



Master's Thesis

Tacit Knowledge Use in Spatial Planning via ICT

A Study into Digital Collection and Integration
Potential

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Master Thesis Geographical Information Management and Application

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Summary

With the start of the Environmental Planning Act trajectory in the Netherlands in 2019 new forms of public participation will be needed to provide for effective public engagement in an earlier stage of spatial planning. Locational and experiential knowledge owned by the public greatly contributes to improving the living environment. This knowledge is sometimes also referred to as tacit knowledge. Information and communication technologies have potential to collect tacit knowledge and integrate it with professional knowledge. Developments such as Web 2.0, PPGIS, SoftGIS, and Serious Gaming prove to be essential for this mainly deriving from their abilities to visualize complex information understandable by laypersons but also to process data input by citizens representing their contributory knowledge. Nevertheless, contemporary academic work concerning this topic is limited. This master thesis has attempted to create new knowledge towards better understanding of the abilities of ICT-tools and methods that can facilitate the collection of tacit knowledge and its integration with professional knowledge. Tacit knowledge collection via ICT-tools is possible but integrating it with professional knowledge remains somewhat unclear. Therefore, more research is necessary to continue creating knowledge of how full integration can be facilitated.

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Abbreviations Glossary

BAG	Basisregistratie Adressen en Gebouwen
CNA	Community Network Analysis
DMAMPO	Des Moines Area Metropolitan Planning Organization
DSO	Digitaal Stelsel Omgevingswet
EGG	Essex Government Group
EGSSSH	Erasmus Graduate School of Social Sciences and the Humanities
EPA	Environment and Planning Act
EV	Envision Victor
GIS	Geographical Information System
ICT	Information and Communication Technology
KM	Knowlegde Management
MC-SDSS	Multi-Criteria Spatial Decision Support System
MIE	Ministry of Infrastructure and Environment
MEV	Municipal Environment Vision
NRVPDC	New River Valley Planning District Commission
PGIS	Participatory Geographical Information System
PPGIS	Public Participation Geographical Information System
PSS	Planning Support System
RWS	Rijkswaterstaat
SaaS	Software as a Service
SDI	Spatial Data Infrastructure
SoftGIS	Soft Geographical Information System
VGI	Volunteered Geographical Information
VNG	Vereniging Nederlandse Gemeenten
VNO NCW	Verbond Nederlandse Ondernemingen / Nederlands Christelijk Werkgeversverbond
WPPGIS	Web-based Public Participation Geographical Information System
URI	Uniform Resource Identifier

Introduction

In the year of 2019 De Omgevingswet, a new national law concerning urban and spatial development in the Netherlands, will come into force. With this law, the Dutch national government wants to simplify current legislation by combining twenty-six existing laws into one comprehensive law. Minister Schultz van Haegen wrote in a policy paper (Ministry of Infrastructure and the Environment, 2011) that the Omgevingswet (translated: Environment and Planning Act) creates serious room for public participation in spatial development. Fitting public participation onto essential stages of urban and spatial planning can greatly improve the transparency and approval of decision-making. Participation will be obligatory in project decisions and governmental authorities must indicate how they have involved civilians, companies, and other actors when establishing environment visions and plans (Ministry of Infrastructure and the Environment, 2016a). Currently, all municipalities in The Netherlands are obligated to draft one or more territorial covering structure visions (Dutch: structuurvisie). These visions include strategic plans for environmental, infrastructural, and hydrological matters (VNG, n.d.). The arrival of the Gemeentelijke Omgevingsvisie (translated: Municipal Environmental Vision, MEV) will integrate all these strategic visions into one coherent vision, in line with the Environment and Planning Act (EPA).

The MEV will become the administrative tool for Dutch municipalities to make holistic environment plans. However, some scepticism exists regarding the way the law can be implemented in the Dutch society. In order to anticipate problems concerning the implementation of MEV and to get used to the new administrative instruments, an initiative was undertaken by the Ministry of Infrastructure and Environment (MIE) to experiment with pilot studies. These pilots were conducted by several provincial and municipal governments in The Netherlands. Professionals active in different administrative bodies and urban planning advisors cooperated to obtain new knowledge and experience regarding the implementation of the Environment and Planning Act. On January 4th of 2016, the MIE published a report about the results of the pilots conducted. Conclusions regarding the participative successes of the pilot were semi-positive. In general, the pilots weren't ready to implement broad participation. Nevertheless, the same broadly oriented participation was acknowledged but is still in the process of translating it into something that can become an integral and effective part of the MEV (Ministry of Infrastructure and the Environment, 2016b). Many methods to improve participation were used in the pilots, including think tanks and focus groups, and were supported by inter alia websites, graphical presentations, and films. The report concluded that public participation in future MEVs can be best supported with receptive governmental planning bodies and professionals that maintain an open attitude towards participatory initiatives. Nevertheless, no real concrete strategies or instruments have been put across that are expected to use the knowledge of the public in an effective way. Unsurprisingly, the desired level of public participation wasn't reached with any implementable or executable methods for Dutch municipalities. Traditional means of engaging the public in spatial and urban planning have been to the subject of some criticism. Their ability to provide useful data originating from the public sphere and exchange ideas has been deemed insufficient by some researchers (Bugs, Granell, Fonts, Huerta, & Painho, 2010). Moreover, planning bodies and institutions have paid to little attention to the added value of planning support technologies such as Planning Support Systems (PSS) (Pelzer, Geertman, & van der Heijden, 2015). Nevertheless, they can play a crucial role in combining analytical and

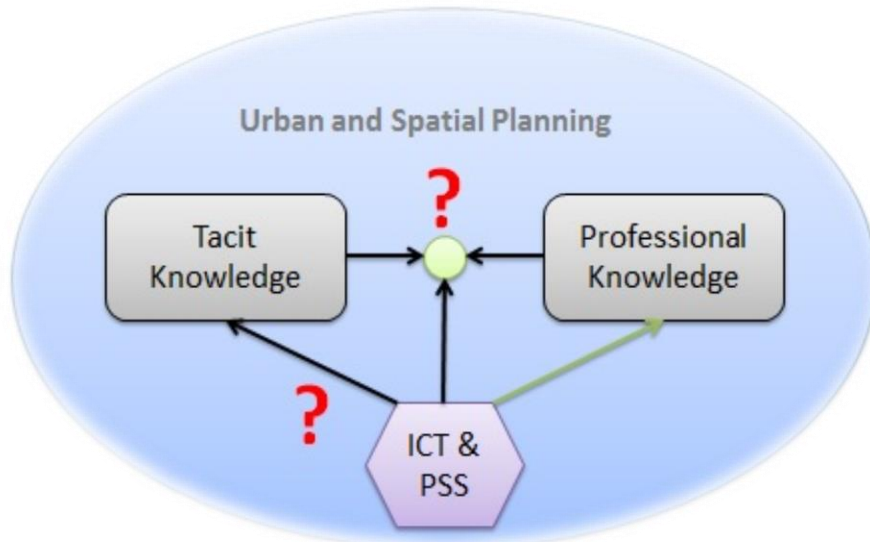
communicative approaches to planning. Furthermore, other information technologies (Hanzl, 2007) and social media tools such as Facebook (Casteltrione, 2016; Evans-Cowley, 2010) have the potential to support participatory planning processes by providing communication platforms, allowing distant contacts, supporting engagement with audiences that are traditionally less active in such processes, and in general improving sustainable urban planning (Alenka Poplin, Corso Pereira, & Furtado Rocha, 2013).

Developing effective public participation still seems to hold some serious difficulties within The Netherlands, as stated by the VNO NCW (2016) a Dutch national business organization committed to improving the Dutch business climate. This is especially true when it comes to creating a representative composition of participants. The association of Dutch municipalities (VNG) states that civil participation cannot be expected to be self-evident (2016). The government needs to be clear in its communication and should be focused on giving the citizens the opportunity to get involved at the right time and making them aware of when they can deliver input and of what happens with it. Although the timing and the clarity of participation seem to be essential, not much is stated about how the knowledge of the public actually gets obtained and how it can effectively be combined with professional knowledge. Knowledge of the public can be seen as specific local knowledge that is obtained through living in their communal environment (Bugs et al., 2010; Rantanen & Kahila, 2009a). Tacit knowledge is a concept that is often associated with this form of knowledge and has been promoted by some academic authors as useful or even essential to good urban and planning (Frantzeskaki & Kabisch, 2016; Hanzl, 2007; Rubenstein-Montano, 2000). Since it is a less fluid form of knowledge than professional and scientific knowledge, the dissemination of tacit knowledge can be a sophisticated undertaking. This is mainly due to the fact that tacit knowledge is of a more qualitative nature and consists out of local experiences, feelings, visions and ideas (Panahi, Watson, & Partridge, 2013; Polanyi, 1966). Chapter 4 will further elaborate on this concept and will formulate a definition that will be used in this thesis. In order to collect such knowledge and use it in smart way in urban planning processes, a better understanding of the nature of tacit knowledge is needed. This does not only raise the question of how communication and information technology can collect tacit knowledge, but since it is being used for urban planning it will also have to be integrated to some extent with other kinds of knowledge. This thesis will therefore look into existing ICT communication technologies used in the planning environment (or technologies that hold considerable potential for being used for planning processes) and will further study the complex nature of tacit knowledge. A better understanding of what tacit knowledge is, how it relates to other kinds of knowledge, and how it can subsequently be used alongside or integrated with professional knowledge can contribute to contemporary insights in smart participatory urban planning.

1. Research Identification

The use of Information and Communication Technology (ICT) and in particular PSS to disseminate, communicate, and analyze professional knowledge is a relatively well-inquired field of study (Stan Geertman, 2016). That said, the potential role of such technologies in communicating tacit knowledge is a more unknown territory. This supposedly neglected subject in current academic research will be the focus of this master's thesis. Figure 1 displays a visualization of the current gap in urban planning studies:

Figure 1: Contemporary hiatus in academic literature visualized



Understanding the role that ICT can play in the sphere of urban planning when using tacit knowledge can be of great value in improving contemporary urban and environmental planning. The main objectives of this thesis are:

- 1) Acquiring more insight into the abilities of ICT to collect tacit knowledge.
- 2) Acquiring more insight into how tacit knowledge can be integrated with and used alongside professional knowledge by the use of ICT for urban planning.

Gaining these new insights will be attempted by looking into existing technologies in use and assessing their abilities to transfer tacit knowledge. In addition, pioneers in the field of spatial development using innovative technologies will be discussed in order to find out what new developments can be expected. These findings will be applied to the conducted extensive theoretical review and a general assessment will be made to define which technologies actually hold the potential of disseminating tacit knowledge between the public sphere and the of the professional spatial planner in such a fashion that it can contribute to modern urban planning. This means that the proposed technologies understand the complexity of tacit knowledge and have found a way of collecting it and preserving its qualitative nature. Ultimately, this thesis will answer the following research questions:

Main research question:

How can information and communication technologies such as PSS and GIS help collect tacit knowledge and integrate it with professional knowledge to use it in spatial planning?

Sub-questions:

- Which ICT-tools and what methods can help to collect tacit knowledge?
- How can tacit knowledge be integrated with professional knowledge in spatial planning?
- Which ICT-tools and methods can be used for the integration of tacit and professional knowledge?

The thesis will be of a partly theoretical and partly explorative nature. Since academic work suggests that more research is needed to effectively understand what the dynamics of tacit knowledge are and how they relate to other forms of knowledge that play a role in urban planning processes, this explorative and qualitative research is part of the first steps to realize effective tacit knowledge usage in urban planning.

2. Scope of Research

Since this thesis consists of a theoretical and explorative study (which will be further explained in the methodology chapter), its conclusions will be relevant for the academic and scientific sphere of planning. It will be an addition to existing insights with an attempt to specify which technologies hold the most potential of collecting tacit knowledge that is relevant for planning processes. Additionally, this thesis will look into the possibilities of knowledge integration and the role ICT can play in this integration process. Currently, few to no initiatives have been undertaken that have acknowledged the essential role tacit knowledge can play in a transparent, democratic, effective, and efficient urban planning process. This complies with the fact that current academic work on this topic is not rich or extensive enough to create a real understanding of the complexities of knowledge, specifically tacit knowledge, and how knowledge interactions work within the urban planning sphere (Brown & Kytä, 2014; Rantanen & Kahila, 2009b; Raymond et al., 2010). Therefore, this thesis will attempt to enrich the existing literature and serve as a stepping stone to further more empirical inquiry. Nevertheless, since this thesis starts from a geo-technological approach, it will offer some insight into the capabilities technologies should have when they are occupied with the collection and dissemination of tacit knowledge and its integration with professional knowledge. These insights can function as advisory for Dutch governmental bodies and societal science institutes regarding what features of contemporary PSS, Public Participation Geographical Information Systems (PPGIS), and geoICT show potential for implementing tacit knowledge more effectively and efficiently in planning processes and decision-making.

As noted, the understanding of effective ways of how to use ICT, and in particular Geographical Information Systems (GIS) and PSS, for using professional knowledge in planning processes has been notably improved in the last decade. Therefore, the focus of this thesis will not be put on this subject. This is not to say that this thesis suggests that further research to this topic is unnecessary. On the contrary; the dynamic topic of PSS and communicative technology to improve urban planning is anything but finished and requires further attention (Geertman, 2016). This thesis will only argue that the gap between understanding how ICT and PSS can improve the use of professional knowledge in urban planning processes on the one hand, and how it can help collect, integrate and use tacit knowledge on the other hand, is too big. This supports the urgency of more elaborate research to the topic of tacit knowledge usage in urban planning.

Public participation as a subject is naturally connected to the study of tacit knowledge. When tacit knowledge is used in planning processes, the two are inherently part of the same process. That said, this thesis will not focus on what technologies provide for the optimal participation process in terms of equal inclusiveness and quantitative accessibility. Participation is complex and cannot be approached as a straightforward process wherein connecting to the public is the whole story. The democratic principles residing in participatory processes, like that of urban planning, have been extensively discussed both in the scientific/professional environment and in the public and political sphere. Nevertheless, only little attention will be paid to the socio-economic and democratic dynamics behind public participation in this thesis. The central focus will be the topic of technologies that can be used in participatory urban planning and that have the ability to collect, integrate and apply tacit knowledge. However, since both topics are inherently related with socio-economic and democratic issues, they will sometimes be

complementary to arguments for using particular tools and techniques. A next step to this study can be a further investigation into the range of different participatory strategies and the social dynamics behind the use of tacit knowledge supporting technologies. This thesis does however acknowledge that using digital technology for supporting participation in and of itself can create an exclusive participatory process to a considerable extent. GIS functionalities have been found to be difficult to use (Nuojuua, 2010) and some forms of e-governance such as Volunteered Geographical Information (VGI) tools only comprise expressed needs for those with advantageous accessibility, which often excludes marginalized groups (Pfeffer, Martinez, Baud, & Sridharan, 2011). However, making technologies like GIS and Web 2.0 GIS-based applications more user-friendly and accessible to the public does stimulate the democratization of technologies and geographical information as well (Morgado, Gomes, & Costa, 2014). Indeed, web-based applications may empower citizens to participate and may give voice to groups of potential participants that are typically excluded from conventional participatory processes (Narooie, 2014). The discussion of democratizing factors or, in opposition, marginalizing factors is by any means an interesting and useful one but does not fall within the scope of this thesis. Understanding the influence on socio-democratic structures when collecting tacit knowledge through distinct digital means, should be preceded by the process of determining whether such means and tools have the ability to do so in the first place.

Although the relationship between tacit knowledge and other kinds of knowledge will be investigated, as will subsequently, the way in which they can be integrated to form useful and rich information for planning processes, further research into to the use of knowledge in planning processes and management will not be conducted. Studies into what knowledge actually entails, how comes about, and which epistemological and ontological discourses can structure knowledge and knowledge claims, have been part of many long discussions in psychological and social sciences. That said, the basic conceptions of knowledge and knowledge claims will be discussed in order to understand the basic definition of tacit knowledge from a scientific point of view. In conclusion, two conditions apply the findings of this thesis with regard to its scientific and societal relevance. The findings will:

- A.** Contribute to the existing body of scientific and academic knowledge in which a hiatus can be identified concerning the use of PSS, GIS, and other ICT-tools for collecting and integrating tacit knowledge for spatial planning purposes.
- B.** Contribute to the process of finding answers to the EPA's need for innovative public engagement methods in Dutch spatial planning.

3. Constraints of Research

This study concerns a topic that has received little attention from planning and knowledge scientists. Therefore the amount of written academic work treating this topic is limited. This means that the theoretical foundation of this thesis is mostly a synthesis of different themes relevant for this thesis and cannot be built upon many theoretical works that specifically deal with the possibilities of ICT and PSS in collecting, integrating and using tacit knowledge in urban planning. This thesis will attempt to provide a new body of knowledge for this field of study and contribute to abating the hiatus in contemporary academic work.

The context of this thesis is one of inquiring into the possibilities of information and communication technologies for disseminating tacit knowledge, for which the Dutch planning environment currently has no real answers. An implementable guideline containing real technologic functionalities that directly fits in with the Dutch planning system is not the final objective of this study. In and on itself, the thesis will be an extensive research that must be accompanied by a cultural and administrative transition in the Dutch planning system. The outcome of this study will be an explorative insight into of how communicative technology as a medium is able to transfer tacit knowledge. When the right features of technology have been identified, a next step will be to investigate how such features can be implemented in a particular planning environment such as that of the Netherlands. This will entail a complex and extensive process of investigating the data format to be used, the servers to be used to provide platforms or media for citizens to share their input, the best means to store and maintain this data, the standards of data to be used, and the best means to translate integrated knowledge in to applicable spatial and environmental policies. Although already extensive, this research only focuses on the technological dimension. The whole story consists of more than that. Technological innovation only works when the organizational infrastructure facilitates its use in an efficient and effective manner. Inevitably, considerable changes to the current planning system in the Netherlands will be needed. The necessary technological innovations in the system, along with organizational reforms, will have to be the subject of future research that elaborates on this and on other relevant scientific work. This thesis will provide an exploratory introduction to the topic, but will not provide new insights for organizational reforms or any step-by-step plan for technological innovation in these organizations.

The use of ICT-based tool such as PSS in urban planning is in general a fairly new endeavour. With the emergence of studies into topics like sustainable urbanization and “Smart Cities”, ICT and other telecommunications have been introduced to post-industrial cities of the 21st century (Battarra, Gargiulo, Pappalardo, Boiano, & Oliva, 2016). So far the focus has been put, as mentioned, on the collection and dissemination of professional and scientific knowledge. This means that the use of tacit knowledge, a topic lagged behind the use of professional knowledge, is practically a brand new endeavour in studies into PSS and urban planning supporting information technologies. This puts a strain on the amount of existing cases that can be analysed and evaluated. This absence of relevant cases further emphasizes the need for further research.

4. Theoretical Research

As stated above, the amount of written works concerning the benefits of using ICT (such a PSS or GIS) for collecting and integrating tacit knowledge is fairly limited. Nevertheless, before getting to this part, the main concepts investigated in this thesis need to be addressed individually. The theoretical framework will consider several approaches to the concept of tacit knowledge. Research into the value and content of tacit knowledge and into how it gets obtained by the initial owner has been conducted by different social and planning scientists. Some key theories will be elaborated upon and linked to each other. Subsequently, the relationship between tacit knowledge and professional knowledge will be investigated. How do they relate? How can they be combined and used alongside each other in the field of urban planning? The theoretical framework will conclude with a section addressing the potential of ICT-based technologies when using tacit knowledge. First, an introduction to the central concept of tacit knowledge will be provided. Although it is a fairly old concept, real investigation into the subject of tacit knowledge and its characteristics has been sparse in the scientific field. When the nature of the concept has been elucidated, this chapter will proceed to connect tacit knowledge with professional knowledge and other forms of codified and formal knowledge. Crucial to this is an understanding of how they can interact and be combined, specifically in the field of urban and spatial planning. Finally, the technological aspect of this thesis will be integrated in this theoretical framework by looking into literature written about the potential of using ICT (including online social media) in the endeavour of, firstly, collecting tacit knowledge, and secondly, combining it with other forms of knowledge in urban and spatial planning processes.

Throughout the theoretical framework, the concept of spatial planning will be used interchangeably with that of urban and environmental planning. Although it can be argued that some nuanced differences exist between the different terms, describing these differences can be an extensive enterprise on its own. This thesis will approach them as substantively equal concepts. The concept of tacit knowledge can also be interpreted in different ways and interchanged with other concepts. The concept of tacit knowledge will be elaborated upon by defining its meaning through different approaches. This thesis will consider tacit knowledge to be unwritten knowledge owned by the public as being a counterpart to other codified kinds of knowledge often held by professionals. This thesis also acknowledges that tacit knowledge is not exclusively present in the domain of the public but is also present in professional contexts. Nevertheless, tacit knowledge outside the domain of the public and irrelevant for improving the living environment will not be discussed any further. The terms of lay, local, and experiential knowledge will be approached as concepts that embody content similar to publicly owned tacit knowledge and will therefore be treated in this theoretical section as concepts that are interchangeable to a certain extent.

4.1 Tacit Knowledge

Several definitions have been put forward with regard to tacit knowledge. Michael Polanyi was the first to use the concept. In his assertion comes the notion that “we can know more than we can tell” (Polanyi, 1966). Tacit knowledge consisting of tradition, inherited practices, implied values, and prejudices, and is a crucial part of scientific knowledge. Nevertheless, it is not articulated in any written works or publications. It relates more to a dependency on the holder and is difficult to communicate. Often it is

deeply rooted in a person's experience or unique practice. Panahi et al. ascribe several terms to tacit knowledge that touch on the nature of its content. Examples are "hands-on experience", "rules of thumb", "gut feeling", and "emotions" (Panahi et al., 2013). Its counter concepts are codified and explicit knowledge, though some see this opposition as two extreme ends on a continuous scale. Leonard and Sensiper (1998) approach knowledge as being inherently located on this spectrum. At one end, knowledge is completely tacit and is therefore semiconscious to unconscious knowledge stored in people's head. At the other end, knowledge is completely explicit meaning it is fully codified, structured, and accessible to people other than the one originally holding the knowledge. Tacit elements of knowledge are subjective, experiential, and created in the "here and now" whereas explicit elements are objective, rational, and created in the "then and there". Instead of being directly transmittable know-how, tacit knowledge is more a disembodied know-how acquired via the informal take-up of learned behavior and procedures (Howells, 2002). This can, as Leonard and Sensiper agree, be an unconscious process of learning that is also referred to as 'subception'. Tacit knowledge is often linked with the concept of local knowledge, since it is a very specifically detailed knowledge that is to a great extent only applicable to the context from which it originates. Tacit local knowledge is deeply personal, intuitional, and often considered soft (Rantanen & Kahila, 2009a).

A more linguistic study conducted by Martin Davies (2015) describes the notion of tacit knowledge in an insightful way. Since tacit knowledge resides more in verbal communication and not in any codified or written form, a linguistic approach is very helpful in describing the sense of what 'tacit' exactly means. Davies (2015) states that a native speaker of a language has s knowledge of the grammar used in his language and is able to use it correctly. At the same time, verbally expressing the rules or principles of the grammar is usually difficult or even impossible to the speaker. The rules are therefore part of the speaker's tacit knowledge, obtained through the use of the language in his everyday communication. Tacit knowledge has attracted more attention in the last decades, specifically in the area of management research (McIver, Lengnick-Hall, & Ramachandran, 2015). Here it is seen, continuing on earlier work by Nonaka and Takeuchi (Nonaka & Takeuchi, 1995), as the counterpart of explicit knowledge in that both are part of an iterative process consisting of four different modes: socialization, externalization, combination, and internalization. The first three steps that are of interest to this thesis since they deal with the sharing, transformation, and combination of tacit knowledge with other forms of knowledge. Nevertheless, McIver et al. (2015) stress that the tacit component of knowledge, including its learnability, is a unique phenomenon and is still not well understood. A link between Polanyi's original theory and contemporary studies by psychology scholars into this distinctive personal kind of knowledge is needed.

Thus, tacit knowledge can be seen as something that is part of an individual's experience and is not as fluid as forms of codified knowledge, like scientific knowledge. Nevertheless, since it is inherently embedded in the experience of the direct environment, it promotes itself as useful knowledge for planning that environment:

"The changes in real urban environment are preceded by creation of the coherent vision of what is planned. Therefore, the city representation in the citizens' minds plays an essential role in reshaping real space" (Hanzl, 2007; p289)

Following on the characteristics of tacit knowledge mentioned above, the definition used in this thesis will be:

A form of semiconscious to unconscious knowledge that is characterized by its personal and local content and its difficulty to be articulated and therefore communicated, and that can be seen as an opposite form to explicit and codified knowledge.

Tacit knowledge can be owned by anyone, but this thesis will focus on tacit knowledge held by the public/non-professionals that can, when collected, contribute to urban and spatial planning.

Tacit (local) knowledge is produced in diverse interactions, and therefore there is a need to find new ways to collect and connect this knowledge (Rantanen & Kahila, 2009a). Though perceived as a less fluid form of knowledge, dispersal and distribution of tacit knowledge does happen. Zhu et al. (2016) compare its dispersal with the behaviour of infectious diseases. Contact made by a susceptible individual with the owner of the knowledge can cause a transmission of the knowledge to occur. Direct contact is therefore essential in the transmission process.

4.2 Bridging Tacit Knowledge with Professional Knowledge in Urban Planning

The potential of tacit knowledge for better urban planning can be easily argued by noting that the people living in a specific environment own the true experience of local dynamics and needs. Indeed, good regional planning includes confronting all knowledge claims, positions, and interests, in order to create a cohesive story (Hayer, van 't Klooster, & Grijzen, 2010). Inhabitants know the reality and the problems around them better than anyone else (Bugs et al., 2010). Actors living in a community accumulate knowledge in their domain through continuous interaction and the development of a shared practice (Rantanen & Kahila, 2009a). Nevertheless, collecting tacit knowledge for planning purposes is all but easy, since it consists of experience, opinions, and emotions residing in the minds of the people. These experiences, opinions, and emotions need to be expressed first. Secondly, they need to be heard. Thirdly, they need to be transformed into a state that can be seen and accepted as being knowledge, like scientific and professional knowledge. Yvonne Rydin is an important contributor to recent theory that deals with the complexity of what knowledge actually is, and how different kinds of knowledge can contribute to the field of planning. Knowledge is essential for planning, since it embodies that very essence of planning:

“The use of knowledge is a central element in achieving change through planning. Indeed the very rationale for planning within modernism is that knowledge can be harnessed through planning to achieve positive change.”(Rydin, 2007; p 53)

Rydin argues that knowledge claims, originating from insights in causal relationships, are an important part of planning but should be approached as inherently multiple that does not limit itself to the domain of the expert (Rydin, 2007). Rather, knowledge is associated with a variety of actors in a variety of social locations. Rydin also puts forth the accompanying difficulties arising with the use of lay knowledge, as opposed to expert knowledge. Firstly, in processes such as planning, specific types of knowledge are required, but the process should be able to handle multiple kinds of knowledges when tacit or lay knowledge is introduced. Secondly, an engagement between lay and expert involves translation. And thirdly, a space for testing knowledge claims, such as the claim that lay knowledge should be acknowledged in planning processes, is needed before it is fit to be used in professional environments. She concludes that a new approach to the value of knowledge is needed alongside the value of involving different stakeholders, making clear that effectively involving public or non-professional actors in planning processes is only half the job. Frantzeskaki and Kabisch (2016) agree on the need for different kinds of knowledge by engaging with different stakeholders, but approach the process of knowledge integration as knowledge co-production. Conditions that influence processes of co-production are an open process for sharing and learning, the inclusion of different types of knowledge, and legitimation of knowledge.

In another perspective to knowledge, Jan Lambooy (2002) argues that knowledge is acquired through an interactive process of learning. It is based on the cognitive competencies of the actor, making knowledge both person-specific and context-specific. Two different types of knowledge are put forward by Lambooy, namely codified and tacit knowledge. Whereas the former can be transferred or sold, tacit knowledge has not (yet) been articulated by the owner into a transferable status. That said, tacit knowledge can be developed into a codified form through research when 'skills', 'feelings', or 'capabilities' are formalized or codified into rules. The reverse is also possible when codified knowledge becomes embedded in behaviour and is subsequently implemented in new situations. Communicating tacit knowledge is possible without codifying it, but due to its contextual non-verbal nature, it relies on performance and imitation rather than on telling and understanding (Davies, 2015).

Tennøy et al. (2016) also argue that different kinds of knowledge can contribute to planning, including lay knowledge. In response to Rydin's (2007) elaborate theory on knowledge claims, Tennøy et al. (2016) acknowledge that testing lay knowledge is important before it can be used in planning processes and combined with more formal legitimate knowledge that has more substantiated knowledge claims. Rubenstein-Montano (2000) confirms the importance of tacit knowledge in urban planning by stating that true knowledge management extends beyond the technical system and should encompass both explicit and tacit knowledge. However, tacit or lay knowledge in the field of environmental planning can overlap with expert or scientific knowledge (Raymond et al., 2010), to the same extent that other categories can overlap. Rantanen and Kahila (Rantanen & Kahila, 2009a) approach urban planning as a knowledge-building process on itself. Knowledge-building recognizes the importance of creating new knowledge, which occurs when communities learn to assimilate their ideas into larger contexts. The integration of different kinds of knowledge categories in urban planning is a process that heavily depends on flexibility. Raymond et al. (2010) argue that the integration of scientific and local/tacit knowledge requires dialogue and deliberation. Such processes can be influenced by differences in world

views, differences in institutional power and control over resources, and the changes in perception of the benefits of a project or planning operation. Identification of knowledge is paramount when integration is being executed in order to establish a semantical overview. Otherwise, knowledge will be based on every actor's own representation.

This, the importance of including tacit knowledge in planning processes and combining it with other forms of knowledge is apparent. Nevertheless, combining lay knowledge with professional or scientific knowledge is traditionally problematic. Pelzer, et al. (2015) see storytelling as a potential way of stimulating a cohesion of knowledge. Storytelling comes from the idea of deliberative and discursive planning practices and is about the integrative development of both process and content. Storytelling does not focus on truth claims but rather develops a cohesive story about how the spatial future might unfold as a result of both planning interventions and autonomous trends.

Tacit knowledge that resides in the minds and experiences of the public is, as has been put forth above, considered by several authors to be an essential aspect of modern urban planning. Nevertheless, identification and testing of the knowledge are necessary, as argued by several authors, before it can be properly interpreted and integrated into other kinds of knowledge usable for urban planning.

4.3 Using ICT for Collecting and Integrating Tacit Knowledge

Now a conceptualization of tacit knowledge is offered, both of the individual concept and of its relation to professional knowledge, this thesis will continue by theorizing how such knowledge can be collected by the use of ICT, and, more importantly, how it can subsequently be integrated with professional knowledge.

Although being a broad concept, ICT will be approached evenly broad in this thesis. All digital media and other means of digital communication that disseminate information and, potentially, different kinds of knowledge from one person to another will be relevant for investigation. This open attitude and broad focus is necessary since every digital means is approached as being a potential instrument for disseminating tacit knowledge. ICT has taken on a key role in contemporary sustainable urban planning. With the emergence of the "Smart" label, ICTs have given many opportunities to create networks and collect a large amount of data that can constantly be updated, aimed at improving urban planning (Battarra et al., 2016). Furthermore, ICT can help formulate demand and needs of urban stakeholders and can, therefore, be part of the effort of improving urban governance (Sutriadi & Wulandari, 2014). Using ICT for improving the living environment by the use of geo-referenced data is the pinnacle of Planning Support Systems. A good definition of Planning Support Systems is given by Geertman, Toppen, and Stillwell (2013):

"Planning Support Systems (PSS) are geo-information-technology-based instruments that are dedicated to supporting those involved in planning in the performance of their specific tasks."(Geertman et al. 2013; p1)

PSS can be seen as geo-ICT tools designed for spatial planning and can play a crucial role in combining analytical and communicative approaches to planning (Pelzer et al., 2015). Its software enables displaying data in forms that are easy to understand for a layperson (Hanzl, 2007).

Using tacit knowledge for urban planning processes inherently involves civil participation. The concept of using information systems to collect subjective experience owned by civilians is, as noted, not as well developed as the use of information systems collecting professional knowledge. Nevertheless, more and more research is being conducted towards new technologies and geographical information systems (GIS) play an important role in these studies. This has given rise to the concept of public participation GIS (PPGIS). A PPGIS can be defined as a part of geographic information science that focuses on ways the public uses various forms of geospatial technologies to participate in public processes (Greg Brown & Kyttä, 2014). PPGIS is the specific element of PSS that is engaged with integrating empirical knowledge and experiential knowledge in planning support and serves data with spatial reference to a wide audience via the internet (Greg Brown & Kyttä, 2014; Hanzl, 2007). Its purpose is to gather local and lay knowledge, which can be found in the form of resident's illustrated visualizations, mental maps, photos, narratives, and testimonials. This collected local (tacit) knowledge can subsequently be used by planning professionals. Although Pelzer et al. (2015) argue that PSS should focus more on experiential knowledge since participatory GIS holds promising potential, it also helps planning processes regarding knowledge claim testing and storytelling by:

- distinguishing sense from nonsense
- developing a shared visual or spatial language
- learning from the causal dynamics of the applied models
- providing a more structured and efficient approach

Moreover, traditional GIS capabilities have received some criticism based on the limited ability to engage the public, provide useful data, and stimulate the exchange of ideas (Bugs et al., 2010). PPGIS, on the other hand, holds the potential to enable more interactive models. It contributes as an addition to the toolbox of participatory planning methods but offers capabilities of reaching a potentially larger number of participants that are hard to reach with more traditional methods. Brown & Kyttä (2014) note that some critical remarks about PPGIS exist as well, particularly, concerning the lack of evidence to support that PPGIS has actually influenced land use decisions. This can jeopardize the will of participants to further participate since their role is seen as too limited. Therefore, existing power structures are required to hold an accepting attitude towards tacit knowledge.

Alongside the emergence of PPGIS came the development of Web 2.0 technologies. These technologies are characterized by the fact that they allow users to interact and collaborate with each other via virtual communities (Shih, 2011). Two important features that can be assigned to Web 2.0 technologies are micro-content and social media/software (Alexander, 2006). Micro-content can be approached as little 'chunks' of information containing ideas or concepts that are meant to be reused in multiple ways and places. Social software pertains to the transition from traditional websites designed around computer hierarchies of directory trees to websites designed around people. Part of this new digital technological development was the appearance of the concepts of Neogeography and Voluntary GIS (Bugs et al.,

2010). Contrary to the existing technologies, these new developments started providing the capabilities for online techniques to enable the user to share their own personal spatially referenced data. Like PPGIS, they have also been introduced in participatory planning strategies to help develop alternative ways of public participation. Different from traditional meetings held for public engagement, they promote communication among users 24/7 and do this, most importantly, vertically with decision-makers in a more interactive and straightforward way.

Some research has been carried out into potential means to facilitate the collection or dissemination of tacit knowledge. Zhu et al. (2016) conducted a research concerning the spread of tacit knowledge between employees within an organization. Although being a different environment than that of urban planning, some conclusions were made that were acknowledged to be significant to knowledge management. One of the conclusions was that it is more efficient to improve the employee's capacity to distribute tacit knowledge through online social networks than to spread it through face-to-face physical contact, crediting the possibilities of online communication. Elaborating on this, the role of social networking has also been investigated in relevance to public participation processes. As it emerged as being a key tool in promoting civil participation in planning processes it was found that Facebook has the ability to further increase political activity of active citizens (Casteltrione, 2016). Nevertheless, Facebook users with limited levels of political participation can also be stimulated by reducing thresholds of participation opportunities by using low-threshold and user-friendly communication.

Rantanen and Kahila (2009) promote a Soft-GIS approach to tacit knowledge collection, pointing to the use of soft knowledge in spatial analysis. The approach entails internet-based methods that are developed to support the use of local knowledge in research, communicative planning practices, and long-span development processes. They argue that local knowledge (tacit knowledge) can be managed in two different ways: whereas a SoftGIS Research approach concentrates on GIS and other quantitative techniques, the Development Forum approach functions as an open collaborative learning environment. In order to communicate and use tacit knowledge, they continue, it must undergo a process - collaborative, scientific or other - in which it is analyzed and formed so it can subsequently be expressed, discussed and processed further.

Digital means (such as social media) have so far been put forth as potentially effective instruments for collecting tacit knowledge. Nevertheless, some criticism concerning the online digital environment has been expressed as well. Virtual space does not guarantee democratic and rational discourse, nor does it guarantee a sustainable public sphere (A Poplin, Pereira, & Rocha, 2013). Moreover, whereas some groups have adapted rapidly to online environments, other have not. This has resulted in what is called digital inequality, which can be influenced by race and ethnicity, gender, and parental educational background (Evans-Cowley, 2010). Gottwald et al. (2016) state that older adults are particularly under threat of being socially excluded and should be specifically targeted in scientific research and surveys into PPGIS. Equal participation is a complex endeavour and therefore, Evans-Cowley (2010) argues, planners should regard online social networks as one more "tool" in the "participatory toolbox".

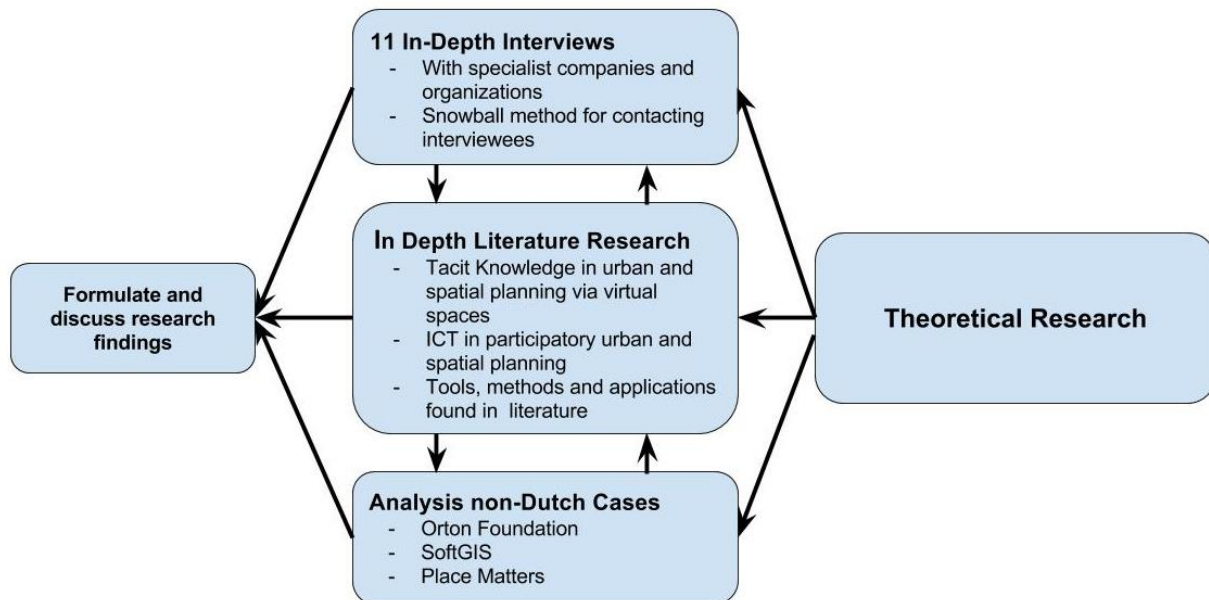
This chapter has provided a definition of tacit knowledge based on existing theoretical approaches to the concept, exploring its characteristics. This definition will be used for the remainder of this thesis, but it

should be noted that the words experiential, local, and lay, when used as adjectives to knowledge, cover similar contents and have been used by many authors as related concepts. In addition, the importance of tacit knowledge for spatial planning has been made clear, but translation is needed when it is to be used alongside professional knowledge, such as used in spatial planning processes. Furthermore, the role that ICT can play, such as GIS and PSS, has been explored. The emergence of Web 2.0 technologies, PPGIS, and SoftGIS provide potential answers to limitations of traditional GIS applications for collecting tacit knowledge.

5. Methodology

This chapter will provide the methodological steps that will be taken in order to formulate answers to the research questions. As noted before, this thesis will conduct a research that is based upon a theoretical and explorative research. Additionally, eleven interviews will be conducted with pioneers in the field of Dutch innovative spatial planning, and three cases of non-Dutch innovative methods of tacit knowledge collection and integration will be evaluated. Figure 2 displays a conceptual model of the methodology that will be used in this thesis.

Figure 2: Conceptual Model of Methodology



5.1 General Theoretical Framework

The starting base of this methodology will be a general literature review (see chapter 4) that has attempted to provide more insight into several issues, namely: defining and formulating the characteristics of tacit knowledge, integration issues for tacit knowledge with forms of codified knowledge such as professional knowledge, the scientific notions concerning the use of ICT and PSS for collecting tacit knowledge, and the scientific notions concerning the use of ICT-tools for integrating tacit knowledge with other forms of knowledge. The outcome of this general literature study will provide for a theoretical basis that will support the subsequent steps of the thesis. Notably, its findings will be used to continue a more focused in-depth literature exploration in chapter 6.

5.2 In-Depth Literature Research

Simultaneously, alongside the interview conduction and analysis, an in-depth literature research has been carried out. In order to gain extensive knowledge of the possibilities that exist and have been studied regarding the dissemination of tacit knowledge through communication and (spatial) information technology, a more in-depth research of the literature is necessary. Although the specific topic of collecting, disseminating, and integrating tacit knowledge with the objective of using it for improving spatial development and better decision-making regarding urban planning is somewhat neglected in current research, studies that share relevant features are worth looking at. The very essence of this study is to find out how tacit knowledge in its complexity and characteristics can be understood in order to make it transferable. Its dissimilar nature to explicit knowledge, whose transferability is often well understood and easily dispersible through conventional and less complex media and communication technologies, demands an in-depth inquiry into how such knowledge can exist and behave in virtual spaces. Studies that inquire into the possibilities of collection and transferability, but that do not necessarily focus on how it can be implemented in spatial planning processes, can therefore be still relevant. They, too, share the objective of making tacit knowledge transferable or understanding which configuration of technology can or holds potential to facilitate this process. The objective of this 'in-depth' literature research, therefore, is to compose a framework synthesized from the collected literature that offers insight into how tacit knowledge can be collected and transferred digitally and can be used in processes of spatial and urban planning and participation. Inclusively, several articles containing evaluations and analysis of existing tools and application that are occupied with collecting and transferring tacit knowledge will be looked at. By doing so, some factors that have been concluded as essential for a successful implementation of tacit knowledge collection and dissemination through ICT, GIS and other systems can be identified.

Before accessing the academic literature databases a list of relevant concepts was compiled in order to create search queries. The concepts were chosen both for obvious reasons as well as on the basis of gained knowledge in the general literature research. The concept of tacit knowledge was considered the key concept and was subsequently combined with several sub-key concepts. The combination was then formulated in a query sentence. Two well-known databases of academic works and literature were accessed, namely Google Scholar and Science Direct. These were selected because of their great bodies of scientific content and because of access rights to the content. Table 1 presents a schematic overview of the used queries and found literature. The range of the queries was set to the time frame of 2007-2017. The reason for setting such a time frame is to filter out older academic work since its content will most likely be outdated due to rapid innovative development regarding GIS and ICT in the past decades. Since the subject of this thesis consists of many abbreviations such as GIS and ICT some queries were repeated with the abbreviated words fully written out. As is visible, some queries did not result in finding any relevant academic work. Other queries, however, were more effective, which resulted in a selection of 24 academic works:

Table 1: Search queries and found literature

Sub-key Concept	Queries	Science Direct	Google Scholar
VGI	<p>“Tacit Knowledge” AND VGI ; “Tacit knowledge” AND “Voluntary geographic* information”</p> <p>“Voluntary geographic information” AND “public participation”</p>	<p>Malecki (2016) <i>Real people, virtual places, and the spaces in between</i></p> <p>Crowe et al (2016) <i>Operationalizing urban resilience through a framework for adaptive co-management and design: Five experiments in urban planning practice and policy</i></p>	<p>Pfeffer et al (2011) <i>Knowledge production in urban governance systems through qualitative GIS</i></p> <p>Baud et al (2011) <i>Developing participatory spatial knowledge models in metropolitan governance networks for sustainable development: literature review:</i></p> <p>Ganapati (2010) <i>Using GIS to increase citizen engagement</i></p>
ICT/IT	<p>“Tacit knowledge” AND ICT</p> <p>“Tacit knowledge” AND “Information technology”</p>	<p>Al-Qdah & Salim (2013) <i>A Conceptual Framework for Managing Tacit Knowledge through ICT Perspective</i></p> <p>Al-ghamdi & Al-ghamdi (2015) <i>The Role of Virtual Communities of Practice in Knowledge Management Using Web 2.0</i></p>	<p>Panahi et al (2013) <i>Towards tacit knowledge sharing over social web tools</i></p> <p>Wu et al (2010) <i>Assessing the suitability of process and information technology in supporting tacit knowledge transfer</i></p> <p>Ehrensperger et al (2011) <i>Towards a Differentiated Assessment of Geographic Information Sciences for Sustainable Development</i></p>
PSS	<p>"Tacit knowledge" AND PSS"</p> <p>"Tacit knowledge" AND "planning support systems"</p> <p>"Tacit knowledge" AND "planning support systems" AND "public participation"</p>	<p><i>No literature obtained with this query</i></p>	<p>Simão et al (2009) <i>Web-based GIS for collaborative planning and public participation: An application to the strategic planning of wind farm sites</i></p> <p>Higgs et al (2008) <i>Using IT approaches to promote public participation in renewable energy planning: Prospects and challenges</i></p> <p>Pfeffer et al (2015) <i>Geo-Technologies for Spatial Knowledge; challenges for inclusive and sustainable urban development</i></p>
PPGIS	<p>"tacit knowledge" AND PPGIS</p> <p>"tacit knowledge "AND</p>	<p><i>No literature obtained with this query</i></p>	<p>Pfeffer et al (2012) <i>Participatory spatial knowledge management tools</i></p>

	<p>"public participation GIS"</p>		<p>Ertiö (2012) <i>M-participation: the emergence of participatory planning applications</i></p> <p>Brown et al (2008) <i>Public Participation GIS: A Method for Identifying Ecosystem Services</i></p> <p>Noujua (2010) <i>WebMapMedia: a map-based Web application for facilitating participation in spatial planning</i></p> <p>Narooie (2014) <i>Boosting Public Participation in Urban Planning through use of web GIS technology; a case study of Stockholm county</i></p> <p>Ertiö (2015) <i>Participatory Apps for Urban Planning—Space for Improvement</i></p> <p>Malinowski (2013) <i>Decision-making processes based on knowledge gained from spatial data</i></p> <p>Jankowski (2009) <i>Towards participatory geographic information systems for community-based environmental decision making</i></p>
<p>geolCT</p>	<p>"tacit knowledge" AND geo-ICT (ScienceDirect in: Environmental Science)</p> <p>"public participation" AND geo-ICT</p>	<p>Morgado et al (2014) <i>Competing visions? Simulating alternative coastal futures using a GISANN web application</i></p>	<p>Kurniawan & De Vries (2015) <i>The Contradictory Effects in Efficiency and Citizens' Participation when Employing Geo-ICT Apps within Local Government</i></p>

After the literature was collected, the works were analyzed for their content. This was done by systematically putting all relevant literature content in a spreadsheet in order to create an overview. The format of the spreadsheet is presented in figure 3. Every article is given a row with the columns displaying the information and content of the articles, categorized as follows: *author, title, year of publication, key words, abstract, introduction and goal, theory, methodology, results and evaluation, conclusion and discussion*. All 23 articles were studied extensively and relevant content was critically selected and put in the spreadsheet in the designated column. The found content is further evaluated in this document in three sections (see chapter 6).

Figure 3: Compacted spreadsheet format for every row (displayed example covers one row in the spreadsheet document)

Author(s)	Title	Year & Publication	Key words
Al-ghamdi, H.A.K. & Al-ghamdi, A.A.K.	The Role of Virtual Communities of Practice in Knowledge Management Using Web 2.0	Procedia Computer Science, 65 (2015) pp: 406-411	Tacit Knowledge; Web 2.0; Virtual Communities of Practice; Knowledge Management
Abstract		Intro/Goal	
<p>Despite the critical importance of Knowledge Management (KM) in helping organizations to improve performance and achieve the desired goals, the reality of the application of KM indicates that there are still plenty of obstacles in the way; most prominent of which are the difficulty of tacit KM, the poor cooperation and sharing in KM, and the difficulty of dealing with KM techniques. This paper aims to determine how to take advantage of the virtual communities of practice that employ Web 2.0 technologies to overcome these obstacles. Employing the descriptive analytical approach methodology based on theoretical analysis of literature, the results revealed that Web 2.0 technologies involve important applications in personal KM, supporting participation in participatory KM, in addition to supporting communication and interaction mechanisms. Moreover, results indicated that Web 2.0 based communities of practice plays major roles in capturing tacit knowledge, facilitating innovation, as well as knowledge sharing and collaboration.</p>		<p>There has been a vast array of modern trends in KM, such as increased dependence on information and communication technologies (Kidwell, Linde & Johnson, 2000: 28) which facilitated the processes of knowledge acquisition, representation, exchange, and sharing (Nath, 2012).</p> <p>the present paper aims to address the role that could be played by Web 2.0 based virtual communities of practice in KM of organizations</p>	
Theory		Methodology	
<p>Web 2.00 tools go further to enable participants in virtual communities of professional practice to share tacit knowledge, or that is being most applicable or of newsworthy nature (Richards, 2009).</p> <p>Therefore, it can be said that the use of the Web 2.0 tools in the context of virtual communities of practice would resolve one of the biggest challenges of KM; that is to deal with the tacit knowledge (Wegner, 2006; Nath, 2012).</p>		<p>descriptive analytical approach</p>	
Results/Evaluation		Conclusion/Discussion	
<p>- Traditional KM systems emphasis is limited to dealing with explicit knowledge, with clear deficiency in dealing with tacit knowledge, which is of great importance to improve performance in organizations.</p> <p>- Traditional approaches to KM do not help the use of knowledge (especially tacit knowledge) to facilitate access to innovative solutions to problems.</p>		<p>Virtual communities of practice can be defined as: "Groups of professionals brought together by shared goals and common concerns regarding participation, exchange, trading, organizing and management of their tacit and explicit knowledge in order to improve their professional performance, as well as the performance of their organizations as a whole. These communities are characterized by self-regulation. They rely on virtual space on the Internet, using social Web 2.0 tools, such as: social networks.</p> <p>One of the well-known methods for the management of tacit knowledge is the dialogue and interaction among individuals serving in the organization. In this respect, it is observed that virtual communities of practice that employ Web 2.0 would facilitate dialogue through social interactions.</p>	

5.3 Conduction of Open Depth Interviews with Key Knowledge Holders

Since this field of study has gained considerably little attention by academics and researchers as of yet, a qualitative investigation into current development is an appropriate way to do research, and interviewing promotes itself as a useful method to do qualitative research. Therefore, 11 in-depth interviews have been conducted. In order to gain some more inside information about innovative projects and ideas about this subject, pioneers in the field of spatial development have been consulted. This part of the thesis will focus on actors active within The Netherlands, in order to conduct face-to-face interviews. This phase of the thesis will embody the collection of knowledge owned by pioneers in the field of innovation in urban planning and development. This will be conducted by the use of open-ended

in-depth interviews, and the snowball method will be used. This means that new knowledge and contacts are obtained through initial interviewees. This method of interviewing is commonly used in qualitative research and is useful due to its flexible nature (Bryman, 2008) although some structure will be provided in the form of several pre-set interview questions. The format of an open-ended in-depth interview was selected because it creates room for the interviewee to provide information that was not anticipated or expected, which is likely to occur since they are expected to be knowledgeable in their field of profession. Table 2 shows the organizations that were consulted during the 11 in-depth interviews with a brief summary of their occupations and missions.

Table 2: Lists of approached organizations

Geonovum

A governmental foundation that collects knowledge concerning the use and dissemination of geo-information and has an extended network. Its goal is to improve government's use of geo-information by improving accessibility to geo-information and standardizing it with other kinds of data.

Kadaster

An independent governing body (since 1994) that autonomously executes its tasks but has accountability to the Ministry of Infrastructure and Environment. Activities of Kadaster are:

- The management of Dutch registrations and national facilities like registration of real estate, topography, ships and airplanes.
- Provision of information, like databases, formal documents and maps.
- Customized and specialized work and advice. Also on an international level.

Platform31

A network and knowledge organization that acts independently between governmental, societal, and market actors. It connects policy, practices, and science with contemporary issues and develops strategies that help decision makers, policy makers, and policy executors in their activities concerning economics, social issues, and the living environment.

Ministerie van Infrastructuur en Milieu (Ministry of Infrastructure and Environment; I&M)

The governmental ministry that is occupied with the national accessibility, livability, infrastructure safety and protection against water bodies and aerial and water pollution.

Rijkswaterstaat (Department of Public Works and Water Management; RWS)

A department of I&M that is responsible for the design, construction, management and maintenance of the main infrastructure facilities, including the main road network and the main waterway and watersystems.

Rathenau Instituut

An independent institute funded by the Dutch ministry of Culture, Education and Science which mission is to stimulate public and political opinion forming concerning societal aspects of science and technology. It conducts scientific research and organizes debates about science and technology.

Rho – Advisors for the physical living environment

A national consultancy agency for spatial design and spatial management for governmental and private innovative and developing companies. It possesses expertise to convert ideas to practical solutions and implementations.

Erasmus Graduate School of Social Sciences and the Humanities

An educational institute that facilitates doctoral education in several academic fields such as public policy making in order to nurture research excellence and a vibrant community. It is a joint venture of the Erasmus University of Rotterdam of the Faculty of Social Sciences, the Erasmus School of History,

These parties have the potential, or are expected to be knowledgeable in the field innovation in urban planning and the use of modern technology, to improve policy and urban and spatial development. Multiple individuals active at these organizations were approached for open-ended interviews. The main goal is to collect knowledge owned by these parties and their employers that is relevant to the topic of this thesis and to penetrate their network in order to find new contacts that are perceived as potential holders of essential knowledge. This thesis understands the vulnerability of the snowball method in this case, because it guarantees no interview responses or even new contacts. Nevertheless, a separate own inquiry to other actors and organizations that potentially hold relevant knowledge will be conducted to support the collection of knowledge and information. The questions that will be used in the open-ended in-depth interviews will heavily depend on the context of the interview, although as noted, some key questions will be used in every interview.

First, the interviewees were familiarized with the content and subject of this thesis by supplying them with some preliminary information in the form of a thesis topic and goal introduction. This document clarifies what this thesis attempts to investigate and what information will be needed to conduct the research. In order to overcome situation wherein the interviewee is unaware of some concepts used in this thesis, definitions, when needed, will be shortly elaborated upon prior to the interview. As noted above, some pre-set questions have been set up that will be used as a startup for the interview and to steer the interview into the direction that remains relevant for the thesis and its research questions. The interviews were conducted in Dutch but the content of these questions can be loosely translated into:

Start-up question:

“Are you aware of any IT or communication technology that is or can be used for collecting tacit knowledge held by the citizen?”

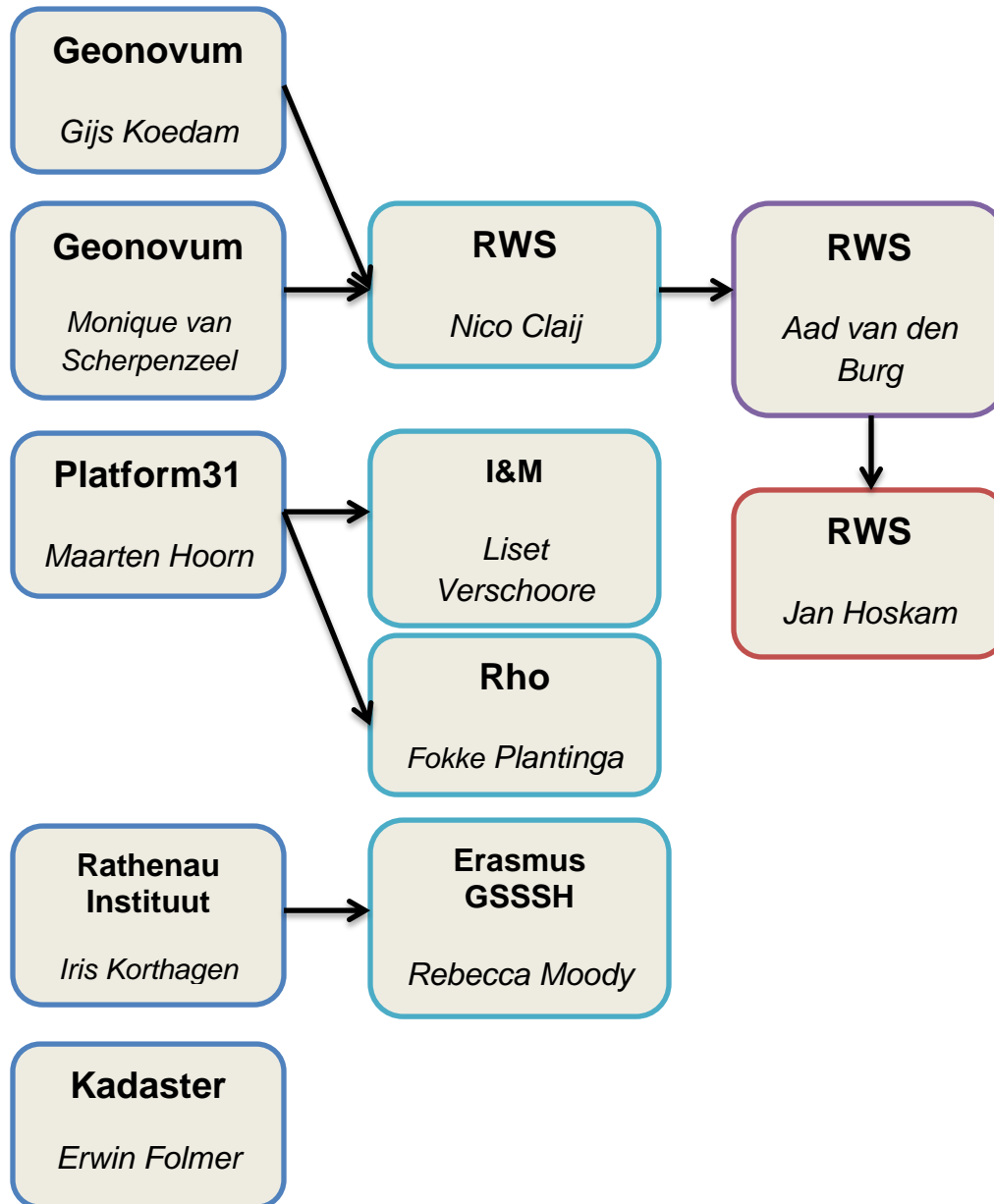
Mid-interview questions:

“What technologies would have the potential to collect and disseminate tacit knowledge?”

“What technologies have the capacity or hold the potential to facilitate the integration of tacit knowledge with professional knowledge as used by policy developers and decision makers?”

Further questions asked during the interviews depended on the course of the interview. All interviews will be transcribed in order to analyze them. In the analysis, all findings, notions, and assertions of the interviewees will be put together to create an overview of collected relevant knowledge. The (sub-) research questions will be used as a structure of the interview analysis and citations will be appointed to one of the questions and discussed alongside other citations. The insights gained from the interviews can help create an understanding of the characteristics of tacit knowledge dissemination, what technologies can be used for its dissemination and how it relates to other kinds of knowledge and how integration can be facilitated. Figure 4 presents the list of interviewees modelled in the conducted snowball method.

Figure 4: Interview schematically in the snowball method



5.4 Analysis of the Three Non-Dutch Cases

In addition to the tools and applications found in the in-depth literature research and the examples provided by the interviewees, a complementary analysis will be conducted of three cases outside the planning environment of the Netherlands. This will not only enhance the range of this thesis' analysis but will provide some insight into non-Dutch initiatives that could possibly serve as example models for the Dutch participatory planning systems as well. As noted, a selection of three cases is made, namely:

- The Orton Family Foundation (USA)
- Place Matters (USA)
- SoftGIS (Finland)

In cooperation with the supervisor of this thesis, the selection of these three cases were selected from a list of initiatives and organization that in some way are involved in forms of using local and tacit knowledge in processes of urban and environmental planning. Below follows a brief summary of the content of the activities the selected initiatives conduct:

(1) The Orton Family Foundation is the supplier of the Heart & Soul Method, which is a 'barn-raising' approach to community planning and development with a focus on stimulating participation in local decision-making (Orton Family Foundation, 2016). (2) Place Matters is a non-profit think tank for civic engagement and process in planning that support informed decision-making in the planning of cities and communities (Place Matter, n.d.). The organization works nationwide in the USA on improving public processes with new technologies with the goal of making civil engagement a more valuable component of the planning process. Examples of Place Matters' projects are the web-based game CrowdGauge and the Sustainable Communities Initiative. (3) SoftGIS is a Finnish innovation which refers to a collection of internet-based surveys which allow the locality-based study of human experiences and everyday behaviour (Kyttä & Kahila, 2011). In order to support the development of better user-friendly environment settings, the SoftGIS method was invented that combines 'soft' subjective data with 'hard' GIS data. The ambition of the first authors was to try to implement information containing experiences of local inhabitants in planning or designing the physical environment.

A more detailed summary of the initiatives' goals, studies, and method will be given in chapter 7. In the analysis of The Orton Foundation the Heart & Soul Method will be assessed focusing on their digital means of prospering community participation in planning their environment. Firstly, these features will be explained, and secondly, their implementation will be explored for indicators of success or failure by looking at existing assessments of both the public and the organization applying the Heart & Soul Method. The assessment of Place Matters' will consist of an exploration of their case studies and developed methods and applications that are used for improving participatory processes. The SoftGIS method will be assessed by looking into the particular articles that have been published by the involved authors and the implementations that have been realized in planning processes based on the method.

When assessment of the three initiatives has been conducted, the conclusion will be put next to the research question in order to produce preliminary answers that can be drawn from this section. These preliminary findings will subsequently be included in the thesis' final conclusion.

6. In-Depth Literature Research:

Whereas the general academic literature focused on the content of tacit knowledge, its characteristics, and the role ICT can play in collecting and integrating it, this chapter will conduct a more targeted literature research. It will focus on the contemporary knowledge that exists concerning the possibilities and potentials of ICTs, such as GIS, PSS, online media and other digital communication tools for collecting and disseminating tacit knowledge, and on what they can offer for planning and participation processes in terms of knowledge integration. In the first section, attention will be given to some theories that deal with the possibilities of virtual spaces in disseminating tacit knowledge and some insight will be produced into the kinds of media characteristics that are necessary to facilitate the sharing process and bring the knowledge into the field of urban and spatial planning. The second section will focus on existing general technologies that are specifically occupied with disseminating tacit and local knowledge for urban and spatial planning purposes. The third section will elaborate on some actual ICT-tools making the last step from theory to practice. The gained insights of this chapter will be listed in the fourth and last section.

6.1 Tacit Knowledge in Urban and Spatial Planning via Virtual Spaces

Whereas tacit knowledge is not confined to the realm of public participation, it neither is a phenomenon that is inherently related to digital environments. It is exactly this virtual space that has no academic consensus on whether it is able to facilitate tacit knowledge dissemination (Panahi et al., 2013) but current developments like Web 2.0 technologies offer new possibilities (Al-Qdah & Salim, 2013). The first step, therefore, is to understand how tacit knowledge sharing over the web may occur, and which features of the virtual space are necessary to allow for this sharing.

A basic principle of ICT communication between urban planners and citizens is that it enables not only planners but also citizens to participate in the production of urban information (Narooie, 2014). The virtual domain that facilitates this communication has become less distinct from the real world. Malecki's work (2016) addresses the blurring of this distinction. Mobile applications and cloud data storage, among other things, serve to blend both worlds into a user-generated cyberspace but also create a space in which knowledge production takes place. This increasingly complex cyberspace environment demands responses from policymakers in order to make use of new knowledge production possibilities. The growing virtual world and the accompanying collaboration of science in this space have made it increasingly clear that tacit knowledge can be exchanged among dispersed people, as stated by Al-Qdah and Salim (2013). They argue that tacit knowledge can be transferred with the use of ICT. This can be done by using a special type of technology based on the Media-Richness theory. This theory states that efficiency of a task can be enhanced by the features of matching media to the requirements of the task. More equivocal tasks should be answered with richer media. Nevertheless, difficulties with transferring tacit knowledge via ICT exist, but can often be related to a lack of understanding of tacit knowledge and its relationship with ICT. More study into the role of ICT in the transferring process is needed and Al-Qdah and Salim (2013) state that current academic work remains arguable. Al-Ghamdi and Al-Ghamdi (2015) look more into the role of Web 2.0 virtual communities in knowledge management (KM) and the dissemination of tacit knowledge. They suggest that Web 2.0 tools go further than traditional tools and can enable participants of a virtual community to share tacit knowledge and can help resolve one of the

main challenges of KM, namely, dealing with that exact tacit knowledge. Traditional KM systems focus greatly on explicit knowledge transfers which can greatly hamper innovative solutions. The dialogue needed in the process of tacit knowledge dissemination is absent in these systems, whereas Web 2.0 tools offer the potential to facilitate such dialogue.

Nuojua (2010) also looked into the capabilities of Web 2.0 technology to facilitate participation in spatial planning processes and to provide a forum in which knowledge creation can be achieved. He also addresses the weakness of GIS functionalities deriving from being perceived as either unnecessary in public participation or too difficult to use. Efforts in enriching expert knowledge used in GIS with local knowledge acquired with Web-based technologies have so far been limited to some experiments. Background knowledge, fast and frequent feedback, and the providing of rich media are needed to create a cooperative system and common understanding. The tools of storing, processing, and presenting qualitative information are needed to create such understanding. Moreover, in order to make spatial planning issues understandable, alternative forms of knowledge representation are necessary. GIS have often been criticized for lacking the abilities to do so. Web 2.0 technologies, however, can provide for means to create knowledge collectively with less necessary commitment. Nuojua argues that map-based Web 2.0 technology is suitable for acquiring local qualitative knowledge and can also facilitate the combining process with expert knowledge. Ertiö (2015) shares this belief and states that new development of user-friendly tools, such as VGI, Bottom-Up GIS and SoftGIS, has created the ability to allow citizens to create data on a map based on their knowledge of their neighborhood.

Tacit knowledge dissemination via ICT has been argued difficult or practically impossible by previous studies in the last decades. Nevertheless, Panahi et al. (2013) think that these inabilities of tacit knowledge sharing are likely to disappear with the potential of new social web tools. The ease of use, informality, openness, multimedia-oriented, and community-based features of social media applications have created opportunities for sharing tacit knowledge. Wu et al. (2010) similarly looked into how better utilization of ICT can help the process of transferring tacit knowledge. They divide this process into five stages: the knowledge provider's cognitive system, the knowledge externalization, the knowledge object, knowledge interpretation, and the knowledge receiver's cognitive system. Each stage influences the efficiency of the process, but it is argued that the cognitive systems play the most important role. For the providing end the database technique and information systems application are seen as most crucial. For the receiving end, the software tool and the information system applications are crucial.

As noted above, GIS-based techniques have been criticized for being often too complex to be used in participatory processes. Nevertheless, Pfeffer et al. (2015) have looked into the possibilities of interactive knowledge-building processes wherein GIS and other geo-technologies can mediate. They argue that GIS, among other techniques, can help digitize perceptions and lay knowledge by the use of sketch maps and create, import, and modify attribute information to characterize geo-spatial data. Examples for these knowledge building processes are: participatory budgeting using cartographic representations, community mapping, and internet applications with GIS functionality that seeks to inform and get feedback from citizens. Knowledge processes can be enhanced by geo-technologies in their efficiency, effectiveness, and transparency, and can stimulate citizens' spatial awareness. GIS-based geoICT-tools have the ability to link different types of knowledge to one geographical locality through

GIS. For example, qualitative community-based information can be linked to all kinds of spatial information like cadaster information (Pfeffer, Baud, Denis, & Scott, 2013). The linkage of knowledge through GIS has the ability to visualize the various kinds of knowledge and can make exchanges on priorities, conflicts, and synergies more explicit. Thus, geoICT-tools can provide opportunities for exchanging community knowledge by facilitating online access to spatial data and online collaboration. Individual knowledge and perceptions are given a platform for participating in planning and decision-making. Kurniawan and De Vries (2015) support this notion. They state that GeoICT-apps can increase both involvement of citizens and the effectiveness of internal processes of spatial planning agencies. The concepts of PGIS and PPGIS have become synchronous to integrating local knowledge in participatory processes by means of GIS-based tools (Jankowski, 2009). Further attention to these concepts will be given in the next sections.

6.2 ICT in Participatory Urban and Spatial Planning

Generally, urban and regional planning practices are mostly map-based endeavours. This means that the most efficient way of acquiring local and tacit knowledge is through map-based applications (Narooie, 2014). But how can tacit knowledge be brought to policymakers? Participatory GIS methods such as participatory mapping have been used to integrate community, local, and tacit knowledge. By researching several workshops in four Indian cities, Pfeffer et al. (2011) show that the use of GIS can help understand the local context, can produce spatial knowledge that is absent in local databases, and it can facilitate the integration of multiple forms of knowledge. This, Pfeffer et al. (2011) argue, depends largely on the quality of the maps used in the process and the ability of the user to understand the map and their situated knowledge. Nevertheless, the mapping strategy was generally received well due to the perceived usefulness of the spatial perspective of governance issues.

As noted earlier, ICT holds potential abilities for public participation by collecting citizens' needs and recognizing important planning issues. Pfeffer et al. (2011) address this question and explore in a mixed-method approach which e-governance tools, in particular GIS-based approached, can help this process. New patterns of interaction, led by tools such as Google Earth and Web 2.0 and location-based services in mobile devices, have increased the 'wikification' of mapping. Citizens have transformed from information consumers to producers due to the possibilities of VGI and other human sensors and have created new forms of participation and volunteered production of local knowledge through ICT. VGI opens up new opportunities for urban analysis, changes the societal structure of spatial knowledge and, together with Web 2.0 and web mapping services, has the potential to improve technical spatial knowledge (Baud, Pfeffer, Sydenstricker, & Scott, 2011). The voluntary information holds potential for collaborative map-making that goes beyond traditional agency domains (Ganapati, 2010). It offers mapping opportunities that can substitute the declining traditional national mapping efforts done by cartographic agencies. The combination of using location-based mobile devices together with web mapping and other Web 2.0 technologies can complement technical forms of knowledge (Pfeffer et al., 2013). Nevertheless, some skepticism about the credibility of VGI and its use for constructing SDI (spatial data infrastructure) exists. Spatial knowledge derived from various technical sources depends on timeliness, reliability, accessibility, and the ability of involved actors to understand it. Moreover, when comparing it with PPGIS some disparities are noticeable (Ganapati, 2010). Whereas VGI is mostly

concerned with application and information, the latter is more focused on processes and its outcomes which might be a more fruitful approach when using it for e-governance. The Geospatial Web 2.0 platform, however, can play a supportive role in online deliberation and engaging citizens in planning and decision-making processes.

Web 2.0 technologies show potential, but their use in current planning processes is very much limited. The lack of use of such platforms by governmental planning authorities on different scales is not a technological issue, but rather an institutional one, argues Ganapati (2010). The broader accessibility of GIS technology in planning processes is more likely to be impeded by political motivations that hinder broader participatory processes. This is acknowledged by Nuojua (2010), who claims that planner attitudes towards the use of map-based Web 2.0 technologies in planning processes should be more responsive. An open and collaborative approach is necessary for an effective use of Web 2.0 technology, but the use of technology should be synchronized with the planning process and adapted to its dynamics. When using map-based technology the focus on relevant issues in the planning process can be better communicated with the public, subsequently simplifying the integration of local knowledge. However, concerning the integration possibilities of tacit and local knowledge with scientific knowledge, a stronger co-operation is needed with the scientific/expert community. The linking of multiple forms of knowledge needs more emphasis on the situational context in which the knowledge production takes place and has to be more customized to local processes (Nuojua, 2010).

The rise of GIS use in planning support and decision-making has not failed to feed the emergence of critical discourse as well. Ehrensperger et al. (2011) have looked into the potential and limitations of GIS for spatial and urban planning. Critical arguments must be distinguished, they argue, between different types of applications at different scales:

“At the local scale, stakeholders’ tacit knowledge is directly present in situation diagnoses and goal setting. From the subnational to the national scales, the use of tacit knowledge and real-life experience diminishes.” (Ehrensperger et al., 2011; p363-364)

Therefore, a GIS must in its functionalities be relevant for the scale on which it is applied. At the local level GIS has strong potential for fostering participation in urban and spatial planning and is on equal footing with other information- and knowledge-based contributions to improving the living environment. Graphic representation can help raise issues that might have been overlooked otherwise, since improved information can enable people to better defend their interest and articulate their needs. Higgs et al. (2008) acknowledge the potential of GIS in visualizing planning issues and public perceptions of landscape change. GIS packages increasingly provide possibilities for the public to engage into participatory decision-making processes, although GIS has been particularly good in handling ‘hard’ data. Subjective information, for that matter, has been incorporated far less in these systems. As a category of GIS, PPGIS have been developed to tackle this problem and to engage the public in planning processes. Brown et al. (2012) argue that:

“PPGIS data collection systems should be guided by the principle that participants have important knowledge, perceptions, and experiences to contribute, and the system should not arbitrarily truncate opportunities to express this information.” (Brown et al., 2012; p647)

PPGIS help create community discourse in planning processes, and maps produced by these systems should be acknowledged as a valid way to inform policy makers. The goal of a participatory decision-making process is to find solution for spatial conflicts, and PPGIS is at the center of the mediating process between stakeholders and decision-makers (Morgado et al., 2014). Moreover, PPGIS is useful for solving complex spatial issues that always involve multiple stakeholders. Through this form of ‘democratizing technology’ that makes use of geographical information, these issues can be simplified and public knowledge relevant to a specific area can be integrated in order to improve decision-making processes of that specific area. PPGIS that specifically focus on internet-based systems are also defined as Web-based Public Participatory GIS (WPPGIS). Narooie (2014) explores effective designs for WPPGIS and argues that they should be user-friendly, flexible, transparent, and adaptable to the planning situation. She states that public participation and ICT can go hand in hand due to the provision of advanced abilities to collect people’s needs with their local knowledge. Nevertheless, a WPPGIS application must be used to increase public participation. It should and not function as a complete substitute for conventional methods and the limits of technology-based solutions should be acknowledged. Which PPGIS tools should be used in a process of public participation depends predominantly on the level of participation that is desired (Jankowski, 2009) as well as on the constraints of the problem domain and the characteristics of the tool participants. In addition, the help of experts in a process like technical assistance must be balanced. Too much influence of experts over the process can lead to a decrease in participant empowerment and their trust in the outcome of the process. An important challenge for any PPGIS, therefore, is to facilitate ICT to such an extent that the participant’s creativity is not compromised.

In addition to VGI, PGIS/PPGIS, and other GIS-based technology, two other recurring concepts that are relevant for online participatory processes must be mentioned, namely e-governance and m-governance. Both forms of governance have risen in the last decade and have shown potential for disseminating tacit knowledge. M-governance focuses on application on mobile devices that can share spatial information and support citizen participation in urban planning (Ertiö, 2013). Ertiö (2013) investigated a large amount of such urban applications. One major challenge of e-governance and m-governance is the need for constant monitoring due to the vast amounts of data that are being offered by mobile devices. Nevertheless, automated algorithms are becoming more and more cost-efficient and equipped to deal with these large amounts of data. Ertiö (2013) concluded that, although the most interesting applications are still to be developed, apps that have a human-centric approach and can tap into citizens’ tacit local knowledge create more strategic leverage. However, a dialogue remains necessary to make the tacit knowledge understandable (Ertiö, 2015; Ertiö, 2013). The impact of participatory apps so far has not been extensive, but the role of citizens has already been changed from being merely receivers to becoming suppliers of content and being partners in application development.

6.3 Tools, Methods and Applications Found in Literature

This section will move forward to actual implemented applications and online methods that have been evaluated in contemporary academic literature. As such, an attempt will be made so identify some essential factors that contribute to collecting and integrating tacit knowledge for spatial and urban planning purposes. In order to maintain a clear overview, some selected articles will be discussed individually, while others will be jointly integrated within one paragraph.

Dublin's Collaboration Dashboard (Crowe, Foley & Collier, 2016)

Crowe et al. (2016) discuss some experiments that explore urban planning practices within the discourse of social-ecological resilience thinking. They address the need to solve urban planning problems more collaboratively by using the imagination and creativity of all actors involved, including the public, in order to stimulate innovation. Two tools explored in this article will be discussed here, namely the Geo-Timeline developed by the University of Nottingham and University College Dublin, and the Collaboration Dashboard developed by the Dublin City Council (DCC). The Geo-Timeline is an interactive tool that uses crowd-sourcing in order to identify drivers of change in time and space within a specific geographical space. It works through the use of tools that allow categorized geo-tagging and time-tagging with additional information as metadata. The idea is to identify events or interventions that have been assessed by input contributors as having negative or positive effects. Geographic locations, along with knowledge input by public contributors, can subsequently be used to identify drivers and inform future plans. Initial findings of the tool indicate that populating it with data cannot effectively be done with online crowd-sourcing alone, but requires resource-intensive workshops and research projects as well.

The Collaboration Dashboard of the DCC acts as an online portal to improve transparency for communities and projects and supports horizontal networking. Its goals are to make tacit knowledge explicit, encourage collaboration, and to disseminate of knowledge (Crowe et al., 2016). The DCC makes use of mobile urban planning game applications, digital town hall meetings, hack the city competitions and social media engagement through the "Sense It See It Make It" program by OurDublin in order to encourage citizen participation (Institute without Boundaries, 2013). Multiple community groups have expressed their interest in using the platform and public individuals have volunteered to do the 'back-end' development of the website. Although maintaining the website might become considerably burdensome, the fact that it is already situated within an institution will support sustainable practice. Both explored experiments address the deficit in knowledge and space in urban planning policy, and further exploration is needed.

Practices of VGI

Ganapati (2010) has likewise explored several applications that offer new opportunities for e-governance but specifically citizen-oriented geospatial Web 2.0 applications. A noticeable example in the domain of VGI is OpenStreetMap, based on the open TIGER (Topological Integrated Geographic Encoding and References) Map Service developed by the US Census Bureau. It organized online mapping parties to clean up TIGER data, which resulted in updated maps that comply with community needs. Another example of VGI is counter-mapping which provides a platform for spatial discussion and can produce knowledge through civil input and can be used to support the democratization of mapping tools and stimulate participation (Baud et al., 2011). Counter-mapping produces alternative knowledge challenging official records and advocating change by making qualitative knowledge of places and spatial perceptions visible (Pfeffer et al., 2013). Ganapati (2010) also briefly explored a more participation and engagement-focused GIS tool developed by the Portland metropolitan area (Metro), the "Build-a-system" tool. The Portland Metro launched the Geospatial Web 2.0 platform (via Google Maps) in 2008 to engage citizens

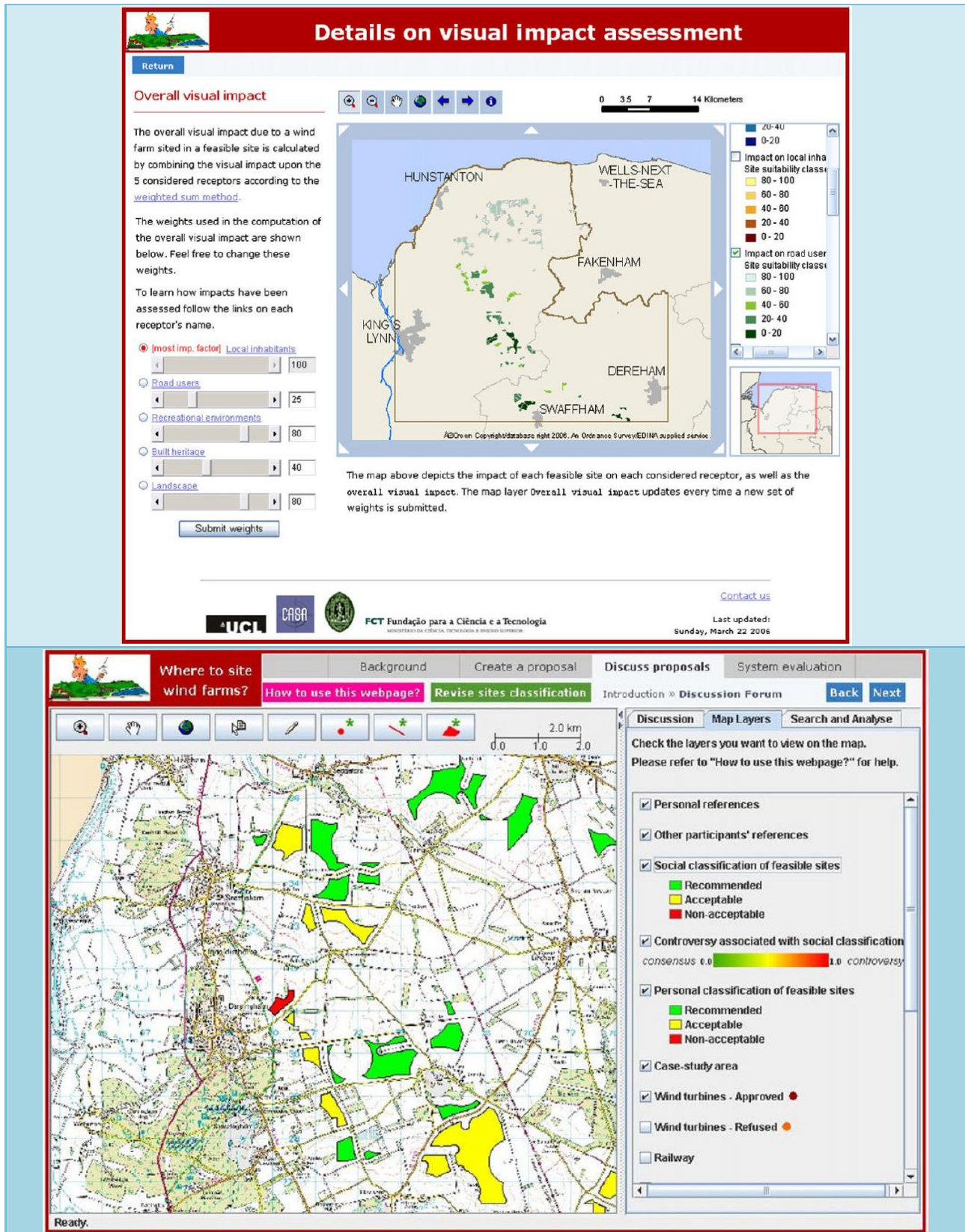
in the planning of the region's High Capacity Transit System. Through using the tool, residents could select each potential corridor for the transit system and assess their capital cost, operating cost, ridership, and environmental benefits. Ganapati argues that Metro's tool shows the potential of using Geospatial Web 2.0 platforms as a decision support tool for transportation planning and decision-making processes.

A MC-SDSS and Argumentation Map combination (Simaõ, Desnham & Haklay, 2009)

Simaõ et al. (2009) describe in their paper a web-based application that integrates two types of tools: a Multi-Criteria Spatial Decision Support System (MC-SDSS) and an argumentation map. The combination of tools in a single coherent framework provides for an innovative system that creates a new method of dealing with spatial planning problems. With the MC-SDSS, a framework is provided to the user within which they can explore and formalise their problems and learn about their preferences concerning decision-making. This works through iteratively generating and evaluating alternative solutions. Solution strategies are formalised through assigned weights to decision criteria, which can subsequently stimulate discussion about these strategies. Nevertheless, MC-SDSS does not support discussion on itself since reasons behind the weighted criteria are not clarified, nor is an assessment method for the stakeholders' interests and concerns provided. However, the argumentation map can make up for this shortcoming since it supports geo-referenced discussion. In doing so, it enables the sharing of tacit, local, and scientific knowledge. The integration of both tools in an internet-based system can compensate for shortcomings and create a method that can greatly support collaboration in spatial planning.

Simaõ, Desnham and Haklay (2009) argue that a PSS should be designed to enhance learning and should therefore help its users to make sense of their own experiences and tacit knowledge. It should enable them to develop personal knowledge by being able to efficiently scan through different channels of information, and it should allow for interaction with other stakeholders. The integration of MC-SDSS with argumentation maps is a response to criticism on both tools individually. A framework consisting of this integrated method was used for the development of the WePWEF application, the Web Based Participatory Wind Energy Planning in Norfolk, United Kingdom. In the phase of being a proof-of-concept implementation, some initial evaluation were conducted. These were rather favourable, as participants valued the possibilities of interaction and the way the application is able to help understand the complexity of the real world and all the aspects that need to be considered. Figure 5 displays the MC-SDSS tool and the interface of the embedded argumentation map. The MC-SDSS tool is provided with several weighted variables that can be altered by the user and that change the values of potential wind farm locations. The argumentation map offers the opportunity to start geographically referenced discussions in layered maps but, as is displayed in figure 5, also offers support tools to guide the user through the website's functionalities which improves the website's user-friendliness.

Figure 5: Above: the web page interface of the MC-SDSS. Below: The argumentation map



Source: Simaž et al. (2009)

A PPGIS for Ecosystem Services (Brown et al., 2012)

In order to better identify and value ecosystems services Ground Country (Colorado, U.S.) developed a PPGIS. Brown et al. (2012) recognized the lack of existing studies into the effectiveness of such ecosystem services valuation, and analyzed the internet-based application. The main goal of the PPGIS is to engage participants in order to use their knowledge and perceptions. Brown et al. (2012) evaluated the PPGIS through survey research to assess data quality, evaluate the validity of spatial measures, and an evaluation of the usability of the system's interface. The strengths and weaknesses of the PPGIS were determined through assessments by study participants of the user interface, the clarity of the definitions used for the ecosystem services, and the level of difficulty encountered when identifying and mapping the services. An important objective of the PPGIS is to make the "invisible" ecosystem services more visible. This occurs by helping the participants discover the tacit knowledge that is presumed to be held by them. In general, the internet-based PPGIS interface has been positively evaluated in its ability to collect ecosystem service data although the respondents do not truly reflect the targeted audience. This unrepresentative response mainly derives from the higher response rate of higher educated participants. A more definitive examination of the validity of the contributed data would require a map overlay of the PPGIS data with "expert" maps in order to assess the spatial congruency.

Optimal WPPGIS Features (Narooie, 2014)

Narooie's study (2014) resulted in a description of features that can together make up for an optimal WPPGIS. Seven main criteria were selected for evaluating WPPGISs: The licensing model (1) of a WPPGIS can best be focused on Open Source Software (OSS) which has proven to provide better value with lowered costs. Moreover, it would stimulate improved security, lower the amount of bugs and increase the modularity, speed up release cycles, and, in the long run, improve performance concerning modern enterprise considerations. GIS functionalities (2) should allow for map browsing, spatial queries, and map printing. The interface (3) should be user friendly with easy and fast navigation, complete, and correct. The security implementation (4) criterion should entail login authentication and forum security. The sharing of information (5) through the WPPGIS must ensure that meeting documents and project details are available. The WPPGIS must have the possibility for consultation (6) through commenting tools (by sketches or annotation), voting tools, a discussion forum, and the ability to see participants' feedback. And, finally, the WPPGIS should entail synchronous collaboration and decision-making (7) through real-time messaging, video conference, and screen sharing.

Scenario Building with PPGIS (Morgado et al., 2014)

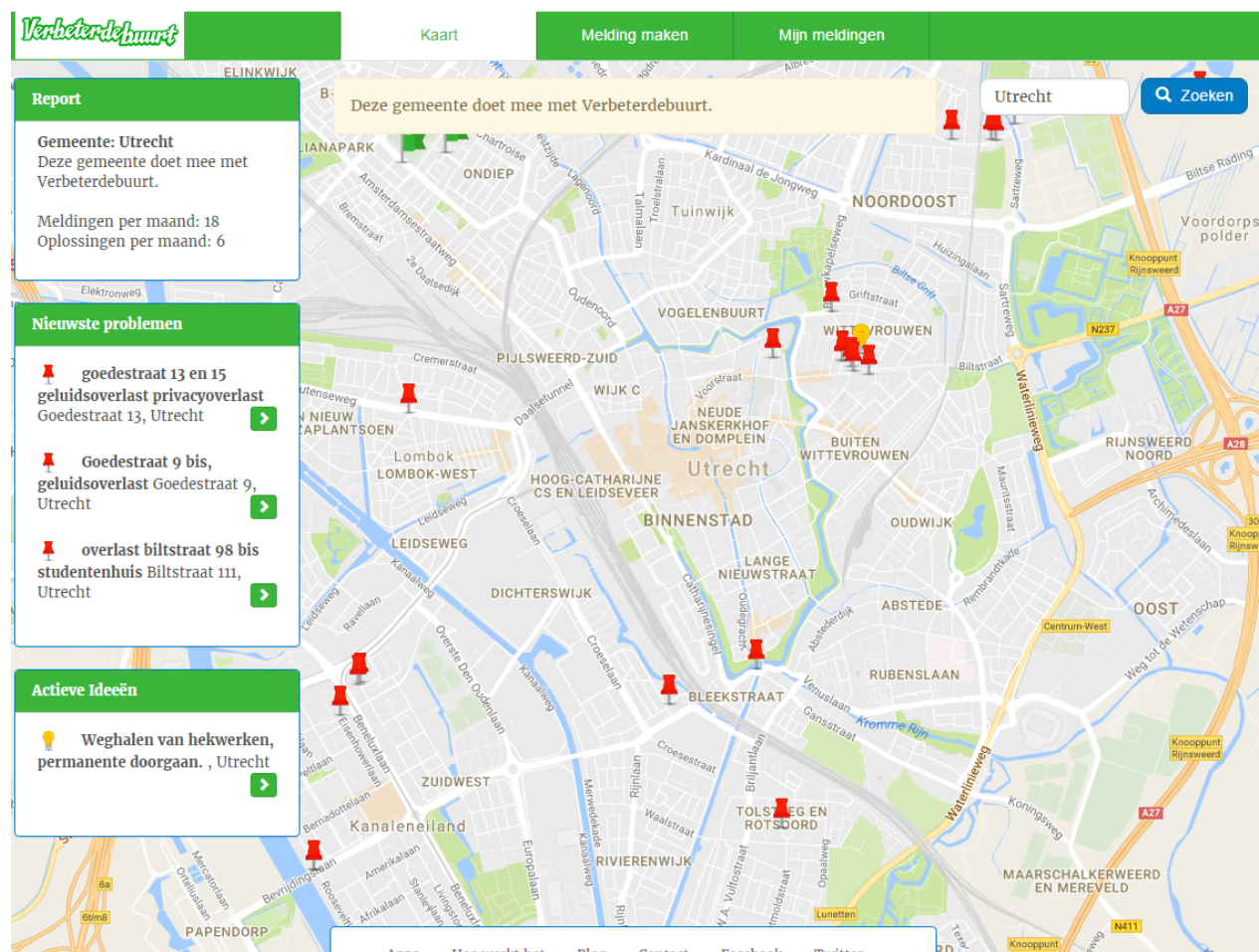
Morgado et al. (2014) study how a scenario building PPGIS of a small coastal area can effectively facilitate a balanced organization and management of that particular area. They use a GIS-ANN (artificial neural networks) tool, the Multilayer Perceptron (MLP), with a user friendly graphic user interface (GUI) that runs on Google Earth's platform. In the tool, users are able to conduct sensitivity analyses for various competing scenarios that simultaneously give insight in causal connection between the scenarios and articulate trade-offs. The user-friendliness of the web-based tool helps promote stakeholders' participation and can help reduce the issue of the participant's technology capacity deficit. Local communal involvement in the planning process, thus, is supported. Having a personal component in the

tool, as argued by Morgado et al. (2014), is essential in order to get in touch with local citizens that are unfamiliar with modern ICT. This can compensate for the disadvantages of displacement that naturally occur with WPPGIS. Scenario planning does not forecast the future but it greatly improves the ability of stakeholders to strengthen their position concerning unexpected events. Although the GIS-ANN has been assessed as user-friendly and is capable of advanced spatial analysis some GIS competencies are likely to be necessary in order to properly use the tool.

Verbeterdebuurt Application (Kurniawan & De Vries, 2015)

Kurniawan and De Vries (2015) studied the Verbeterdebuurt App used in the Dutch municipality of Enschede. The examination of the application's functioning and its role as an intermediary was conducted through semi-structured interviews with respondents with differentiated roles concerning the app and the planning process around it. In addition, they collected documentation about the design of the app as well as its supporting infrastructure, and statistical data based on web content analysis of the municipal websites of Enschede. The application (see figure 6) can be used by smartphones which is considered to be a stimulant for transparency since it enables the user to see who else accessed the map and what responses have been produced by the municipality. In addition to reporting, the application

Figure 6: Interface of Verbeterdebuurt Application



Source: Verbeterdebuurt.nl (2017)

also provides for the possibility of idea contribution by the app user. To do so, a smartphone photo can be uploaded and pinpointed to the location of the photographed subject. The idea added to the photo needs 10 'upvotes' from other users to get a response from the municipality. Result of the evaluation stated that citizens had little faith in the reports being processed and kept a preference for more direct communication like telephone calls. Nevertheless, more complaints were reported which suggests that the geo-ICT app did improve the efficiency in finding deficiencies and effectively locating them. The evaluation of the app's performance concluded that the difficulty of processing reports with citizen-generated locational information was reduced. This was the result of being able to handle the reports in real time, which increased the effectiveness and the efficiency of the process. Duplication of information, however, remained a risk. The locational information increased the ability to spatially locate the problem and, more importantly, design effective strategies to address the specified problem. Historically storing the reports also gave the municipality the opportunity to observe spatially clustered problems. The most important negative side effect of the application was intentionally erroneously generated input. Kurniawan and De Vries' (2015) study concluded that technical intermediary, such as the deployment of a geoICT tool for participatory purposes, does indeed provide more opportunities for governance, but allowing the generation of data online will invariably limit the choice of types of data that can be uploaded.

6.4 Results

Drawn from the analyzed literature, several concluding remarks can be put forth. Concerning the dissemination and production of tacit knowledge via virtual spaces, it has been argued that in order to do, so rich media is necessary. Only rich media can facilitate the dialogue necessary for transferring tacit knowledge. Web 2.0 tools offer an opportunity to fulfill this role of rich media due to their potential ability to facilitate non-explicit and qualitative dialogue. Therefore, they present itself as potential tools for tacit knowledge dissemination. Until now, only few web-based GIS experiments in participatory processes were conducted. In order to make it work, the public needs to be facilitated with background knowledge and fast and frequent feedback along with alternative forms of knowledge. Web 2.0 technologies, especially when map-based, can be suitable for this, since they can work with local and qualitative forms of knowledge. Essential for their success is a user-friendly online environment, which has been embraced by developments such as VGI and softGIS. They must provide for easy to use, informal, and multimedia-oriented application features in order to create opportunities for tacit knowledge sharing.

In the field of urban planning and the use of ICT for tacit knowledge dissemination and integration, several things can be derived from the literature. Since urban and spatial planning processes are naturally often map based, the collection of tacit knowledge and its integration with other forms of knowledge can be best approached with map based tools and applications. Map-based technology stimulates the focus on relevant issues and improves communication, which can simplify the integration of local knowledge. ICT has proven to be able to possess abilities that support the collection of citizens' needs and issues. With the process of 'wikification' of mapping, citizens' role in ICT and geoICT has changed from being consumers to becoming (co)producers by means of local knowledge producing technologies such as VGI. GIS can help users understand the local context, and through that, produce

spatially embedded knowledge helping the facilitation of knowledge integration. Nevertheless, this heavily depends on the quality of the maps and the user's understanding of the maps along with its situational context. Knowledge linking and integration processes need to emphasize situational context and must be customized to local planning processes. PPGIS, more so than VGI, is known to have a more extensive focus on the process side of data collection. Collaborative map-making can produce local and tacit knowledge that is complementary to technical knowledge, although it needs to be understandable, reliable and accessible. Geo Web 2.0 has the ability to support online deliberation and citizen engagement, but the greatest impediments to actually implementing it in spatial planning and decision-making processes are mostly of an institutional and political nature. Critical discourse on GIS in planning processes argues that criticism ought to be specified on the scale on which the GIS functionalities are used. Tacit knowledge, for that matter, is mostly relevant for subnational processes of planning. Historically, GIS has been mostly applied to hard data but PPGIS (and WPPGIS) can use their visualization functionalities for representing citizens' perceptions which can help create community discourse produced on maps that can function as a valid method to inform policy makers. Nevertheless, it cannot be a complete substitution for traditional methods of public participation. Spatial issues need to be simplified for the user and a good functioning WPPGIS should be user-friendly, flexible, transparent, and adaptable, but most importantly, it must compromise the user's creativity as little as possible.

The tools, methods and application found in the literature show some interesting means of applying PPGIS and other geoICT related applications. Generally, Geospatial Web 2.0 platforms show great potential for supporting planning and decision-making processes. The combination of the multi-criteria spatial decision support systems (MC-SDSS) and with an argumentation map, as analyzed by Simaõ et al. (2009), shows great possibilities for integration. Trade-off functionalities and mapped argumentation can provide for a system that both helps the user understand causal relations that are spatially represented and can share local and tacit knowledge through a spatially embedded discussion platform. Gaining insight in tradeoffs and the effects of different scenarios through a user friendly API are important to a well-functioning WPPGIS. However, users learn to make sense of their own experience and tacit knowledge through interaction with different stakeholders and the provision of different channels of information. A proper way to validate data contributed by the public can be by using map overlays with expert knowledge to check spatial congruency. Locational information based on tacit knowledge provided by the public can help design more effective strategies to observed issues.

7. In-Depth Interview Analysis

This chapter will deal with all interviews¹ that have been conducted with experts working for different institutes that have been selected as knowledgeable in the field of spatial planning and innovative means of improving the living space. All institutes and organizations have been introduced in the methodology chapter and will therefore not be given any further attention here. Every institute will be treated individually although some institutes were approached multiple times. The transcribed interviews have been analysed by selecting the relevant citations and content that originates from the spoken interviews. When all participating institutes have been covered, the gathered knowledge will be put next to research questions and some preliminary answers will be given.

In terms of dealing with privacy matters, all respondents have been given the opportunity to agree to the transcribed interviews. When spoken words were perceived as unintentional or misplaced, acceptable alterations were made to the document.

7.1 Geonovum

Interviewed: Monique van Scherpenzeel, Erwin Koedam

In relevance to the EPA, it is acknowledged that a more timely possibility of civil participation is needed in the new planning system. One of the main goals to create broad support before an environment plan will be become juridically effective in order to drastically lower the amount of legal conflicts between the state and private parties. However, how such a system can be implemented is as of yet still very unclear. In brainstorming sessions the idea of creating a new level of digital communication space has been put forth. Occupied with digital communications and data dissemination procedures within the EPA trajectory is the sub-program DSO (Digital Stelsel Omgevingswet or the Digital System of the EPA). The DSO has been developing virtual cooperation spaces that can be used by officials and stakeholders in order to communicate for the purpose of spatial planning processes. Two identified levels of communication are already part of ongoing developments within the EPA trajectory, namely a level for different hierarchic levels of government to communicate, and a level for building permit applicators and governmental bodies to communicate. A third level would allow for semi-formal to informal communication that gives all stakeholders the possibility to share sketches based on personal knowledge and share local knowledge that is not limited by formally imposed formats of data use and communication. Everybody involved shares the conviction that such a communication and deliberation platform is very much needed, but at the same time fears the complexity such a system might entail. Nevertheless, the current information that is provided to the civilians is judged to be almost impossible for the average civilian to comprehend due to the juridical vocabulary used in these publications. Change is, indeed, necessary both for improving the usability of the provided documents to the average civilian and the timing of informing the public about spatial projects and visions. The idea that is being promoted by Geonovum is to provide the same 'basic information' to the involved authorities, the private initiators, and all the stakeholders. This basic information ought to be correct and complete, so that it can be used for own analysis and exploration, or for means to construct arguments in legal conflicts. The

¹ All interviews have been fully transcribed but are not added to this document. The content of the transcriptions can be requested on demand by contacting stephanepulles@gmail.com.

discussion that will manifest in this level of communication is perceived by the national government and involved ministries as essential in order to better explain to the public why spatial planning measures are being taken and why initiatives are supported or not. So far, the technical possibilities to create such a medium are judged as limited. Nevertheless, the government pursues the ambition concerning the implementation of the EPA to provide the user of the available spatial planning information with understandable visualizations of policy texts into maps. Both interviewees acknowledged the added value of such visualizations. For example, 3D visualizations can contribute to people's understanding of spatial planning possibilities. Therefore, in addition to traditional analogue methods of civil engagement, citizens can become much more aware of the spatial implications and create better judgement, improving their ability to respond to and complement their local knowledge of spatial plans. An important aspect of this ambition is the supply of planning information in layman's terms, as is also done in other legal departments based on European specified standards of language comprehension. Although it is expected that such translations of juridical texts into understandable visualizations are difficult, they are claimed to be necessary in the new planning systems. The governmental ambition even goes a step further by developing the possibility to automatically conduct texts queries when a geographical location is pinpointed on an online map representing the basic data. The result will be a selection of exclusively relevant and applicable text documents based on a data standard that is smart enough that it can make such selections by means of rich meta-data. Although a complex system, Geonovum states that parties are already busy with developing such techniques. Concerning the use of social media participation techniques, Geonovum sees them as means to reach the public rather than to use them as knowledge collection channels.

7.2 Kadaster

Interviewed: Erwin Folmer

In addressing the issues related to data use in future EPA legislation and policy, Kadaster stated that it will no longer be sufficient to use formal sources only. It is essential to use as many sources for data as possible, in order to efficiently and effectively deal with building permits for example. Kadaster puts forth the possibilities of linked data as a new method of linking sources of data without storing the data in one or few databases. One source of data that is important to this is data owned by the public. Using the community to improve data sources can be done in two different aspects: the mass numbers of the public can outperform conventional surveying tools due to data collection and analysis by smart mobile phones, and Open Source tools such as Openstreetmaps and Google Maps and their verification tools can be used to improve the completeness of information owned by institutes such as Kadaster. An example for useful linked data would be to link data to Kadaster's BAG ('basisregistratie adressen en gebouwen' or registration of addresses and real estate) data. This data could consist of photos or any other documents that have URI codes (Uniform Resource Identifier) as metadata. This URI code refers to unique codes that is assigned to every address and building in the Netherlands. This is an effective way to link additional data to geographically referenced data that can, when properly indexed on Google for example, be searched and retrieved by simple online queries. When blue prints of buildings or images of unusual characteristics of buildings are linked, this information can be used by, for example, governmental bodies that process building permits or fire departments that can anticipate unusual

circumstances when they need to be at a particular location. This is a way of sharing local information, which can be hard data but also more qualitative digital data like photos and text files that contain information about local contexts added by residents. These possibilities exist for public spaces as well. Data concerning land use at a very detailed level is part of the Kadaster's BGT ('basisregistratie grootschalige topografie' or registration of national topographies), a dataset that also contains URIs for every object. Another way of linking community knowledge to geographically referenced data is by linking Wikipedia pages to the URIs, which is an open community based body of knowledge. These possibilities can complement future technical and qualitative data sharing by linking data on basis of unique identifiers without having to have all the data at the same location.

7.3 Rathenau Instituut

Interviewed: Iris Korthagen

Although the Rathenau Instituut does not apply itself particularly to the domain of spatial planning when it comes to public engagement and e-governance, they do state that the realm of urban and spatial planning is eminently fit for experimenting with those initiatives. However, in a few case studies that are part of Rathenau Institute's research portfolio, some interesting and relevant features for public engagement and the use of their local and tacit knowledge for improving the environment can be put forth. In a case study of an engagement tool in Berlin, Germany, a consultative tool was studied. Environment planning visions were developed collaboratively with the public, by means of submitted proposals by the public on basis of budgeting distribution. Submission was possible both online as well as offline. By applying a 'traffic light' method, the participants that submitted proposals were insightfully communicated with by being given either a green light (proposal accepted), an orange light (in process), or a red light (proposal denied). These assigned lights were complemented with short textual feedback. Such consistent feedback is rarely seen in communication flows between governmental planning bodies and public participants. Although the ICT component of the tool is limited, online communication is facilitated for participation in the development of environment planning visions. A critical side note to this tool is the notion that residents that participate in such tools are often mainly dedicated to the design and presentation of their own plan. Deliberation with the plans of other participants is often missing, while compromises are inherently inevitable in the planning process. Moreover, this tool mainly focuses on proactive knowledge held by the public and not so much hidden tacit knowledge. Nevertheless, in deliberation, when such cooperation is facilitated, tacit knowledge sharing can be stimulated. The Rathenau Instituut acknowledged the value of visualization in communicating complex policy to laypersons. For example, short movies can greatly simplify the explanation of spatial consequences of a particular policy. When stimulating residents to share their tacit knowledge with policy- and decision-makers, you need to create a level of communication that can facilitate the translation of both semantics. This can be approached as a sort of new dimension that links the dimension of the planner with that of the participating civilian. Visualization is an important way of constructing such a dimension, by visualizing spatial dynamics or effects of budgeting decisions. Another way is to organize participants' arguments (pros and cons) in such a manner that they provide an overview of general feelings and opinions towards a specific subject. When using online methods, another contribution is that all shared expressions are much stronger, considering the fact that they

remain stored in databases or online communication platforms. Spoken words in town meetings have a much higher risk of being forgotten afterwards. In conclusion, visualization can provide for potentially effective means for communicating complex information, but the implementation of these tools can expect some difficulties when feedback is lacking or when planning bodies are reticent towards using new digital and online tools.

7.4 Platform31 / EGSSSH

Interviewed: Maarten Hoorn (Platform31)

Rebecca Moody (EGSSSH)

Since the interviews with both Platform31 and Erasmus Graduate School of Social Sciences and the Humanities (EGSSSH) were relatively short, both interviews are combined in one section.

The interview with Platform31 provided for some brief insights. When engaging the public and stimulating them to participate and share their knowledge, the stimulant to use online platforms for facilitating this communication depends primarily on the effectiveness of such platforms. Important in the creation of such a platform is to facilitate it with people that are occupied with handling and processing the input non-stop. Otherwise the effectiveness will decrease and people will become less willing to share their information due to feelings of futility. If a system is effective, the problem of integrating different forms of knowledge by means of semantical analysis cannot be easily solved by planning bodies. They currently do not possess, to the knowledge of the interviewee, any technical analysis tools that can differentiate knowledge from useless content which often comes along with it when residents provide for participatory input. Such textual analysis tools are most likely too expensive for planning bodies to use them for participatory purposes. Nevertheless, other techniques, such as virtual reality, can provide for other means to communicate residents' emotions and needs.

The interview with EGSSSH resulted in some insight regarding the potential of mobile and online application for the collection of local and tacit knowledge owned by the public. When developing any sort of application, the problem often is that application with relatively simple software and a limited capacity in processing data does not provide for any meaningful tools for facilitating participation, whereas applications with more complex software are often too expensive for planning bodies. Nevertheless, if an application would be developed, crucial is to design a Facebook-like environment to create a user-friendly user interface without having to deal with complicated log-in protocols. Important for the effective use of tacit knowledge however, for example through collecting it with GIS-based tools or applications, is that planning bodies consider this knowledge to be as important as their own professional knowledge. If planning bodies fail to do so, the integration of both forms of knowledge becomes significantly more difficult. Moreover, residents sharing their knowledge through such applications need to trust the parties behind the developed apps. In order to build this trust, face-to-face promotion of the app or online tool might be necessary. Creating a knowledge-collecting application might also be more easy when its designed to serve a smaller area of region. When aggregating it to higher levels, for example for larger cities, provinces or for national purposes, translation and integration

processes will increase in complexity as well. The current potential of knowledge collecting applications and online tools are perhaps too limited, but due to rapid ICT innovations a lot can change in ten years.

7.5 I&M (Ministry of Infrastructure and Environment)

Interviewed: Liset Verschoore

Some workshops and conferences have been organized to explore the possibilities of using social media and online tools to foster and improve public participation in spatial planning processes. The future will offer some possibilities in the form of augmented or virtual reality-based tools, although no such tools are currently active other than small scale initiatives. In the project of the development of the provincial road N18 a 3D model of the future road was designed to visualize it for residents and provide them with the opportunity of asking well-aimed questions. In conventional methods, residents would need to apply their conflicting views by working their way through numerous official and tenacious documents. The 3D model greatly simplified the communication, and miscommunications about semantics and focus of subject decreased. Moreover, the formally applied conflicting views by residents consisted of better and well-articulated argumentation. In summary, as formulated by the interviewee, better informed participants can participate more effectively. Although this 3D model was primarily used to collect residential questions about the N18 project, similar models can also be used to collect knowledge. Such a model can also be provided physically in the form of map tables. These can be used to give participants the opportunity to draw and sketch their ideas. Nevertheless, the use of ICT-tools, such as 3D models, by governmental bodies like the I&M are limited by official directives for both content and used techniques for public governmental websites and applications. These directives can only be ignored to a very limited extent, and when doing so the website or application should be complemented with a notion that explains this. However, focusing on mobile applications under the theme of 'mobile first', the idea of responding to the growing focus on smart-phone communication, is important for future participatory methods and tools. The use of interactive games can be part of this development. In exploring these possibilities, the ministry designed a game that offered an insightful way of showing users the principles of the EPA and teaches them the complexity of trading off stakeholders' interests and the difficulties that come along with large scale collaboration. Again, the game was not designed to collect input and knowledge from participants, but its potential to do so is being acknowledged. What should be kept in mind is that forms of e-participation do not apply to all purposes. Moreover, the reason for choosing to facilitate forms of e-participation may not only depend on wanting to use new innovative forms of participation, but more on arguments of efficiency and time.

Regarding the integration of multiple forms of knowledge, text-analysis tools can provide for effective ways to do so. An example is to disseminate the submitted official conflicting views of citizens by the use of such a tool. Due to the great volume of text that is being submitted by residents, a non-computer-supported analysis cannot deal with the complexity and size of the data adequately. Data-analysis of these texts can more effectively see overall patterns, both in the present as well as retroactively in the past. Creating a form classification can also provide for the possibility to conduct thematical analyses. The interviewee states that the ministry does own a tool that can do comparable analyses, but the biggest problem in using it lies in the fact that the organization owns too little data scientists and too much conventional officials for that matter. The organization needs to become more data-driven to be

able to support such change. Additionally, the purchase or expansion of such analysis software is not the only step to be taken. When using text-analysis tools a glossary needs to be build built up for semantical translations, and some form of classification needs to be realized to bundle data. Nevertheless, having all submitted texts of residents in digital format does ensure that all expressions are captured and stored, contrary to many words spoken in physical community meetings.

In conclusion, based on the findings of this interview, digital tools such as interactive games and digital text-analysis software can contribute to collecting knowledge owned by the public. Visualization of complex information that is often part of spatial development policy can be greatly supported by means of 3D models but in the nearby future, augmented and virtual reality technology can complement these methods. Contrary to what is believed in some non-governmental institutes, as is shown in this chapter, the Ministry of Infrastructure and Environment does hold tools to do more complex analyses such as complex text-analysis, but it needs organizational change before such tools can be put to effective use.

7.6 Rho

Interviewed: Fokke Plantinga

Until now, concerning geographically referenced public knowledge use in participatory planning processes, the use of 'geo-forms' was a method commonly used by Rho. These forms concern reactions made by residents on an online spatial plan or vision made available by the municipalities. These geo-forms can subsequently be visualized in a geo-environment. They thus facilitate a communication flow between the resident and the municipal planning body for ongoing spatial projects. Nevertheless, these geo-forms could also be applied when providing scenarios in a digital mapping tool. Based on the input provided by the public, priorities can be identified as valued by the public. This can be an innovative way of reaching people who would otherwise be absent from conventional participatory instruments, such as community meetings. The problem, however, when trying to collect rich local knowledge in a digital manner, is that the geo-forms should be as little structured as possible. Open forms can provide for this opportunity, but will result in a very laborious processing operation in which a large amount of inconsistent input needs to be organized. When more structured forms are used, processing the input will be much easier.

Rho's experience with gaming tools for participatory planning processes, also known as 'Serious Gaming', lies with the Tygron Omgeving (Tygron Environment). Tygron is a Dutch company that develops engines for the creation of a realistic multi-use 3D-world based on different types of geo data. These environments can be used to make holistic calculations for spatial construction projects, and are used by the municipality of Nijmegen in the design of its environment visions. In order to make these environments usable for residents in adding and checking data, a highly detailed level of reality is necessary. Users should be able to easily recognize their living environment and its features and objects. However, as is being stated by the interviewee, using it for collecting qualitative local knowledge might require additional face-to-face meetings in order to properly communicate this knowledge. Providing such a game online without face-to-face contact is possible based on a SaaS (Software as a Service) approach that can run entirely 'in the cloud'. That said, optimal use of such games is furthered by physical contact. The semantical issues that would be involved in facilitating the integration of tacit

knowledge of the public will be problematic since semantical standardization is in and of itself a tenacious process between all parties involved in the planning process. Nevertheless, the EPA is partially designed to make these processes less complicated but establishing standardized semantics for public knowledge currently still requires considerable work and research. Visualization will always be a great method of supporting the integration but it also contains the risk of creating mock realities that might be perceived as how the end result in real life will be. This can spark tensions when residents are disappointed when real life results might not be as they observed in digital 3D environments. Nevertheless, visualization remains indispensable in communicating complex information.

Another way to use local knowledge of the public is through participatory budgeting. In the municipality of Cappelle Aan De Ijssel, such a project was carried out in order to see how residents of particular districts of the municipality would distribute their budgets based on their own knowledge of which issues should be prioritized and which not. Social media also have some potential of sharing and disseminating local knowledge that can be used to improve the environment when collected. Since all messages nowadays are geographically referenced, this offers some opportunities, especially since social media communication often concerns observed abnormalities. If these observed abnormalities concern issues related to the quality of the living environment, they can be used to identify issues at hand. When collecting these social media messages on a large scale hotspot analysis by means of smart filtering queries can visualize these issues in their geographical location and in their quantity of placed messages by residents. However, a down-side to social media messages is the often emotional and ad hoc content. This can create difficulties when trying to process and analyse the textual content of the messages.

In summary, serious potential can be identified for sharing local and tacit knowledge. Nevertheless, limitations need to be acknowledged as well. Serious Gaming can, by means of detailed realistic visualization, help communicate complex information, and it can help residents respond to proposed plans or scenarios. That said, collecting actual local and tacit knowledge can best be facilitated by face-to-face contact and non-digital verbal deliberation. When trying to collect tacit knowledge in its full quality, more laborious processes will be involved, which might result in unrealistic or overly complex analyses. Since social media remain an important way of the current and following generations to communicate every day life observations, enhanced with geographical locations, large scale collection along with smart filtering tools might become a useful way of identifying issues that are going on in the living environment.

7.7 Rijkswaterstaat (RWS)

Interviewed: Aad van den Burg, Nico Claij, Jan Hoskam

RWS, as the executive department of the Ministry of Infrastructure and Environment, has experience with projects and initiatives that explore the possibilities of new methods of public participation that can be used for future participatory processes under the EPA. Serious Gaming, along with techniques such as virtual and augmented reality, has the potential of being applicable as such a new innovative tool. It can be used for scenario building, which can be presented to the public for response and contributory input. Virtual spaces, when the citizen is accustomed to this environment, can make users able to deeply experience what is presented to them and will enable them to discover their preferences and conflicts

regarding what they see. It creates a digital environment that can make planning scenarios or spatial issues more comprehensible to lay persons in contrary to textual administrative documents. It goes without saying that a higher level of understanding by the public will most likely result in better responses and public input. Moreover, the collaboration with the public in such virtual spaces creates a deeper participatory process than when several plans or scenarios are simply proposed to the public and a simple voting method decides what scenario is most preferred.

Nevertheless, using Serious Gaming is not a straightforward process and needs much guidance throughout its use and application by, for example, municipal planning bodies, but also for the end user. Many forms of games exist, and developing a game that is generally applicable for all planning bodies is currently too challenging. Developing 'tailor made' participatory games for specific initiatives and contexts is likely to be most effective. The element of time is important as well, since it can be expected that a respondent can only focus on playing a game for a limited amount of time. Nevertheless, short games can result in too shallow interactions and too little communicated information to the civilian game player. The distinction between serious games and simulation techniques should also be recognized, although both can be put on a continuous scale. Whereas serious games might be more about the creation of non-committal awareness of spatial issues and visions, showing trade-offs and conflicting scenario's might be more relevant for simulation techniques. For that matter, simulation techniques might be more useful for knowledge collection.

A great obstacle for using Serious Games with public input of local knowledge is the interpretation of the user's input. This will hold some difficulties when translating it to executable plan adjustments. Integrating emotions and individual expressions with professional information is a challenge for ICT-tools. Nevertheless, the general sentiment by RWS is that the use of digital visualization techniques such as 3D-models, Serious Gaming, and simulation models should be explored and expanded more. Current non-committal games for participatory purposes may develop into decision-supporting systems. The same has been the case for Alliander, a large Dutch energy supplier that uses games to connect supply with demand in their heating network. The public will increasingly become suppliers of information in the future, and easy accessibility and recognizability will be important to construct tools such as serious games and simulation tools that can collect local information and knowledge.

Concerning the use of social media such as Facebook for collecting public knowledge and official participatory processes RWS sees some great limitations. Deep participation is most likely impossible, since the level of communication is insufficient. Online polls can help explore public opinions and perceptions about particular issues, but they will lack a geographical or spatially referenced component. Overall, visualization tools offer some great possibilities that RWS does not ignore. When it comes to transferring complex information, the potential is clearer than for knowledge integration methods. Visualization with tools like Serious Gaming and simulation techniques does support civil understanding and therefore their ability to respond with more informed feedback and input but streamlining this feedback with professional knowledge remains a challenge.

7.8 In-Depth Interview Findings

Based on the analysis of the conducted interviews some insights can be formulated that can be put next to the research questions. The next three paragraphs will summarize the findings, but will not focus separately on interviewees or organizations since they are not part of the analysis in and of itself but rather contribute to the analyses as a whole. It should be noted that the second and the third part of the next section overlap to some extent. Nevertheless, whereas the second research question focuses more on the approach to knowledge integration, the third deals with practical ICT-tools that have been or can be deployed for actual knowledge integration. This notion also applies for section 8.4.

Which ICT-tools and what methods can help collect tacit knowledge?

Visualization tools can communicate complex information to a great extent. This became clear from several interviews. Such tools provide participant with opportunities for feedback in which the participants can potentially share their own knowledge while being better informed and able to use stronger arguments. This notion is generally supported by all interviewees. Visualization tools facilitate the collection of tacit knowledge, since they need a communication level in which mutual understanding exists. A tool that can provide this virtual dimension and that has great potential to facilitate this communication is 3D-based visualization. Some examples given by interviewees are the N18 3D model, the Tygron Omgeving and Serious Gaming initiatives. These virtual 3D spaces allow the possibility for users to deeply experience future spatial plans and visions. Moreover, simulation tools and future scenario presentations can visualize spatial impacts. Nevertheless, it will be important to create these virtual environments with an eye for great detail and recognizability. Moreover, non-complex interfaces and user-friendly software are essential for creating a virtual space that can make complex information like planning visions and its consequences comprehensive to the user. Additional face-to-face contact is, according to some of the interviewees still necessary to actually collect the tacit knowledge.

Interviewees stated that geo-referenced data is important for effective knowledge collection. In order to facilitate the qualitative nature of tacit knowledge a textual format will most likely be best applicable. Geo-forms and other geo-referenced commenting tools can provide for this. Since current social media are increasingly working with geo-referenced data, they provide some potential. Nevertheless, the role of social media is contested between the interviewees. Although useful to the extent of exploring the public's opinions and emotions it cannot facilitate more complex information sharing. However, some possibilities exist in social media messages, for instance Facebook, Twitter, and Instagram, when collected in mass along with their geographical location. Through smart filtering and hot spot analysis, issues in the living environment can potentially be identified since any abnormalities are commonly shared especially via social media. Although these collected messages contain very local information their content may often not be tacit knowledge but more incidental information.

In summary, ICT-tools that offer 3D visualization of complex information, which may be either scenarios or actual plans or visions, show good potential for tacit knowledge collection. Geo-referenced data is an important basis for knowledge collection via ICT-tools, but may in and of itself not be enough to make, for example, social media capable of collecting valuable tacit knowledge useful for spatial planning.

How can tacit knowledge be integrated with professional knowledge in spatial planning?

Subsequent to the collection comes the integration of tacit knowledge. Several ideas were put forth by the interviewees. One suggestion, shared by multiple interviewees, was that in order to facilitate the integration, an additional dimension of communication must be designed. In this 'third' dimension of communication, informal communication can be expressed between all parties involved, including citizens and private stakeholders. Again, the benefits of visualization can greatly foster this process. Professional knowledge is provided in such a manner that participants are better able to comprehend its content. Conventional methods of making formal documents available online failed to create this level of comprehension, since they were filled with juridical vocabulary. Visualizing spatial plans or scenarios along with their consequences enables the participant to put their own knowledge next to the professional knowledge. Moreover, conflicts and issues in the living environment can be better observed in the virtual 3D space. A challenge, however, is to facilitate deliberation between participants. Often, participants will be focused on their own input without realizing the conflicts that would arise with input from other participants. A 3D model that calculates the user's input and displays possible conflicting interests might be an answer to this issue, but more complex software and data provision is therefore necessary. Nevertheless, the interviewees provided enough evidence to support the idea that developing an application that supports these abilities is definitely within reach of current technology applicable for spatial planning.

Overall, no clear answers can be given to the question of how actual integration between tacit and professional knowledge can take place. Visualization can greatly foster mutual comprehension and can help citizens relate their own knowledge to geographically and spatially displayed professional knowledge. Although both the professional planner and the layperson will have a better understanding of each other's knowledge forms, real integration seems to demand that an extra step is to be taken.

Which ICT-tools and what methods can be used to stimulate the integration of tacit and professional knowledge?

Knowledge integration via ICT, as noted above, is dominantly perceived as a difficult process. Most of the interviewees found it hard provide answers for real integration methods. However, some ideas have been put forth that show potential for transferring tacit knowledge to a form in which it can be used by professionals, namely through semantical translation. When offering the opportunity for citizens to share their knowledge in textual form (perhaps as complementary to spatially visualized tacit knowledge), text-analyses can be used to create structure in the collected data. Although skepticism exists towards governmental bodies being able to use complex text-analysis, interviewees from the ministry itself acknowledge that such a technology can be applied. However, the time needed for creating an efficient text-analysis method can be considerable. A vocabulary needs to be developed that deals with the semantics of collected data. When a semantical translation framework is set up, the data can be categorized, so that themed analyses can be conducted. By applying such technology, the collected public knowledge can be ordered and analysed for useful content. Moreover, patterns can be identified that offer new insights into the collected data. It must be noted that creating a semantical

framework is a very complex endeavour which should be taken into account when working with text-analysis technology.

Overall, the interviewees acknowledge that ICT-tools focused on visualization such as 3D virtual spaces offer some promising potential to collect tacit knowledge. However, integration of the knowledge remains a sophisticated endeavour. Mutual understanding of tacit knowledge and professional knowledge by laypersons and professional planners does enable a relationship between the two forms. Integrating both forms into one seems to be more of a challenge. Smart text-analyses might be able to create a semantical framework that can help transform tacit knowledge into structured data directly usable for professionals. Nevertheless, not much evidence can be put forth to support this potential.

8. Analysis of Three Non-Dutch Cases

This chapter will deal with three cases outside the Dutch planning environment that entail some form of occupation with the stimulation of public participation by using the public's tacit and local knowledge to improve their living environment. As mentioned in the methodology chapter, the cases that will be treated are:

- The Orton Family Foundation's Heart & Soul Method (USA)
- SoftGIS (Finland)
- Place Matters (USA)

The chapter will be structured by dealing with all three cases separately, followed by some concluding remarks based on the research questions. Firstly, each case will be introduced. Secondly, the nature and characteristics of the applied methods will be explained. Thirdly, an evaluation of the case or a critical assessment of the method will be given.

8.1 The Orton Family Foundation's Heart & Soul Method

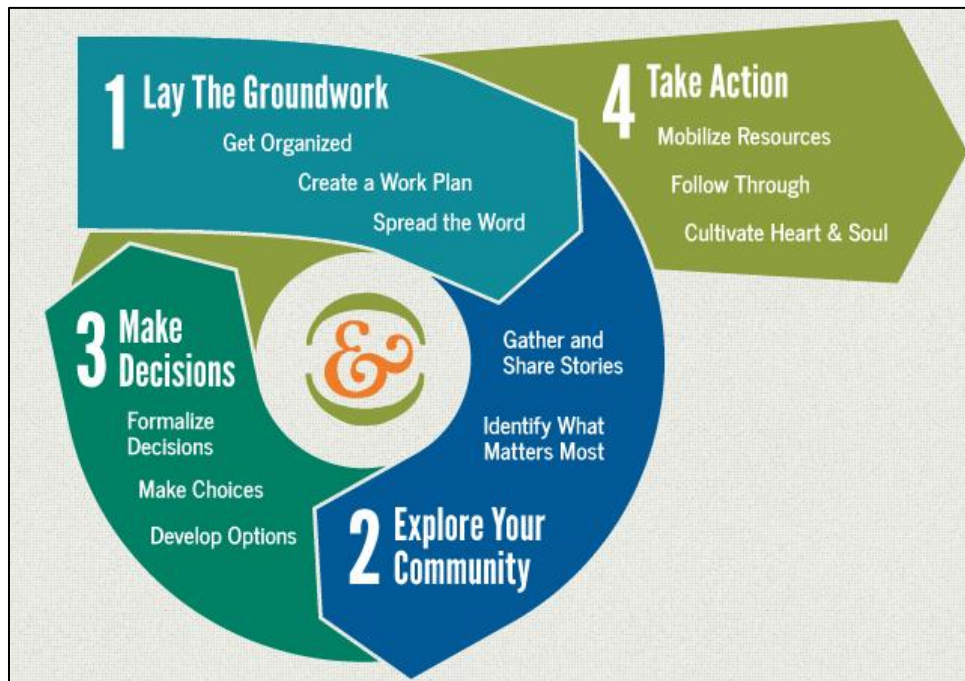
8.1.1 Introduction

The Orton Family Foundation was founded in 1995 in Vermont. Its focus is to help building stronger, healthier, and more economically vibrant small cities and towns across the US (Orton Family Foundation, 2017a). It supports community development and has developed a model that empowers residents to shape the developments of their communities and living environments. The Community Heart & Soul method supports projects occupied with creating positive resident-driven change and recognizes the value of uniqueness that is held by every community's location. Important for their model is seeking the collective wisdom of all residents including those who are often excluded and whose voices are often missing. They state that collective insights into what truly matters most often contribute to better decision-making (Orton Family Foundation, 2017a).

8.1.2 Heart & Soul Method

As stated, the environmental focus of the foundation is on American towns and smaller cities. They have developed the Heart & Soul method, which is an A-to-Z path for such communities through a 'barn-raising' approach that increases participation in local decision-making (Orton Family Foundation, 2016). Public engagement techniques are approached from a broad perspective and consist of varying (online) techniques. Such digital methods for public engagement will be looked at in this section. All techniques are used to collect qualitative data held by the public, which consist of three types of data: what matters most to them, hopes and concerns, and ideas. Although most techniques are based on face-to-face contact, their "hit the streets" approach does use online platforms as well, such as Facebook and web forums. Figure 7 displays the model of the Heart & Soul method.

Figure 7: Orton Family Foundation's Heart & Soul Method



Source: Orton Family Foundation (2016)

The model consists of four phases that work as a cyclical iterative process, but the final objective of the model is get to the last phase in which actual action is undertaken based on what is learned in the first three phases. Online methods that are spread for these phases include:

- Online forums
 - o Send messages to local online forums or via email lists (phase 1)
- Online surveys
 - o Distribute a questionnaire asking people what matters most to them (phase 2)
- Online surveys
 - o Focus on finding ideas for advancing the community's Heart & Soul or for prioritizing actions (phase 3)

The Heart & Soul method also acknowledges the importance of locative media as an engagement method that links information to geographical locations (Orton Family Foundation, 2016). The context of the community discussion becomes more understandable when information is tied to specific places. Online forums allow people who might otherwise be unavailable to attend face-to-face activities to share their ideas and insights, but online techniques should remain complementary to face-to-face activities.

The Heart & Soul method advises to conduct a Community Network Analysis (CNA) before communicating with the community. The aim of such an analysis is to identify audiences and demographics and help map communication channels. Online presence in one of the steps of a Heart & Soul communication plan should include:

- A website
 - o Stimulate learning and allow for the tracking of ongoing projects in the community
 - o Create an online communication platform for community engagement
- Social media presence
 - o Consists of many options such as Facebook, Instagram, and Snapchat, but the chosen medium should rely on the judgement of a social media manager of which medium is most effective in the relevant area.
- Email blasts
 - o Continue to get the word out: newsletters, updates, event invites and so on and so forth.

Thus, online communication options vary and depend on the community context. Sufficient knowledge about the community is of paramount importance to the communication plan in order to judge how effective e-communication will be.

The Heart & Soul Method describes some general advice when using social media (see figure 8).

Figure 8: Heart & Soul's Social Media Advice

Rule of thumb for all social media platforms:

- Only use it if you keep it current and figure out how to make it useful.
- This will take significant time and energy at the front end, just to get systems working.
- A mis- or under-used social media identity can actually hurt your reputation.
- Assess its usefulness for targeted audiences
- Let it go if you don't have the resources and/or it's not working to fulfill your goals.
- Maintaining them effectively takes attention.

Facebook

- It's about participation, conversation, community
- Start and follow conversations
- Comment as you hope to be commented on
- Don't take it on if you can't have an active presence
- Facebook connects with everything, your website, blog, twitter, etc.

Twitter 140 characters

- Listen first. What's the buzz?
- Identity matters: don't let others use your handle, choose good handle
- Who's tweeting? Content counts
- Use for BREAKING NEWS
 - o Transparency plus Authority leads to Trust
- Timely & Active; Get to the *verb* quickly
- Responsive, relevant
- Who's following you?
 - o Quality or quantity? **Quality** is an important key to quantity

Source: Orton Family Foundation (2016)

As can be gathered from figure 8, it is primarily important that online tools such as social media must only be used when their use is considered complementary to the public engagement process. Moreover, it is considered essential that enough resources should be present that can make optimal use of the online medium. Partial commitment to the communication channel will not contribute to better public engagement and can actually hurt the project's reputation. This aligns with the idea of Noujua (2010) that fast feedback is essential to create common understanding and a cooperative system based on a rich medium. This is also backed by results from the interviews with Platform31 and Rathenau Instituut (p.c).

Another concept that is central to the Heart & Soul method is 'Storytelling'. Stories can reveal what matters most to residents, forge new relationships, bridge divides, build trust, and stimulate novel solutions (Orton family Foundation, 2016). Stories are approached as a form of data but with a 'soul'. They can be complementary to statistical numbers and can deepen the understanding of whether life in the community is perceived as improving or eroding. The Heart & Soul method produces stories as statements (Heart & Soul Statements) that consist of emotional expressions, feelings of connectedness, and expressions of what makes the community unique. Those statements are integrated into decision-making by focusing on action words or verbs such as "treasure", "value", "respect", "honour", and "will be/will have" that speak to the community's aspirations. Statements focus on the 'what' and 'why', wherein the 'what' can be categorized into themes and attributes and the 'why' refers to the benefits. Statements should be clear and concise but should contain enough detail as well, to reflect the unique attributes and benefits of the community.

8.1.3 Results of the Heart & Soul Method

The Orton Family Foundation identifies thirty-four success stories of Heart & Soul implementations in towns and cities across the USA. Most of them are located in the states of Maine (9), Pennsylvania (6), and Colorado (6) (Orton Family Foundation, 2017b). A selection is made from these success stories, as is evaluated by the Norton Family Foundation, based on their used method. Since the focus of the Heart & Soul method is not on digital tools in general, cases will be selected that have made most use of digital and online tools. The selection was made through exploring all cases, and the selection criteria were:

- (1) Available online documentation about the implemented Heart & Soul method
- (2) Extent of implementation of the Heart & Soul method
- (3) The use of digital and online ICT-tools as part of the Heart & Soul method

The first criterion ensures that the selected case has enough information that can be assessed, otherwise any evaluation would be challenging. For many cases this meant that they were unfit for further evaluation. This is not surprising, since the municipalities that use the method are limited in population size and have a relatively small bureaucratic apparatus. Indeed, the Heart & Soul method was precisely developed for such smaller municipalities. Concerning the second criterion, many of the Orton Family Foundation's success stories were only small planning interventions, and provide for too little material to be evaluated. Moreover, some of the Heart & Soul implementations were still in initiation phases meaning no real results were yet present in documented form. The third criterion, essential to the topic

of this thesis, was used for selecting cases that were relevant for the research questions. This means that cases are only relevant when they try to use the local and tacit knowledge of the people through digital tools and online platforms.

The following three cases were selected:

- Victor (Idaho)
 - o Teton County
 - o Population: 1,928 (2010)(City of Victor, 2012)
 - o Available documentation
 - o Usage of online tools
- Essex (Vermont)
 - o Chittenden County
 - o Population: 19,765 (Town of Essex, 2016)
 - o Available Documentation
 - o Online forum and tools
- Biddeford (Maine)
 - o York County
 - o Population: 21,277 (suburbanstats.org, 2016)
 - o GIS mapping project

Victor, Idaho

On March 25th 2011 the town council of Victor published the final summary report of Envision Victor (EV) which was initiated in 2008. The project of EV's goal was to develop the town's planning vision alongside with intensive public engagement based on the Heart & Soul method since its citizens viewed formal land-use planning as unfair and intrusive (City of Victor, 2011). As part of their civil engagement methods, they used storytelling, among other initiatives, to articulate action steps and to encourage the integration of the community's values and visions in the decision-making policy. Another objective was to hire a GIS/Community Viz' that would help visualize the impacts of planning scenarios for the residents and to make planning decisions reflect the citizens' values. In March 2009, the Digital Expressions Storytelling was introduced and a CNA was performed and in April 2009 the Digital Expressions Storytelling training workshop for project partners and volunteers was executed. From October 2009 onwards, the collected stories were processed, and in 2010 sustainable values of Victor were identified and processed for EV's final report (City of Victor, 2011). In general, the achievements of the EV were the strengthening of the community engagement in planning and helped creating more civil dialogue. Community tools such as the Community Viz helped to ensure that the City's decisions were supported by public values. The final report of EV also contains 9 public comments from community members and project stakeholders which are all positive about the project's results (City of Victor, 2011) and regional media praised the outcome of EV:

"After more than two years of innovative public outreach and community – based planning exercises, the Envision Victor project has met its goals and left the City of Victor with a plan to continue to incorporate the Heart & Soul values of the community into public decisions."(Teton Valley Advocates, April 4th 2011)

Although it is hard to precisely identify the contribution of the Digital Expression Storytelling and the Community Viz to the success of EV, it is safe to say they were complementary to the success. The Community Visualization, developed by Sunrise Engineers, allowed for the visualization of resulting effects of different planning decisions with the capacity of running sophisticated calculations related to capital projects, public works, and large scale land use (City of Victor, 2011). Moreover, younger generations' awareness was increased and the Storytelling method helped bridge differences and formulate Heart & Soul values that are recognized by the City's council as useful for planning decisions. The Council expects such engagements processes to continue. With 550 unique participants (29% of total population and 17% of the population of Victor Impact Area) (City of Victor, 2011) the engagement of the public and the improvement of public participation in Victor has significantly increased with praised results. In conclusion, it can be concluded that ICT-tools such as Digital Expressions Storytelling and the GIS-based Community Viz have contributed to collecting local values and knowledge and have improved land use planning processes in Victor.

Essex, Vermont

On February 10th 2014 the Heart & Soul off Essex project was summarized. The goals of the project were to improve public engagement and identify shared values for future decision-making. Heart & Soul played three main roles in the community:

- Convener (improving community communication)
- Connector (connecting citizens with the local government)
- Champion/advocate (ensuring the incorporation of community values in decision making)

Digital engagement tools used were social media information sharing, keypad polling, but also online forums that gave residents the opportunity to stay in touch and participate in the local government (Heart & Soul of Essex, 2014). In a public engagement practices workshop held by Essex stakeholders on December 2nd 2016, the importance of establishing local online forums was underscored. Several essential factors in making such forums successful were identified; the forum should have: regularity, predictability, continuation, and it should be audience-oriented (Heart & Soul of Essex, 2017). In evaluation of the project by stakeholders, one shortcoming of the project was the capacity used for online engagement which resulted, among other factors, in difficulties concerning the inclusion of a broad range of people (the same two hundred people were involved in everything). "Online platforms for engagement stimulate strong participation," (Heart & Soul of Essex, 2017) was one of the statements that were concluded at the workshop. The Essex Government Group (EGG), a project group funded by the Orton Family Foundation, explored, along with citizens via online surveys in 2014, the ways Essex can continue to improve civic engagement and processes of governance. In their publication, they stated that a lack of online opportunities is a big barrier for young people. Moreover, they acknowledged the desire for more proactive information sharing through the use of technology and online platforms. In the survey 23%, of the respondents identified the lack of online opportunities to participate the biggest barrier preventing them from participation (Heart & Soul of Essex, 2015). Only lack of shared information scored higher (32%) but this can be viewed as a problem that can be solved with similar solutions, since a more proactive online presence also means more opportunities for sharing essential information. Thus, the lack of online and more technical opportunities to participate and share knowledge were recognized

as shortcomings of the Heart & Soul of Essex project. Nevertheless, Heart & Soul of Essex states that outcomes of the project were (Heart & Soul of Essex, n.d.):

- (1) Coordinated planning efforts that reflect the community's values and vision in land use planning
- (2) A culture that encourages and supports residents who want to participate in the civic life of the community
- (3) A landscape that reflects local values

EGG's main findings were more critical and stated that future engagement methods should be more proactive in communication, should stimulate more empowerment for the neighbourhood, and should provide for more informed and deliberative voting opportunities (Heart & Soul of Essex, 2015). Both slightly opposing conclusions regarding the outcomes of the Heart & Soul of Essex project suggest that improvement of the method is welcome. It is clear that better and more available online participation tools and technology (ICT) can greatly contribute to this.

Biddeford, Maine

The Heart & Soul Community Planning initiative was set up to produce The Heartworks Master Plan. The plan is focused on revitalizing downtown Biddeford by seeking to engage the dispersed communities and identify common values (Heart of Biddeford, 2017). These identified values were subsequently incorporated into the Master Plan and into all future planning and development decisions. The project was executed between 2008 and 2010 and was used to tackle the city's decline due to the abandonment of the textile industry (Orton Family Foundation, 2017c). Heart of Biddeford served as the project coordinating body and used Storytelling and community-wide forums as online and digital approaches to improve public engagement (Heart of Biddeford, 2017). The information and values resulting from these activities were subsequently visualized into planning alternatives by the use of a GIS mapping project called Mapping Stories. The objective of Mapping Stories was to create GIS maps that reveal valuable locations as assessed by the public (Heart & Soul attributes). Results from the project were a .KML file developed for the project's website and four maps profiling geospatial information and civic opinions on land use (Andrews & McBride, 2010). The project, in cooperation with the University of Southern Maine's GIS Department, concluded that the maps enhanced by multi-media provide broader opportunities for public participation, as well as longevity for public interest beyond the culmination of the planning process. The layering of community stories among geospatial datasets in GIS maps offers a unique method for public participation. Moreover, the GIS mapping tool stimulated the opportunity for decision-makers to make more informed decisions based on values that are held dear by residents and stakeholders in Biddeford (Andrews & McBride, 2010).

The Heartworks Master Plan was finalized and issued in July 2011. Storytelling was evaluated as successful by the Master Plan in broadening participation and building social capital, which was provided by the Heart & Soul method (City of Biddeford, 2011). The use of GIS mapping for visualizing community values was a good method for integrating the collected values and knowledge into policy development (Andrews & McBride, 2010) and can therefore be seen as a useful extension to the Heart & Soul method for integrating local knowledge into broadly supported policy.

8.2 SoftGIS

8.2.1 Introduction

SoftGIS is a Finnish innovation that refers to the collection of online surveys that collect and study geographic referenced human experiences (Kyttä & Kahila, 2011). In traditional PSS, the use of 'hard data' was dominant, but the SoftGIS methodology introduces its integration with 'soft data'. It has the potential to enhance participation by allowing civilians the possibility of producing and sharing their knowledge of their living space with urban planners and researchers (Kahila & Kyttä, 2009). SoftGIS received the Technology Innovation Award for Web GIS at the 2011 Geospatial World Forum in Hyderabad (India) and was later also applied in urban areas in both Japan and Australia. Marketta Kyttä and Maarit Kahila, both researchers at the Finnish Aalto University, set up an overview of SoftGIS methodology. The next paragraph will be dedicated to demonstrating this methodology. Thereupon, some features and challenges of what good practices of SoftGIS entail will be elaborated upon.

8.2.2 The SoftGIS Methodology

The SoftGIS methodology does not only include a set of individual SoftGIS methods but also the collection of theories, concepts and ideas. SoftGIS methods were first developed in 2005 based on open-source technology. Today, SoftGIS methods are based on Esri technology, but new steps towards open-source technology are being taken (Kyttä & Kahila, 2011). Through SoftGIS surveys, large datasets can be collected that are directly digitally available, and its analysis is performed scientifically. This knowledge collection happens through user-friendly internet-based applications (Kahila & Kyttä, 2009). Via GIS techniques, the perceptions of civilians are combined with physical land use data and simultaneously analyzed. Occasionally, place-specific analyses are conducted in order to study the physical structure of locations that are determined as important to inhabitants (Kyttä & Kahila, 2011). SoftGIS methods are built on five principles (Kahila & Kyttä, 2009):

1. The operationalization of perceived knowledge is grounded in the theories of humanistic geography and environmental psychology
2. The perceived knowledge is gathered through scientifically valid, reliable and ethical methods
3. SoftGIS methods are developed in cooperation with urban planners, who can use this novel knowledge in their planning practices;
4. The database makes systematic GIS and statistical analyses possible
5. The methods provide a user-friendly internet platform for residents to evaluate their everyday living environment.

Based on promotion of sharing residents' experiences concerning their living environment, the SoftGIS approach believes that web-based GIS application can become an important way of communication between civilians and planners (Kahila & Kyttä, 2009).

8.2.3 Features of and Challenges for Good SoftGIS Practice

Kahila and Kyttä (2009) conducted a critical evaluation of SoftGIS methods. They have compared SoftGIS with some examples of PPGIS and PSS and argue that SoftGIS can build a bridge between these two systems. They state that GIS should not only be seen as a container of digital maps but also as:

- A supporting system for spatial decision-making
- A facilitator of spatial thinking in the planning process
- A tool for revealing soft spatial knowledge that is otherwise invisible in geo-information

Traditionally, residents are often neglected in PSS development. PGIS and PPGIS aim to integrate the layperson into the GIS and make use of local knowledge although they often rely technically on expert systems and are not designed for laypersons. However, Kahila and Kyttä argue (2009) that easy-to-use internet-based systems have the potential to tackle hard-to-use conventional GIS application, although more developmental work is needed for SoftGIS in order to create a two-way channel of continuous communication between the public and the planners.

Visualization, Kahila and Kyttä (2009) continue, plays a key role in challenging the task of information overload, which is one of the issues that already exists in conventional GIS use and increases with the introduction of experiential and local knowledge. A 'softGISview' tool, currently still in development, can be of assistance in exploring all available data by urban planners and other interested parties. A map overlay of experiential knowledge collected through online surveys with thematic city structure maps can be an example for this.

Representing objects and subjects via mapping technology can have its difficulties. From a theoretical basis, originating in human geography and environment psychology, the mutual repercussion between human behaviour and ecological and geographic processes has always created a dualistic approach to socio-geographical issues. A response to this dualistic approach is 'affordance', a concept used in ecological perceptual psychology (Kahila & Kyttä, 2009). The concept refers to the perceived opportunities and restrictions concerning a person's spatial behaviour and can be expended with emotional, social, and social-cultural opportunities and restrictions. Because affordance breaks with the subject-object dichotomy, since it has no characteristics of the person or the environment, the transactional relationship between the person and the environment can be operationalized. This process is what SoftGIS methods attempt to do as well. It tries to capture the experiential knowledge, the environmental behaviour data, and the use of infrastructure in every day life. GIS has the ability to operationalize the depiction of the physical environment although it can never be an objective visualization. Nevertheless, it presents itself as the most useful method so far.

Regarding the processing of SoftGIS data, Kahila and Kyttä (2009) have described some findings. Maps are generally easier to navigate and use by public users when address maps are used. Aerial photographs were proven more problematic in that sense. Mapping tools are often perceived most difficult by the elderly and the young. Mapping aid tools are therefore necessary, but are still subject of ongoing research. The soft 'fuzzy' nature of local and experiential knowledge can be best addressed with spray can tools that give the tool user the possibility to locate more geographically dispersed and diffuse phenomena, such as areas that are perceived to be struggling with high crime rates. SoftGIS data can

also be analyzed quantitatively when closed or classified questions are used in surveys. Applying qualitative analyses methods, such as argumentation maps, might seem more valuable but are often considerably more laborious.

In conclusion, prominent to the SoftGIS methodology is that visualization is an effective way to deliver knowledge, as is proven by prior research (Kahila & Kytä, 2009). Web-based GIS applications have great potential for bridging PSS and PPGIS/PGIS and providing for user-friendly tools to laypersons. Nevertheless, limits and challenges have to be acknowledged as well. Information overload remains a challenge, and further ICT/GIS innovation is needed alongside social and societal innovations. Methodologies for stable technical platforms are to be further developed, both with new and relevant ways to analyse geographically referenced experiential knowledge and its integration in planning practices and decision-making.

8.3 Place Matters

8.3.1 Introduction

Place Matters is a Denver (Colorado) based non-profit think tank for civic engagement in planning processes (Place Matters, n.d.(a)). Their objective is to create informed and inclusive decision-making in planning processes of cities and communities. They work throughout the USA to improve these processes by means of new approaches and technologies. As a result, many communities have experienced a more engaged and effective democracy. Place Matters has executed several initiatives and some of them will be elaborated upon in this section. They do not apply a particular method or strategy that is articulated in any document or publication. Therefore, no method similar to the sections dealing with the Heart & Soul method of the SoftGIS methodology will be explored and demonstrated. A case study originating from the initiatives conducted by Place Matters will be evaluated in this section. The case study was selected from a list of case studies published by Place Matters, although many of these cases lack broad documentation by the official planning parties concerning the implementation of the developed tools. The case study was selected means of similar criteria as those used for the Orton Foundation's success stories. The criteria for the case studies were:

- (1) Available online documentation about the implementation
- (2) Extent of the developed tool or method's influence on planning processes
- (3) The use of digital and online ICT-tools for collecting tacit and local knowledge

The selected case study concerns the development of the CrowdGauge game used in multiple cooperations of Place Matters with different American planning bodies. De metropolitan area of Des Moines made most extensively use of the gaming application and its implementation of the tool will therefore be the center of attention in the next section.

8.3.2 Crowd Gauge Game for Des Moines The Tomorrow Plan

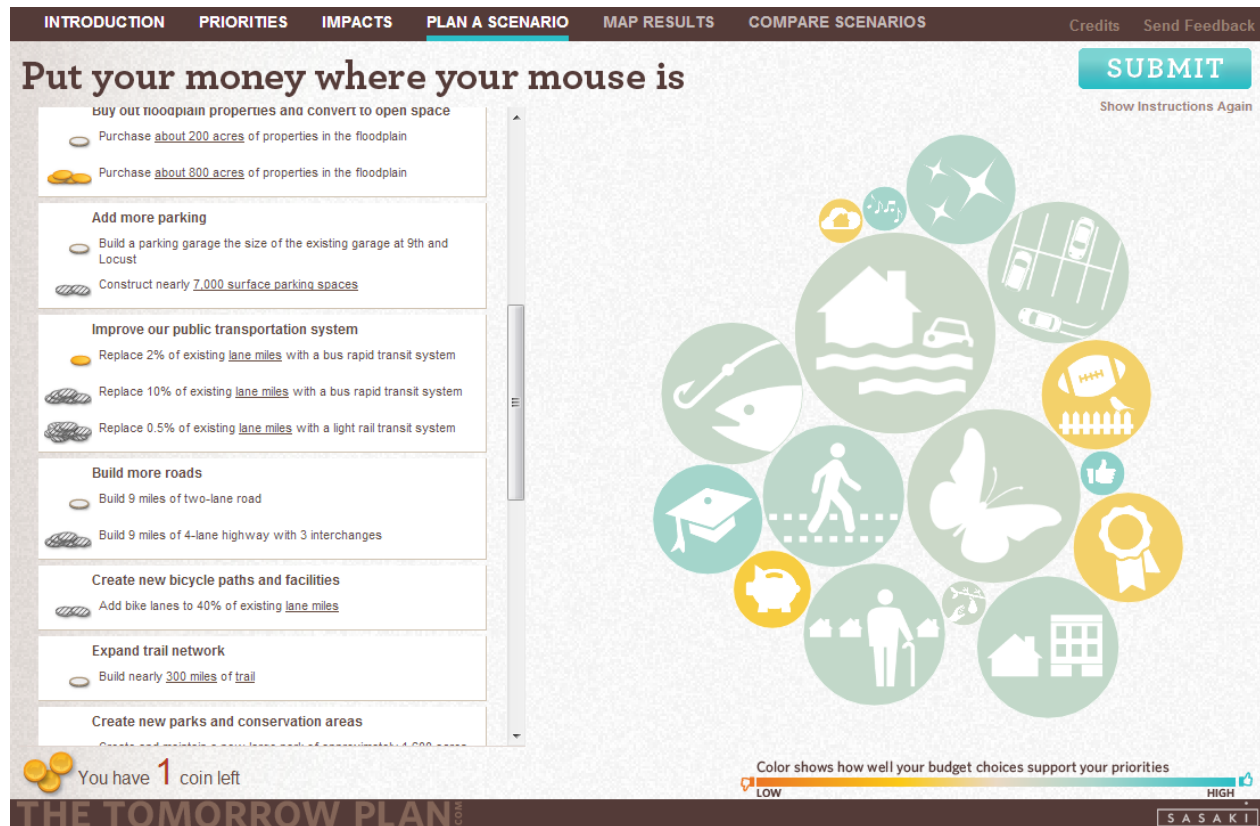
Since unprecedented amounts of data are available for urban planning professions, along with unprecedented efforts of engaging public in the processes of planning, a new challenge has risen. Many perceive that knowledge concerning the needs and demands of the living environment can no longer be

solely possessed by the professional alone (Place Matters, n.d. (a)). Data visualization and other emerging technologies are means for Place Matters to tell the stories that underlie complex data. These visualizations can help communities explore the choices they face and make more informed and inclusive decisions. A case study that is a result of this initiative will be explored. In collaboration with other parties, Place Matters dealt with the challenge of communicating complex data to and with the public by designing games and visualization tools. The case of the CrowdGauge game will now be evaluated in how it contributed to planning processes in Greater Des Moines.

Often planning processes that try to engage with the public and stimulate their participation have to find a way of deal with two extremes. Firstly, too much technical jargon and maps are often used when planners converse about urban planning. Secondly, planning issues that are simplified for civic engagement tend to receive feedback that lacks the specificity needed to provide for useful direction for planners and policy-makers (Place Matters, n.d. (b)). CrowdGauge is an entirely Open Source web-based game that tries to find a middle path between these two extremes. It yields rich data containing residents' needs and the trade-offs they are comfortable with. In addition, it also collects basic demographic and geographic information about each set of responses. This allows for the analysis of underlying demographic and geographic patterns behind the full set of responses. CrowdGauge (originally named DesignMyDSM) was developed by PlaceMatters in collaboration with Des Moines Area Metropolitan Planning Organization (DMAMPO) and Sasaki as part of the Tomorrow Plan, which is a regional plan for sustainable development in the Central Iowa Region (CrowdGauge, n.d.). The game (see figure 9) works by first asking the users to rank a set of priorities. Secondly, the game subsequently demonstrates how a series of actions and policies might impact those priorities. Thirdly, the user is given a limited amount of coins that can be spent on the action they support the most through scenario planning. The participant's input will subsequently be mapped and afterwards, different scenarios can be compared. In order to make such a game attractive to potential participants and subsequently collect their local knowledge, the development team explored several dynamic media options. They chose to use dynamic Javascript elements that would make the user's interface more attractive and user-friendly (The Tomorrow Plan, 2012a). Mockups of the infographics were an important way to communicate with The Tomorrow Plan committees and discuss their purposes.

The Tomorrow Plan project analyzed the effects of the game and saw that, in a region with approximately 480,000 residents spread over seventeen communities identified in the The Tomorrow Plan, study participation was realized in all these communities (The Tomorrow Plan, 2012b). Compared to the average population in the zip codes that are part of the study area the participants' average age was considerably younger. The game also got attention outside of the study area, resulting in a considerable amount of respondents that do not live in the study area. These respondents were excluded from the analyses on basis of their entered zip codes. In their final evaluation of the game, DMAMPO's Tomorrow Plan concluded that it had accomplished engagement of the community, that it reached a younger generation, and that it served as one of many opportunities for public input (The Tomorrow Plan, 2012c). Based on the coin spending game feature the game helped identify priority projects that were in need of most investment, and the ongoing policies that were most popular. The later published final report of the Tomorrow Plan stated that the outcomes of the game aligned with

Figure 9: The CrowdGauge game



Source: CrowdGauge (n.d.)

what the project had heard throughout the process regarding residents' priorities (Greater Des Moines, 2013), supporting the argument that the game was able to identify the needs of the residents correctly. What the game contributed to other engagement methods was the ability to reach younger generations of participants. The CrowdGauge game has shown that it has contributed to spatial planning and the forming of a large urban planning vision, by means of innovative gaming features that gave respondents, among whom were people that are generally excluded from conventional participatory methods, an attractive platform to share their values and knowledge. Stated findings by Place Matters were that projects around the CrowdGauge game in several communities have shown that the game is not only valuable for communicating complex information to non-technical audiences, but it also did this for professional planners (Place Matters, n.d. (b)). In its implementation in the River Valley (Southwest Virginia), the game supported the process of specifying the connections between priorities and actions and clarify and refine their own understanding of the issues put forth by the residents.

8.4 Non-Dutch Cases Findings

Some insights have resulted from the three cases. These will now be summarized and put next to the research questions in similar style to the previous chapters. The results will be separately elaborated upon for each of the cases, ending with a general concluding remark that attempts to formulate a preliminary answer to the research questions.

Which ICT-tools and what methods can help collect and communicate tacit knowledge?

The Orton Family Foundation's Heart & Soul method offers opportunities to collect local values and knowledge. The Digital Expression Storytelling is a component of the method and was applied in both Viktor and Biddeford. Nevertheless, the focus of the Heart & Soul method is not aimed at the use of online tools. It is difficult to judge what the exact added value of using online participatory tools was, but it is safe to say that it contributed to the success of the implemented Heart & Soul methods. It helped to reach to more people and was able to collect similar public local knowledge as the analogue participatory methods did. In Essex, the lack of capacity provided for online participation was even criticized in the evaluation of the Heart and Soul of Essex project.

The SoftGIS methodology presents itself as an effective methodology for tacit knowledge collection, although information overload remains an acknowledged issue when analyzing knowledge of the public. Visualization possibilities in GIS-web-based applications are able to share knowledge between planners and citizens. Essential to the effectiveness of such applications is user-friendliness. Mapping tools that can contribute to user-friendly map-based applications are still subject of ongoing academic research. Tools like the spray-can function hold potential, since they are able to visualize more diffuse spatial objects or phenomena that can be useful for visualizing tacit knowledge based. Tacit knowledge often consists of lay knowledge that is not expressible in concrete spatial demarcation, making such tools potentially helpful.

Regarding Place Matters' CrowdGauge, the game offered some creative possibilities for participants to share their knowledge. The outcome of the game was similar to what analogue methods concluded. The game, therefore, enables people to identify their needs online similarly effective to analogue methods. Furthermore, the game was valuable for communicating complex information for both non-technical laypersons and professional planners. Planners using the results of the game were able to connect priorities with actions and understand the issues put forth by participants. These conclusions support the notion that the game is able to collect tacit and local knowledge from residents.

ICT-tools that show potential for tacit knowledge collection are the Heart & Soul's Digital Expression Storytelling (although most likely more effective in smaller communities), GIS-web-based application based on SoftGIS methodologies, and gaming applications such as the CrowdGauge game. Gaming applications are recurrent in this thesis' findings and seems to hold broadly acknowledged potential. However, since the SoftGIS methodology focuses explicitly on local experiential and thus tacit knowledge, it can be seen as the most effective way of tacit knowledge collection of all three cases.

How can tacit knowledge be integrated with professional knowledge in spatial planning?

Concerning the Heart & Soul method, the integration processes of collected tacit knowledge was not very clear. The integration seemed to go without the use of any techniques building up to the argument that the collected knowledge was used to inform decision makers without any translation. The Digital Expression Storytelling was used to identify the needs of the public, and the involved planning bodies took these into consideration in the development of spatial planning visions. This direct use of tacit knowledge by professionals seems to be somewhat dissonant with studies occupied with the means of local/tacit and professional knowledge integration and knowledge claims such as Raymond et al. (2010) Tennøy et al. (2016), Rydin (2007), and Pfeiffer et al. (2011). Additionally, some acknowledge that

combining lay and experiential knowledge with systemized knowledge such as professional knowledge is traditionally problematic (Pelzer et al., 2015). However, the three Heart & Soul cases consist of considerably small-sized communities, which might put a different perspective on this matter. Small communities are generally occupied with smaller spatial issues, due to the size of their community's geographical boundaries. Similarly, implications of spatial interventions in small communities are relatively small and less complex and therefore easier to identify. This might decrease the need of translating the tacit knowledge of the public with the professional knowledge of the planners.

The SoftGIS methodology addresses the integration process as a bridge between PSS and PPGIS/PGIS. Based on the theories of human geography and environment psychology, the affordance approach offers possibilities. It combines experiential knowledge with environmental behaviour data and infrastructure use in everyday life. This facilitates the integration of tacit knowledge with professional knowledge.

The CrowdGauge game has shown that gaming tools can facilitate the communication of complex information to both the planner as to the participant. Priorities identified by the participants and actions needed to address these were connected. Furthermore, spatial issues put forth by participants were understandable by means of the game's possibilities and were subsequently used for the Des Moines Tomorrow Plan, thus contributing to the integration of multiple knowledge forms.

Whereas Orton Family Foundation's Heart & Soul method cannot give any straightforward answers to how integration between different knowledge forms can be facilitated, the SoftGIS methodology offers a theoretically based solution through the affordance principle that can integrate hard datasets with soft datasets. The CrowdGauge game enables the communication of multiple knowledge forms and effectively transfers participants input into values that were subsequently used for professional plan-making. Along with the recognized success of the game, it can be stated that a form of integration was found.

Which ICT-tools and what methods can be used to stimulate the integration of tacit and professional knowledge?

The Heart & Soul Method does not provide any real integration techniques for tacit and professional knowledge concerning the use of ICT-tools. It does, however, show that extending the method with tools that hold the potential for such integration is possible. In the Biddeford case, the GIS mapping tool can be seen as such an extension. Andrews and McBride (2010) provide evidence for this statement. The tool was assessed as a good method for integrating local and tacit knowledge into broadly supported planning policy through the layering of community stories and opinions on land use. Nevertheless, it should be mentioned that this cannot be determined as a success factor of the Heart & Soul method in any plausible way since the Heart & Soul method does not make any statements that support this.

The SoftGIS methodology offers some guidelines for using ICT-tools for the integration of different knowledge forms. The use of web-based applications that include map-based analysis tools can provide a means for integration. Map overlays of experiential knowledge with thematic city structure maps are good examples of this. This is a result of the affordance approach that allows the combination of hard data with soft data, such as experiential knowledge. The web-based applications show great potential,

but further research with empirical evidence must be produced in order to formulate more conclusive arguments concerning the ability of the SoftGIS methodology of integrating tacit knowledge with professional knowledge.

The CrowdGauge game has shown to be a contribution to spatial planning processes. By yielding rich data that contains values and needs of participants based on a trade-off system, it proves to be potentially useful for integrating tacit knowledge and professional knowledge owned by planners and policy-makers. The CrowdGauge game overcomes the problem of overly simplified feedback by citizens that cannot provide enough content to support decision-makers. By using a game feature wherein the game player is given a limited amount of coins, the values of the citizens and their level of priority are visualized. Essential for the game's success was with the development of dynamic media options supported by a user-friendly interface.

Resulting from the Heart & Soul method analysis no real ICT-tools for knowledge integration can be identified apart from the GIS mapping tool. Nevertheless, it has been evaluated as a successful tool for knowledge integration, promoting the use of such visualization tools and analysis. The use of GIS as an ICT-tool for knowledge integration is also supported by the SoftGIS methodology. It promotes the use of web-based application for both collection and integration through smart mapping tools and overlays base integrating hard and soft data. The CrowdGauge is an ICT-tool in and of itself but the trade-off and prioritizing systems are at the basis of its success.

9. Conclusion

The applied triangular methodology has resulted in some insights. This chapter will summarize the findings of the thesis and will use these to formulate answers to the research questions. The general theoretical research stated that tacit knowledge is an important source of knowledge for spatial planning. Nevertheless, translation is needed and, additionally, a challenging undertaking. This became apparent in both the in-depth interviews and the non-Dutch cases that both did not have any significant evidence of how tacit knowledge can be integrated with professional knowledge. The general theoretical research also acknowledged the potential of Web 2.0 technologies for the collection of tacit knowledge. This potential was underscored in all three parts of the applied methodology.

The in-depth literature research concluded that Web 2.0 technologies offer potential due to its media richness and ability to facilitate non-explicit and qualitative dialogue. Web 2.0 technologies are suited to work with local and qualitative forms of knowledge especially when map-based. A user-friendly interface and a multimedia orientation are important for successful knowledge sharing. Since spatial planning is naturally map-based, collecting and integrating tacit knowledge for spatial planning purposes can as well be best approached with map-based applications. GIS can facilitate such applications and have the ability to help users understand local context through which spatially embedded knowledge can be produced. Such knowledge can be helpful to knowledge integration processes. However, integration processes need to emphasize situational contexts must be customized to local planning processes and make sure that the quality of the used maps is high enough for users to understand them. Additionally, applications (like WPPGIS-based apps) should be transparent, adaptable and, most importantly, hold as little limitations to the user's creativity as possible. The found tools and application in the in-depth literature research have shown some interesting methods that were mostly based on Web 2.0 technologies. This complies with earlier theoretical findings. Especially when different methods are combined, useful and effective applications can be developed. The combination of multi-criteria-analysis tools (such as the MC-SDSS) with argumentation maps that provide room for geographical referenced discussion is an important example for this. Trade-off functionalities, integrated in this method, learn users to make sense of their own knowledge through interaction with different stakeholders and the provision of different channels of information.

The general outcome of the interviews is that visualization plays a very important role in collecting tacit knowledge and its integration. This is consistent with the functionalities of map-based Web 2.0 applications and acknowledges, therefore, with found theoretical insights. Mutual understanding is essential for tacit knowledge dissemination. Applications that provide 3D-based visualization have the ability to facilitate this mutual understanding and communicate complex information like official planning visions and its spatial implications. Important for such visualization are recognisability, non-complex interfaces and user-friendly software. The interviewees' ideas about integration processes were not straightforward. Several interviewees opted for the creation of a new (third) dimension for informal communication. Again, visualization offers opportunities. Conventional methods of information sharing by planning bodies included incomprehensible formal documents. Visualizing this information can lower the level of complexity and create a level on which citizens and officials can both communicate. Although different knowledge forms can be more easily related to each other by means of (3D) visualization, it is

questionable of this can be perceived as actual knowledge integration. Another option for integration, noted by several interviewees, is text analysis although this discards the abilities of visualization and no theoretical support for the use of such tools was identified. Semantical translation analyses can develop a vocabulary with which both knowledge forms can be linked seamlessly. Nevertheless, the estimated time needed to build such a vocabulary is considerable. The role of social media was contested by the interviewees due to its lack of facilitating the communication of complex information. Nevertheless, smart filtering of social media messages along with using its geographically referenced locations can potentially offer the possibilities of spatial analysis such as hot spot analysis. The relatively low attention given in scientific work to tacit knowledge collection and integration via social media (such as Facebook, Twitter and Instagram) supports the scepticism of its abilities to do so.

The non-Dutch cases provided some practical examples and methods of means to collect tacit knowledge for spatial planning purposes. The precise value of ICT-tools in the Orton Family Foundation's Heart & Soule method is hard to define although positive responses to its use can be identified. The SoftGIS methodology is a promising development for tacit knowledge collection and integration. The methodology promotes the use of user-friendly GIS-web-based applications and can be seen as part of the Web 2.0 development but based on human geographical and environmental psychology science. The CrowdGauge game presents itself a useful way of communicating complex information to both planners and citizens based on the above formulated merits of visualization. Several interviewees mentioned the use of Serious Gaming for similar purposes which support the potential value of such games for tacit knowledge collection. Again, methods for knowledge integration were not clear for the most cases. Nevertheless, the SoftGIS methodology's use of the affordance approach and smart mapping tools provides promising integration functionalities. Additionally, map overlays of experiential knowledge with thematic city structure maps are effective ways of combining hard data with soft data.

Based on the above summarized conclusions, some answers can be formulated to the research questions. First, a brief answers will be given to the main research question:

How can information and communication technologies such as PSS and GIS help collect tacit knowledge and integrate it with professional knowledge to use it in spatial planning?

In general, ICT has the ability to collect tacit knowledge through multiple ways, but most notably through visualization that enables the sharing of complex information to the citizens and to the spatial planner or decision-maker. Integration processes are more difficult and conclusions to which ICT-tools can facilitate full integration remain questionable. Now, by answering the sub-questions, the final conclusions of this thesis will be enhanced with more detail:

Which ICT-tools and what methods can help to collect tacit knowledge?

ICT-tools that have proven themselves as promising means for tacit knowledge collection are map-based Web 2.0 applications that use (by preference 3D) visualization for communicating complex information. Firstly, this will enable an effective way of communicating spatial visions or plans and their spatial implications comprehensively to the citizen. Secondly, the now more knowledgeable citizen will be better equipped to respond with well-founded geographically referenced arguments. Thirdly, the tacit

knowledge owned by the citizen can now be communicated to the planner in such a manner that the receiver understands its content. The SoftGIS methodology is a promising approach to developing such applications. Additionally, the MC-SDSS combination with the argumentation map contains the features assessed as essential for effective tacit knowledge collecting applications.

How can tacit knowledge be integrated with professional knowledge in spatial planning?

Although the thesis has attempted to identify effective integration methods via ICT-tools, it has become apparent that it is a most challenging process. When is knowledge truly integrated? Is mutual understanding between the planner and the participant sufficient? Visualization tools like gaming applications and 3D-models show effective ways of relating different knowledge forms. Both professional knowledge as lay knowledge is by such means transferred to a level in which they can both be used. This said, it can be stated that by doing so, some form of integration is realized.

Which ICT-tools and methods can be used for the integration of tacit and professional knowledge?

Based on the above summarized conclusions, ICT-tools that have potential for integrating tacit knowledge with professional knowledge must have strong, user-friendly and recognizable visualization functionalities. This can be either 2D map-based or in the form of 3D-models like scenario simulation engines and gaming applications. The CrowdGauge game, the N18 3D-model, and web-based applications based on the SoftGIS methodology's affordance approach have shown to be effective tools to create a knowledge level in which both planners and citizens can communicate their knowledge in a mutually comprehensive manner.

10. Discussion

This thesis attempted to shed more light on a considerably under researched topic. Although some promising possibilities have been identified some attention has to be given to the value of these acquired insights. Whereas the technological advances in the realm of ICT show no sign of stagnation the organizational and political value of it has to travel a more intricate road. As was put forth in the interview with I&M governmental bodies need to comply to directives for communication with the public and other stakeholders. Although experiments and explorative researches are being conducted, changes inside the organizations are necessary as well. This was not part of this thesis' topic but is a necessary one to future research that continues on this and other relevant work. How can governmental planning bodies become more data-driven? How can ICT-tools be used so that it both answers to mandatory directives and to the needs of new participatory approaches? These are questions that arose from the conducted interviews and require further attention. Next to governmental directives and policy towards technology use it is also important to keep in mind that expenses related to the development of ICT-tools for participatory purposes, like Serious Gaming and 3D-models for scenario visualizations, can be (too) high for current Dutch planning bodies. Nevertheless, along with technological advance concerning ICT and its applications, comes costs reduction concerning the development, implementation, and use of these technologies. The future might therefore add to the potential of what is inquired in this research.

Promising innovative approaches to the collection and integration of tacit knowledge by means of ICT-tool such as PSS and GIS-technology can be of contribution to better spatial planning processes but resulting from the interviews one must be aware that interaction between planning administrators and the public is a delicate thing. Although it was not part of the analysis, feedback is an important feature in any participatory ICT-tool. Planning bodies must acknowledge that in order to stimulate the public in sharing their knowledge they must have a sense of being of contributory value. Often, creating such feeling of usefulness can be created by feedback or visualizing the participant's input. Visualization tools can offer such instant feedback but additional feedback might remain necessary in order to avoid the feeling of being processed in an automated and mechanical manner. A human touch of interaction will most likely remain important when facilitating such interaction online. Although this thesis did not explicitly focus on this manner it acknowledges that any implementer of an ICT-tool for participatory planning purposes must be aware of this.

First steps towards effective tacit knowledge collection and integration are being taken. This thesis has been one of them. Although some experiments have been conducted and evaluated more evidence for effective means is necessary. Further developments in Web 2.0 technologies and GIS-based applications will most likely increase the possibilities of technological feasible participatory ICT-applications. Important for the planning sphere is to keep experimenting with these technologies and support research to improve them. Furthermore, more scientific work is needed to further fill the current gap in academic literature. Especially a focus on tacit knowledge is important due to its value for better spatial planning that accurately addresses the needs and issues that exist in the living environment. This means that further research to the complexities of knowledge and tacit knowledge in particular is needed as well. As became apparent in this research, integrating tacit knowledge with professional knowledge

remains challenging. The SoftGIS methodology holds great potential but contemporary researchers involved in these studies acknowledge that more research is necessary.

In conclusion, this thesis has provided some new insights by the use of three different forms of analysis: an extensive literature research, eleven in-depth interviews, and three non-Dutch case studies. This triangular approach attempted to collect knowledge from a broad range of sources that together provide for a solid methodology. However, the research was of exploratory nature. More extensive evaluations are needed that specifically focus at particular applications. The potential of ICT-tools such as PSS and GIS have been put forth and analysed for its use for tacit knowledge collection and integration for spatial planning. ICT-tools can be used and will most likely be used more in the future than they are currently. However, one final reminder needs to be put forth. As was also acknowledged by several interviewees, digital means to improve participatory processes can never cover the complete story. In other words, ICT-tools will remain, at least for the nearby future, complementary to all applied methods of public participation in spatial planning. Face-to-face contact possibilities such as city or neighbourhood meetings and other analogue methods will remain necessary for democratic reasons. Using only ICT-tools for participation will exclude less digitally knowledgeable citizens such as older generations and will mostly, intentionally or not, focus on younger citizens or citizens that are more familiar with using computers and have better digital accessibility. Nevertheless, this works both ways, meaning complementary ICT-tools can contribute to engaging to a broader range of the population.

11. Reflection

In general I look back at a very educational process. I found it initially difficult to come up with a topic for my master thesis that would provide enough stimulation for a master's thesis, but when scrolling down the lists of topic options I encountered the term tacit knowledge. I was familiar with this term from my bachelor studies (Human Geography and Urban Planning) in Amsterdam and was always intrigued by how local created knowledge can be so different to knowledge created elsewhere. Local specialism or experience can create a unique context with which it can differentiate itself from other localities. Concerning spatial planning, this applies to every locality since improving the environment starts with listening to the environment itself. A neighbourhood's residents know best about local social dynamics and therefore hold potentially the most crucial knowledge to improve or maintain the living quality of that neighbourhood. The GIMA program allowed me to look to this knowledge from a technological perspective. The hiatus in current scientific work and the need for new innovative forms of participation with the coming of the Dutch Environmental Planning Act was an ideal situation to conduct this research. Nevertheless, the complexities of knowledge and especially tacit knowledge have proven to be hard to grasp. This was most notably the case during the interviews. Since it is a term that resides mostly in theoretical work its unfamiliarity was unsurprisingly. Perhaps if I was to continue on this path of research I would try to find ways to better describe the term when discussing it with others. Initially I was a bit sceptical about the applied snowball-method, but with eleven conducted interviews I look back at a successful operation. Reaching to contact persons for interviews was generally easier to me than I initially expected. Of course, for this my gratitude goes out to all the interviewees for making time for correspondence and the interviews. The interviews provided me with several interesting conversations with people with whom I will most likely share the work field in the nearby future. The in-depth literature research was extensively laborious, but with experience of a successful individual literature research (graded with a 9) during my bachelor studies provided me with some skills for efficiently reading scientific articles. Personally, I look back at a fruitful cooperation with my supervisor with whom I sat several times to discuss the thesis' progress. My study will now continue with an internship in order to start building up practical skills and to get prepared for entering the work field of geo-ICT.

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