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Volunteered Geographic Information: the nature and motivation of produsers*

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Abstract

Advances in positioning, Web mapping, cellular communications and wiki technologies have outpaced the original visions of GSDI programs around the world. By tapping the distributed knowledge, personal time and energy of volunteer contributors, GI voluntarism is beginning to relocate and redistribute selected GI productive activities from mapping agencies to networks of non-state volunteer actors. Participants in the production process are both users and producers, or 'produsers' to use a recent neologism. Indeed, GI voluntarism ultimately has the potential to redistribute the rights to define and judge the value of the produced geographic information and of the new production system in general. The concept and its implementation presents a rich collection of both opportunities and risks now being considered by leaders of public and private mapping organizations world-wide. In this paper, the authors describe and classify both the types of people who volunteer geospatial information *and* the nature of their contributions. Combining empirical research dealing with the Open Source software and Wikipedia communities with input from selected national mapping agencies and private companies, the authors propose a taxonomy of voluntary geospatial information contributors. Differentiating between three different contexts in which these volunteer contributors operate – market-driven, social networking, and civic/governmental – the authors describe key opportunities, constraints and factors to consider in each case when determining whether and how to assess information provided by such sources.

Keywords: volunteered geographic information (VGI), volunteers, produsers, spatial data infrastructure, crowdsourcing, urban sensing

1. BACKGROUND

Advances in geospatial positioning, Web mapping, cellular communications and wiki-based collaboration technologies have now outpaced the original visions of the architects of spatial data infrastructures around the world [e.g., (Goodchild, 2007), (Craglia et al., 2008) and others]. Collaborative Web-based efforts like *Open Street Map, Tagzania, Wayfaring.com,* the *People's Map,* and *Platial: The People's Atlas*, now enable experts and amateur enthusiasts alike to create and share limited, theme oriented geospatial information. Examples of ways in which citizen input is used to strengthen emergency response efforts are now found in the popular press in and in refereed media (e.g., Laituri and Kodrich, 2008).

Commercially, Google Map Maker now provides to citizens in 43 countries with the ability to help populate and update Google Maps road centerline and attribute data in that country [(Jones, 2007); (Google, 2009)]. (See Figure 1.) Firms like TeleAtlas, Navteq and TomTom each already use Web-based customer input to locate and qualify mapping errors and/or feature updates required in their road network databases [(Biersdorfer, 2007); (Helft, 2007)].

Figure 1: Countries in which Individuals Collect and Edit Their Own Data using Google Map Maker (Google, 2009)

Finally, McLaren and Enemark (2008) discuss the role of cellular telephones in generating a move to distributed citizen / participatory sensing and supporting "Mobile(M)-government" as an extension supplement to e-government, providing information and services through mobile devices like cell phones, laptops, PDAs and even RFID tags working within a wireless communications infrastructure. Cuff et al. (2008) coin the term "urban sensing" to describe this.

The concept of “user-generated content" (also called “user-created content" or "consumer-generated media) is nothing new [(IAB, 2008), (OECD, 2007)]. Cook (2008) and others document a long history of both passive and active “User Contribution Systems (or UCS) in the consumer market. Further, there are numerous examples of public participation GI systems where interested individuals have offered input and feedback to professionals and communities of interest in both roundtable and Web-based settings (e.g., (Craig, 2002); (Sieber, 2006); (Tang et al., 2008)].

What is different with Web 2.0-based contribution initiatives is the more influential role assumed by the community. In his book *Blogs, Wikipedia, Second Life, and Beyond: From Production to Produsage*, Axel Bruns (2008) outlines four fundamental characteristics of informational ‘produsage’ as distinct from informational production:

1. *community based:* collaborative engagement of large communities of participants in a shared project, that exploits the ‘power of eyeballs’ and the ‘long tail’ of diverse knowledge, abilities and interests outside a narrow elite of knowledge workers;
2. *fluid roles:* the necessity to allow for a fluid movement of individual ‘produsers’ between different roles within the community;
3. *unfinished artefacts:* the ‘produsage’ of content is palimpsestic; content resembles the repeatedly overwritten pages of ancient texts which hold the latest version and the history of examination, discussion and alteration of the artefact; and
4. *common property – individual merit:* members of the produsage community adopt more permissive approaches to legal and moral rights in intellectual property than is the norm in traditional content production.

Along the same vein, Turner (2006 & 2007) suggested the term “neogeography” be used to define “geographical techniques and tools used for personal activities or for utilization by a non-expert group of users; not formal or analytical”. Similarly, the term “Volunteered Geographic Information” (or VGI) was coined by Goodchild (2007) to define the user-generated geospatial content being created in these and many other sites to satisfy a variety of needs within industry, government, and social networking communities.

As large private companies have already discovered, the potential exists for government mapping agencies to harness the power of new media and voluntarism in order to improve their own change detection and geospatial data updating processes. In fact, such voluntarism can ultimately change the balance between traditional values, practices and rules. At the very least, it has the power to complement existing practices and enable new production systems.

However, focusing purely on the "information" aspects of VGI ignores the rich human element driving this phenomenon. As Bruns (2008) argues, external organizations and produsage communities alike must strive to better understand the processes by which they operate -- and by which they generate content. *"This then is also a crucial task for individual produsers themselves, who must develop a better understanding of what, how, and why they contribute as individuals to produsage projects, as well as why such projects operate on a larger scale" (p.10).*

With this in mind, important questions remain over people's motivation to volunteer information and the processes ultimately required to take into account not only issues of quality of the geographic information provided, but also the values and rationalities of the volunteer contributors and the performance of the new social production system [Kuhn (2007); Craglia et al. (2008); Boathook et al., 2008)]. The question: "What motivates people to voluntarily contribute information?" has already formed the basis for empirical research into characterizing both contributors *and their contributions* to open source software development [(Raymond, 1990); (Krishnamurthy, 2002) and to Wikipedia [e.g., (Anthony et al, 2005); Katter et al., 2007); (Ortega et al., 2007) and many others].

Can we assume that VGI contributors will similarly follow documented trends of those voluntary contributors and contributions found in the Open Source software and Wikipedia communities – especially when those contributions may ultimately be to more "formal" or authoritative data source? Are there important differences within and among VGI contributors that may influence their behavior and, ultimately, the nature, frequency and quality of their contributions? Are new approaches required to evaluate the performance of volunteered geographic information (VGI) production systems in the market, social networks and public participation?

In this paper, the authors describe the challenges involved in describing and classifying both the types of people who volunteer geospatial information and the nature of their contributions. After introducing and describing results of previous empirical research dealing with voluntary contributors in other fields, the authors propose a taxonomy of geospatial information contributors. They describe the respective contexts within which they operate, and the importance of not confusing volunteers from different contexts when defining opportunities and constraints of this important new phenomenon.

2. THE CONTRIBUTORS AND THEIR MOTIVATIONS

2.1 Early Characterizations

Influential enthusiasts like those mentioned above as well as O'Reilly (*2005*), Tapscott & Williams (2007) and Cook (2008) see tremendous benefit from this revolution in user contributions. However, critics like Robert McHenry (2004), Jaron Lanai (*2006)* and, more recently, Andrew Keen (*2007*) are equally articulate in their concerns that such "crowdsourcing" represents a disturbing trend that increases the influence of amateurs at the expense of legitimate experts and professional media organizations.

In what has become a very polarized debate, the authors propose that these contributors may be broken down into five overlapping categories along a spectrum (Figure 2):

1. *"Neophyte"* -- someone with no formal background in a subject, but possessing the interest, time, and willingness to offer an opinion on a subject;
2. *"Interested Amateur"* -- someone who has "discovered" their interest in a subject, begun reading the background literature, consulted with other colleagues and experts about specific issues, is experimenting with its application, and is gaining experience in appreciating the subject;
3. *"Expert Amateur"* -- someone who may know a great deal about a subject, practices it passionately on occasion, but still does not rely on it for a living;
4. *"Expert Professional*" -- someone who has studied & practices a subject, relies on that knowledge for a living, and may be sued if their products, opinions and/or recommendations are proven inadequate, incorrect or libelous; and
5. *"Expert Authority"* -- someone who has widely studied and long practiced a subject to the point where he or she is recognized to possess an established record of providing high-quality products and services and/or well-informed opinions -- and stands to lose that reputation and perhaps their livelihood if that credibility is lost even temporarily.

Given the imperfect ways humans still assess information, clearly the power of guilds & professional associations, peer groups, cliques and social networks still determines who is "in" and who is "out" of each group. For example, the *first* inclination of a mapping organization might be to assess a higher level of credibility or "trust" to contributions from another surveying or mapping organization or professional individual. However, as will be seen below, this should only be only one consideration of many.

Figure 2: The Spectrum of Contributors: A First Cut

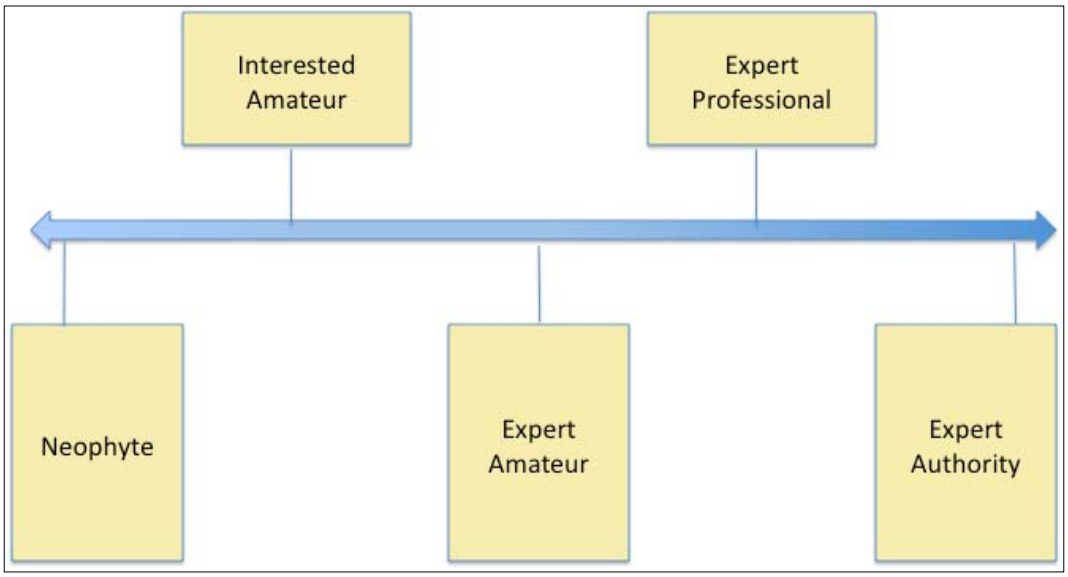


Table 1 provides examples of individuals who might fall into each category in three different contexts:

1. *"Market-Driven"* – where the goal may be a contribution to a commercial database or service (e.g., TomTom, Garmin, Navteq, etc.)
2. *"Social Networks"* – where the contribution may be made to a site like (e.g.,) Open Street Map, Platial.com, Wayfaring.com, etc.
3. *"Civic/Governmental"* – where the contribution supports some act as a concerned citizen of a given town or city (e.g., PPGIS input), a member of an environmental or animal rights group.

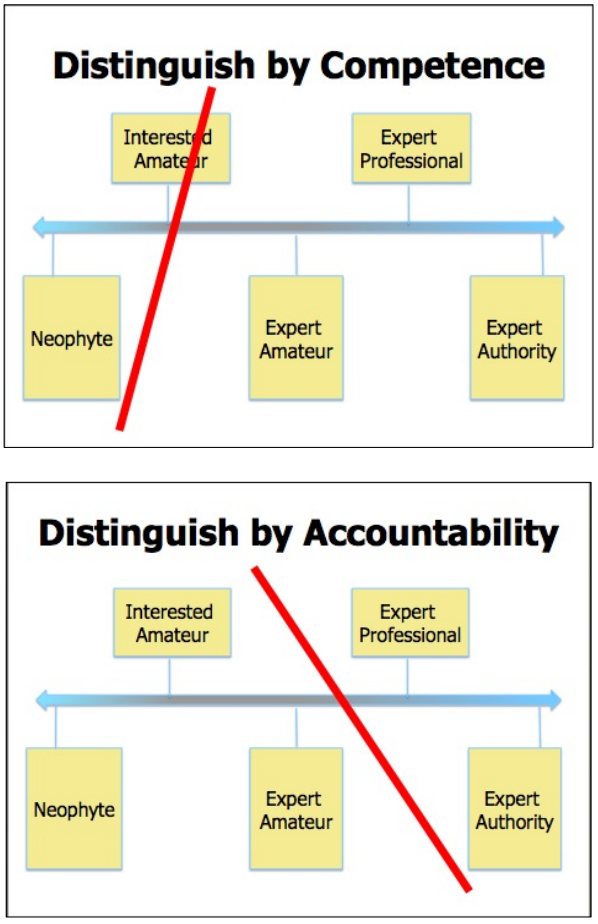
In analyzing the discourse of the two opposing camps debating the value of user-generated contributions, both sides defend their respective positions by selectively targeting of groups along the spectrum and characterizing them in terms of their perceived competence and legal accountability. (See Figure 3.) Favorable articles by Tapscott, O'Reilly and others tend to characterize the average contributor as usually being either an "Expert Amateur" or, at worst, a capable "Interested Amateur", and tend to ignore issues of legal accountability. On the other hand, the more critical articles by McHenry, Keen and others offer anecdotes showing the consequences of accepting data from either incompetent "Neophytes" or misinformed "Interested Amateurs". They also emphasize, rightly, that professionals and commercial media sources could be sued for providing incorrect, deliberately misleading or libelous information. Given the acceptance of anonymity in offering opinions and the reluctance of Internet

Service Providers to give details of site owners or contributors, it has been to date very problematic to take legal action against individual amateur contributors.

Table 1: Examples of Contributors in Each Category along the Spectrum

	Market-Driven *(Example: GPS Navigation)*	**Social Networks** *(Example: Restaurant Reviews)*	**Civic/Governmental** *(Example: PPGIS)*
Neophyte	No experience with GPS positioning, map reading or navigation	Reads and uses review information provided at a given Website without question.	Citizen views a GIS map in a town hall meeting around the siting of a power plant in the town
Interested Amateur	Owns a personal system, uses it extensively, and is aware of key strengths and limitations	Regular viewer; Occasional contributor to restaurant review Website.	Citizen fashions a map to present a counter claim in a town hall meeting around the siting of a power plant in the town
Expert Amateur	Familiar with the strengths and weaknesses of multiple systems, has owned more than one	Is familiar with a variety of different sites and can rank them in terms of reliability. Regularly contributes reviews.	Individual familiar with conditions in a given neighborhood and with the operation of the Web-based PPGIS system in use.
Expert Professional	Surveying or mapping professional specializing in GPS positioning	Paid Restaurant Reviewer for Local Newspaper	Practicing Urban Planner
Expert Authority	Noted specialist regularly consulted re: specific problems and/or new developments by other professionals.	Restaurant Reviewer for national media chain with extensive professional experience in hospitality and food services.	City Planner with extensive knowledge of developments in the area of interest.

Figure 3: Alternative Approaches to Differentiating between Different Types of Contributors



While useful in its provocation, the issue is more multi-dimensional than these breakdowns would suggest – especially when considering geographic information. For example, using one of the scenarios from Table 1, an "Expert Professional" may be proficient in terms of operating a hand-held GPS, but her knowledge of a given geographic feature and its attributes may be limited. On the other hand, a "Neophyte" contributor may know little to nothing about positioning systems but be very familiar with the attributes of the feature or area being mapped.

2.2 A Closer Look

The number and type of persons who ultimately contribute to Wikipedia has been the subject of rigorous investigation. One of Wikipedia's founders suggested "2%

of the users do 75% of the work" (Wales, 2005). Subsequent in-depth analyses of Wikipedia contributions by Kittur et al. (2007), Ortega et al. (2007), Priedhorski et al. (2007) and others confirm that even smaller percentages of committed, registered contributors -- called "zealots" by Anthony et al. (2005), "insiders" by Swartz (2006), and "elite users" by others -- undertake the vast majority of the individual edits. However, they also found that a significant proportion of *new content contributions* comes from *occasional* contributors or, in the words of Anthony et al., "good Samaritans".

Empirical research by Anthony et al., Swartz, Ortega et al., Priedhorsky et al. (2007) and others have further characterized contributors by:

- their *humanity* (i.e., whether or not edit operations are made by a human or by a recognized automated "bot" routine);
- the *frequency, type and degree* of a contributor's edit operations;
- the *quality and veracity* of a contributor's operations (in terms of whether or not a given edit is subsequently changed by someone else); and even
- whether or not an individual's *reputation for reliability* in terms of past contributions and edits influences the "lifespan" of subsequent contributions.

2.3 Motivations to Contribute

To better understand *why* individuals may contribute geographic information, lessons may be drawn from experiences in the Wikipedia and Free or Open-Source Software (or "F/OSS") communities. Empirical research by Anthony et al. (2005), Kuznetsov (2006) and Schroer & Hertel (2007) all build from a social-movement research base to interpret why people contribute to Wikipedia. Research by Lakhani and Wolf (2005) suggests that F/OSS developers are encouraged by slightly different motivators than those reported by Wikipedia contributors. Finally, armed with consumer marketplace examples, Cook (2008) offers reasons as to why people actively provide information to on-line User Contribution Systems of all kinds.

Consolidating and summarizing these lists of F/OSS, Wikipedia and UCS motivators yields the following list of motivators to make constructive contributions:

1. *Altruism* – contributing purely for the benefit of others with no promise of gain or improvement of one's own personal situation;
2. *Professional or Personal Interest* – making a contribution as part of an existing job, mandate or personal project;

3. *Intellectual Stimulation* -- improvement of technical skills, knowledge and experience gained through contributions;
4. *Protection or enhancement of a personal investment* – where offering a practical solution to a shared problem offers an immediate payback for participation through shared improvement of a common resource;
5. *Social Reward* -- by being part of a larger network or virtual community where -- through collaboration, discussion and development of the resource – contributors acquire "…a sense of common purpose and belonging that unites them into one community" and encourages further sharing (Kuznetsov, 2006);
6. *Enhanced Personal Reputation* -- providing the opportunity for registered contributors to develop on-line identities that are respected, trusted and valued by their Wikipedian peers, thereby increasing their own sense of self-worth;
7. *Provides an Outlet for creative & independent self-expression;* and
8. *Pride of Place* – where adding information about one's own group or community may be good for public relations, tourism, economic development, or simply demonstrating that one's own street or establishment is "on the map".

There are also more negative but no less important motivators to consider as well. Not all contributors may be interested in providing objective or reliable information. The motivations behind some such contributors are easy to identify:

1. *Mischief:* Mischievous persons or "vandals" hoping to generate skepticism or confusion by replacing legitimate entries with nonsensical or overtly offensive content. Viegas et al. (2004) and more recently Priedhorsky et al. (2007) offer excellent examples of empirical research into quantifying and characterizing the prevalence of such entries in Wikipedia and propose approaches to their quick correction.
2. *Agenda:* Independent individuals or representatives motivated by beliefs in a given community, organization or cause – By tracing individual Wikipedia contributions back to specific network IP addresses, the recently-developed WikiScanner software identified and characterized the practices of specific corporations, government institutions, and special interest groups in systematically making overtly biased, incorrect and/or misleading modifications to Wikipedia entries of direct interest to them, their members and/or their agenda (Borland, 2007).
3. *Malice and/or Criminal Intent:* Individuals possessing malicious (and possibly criminal) intent in hopes of personal gain – A recent example of this occurred when unknown perpetrators posted false report to the *iReport.com* site re: Steve Jobs hospitalization, resulting in them causing and benefiting from a short-term price fluctuation in Apple shares (Cohen, 2008a).

As one progresses from (1) to (3), it is more difficult to develop automated approaches to monitoring, identification, editing and overall QA. Vigilance is essential. In public planning instances, for example, planning professionals *should* be aware of and be prepared to deal with the "…digital vandalism, yelling, and deliberate misdirection" coming from some contributors and that developing a "healthy skepticism" of data coming from VGI sources may in fact help target staff investigations and avoid the spread of false rumours during a plan development process (Tulloch, 2008).

3. CHARACTERIZING THE CONTRIBUTIONS

Drawing from the work of Viégas et al. (2004), Anthony et al. (2005), Swartz (2006) and especially Priedhorsky et al. (2007), contributions to Wikipedia may be termed either "Constructive" or "Damaging" and fall into one of eight categories. Specifically:

Constructive

- Legitimate New Content – a new article or entry;
- Constructive amendments – clarifications and additions that improve the veracity, completeness and depth of the original entry;
- Validation & Repair – identifying damaging content and making the appropriate corrections, and
- Minor Edits & Format Changes.

Damaging

- Mass Deletes – Removal of all or nearly all of an article's content;
- Nonsense – Text that is meaningless to the reader and/or irrelevant to the context of the article;
- Spam – Advertisements or non-useful links incorporated into the article;
- Partial deletes -- Removal of some of an article's content, from a few sentences to many paragraphs;
- Offensive content – Inclusion of (e.g.) obscenities, hate speech, unwarranted attacks on public figures, unexpected links to pornography; and
- Misinformation – Clearly false information, such as changed dates, subtle insertions or removal of certain words which changes the meaning of a passage, stating incorrectly that a public figure is dead, etc.

Understandably, there will be topics on which there is legitimate and ongoing debate over details, context, and motivations. In such cases, it may be arguable whether a particular amendment is indeed "constructive" or "damaging". Coming back to individuals and organizations with an agenda, there are already examples of citizen groups and organizations which would like to see digital map

and attribute data amended to, for example, re-route traffic around older village centers, residential neighborhoods and school zones [e.g., (Lyall, 2007); (Stichting Onderzoek Navigatiesystemen, 2007)].

4 GEOSPATIAL PRODUSERS AND AUTHORITATIVE DATABASES

What lessons may be drawn from these findings, and how may they be applied to scenarios involving volunteered geographic information?

First, we recognize that VGI to date in most applications has taken the form of georeferenced point- and line-based data along with (usually) a limited set of attributes. Contributions of area-based features have also been made to some sites, but the proportion would be relatively small in relation to the other data types. The amount of attribute data accompanying the contributions is relatively small and, at the time of writing, usually limited to a few entries or tags. The amount or organization of such tags would rarely conform to any standards-based metadata specifications endorsed by public or private mapping organizations, although organizations like OpenStreetMap are well on their way to defining more extensive sets of structuring and tagging specifications.

Assessing the credibility of contributors is important to evaluating the overall reliability of a contribution (Flanigan and Metzger, 2007). There are definite spatial and temporal considerations that make VGI contributions unique, and these may be used to support or refute the credibility of a given contributor. For example, while anyone from anywhere may be in a position to contribute to an article on "Mozart" or "Orienteering", a volunteered contribution of mapped information covering a new subdivision in Ottawa, Canada may be justifiably flagged for review if it originates from a contributor in Enschede, Netherlands.

Further, we accept that geographic knowledge may be "locus-related" as well. Long-haul truck drivers may be good sources of information concerning data within a certain buffer along a given route – say from Amsterdam to Paris or Boston to Washington, D.C. Indeed, such people are valued sources of updates to value-added road network data suppliers like TomTom, TeleAtlas, Navteq, and others. Finally, the date and time at which a volunteered contribution is made concerning (for example) a given segment of highway may have a bearing on its credibility, especially when trying to assess the reliability of two or more competing or contradictory contributions. Bishr and Kuhn (2007) offer a more in-depth look at spatio-temporal considerations which may be taken into account when assessing the credibility of a given contributors. Other methods to assess the relative credibility of different contributors and the reliability of their contributions will be the subject of future research by the authors.

How do we use our findings to determine what types of information volunteers can best contribute to authoritative databases? Can we predict the types of features that will constitute the majority of volunteered contributions? What about the balance of location-related versus descriptive attribute information? Most of the motivators drawn from research in other sectors and described in Section 2.3 are applicable to contributors of VGI, but some may be more prevalent than others in different contexts. Table 2 classifies examples of contributions which would fall into the different categories mentioned above and sorted under the same headings of Market-driven, Social Networks and Civic/Governmental type applications introduced earlier.

Table 2: Examples of Contributions of Volunteered Geographic Information based on Different Motivators

	Market-Driven	**Social Networks**	**Civic/Governmental**
Altruism	Updating present traffic conditions and sharing it with other users of GPS navigation devices.	Passing along informal reviews and recommendations regarding good restaurants.	Updates to road networks and points of interest to assist in emergency situations.
Professional or Personal Interest	Updates to road network information by truck driver.	Hiking trails recently completed.	Spatially-based observations to a PPGIS project by interested community member.
Intellectual Stimulation		Learning more about positioning & mapping capabilities of your cell phone application.	
Protection or Enhancement of a Personal Investment	Updates to road network attribute data by the owner of a personal GPS navigation device.		PPGIS
Social Reward		Part of the *Open Street Map, Platial* or *Wayfaring* community.	
Enhanced Personal Reputation		Gaining experience as a recognized expert contributor to *Open Street Map.*	

Outlet for Creative and Independent Self-Expression			
Pride of Place	Addition of map information concerning one's own subdivision.	Updating *Open Street Map, Flicker,* or *Platial* with info regarding one's own community.	
Mischief	Indicating removal of certain Points of Interest that really still exist.	Marking an ex-husband's new house as the site of illegal activities on "RottenNeighbors.com"	Providing incorrect information in emergency response situations to re-route and hijack relief convoys.
Agenda	Deliberately making incorrect changes to speed limits and street directions to divert traffic around a given area.		Drawing attention to formerly secret military sites
Criminal Intent			Providing incorrect information to emergency response situations in order to re-route and hijack relief convoys.

If national mapping organizations wish to tap into the distributed knowledge, time and energy of volunteer producers to contribute authoritative geospatial data, they must be prepared to entertain some important procedural and cultural changes that build on the motivations and recognize the characteristics of the culture as articulated below (Bruns, (2008b):

(1) Accept and respect rules imposed by the produsage community, much like commercial operators having to survive in the open source community.

For example, geospatial produsers would want to see their contributions acknowledged instantaneously, posted quickly, and ideally credited to them via tags or metadata entries. In order to keep their interest, the turnaround time from contribution to posting would have to be very short.

(2) Tolerate a regime of "heterarchy" instead of hierarchy, where the produsage community's values take precedence over traditional practices and policies.

Releasing some control to "the crowd" over decisions whether or not to post a contribution would certainly represent a major shift to an organization used to very different kinds of quality assurance processes.

(3) Accept the fact that the geo-information "produsedˮ is a perpetually unfinished artefact (or a "palimpsest", as Bruns terms it).

The notion of authoritative geo-information in a state of constant imperfection and fluidity may be perceived by some to undermine government legitimacy. It maybe the most difficult barrier for government participation in produsage communities.

(4) *Introduce new rules and/or legislation to account for and balance the rights of individual contributors to those of both the produsage community and the mapping organization.*

Here is where larger organizations have the opportunity to be proactive in a time of uncertainty and suggest new rules of their own which represent positive compromises on both side. For example, even some of the most recognized evangelists of the "wiki" movement suggest some evolution of roles and responsibilities is required moving forward (Cohen, 2008b).

Clearly, it would be naïve to trivialize the genuine tensions and modifications to cultures, policies and processes necessary for established public sector organizations to accommodate volunteered information to their databases. That said, large private sector mapping firms like *TomTom*, *Navteq* and *TeleAtlas* are now all taking advantage of produser input to enable quicker turnaround times of updates and improved customer service. How one such company has dealt successfully with such change is the subject of a forthcoming paper.

5. QUESTIONS GOING FORWARD

In this paper, the authors have drawn from other related fields to characterize the motivations of volunteer contributors (or produsers), and the different types of contributions they may make. It then extends these generic classifications to demonstrate how they may relate to contributions of geospatial information.

Going forward, if a mapping organization wishes to capitalize on a distributed network of volunteer geospatial data produsers, then it must start refocusing attention across what happens both inside that organization *and also* in the new social network of geo-information production. New rules and standards will be required to take into account the values of these volunteers — equity, security, community building, privacy — in evaluating the performance of this new production system.

Many important questions remain to be answered. For example:

(1) *What questions should an organization ask in determining how, if at all, it should employ volunteered geospatial information provided by produsers?*

What problem(s) is the organization trying to address by incorporating such information? What are the benefits and risks? What criteria determine whether or not such an initiative is considered effective by its stakeholders? Given these criteria, how does such an initiative need to be resourced in terms of people and technology in order to be effective? Are there any institutional and/or cultural constraints that must be addressed?

(2) *How does an organization assess the credibility of a new produser and the degree of trust it can place in that person's contributions?*

How is credibility assessed and/or conferred, and who does the ongoing evaluation of contributions? Members of the mapping organization? A moderated on-line community? Members of the Web at large? What is most effective in terms of delivering the most credible input with the fastest turnaround times?

(3) *Are we sure people will want to contribute to government in the same way they contribute to social networks and even to industry?*

The Economist (2008a) points out that “It is noticeable how individuals may be less concerned about giving away personal information to a private company than to a government organization”. Citizen to Citizen (or "C2C") literature suggests that citizens interact with other citizens to promote the common good, but avoid direct relation to the government (IAB, 2008). Still, experiences dealing with different communities of practice engaging in the Canadian Government's GeoConnections program suggests that individuals and community organizations may indeed be prepared to contribute information if their contribution ultimately serves a higher purpose.

(4) *How do attract new produsers? How do you keep existing volunteers “engaged” -- or do you assume they will cycle in and out?*

Such questions are critical given that completeness and timeliness of a given geospatial dataset can be important public policy drivers to a national mapping organization. Longitudinal studies of members of social networks, wiki communities and even on-line auction sites are required to determine what proportion of individuals "stick" with a given community over a long period versus how many leave after a few transactions. Recall that Anthony et al's "Good Samaritan" content providers may actually make very few unique contributions, but the "elite regulars" stick around to make sure community members new and old all adhere to the technical and cultural norms of the on-line community. Looking to the future, Bruns (2008) suggests that educators must take a more active role in order to make sure

the coming generation of contributors possesses the creative, collaborative, critical and communicative skills required to be "deliberate" rather than "accidental" produsers.

Subsequent research will focus on these questions as well as more practical ones examining best practices and lessons learned in implementing produsers contributions in both private and public sector mapping organizations.

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