowdsourcing would deliver trustworthy data. Again, there is little difference between source holders and volunteers, which is also proven with a t-test (sig. 0,545>0,050) and a Mann-Whitney test (sig. 0,515>0,050). However, it is clear that there more people disagree to this statement compared to previous. This supports the literature that trust in VGI is a possible restraint to use or adopt VGI data, but it does not indicate that governments would think worse about the trustworthiness of VGI data than volunteers.

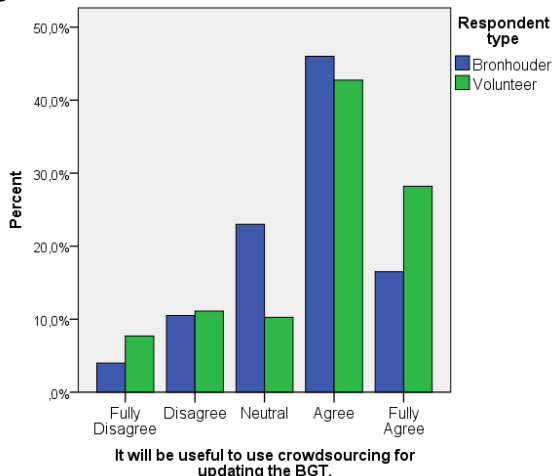


Figure 14 Distribution of response on the question whether it would be useful to use crowdsourcing (b=200; v=117<sup>10</sup>).

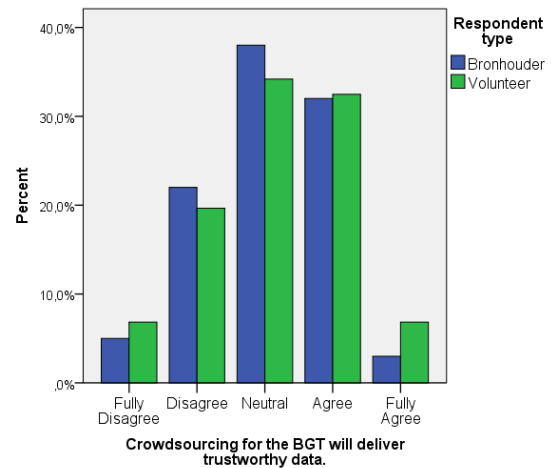


Figure 15 Distribution of the response on the statement that crowdsourcing would deliver trustworthy data (b=200, v=117).

<sup>10</sup> In order to distinguish the response per group, the frequency of the response is indicated with the letters 'b' and 'v'. 'b' stands for bronhouders (source holders) and 'v' for volunteers.

However, another result indicated that source holder actually do think slightly more negative about the quality of VGI than volunteers. On average, source holders (b=185) think that 27,1% of the contributions will exist of unintentional errors. Volunteers (v=112) think that this percentage will be 21,8%. A t-test shows that this is a significant difference (sig. 0,036<0,050) and therefore we can say that an average source holder expects a lower quality of the contributions than an average volunteer. Of course, this makes sense because the volunteers are the proposed creators and they would expect to deliver an useful contribution.

Also when it comes to intentional errors, source holders estimate the percentage on average higher: 10,1% (b=185) against 7,6% (v=112). However, there is no significant difference in this case (sig. 0,084 > 0,050).

Interesting is that both groups are quite high in their estimates compared to the experience of the Kadaster. In their pilot (see textbox 3) they rejected 11,0% of the 384 contributions (Grus, 2014). Also, since December 2014, when crowdsourcing is used as an official change detection source, again 11,0% of the 91 contributions were rejected. According to employees of the Kadaster this were all unintentional errors (see textbox 4).

It must be said that the contributions during both periods were mostly made by persons who work with geo-information. It is not known if this error percentage would rise when 'average' citizens would contribute.

#### Textbox 4: Learning from errors

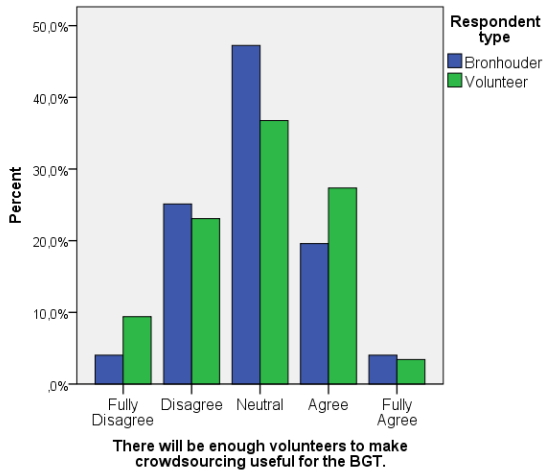
The crowdsource projects of the Kadaster (see also textbox 3) shows that wrong contributions are not necessary annoying. On the contrary: errors could be very informative:

*'The most interesting rejections were people who showed us that we missed quite some gas stations along provincial roads, someone else pointed us that we missed several helicopter platforms. The reason for these rejections was simply that they did not fit in with our regulations for topographic data. But it made us aware that crowdsourcing could also be a source to get insight in the demands of some users (Interview Kadaster Apeldoorn).'*

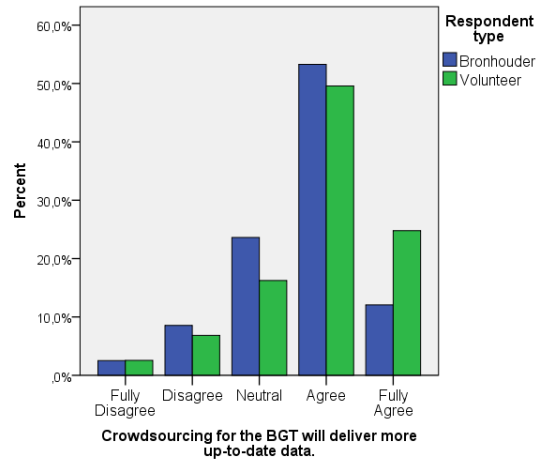
Furthermore, these errors also 'learned' the crowd not to report missing gas stations or helicopter platforms anymore. There were no missing gas stations reported anymore in the 'official' two months of the project. However, it should be questioned whether this learning by 'punishment' (rejection) would not harm the crowd too much. Proper communication seems to be as important as always (Source: Interview with Kadaster)

An important condition for VGI is the amount of 'crowd'. There should be confidence in the existence of a potential VGI crowd before a system should be created to facilitate them. Figure 16 shows the response to the statement that there will be enough volunteers. Again, there are no extreme differences between source holders and volunteers. The differences are therefore also not significant (b=199, v=117; sig. t-test: 0,847>0,050; sig. Mann-Whitney: 0,918>0,050).

The assumed main benefit of crowdsourcing is that it will provide governments with more up-to-date data. Most volunteers and source holders also think that this will be the case (figure 17). While the results does not seem to show a divergent pattern between source holders and volunteers, the t-test and Mann-Whitney test both give a significant difference (sig. 0,029<0,050 and 0,011<0,050 respectively). This difference is caused by the fact that most volunteers agree to fully agree, while most source holders are neutral to agree. The source holders are thus a bit more reserved, but the largest share is still positive.



**Figure 16** Distribution of the response on the statement that there will be enough volunteers (b=199, v=117).



**Figure 17** Distribution of the response on the statement that crowdsourcing will deliver up-to-date data (b=199, v=117).

However, to what extent is it important that the BGT should be up-to-date? Figure 18 shows the response to the statement that the quality of the BGT is more important than the fact that the data is up-to-date. Surprisingly, relatively more volunteers than source holders agreed with the statement, while the source holders slightly disagree more than the volunteers. This goes against the expectation that preliminary volunteers would value up-to-date information more than governments. However, in this case the differences are not significant, so we cannot assume that source holders think significantly different on this subject than the volunteers (b=200, v=116; sig. t-test: 0,227>0,050; sig. Mann-Whitney: 0,164>0,050). Also the results of this statement should be handled with caution, because the quality of the data includes the contemporariness of it.

In figure 19 the response to a question about the most desirable update interval for the BGT is shown. Compared to the original survey response, the answer categories are reclassified, because the category 'other' contained some similar response: several respondents (b=25; v=6) said they would desire continuous updates. These responses were reclassified together with the 'weekly' response as 'weekly or sooner'. In the 'other' category remained mostly respondents who said it depends per object or chose for the legal update interval. The legal update interval also depends per object (6 months for buildings and road infrastructure, 18 months for other objects (Brink et al., 2013)).

Again, it is surprising that the source holders and volunteers are again somewhat on one line. There is also no significance found (b=186, v=113; Chi-square test sig. 0,069>0,050; when the 'other' category is left out 0,539>0,050).

The ambition by many governments to update more frequent than necessary is not only found in this research but also in the BGT monitor reports (Ministerie van Infrastructuur en Milieu, 2014a). It is a positive development for the adoption of crowdsourcing and maybe even a necessity (Coleman, 2013). It could indicate a culture shift of governments which also explains why so many source holders are relatively positive to the statements. Also it could be that source holders are aware of the importance of an up-to-date BGT (see textbox 5).

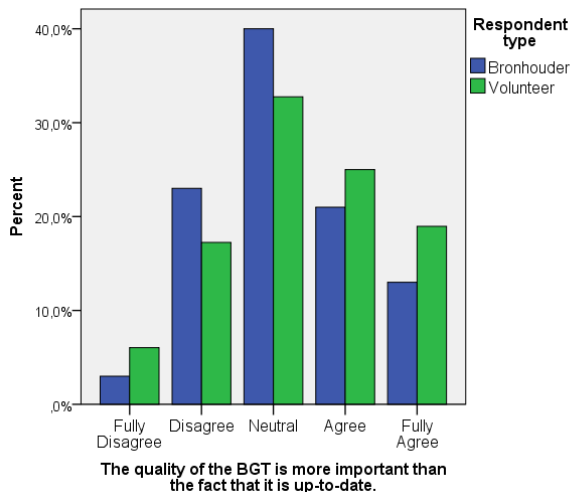


Figure 18 Distribution of the response on the statement that quality is more important than the contemporariness (b=200, v=116).

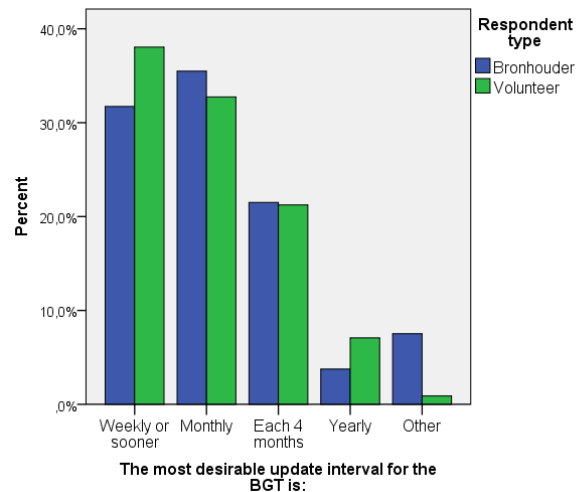


Figure 19 Distribution of the response on the question what the most desirable update interval for the BGT is (b=186, v=113).

**Textbox 5: BGT users and the need for up-to-date information**

How the BGT will be used by society and who the external users of this data are, is difficult to predict. However, this does not mean that all users are unknown. Interviews from BGT-web (2014) and the interviews conducted for this research identified some important users and use. Many interviewees praise the uniformity, openness and exchangeability of the BGT, which will smoothen the work processes.

The BGT will therefore be important for the internal processes of governments. For example for the management of the public space and to determine permits and taxes. Also for spatial planners is it an important reference layer for determining zonal plans. But is it important that the map is always up-to-date? Spatial planner Bram van Hoeve has his reservations: *‘As spatial planner is the BGT certainly very useful and it is a blessing that it will be open data. However, the BGT will be mainly used as reference. Errors in accuracy and contemporariness are annoying, but do not affect the activities of a spatial planner. Legal information is more important.’*

But for other processes can the contemporariness of the data be very important. An employee of ProRail told that the BGT data is not very important for their current work processes, as the BGT does not contain information about railway infrastructure such as switches and signals. But it becomes very important for determining the shortest path in case of emergencies. *‘We are therefore very happy that the BGT is uniform for all areas, because our railway tracks will cross 300 municipalities, 24 water boards and 12 provinces.’* Also for other emergency response teams such as fire departments, police and ambulances will the BGT be very useful. The contemporariness of the data is therefore very important (Source: BGT-web, 2014 and additional interviews).

**4.2.1. Influence of other characteristics**

So it does not seem that source holders and volunteers are thinking radically different about crowdsourcing. But are other respondent characteristics of any influence such as age or the experience with crowdsourcing?

In order to conduct an analysis on this, the first four statements, about the usefulness, trustworthiness, number of volunteers and the up-to-date benefit of VGI, are for each respondent

summed up and averaged<sup>11</sup>. In this way each respondent gets an individual score, which indicates if a person is on average positive about crowdsourcing or that a person is negative. An item-analysis indicates a Cronbach's Alpha of 0,804<sup>12</sup>, which indicates that combining the responses to these statements is a proper way to measure the crowdsourced 'attitude' of a person.

Furthermore to measure the effect of experience with crowdsourcing, the response about the contributions and use of crowdsourced projects were added up to each other, so three categories emerged: 'contributors and users', 'users'<sup>13</sup> and 'non-users' of crowdsourced data. With these two newly created variables a correlation matrix is calculated, see table 4. Spearman's rho is used, because the experience with crowdsourcing exists of ordinal data.

The matrix shows that there is a positive, but quite weak relationship between the attitude and the experience with crowdsourcing. The unintentional and intentional errors are also in general estimated lower when there is a more positive attitude or more experience. Remarkable is the correlation between age and crowdsourced experience, but the absence of a correlation between attitude and age. This is interesting because from the data it appears that respondents of 35 or younger have much more experience with crowdsourced data than people who are 50 years or older (5,3% of the young group has never used or contributed crowdsourced data compared to 47,2%).

The relationship between experience and attitude seems thus less strong than expected. Some respondents with lots of crowdsourced experience, react negative to the statements. With the help of the open questions of the survey four reasons can be distinguished:

**Table 4 Correlation matrix which includes all combined responses to the two surveys.**

Spearman's rho	Crowdsourced attitude	Crowdsourced experience	Unintentional errors	Intentional errors
Crowdsourced attitude	1			
Crowdsourced experience	,202**	1		
Unintentional errors	-,202**	-,102	1	
Intentional errors	-,181**	-,273**	,349**	1
Age	-,098	-,308**	,036	,065
<b>**.</b> Correlation is significant at the 0.01 level (2-tailed).				

- 1.) *BGT specific reasons:* Some respondents have experience with crowdsourcing, but do not feel it will be helpful for the BGT. Reasons such as the legal state of the BGT or the constant quality control which will demand more resources are given;
- 2.) *Crowdsourced specific reasons:* Some state they have had negative experiences with crowdsourcing due to (map) misinterpretations from the crowd;
- 3.) *Anti-government sentiment:* some respondents do not like the idea that the government would copy the concept of OSM, instead of using OSM instead;
- 4.) *Misinterpretation of the survey:* Some people thought crowdsourcing would automatically mean that citizens could directly edit the data, which they did not like. However some stated they were not against a system which is moderated by a source holder or an error report system.

A study about a less socio-political sensitive dataset and a better specified crowdsourced system would perhaps find a stronger relationship between a higher awareness of crowdsourcing and a more positive attitude towards it.

<sup>11</sup> The statement about the quality vs. update frequency is not included, because the statement is not about crowdsourcing.

<sup>12</sup> A Cronbach's Alpha lower than 0,700 would indicate that we should not combine the statements.

<sup>13</sup> In theory also persons which only contribute but do not use crowdsourced data could emerge. However, this did not happen, which also makes sense.

#### 4.2.2. Summary

- Despite the expectations that source holders would be more reticent than volunteers, the results show that the actual differences in attitude between volunteers and source holders are quite small.
- Furthermore, the results show that most people have a quite positive attitude towards crowdsourcing and the ambitions of source holders to update the BGT data sooner than legally necessary fit well in the process of adopting crowdsourcing.
- The relationship between crowdsourcing experience and attitude towards the statements is less strong than expected. This could originate from the subject of the research (BGT) and the research method.

#### 4.3. Volunteer-specific part

As was found in chapter 2, three main influences were distinguished which have an important influence on whether a volunteer would contribute or not: Intrinsic motivations, background characteristics and extrinsic motivations. Intrinsic motivations proved to be the most important trigger to contribute to a VGI project. These will be discussed first.

##### 4.3.1. Intrinsic motivations

The following intrinsic motivations as described by Coleman (2010) and Budhathoki (2010) were measured in the survey: Altruism, learning, social, local knowledge, fun and self need. The response supports the findings in literature that altruism (52,2% agrees<sup>14</sup>), learning (55,6% agrees), fun (64,1% agrees), self need (55,6% agrees) and local knowledge (statement 1: 59,9% agrees; statement 2: 69,2% agrees) are important motivations to contribute. In all cases the responses to the agree categories are higher than the responses to the other categories. Furthermore, the neutral category is always bigger than the disagree category. The fully agree and disagree options are not chosen very often. However, it is generally known that respondents mostly tend to avoid the extreme responses of a Likert scale, which is furthermore also sensitive to cultural differences (e.g. Lee et al., 2002). Therefore, there should not be too much value attached to the lack of extreme responses, either fully agree or fully disagree.

The statement: *'I would like to contribute to the BGT, because I find it annoying to see errors in my neighborhood (local knowledge statement 2),'* gained of all intrinsic motivations the most positive response. This indicates that this is perhaps one of the most important triggers to contribute to a crowdsourcing project. It could further be an explanation why most people only contribute a few times: they see an error, fix it, but do not necessarily get engaged with the project. The study of Budhathoki (2010) also supports the importance of the motivational factor 'local knowledge':

*'The fact that local knowledge turns out to be the most important motivational factor suggests a unique nature of VGI, which is grounded in place (Budhathoki, 2010, p. 84).'*

The responses to the intrinsic motivations was quite similar: are there any relationships between the responses to these questions? Table 5 shows the correlation matrix between the variables. All intrinsic motivations have a significant positive relationship. This means that respondents who react positive to an intrinsic motivational statement, are likely to react positive to another intrinsic motivational statement as well.

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<sup>14</sup> 'Fully agree' and 'agree' are combined to create this percentage. Unless otherwise specified all percentages are constructed like this in the next part. This also counts when a percentage is presented about the share of respondents who disagree.

The responses to these statement are thus quite interrelated. It would be helpful for further analyses to combine these responses into one ‘intrinsic motivation’ score. An item analysis reveals a Cronbach’s Alpha of 0,866, which is quite high. Therefore this ‘intrinsic motivation’ score is created, which will tell us to which degree a respondent is motivated by intrinsic motivations. This score will be put to use in paragraph 4.3.4.

**Table 5 Correlation matrix which shows the relations between the several intrinsic motivations.**

Spearman's rho	Fun	Learning	Local Knowledge1	Altruism	Self need
<b>Fun</b>	1,000				
<b>Learning</b>	,625**	1,000			
<b>Local Knowledge1</b>	,501**	,345**	1,000		
<b>Altruism</b>	,384**	,378**	,514**	1,000	
<b>Self need</b>	,497**	,449**	,652**	,503**	1,000
<b>Local knowledge2</b>	,252**	,257**	,518**	,478**	,519**

**\*\*.** Correlation is significant at the 0.01 level (2-tailed).

### 4.3.2. Extrinsic motivations

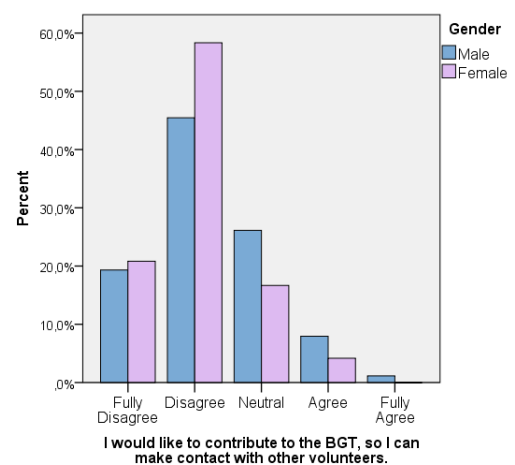
While intrinsic motivations are more present in the literature (which is also supported by the previous paragraph) extrinsic motivations could reinforce these motivations which could increase participation. Extrinsic motivations which were questioned were social contacts, money, commercial applications and implementation of the contribution.

Reactions to the statements about extrinsic motivations were in general much less positive. Especially to the social and money statement people reacted overall very negative. 67,2% disagreed with the statement that they would like to contribute to make social contacts. 65,8% disagreed that they only want to contribute when they got money for it. Many volunteers also disagreed with the commercial statement (*I want to contribute, because I would like to use the BGT in commercial applications*; 44,4% disagreed), but the distribution of the response to this statement was less clear. Furthermore, it is impossible to draw conclusion from this statement, because the (commercial) background of the respondents was not asked in the survey. The response to this question is therefore dropped from further analyses.

From the money statement we could derive a clear signal: people want to contribute to BGT on a voluntarily basis, which is good news for the concept of VGI. However, it is unknown if people would contribute more or better when they are rewarded with money. To answer this question more research is necessary.

It is interesting to see that volunteers do not like to contribute to make social contacts. This could have serious implications for community development. According to Coleman (2013) are long lasting contributors necessary for the quality control and according to Budhathoki & Haythornthwaite (2013) is a community especially important to these long lasting contributors. This seems problematic, but in contrary to ‘open’ VGI were experienced contributors need to perform the quality control, VGI for the BGT would have the source holders as quality checkers. The need for an active community is thus less strong.

However, according to Steinmann et al. (2013), the lack of social aspects of many VGI platforms could be the cause of the extreme gender imbalance. Figure 20 shows the



**Figure 20 Gender division on the social statement (male=91, female=24).**



relative responses to the social statement of the survey, distributed over both sexes (91 responses from males, 24 from females). Despite the small sample of female respondents, the graph makes clear that there are not many differences in attitudes between man and women towards this statement. The female respondents are surprisingly even a bit more negative, but this is not a significant difference (sig. Mann-Withney 0,293>0,050).

Two reasons could possibly explain this disagreement with the literature. First of all, the female sample is not only small, it also preliminary consists of GI-students and professionals, which could have a different view on this matter than the 'average' female. A second, and perhaps more probable reason, is that the research of Steinmann et al. (2013) used a very broad definition of VGI and user-generated content by including social media as Facebook and Foursquare in the analysis. While these websites are based on user-generated content and the latter is certainly geo-related, the goal of the contributors to these website is not to create (spatial) crowd data, but to share social events. It is unlikely that the BGT becomes a new social media platform comparable to Facebook and Foursquare.

Not to all extrinsic motivations respondents reacted negative. On the contrary, the statement: *'It would be fun to see my contributions be implemented'* gained a lot of positive response (76,9% agrees). This is in line with the research of Coleman et al. (2010; 2013), who stressed the importance of quick feedback and implementation.

### 4.3.3. Barriers

Schmidt et al. (2013) identified reasons why people do not want to contribute (anymore) to OSM. The most important issues were the completeness of data and the fact that contributing is time consuming. Also in this research, most respondents find it important that contributing would not cost too much time (72,7% agrees).

Interestingly, most people reacted neutral (39,3%) or negative (44,4%) to the statement that they are of no added value because the BGT will be very complete. This indicates that most people would expect that there will be enough errors in the BGT.

This is not really strange: an interview with the Kadaster, an experienced cartographic organization, revealed that 100% correctness is unrealistic to demand and therefore they strive for a quality level of at least 97%. Furthermore advises the program office of the BGT to be not too perfectionistic: *'Sometimes it is better to accept temporarily small differences in the content in order to move on with the project. You can fix these always later (see figure 21, Ministerie van Infrastructuur en Milieu, 2014b).'* There are thus enough reasons to assume that there will be enough errors to make crowdsourcing useful for source holders and interesting for volunteers.

Furthermore, a statement was proposed to test if people wanted to be anonymous when they contribute. Johnson & Sieber (2013) warned that making a non-anonymous system will reduce participation. Most people did not really have problems with being identifiable when they contribute (48,7%). However, 17,1% of the respondents did have problems with being identifiable. A non-anonymous system could thus indeed reduce participation, but most people do not have problems with it.



Figure 21 BGT-Cartoon about the advise to keep small differences: 'Everything is right, except for this little bush, should I cut it?' 'Just leave it there' (Ministerie van Infrastructuur en Milieu, 2014b).



#### 4.3.4. Background/personal characteristics

Only 8,0% of the respondents stated that they would not contribute to the BGT in the future. The rest sees themselves contributing, only at a different estimated frequency (4,4% several times per week, 30,1% per month, 46,9% per year, 10,6% per decade). In order to test which characteristics have the biggest influence on this, table 6 shows a correlation matrix.

In comparison to table 4, there are some stronger relationships found. Intrinsic motivations show a strong relationship with the attitude towards crowdsourcing. Respondents who reacted positively to the attitude statements reacted thus mostly also positive to the intrinsic motivational statement.

BGT contribution showed to have a negative relationship with attitude, intrinsic motivations and the BGT use. These relationships are negative, because the more frequent options (daily, weekly, monthly etc.) had a lower ranking (1,2,3 etc.). The negative relationship with BGT use is not really surprising as it means that persons who will use the BGT more often also state that they would contribute more often and vice versa. The relative strong relationship with the intrinsic motivations furthermore support the importance of these.

The correlation matrix showed some interesting relationships, but there is no reason to assume that a certain background or personal characteristic of a respondent would influence their opinion. What mostly emerged is that persons who reacted more positive to the intrinsic motivations statement, also are generally more positive about crowdsourcing for the BGT and would contribute more frequent than respondents who are overall negative.

**Table 6 Correlation matrix which shows the relations between background characteristics, motivations and future behavior.**

Spearman's Rho	Crowd Attitude	Crowd Experience	Intrinsic Motivations	Age	GI-experience	BGT use
<b>Crowd Attitude</b>	1,000					
<b>Crowd Experience</b>	,095	1,000				
<b>Intrinsic Motivations</b>	<b>,515**</b>	,053	1,000			
<b>Age</b>	-,065	,019	-,054	1,000		
<b>GI-experience</b>	-,046	,111	,121	<b>,561**</b>	1,000	
<b>BGT use</b>	-,144	-,161	<b>-,316**</b>	-,146	<b>-,307**</b>	1,000
<b>BGT contribution</b>	<b>-,259**</b>	,017	<b>-,418**</b>	-,190*	-,215*	<b>,432**</b>
* . Correlation is significant at the 0.05 level (2-tailed).						
** . Correlation is significant at the 0.01 level (2-tailed).						

#### 4.3.5. Summary

- Intrinsic motivations showed to be an important motivational factor for volunteers, especially those about local knowledge and fun.
- Except for statement about the actual implementation of a contribution, reacted most volunteers negative to the extrinsic motivational statements.
- Volunteers stressed the importance that the system should not be time-consuming. Most volunteers did not think they were useless because the BGT would be very complete.
- Most respondents think they will contribute to the BGT in the future. The frequency of their contributions seemed be interrelated with intrinsic motivations, attitude and BGT use.

## 4.4. Source holder specific part

There were three hurdles identified that source holders have to overcome, before they are willing to adopt VGI. These were trust in VGI and its quality, the availability of resources and the organizational culture. This paragraph will discuss the results of the survey on the basis of these three findings.

### 4.4.1. Trust

Trust is already largely discussed in paragraph 4.2. There were mixed responses from source holders to the statement that crowdsourcing would deliver trustworthy data, but there was slightly more agreement than disagreement. Furthermore, it appeared that source holders estimate the percentage of unintentional errors in the contributions higher than the volunteer sample and real findings.

While most source holders reacted positive to the statements about crowdsourcing, trust did thus prove to be a difficulty for some. However there are ways to improve trust in the crowd: by assessing contributions and contributors. Through this, source holders can distinguish more trustful contributions and protect themselves from spam and vandalism (Coleman et al., 2010; 2013).

Most source holders therefore agree with the statements about these matters: 61,0% agrees that volunteers should be evaluated on their useful contributions and 57,0% agrees that volunteers should always be identified. It is somewhat remarkable that more people disagree with the statement that volunteers should always be identifiable compared to other statement (21,0% against 11,5%). It is namely hard to evaluate volunteers, when you do not know it was the same contributor.

It is unclear how this discrepancy is caused. It could be that some source holders do not see the need to fully identify a person. A pseudonym could also work, as one respondent suggested. Also it could be that the statement is misread by some respondents. For example, people could think the question stated that the contributions of volunteers should be evaluated instead of volunteers themselves.

### 4.4.2. Resources

As Johnson & Sieber (2013) pointed out, crowdsourcing is not per se resource reducing as some people expect: there are of course start-up costs and moreover the contributions should be monitored every day.

Source holders seem to acknowledge this and react mixed to the statements that crowdsourcing would cost more money and time than it brings. Most respondents react neutral (time statement 41,5%; money statement 47,0%). Slightly more respondents furthermore disagree than agree with the statements, indicating that they think crowdsourcing will create some revenues. Unfortunately, the real answer to this difficult question is unknown.

Almost all source holders are neutral or negative about the availability of resources to set up a VGI platform. Only about the availability of knowledge and technology there is a substantial group which does agree (respectively, 26,5% and 25,5% agrees).

In order to reduce data for further statistical analyses, an item-analysis is carried out in order to check if we can sum up all four resource statements into one general resource score. The analysis gives a Cronbach's Alpha of 0,828 which indicates that the statements can be combined.

To check if the response to the resource statements were not only based on feelings, but also on facts, statistics about the extent of each municipal budget and the budget per capita in 2014 were retrieved from the Dutch statistics institute CBS (Centraal Bureau voor de Statistiek, 2015).

We would expect that these statistics at least correlate with the statements. Table 7 shows the correlation coefficient between the statistics and the resource statements<sup>15</sup>. The correlation coefficients indicate all that there is an acceptable significant positive relationship<sup>16</sup>. The highest coefficients are found for the combined ‘resources’ score which highlights the reliability of this construct.

Because most respondents are negative about the availability of the resources in their organization to set up a VGI platform, it is not surprising that 61,5% of the respondents desire that crowdsourcing should be arranged on country level. An implementation on country level would probably be more efficient and less resource demanding for the source holders.

#### 4.4.3. Organizational culture

As explained before, it is difficult to measure the organizational culture with a few survey questions. Nevertheless, source holders were asked if they think that their organizations is always welcoming innovations and if their organization works frequently with other organizations on GI.

Surprisingly, while the innovating nature of many governments is criticized by academics (see for example Vonk et al., 2007), most respondents feel that their organization is always welcoming innovations (54,0% agrees, only 10,5% disagrees). This does of course not mean that innovations are necessarily quickly implemented, but it is an interesting outcome.

Respondents also feel that their organizations frequently collaborate with other organizations on geo-information (63,0% agrees). This is not extremely surprising, because setting up the BGT forces governments to cooperate together to a certain extent. For example, source holders have to make appointments about connecting their BGT data to the BGT data of neighboring source holder. Some source holders even operate in joint ventures to create the BGT together.

#### 4.4.4. Effect on implementation

To test if these hurdles really have an effect on the actual implementation is impossible to determine with this response, because the actual implementation of crowdsourcing is not really considered by any organization. However there is asked at which implementation speed, source holders could implement VGI. Furthermore, we can try to find out what kind of characteristics of source holders have an influence, like has been done in the volunteer part. Table 8 shows the calculated correlation matrix. In order to reduce data, the two statements about crowdsourcing costing more than it brings, are combined into ‘Costs vs. Benefits’ (Cronbach’s Alpha = 0,854). The other statements did not have enough coherence to be combined.

The correlation coefficients are again not very strong, but are a nice indication about the possible relationships between the responses. As in the previous results, respondents with a positive attitude towards crowdsourcing seem to be also more positive about the other statements: overall seen they think crowdsourcing would bring more than it costs, estimate a higher resource availability and think their organization could implement VGI relatively quick.

The openness to innovations and the cooperativeness do not have any effect on the attitude towards crowdsourcing. Also age and GI-experience do not have any influence. The created resources score is interesting. In contrast to the real ‘budget’ of a municipality, it has a positive

**Table 7 Correlation matrix about the resources.**

Spearman’s rho	Total budget	Budget per capita
<b>Resources</b>	,565**	,438**
<b>Enough human resources</b>	,517**	,356**
<b>Enough monetary resources</b>	,411**	,318**
<b>Enough knowledge</b>	,430**	,316**
<b>Enough technology</b>	,452**	,368**
<b>**.</b> Correlation is significant at the 0.01 level (2-tailed).		

<sup>15</sup> Only the respondents who are traceable to a municipality with a known budget are included in this analysis (n=133). Average budgets are calculated when a respondent worked for multiple municipalities.

<sup>16</sup> A Pearson’s correlation showed somewhat less high relationships, but they were still positive and significant.

relationship with the crowd attitude. Both resource scores have a negative relationship with the implementation speed, which indicates that they both are implementation accelerators.

**Table 8 Correlation matrix which shows relationships between motivations, characteristics and implementation speed.**

Spearman's rho	Crowd Attitude	Crowd Experience	Costs vs. Benefits	Resources	Open to innovations	Cooperative	Age	GI-experience	Implementation
<b>Crowd Attitude</b>	1,000								
<b>Crowd Experience</b>	,276**	1,000							
<b>Costs VS benefits</b>	-,487**	-,236**	1,000						
<b>Resources</b>	,238**	,093	-,151*	1,000					
<b>Open to innovations</b>	-,011	-,047	,043	,265**	1,000				
<b>Cooperative</b>	,016	,105	-,060	,198**	,283**	1,000			
<b>Age</b>	-,093	-,312**	,052	-,005	-,051	-,128	1,000		
<b>GI-experience</b>	,045	,027	-,143	,045	,058	,146*	,286**	1,000	
<b>Implementation</b>	-,334**	-,056	,214**	-,350**	-,056	-,042	-,013	-,020	1,000
<b>Total budget</b>	,153	,078	-,343**	,565**	,156	,121	,038	,200*	-,364**

\*. Correlation is significant at the 0.05 level (2-tailed).  
 \*\*. Correlation is significant at the 0.01 level (2-tailed).

One important question is still unanswered, is there a relation between management level of a respondent and the attitude towards crowdsourcing? Because the question allowed multiple answers, it was difficult to test with statistical software. However, table 9 shows the means, which clearly do not differ extremely. It is interesting to see that the highest means are found at the highest management level, namely coordinating/decision-making. There is thus in general no negative perception at the higher management level, compared to other BGT tasks.

**Table 9 The differences in attitude towards crowdsourcing per responsibility levels.**

	Coordinating/ decision-making	Managing	Performing	Using
<b>Attitude</b>	3,31	3,24	3,28	3,21
<b>Resources</b>	2,48	2,47	2,48	2,42
<b>N (Attitude)</b>	121	108	85	44
<b>N (Resources)</b>	115	105	84	45

#### 4.4.5. Summary

- Distrust in VGI data quality is certainly present by a share of the source holders. Most source holders would like to assess and identify the contributors and their contributions.
- Source holders are negative about the availability of resources in their organization for setting up a VGI project. 64,0% of the respondents also state that the implementation of VGI for the BGT should happen on country level.

- Source holders were positive about the innovating and cooperative nature of their organization, but there were no relationships found between this and the attitude and implementation of crowdsourcing.
- Similar to the volunteer response, source holders who are positive towards crowdsourcing are in general more positive about other things, such as that crowdsourcing would yield more than it costs and they estimate a quicker the implementation period of VGI. Also they are less negative about the availability of resources for implementing crowdsourcing in their organization.

#### 4.5. System recommendations

Both respondent groups were asked what kind of system they preferred as a crowdsourcing tool. There were three options:

- 1.) Volunteers fill in an online text form with a description where something is wrong;
- 2.) Volunteers indicate on a digital map incorrect places;
- 3.) Volunteers are offered to fix errors themselves in a digital environment. Each option was accompanied with a screenshot of a real 'VGI' project (see appendix A/B).

Figure 22 shows the distribution between the options. Option 1 is not very much chosen and also would not really fit the definition of VGI, because the volunteers would not really deliver geo-information. However it is how the current feedback option for the BAG works (see textbox 1). The second option was the most popular one. This method has definitely advantages: it is easy to use for non-GI-specialists and less time consuming. Furthermore, it has the advantage above option 1 for source holders that they know immediately the place of the error, instead of having to interpret a description of the possible place. This option is used in the crowdsource project of the Kadaster (see textbox 3)

Option 3 was also quite popular, especially among the volunteers. This system will give volunteers more flexibility and freedom like OSM, which will probably increase the fun factor for a volunteer. This system could also be an improvement for source holders. When volunteers need to use point features to depict line and polygon features, it could be unclear for source holders to determine the exact connection or shape of this proposed change.

However, the fact that most source holders do not prefer this method makes sense, because they have the legal obligations to maintain the BGT quality. By directly implementing contributions from unknown volunteers, they could be held responsible for the actions of another. Source holders want to stay in control of their part of the BGT. Several people who reacted on the 'other' option, state that a hybrid system would be most desirable. Five respondents (b=1; v=4) would like to see a hybridization between option 1 and 2. Thirteen (b=7; v=6) respondents would like a combination of option 2 and 3. The interpretation of this hybridization is only different among the respondents: some would like to see a system where you could use geometry to sketch the real situation, but do not directly fix it; some would like to see a system where more 'expert' users could get

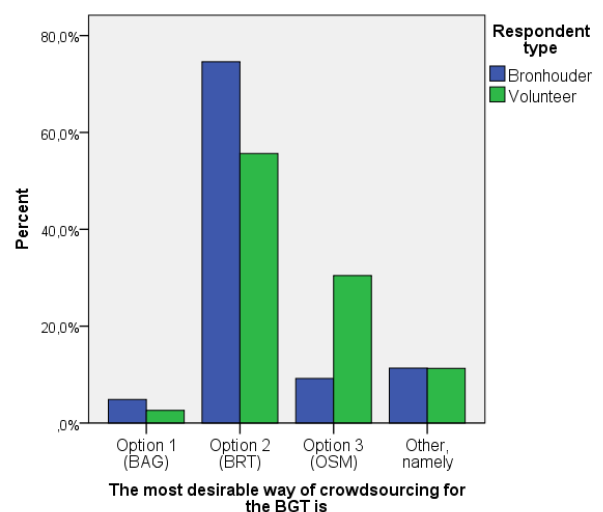


Figure 22 The most desirable VGI system for the BGT according to both respondent groups.

access to the 3th option and get permission to fix errors to a certain extent.

Also Coleman (2013) recommends to create a hybrid system with a simple and easy-to-use interface for occasional users and a more sophisticated and multifunctional web interface for internal staff and “power” users. Hybrid systems are also commonly employed in corporate VGI, for example by TomTom and Google Maps (Coleman, 2013; see figure 23).

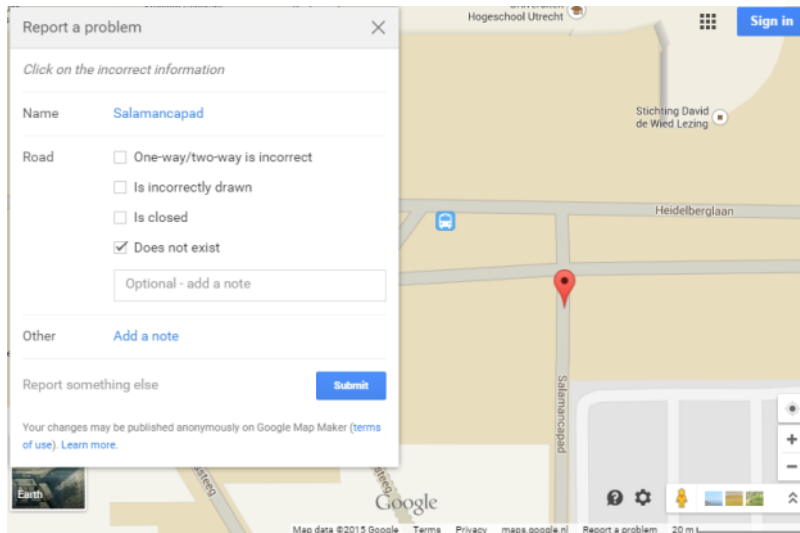


Figure 23 The ‘Report a problem’ interface of Google Maps works like option 2: people will pick a point and type a comment or choose from the list. These ‘problems’ could be send to Google Map Maker where ‘expert’ volunteers could modify the problems (to a certain extent), like in option 3 (see also paragraph 2.2.3; Google Maps, 2015).

#### 4.5.1. Summary

- Most respondents favored a VGI system where volunteers could pick errors on the map and type a description.
- Directly fixing the BGT was relatively more popular among volunteers than source holders. However, a hybrid system was also a possibility for some source holders.

### 4.6. Comments from the crowd

At the end of both surveys there was room for suggestions. Many people left a comment, about for example crowdsourcing, the BGT, experiences, ideas or the survey itself. Common themes were found and this paragraph will handle most of the comments per theme. Of course, many things are actually interrelated. The comments about the research are already partly discussed in the methodology and will be further discussed in the next chapter: Discussion.

#### 4.6.1. BGT specific

Many respondents identified opportunities and threats which are BGT specific. Within this research there is not much elaborated on the technical details of the BGT, but they are of course of importance when a practical implementation is considered.

First of all, respondents stressed the importance that the BGT should be country covering and fully accessible to the crowd via the web/cloud. Because this is also a legal obligation, this condition would be easily fulfilled. Another legal obligation that people pointed out was the obligatory ‘feedback system (terugmelding)’: governments are obliged to report errors they find in the data of



another source holder. This is actually also a form of crowdsourcing, but of course not very voluntarily. This system could of course be extended towards the crowd.

Some pointed out that the coordination with other source holders could be difficult. Which source holder will pick up the contribution when it lies at a source holder boundary? Furthermore one respondent reported trust issues:

*'As long as source holders do not trust each other with the exchange of data, there needs to happen a lot before we will trust the crowd.'*

The BGT is also very complex. The data is generalized from different systems, but also has to work with different systems. The specific knowledge about the BGT standard would be too difficult for volunteers and publicly available outdated aerial imagery and consumer GPS will probably not fit the accuracy requirements. On the other hand, one respondent noted that volunteers could be useful for the creation of the so-called 'plus'-topography: the BGT exists of two standards, one obligatory and one optional add-on (IMGEO). Municipalities can choose depending on their resources and demands if they only do the minimum required part of the BGT or also the 'plus'-topography.

These differences in implementation between municipalities are on the one hand an opportunity for the adoption of VGI. Because the quality of the BGT would be heterogeneous anyway, accepting heterogeneous VGI quality would probably be less problematic. On the other hand, the different use of BGT standards could easily confuse volunteers. Within the BGT data there are for example 'white gaps' between features, which are not obligatory to fill in. According to a respondent, explaining this to each volunteer would probably cost more time than it brings. Another said about the homogeneity of the BGT:

*'The BGT will be a crossing between a patchwork and a Swiss cheese and still fit the legal obligations. This aspect of the BGT is difficult to explain to guileless volunteers. An error in one municipality, does not have to be an error in the other.'*

One respondent did notice that crowdsourcing would be actually unnecessary, because for every change in the built environment, one needs a permit in the Netherlands. This permit needs to be issued by the municipality itself. With other words: a municipality is in theory always aware of changes in the built environment, which is the most important source for changes in the BGT. But in most cases, the communication between the permit department and the geo-department is not that streamlined.

One very important aspect of the BGT is its legal state and the responsibilities of source holders: the BGT could be used by lawsuits and on the accuracy of the data, maintenance budgets of public spaces can be calculated (for example the amount of m<sup>2</sup> grass that needs to be mowed). These budgets can easily reach a million euro, according to a respondent. A water board pointed out that they will use the BGT for granting permits. When people could change the BGT to their advantage, they could avoid the need of a permit. Abuse of crowdsourcing in favor of self-interest should of course be prevented.

However, one respondent said that the legal obligations of the BGT are too strict:

*'The obligatory use and feedback for governments does not fit the geo-key registers. Because the legal texts of the geo-key registers are almost a copy of the more administrative key registers, the legislation has become too strict. In my opinion would crowdsourcing be very helpful for the geo-key registers, but the law does not really facilitate this.'*

Because these legal obligations and responsibilities, it is clear that source holders cannot approve a contribution without verifying it. Several respondents stated that controlling the contributions always will cost more time and money.

Some respondents had clearly some negative experiences with citizen feedback, which mostly arose due to misinterpretation of a map by a citizen. Also one said that they never had any (useful) feedback on another key register, the BAG. However, this key register does not have a very accessible feedback system.

For the Ministry of Defense and ProRail would the implementation of crowdsourcing be useless: Both manage terrains which are largely forbidden for unauthorized persons.

#### 4.6.2. The system

Respondents pointed out that the VGI system should be implemented on country level. This will prevent a sprawl of VGI systems and is more clear for citizens and source holders. However, it will bring some challenges: there should be an automatic dispatch function to send the feedback to the right source holders. Also will a country system increase the distance between local source holder and local citizen. One respondent suggested to do some social events with volunteers and source holders, in order to enhance motivation and quality.

Many respondents found the identification of respondents a difficult dilemma. Some suggested that identification is unnecessary, but should be optional if the contributor wants feedback. Another suggested that it is necessary for the communication between source holder and volunteer, but that a pseudonym would be sufficient.

The system should further be easily accessible and friendly to use. It should be focusing on the 'average' citizen, the GI-specialist would probably find its way to give feedback anyway. Also creating an integrated VGI system with other key registers and datasets would be useful and fits the philosophy behind the key registers: 'Gather once, use multiple times.' Furthermore, contributions should be processed as quick as possible, while the volunteers should be kept informed at all times (if this is possible).

#### 4.6.3. Ideas

In order to make crowdsourcing useful, many respondents stated that the BGT should be used in 'average' citizen applications, such as in walk, cycle, navigation, geocaching and neighborhood improvement applications. These applications should be working on multiple devices (smart phones, tablets, pc's and other smart wear). Also non-recreational applications could be used to show the BGT to the crowd, such as the estimation of property (WOZ) taxes. When a volunteer reports an error, it would ideally be possible to upload next to description, a photo with geographical coordinates.

Someone noted that projects like OpenStreetMap already have problems with attracting and retaining enough volunteers. Several respondents therefore stressed the importance of rewarding volunteers. One suggested to give (a small) discount on the municipal taxes when a citizen contributed an 'x' number of useful contributions. Others said that it does not have to be a monetary reward, but also virtual status points could be assigned. This will also be helpful by a hybrid system where persons with a high number of points would gain more rights to edit than persons without any points. Of course, these systems would increase the necessity to identify a contributor.

Another recurring idea was to search for cooperation with private partners. For example with creators and developers of recreational data and applications (such as the ANWB and cartographic companies). Also cooperation should be sought with current big open data users like Google, Bing and TomTom.

Some persons suggested that there should be a better cooperation with hired contractors who work in the field for the source holders. One respondent said that by inaccuracies the contractor will always gain the upper hand. For example, if there is more grass to mow than stated in the contract (which is based on the BGT), the contractor would demand more money. If there is less grass, the contractor would probably not report it. There should be a system where contractors gain money by

telling the actual situation. Also sensors, for example a GPS tracker to track the path of a garbage truck, could be insightful to get knowledge about the complete road network.

The last, but resisting recurring cooperation partner was the OpenStreetMap community. Many people pointed at the usefulness of OSM data and suggested to make the BGT and OSM easily interchangeable. Some stated that the government should not reinvent the wheel and use VGI from OpenStreetMap instead. OSM is because of its openness also probably an easier partner to exchange information with compared to the companies with corporate VGI.

#### 4.6.4. Summary

- Many respondents pointed out that the BGT is not really suitable for direct editing from users, due to its complexity and legal status.
- The system should be implemented on country level and be easily accessible and friendly to use even for 'average citizen'. These citizens could be reached by creating useful BGT applications for them.
- Smooth cooperation with existing VGI platforms and contractors will be useful for the implementation of a system and the exchange of information.

## 5. Discussion

From the massive response to the surveys emerged some really interesting results, which are helpful to determine if VGI would be a viable option for keeping the BGT up-to-date. While the previous chapter discussed the results already in detail, this chapter will critically discuss the overall findings and put them in a broader perspective. Also the limitations of this research are indicated.

### 5.1. Volunteers

Reaching potential VGI volunteers proved to be difficult, especially because an 'average' citizen would have too less specific knowledge about the BGT, geo-information and crowdsourcing to complete a survey. Therefore was chosen to aim for GI-professionals, because they are more aware about these concepts and also probably the 'early adopters'. However, during this research it appeared that even for measuring GI-specialists, the sample was probably too biased and certainly not representative.

It was therefore surprising that the results showed a very similar pattern with the studies of Budhathoki (2010) about motivations to contribute. Intrinsic motivations proved to be important, such as altruism, learning, self need and especially fun and local knowledge. Also was found that seeing your contribution being implemented was also very important motivator, as Coleman et al. (2010) also argued. The extrinsic motivations, social contacts and monetary motivations, were not found to be important in this research. This is directly in line with the research of Budhathoki (2010).

However, the statement about monetary motivations did not ask if people would not like to be rewarded with money. It only studied if people demanded money instead of contributing on a voluntary basis. Also the effects of virtual rewards and 'gamification' were not studied.

The influence of rewards and incentives on VGI therefore remains unknown and further research is necessary. Several respondents suggested that rewards could be important to stimulate and retain contributors. From the results and accompanying literature, it appeared that retaining volunteers can be difficult. Because most respondents were not interested in getting in touch with other volunteers, it is doubtful if there will emerge an active volunteer community. Rewarding can therefore be useful to stimulate motivation, but according psychological theories also the reverse could happen. This is known as the 'over-justification effect' (Lepper et al., 1973): when people get rewarded for things they would do out of intrinsic motivations, the rewards can create doubt about the true motive and lower the (intrinsic) motivation (Ihl et al., 2012). With other words: people can get the feeling they are being 'bribed.' The impact of the over-justification effect on contributors to VGI is not yet studied.

Luckily, the results give us certainly some leads how to gain a large voluntary crowd. The system should be easily accessible, friendly to use and not time-consuming. Most respondents found it annoying to spot errors on the map of their neighborhood and would therefore contribute. There should thus be a lot of exposure for the BGT and its VGI system in order to gain as many views as possible.

However, how the BGT will land in society is at this moment unknown. It could become the new Google Maps or a forgettable data source (see figure 24): this is up to the promotion of the government and the enthusiasm of GI-professionals in the Netherlands. Because the source holders will act as quality controllers, the lack of an active community would be less important.

Although the volunteer sample was not representative it showed very interesting results. Especially the accordance



Figure 24 BGT Cartoon: 'Forget Google Maps, use the BGT'. For example for planning your running round (Ministerie van Infrastructuur en Milieu, 2014b).

with scientific literature showed that the motivations to contribute to OSM could possibly be applicable to other VGI platforms. These confirmations lead to a better understanding of motivations to contribute to VGI in general.

## 5.2. Source holders

This research limited its focus on studying the willingness of source holders to adopt VGI and did not paid much attention to the benefits of VGI. The source holders were quite positive and willing, but a research about the real costs, quality and benefits of VGI could perhaps further take away the dominating reservations. The responses to the availability of resources was very negative. The statements about the trustworthiness of VGI data gained mixed responses, but were overall more positive than expected. These reservations supported the literature to a certain extent, but were certainly not as strong as expected.

The overall positive attitude of source holders towards crowdsourcing was therefore very surprising. Also the fact that most source holders stated that their organization was open to innovations, cooperative and that they desired to update the BGT more frequent than was legally necessary was unexpected. As was written in the introduction, governments are known as bureaucratic structures and slow innovators (Vonk et al., 2007; McDougal et al., 2009). Their geo-information was constructed via slow conventional methods and typically outdated (Coleman, 2013). Why is there such a discrepancy between the results and the scientific literature?

Various reasons can be thought of ranging from pessimistic to optimistic reasons. One of the most pessimistic reasons is that the survey generated mostly socially desirable response. This is not uncommon for surveys. However, because of the size of the sample it is unlikely that all respondents did fill in socially desirable responses. Furthermore, the ambitions of several source holders to perform better than legally necessary is also found in the monitor reports of the BGT (Ministerie van Infrastructuur en Mileu, 2014a).

An interviewee explained another reason, namely that geo-information employees are keen on innovation, but that there plans are generally blocked by other employees:

*‘Public servants are afraid of change, because when something goes wrong, they have to take the responsibilities. The first law of public servants therefore goes: ‘Nothing will change and if something has to be changed, it should change as little as possible.’ This is perhaps less applicable on geo-information departments, but certainly legal experts, spatial planners and municipal executives have problems with change.’*

This is somewhat in line with the in the introduction cited quote from Vonk et al. (2007) that *‘visionary middle-level and frontline public servants’ attempts to innovate’* mostly fail due to *‘the hurdles of bureaucracy (p.745).’* This article was also specifically written about the Dutch GI-context. However, the survey response contradict these citations because respondents stated that *their organization* was open to innovations, not only their department. If their innovating attempts would often fail, it is unlikely that these respondents would agree with this statement.

A more positive explanation of these results, is that there has been important modernizations in the Dutch governmental GI-sector in the past 10 years. In this period, important institutions and policies were launched, such as ‘Ruimte voor Geo-informatie’ (Space for Geo-Information)’ in 2004 , ‘Beraad voor de geo-informatie’ (Council for Geo-information) in 2006, foundation Geonovum in 2007, GIDEON in 2008 and GeoSamen (‘GeoTogether’) in 2014 (Barneveld et al., 2008; Ministerie van VROM, 2008; GeoSamen, 2014). Furthermore, the BGT and the whole key register system itself (see textbox 1) are an important product of these ambitions. Thanks to these policies, open data also has become commonplace in the past few years.

All these policies, programs and institutions could be an important cause of a cultural shift within Dutch governments to be more efficient, cooperative an open to innovations. VGI fits perfectly in

this shift. Furthermore, the idea of a participatory society created a lot of buzz in the Netherlands due to the Dutch King's speech in 2013 (Sociale Vraagstukken, 2015). VGI also fits neatly in this idea of a participatory society.

While all these reasons could be of influence, more research is necessary to determine the underlying reasons. To test if this response is quite specific to the current Dutch GI-context, perhaps a similar research in a different country would be interesting. Nevertheless, this first quantitative research about VGI adoption by governments has found hopeful results in favor for VGI adoption. The prevailing image about governments seemed to be too pessimistic and a successful adoption of VGI is certainly feasible on a short term.

### 5.3. Overall remarks

Overall, the results support the idea that VGI could be very useful for keeping the BGT up-to-date. But we should be careful with the conclusions of this research, because distortions may have arisen due to methodological issues. For example all responses were estimations of future behavior and there are no obligations for a respondent to act as he/she said. Furthermore, the answers are sometimes probably blind guesses, as some people responded they missed the 'I don't know' option in the survey. When people face a real choice whether to adopt VGI or not and whether to contribute or not, it is likely that people would make different choices. However, it is the best indication there is at the moment.

Also, because many questions in the survey were interrelated, this could also generate some distortions due to different interpretations of the situations. In order to steer respondents as little as possible, questions were quite general formulated and no specific systems or suggestions were made. Now this research generated some good indications about user demands. It is recommendable that future research would be more specific in order to find stronger causalities. For example by proposing scenarios where people could react on or experiment with users testing a real VGI system.

The BGT played a central role in this research about VGI. The BGT is an unique opportunity to get access to an enormous amount of governments to gain knowledge about VGI adoption, but we should keep in mind that the context of the BGT is quite specific and also legally bound. Opponents of crowdsourcing for the BGT are thus not necessarily opponents of crowdsourcing for other governmental datasets with more freedom and less requirements.

Furthermore, we should not forget that VGI is not the only solution to keep the BGT up-to-date. Several reasonable ideas came up from the respondents, such as using sensors and streamlining the communication between the spatial planning/permit department and the geo-information department. We should therefore not forget the lesson of Coleman that:

*“VGI is not the ultimate solution to all geospatial data updating and maintenance challenges now faced by mapping organizations. However, there is growing agreement that it represents one important channel of such updates—one that needs to be investigated, prototyped, and introduced in a reasonable, informed manner (Coleman, 2013, p. 260).”*

This research supports this growing agreement. It fits in the current scientific and societal interest to gain more knowledge about VGI and its underlying motivations. It shows that governments are in general becoming ready to implement VGI and that volunteers are in general intrinsically motivated enough to contribute. VGI seems therefore a very reasonable option in order to keep governmental data such as the BGT, better up-to-date.



## 6. Conclusion

This research investigated if volunteered geographic information (VGI) is a serious option to keep the Basisregistratie Grootchalige Topografie (BGT) up-to-date. In order to make VGI for the BGT successful, volunteers should be willing to contribute VGI and source holders should be willing to adopt VGI. Therefore two research questions were formulated:

1. *Are the Dutch BGT source holders willing to use VGI as source for updating the BGT and why (not)?*
2. *Are there potential volunteers willing to contribute VGI as source for updating the BGT and why (not)?*

To answer these two questions, a literature review, two surveys, several interviews and discussion groups were conducted. In total, 117 useful potential volunteer surveys were filled in and 200 source holders gave a useful response. The results show that:

- **Source holders** are in general positive about crowdsourcing and think it will be useful for keeping the BGT up-to-date. In contrary to indications from scientific literature, source holders were much less reserved in their opinions towards crowdsourcing than expected. Also they appeared quite positive about the innovating and cooperative nature of their organization and most of them stated ambitious desirable update intervals for the BGT. However, source holders reacted somewhat mixed about the trustworthiness of VGI data, the amount of volunteers and the revenues of crowdsourcing. Source holders therefore desire to be in control over the contributions and the contributors. Source holders were very negative about the availability of resources to launch a VGI platform themselves. They therefore desired that VGI would be arranged on country level.
- **Volunteers** are in general also very positive about crowdsourcing. Most of them stated they would like to contribute in the future. Similar as was found in the literature study, volunteers are mostly intrinsically motivated to contribute. Important intrinsic motivators are altruism, learning, self need and especially fun and local knowledge. The actual implementation proved also to be a very important motivator, while other extrinsic motivations seemed ineffective. Also there were no strong relations found between personal characteristics and the attitude towards crowdsourcing.
- The **VGI system** should, according to source holders and volunteers, be easily accessible and friendly to use, also for non-GI professionals. Contributing should not be time consuming and the system should desirably be implemented on country level. The most desirable system would be a system where volunteers could pick points on a map and type a description. However, a hybrid system with more functionality/freedom for the volunteers would perhaps also suit, as long as the source holder remains in control.

Because both groups are overall positive about the usefulness of crowdsourcing, it seems that the time is ripe for implementing VGI within governments. Especially when source holders are trying to update the BGT more frequently or even continuously, VGI would be a great additional instrument for source holders.

Because there are good indications that there will be a crowd to contribute voluntarily and source holders are much less reserved as expected, we can conclude that: **VGI could be a very useful option for keeping the BGT up-to-date.**

## 6.1. Recommendations

In order to gain and retain **volunteers** the following recommendations can be made:

- Promoting BGT use and creating exposure for the VGI system is very important to make VGI successful for the BGT. The more views, the more contributions, especially because spotting errors in your neighborhood was a key motivation to contribute.
- In order to satisfy volunteers and keep them motivated, the contributions should be as quickly as possible be implemented. Also clear communication between the source holder and volunteer about the status of their contribution is important.
- The VGI platform should be easily accessible, friendly to use and not time consuming to contribute.

On the **source holder** side, the following recommendations can be made:

- In order to improve trust in VGI quality, identification and assessment of users and their contributions can be considered.
- Source holders should always be in final control, due to their legal responsibilities to keep the quality high. This implies that work processes ideally have to be changed: BGT update intervals have to be sped up and handling VGI contributions should be a daily routine. This will imply that extra resources need to be assigned.
- VGI should be implemented on a nationwide level, because most municipalities are lacking the resources to create a system themselves and a sprawl of VGI systems would only confuse volunteers.

## 6.2. Further research

In order to improve and smoothen a successful implementation of VGI for the BGT, further research could be done to:

- Determine the costs and benefits of VGI for the BGT with a proper business case. If this research is positive it will probably take away most of the source holders rejections.
- Determine more detailed system requirements, which should be appealing to potential volunteers and source holders.
- Gain more insights in the motivations to adopt and contribute, a pilot study will be useful. This will require more commitment of both groups, which will give a better insight in the motivations and behavior of both groups.

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## Appendices

### Appendix A – Offline Volunteer Survey

# Onderzoek Crowdsourcing voor de BGT<sup>17</sup>

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Veel overheden zijn op dit moment druk met de realisatie van de **Basisregistratie Groot-schalige Topografie (BGT)**. Dit is een zeer gedetailleerde kaart van Nederland waarop alle fysieke objecten zoals gebouwen, wegen, water en groen eenduidig op zijn vastgelegd. De BGT is open data, waardoor iedereen de kaart straks kan raadplegen en gebruiken. Hierdoor kan ook iedereen fouten of achterstalligheden ontdekken, maar op dit moment is er geen (laagdrempelige) manier om deze fouten door te geven.



Screenshot van de BGT van Leiden

Dit onderzoek bekijkt of het wenselijk is om gebruik te maken van **crowdsourcing**. Hiermee wordt bedoeld dat **iedereen** de mogelijkheid krijgt om bij te dragen aan het actueel en correct houden van de BGT. Met crowdsourcing kan dus, in theorie, de kennis van de hele samenleving worden benut. Er wordt tegenwoordig veel gebruik gemaakt van de ‘crowd’ door zowel commerciële bedrijven (bijv. Google Maps, TomTom), als niet-commerciële organisaties (bijv. Wikipedia, OpenStreetMap), maar veel overheidsorganisaties gebruiken crowdsourcing (nog?) niet.

Dit onderzoek bekijkt of het gewenst en/of zinvol is om crowdsourcing te gebruiken voor het actueel houden van de BGT. Hierbij wordt aan de ene kant de bereidheid van overheden onderzocht, aan de andere kant de **bereidheid van (mogelijke) vrijwilligers**. Hiervoor is deze enquête bedoeld<sup>18</sup>. Ook wordt onderzocht op welke manier crowdsourcing voor de BGT moet worden ingevuld.

Om tot een zo nauwkeurig mogelijke conclusie te komen, zou ik graag uw mening willen horen! U kunt me helpen door de volgende enquête in te vullen. Dit duurt ongeveer **5 tot 10 minuten**. Alle ingevulde enquêtes worden vertrouwelijk behandeld. Er zullen geen uitspraken gedaan worden op basis van een individuele enquête.

Dit onderzoek is een **masterthesisonderzoek voor de opleiding GIMA** (Geographical Information Management and Applications) aan de universiteiten van Delft, Enschede, Utrecht en Wageningen. De uitkomsten van dit onderzoek zullen in eerste instantie voor wetenschappelijke doeleinden worden gebruikt, maar ze kunnen van invloed zijn op het toekomstige beleid voor het beheren van de BGT.

Alvast hartelijk bedankt voor uw medewerking,

Jaap-Willem Sjoukema

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<sup>17</sup> Translations of questions and answers are visible in the graphs of appendix C.



# Onderzoek Crowdsourcing voor de BGT

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1. Wat is uw leeftijd? .....

2. Wat is uw geslacht? Man/vrouw

3. Wat is uw woonplaats? .....

4. Hoeveel jaar ervaring met geo-informatie heeft u? Zet een kruisje in het bolletje dat van toepassing is.

- Ik heb geen ervaring
- Ik heb een klein beetje ervaring
- Ik heb 1 tot 5 jaar ervaring
- Ik heb 6 tot 10 jaar ervaring
- Ik heb meer dan 10 jaar ervaring

5. Heeft u wel eens vrijwillig bijgedragen aan een crowdsource project zoals bijv. Wikipedia, OpenStreetMap of een Open Source Software project?

- Ja, namelijk:  
.....
- Nee

6. Heeft u wel eens gebruik gemaakt van een crowdsource project zoals bijv. Wikipedia, OpenStreetMap of een Open Source Software project?

- Ja, namelijk: .....
- Nee

7. Hoe vaak denkt u de BGT waarschijnlijk te gebruiken in de toekomst?

- Dagelijks
- Enkele keren per week
- Enkele keren per maand
- Enkele keren per jaar
- Enkele keren per 10 jaar
- Ik ga de BGT niet gebruiken
- Ik weet niet wat de BGT is

Omcirkel in hoeverre u het eens bent met de volgende stellingen:

<b>8. Het lijkt me nuttig om crowdsourcing te gebruiken voor het actualiseren van de BGT.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>9. Crowdsourcing voor de BGT zal voor betrouwbare data zorgen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>10. Er zullen voldoende vrijwilligers zijn om crowdsourcing voor de BGT nuttig te maken.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens



Omcirkel in hoeverre u het eens bent met de volgende stellingen:

<b>11. Crowdsourcing voor de BGT zal voor actuelere data zorgen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>12. Voor de BGT gaat de kwaliteit van de data boven de actualiteit.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>13. Het lijkt me leuk om bij te dragen aan de BGT.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>14. Het lijkt me leerzaam om bij te dragen aan de BGT.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>15. Het lijkt me leuk om mijn aanwijzingen doorgevoerd te zien worden.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>16. Ik zou willen bijdragen aan de BGT, omdat ik accurate kennis over mijn lokale omgeving kan leveren.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>17. Ik zou willen bijdragen aan de BGT, omdat ik het belangrijk vind om andere mensen te helpen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>18. Ik zou willen bijdragen aan de BGT, omdat ik de BGT in de toekomst zelf wil gebruiken.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>19. Ik zou willen bijdragen aan de BGT, omdat ik het vervelend vind om fouten in mijn omgeving te zien.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>20. Ik zou willen bijdragen aan de BGT, zodat ik in contact kan komen met andere vrijwilligers.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>21. Ik zou willen bijdragen aan de BGT, omdat ik de data wil gebruiken in commerciële toepassingen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>22. Ik zou alleen willen bijdragen aan de BGT als ik anoniem kan blijven.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>23. Ik zou alleen willen bijdragen aan de BGT als het me niet teveel tijd kost.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>24. Ik zou alleen willen bijdragen aan de BGT als ik hier geld voor kreeg.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>25. Ik denk niet dat ik van veel toevoeging ben voor de BGT, omdat de BGT erg compleet is.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>26. De meest wenselijke manier van crowdsourcing voor de BGT is:</b>					

BAG terugmelding

Het dit formulier kunt u 1 waarneming doorgeven. Wij sturen uw melding door naar de betreffende bronhouder. Het Kadaster maakt geen gebruik van uw gegevens.

**Gegevens melder**

Baai(organisatie)\*

Naam\*

E-mail\*

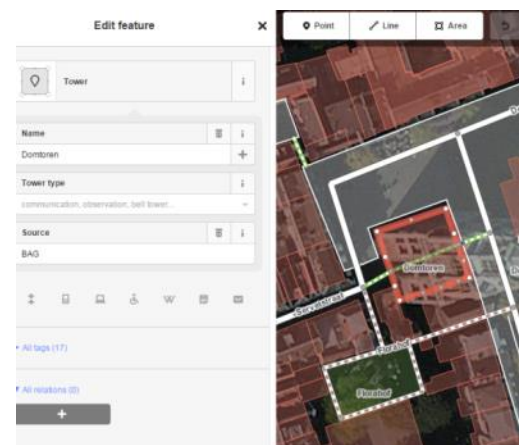
E-mailadres waarop de bronhouder u kan informeren

E-mail bevestigen\*\*

Datum waarneming

Waargenomen in

- Aank. Sittout
- BAG Content
- BAG Gegevens
- BAG Wkz
- BAG Vrezer (Gegevens in de BAG. Vrezer zijn niet per definitie actualiteit of compleet. Toets op volledigheid in BAG Wkz.)
- Andere



- Vrijwilligers een digitaal formulier laten invullen met een beschrijving waar iets niet klopt.
- Vrijwilligers op een digitale kaart plekken die niet kloppen laten aangeven.
- Vrijwilligers aanbieden om fouten zelf te repareren in een digitale omgeving.

- Anders, namelijk .....

**27. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **onopzettelijke** fouten zal bevatten.

**28. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **opzettelijke** fouten zal bevatten.

**29. De meest wenselijke update interval voor de BGT is:**

- Wekelijks
- Maandelijks
- Per kwartaal
- Jaarlijks
- Eens per twee jaar
- Anders, namelijk .....

**30. Als ik in de toekomst zou bijdragen aan de BGT, dan zou ik dit waarschijnlijk:**

- Enkele keren per week doen
- Enkele keren per maand doen
- Enkele keren per jaar doen
- Enkele keren per 10 jaar doen
- Ik ga niet bijdragen aan de BGT.

**31. Heeft u nog opmerkingen of suggesties over crowdsourcing, de BGT of dit onderzoek?**

.....

.....

.....

.....

.....

Hartelijk bedankt voor uw medewerking! Wilt u op de hoogte worden gehouden van de resultaten van dit onderzoek? Vul dan hieronder uw e-mailadres in.

.....

# Onderzoek Crowdsourcing voor de BGT

Beste BGT-bronhouder,

Veel bronhouders zijn op dit moment druk met de realisatie van de **Basisregistratie Grootchalige Topografie (BGT)**. Deze gedetailleerde digitale kaart van Nederland is open data, waardoor iedereen de kaart straks kan raadplegen en gebruiken. Hierdoor kan ook elke burger fouten of achterstalligheden ontdekken, maar op dit moment is er geen (laagdrempelige) manier voor hen om deze fouten door te geven.



Screenshot van de BGT van Leiden

Dit onderzoek bekijkt of het wenselijk is om gebruik te maken van **crowdsourcing voor de BGT**. Hiermee wordt bedoeld dat **iedereen** de mogelijkheid krijgt om bij te dragen aan het actueel en correct houden

van de BGT. Met crowdsourcing kan dus, in theorie, de kennis van de hele samenleving worden benut. Er wordt tegenwoordig veel gebruik gemaakt van de ‘crowd’ door zowel commerciële bedrijven (Google Maps, TomTom) als niet-commerciële organisaties (Wikipedia, OpenStreetMap), maar veel overheidsorganisaties gebruiken crowdsourcing (nog?) niet.

Dit onderzoek bekijkt of het gewenst en/of zinvol is om crowdsourcing te gebruiken voor het actueel houden van de BGT. Hierbij wordt aan de ene kant de bereidheid van vrijwilligers onderzocht, aan de andere kant de **bereidheid van bronhouders**. Hiervoor is deze enquête bedoeld<sup>20</sup>. De manier waarop burgers kunnen bijdragen aan de BGT is ook onderdeel van dit onderzoek.

Om tot een zo nauwkeurig mogelijke conclusie te komen, zou ik graag uw mening willen horen! U kunt me helpen door de volgende enquête in te vullen. Dit duurt ongeveer **5 tot 10 minuten**. Alle ingevulde enquêtes worden vertrouwelijk behandeld. Er zullen geen uitspraken gedaan worden op basis van een individuele enquête.

Dit onderzoek is een **masterthesisonderzoek voor de opleiding GIMA** (Geographical Information Management and Applications) aan de universiteiten van Delft, Enschede, Utrecht en Wageningen. De uitkomsten van dit onderzoek zullen in eerste instantie voor wetenschappelijke doeleinden worden gebruikt, maar ze kunnen van invloed zijn op het toekomstige beleid voor het beheren van de BGT.

Alvast hartelijk bedankt voor uw medewerking,

Jaap-Willem Sjoukema  
MSc GIMA Student

<sup>19</sup> Translations of questions and answers are visible in the graphs of appendix D.

<sup>20</sup> **LET OP: Deze enquête is bedoeld voor personen die betrokken zijn bij het bronhouderschap van de BGT. Bent u hierbij niet betrokken, maar wilt u wel meewerken aan dit onderzoek? Vraag dan om een vrijwilligers/gebruikers-enquête.**



# Onderzoek Crowdsourcing voor de BGT

---

1. Wat is uw leeftijd? .....

2. Wat is uw geslacht? Man/vrouw

3. Hoeveel jaar ervaring met geo-informatie heeft u? Zet een kruisje in het bolletje dat van toepassing is.

- Ik heb geen ervaring
- Ik heb een klein beetje ervaring
- Ik heb 1 tot 5 jaar ervaring
- Ik heb 6 tot 10 jaar ervaring
- Ik heb meer dan 10 jaar ervaring

4. Heeft u wel eens vrijwillig bijgedragen aan een crowdsource project zoals bijv. Wikipedia, OpenStreetMap of een Open Source Software project?

- Ja, namelijk:  
.....
- Nee

5. Heeft u wel eens gebruik gemaakt van een crowdsource project zoals bijv. Wikipedia, OpenStreetMap of een Open Source Software project?

- Ja, namelijk: .....
- Nee

6. Bij welke overheidsorganisatie bent u betrokken bij het bronhouderschap?

- Gemeente, namelijk .....
- Waterschap, namelijk .....
- Provincie, namelijk .....
- Rijksoverheid, namelijk .....
- Overige bronhouder, namelijk .....

7. Welke rol speelt u in het bronhouderschap van uw organisatie? Meerdere antwoorden zijn mogelijk.

- Coördinerend/besluitvormend
- Beherend
- Uitvoerend
- Gebruiker
- Overig, namelijk .....

8. Heeft uw organisatie al eens een crowdsource project opgezet (evt. in samenwerking)?

- Ja, mijn organisatie heeft een crowdsource project opgezet.
- Nee



Omcirkel in hoeverre u het eens bent met de volgende stellingen:

<b>9. Het lijkt me nuttig om crowdsourcing te gebruiken voor het actualiseren van de BGT.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>10. Crowdsourcing voor de BGT zal voor betrouwbare data zorgen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>11. Er zullen voldoende vrijwilligers zijn om crowdsourcing voor de BGT nuttig te maken.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>12. Crowdsourcing voor de BGT zal voor actuelere data zorgen.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>13. Voor de BGT gaat de kwaliteit van de data boven de actualiteit.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>14. Crowdsourcen kost bronhouders meer tijd dan het oplevert.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>15. Crowdsourcen kost bronhouders meer geld dan het oplevert.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>16. Om crowdsourcing voor de BGT te accepteren, moeten vrijwilligers op hun bijdragen geëvalueerd worden.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>17. Om crowdsourcing voor de BGT te accepteren, moeten vrijwilligers altijd te identificeren zijn.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>18. Mijn organisatie staat altijd erg open voor innovaties.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>19. In mijn organisatie werken we op het gebied van geo-informatie veel samen met andere organisaties.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>20. Binnen mijn organisatie is genoeg mankracht om een crowdsource project op te zetten.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>21. Binnen mijn organisatie is genoeg geld om een crowdsource project op te zetten.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>22. Binnen mijn organisatie is genoeg kennis om een crowdsource project op te zetten.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>23. Binnen mijn organisatie is genoeg technologie om een crowdsource project op te zetten.</b>	Zeer oneens	Oneens	Neutraal	Eens	Zeer eens
<b>24. De meest wenselijke manier van crowdsourcing voor de BGT is:</b>					

BAG terugmelding

Het dit formulier kunt u 1 waarneming doorgeven. Wij starten uw melding door naar de betreffende bronhouder. Het kadaster maakt geen gebruik van uw gegevens.

**Gegevens melder**

BuB(organisatie)\*

Naam\*

E-mail\*

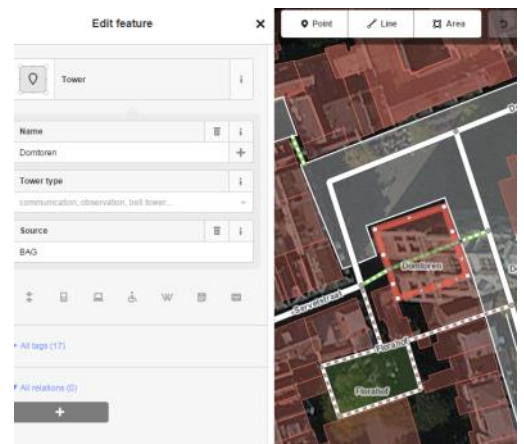
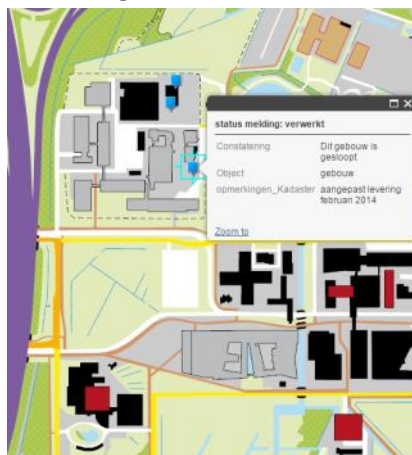
E-mailadres waarop de bronhouder u kan informeren

E-mail bevestigen\*

Datum waarneming

Waargenomen in

- BAG Lintsoed
- BAG Gemeent
- BAG Beweging
- BAG Wsk
- BAG Vloer (Congresen in de BAG Vloer zijn niet per definitie actuali en/of compleet. Toets uw waarneming op BAG Wsk.)
- Anders:



- Vrijwilligers een digitaal formulier laten invullen met een beschrijving waar iets niet klopt.
- Vrijwilligers op een digitale kaart plekken die niet kloppen laten
- Vrijwilligers aanbieden om fouten zelf te repareren in een digitale omgeving.





aangeven.

- Anders, namelijk .....

**25. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **onopzettelijke** fouten zal bevatten.

**26. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **opzettelijke** fouten zal bevatten.

**27. Crowdsourcing voor de BGT moet op:**

- Landelijk niveau geregeld worden
- Provinciaal niveau geregeld worden
- Regionaal niveau geregeld worden (bijv. samenwerking meerdere gemeenten)
- Gemeentelijk niveau geregeld worden

**28. De meest wenselijke update interval voor de BGT is:**

- Wekelijks
- Maandelijks
- Per kwartaal
- Jaarlijks
- Eens per twee jaar
- Anders, namelijk .....

**29. Het implementeren van crowdsourcing voor de BGT zal in mijn organisatie:**

- Binnen 1 jaar gebeuren.
- 1 tot 3 jaar duren.
- 3 tot 5 jaar duren.
- 5 tot 10 jaar duren.
- Meer dan 10 jaar duren.
- Niet gebeuren.

**30. Heeft u nog opmerkingen of suggesties over crowdsourcing, de BGT of dit onderzoek??**

.....

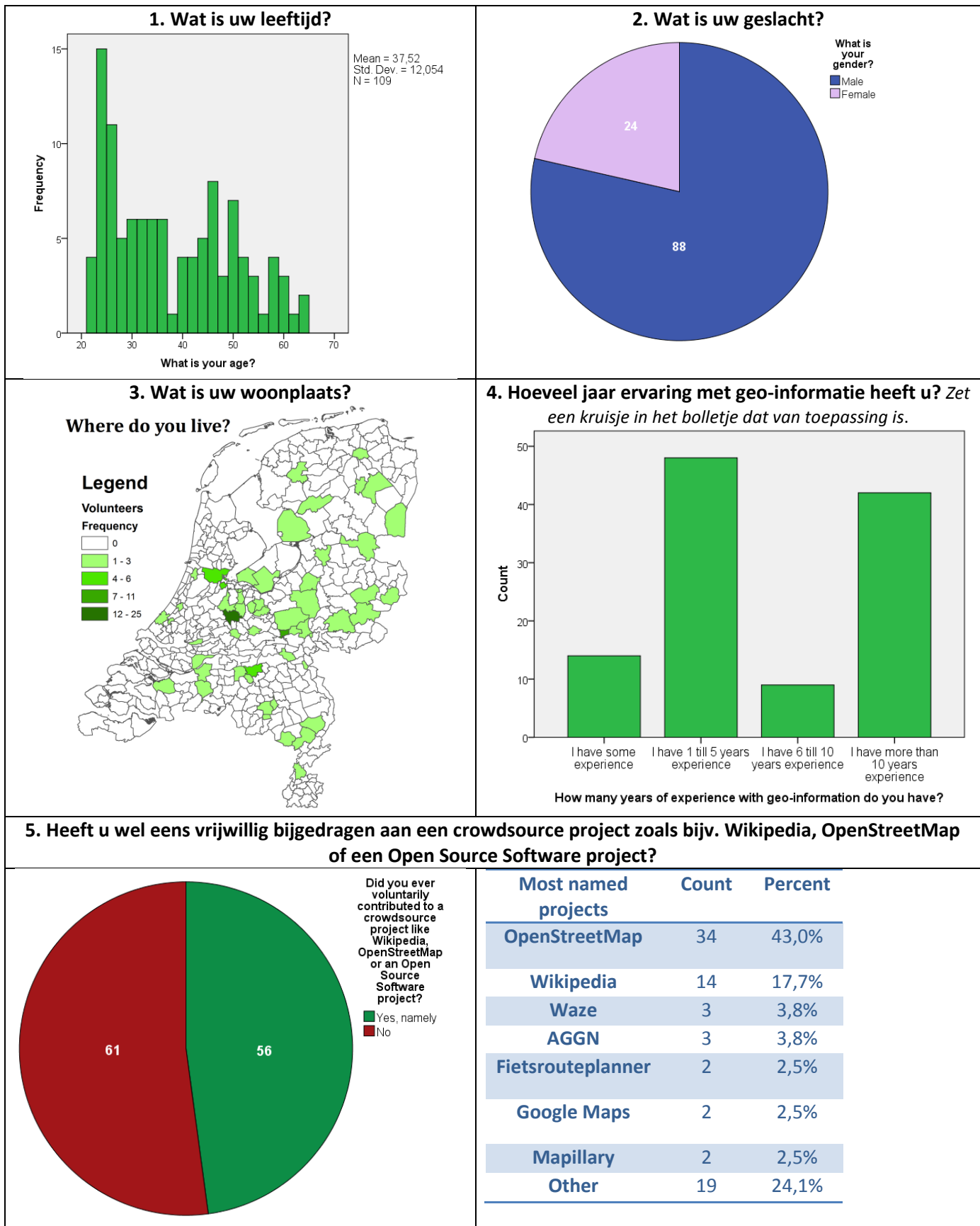
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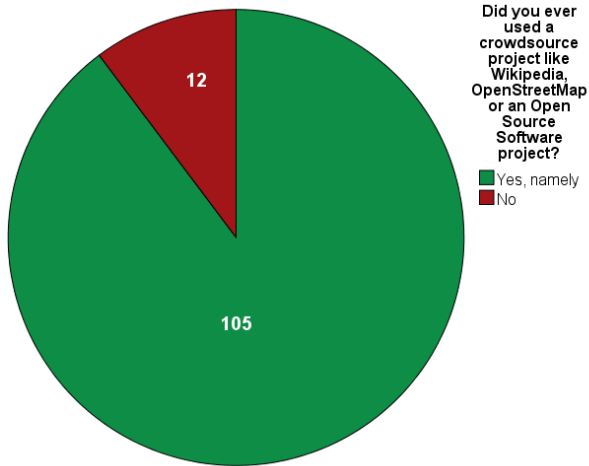
.....

Hartelijk bedankt voor uw medewerking! Wilt u op de hoogte worden gehouden van de uitkomsten van dit onderzoek? Vul dan hieronder uw e-mailadres in.

## Appendix C - Results volunteer survey

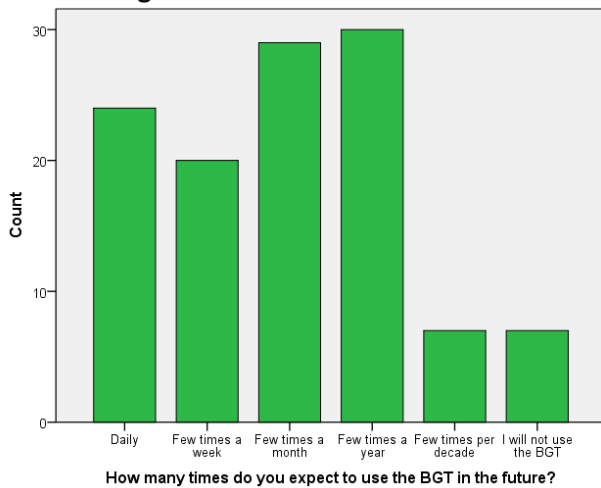


**6. Heeft u wel eens gebruik gemaakt van een crowdsource project zoals bijv. Wikipedia, OpenStreetMap of een Open Source Software project?**

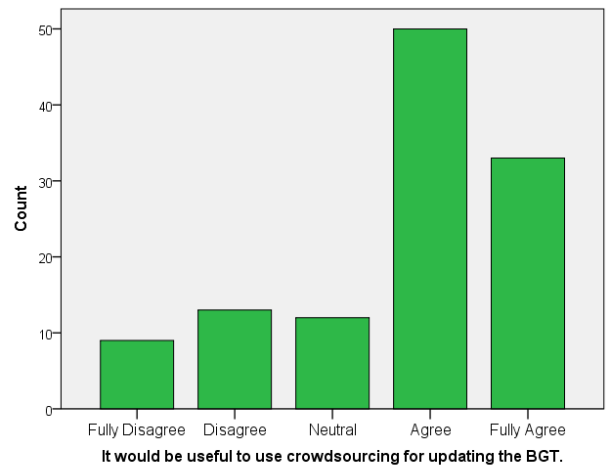


Most named projects	Count	Percent
OpenStreetMap	77	35,8%
Wikipedia	75	34,9%
OpenSource Software	18	8,4%
Qgis	5	2,3%
Fietsrouteplanner	3	1,4%
R	3	1,4%
Overige	34	15,8%

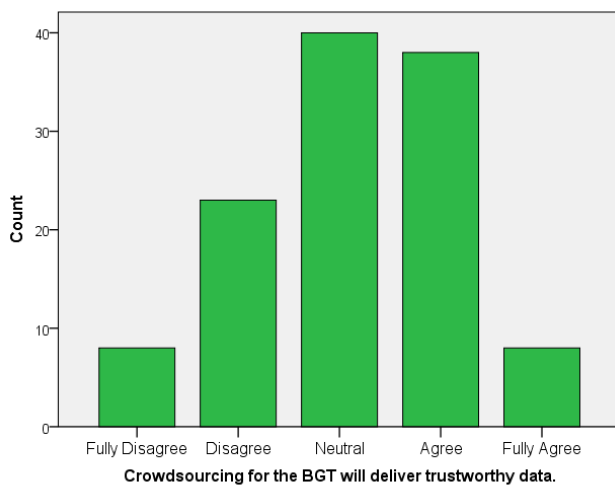
**7. Hoe vaak denkt u de BGT waarschijnlijk te gebruiken in de toekomst?**



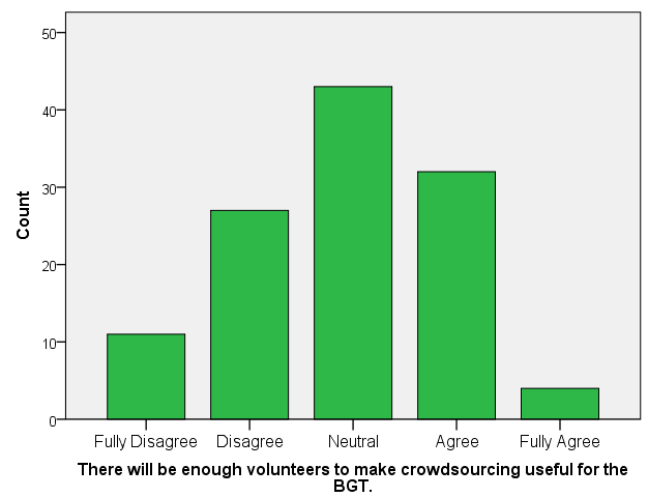
**8. Het lijkt me nuttig om crowdsourcing te gebruiken voor het actualiseren van de BGT.**



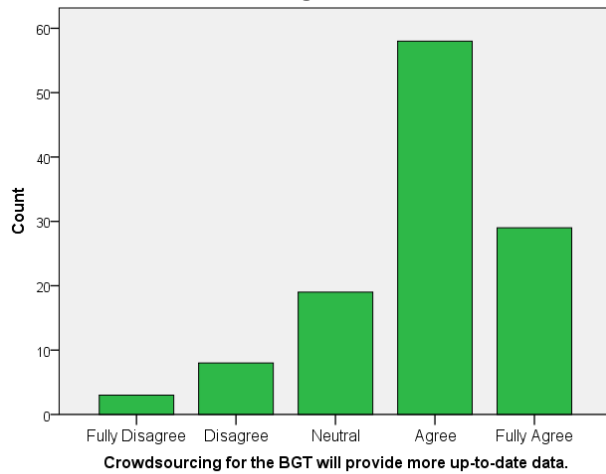
**9. Crowdsourcing voor de BGT zal voor betrouwbare data zorgen.**



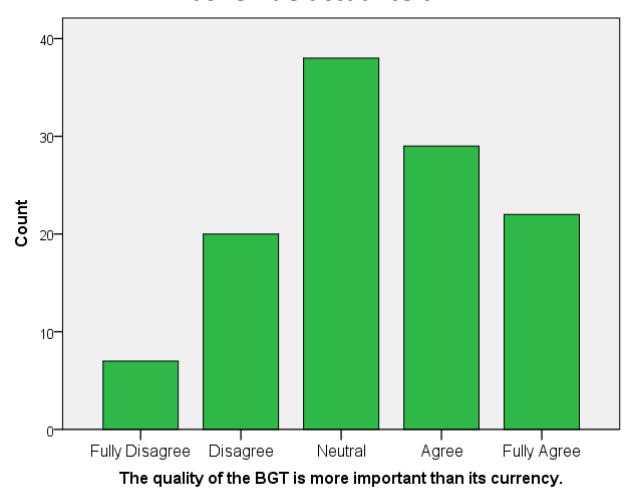
**10. Er zullen voldoende vrijwilligers zijn om crowdsourcing voor de BGT nuttig te maken.**



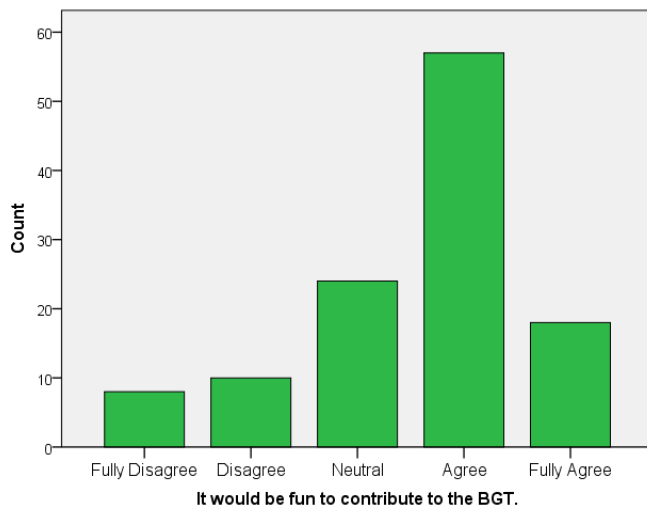
**11. Crowdsourcing voor de BGT zal voor actuelere data zorgen.**



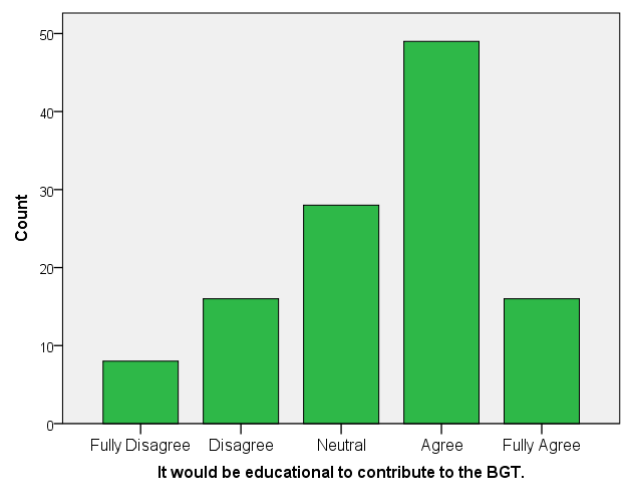
**12. Voor de BGT gaat de kwaliteit van de data boven de actualiteit.**



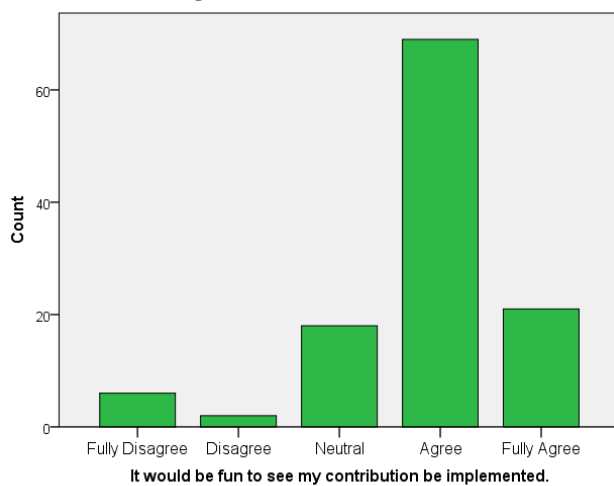
**13. Het lijkt me leuk om bij te dragen aan de BGT.**



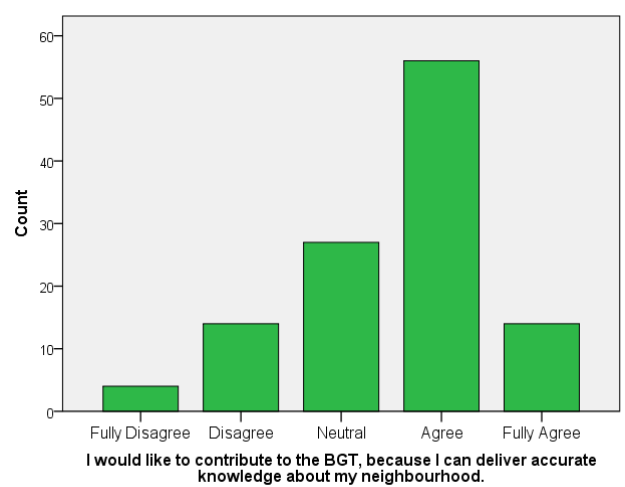
**14. Het lijkt me leerzaam om bij te dragen aan de BGT.**



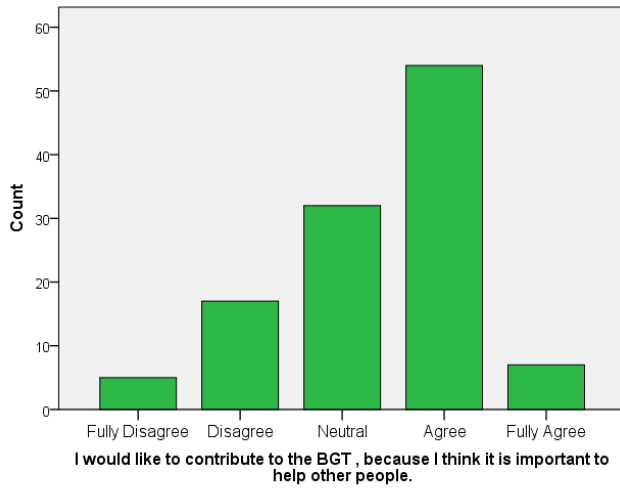
**15. Het lijkt me leuk om mijn aanwijzingen doorgevoerd te zien worden.**



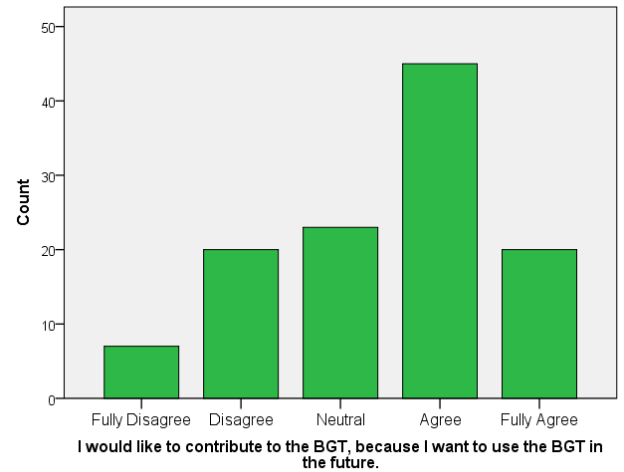
**16. Ik zou willen bijdragen aan de BGT, omdat ik accurate kennis over mijn lokale omgeving kan leveren.**



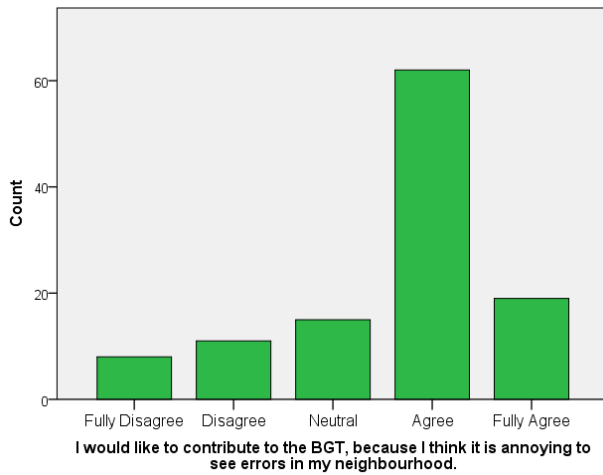
**17. Ik zou willen bijdragen aan de BGT, omdat ik het belangrijk vind om andere mensen te helpen.**



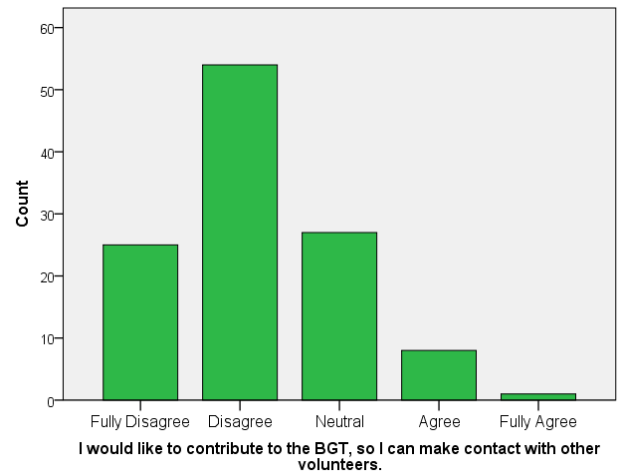
**18. Ik zou willen bijdragen aan de BGT, omdat ik de BGT in de toekomst zelf wil gebruiken.**



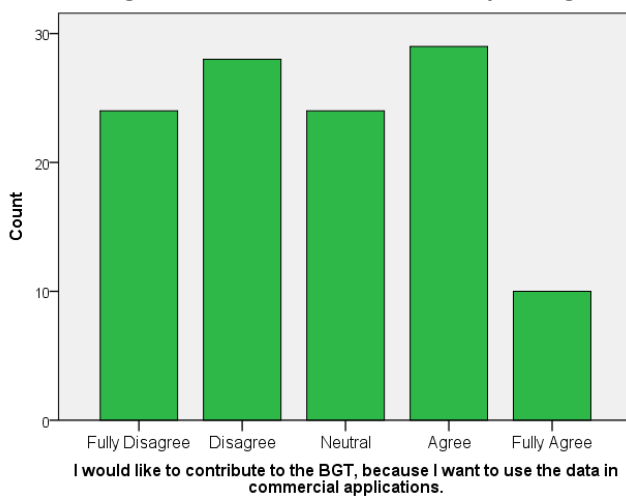
**19. Ik zou willen bijdragen aan de BGT, omdat ik het vervelend vind om fouten in mijn omgeving te zien.**



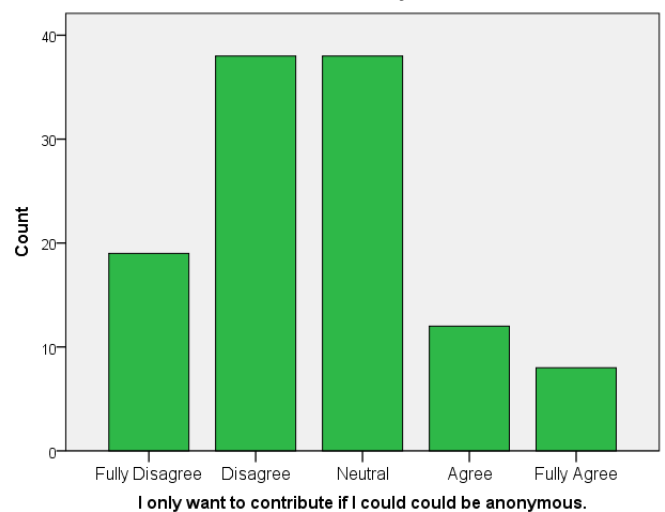
**20. Ik zou willen bijdragen aan de BGT, zodat ik in contact kan komen met andere vrijwilligers.**



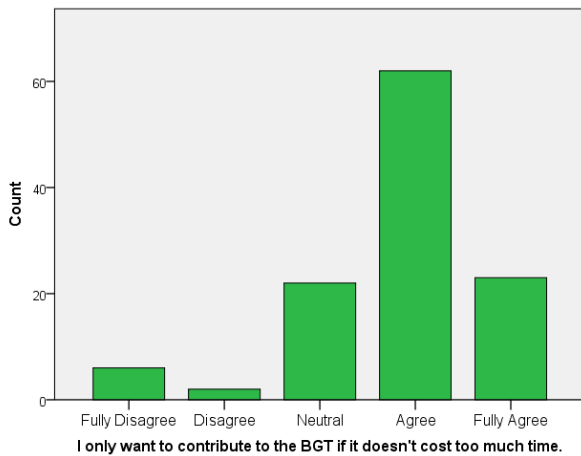
**21. Ik zou willen bijdragen aan de BGT, omdat ik de data wil gebruiken in commerciële toepassingen.**



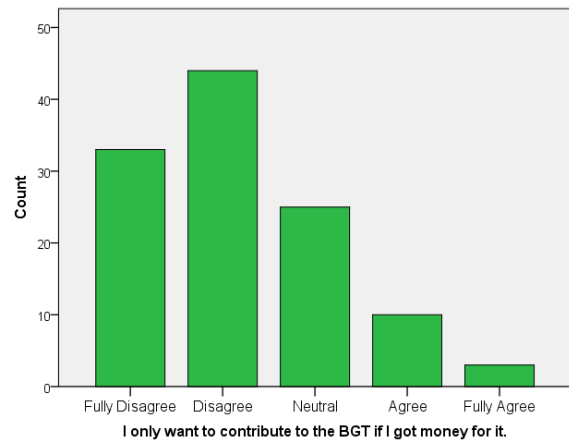
**22. Ik zou alleen willen bijdragen aan de BGT als ik anoniem kan blijven.**



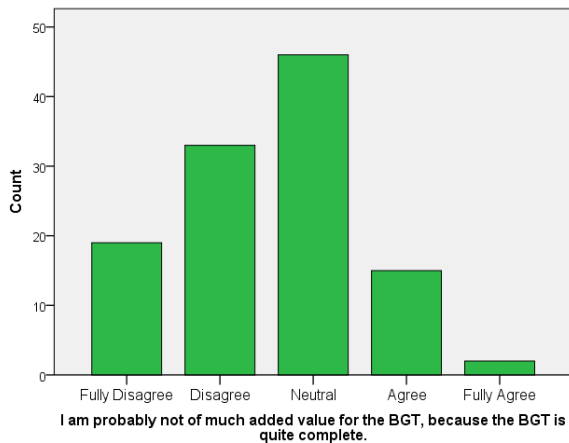
**23. Ik zou alleen willen bijdragen aan de BGT als het me niet teveel tijd kost.**



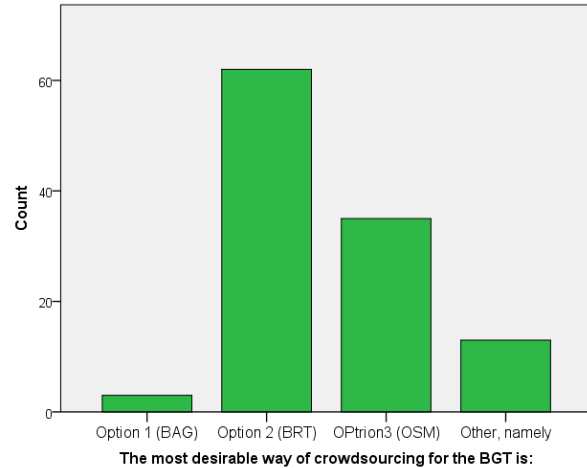
**24. Ik zou alleen willen bijdragen aan de BGT als ik hier geld voor kreeg.**



**25. Ik denk niet dat ik van veel toevoeging ben voor de BGT, omdat de BGT erg compleet is.**



**26. De meest wenselijke manier voor crowdsourcing voor de BGT is:**

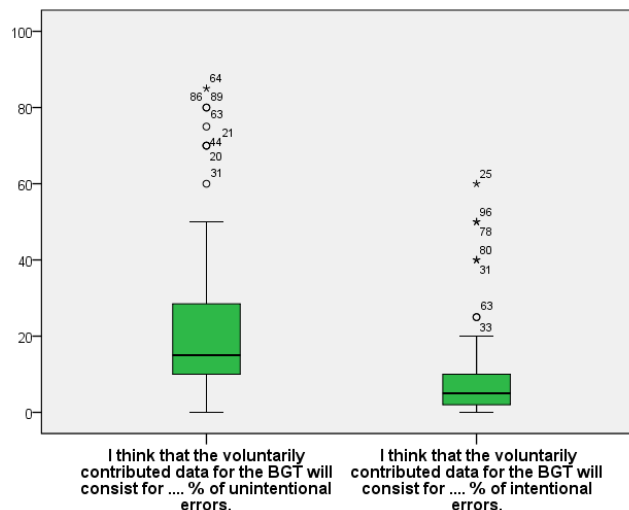


**27. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **onopzettelijke** fouten zal bevatten.

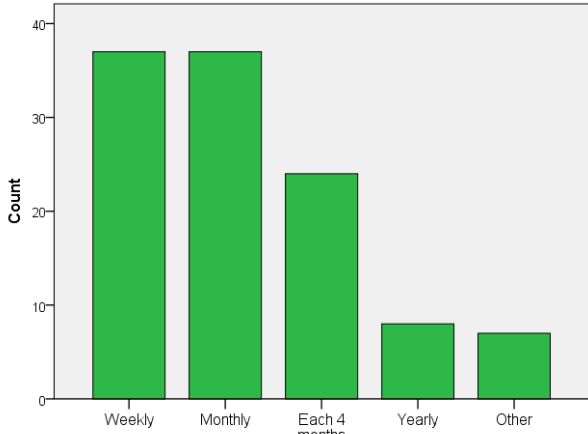
**28. Vul in:**

Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **opzettelijke** fouten zal bevatten.



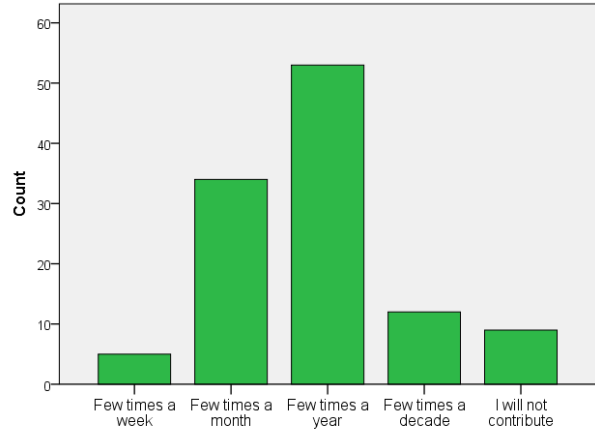


**29. De meest wenselijke update interval voor de BGT is:**



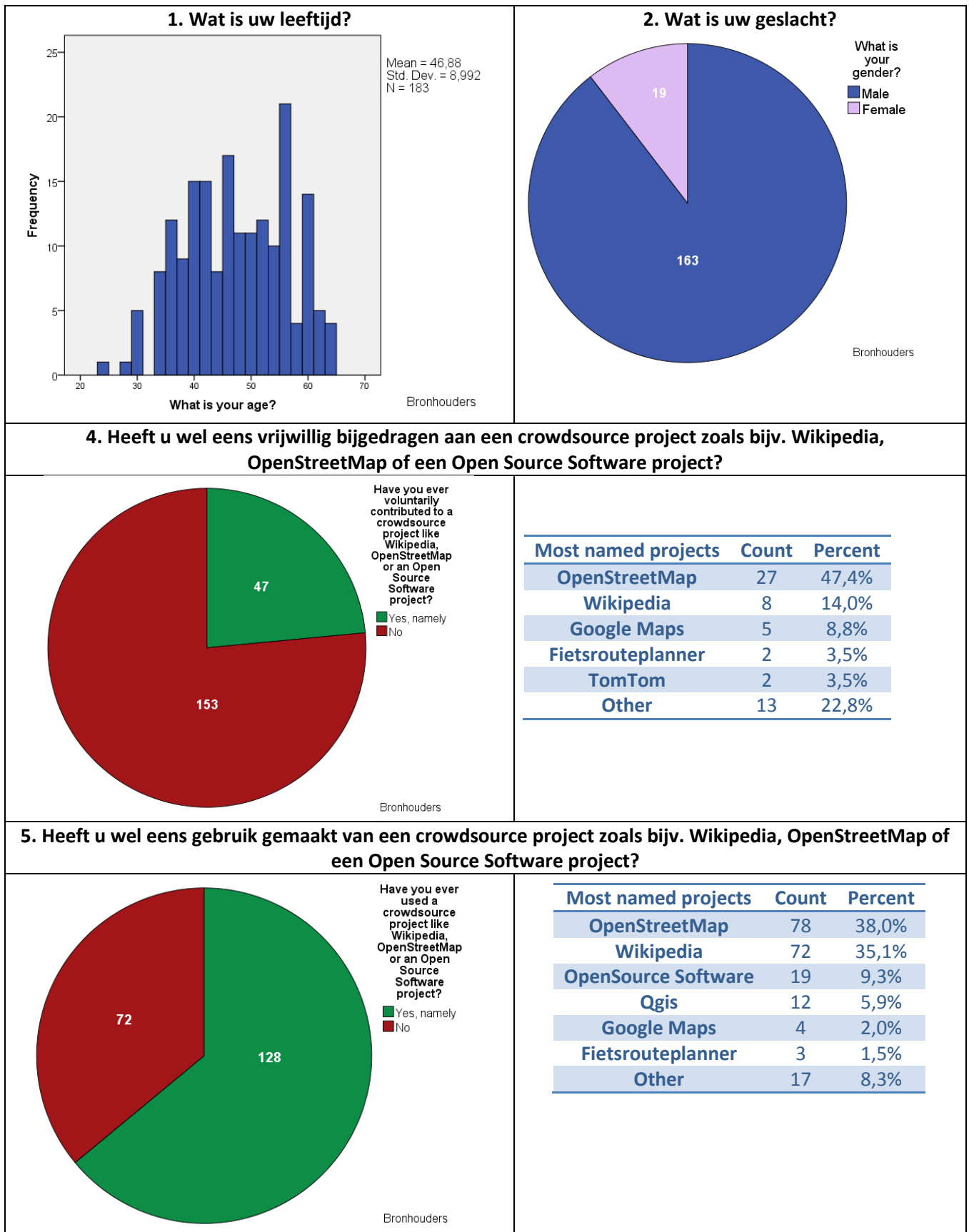
The most desirable update interval for the BGT is:

**30. Als ik in de toekomst zou bijdragen aan de BGT, dan zou ik dit waarschijnlijk:**

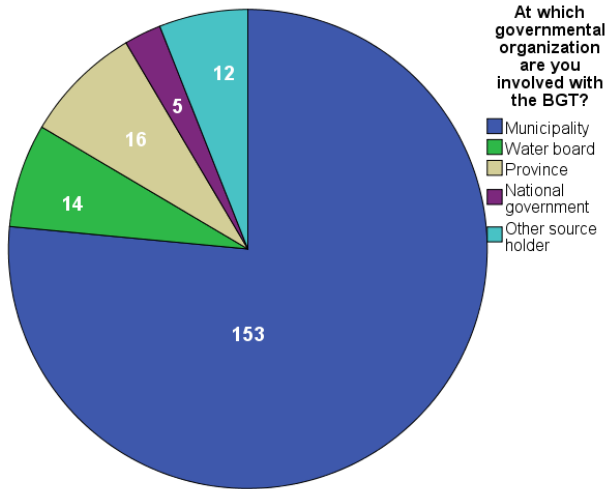


If I would contribute to the BGT in the future, I would probably do this a:

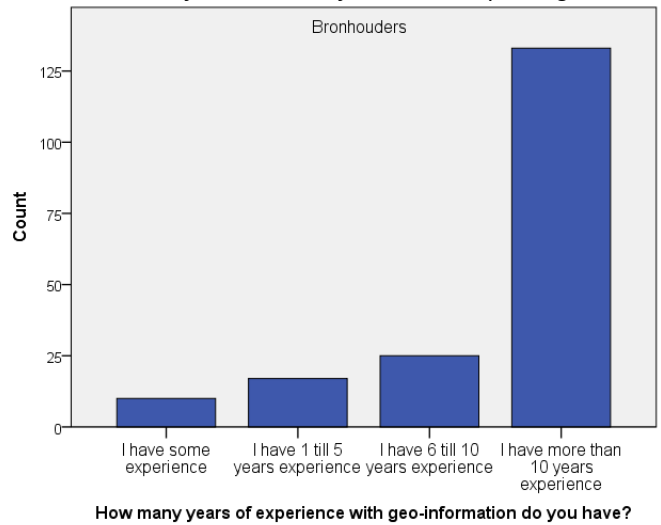
## Appendix D - Results source holders survey



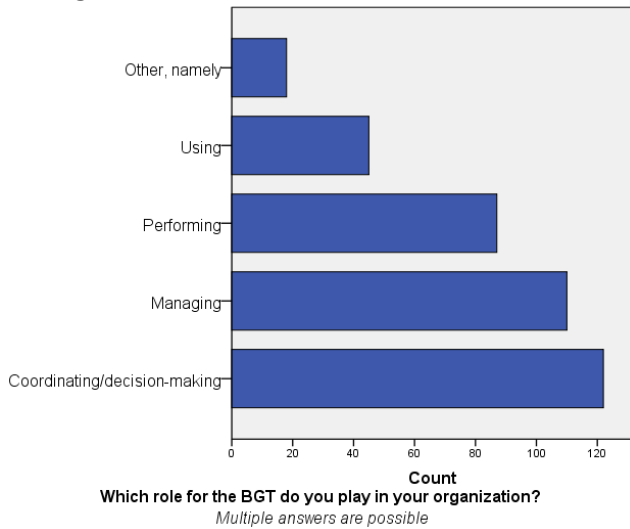
**6. Bij welke overheidsorganisatie bent u betrokken bij het bronhouderschap?**



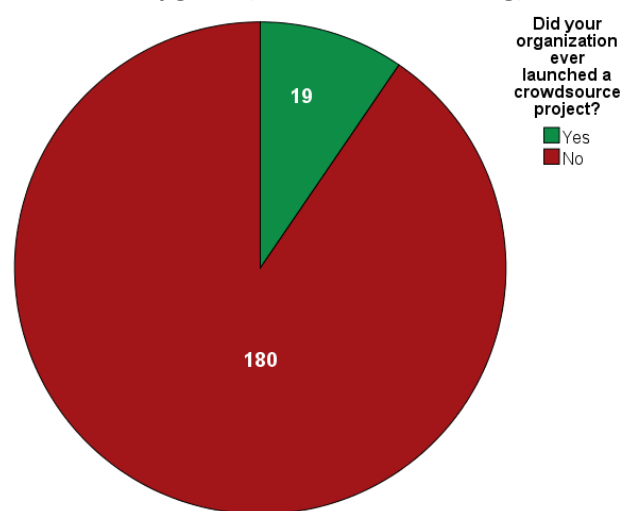
**3. Hoeveel jaar ervaring met geo-informatie heeft u? Zet een kruisje in het bolletje dat van toepassing is.**



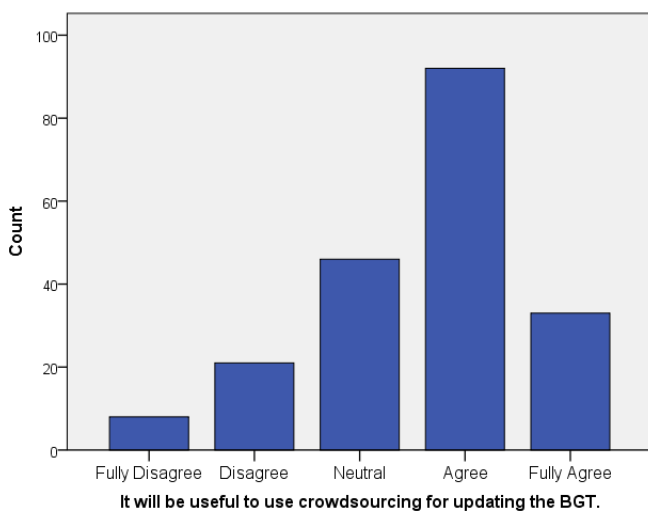
**7. Welke rol speelt u in het bronhouderschap van uw organisatie? Meerdere antwoorden zijn mogelijk.**



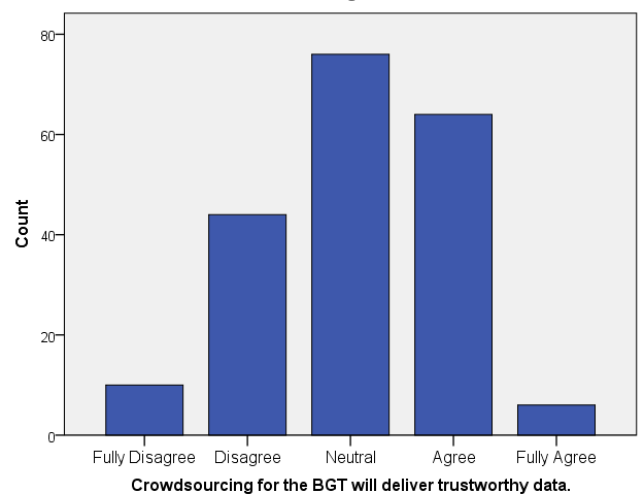
**8. Heeft uw organisatie al eens een crowdsource project opgezet (evt. in samenwerking)?**



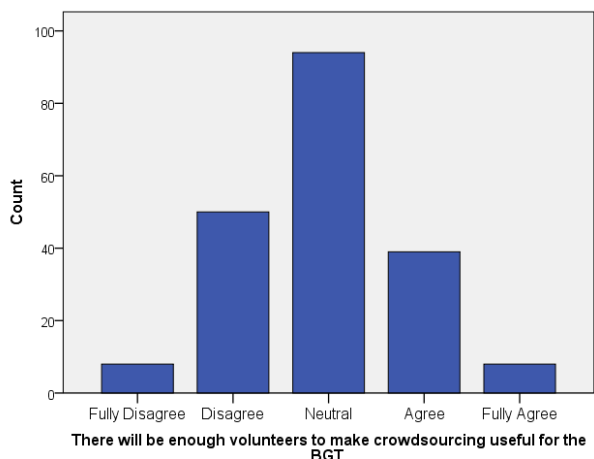
**9. Het lijkt me nuttig om crowdsourcing te gebruiken voor het actualiseren van de BGT.**



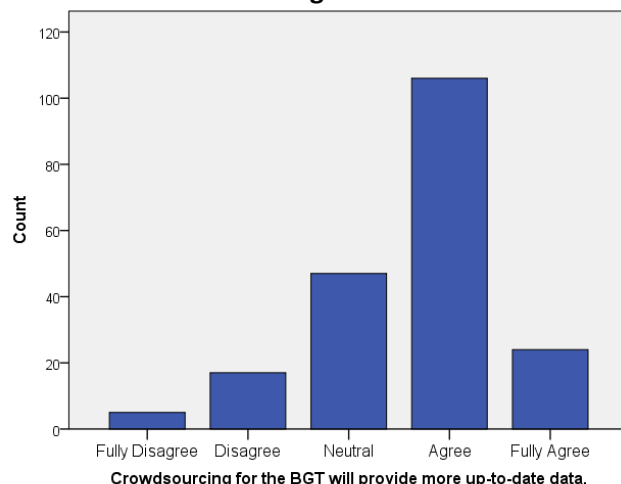
**10. Crowdsourcing voor de BGT zal voor betrouwbare data zorgen.**



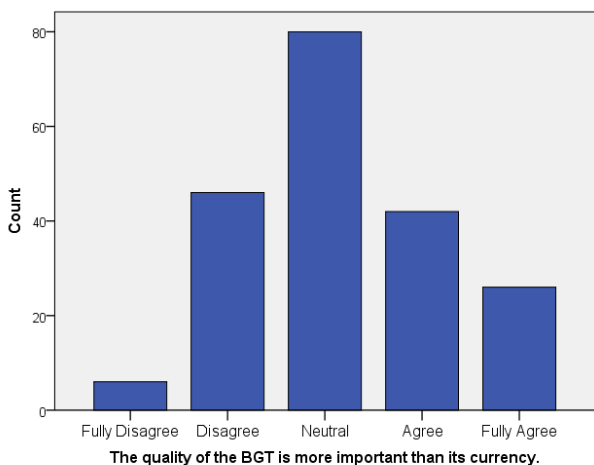
**11. Er zullen voldoende vrijwilligers zijn om crowdsourcing voor de BGT nuttig te maken.**



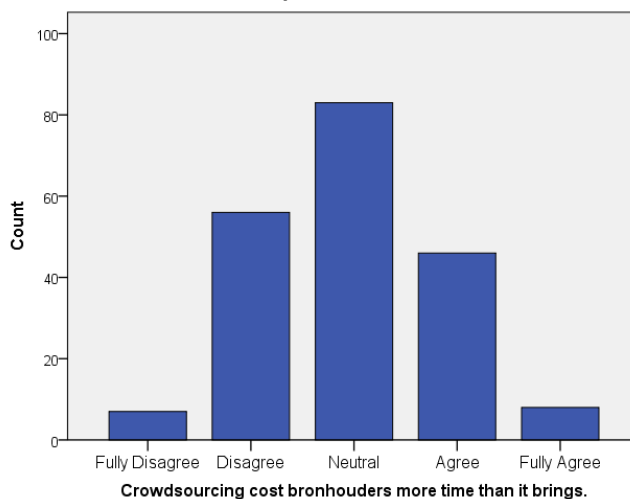
**12. Crowdsourcing voor de BGT zal voor actuelere data zorgen.**



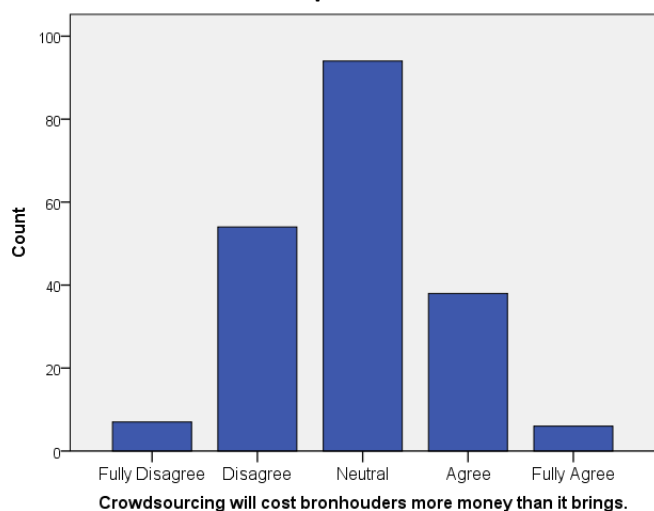
**13. Voor de BGT gaat de kwaliteit van de data boven de actualiteit.**



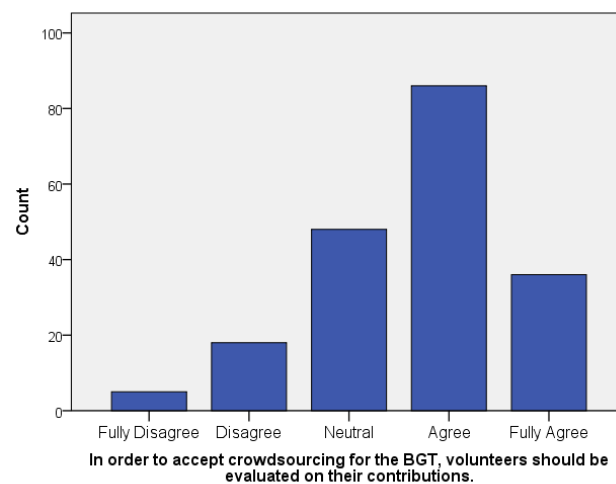
**14. Crowdsourcen kost bronhouders meer tijd dan het oplevert.**



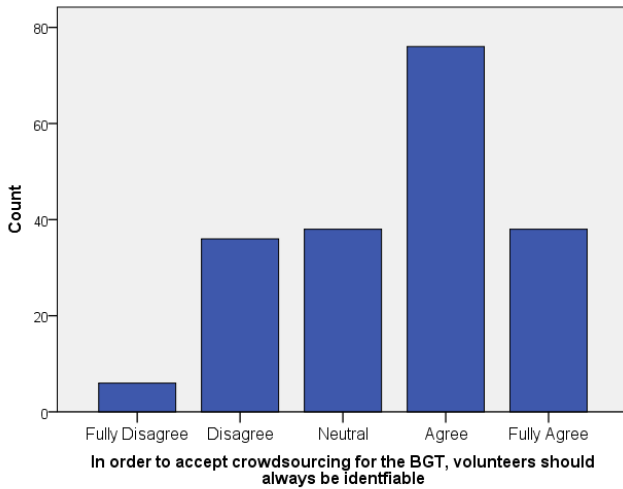
**15. Crowdsourcen kost bronhouders meer geld dan het oplevert.**



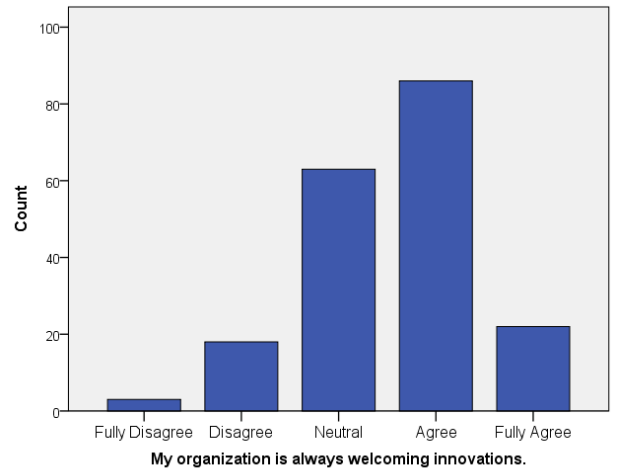
**16. Om crowdsourcing voor de BGT te accepteren, moeten vrijwilligers op hun bijdragen geëvalueerd worden.**



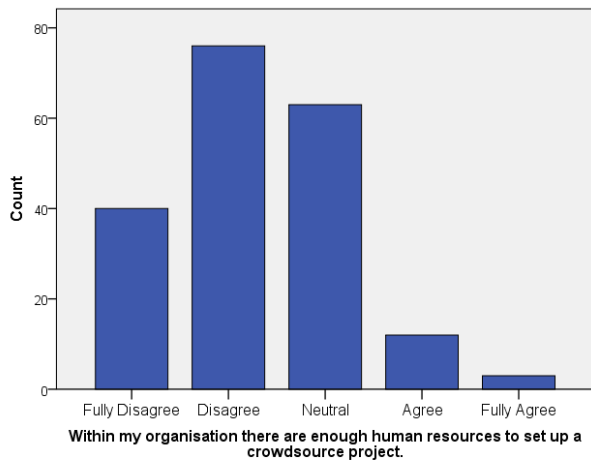
**17. Om crowdsourcing voor de BGT te accepteren, moeten vrijwilligers altijd te identificeren zijn.**



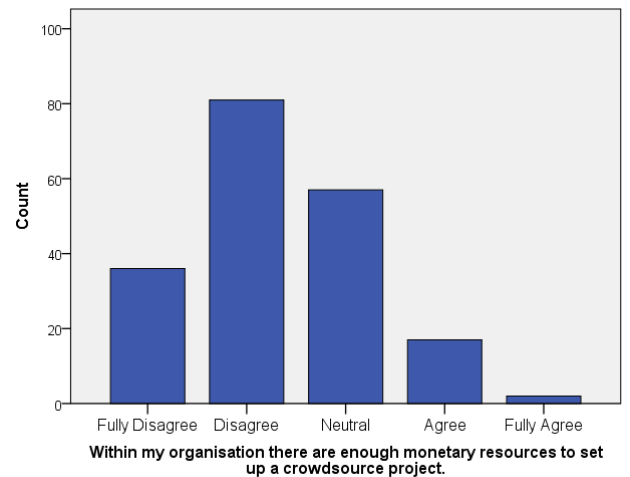
**18. Mijn organisatie staat altijd erg open voor innovaties.**



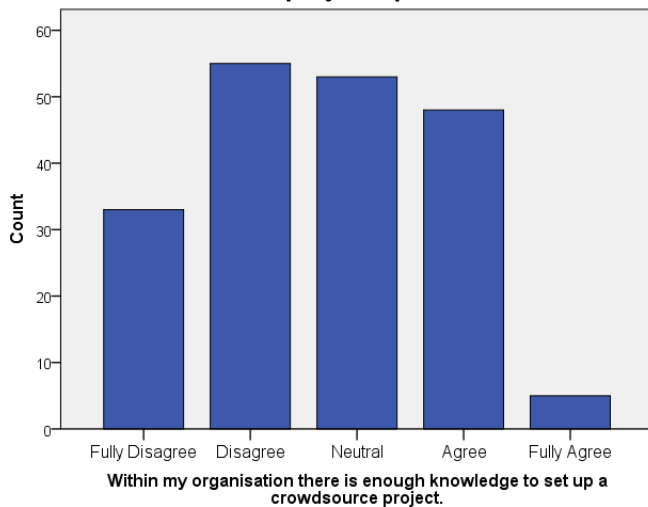
**20. Binnen mijn organisatie is genoeg mankracht om een crowdsorce project op te zetten.**



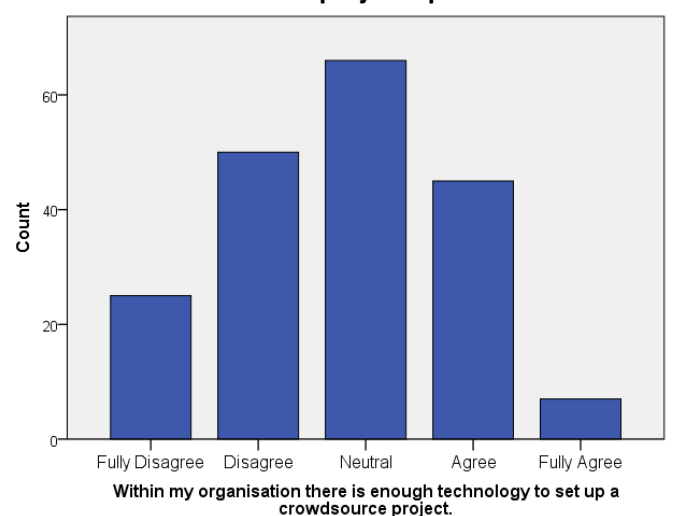
**21. Binnen mijn organisatie is genoeg geld om een crowdsorce project op te zetten.**



**22. Binnen mijn organisatie is genoeg kennis om een crowdsorce project op te zetten.**



**23. Binnen mijn organisatie is genoeg technologie om een crowdsorce project op te zetten.**

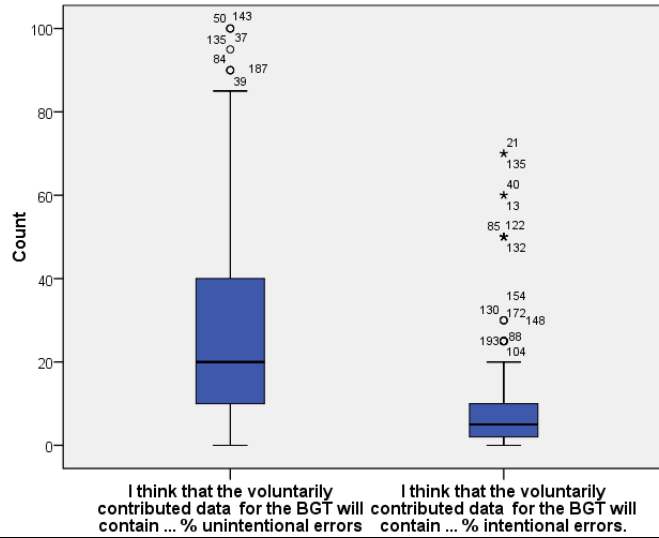


**25. Vul in:**

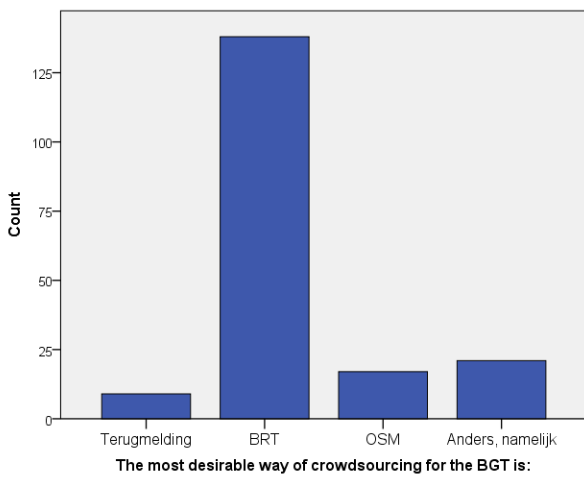
Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **onopzettelijke** fouten zal bevatten.

**26. Vul in:**

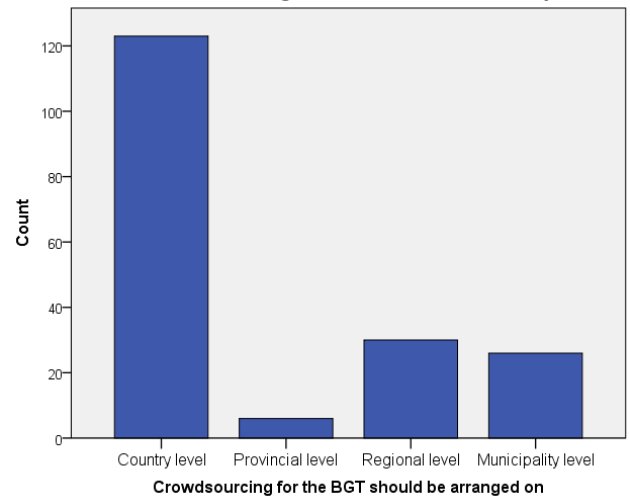
Ik denk dat de door vrijwilligers bijgedragen data voor de BGT ..... procent **opzettelijke** fouten zal bevatten.



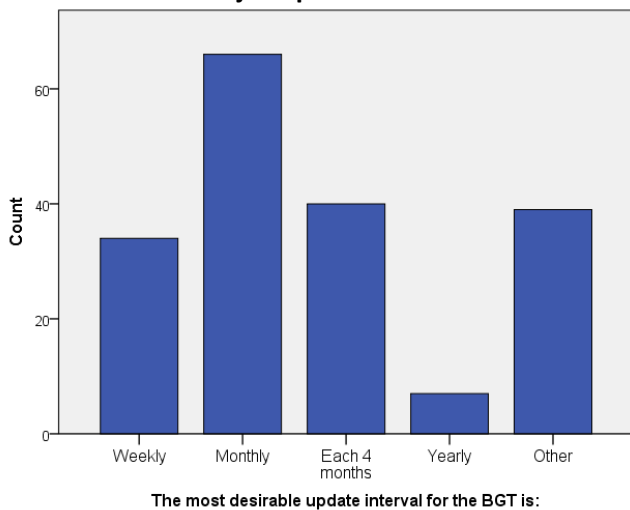
**26. De meest wenselijke manier voor crowdsourcing voor de BGT is:**



**27. Crowdsourcing voor de BGT moet op:**



**28. De meest wenselijke update interval voor de BGT is:**



**29. Het implementeren van crowdsourcing voor de BGT zal in mijn organisatie:**

