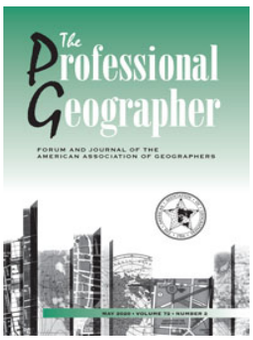

The Professional Geographer

ISSN: 0033-0124 (Print) 1467-9272 (Online) Journal homepage: https://www.tandfonline.com/loi/rtpg20

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To cite this article: Sabine Hennig (2020) Motivation and Its Consideration in Participatory Spatial Data Contribution, The Professional Geographer, 72:2, 238-252, DOI: 10.1080/00330124.2019.1676799

To link to this article: https://doi.org/10.1080/00330124.2019.1676799

Motivation and Its Consideration in Participatory Spatial Data Contribution

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Advances in Web technology have triggered new modes of participation. In the context of online participation, the use of geospatial technologies has received increasing attention. This includes possibilities for the public to contribute spatial data to any initiative or project. In this context, it is important to be aware of and consider the motivations that drive people to take action, both in the implementation of participatory projects and in the development of tools that support spatial data collection and reporting. Even though literature provides extensive knowledge on why people participate and how to address their motivations, the question remains to what extent project designers actually take this into account. Results of a questionnaire and an analysis of Web sites and Web applications reveal that project designers consider motivations in their initiatives to varying degrees. To increase the extent to which motivational factors are considered and addressed in project implementation, two approaches are discussed, namely, participatory design and user interface design patterns. **Key Words: motivational factors, online participation, spatial data collection and reporting.**

网络技术进步催生了新的参与模式。在网络参与的大环境下，地理信息科技的应用受到越来越多的关注，公众可将空间数据用于任何计划或项目。为了支持空间数据收集和报告，人们实施了各种参与式项目，开发了很多工具，但是什么驱使人们在这个过程中采取行动呢？了解这一动机并加以思考非常重要。尽管有文献提供了大量关于参与原因和动机处理的信息，但项目设计者在这方面的关注程度不得而知。调查问卷结果以及网站和网站应用分析显示，项目设计者在其计划中对动机的关注度各有不同。为提高项目实施中对动机因素的关注和处理，本文讨论了两种方法：参与式设计模式和用户界面设计模式。**关键词：动机因素，在线参与，空间数据采集和报告。**

Los avances en la tecnología de la Web han dado lugar a nuevos modos de participación. En el contexto de la participación en línea, el uso de tecnologías geoespaciales ha recibido creciente atención. En eso se incluyen las posibilidades para el público de contribuir datos espaciales para cualquier iniciativa o proyecto. En ese contexto, importa estar al tanto y considerar las motivaciones que empujan a la gente a tomar acción, tanto en la implementación de proyectos participativos como en el desarrollo de las herramientas que sustentan la recolección y reporte de datos espaciales. No obstante que la literatura provee amplia información sobre por qué participa la gente y cómo enfrentar sus motivaciones, subsiste la cuestión del alcance con que los diseñadores del proyecto toman en cuenta eso. Los resultados de la aplicación de un cuestionario y un análisis de sitios y aplicaciones Web revelan que los diseñadores de proyectos consideran las motivaciones en sus iniciativas en grados diferentes. Para aumentar el alcance con el que son considerados y abocados los factores motivacionales en la implementación de proyectos, se discuten dos enfoques, a saber, el diseño participativo y los patrones de diseño de la interfaz del usuario. **Palabras clave: factores motivacionales, participación en línea, recolección y reporte de datos espaciales.**

The possibilities of communication, exchange, and interaction provided by the Internet, together with high Internet user penetration rates, have triggered new modes of participation (Wellman et al. 2001; Crowstone and Fagnot 2008; Lwin, Hashimoto, and Murayama 2014). This refers, among other modes, to online participation, which includes and enables different types of activities involving the public; for example, taking part in problem definition and decision making, as well as contributing data (Haklay 2013; Nov, Arazy, and Anderson 2014).

In this context, the use of geospatial technologies has received increasing attention. Today, different kinds of applications enable the public to contribute spatial data (Peris et al. 2011; Brown and Kyttä 2014; Pánek 2016). Such applications find use in various types of initiatives: citizen science (Haklay 2013), spatial planning (Pánek and Pászto 2017), citizen reporting (King and Brown 2007), and crowdsourced information portals (Mobasheri, Deister, and Dieterich 2017). Techniques used for these participation initiatives are the contribution of text (coordinates, postal addresses), geotagged media, self-recorded Global Positioning System (GPS) data, or users adding features to Web maps (Newman et al. 2012; Rinner and Fast 2015; Mooney et al. 2016).

There are several reasons for the implementation of participation projects and projects allowing for participatory spatial data contribution: Data that are otherwise not available or difficult to access can be received. This refers to people's local spatial knowledge and how they perceive, value, and use infrastructure or resources (International Fund for Agricultural Development [IFAD] 2009; Herfort et al. 2015; Hennig 2017). It creates the opportunity for data to be gathered on larger geographic scales and over longer periods of time than what is possible with traditional data collection approaches

The Professional Geographer, 72(2) 2020, pages 238–252
Initial submission, September 2018; revised submissions, May and July 2019; final acceptance, September 2019.

(Cohn 2008). In many cases, involving the public is less expensive, less time consuming, and less cumbersome compared to nonparticipatory methods (Nov, Arazy, and Anderson 2011; Lwin, Hashimoto, and Murayama 2014). Moreover, participation supports learning and skill acquisition, including, in particular, spatial literacy skills (McCall and Minang 2005; Hennig and Vogler 2016). It also helps to increase public awareness and positive attitudes toward science, the environment, or public concerns (Cohn 2008; Bonney et al. 2009; Newman et al. 2012), and it is a means to citizen empowerment by giving the public a voice (McCall 2014).

In addition to benefits, participatory spatial data contribution faces several challenges: Crowstone and Fagnot (2008) and Nielson (2006) explained that in many cases the number of persons contributing is lower than expected. Often, the participants come from only one background or they belong to one segment of society, even though individuals from a wide range of backgrounds are invited to contribute (King and Brown 2007; Vogler, Hennig, and Ferber 2017). Frequently, merely a small share of committed individuals contribute the vast majority of data to a project (Coleman, Georgiadou, and Labonte 2009; Haklay 2013).

To benefit from advantages and to face the outlined challenges, a key factor is to understand the motivations that drive people to contribute their skills, time, and effort to a project (Morais, Raddick, and dos Santos 2013; Nov, Arazy, and Anderson 2014; Geoghegan et al. 2016). Fritz, See, and Brovelli (2017) stressed that the people who contribute are the reason why participatory approaches are successful. Thus, project designers must be aware of and consider factors that influence and motivate participation when implementing their projects, including project-related Web sites and Web applications (West and Pateman 2016).

Because the question of what, in general, drives people to participate in actions, including online actions, has been widely researched, abundant literature exists on this topic (Nov 2007; Fritz, See, and Brovelli 2017). There is a difference, however, between knowing and applying this knowledge. This is especially true when it comes to engaging the public to contribute spatial data. In this context, whereas the technological pillar of tools for spatial data collection and reporting has been widely discussed, the motivational dimension has received less attention (King and Brown 2007; Coleman, Georgiadou, and Labonte 2009; Nov, Arazy, and Anderson 2011). To face this gap, the topic of motivation is, nowadays, an integral part not only of geography (Pánek 2016) and participation research (Weiner, Harris, and Creaig 2002) but also of geoinformatics research (Mooney et al. 2016).

Because people's motivations are integral to designing and implementing participatory projects and for developing the related Web sites and Web applications (Gómez-Barrón et al. 2016; Fritz, See, and Brovelli 2017), the question is what significance project designers attach to motivational factors in the context of their projects. Which techniques and tools from the wide variety of possibilities do they use to motivate people to contribute? How can we increase the extent to which they take motivational factors into account and diversify the way in which this occurs? These questions are discussed in the following sections, focusing on participatory spatial data contribution projects taking place in Austria, Germany, and Switzerland.

Background on Motivation and Related Work

Participation is a broad concept that can mean different things to different people. Various definitions exist (Agarwal 2001; Claridge 2004; Piškur et al. 2014). Generally, participation refers to the involvement of specific groups in different tasks, which can occur to varying degrees and in different ways (Claridge 2004; International Association for Public Participation 2014; European Urban Knowledge Network n.d.). It is closely linked to volunteering; thus, participation cannot be enforced, but it is important to encourage people's involvement, and individuals must make their own decision to take part in a given activity (Involve 2005). Because this is also true for participatory spatial data contribution, the literature on motivation for participation including online participation is useful for understanding the factors that trigger people to contribute spatial data (Nov, Arazy, and Anderson 2014; Geoghegan et al. 2016; West and Pateman 2016).

Motivational Factors and Their Categorization

A great variety of motivations, generally divided into intrinsic and extrinsic factors, drive people to participate (Hars and Ou 2002; citizenlab 2016; Juhász and Hochmair 2018). *Intrinsic motivation* refers to motivation stemming from within, for example, based on the desire to feel competent and self-determined. These factors derive from people's core selves; they are not based on the outside world. In contrast, *extrinsic motivation* refers to external motivating factors driven by the world around us. It refers to rewards such as monetary compensation, expected returns, and any other kind of recognition (Hars and Ou 2002; Zichermann and Cunningham 2011).

In addition to intrinsic and extrinsic motivation, other categories of motivational factors are discussed in the literature. Based on Clary et al. (1998), Coleman, Georgiadou, and Labonte (2009), Feng et al. (2018), Fritz, See, and Brovelli (2017), Iacovides et al. (2013), Nov (2007), and Nov, Arazy, and

Table 1 *Categories of volunteer motivation and related motivational factors*

Category	Motivational factors
Learn and experience (based on 1, 2, 4, 6, 7)	• To learn something new (e.g., learn about the project topic and about related methods to be used, establish technical skills) • To use and practice new competencies or skills
Value and meaningfulness (based on 1, 2, 4, 6, 7)	• To help (due to consternation) for the benefit of others (including one's own community, etc.) • To do something good and important for personal enrichment and satisfaction
Social aspects and community relatedness (based on 1, 2, 3, 4, 6, 7)	• Establish and maintain contacts with others; cooperate with others (e.g., strengthening social relationships) • Being part of a community (e.g., getting recognition from the community; showing one's relationship to a community and a place)
Self-presentation (based on 1, 2, 3, 4, 7)	• To have the possibility to express one's own skills and knowledge as well as relationship to one's community and place) • To receive (public/private) feedback and rewards (e.g., being mentioned in public media, seeing one's own contributions online) • To cooperate with experts and community members (including important stakeholders and personalities)
Fun and excitement (based on 3, 4, 5, 6)	• To get to know, experience, and enjoy new or entertaining concepts, products, materials, and resources as well as an interesting and appealing design • To game (with or without competition, rewards, and feedback)
Work and career relatedness (based on 1, 2, 4, 6)	• To acquire work-related benefits (related to a certain topic, specific skills, etc.) • To access materials to be used for work-related activities (e.g., teaching) • To make a contribution as part of an existing job, mandate, or personal project

Notes: 1 = Clary et al. (1998); 2 = Coleman, Georgiadou, and Labonte (2009); 3 = Feng et al. (2018); 4 = Fritz, See, and Brovelli (2017); 5 = Iacovides et al. (2013); 6 = Nov (2007); 7 = Nov, Arazy, and Anderson (2011).

Anderson (2011), six categories of motivational factors can be distinguished: Learn and Experience, Value and Meaningfulness, Social Aspects and Community Relatedness, Self-Presentation, Fun and Excitement, and Work and Career Relatedness; Table 1).

The different categories of motivational factors partially interrelate. For example, being part of a community (Social Aspects and Community Relatedness) is the prerequisite for receiving recognition from others (Self-Presentation), and Learning and Experiencing something new by contributing can lead to Fun and Excitement (Coleman, Georgiadou, and Labonte 2009).

Several of the motivational factors grouped under these six categories relate to people's local concerns, interests, and connections (Napolitano and Mooney 2012). They contribute to their sense of pride in a place (Coleman, Georgiadou, and Labonte 2009; Juhász and Hochmair 2018). Thus, for instance, the desire to improve a place drives people to contribute (Value and Meaningfulness), and they may derive joy from presenting any kind of information about their community (Fun and Excitement), for example, on a Web map (Self-Presentation, Social Aspects and Community Relatedness).

Moreover, the importance attached to the different categories of motivational factors varies depending on the project aim and topic, the level and type of participation, and the target audience (Tiwari, Agrawal, and Shekhar 2010; Nov, Arazy, and Anderson 2014; Geoghegan et al. 2016; Hennig and Vogler 2016). This also applies to the three phases of participation: pre, initial, and ongoing participation. For example, Learn and Experience motivational factors are useful for motivating people in terms of pre and initial participation, whereas factors related to self-presentation and social aspects and community relatedness foster ongoing engagement (Crowstone and Fagnot 2008; Iacovides et al. 2013; Robinson and Phillips 2016; Fritz, See, and Brovelli 2017).

Techniques and Tools to Address Motivational Factors

A multitude of possibilities exist to address people's motivations (Newman et al. 2010; Nov, Arazy, and Anderson 2011; Iacovides et al. 2013; National Oceanic and Atmospheric Administration Office for Coastal Management [NOAA OCM] 2014). These can generally be categorized into four groups of techniques and tools: delivering information, giving rewards and feedback, enabling community-related activities, and providing specially created design solutions and material (Table 2).

Information A variety of techniques and tools are available to deliver different types of information to the participants (Table 2): information on the project (i.e., project baseline information such as topic, mission, and aims; the team involved; etc.; Nov, Arazy, and Anderson 2011, 2014; Iacovides et al. 2013), the data collection and reporting process (Engels 2015), the project findings and progress (NOAA OCM 2014; Nov, Arazy, and Anderson 2014; Geoghegan et al. 2016), and the benefits that

Table 2 *Possibilities and incentives (i.e., nondigital and Web-based techniques and tools) to address the people's motivations for participation*

Groups	Techniques and tools
Information	• Public media such as newspaper, television, radio • Flyer and brochures • Science-related magazines, scientific publications • Web sites, portals, platforms • Messenger chat, e-mail • Social media, blogs and forums, feeds • Online help, (multimedia) tutorials and trainings • Possibilities for face-to-face contact such as events and workshops
Rewards and feedback	• Being mentioned in public media (newspaper, television, radio, etc.), scientific publications, newsletters and (progress) reports, as well as Web sites, social media, blogs and forums (e.g., using statistics, lists, maps, charts), and during meetings, events, workshops, and so on • Using gamification elements such as leaderboard, ranking and point systems, badges, and so on • Allowing for likes, comments, emoticons on people's input • Receiving personal messages by e-mail, Messenger chat
Communication and community	• Group building services, possibilities for exchange, sharing, and cooperation (based on social networking services) • Social media, blogs, and forums • E-mail, Messenger chat • Face-to-face contacts (e.g., events, workshops)
Design and material	• User-centered design (colors, symbols , language, etc.) • Games and gamification elements (ranking, point systems, badges, etc.) • Customized data entry processes and forms (e.g., due to the design, collection, and reporting process allowing for teamwork and cooperation)

Notes: Based on Hennig (2018), Iacovides et al. (2013), Newman et al. (2010), National Oceanic and Atmospheric Administration Office for Coastal Management (2014), and Nov, Arazy, and Anderson (2011).

can be derived from participation (Fritz, See, and Brovelli 2017). Apart from choosing and using appropriate techniques and tools, several other aspects are key for providing information to the participants. This refers, for instance, to the use of appropriate media and the quality of the information in terms of, for example, timeliness, clarity, and accountability (IFAD 2009; Geoghegan et al. 2016).

Rewards and Feedback People who contribute their time and energy to support a project enjoy and appreciate gratification and a response to their work. Thus, rewards and feedback play a key role (Crowstone and Fagnot 2008; Zichermann and Cunningham 2011; Iacovides et al. 2013) and can take on different forms (Crowstone and Fagnot 2008; Coleman, Georgiadou, and Labonte 2009; Goh, Pe-Than, and Lee 2017). In this sense, it distinguished between material (monetary, nonmonetary) and virtual rewards (rankings, leaderboards, point systems, badge systems, etc.) and between public (newsletters, blogs, etc.) and private feedback (e-mail, messenger chat, etc.). Especially, the usefulness of material rewards is widely discussed in the literature. Vrbik (2016), for instance, outlined that rather than material rewards, it is their interest in the topic that leads people to participate.

Community-Related Activities The sense of belonging to a real-world or virtual community and the ability to identify with one is a pivotal point for mobilizing people to contribute (particularly regarding ongoing engagement). This is based on opportunities to interact, exchange, and work collaboratively with others and have a social outlet to express oneself (Koh and Kim 2001; Blanchard and Markus 2002; Broß, Sack, and Meinel 2007; Iacovides et al. 2013). In this respect, Nov, Arazy, and Anderson (2011) underlined the necessity of establishing a project-related community. Web-based tools employed for community building (Table 2) rely on social networking services (SNS) that enable the development of an online persona (virtual identity), the building and maintenance of networks including network interaction (to communicate, share, or exchange), the generation of virtual content, and network self-governance (Medaglia et al. 2009). In addition to Web-based tools, real-world contacts are an important means to build and maintain project-related communities. A good example of this is the OpenStreetMap project (OSM; see www.osm.org). Based on the Wikipedia model of crowdsourcing, the OSM project is aimed at creating a free, worldwide geographic data set. To achieve this aim, OSM not only pays attention to building and maintaining a virtual community but also fosters opportunities for volunteers to meet and exchange personally (e.g., OSM regular tables, OSM Mapathons; Seeger et al. 2014).

Design and Material An appealing design (e.g., matching users' preferences regarding color and symbols), an easy-to-use user interface (e.g., avoiding technical terms), and elements of excitement can clearly influence people and motivate them to take part in an initiative (King and Brown 2007;

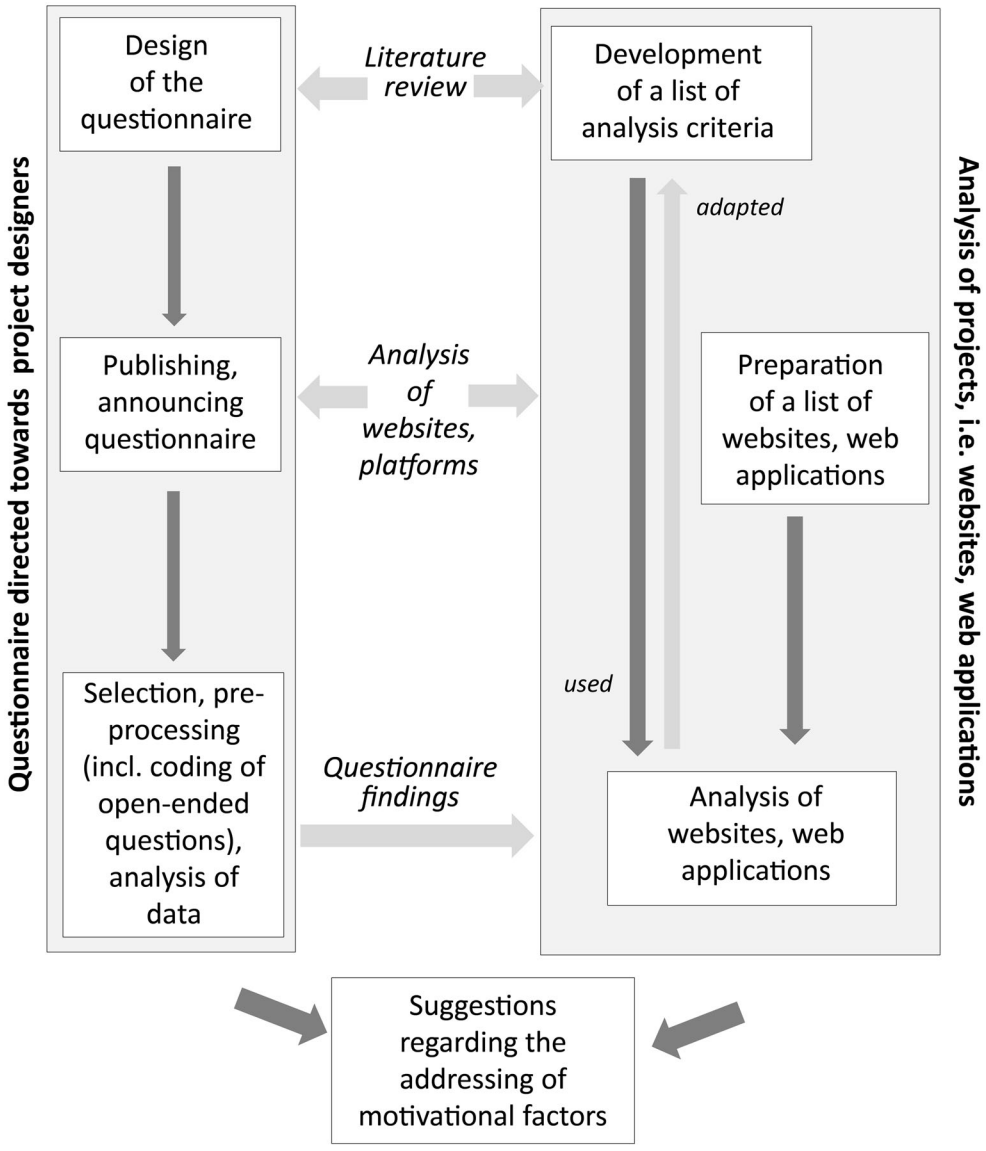

Figure 1 *Workflow and methods applied.*

Newman et al. 2010; Nov, Arazy, and Anderson 2011; Fritz, See, and Brovelli 2017). Apart from multimedia, games and gamification elements (e.g., point systems, badges, and leaderboards) are important excitement factors and are a means to increase participation (Antoniou and Schlieder 2014). They bring a (more) competitive and fun character to projects (Zichermann and Cunningham 2011; Newman et al. 2012; Iacovides et al. 2013; citizenlab 2018). In this regard, gamification elements relate to giving rewards and feedback.

Moreover, with respect to participatory spatial data contribution, it is a great benefit that the public enjoys working with spatial data and related products (Hennig and Vogler 2016). Tulloch (2007) highlighted that exploring and experiencing new concepts and tools excites and motivates people.

Workflow and Methods

Two methods (a questionnaire survey, an analysis of Web sites and Web applications; Figure 1) were used to understand what designers of participatory spatial data contribution projects think about the need to address people's motivations and how they take into account motivational factors.

The questionnaire directed at project designers was implemented as an online questionnaire using SurveyMonkey (www.surveymonkey.com). The questions were informed by our literature review,

Table 3 *Overview on questions directed toward the project designers*

No.	Focus/aim	Type (coding approach)
1	Project name	Open-ended
2	Project Web site	Open-ended
3	Project duration	Open-ended
4	Type of project (e.g., spatial planning, citizen science)	Closed, single choice
5	Data contribution method used (e.g., text, media with geotag, mapping)	Closed, multiple choice
6	Fulfillment of expectation (number of participants, quantity and quality of the data contributed)	Closed, matrix
7	Characterization of the intended target group	Closed, single choice
8	Level of participation by the target group	Closed, single choice
9	Proportion of participants from the target group	Open-ended
10	Characterization of the actual contributors	Open-ended
11	Preproject contact and dealing with the target group	Closed, multiple choice
12	Methods used for informing and announcing the project	Closed, matrix
13	Changes in methods to inform and announce the project	Open-ended
14	Use of target group–specific design and implementation of elements	Closed question, multiple choice
15	Methods actually used to motivate people (i.e., the target group) to take part	Closed question, single choice
16	Respondent's opinion on why people (i.e., the target group) did participate	Open-ended (coding: motivational factors categories)
17	Changes in the approach to motivate for participation	Open-ended (coding: yes, no)
18	Evaluation of possibilities to address motivational factors	Closed, matrix
19	Provision of elements regarding help or support	Closed, multiple choice
20	Best practice examples	Open-ended
21	Respondent's interest in results	Closed, single choice
22	Respondent's e-mail address	Open-ended

and the format considered best practice recommendations for paper and online questionnaire design (Callegaro, Lozar Manfreda, and Vehovar 2015); for example, keeping the questionnaire as short as possible, avoiding suggestive and leading questions, and addressing items of interest in several questions. The final questionnaire included 22 questions (Table 3) with an average answering time of eight minutes.

The questionnaire was distributed in autumn and winter 2017 and 2018. The URL to the survey was e-mailed to about eighty project designers who were identified through projects mentioned in the literature or on different Web sites and platforms (i.e., platforms providing an overview of participatory projects). In addition, the questionnaire was promoted by the network *Österreich forscht* (www.citizen-science.at). A total of thirty valid questionnaires were returned. Open-ended question answers had to be coded (Table 3).

To gain insight into the techniques and tools used by project designers, we scrutinized Web sites and Web applications using the analysis of similar systems (AoSS) technique. AoSS is a well-established technique in software engineering that allows us to examine and evaluate earlier product versions or competitor systems based on a list of criteria of importance in the respective context. Hence, we can gain understanding into what systems or products belonging to a certain domain actually look like, which elements and components have been implemented or are missing, and which problems should be avoided when developing a new system (Nemeth 2004). According to the AoSS a list of criteria was developed to focus specifically on aspects related to addressing people's motivations (Table 4). This was informed by our literature review (Table 2).

Projects to be examined regarding their Web sites and Web applications refer to those mentioned in the literature, listed on different Web sites and platforms, and named as best practice examples by the questionnaire respondents (Table 3, Question 20). A total of thirty-nine projects were identified through this approach (Table 5).

The questionnaire and the analysis of Web sites and Web applications delivered results reflecting project designers' attitudes toward people's motivations and how they address them. Selected findings are presented in the following section. The results allow us to discuss ways of improving the extent to which motivational factors can be considered and to diversify the way in which they can be addressed in future projects.

Questionnaire Results

The benefits and challenges attributed to participatory spatial data contribution are, among others, closely related to the quantity and quality of data delivered, the level of participation in general, and participation of the intended target audience in particular. The questionnaire results reveal that the project designers' expectations regarding these issues were not completely fulfilled (Table 3, Questions 6, 8). Only about one third of the respondents ($n = 10$) stated they were satisfied with the quality and quantity of the data contributed and with the number of contributors ($n = 9$). Half ($n = 15$) stated that they could indeed reach the intended target audience and

Table 4 *Criteria list for the analysis criteria of Web sites and Web applications*

Group	Use, method, and focus of techniques and tools
Information	• Web sites, social media, blogs, and forums • Newsletter, progress report (using list, progress map, etc.) • Online tutorial, teaching material, etc. • E-mail • Poster, flyer/brochure, public media • Face-to-face contact: workshop, info event Type of information provided • Baseline project information • Information to support the data contribution process (e.g., collection and reporting) • Project progress information • Information about benefits from participating in the project
Rewards and feedback	• Material rewards • Newsletter • Project progress (maps and other elements with or without mentioning the data contributor) • Virtual rewards: user ranking, point system, etc.
Communication and community	• User registration/login • Social media, blogs, and forums • Elements to support community building and maintenance (i.e., social networking services) • Face-to-face contact: workshop, info event
Design and materials	• Particular (graphical user interface, map component) design solutions (use of colors, symbols, language, etc.) • Excitement factors: logo, mascot • Excitement factors: games and gamification elements • Excitement factors: video, teaching material

Table 5 *List of projects analyzed regarding their Web site and Web applications*

Name	URL
Admiral	https://www.nabu.de/tiere-und-pflanzen/aktionen-und-projekte/stunde-der-gartenvoegel/index.html
Alleen in Niedersachsen	http://www.alleen-niedersachsen.de/scout4mobile/?project=alleen&restartApplication
Alpensteinbock in Bayern	https://www.lbv.de/mitmachen/fuer-einsteiger/steinbock-melden/
ArtenFinder Service-Portal Rheinland-Pfalz	https://artenfinder.rlp.de/
Beachexplorer	www.beachexplorer.org/
citclops	http://www.citclops.eu/
Crowdwater	crowdwater.ch/de/home/
Digitale Dokumentation von Grabsteinen	http://grabsteine.genealogy.net/
Finde den Wiesenknopf	http://www.ufz.de/wiesenknopf/
Firedatabase	http://fire.boku.ac.at/firedb/
Fotoquest	fotoquest-go.org/
Geomaus	kleinsaeuger.at/GeoMaus.html
Goldschakal	www.goldschakal.at/
Hirschkäferpirsch	http://www.hirschkaeferpirsch.de/index.php?id=147
Hushcity	http://www.opensourcesoundscapes.org/hush-city/
Igel in Bayern	www.igel-in-bayern.de/
Im Schneckentempo durch Deutschland	http://www.arteninfo.net/elearning/mollusken/speciesportrait/182
Info flora	www.infoflora.ch/de/
Insekten Sachsen	https://www.insekten-sachsen.de/
Insektensommer	www.nabu.de/tiere-und-pflanzen/aktionen-und-projekte/insektensommer/index.html
Kleks	https://www.kleks.app
Küstenselvies	http://coastwards.org/
Kultur in der Natur	
Landschaft im Wandel	http://www.landschaft-im-wandel.de/
Mastweb	www.wsl.ch/de/microsites/mastweb.html
Neophyten melden	https://www.korina.info/
observation.org	observation.org
Phaenonet	phaenonet.ch/de/
Ragweedfinder	www.ragweedfinder.at/
Roadkill	roadkill.at
sample' das Saarland	https://www.hips.saarland/sample/
Schweinswale	https://walschutz.org/
Stunde der Gartenvögel	www.nabu.de/tiere-und-pflanzen/aktionen-und-projekte/stunde-der-gartenvoegel/index.html
Stunde der Wintervögel	http://www.stunde-der-wintervoegel.de/
Tagfalter Monitoring	http://www.tagfalter-monitoring.de/
Vielfalt bewegt	http://www.alpenverein.at/portal/natur-umwelt/vielfalt_bewegt/index.php
Vielfalter	https://viel-falter.at/cms/
Wasser schafft	
Wilde Nachbarn	http://bw.wildenachbarn.de/projekt/citizen-science

Table 6 *Importance attached to the different categories of motivational factors by the project designers (n = 30)*

Categories of motivational factors	Absolute (relative)
Value and meaningfulness	13 (43%)
Learn and experience	12 (40%)
Fun and excitement	4 (13%)
Social aspects and community relatedness	3 (10%)
Work and career relatedness	3 (10%)
Self-presentation	
No answer	7 (23%)

Note: Open-ended questions were coded with multiple answers per respondent.

that their members contributed to the desired extent.

When asked why people contributed to their initiative (Table 3, Question 16), project designers listed several reasons. When coded in line with the different motivational factor categories (Table 1), responses show that project designers attach various degrees of importance to the six categories. The categories Value and Meaningfulness and Learn and Experience were considered as particularly relevant; less importance was given to the other categories. Seven respondents did not answer this question (Table 6).

Nevertheless, there is a difference between being aware of people's motivations and, in fact, addressing motivational factors. Although 77 percent of the project designers ($n = 23$) mentioned reasons why people contributed to their project (Table 3, Question 16), the share of respondents who stated that they actually take motivational factors into account in their project implementation was lower (60 percent, $n = 18$; Table 3, Question 15).

When project designers who stated that they pay attention to people's motivations in the context of their projects ($n = 18$; Table 3, Question 15) were asked whether, today, they would do something different to better engage the target audience (Table 3, Question 17), more than half affirmed this ($n = 10$). They highlighted the importance of paying more attention to personal contact with the target audience and to gamification elements. Only one of the project designers who indicated not considering people's motivations in the context of their project ($n = 12$) would change this.

The questionnaire results (Table 3, Questions 12, 14, and 19) indicate that the respondents use techniques and tools to address motivational factors to varying degrees. Table 7 shows that different degrees of importance are attached to the individual possibilities and, thus, to the four groups of motivational factors presented in Table 2.

The project designers' answers reveal that most of them use techniques and tools geared toward information provision. This refers to both Web-based and traditional approaches. Regarding Web-based approaches, 80 percent use Web sites, 77 percent use simple online instructions and tutorials, and 70 percent use e-mail; in terms of traditional approaches, 73 percent make use of flyers, 73 percent use public media, and 63 percent hold events.

In contrast, the group of techniques and tools related to rewards and feedback receives less attention. Aside from the tools and techniques useful for giving feedback and providing information (e.g., public media, e-mail, and events), other tools and techniques are less considered. For instance, only 23 percent of project designers use virtual rewards like point systems and rankings ($n = 7$).

Even less attention is given to the group of techniques and tools related to design and material. Whereas a certain number of project designers stated that they consider design issues such as the use of language ($n = 13$), graphical user interface design ($n = 10$), or use of colors and symbols ($n = 8$), a smaller proportion indicated that they integrate material that excites the participants. For instance, only seven project designers mentioned using gamification elements (e.g., ranking lists) and multimedia content (e.g., video tutorials), and four explained that they employ games.

The tools and techniques available for supporting community-related activities are used by project designers to varying degrees. The questionnaire results indicate that, apart from face-to-face contacts, more than half of the project designers maintain a social media presence (e.g., Facebook), but only four indicated having implemented SNS and focusing on building and maintaining a project-specific virtual community.

Results from the Analysis of Web Sites and Web Applications

The results gained from the analysis of Web sites and Web applications underline the questionnaire findings. First, all but two projects had a Web site available and accessible (Table 5). With respect to the information provided, all Web sites had a clear focus on project baseline information; less attention was given to information regarding the project progress (by approximately two thirds of the Web sites) and the contribution process (three quarters of the Web sites). Only a few Web sites explained the benefits to be gained by participating in the project (e.g., Roadkill, ArtenFinder Service-Portal Rheinland-Pfalz). Depending on the project, however, the information provided varied considerably in terms of quality and quantity. In addition, several projects used their Web sites to announce and share information about project-specific events and workshops (e.g., Phaenonet, Beachexplorer, Neophyten melden, Info Flora, Goldschakal). Material to be used for teaching purposes (in particular in schools) was provided on some of the Web sites

Table 7 *Use of techniques and tools by the project designers surveyed (including their relationship and relevance regarding the different groups of techniques and tools)*

Technique and tool	Relevance of technique and tool for the different categories of motivational factors				Use of technique and tool: Absolute (relative)
	Information	Rewards and feedback	Design and material	Community relatedness	
Web site	x	x			24 (80%)
Simple online instructions and tutorials	x				23 (77%)
Flyer	x				22 (73%)
Public media	x	x			22 (73%)
E-mail	x	x			21 (70%)
Events	x			x	19 (63%)
Social media	x	x		x	17 (57%)
Feedback by progress reports, newsletters, etc.		x			13 (43%)
Use of language/terms			x		13 (43%)
Workshop		x		x	13 (40%)
Graphical user interface design			x		10 (33%)
Data reporting			x		12 (40%)
Use of colors and symbols			x		8 (27%)
Map component design			x		8 (27%)
Video (e.g., guidelines)			x		7 (23%)
Feedback by mentioning the participants/their input, gamification elements, etc.		x	x	x	7 (23%)
Posters/billboards	x				5 (17%)
Building/maintaining of online community/ social networking services				x	4 (13%)
Games			x		4 (13%)
Messenger chat	x	x			0 (0%)

(e.g., Beachexplorer, Crowdwater, Igel in Bayern, Neophyten melden).

Giving rewards and feedback is closely related to informing the participants about the project progress. Most of the projects used Web maps to provide an overview of the spatial data delivered by the participants (e.g., Igel in Bayern, Geomaus, Küstenselvies); a few also made use of tables or lists (e.g., Beachexplorer). Little use was made of features such as point systems (e.g., Beachexplorer) or user rankings (e.g., Crowdwater). Monetary and nonmonetary rewards played a minor role: Only one project, Fotoquest, offered a small monetary reward on its Web site, and two projects communicated on their Web site that they offer a prize draw for contributors (Insektensommer, Stunde der Gartenvögel).

Even though about one third of the products analyzed in this study required or provided the possibility for participants to register, only a few tools included features that support community building activities, such as exchanging and networking (i.e., SNS). Examples of projects integrating such features are Roadkill and Crowdwater, which permitted users to comment on other people's contributions. Links to project-related social media sites could be found on most Web sites (e.g., Facebook, Twitter, and Instagram). In addition to these features, community building was supported by workshops and events that (as already mentioned) were announced on some of the Web sites.

Some of the project Web sites and Web applications provided a particularly appealing design. This included, among others, the use of colors and symbols that bear a relationship to the project and the topic under investigation. The projects Ragweed (ragweed leaf) and Geomaus (mouse), for instance, used project-specific map symbols. In some cases, a project-specific corporate design was applied to all project-related products and materials, both traditional and digital (Igel in Bayern, Insektensommer). In terms of branding, this supports recognition and increases public awareness of a project. To a certain extent, it can also serve to excite people. This is also true for logos and mascots. Whereas providing a project logo is, nowadays, standard practice, the use of project mascots still seems to be an exception. An example of a project with a mascot is the project Igel in Bayern, in which a little comic hedgehog played an important role, not only in the context of the Web site and in videos

(see, e.g., https://www.youtube.com/watch?v=juPrQfJLwBI) but also in the traditional materials such as flyers and posters (see, e.g., https://www.igel-in-bayern.de/igel-faltblatt/faltblatt/).

Another excitement factor, although still an exception, was the use of multimedia such as videos to impart information about the project or the contribution process (e.g., Küstenselfies, Stunde der Gartenvögel, Igel in Bayern, Insektensommer). This is also true for gamification elements (e.g., point systems, user rankings). Although those were not heavily used, games like quizzes could be found on several Web sites. They allow, for instance, testing one's knowledge on the investigation objective (e.g., Neophyten melden, Stunde der Gartenvögel, Goldschakal).

Improving How Motivational Factors Are Addressed

Both the questionnaire findings and the results of the analysis of the Web sites and Web applications show that project designers do not attach the same attention to different motivational factors and the techniques and tools used to address them. To increase the extent to which people's motivations are taken into account and to diversify the way in which this occurs, awareness of the variety of motivational factors and knowledge on how to employ and implement techniques and tools to address them play an important role. For this, participatory design and user interface design patterns are two promising approaches.

Participatory Design

Identifying and implementing the requirements of the target audience are critical to the development of any Web site and application (Pressman 2009; Sommerville 2011). In software and Web engineering, survey and observation techniques are traditionally used to gain the necessary understanding of the intended target group, their needs, and their preferences. The use of these techniques might not be enough, however, because of reasons such as developers' missing perspective on users' abilities and capabilities; on users' unawareness regarding their own needs, knowledge, and competencies; and on users' incapacity to reliably describe their requirements and communicating their problems to the developers (use of different vocabulary or terms, misunderstandings, etc.). Here, cooperating with future users in the product development process is seen as a remedy to these limitations (Firesmith 2007; Hennig and Vogler 2016).

A useful approach is participatory design, which emerged in Scandinavia in the 1970s. Its original purpose was to face design problems in the architecture domain. By now, participatory design has received the attention of all kinds of product developers. In the context of software and Web development, it aims to involve representatives of the future target group in the entire design and development process of an application or Web site, including requirements specification, design, implementation, and testing (Kautz 2010; Sanders, Brandt, and Binder 2010). This can occur with varying intensity. Generally, we distinguish between weak and strong participatory design (Baek et al. 2007). In weak participatory design, user input is solicited, but decisions are largely made by the developers; in strong participatory design, future users not only participate throughout all stages of the development process but they are also involved in decision making (Kensing and Blomberg 1998; Mazzone and Read 2005; Enerson 2013). Regardless of whether a weak or strong participatory design is applied, user knowledge and skills, as well as other aspects usually not known to the developers, are brought into the development process. This helps to generate products that are more centered on the target audience and that let users achieve their aims more effectively (Steen, Kuijt-Evers, and Klok 2007; Muller and Druin 2012).

The participatory design approach is also useful for the implementation of participatory spatial data contribution projects, including the development of Web sites and Web applications. It allows comprehensive learning about the users and what drives them to participate. This was underlined by Newman et al. (2010), who stressed that the requirements of people contributing to such projects are often still not sufficiently understood. In addition, Spielman (2014) explained that the collection of spatial data by untrained people presents several challenges and thus requires special attention. Also, the results of the questionnaire directed at the project designers (e.g., incomplete fulfillment of expectations, focus mainly on selected motivational factors) emphasize the need for project designers to learn more about the participants. Here, Figure 2 shows the advantages of using the participatory design approach in the implementation of participatory spatial data contribution projects.

User Interface Design Patterns

Following best practice examples is a useful approach in the development of more user-centered and, thus, successful Web sites and Web applications, including the ones allowing users to contribute data (Newman et al. 2012). Even more helpful than best practice examples are user interface design patterns, which are widely used in software and Web engineering (Pressman 2009; Sommerville 2011). They are defined as the description of a reusable and well-tried solution for a common but

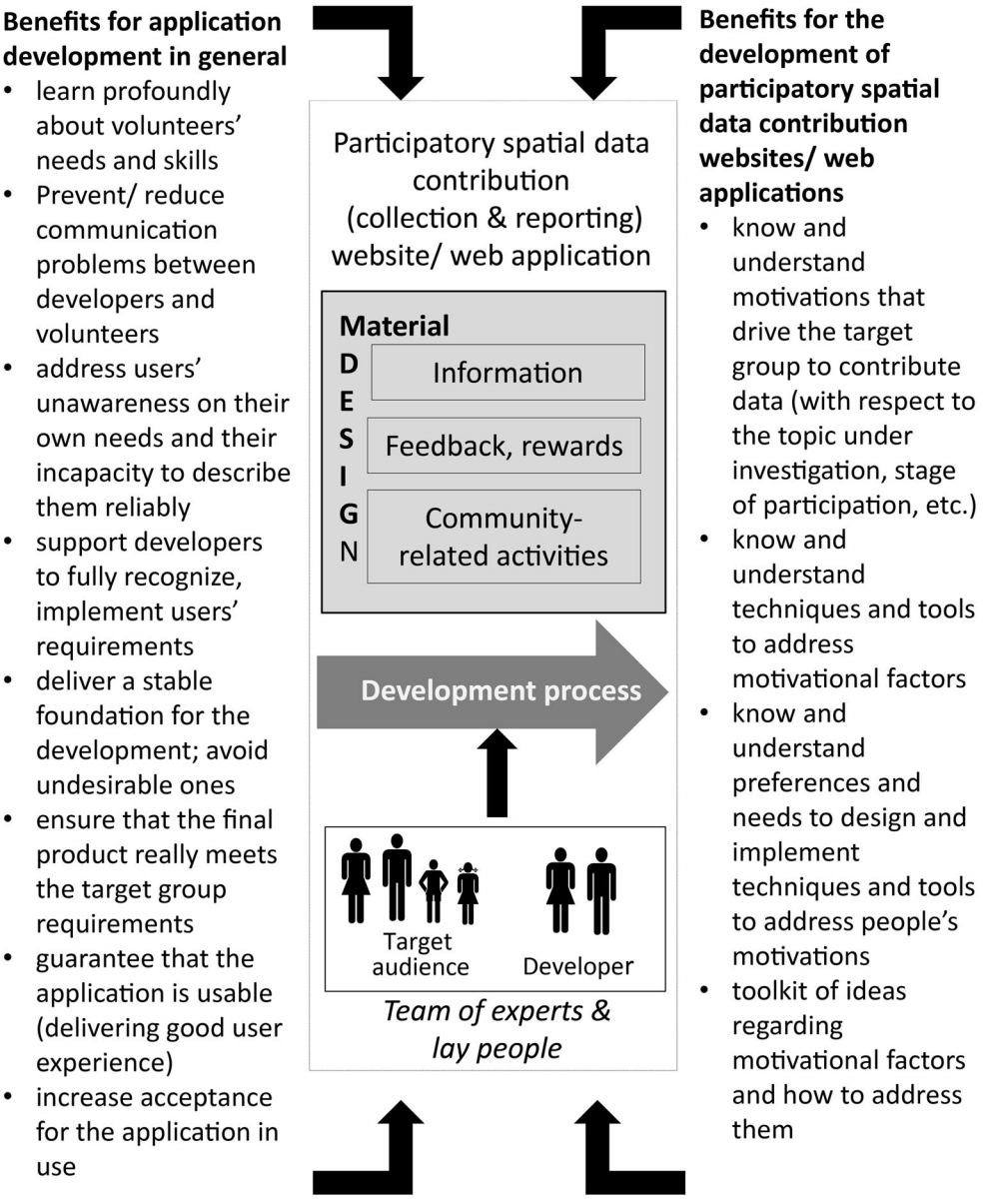

Figure 2 *Benefits of the approach of participatory design in the context of the development of geospatial participation Web sites (based on Ehn 1993; Hekkert and van Dijk 2001; Kujala 2003; Steen, Kuijt-Evers, and Klok 2007; Peris et al. 2011; Walters and Evans 2011).*

specific problem and, accordingly, accumulate wisdom and experience (Sommerville 2011; Dain n.d.). Information delivered by user interface design patterns refers, among other things, to the name of the pattern, explanations on when to use and not to use the pattern, how to use it, guidelines and constraints regarding its implementation, best practice example screenshots, related design patterns, and, if of relevance, exemplary source code (Pressman 2009; Morkes 2015).

The benefits of user interface design patterns are well discussed in the literature (Pressman 2009; Morkes 2015; Brüning 2018). They also provide several advantages for the development of Web sites and Web applications in terms of participatory spatial data contribution. This refers, for instance, to the fact that project designers currently make limited use of the variety of techniques and tools available to address the different motivational factors that drive people to contribute. Furthermore, to support the implementation of more complex tools (e.g., multimedia, SNS, gamification elements), they can provide the relevant background and inspiration and allow

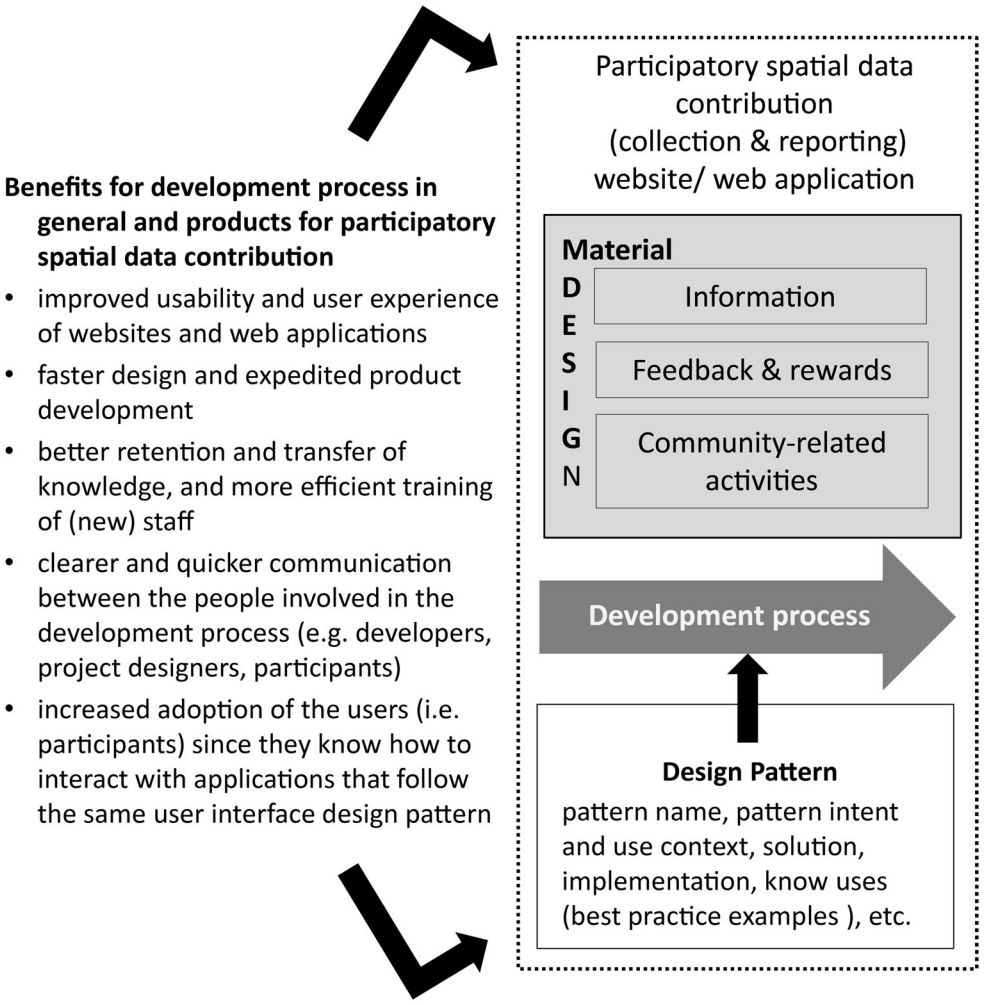

Figure 3 *Benefits of the approach of design patterns in the context of the development of geospatial participation Web sites (based on Pressman 2009; Morkes 2015; Brüning 2018).*

comprehensive learning from best practice examples and others' experiences. Figure 3 provides an overview of the advantages of using user interface design patterns for the development of Web sites and Web applications regarding participatory spatial data contribution.

Conclusion and Outlook

To fully benefit from participatory spatial data contribution, understanding and addressing the reasons why people take part in such activities are crucial aspects. Even though literature provides extensive background on why people participate and how to address their motivations, the question remains as to what extent project designers actually take this into account. A questionnaire administered to project designers and an analysis of Web sites and Web applications revealed that motivational factors are considered important. This mainly refers to people's wish to learn and experience something new, to help, and to do something meaningful, however. Other categories of motivational factors (expressing and representing oneself, community-related activities, fun and excitement, work- and career-related aspects) are considered less important. Tools and techniques to address motivational factors are employed by the project designers to varying degrees. The most commonly used tools and techniques are those used to provide information, whereas others related to rewards and feedback, community-related activities, and design and materials are used less often. Here, the extent to which project designers pay attention to people's motivations in the context of their projects can be increased. To this end, participatory design and user interface design patterns are promising approaches, because these allow project designers to learn comprehensively about future participants and from

others' knowledge. Both approaches have challenges that need to be faced. For example, participatory design requires the use of tools and working materials that are suitable for laymen, and user interface design patterns addressing, in particular, participatory spatial data collection systems still need to be elaborated. Currently, they exist for Web map applications, social media, and gaming applications, which also provide guidance for the development of tools regarding participatory spatial data collection. Finally, the findings presented are applicable not only to spatial data contribution projects but to other participatory approaches. ■

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