

2014-06-12

Design of a Support Tool for Citizens Engaging in Urban Planning Online

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Bliss Taylor, C. (2014). Design of a Support Tool for Citizens Engaging in Urban Planning Online (Master's thesis, University of Calgary, Calgary, Canada). Retrieved from <https://prism.ucalgary.ca>. doi:10.11575/PRISM/25588

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UNIVERSITY OF CALGARY

Design of a Support Tool for Citizens Engaging in Urban Planning Online

by

Coral Bliss Taylor

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF GEOMATICS ENGINEERING

CALGARY, ALBERTA

JUNE, 2014

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Abstract

Online engagement in urban planning is accessible and convenient, but lacks face-to-face expert feedback and support. This research undertakes design of online support for lay citizens, to complement online participation environments. The design examines multiple planning strategy alternatives at various scales and perspectives. It calls for communication using visuals, examples, comparison, discussion of trade-offs, and providing for varied communication preferences. It calls for information specific to existing levels of cooperation and agreement, collective interests, values, and responsibilities, need for resource management, costs of strategies, and explicitly addressing value conflicts. A prototype is constructed using a selection of design components, then tested via online survey, and analysed quantitatively and qualitatively. Results indicate that users appreciated the information and features, and felt informed, confident, and more inclined to contribute to planning. It is concluded that the proposed solution can supplement missing support and feedback, should be further developed, and can be adopted.

Acknowledgements

This thesis would not have been possible without the support and encouragement of so many people, who unfortunately cannot all be personally named.

Principally, I would like to thank my supervisor, Dr. Andrew Hunter, who went above and beyond in providing constant support that perfectly balanced guidance, encouragement, and freedom to explore and develop. Thank-you also to Dr. Mike Barry, Dr. Danielle Marceau, and Dr. Noel Keough for agreeing to review my thesis.

I would also like to thank my research group and extended network of colleagues in the Department of Geomatics Engineering for providing the intellectual environment that I have so enjoyed over the years.

I would further like to acknowledge and thank the community of Glamorgan, Calgary for their time and efforts in an engagement process.

Financial support from GEOIDE and the Neptis Foundation, the Province of Alberta, the Faculty of Graduate Studies, the Department of Geomatics Engineering, and friends, family, and associates of L.R. (Dick) Newby has been invaluable and is gratefully acknowledged. I would also like to thank Ursula Taylor, who has supported all of my post-secondary education.

Finally, I would like to extend my gratitude to my parents and grandparents especially, as well as to all of my family and friends, who provided support, encouragement, advice, diversion, and even housing, when I needed it most.

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List of Symbols, Abbreviations and Nomenclature

AJAX	Asynchronous JavaScript and XML
AMA	Ask Me Anything (commonly used on the entertainment and social networking website Reddit)
APEGA	Association of Professional Engineers and Geoscientists of Alberta
EPA Victoria	Environment Protection Authority Victoria
GIS	Geospatial Information Systems
GJ	Gigajoule
Greenwashing	When existing practices are represented as being environmentally friendly and sustainable, with a greater emphasis on the impression given than on working toward material improvements in environmental performance or sustainability.
HTML	HyperText Markup Language
IT	Information Technology
LID	Low Impact Design
Multi-family housing	Attached housing, such as apartment, row, or townhouse styles of dwellings.
NIMBY	“Not In My BackYard”, a characterization of neighbourhood responses to unpopular proposals for their local area.
PGIS	Participatory Geospatial Information Systems
PHP	Hypertext Preprocessor
POST	Power On Self Test
RAP-GIS	Rapid Appraisal Participatory Geospatial Information Systems
SQL	Structured Query Language
TOD	Transit Oriented Development
Triple Bottom Line	The addition of social and environmental goals and reckoning to business decisions, to supplement the traditional economic “bottom line”.
UN	United Nations

UNICEF	United Nations International Children's Emergency Fund
URL	Uniform Resource Locator
WSUD	Water Sensitive Urban Design
XML	eXtensible Markup Language

Chapter One: Introduction

Web-based participatory geospatial information systems (PGIS) have been proposed as a way to engage the public in urban planning (Borouhaki & Malczewski, 2010; A. J. S. Hunter et al., 2012). The technology involved makes it possible for the public to participate in urban planning via online channels. Online public participation is easier to access and accessible at any time convenient for the participant (A. J. S. Hunter et al., 2012). This can also have positive effects for the practitioner, as accessibility can result in the potential to reach a larger group of participants (Fiorina, 1999). Both sets of benefits make online public participation a good complement to traditional engagement programs.

However, online participation lacks face-to-face contact with experts and decision makers, people who are normally present at traditional public meetings. This absence removes a source of information and feedback that is necessary for a number of reasons: while the public possesses important local spatial knowledge (Gindroz, Levine, & Associates, 2002; Lemma, Sliuzas, & Kuffer, 2006; McCall & Minang, 2005; Rambaldi, Kwaku Kyem, McCall, & Weiner, 2006), lay participants often lack knowledge of (i) environmental issues, (ii) planning strategies that can address these, and (iii) the expected impacts of potential strategies (Laurian, 2003; Schwilch, Bachmann, & de Graaff, 2012). Many also exhibit an incomplete understanding of sustainability (Kilinc & Aydin, 2011; Lefsrud & Meyer, 2012; Leiserowitz, 2006; Reid, Petocz, & Taylor, 2009; Reid & Petocz, 2006; Zeemering, 2009). Knowledge of all of these is necessary for meaningful participation (Kellon & Arvai, 2011; Laurian, 2003).

This research addresses the lack of in-person expert support in online engagement, and the lack of knowledge and understanding of lay participants. As a solution, I attempt to replicate the lost

information and feedback for an online participation platform. To this end, I design a web-based participant support tool tailored to lay community members. The support tool is intended as an accompaniment to an online participation platform. A prototype was developed and tested to gauge the potential effectiveness of the tool in its aim to deliver the support envisioned. Tests were conducted by asking a wide base of users to try out the tool, and then administering an online survey asking if and how the support tool was effective.

In this research, a support tool is differentiated from an online participation platform along the following lines: An online participation platform provides users with the functions necessary to state their needs and opinions regarding planning in general, and specific proposals, and to respond to others' opinions, suggest other potential options, identify and communicate issues in their area, and generally act and assemble (online) in order to bring their message to bear on urban planning in the area (A. J. S. Hunter et al., 2012). The support functions of this multi-use platform include providing background information about planning in general, as well as information about more specific strategies and alternatives that users may consider. It also includes the communication tactics used to convey this information. In general, it involves supporting the many activities participants can engage in while participating online.

I approach this research from the perspective of a geomatics engineer, within the PGIS field. As such, the research is influenced by theories and work in information systems and participatory research and practice. I focus on participation as it occurs in the context of the urban planning process. Because participants are asked to make decisions while participating, I also borrow ideas from work in decision support. Within information systems research, I focus on design science research in particular, for the support tool design. Both qualitative and quantitative methods are used. The support tool is intended for use in practice, so, though guided by theory,

the research primarily proposes to contribute in the area of planning practice. In keeping with this, I adopt a pragmatic worldview, focused primarily on generating outcomes that solve the identified problem, and bypassing debates about what constitutes reality (Creswell, 2007).

Throughout, I am primarily concerned with participants' needs, their level of knowledge and understanding, and their comfort and confidence while participating. My goal is to show that a thorough understanding of these can be synthesized and then operationalized to produce a design for a participant support tool.

The following chapter explains the disciplinary context of the research. I also expand further on the need for support in online participation. I then formally state the problem, followed by the hypothesis, which is further broken down into research objectives and goals. Finally, I briefly introduce the approach taken to solve the problem. I conclude by briefly describing the content of the remaining chapters of the thesis.

1.1 Background

1.1.1 Disciplinary Themes

In PGIS spatial information systems are used to support participation. PGIS emerged from a combination of participatory action research and GIS. As such, it combines two main themes: participation, and spatial information systems. The practice of participatory mapping, in general, is often applied within a community facing a problem that (for example), can be political, environmental, and/or related to planning or economics (Corbett et al., 2006). It involves more formally mapping the local spatial knowledge of the community, though formalization is not necessarily to the extent of officially-sanctioned mapping. The maps and knowledge gathered are

often then applied in advocacy or other communication needs. In PGIS specifically, desktop or web-based geospatial software is used in the process. Within PGIS, this thesis focuses on public participation in urban planning, specifically online participation.

Public participation is important to urban planning (Hodge & Gordon, 2008). As well as being a legislated requirement in local jurisdictions (Alberta - Municipal Government Act, 2000), it results in better urban spaces, and is a key factor in good governance and sustainable development (Hodge & Gordon, 2008). In their report defining and calling for sustainable development, the UN World Commission on Environment and Development (1987) called for widespread public participation, the idea being that local involvement is necessary to sustainable development. They add that participation is important in urban planning in order to ensure that initiatives are manageable for the local population. In addition, in urban planning, locals are more likely to find proposed sustainable initiatives acceptable if they have been involved from earlier stages of the project (Schwilch et al., 2012).

Public participation in urban development can be made easier for participants by providing online opportunities to contribute (A. J. S. Hunter et al., 2012). Online applications can be accessed at any time, from anywhere with an Internet connection, so they are much more accessible than in-person meetings (to those with the requisite technology). In addition, web-GIS offers the ability to combine multiple sources of spatially-based information, potentially allowing users access to any relevant documents about their area, offering both convenient and comprehensive coverage. With recent technological advances there are more web-based tools available to facilitate online participation. One of these developments is the rise of Web 2.0 (O'Reilly, 2005), which emphasizes user-generated content and two-way communication between information provider and consumer (to the point of significantly blurring the line

between the two). Part of Web 2.0, tools for online social networking, can facilitate discussion among participants, while online inquiry and sketching tools can inform them of current plans and allow them to make suggestions and raise concerns. Combined, these features can enable a rich participation experience.

Online participation is a sensible additional element in an engagement program seeking more diverse and widespread participation. Its accessibility and convenience give it the potential to broaden public involvement in planning, and it is expected to be more inclusive and welcoming to more diverse factions of the community (Fiorina, 1999; A. J. S. Hunter et al., 2012). This is beneficial, as widespread participation is an important element in urban sustainability (United Nations Division for Sustainable Development, 1992, p. 21).

In keeping with the focus on online applications and (spatial) information systems, the research is also guided by design science theories. Design science concerns the creation and evaluation of IT artifacts (Hevner, March, Park, & Ram, 2004). This is done because “the process of constructing and exercising innovative IT artifacts enable (*sic*) design-science researchers to understand the problem addressed by the artifact and the feasibility of their approach to its solution” (Hevner et al., 2004). Artifacts can include software, formal logic, rigorous mathematics, informal natural language descriptions, etc., provided they are represented in a structured form. The artifacts must be intended to solve what Hevner et al. (2004) call an “organizational problem”. In this research, the “organization” is slightly different than that anticipated by Hevner et al. (2004), whose language suggests a company or institutional setting. Instead, in this research, the “organization” is the practice of online public participation in urban planning.

1.1.2 Problems with Online Participation

This research is primarily concerned with a collection of issues related to online public participation in sustainable urban planning and development, which are detailed in this section. Essentially, research indicates that to foster participatory, sustainable, urban development, some form of participant support is required.

Residents often have important knowledge about the local area and local needs (Gindroz et al., 2002; Lemma et al., 2006; McCall & Minang, 2005; Rambaldi, Kwaku Kyem, et al., 2006). However, urban planning involves increasingly numerous problems and solutions (Hodge & Gordon, 2008, p. 14), as well as numerous stakeholders (Hodge & Gordon, 2008, pp. 285–287). Many participants remain unaware of the impact of land development, and of potential sustainable alternatives (Schwilch et al., 2012). Conflicting information, lack of clarity, and the appearance that information is being withheld, especially in multi-party decision making processes, can lead to an “information haze” that obfuscates and obstructs public engagement (Futrell, 2003). In addition, many learn about relevant environmental threats in their area through news media and social networks, resulting in inadequate knowledge of relevant issues (Laurian, 2003). Finally, public understanding of sustainability can often be incomplete (Kilinc & Aydin, 2011; Lefsrud & Meyer, 2012; Leiserowitz, 2006; Reid et al., 2009; Reid & Petocz, 2006; Zeemering, 2009).

Perhaps as a result of the above, the “sustainable features” of plans are too often added as an afterthought (Kearney & Smith, 1994; Tippet, Handley, & Ravetz, 2007). They can be tacked on by specialists after participation, rather than discussed and chosen during the participatory process. This excludes public participants from the discussion and decision-making surrounding

sustainable urban development strategies. This often results in infeasible solutions that for a host of reasons are rejected by the excluded public and do not get implemented (Schwilch et al., 2012). In general, if the public do not trust decision makers, especially if they feel that decision makers are not listening, or view decision makers negatively (perhaps as a result of having felt ignored in the past), they will be more likely to oppose proposed plans and developments (S. Hunter & Leyden, 1995). The parties representing multiple “sides” of a discussion can all exhibit this type of behaviour: in oppositional situations, those identifying with one position will not trust those identifying with the other, and vice versa (E. R. Smith & Marquez, 2000). This can have the effect of polarizing issues and creating obstacles to cooperative planning and development.

Another problem resulting from lack of either knowledge, comfort, or familiarity with planning issues and processes is that participants may hesitate to raise issues or offer their opinions and suggestions (Bliss-Taylor & Hunter, 2012e). This appears to result from feeling uncomfortable with the setting or the process, or from feeling undervalued and ignored. Further, confusion, such as the “information haze” mentioned earlier, can stymie the publics’ ability to formulate opinions or action plans, and hence their ability to participate (Futrell, 2003).

For meaningful participation, it is important that those affected be aware of and informed about the relevant issues (Laurian, 2003). From a decision support perspective, Kellon and Arvai (2011), Tippet et al. (2007), and Schwilch et al. (2012) recognize the need to support public participants in making sustainable decisions. Doing so increases the likelihood of generating longer-lasting positions that truly reflect participants’ views. Participants generally require assistance (i) navigating municipal planning processes, (ii) applying best practices in sustainable urban planning, and (iii) identifying and balancing the numerous factors, needs, and stakeholders

involved in planning (Hodge & Gordon, 2008). Participants should also be aware of predicted consequences of each alternative they are considering (Kellon & Arvai, 2011). In addition to this, the United Nations' Agenda 21 (1992) calls for education in general, to support public participation in sustainable development and decision-making. Being aware of and informed about relevant issues makes the public are more likely to participate (Laurian 2003; United Nations Division for Sustainable Development 1992).

Experts and decision makers who are often present at in-person participation events such as town hall meetings or public open houses can supply information and feedback about issues, suggestions, and opinions voiced by participants. However, these sources of information are not often present when participants raise the same issues in an online participation environment. As such, a source of important information and support is missing.

1.1.3 Research Gap

Numerous participation and/or decision making models, methodologies and supports already exist to help participants incorporate sustainability in planning (Condon, Cavens, & Miller, 2009; Tippet et al., 2007). Most of these are either in-person and facilitated processes, or aimed at experts and decision-makers. None address the need for supplemental information in the event that practitioners are not present, and public participants are gathering online.

When it comes to decision support, tools often focus on defined issues in land or environmental management (Schwilch et al., 2012; Thomas, 2002), which in the case of this research would translate into a defined issue within urban planning. However, this research seeks to support a level of participation that *includes* participants' identification of issues (Arnstein, 1969). Though

examples can be found of decision support tools for nebulous problems defying simple definition, the examples found are geared toward professionals rather than the public (Mackenzie et al., 2006). There appear to be no tools tackling the gaps in public participant knowledge and understanding that aim to support participants, while respecting their prerogative to choose what planning issues are important to them. A more thorough review of the available supports is provided in section 2.5.

In general, there appear to be few, if any, complementary support tools for online participation platforms, as the tools mentioned above are stand-alone, in-person participation aids, or decision support tools aimed at single or defined issues or professionals. Perhaps due to online participation being a relatively new practice and possibility, there is little literature concerning potential sources of support for public participants.

1.2 Problem Statement

The purpose of the research is to address the lack of face-to-face feedback in online participation in order to support online planning participants, especially in their use of sustainable development concepts and techniques. It is hoped that this will support both online participation processes and urban planning processes. The “big-picture” aim is to support sustainable urban development and public participation in general.

Problem statement: Online participation platforms for urban planning lack in-person discussion and feedback from experts. As such, they do not provide valuable support that would help participants:

1. Understand relevant issues;
2. Understand sustainability and sustainable urban planning;
3. Understand potential impacts of strategies and weigh alternatives; and
4. Participate more confidently and meaningfully.

I hypothesize that providing participants with accessible and meaningful information about sustainability and related issues, sustainable urban development, urban planning, and potential development impacts, will help provide some of the missing feedback and support.

1.2.1 Research Objectives

The research objective is to develop a tool to provide support as indicated in decision and participation literature (Kellon & Arvai, 2011; Laurian, 2003). The support should enable participation at high levels on the participation “ladder” (Arnstein, 1969), and provide help with the use of sustainable urban development strategies (Schwilch et al., 2012). This support is provided for a specific context: Lay citizens engaging in urban planning in an online environment. As such, the objectives include providing support online, and developing an online tool to provide this support. Further, I aim to provide support to complement an online citizen engagement tool (that is, the support tool is intended for use with an online engagement platform, to augment the platform, but does not provide the functionality of the engagement platform itself). Finally, in accordance with the methodology chosen (design science, refer to

Chapter 4), I aim to test the suitability of the proposed tool, and provide direction for further development of both the concept and the support tool.

1.2.2 Research Goals

For the research to address the problem, the following goals must be met by the support tool:

1. Improve participants' knowledge of relevant issues;
2. Improve participants' understanding of sustainability and sustainable urban planning;
3. Provide participants with information about the range of possible land development strategies and patterns, and their potential impacts;
4. Improve participants' comfort level while participating online in urban planning; and
5. Empower participants to engage in urban planning online.

1.3 Approach

To test the hypothesis, I address the research goals in two phases. In the first phase, I conducted a literature review to establish research foundations (Chapter 2). Then, to gauge the current mindset of intended users, I review literature concerning public understanding of urban planning, sustainability, and issues related to sustainability, (Chapter 3). This included review of literature discussing strategies for improving public understanding and appreciation of planning and sustainability. I also reviewed literature concerning Calgary residents' urban planning priorities and attitudes toward participation. Finally, I reviewed literature covering stakeholders' suggestions for an online participatory urban planning platform, extracting the pieces relevant to participant support.

In the second phase, the literature review was used to design a participant support tool, based on what the review revealed about intended users. Information gleaned from the review was synthesized into a conceptual design and collection of necessary components for the support tool. These were then operationalized as a set of developable components. Descriptive evaluation was then employed to ensure the design met the requirements.

Select elements from the developable components were developed into a prototype tool. The prototype was then tested to ensure it functioned properly. Once this was confirmed, it was evaluated experimentally via simulation to determine whether it solves the identified problem by meeting the research goals – that is, does it provide information, feedback, support, and expanded understanding and appreciation to the intended audience. The test was conducted by asking members of the general public to use the prototype by navigating to the website, and clicking through. Following this, a survey was administered with questions designed to probe whether the research problems had been addressed and the goals met.

Evaluation of users' responses to the prototype support tool helped determine whether the support tool is an effective means of dealing with the identified problems with online participation. Additionally, the results and analysis of the process, tool design, and prototype testing provide information upon which to base further research and practice in online participation.

1.4 Assumptions, Scope, and Limitations

The aim of the research is to develop and test an IT artifact, rather than to develop theory. The support tool designed in this research is intended for use by public participants in urban planning.

The tool was designed based on an extensive review focused on this type of user. The design was created and evaluated with this type of use in mind. Finally, the prototype was built and evaluated with this type of use in mind as well. As such, no conclusions can be drawn concerning the appropriateness of the tool for any other use. The design would likely require modification for support in other types of participatory endeavours. Other uses of online participation platforms and their accompanying support can be imagined, such as communication between government departments, and between private and public stakeholders in planning. However, these other situations were not within the scope of this research. As such, no conclusions can be drawn with respect to the support tool's utility in these other situations.

The tool was designed as a support to an online participation platform, and would require re-purposing and contextualization to be used on its own. It is also confined to online use. As such, Internet access and literacy is a precondition of its use. This presents a limitation, as those without Internet connection will be unable to access the tool. As such, even though the tool is designed to be more inclusive in so far as it provides an alternative medium to traditional in-person meetings, it does exclude those without Internet access.

In Canada, 20% of the country do not have Internet access, either at home, school, work or any other place, such as a library (Statistics Canada, 2010). Younger people (those under 34) are more likely to have Internet access, with 97% of individuals online, while poorer and less educated individuals are less likely than average to have Internet access (Statistics Canada, 2010). As a result, the support tool, if successfully implemented, would likely be more impactful for younger individuals, or for their representation in urban planning engagement, and less so for poorer and less educated individuals. Though the support aims to be inclusive, those without the requisite technology or skillset are further excluded. In-person engagement activities, and their

varieties of support would be more appropriate to the public who are not online, but these are outside the scope of this research.

While the design was evaluated using a design science framework, only the subset of the design representing the prototype was tested by survey. Thus, the survey only directly reflects on the prototype. However, since the prototype is a small portion of the design that is intended to be representative of the eventual functionality, it is reasonable for the most part to draw conclusions regarding the design based on responses about the prototype.

Though the research develops a tool to be used in conjunction with an online participation platform, the tool is tested on its own, without the companion participation platform. This was done in order to isolate the element under scrutiny for initial testing. For future develop-test iterations, it is recommended that the support be tested while integrated with the participation platform, as it is designed to be used.

The research is also limited by the survey sample, which was drawn from both personal and professional networks via social media, email lists, and word of mouth. Though these networks include hundreds of individuals from varying educational, ethnic, cultural, and political backgrounds, they are skewed toward younger, more educated, and/or western backgrounds, and likely toward those with interest in urban planning and/or online participatory applications, and a background in geomatics. However, since the intended users of the support tool are individuals who have opted to participate in urban planning via online avenues, they would likely exhibit similar interests and profiles. As such, it is likely that a similar range of people would use the support tool, so conclusions based on this sample can reasonably be drawn.

The research is approached from the discipline of geomatics engineering, and the researcher's professional experience is primarily in urban planning, including having participated in engagement exercises as both a practitioner and a participant. These influences introduce a disciplinary bias. Further, the researcher's motivations stem from sustainable and participatory ideas.

This study assumes that approaching urban planning from the perspective of sustainable urban development is both necessary and desirable, as is participation in urban planning. As a result, the research objectives and goals, and the support tool created, do emphasize *sustainable* urban planning. This is considered valid based on calls in the planning discipline (Hodge & Gordon, 2008) and by the United Nations (UN World Commission on Environment and Development, 1987; United Nations Division for Sustainable Development, 1992) and other multi-national organizations (ICLEI Local Governments for Sustainability, 2005). Some survey respondents did not like this, and this is likely to be the case in the general population as well. Some may consider it biased. However, the literature review indicates this focus is reasonable, and as such, the research scope and purpose reflect that.

Finally, engagement exercises conducted as part of the broader research project are referenced in this work (Bliss-Taylor & Hunter, 2012b, 2012c, 2012d, 2012e). Information about local views was collected in the Calgary community of Glamorgan through workshops and focus groups concentrating on community-driven planning and sustainability. Three open-invitation workshops and three focus groups for smaller sub-groups within the community (single-family housing areas, multi-family housing areas, and local businesses and institutions) were conducted. Though reports of these exercises were prepared, they were delivered only to the community, who opted to keep them private. Having conducted these, the researcher is influenced by them,

through having knowledge of the findings, reported briefly in this thesis (see Chapter 3). These influenced the research by pointing to avenues of inquiry and the mindset of a subset of the local, general population.

1.5 Thesis Overview

Chapter 2

This chapter presents an overview of the exiting literature that serves as background and conceptual framework for the research. This includes review of sustainability, sustainable urban development, and participation. Local urban planning and participation are then reviewed to provide grounded context. Finally, existing participant support ideas and tools are reviewed. The chapter concludes with a summary of the review and its implications for the research.

Chapter 3

In Chapter 3 the literature review continues, in this case to investigate the potential mindset and understanding of intended users. I delve into public understanding of sustainability and issues related to sustainability, strategies for improving public understanding, some Calgary residents' priorities with respect to urban planning and attitudes toward participation, and planning stakeholders' suggestions for an online participation platform. I then summarize, highlighting the implications of all these for the research.

Chapter 4

This chapter presents the methods used to solve the research problem, including worldview, strategy of inquiry, tool design and prototype construction, and the approach to evaluation. I

explain the choice of a pragmatic worldview, and of survey as a strategy of inquiry. I expand upon the design science approach used to guide the research, including elements used to guide tool design and testing, and the requirements imposed by this type of research. Then, the synthesis of the literature review into an operationalized support tool is explained. The design of the tool is presented, as well as the elements chosen for prototype construction. Finally, the approach to evaluation of both the design and prototype are explained. Descriptive evaluation, used to check the tool design, is explained. Then, the method of survey data collection and analysis, used to evaluate the prototype, is explained.

Chapter 5

In this chapter I present the results of the research and associated analysis. The results of design and prototype evaluations are presented. The descriptive evaluation is presented first; results indicated that the design responds to the problem environment and user requirements. Then, the survey evaluation is reported, which reveals that a majority of users reported the tool would be useful and easy-to-use for them. Finally, responses detailing the favoured aspects of the tool, and critical responses pointing to future work are listed.

Chapter 6

In Chapter 6 I discuss the research results. I address research reliability, and present a critical discussion of the interpretations I make. I also demonstrate that the method detailed in Chapter 4 reliably addressed the identified problem, and that design science requirements are satisfied.

Chapter 7

Finally, Chapter 7 presents the conclusions of the research. Method and findings are summarized, and contributions to the field are highlighted. Finally, areas for future research are suggested.

1.6 Chapter Summary

The preceding chapter gave a brief overview of the background to the research, including the related disciplinary fields, an introduction of the problems addressed and their import, and an exploration of the gap in research surrounding potential solutions. The resulting problem statement that the research addresses was then presented. I elaborated on this by detailing the research objectives and goals. The research approach was then explained, and the assumptions, scope, and limitations involved were detailed. Finally, the remaining chapters of the thesis were summarized.

Chapter Two: Background and Literature Review

In the global push toward sustainability, sustainable urban planning is one of many important components, as is widespread public participation (United Nations Division for Sustainable Development, 1992, p. 21). As such, both sustainability and participation are important topics in urban planning (Hodge & Gordon, 2008). These topics form the foundations of the research presented in this thesis; they provide both the conceptual framework and the direction. Further, I operate on the assumption that they are necessary for good planning practice.

The conceptual model in Figure 2.1 may prove useful as a visual representation of the links between the concepts described here. As shown in the figure, participation is a major tenet of both sustainability (UN World Commission on Environment and Development, 1987) and urban planning (Hodge & Gordon, 2008). At the intersection of these three is sustainable urban development, which is necessary to sustainability (Beatley & Newman, 2009; Calthorpe, 2011; Newman & Jennings, 2008) and, I contend, to good planning practice. Within participation is participatory GIS and online participation. These are participation methodologies with more specific goals, and as such are differentiated within the diagram. Both strive, in different ways, to work toward inclusive participation. Online participation works to do this by lowering barriers to participation, thus making it easier for those with the requisite technology to involve themselves (Fiorina, 1999; A. J. S. Hunter et al., 2012). Since sustainability calls for widespread participation (ICLEI Local Governments for Sustainability, 2005; UN World Commission on Environment and Development, 1987; United Nations Division for Sustainable Development, 1992), and online participation contributes to this, it can also contribute to sustainability. This research addresses issues in online participation, and is situated within that conceptual

framework (see the star in the figure). But, the research is influenced by participatory research, particularly PGIS, so this theme is also displayed in the conceptual framework.

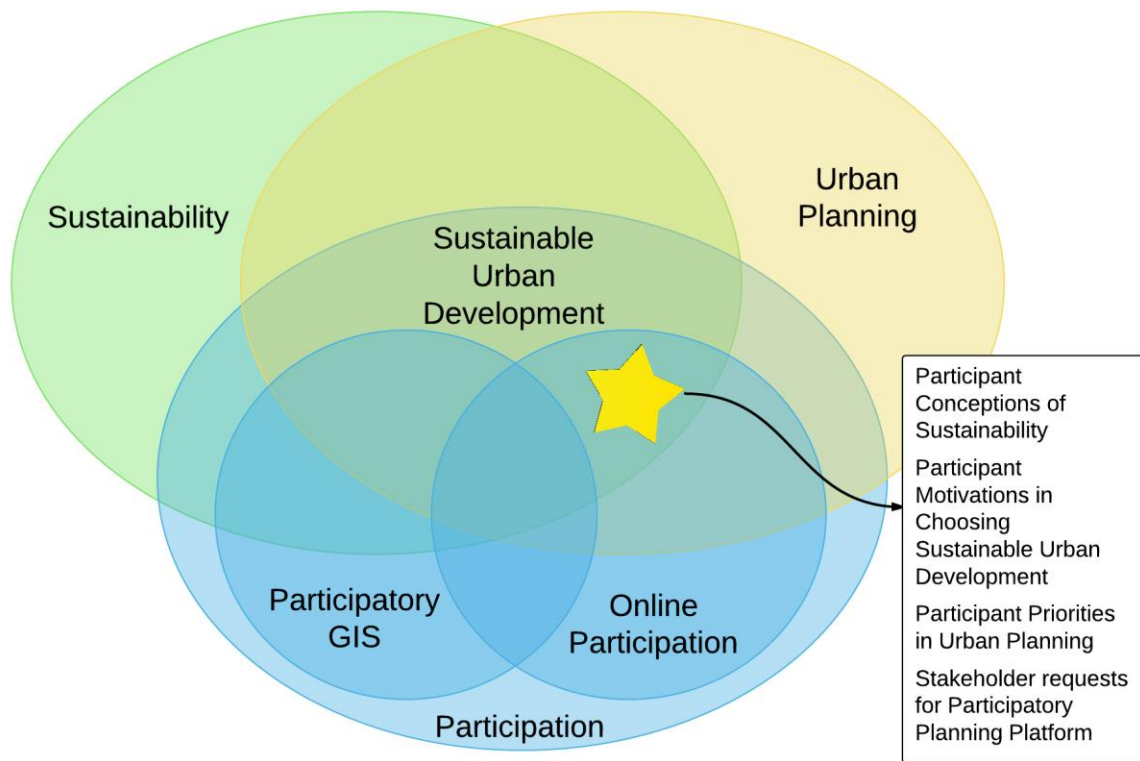


Figure 2.1: Diagram of the conceptual framework, and the relationship between the main concepts in the research. Citizen participation supports urban planning, which in turn supports sustainable development, which requires citizen participation.

To aid the research and design of a support tool, I also conduct reviews in the four areas shown in the rectangle: participant conceptions of sustainability, motivations in choosing sustainability, priorities in urban planning, and stakeholder requests of an online participatory planning platform. Since these are used to inform the design of the tool, rather than as the conceptual

framework of the research, they are separated from the main figure. The reviews of those topics can be found in Chapter 3.

The chapter below develops these ideas; it presents a review of the literature used to frame and direct my research, and sets out the definition of the concepts used in this thesis. First I investigate current work in sustainability and sustainable urban planning to establish how the concept is defined and used in this research. Following this, I examine public participation and establish a definition of it for this research. I then briefly look at local urban planning work to understand how the reviewed concepts are applied locally. Together, all of these form the conceptual framework of my research, as well as providing support for the research need and gap established in the first chapter. I conclude by summarizing related work and ideas in participant support, including similar tools, and by discussing the implications for the research.

2.1 Sustainability and Sustainable Urban Planning

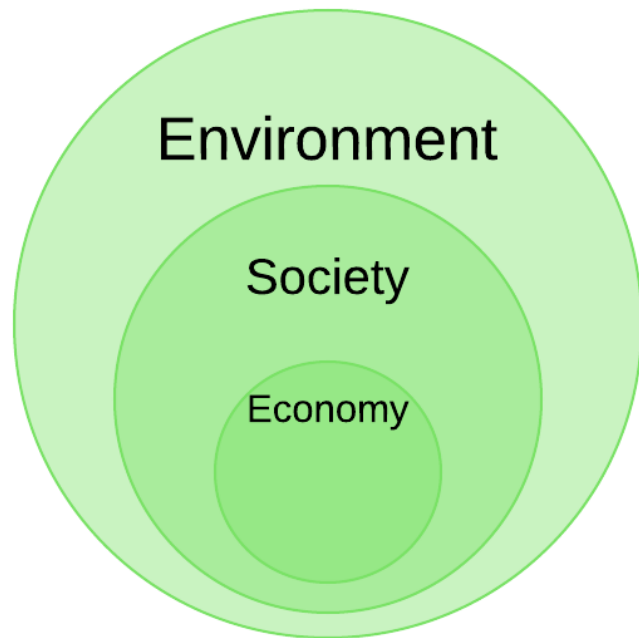
In this section the concept of sustainability is briefly investigated to create a working definition for the current research. The definition guides the research, forms part of the conceptual framework, and is treated as a basic ingredient of good planning practice. As such, its inclusion in planning initiatives, and in the considerations of public participants, is considered a goal worth supporting. The support tool is in part geared toward supporting public participants' use of sustainable development concepts and techniques. As a result, the concept (as defined for this research), influences and directs decisions throughout the research, including necessitating inquiry into public understandings of sustainability, motivations for choosing it, and local conceptions of it (see Chapter 3).

Sustainability, and more specifically sustainable urban development, are desirable because the former aims to create a better society and world to live in, and the latter better urban spaces (UN World Commission on Environment and Development, 1987). It has been used to underpin (among other things) visions and plans to improve the world through development of cities designed to reduce their environmental impact, improve social and economic situations within, and create human settlements that support lasting civilizations and robust societies composed of happier, healthier people (United Nations Environment Programme, ICLEI, & EPA Victoria, 2002; Newman & Jennings, 2008; ICLEI European Secretariat, 2011).

The Brundtland Commission defined sustainable development in 1987, as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN World Commission on Environment and Development, 1987). The commission approached sustainable development with a focus on the environment, while asserting that social and economic needs must be met in order to preserve the environment. A less-frequently quoted passage from the report underscores the connection: “The concept of sustainable development provides a framework for the integration of environment policies and development strategies” (UN World Commission on Environment and Development, 1987, sec. 1). In addition, the commission viewed conventional definitions of environment as ecology, and development as economic development, as being too narrow. Broader definitions are espoused instead: environment as where we all live, and development as things done to improve environment.

The Brundtland Commission (1987) presents sustainable development as an interconnection and interdependence between the environmental, social, and economic elements of a society, with the end goal of a decent life for all people and preservation of the environment on which all depend.

Sustainable development is normally broken down into environmental, social, and economic “spheres”. This helps to describe, understand, and operationalize the concept. Numerous diagrams are used to represent this; my favourite, can be seen in Figure 2.2. This diagram represents the three spheres as nested, demonstrating dependence of the inner spheres on



the outer. That is, the economic environment cannot thrive without a stable social environment, which itself relies on resources from the natural

Figure 2.2: Nested view of sustainability spheres, emphasizing dependence of economy on society, and society on environment. Adapted from Cato (2009).

environment (Cato, 2009, p. 34). The spheres overlap, and it is often a matter of preference or circumstance that determines in which sphere a particular issue is placed. For example, many social elements can also be represented in the economic sphere. For instance, education improves both quality of life and available economic opportunities. These overlaps can also be viewed as interconnections, and as such reflect the holistic nature of sustainability.

Interconnectivity demands a holistic, or systems thinking approach (Jackson, 2003). Because actions have numerous consequences, and each can be related to the function of the whole system, reductionism fails to account for and appreciate the resulting behaviour of the overall system (Newman & Jennings, 2008, p. 92). Reductionism, by focusing only on the parts, fails to

consider the interactions between them (Jackson, 2003). For example, improving one aspect of an issue may have detrimental effects on another, and as such fail to result in overall improvement, or may even be harmful overall.

The need to consider multiple facets, and consider them together, leads to devices such as the triple bottom line (Elkington, 1994) approach. This approach examines the impacts of organizational activities not just from an economic standpoint, but from a societal and environmental standpoint as well. In this research I recognize that system thinking is a beneficial mindset (and that triple bottom line and similar devices are often used to understand and operationalize sustainability (City of Calgary, 2013b)).

It is also worth noting that sustainability can be thought of as an approach, just as easily as it can be thought of as a task or requirement. In the former sense, it would be viewed as a characteristic of the process, in addition to being a characteristic of the end result. As an analogy, sustainability as an approach is not an ingredient you add to a dish, it is the way you cook it. In that sense, it would not be used as a tweak, an addendum, or a part of projects; it would be a way of operating, and a way of approaching all initiatives, which would only then warrant the term “sustainable”. In this research, I recognize both ways of viewing sustainability as valid and important, and bear in mind the fact that I may encounter either mind-set among public participants.

2.1.1 Criticisms of Sustainability

Sustainable development has become a well-used term, however the discussion surrounding it is not without criticism and debate. Three main themes tend to appear in the critical literature. Firstly, the term’s ubiquity is sometimes considered grounds for denigration (Martens, 2006;

Ferry, 2007). These arguments centre on the fact that a concept that can mean anything to anyone effectively carries little to no meaning. This is especially true given the nebulousness of the concept, and the many varying versions of it used in academia, industry, and colloquial language. In this sense, sustainability can be seen as a buzzword that is thrown around and neither creates common understanding and agreement nor leads to concrete actions and improvement. This has been called the “emperor’s new clothes” critique (Priemus, 2005). The analogy deliberately conjures the image of a crowd mentality and a lack of substance. A second main theme in sustainability criticism is that the term is sometimes misused, as when “greenwashing” is done to give the appearance of sustainability. This is related to the first theme – words without clear meaning can be used to sound good while not really saying anything.

Thirdly, many see conflict between the spheres of sustainability. For example, Campbell (1996) works with sustainable development as it relates to urban planning, and discusses specific conflicts between the spheres. Between what he terms ecology and equity is the development conflict. This conflict views environmental preservation as a privilege of the wealthy, as the poor must deplete the environment for economic gain, or must live in unsavoury environments such as near a landfill. When viewed this way, the choice is between environmental preservation and social equity, so the conflict “which should we prioritize?” arises. The conflict between equity and economy is the property conflict. This conflict pits private interests and property versus public interests. For example, private interests develop property, but regulations exist to protect the public interest, thus stifling the free exercise of private interests. The final conflict arises between economy and ecology and is termed the resource conflict. This essentially states that economic interests are met by exploiting the environment, and environmental protection stifles economic interests, so the two are in conflict. It is worth noting that Campbell (1996) appears to

begin by conceptualizing the three spheres as representing divergent interests. This may contribute to the view that they are in conflict.

Godschalk (2004) extends Campbell's (1996) argument by recognizing that planners also strive to create livable communities. Conflicts are identified between each of the spheres and livability. The livability conflict with ecology is the green cities conflict, which concerns values surrounding whether the natural or built environment should take precedence. The conflict with equity is the gentrification conflict, which pits the belief that neighbourhoods (often poorer urban neighbourhoods) should be preserved for the benefit of their current residents, against the belief that they should be redeveloped to attract the middle and upper classes. Finally, the conflict with economy is the growth management conflict. This stems from differences in beliefs about whether growth that proceeds based only on market forces can produce liveable environments.

All of the sustainability criticisms presented are valid, and important considerations in a conscientious urban planning process. The first two carry some weight, and are certainly important caveats to bear in mind when working with the concept. However, while its popularity can make the term prone to abuse, this does not mean that the concept itself is without value. In fact, its common use suggests a general acceptance of the embedded ideas and by extension, the need for sustainable approaches. Further, by its very nature, sustainability requires widespread employment in many, if not all, disciplines, trades, and types of work and lifestyle; for sustainable development to have an impact, it must be widely applied. Calls for sustainable development advocate widespread use of the approach (UN World Commission on Environment and Development, 1987; United Nations Division for Sustainable Development, 1992).

The third theme is less compelling, but appears to me to be more often presented as an important critique. However, as explained earlier in this chapter, the original definition of sustainable development by the Brundtland Commission (1987) emphasizes connections between the aims of environmental preservation and social need, with economic development towards these joint intents. The definition essentially prescribes synthesizing these toward common goals, and this synthesis is presented as one of the goals and methods of sustainable development. As such, criticisms of sustainable development based on conflicts between environment, society, and economy appear to this researcher to miss the point.

In addition, strategies geared toward improvement in any of the spheres often have beneficial effects for the others. Urban agriculture builds community, improving the social sphere, but can also provide locally-grown, organic food, which (when deployed on a large enough scale) can result in environmental improvements from decreased food transportation energy use and pesticide use (Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007). People involved have also cited decreased food costs as important benefits to them (Wakefield et al., 2007).

Hence, criticisms in this vein make more sense when understood as problems with approaches to achieving sustainability or working sustainably, rather than as faults within the original concept of sustainability. Given this, the frameworks proposed by Campbell and Godschalk (1996; 2004) can be usefully applied to assessing or improving sustainable planning approaches.

2.1.2 Definition of Sustainability for the Current Research

The Brundtland Report (1987) calls for sustainable development to be seen as a global objective. This includes urban planning to meet human and environmental development needs, and

participation in urban planning (particularly to serve the needs of poorer communities). These ideas in large part define the concept of sustainability and sustainable development used in this research. They also provide support for the decision to view both sustainable urban planning and public participation as basic tenets of good planning practice.

Further support can be found in numerous documents released since 1987. The document known as “Agenda 21” added to the call for sustainable human settlements and public participation in the process (United Nations Division for Sustainable Development, 1992). Of note, this document calls for widespread participation in land management, for sustainable development, but also to increase awareness. There is a thrust toward increased public sensitivity to development problems, involvement in solutions, and commitment to sustainable development. In support of this, education is cited as necessary, both formal and informal. Local initiatives toward Agenda 21 goals (“Local Agenda 21”) embrace Agenda 21 principles at the municipal level. The International Council for Local Environmental Initiatives (ICLEI) connects municipalities undertaking these initiatives (“Home | ICLEI Global,” n.d.).

Other documents and initiatives have added to the growing body of work advocating, working on, working within, discussing, and criticising sustainability (Berke & Conroy, 2000; ICLEI European Secretariat, 2011; United Nations Environment Programme et al., 2002). Many of these include citizen participation as a central requirement of sustainability (United Nations Environment Programme et al., 2002; ICLEI European Secretariat, 2011).

For the purpose of this research, the works reviewed provide additions to the original definition of sustainability. For example, they provide critiques, or develop some aspects in greater detail. But, they do not change the concept’s essence, as set out by the Brundtland Commission (1987).

Despite numerous variations, the central theme of any of these is the imperative of meeting needs now and in the future. As such, the research here reported will use the original (Brundtland) conceptualization of sustainable development, including the original call for local participation as a major tenet. The definition centres on the effort to ensure that we can meet our needs without hindering the ability of all present and future others to meet their needs. This necessitates (among other things) preservation of the natural environment that meets many of these needs, and construction of living environments that meet our needs while allowing for environmental preservation. It also necessitates participation of the public to ensure their needs are considered, and to ensure that power imbalances (responsible for inequity in meeting needs) are addressed, challenged, and reduced.

Sustainability in this research also includes the use of spheres to group and balance things to be considered. As mentioned above these spheres are primarily viewed as nested or interdependent. The definition of terms such as environment and development are broad, as suggested by the Brundtland Commission (1987). Large-scale issues such as climate change and income inequality also contribute to the understanding of sustainability in this research. These issues are obstacles to achieving sustainability that must be addressed, and they are symptoms of unsustainable practices.

I also adopt the view that there are many ways to work toward and achieve sustainable urban planning. Many of these strategies do not require conflict between the three spheres, and may in fact provide mutual benefit. Where conflicts do exist, trade-offs between alternatives can be examined, or the overall approach may require re-examining.

The definition above is chosen in part because it is a fairly common understanding of sustainability (“Sustainability,” 2013), especially in the sense that the concept is understood as a balance of economic, environmental, and social concerns (though it may be slightly expanded in considering the concept of intra- and inter-generational equity, this is considered an important aspect of the concept, and as such is retained). This is done in order to focus on new applications of the concept, especially as it guides decision making while participating in planning. Working with existing definitions of sustainability while expanding participants’ appreciation of the concept and engagement with it is considered preferable to re-defining participants’ view of sustainability and “starting from scratch”. The main thrust of this research is to introduce lay participants to sustainable urban planning, knowing that this may be a new concept for participants, not as an idea in itself, but more so in the sense of application, depth of understanding, and in guiding decision-making.

2.2 Sustainable Urban Planning

Sustainable urban planning refers to the application of sustainability to urban planning. This can take many forms, embodying any or all of the spheres and mind-sets discussed above. It can be approached from large space and time scales, encompassing an entire region, to small-scale projects such as placing community gardens or first attempts at civic engagement.

For example, sustainable urban planning can contribute to environmental preservation by arranging land uses and transportation efficiently. This can minimize land use, energy use, water run-off, waste production, and other impacts of the built form on energy and environment (Calthorpe, 2011). A high-level scheme such as this would be implemented through the use of contributing strategies. These might include walkable streets, choice in transportation, locally

available daily services, and water run-off management through low-impact development (often known simply as LID (US Environmental Protection Agency Low Impact Development Center, 2000) or water sensitive urban design, WSUD). As further examples, social sustainability may be taken into account by maintaining transparency and legitimacy in municipal government, and/or by operating participation processes at high levels on the participation ladder (Arnstein, 1969). Planners can work toward social sustainability by ensuring that they conduct the planning process with transparency and integrity, and by taking into account local voices, so that local needs are met. Participants may request such qualities such as livability, implemented through considerations like design for all age ranges. Finally, a municipality can practice economic sustainability by providing housing and transportation options, making it possible for a range of income levels to secure manageable household economics for themselves. Manageable municipal economics and taxes will also contribute to this. The above list of examples is by no means exhaustive, but it helps to define what is meant by sustainable development and sustainable urban planning in the context of this research.

Sustainable development and sustainable urban planning are used almost interchangeably throughout this thesis. Because of this, it is useful to clarify what is meant by development at this juncture. I use the word “development” in its sense closest to “progression” or “change”. Most importantly, the term and concept must be understood in context; it relates to the change in municipalities over time, especially structural change in buildings and infrastructure. Development is not used here to refer to economic development, as it is when used in the context of the phrase “developed and developing countries”. In addition, urban development must not be thought of as exclusively urban sprawl. Though some urban development is on the outskirts of the city, it can also take place within the city, in redevelopment of brown- or grey-field lots, in

intensification of existing communities (and even existing buildings). Finally, urban development is also not always growth, it sometimes entails reducing the built form to respond to declines in population.

Sustainable development and sustainable urban planning refer to very similar workflows, which is the reason behind their almost interchangeable use. However, to be very precise I note that sustainable urban planning refers more specifically to the activities done by urban planning professionals in public and private organizations, in conjunction with interested citizens, in order to create visions, land-use plans, policies, and monitor efforts etc. Sustainable development includes this activity, as well as implementation activities such as land-use changes and construction.

2.2.1 Guidelines for Sustainable Urban Planning

Sustainable urban planning can be directly guided by definitions of sustainability. Numerous sources have listed guidelines directing the creation of sustainable human settlement (Berke & Conroy, 2000; City of Calgary, 2006; ICLEI European Secretariat, 2011; ICLEI Local Governments for Sustainability, 2005; United Nations Environment Programme et al., 2002). The guidelines contained are distilled from general definitions, to create directives specific to urban planning. The guidelines can take the form of high-level direction statements through to operationalization and tested evaluation frameworks for sustainable urban planning.

For example, the Melbourne Principles were created to help cities achieve sustainability, especially as envisioned by the Brundtland Commission (United Nations Environment Programme et al., 2002). The ten principles each provide a specific course of action. Take, for

example, Principle 4: “Enable communities to minimize their ecological footprint”. However, the principles do not prescribe a way for cities to achieve these. They leave the specifics to each city, as each will have different circumstances, including variations in values, resources, and capacity. As such, each city is left to find the best solution for their situation. In fact, there is emphasis placed on cities’ uniqueness in more than one principle, including Principle 6: “Recognize and build on the distinctive characteristics of cities, including their human and cultural values, history, and natural systems”. As such, the Melbourne Principles are to be used to focus work toward sustainable urban planning and to ensure the work is comprehensive.

Berke and Conroy’s (2000) principles, also largely based on the Brundtland definition, provide a framework to both guide and evaluate sustainable urban planning. The six principles are formulated to apply sustainability to planning, and are deliberately balanced between the sustainability spheres. The principles are: (i) harmony with nature, (ii) livable built environments, (iii) place-based economy, (iv) equity, (v) polluters pay, and (vi) responsible regionalism (Berke & Conroy, 2000). These principles are further operationalized than the Melbourne Principles: An evaluation process is presented, and used to evaluate 30 plans to gauge progress toward sustainable urban planning. The evaluation process determines whether plans are sustainable by categorizing the policies contained into each of the six principles.

Another program seeks to understand the city as an ecosystem, and to achieve sustainable human environments by mimicking processes such as energy and matter cycling (Newman & Jennings, 2008). This guide provides direct advice concerning all stages of urban planning, including visioning, participation, and sustainable urban development strategies.

Any set of guidelines a city chooses can provide direction in each of the three sustainability spheres. Sustainable urban planning would take action consistent with the guidelines' intent. They can be used, as appropriate, as simple direction statements or as a prescriptive list. For example, when taking an action in urban planning, one would ask whether a course of action increases harmony with nature, or livable built environments. However they are used, the guidelines can help municipalities work toward sustainable urban planning by providing direction and in some cases checklist-type measures to ensure efforts are balanced and comprehensive. They can also gauge their progress against a common standard, and use the common framework for discussion among diverse municipalities.

2.2.2 *Wicked Problems*

Urban planning problems can be characterised as wicked problems, which defy simple definition. Wicked problems cannot be simply defined, as their parameters are not all known; the process of solving them also plays a part in defining them (Rittel & Webber, 1973). Numerous types of problems can be considered wicked; their primary identifying characteristic is that understanding the problem is achieved in part through exploring solutions (Rittel & Webber, 1973). Since there are also no stopping criteria in a wicked problem, there are an unlimited number of solutions to explore. Goal and criteria setting for the solution space can be equally ill-defined, as these depend on the understanding the problem (Rittel & Webber, 1973). Thus, without clear definition, criteria, goals, or stopping point, the wicked problem cannot be simply solved (Rittel & Webber, 1973). As a result, it is hard to say when the issue has been resolved, and opinions on this will likely differ from participant to participant.

Wicked problem definition and solution are also value- and politics- based (Rittel & Webber, 1973). Each person involved, including researchers as well as participants, brings their own conditioning and biases to the definition of problem and solution. In addition, both urban planning and sustainability involve questions of morality (Smil, 2005). Decisions are made, and trade-offs considered in view of the values of the collective and individuals involved (Leiserowitz, 2006). Since a plurality of values and politics are likely to be involved even in a relatively small community group, input must be sought through a participatory process in order to explore the problems and solutions to the fullest extent possible, and in order to reach legitimate and robust solutions.

As a result of the wicked nature of planning problems, problem definition, setting objectives, and identifying and exploring alternatives must all be cyclical processes. Defining sustainability, and considering different sets of sustainability indicators and metrics for application in urban planning can also be thought of as part of the process of understanding the problem (Rydin, Holman, & Wolff, 2003). Decision making structures in urban planning should be understood in that light, and must allow for a resolution process that gradually sharpens these definitions in concert while converging on a workable solution. PGIS provides a framework for this type of iterative decision-making (Corbett et al., 2006).

2.3 Public Participation

Public participation is important to urban planning (Hodge & Gordon, 2008). There are many benefits of a more participatory process. Residents are often experts on their local environment, and can supply important information about issues and preferences (Rambaldi, Kwaku Kyem, et al., 2006). Their involvement often yields important knowledge about the local area and local

needs (Gindroz et al., 2002; Lemma et al., 2006; McCall & Minang, 2005; Rambaldi, Kwaku Kyem, et al., 2006). This allows development to be responsive to those needs, and to create solutions that satisfy pressing local needs or demands, and are accepted, or even better, actively welcomed. This results in more effective plans that better enable the community to meet its goals (Hodge & Gordon, 2008, p. 273).

In addition, in urban planning, locals are more likely to find proposed sustainable initiatives acceptable if they have been involved from earlier stages of the project (Schwilch et al., 2012). As such, participation is important to acceptance of sustainable urban planning and adoption and implementation of strategies (Kearney & Smith, 1994; Schwilch et al., 2012). This may be because participants feel included and as a result take ownership of proposed strategies (Tippett et al., 2007). It may also be a result of participants either vetting or proposing the strategies that they prefer.

Involvement in developing the future of their community places participants in the role of active creator, rather than passive consumer, of their environment. This can help foster a sense of ownership of the place in general (M. K. Smith, 2001). A sense of ownership can result in both greater satisfaction with the neighbourhood, and an empowered community.

Further support for participation can be found in our adoption of sustainability as an important part of or approach to urban planning. As we have seen, most sources calling for sustainable development include in that a call for increased, often widespread, participation (ICLEI Local Governments for Sustainability, 2005; UN World Commission on Environment and Development, 1987; United Nations Division for Sustainable Development, 1992). These

sources recognize the potential of participation to improve responsiveness to the local populations' needs. They also approach participation as a requirement for good governance.

PGIS both requires and can contribute to good governance. In this field, good governance requires accountability, legitimacy, transparency, responsiveness, participation, respect for rights, equity, and local access to governance (McCall, 2003). The same is true of participation for urban planning. It both requires and supports good governance, and uses a similar list of requirements as definition (Hodge & Gordon, 2008). Participation, as well as being a listed requirement itself, can also help legitimize locals' knowledge of the area and their experience of it. It can give them an avenue for asserting their rights, as well as exercising democratic rights (and responsibilities) of civic engagement. Supporting rights and legitimacy can lead to increased equity, especially for marginalized groups. Finally, opening up discussion between stakeholders, and conducting decision-making functions publicly, increases transparency and with it the chances for accountability.

2.3.1 Criticisms of Participation

Participation is not without criticism. It is often viewed as an inconvenience in the development industry. It can also be hard for those who hold power to share some of it through participatory decision-making. Still other critiques are based on the quality of input received. Fiorina (1999) contends that those who chose to participate tend to be more extreme in their views, whereas the public at large is moderate. He argues that those who are willing to overcome time and energy barriers to participation are more likely to hold strong beliefs. These participants may care about different issues than non-participants, and some participants (purists, or "true believers") may

also have different tactics. When these conditions are present, they produce participation that is unlikely to reflect the views of the public at large.

That having been said, Fiorina (1999) suggests that the problem of extreme voices is best solved with more participation, as increasing participation would “dilute” extreme voices; large numbers can compensate for less information. This (perhaps counter-intuitive) solution is suggested because less participation is not a viable option in the current pro-participation political climate. (This also suggests a further criticism, that participation is a political fad. For the sake of evened power relationships and democratic civic engagement, it is hoped that this is not true.) Fiorina (1999) suggests that increased participation can be achieved by lowering the time and energy costs of participating. Online participation methods are suggested for their ease of access and lower time commitment, which lowers the costs of participation. Fiorina’s (1999) arguments and reasoning apply to the American political arena. However, we may assume that similar syllogisms can be said of Canadian, Albertan, and Calgarian participation in urban planning. None of the points raised above is highly specific to the American system, so the general ideas are sufficiently transferable. Fiorina (1999) himself insists he is a social scientist committed to generalisation. In addition, Calgary has a relatively American ethos, due to early settlement by Americans (Miller & Smart, 2011).

The type of knowledge produced by online planning participation tools is an emergent form of combined knowledge, neither purely local experiential knowledge, nor expert/technical-rational (Bamberg, 2013). This is because these tools can gather knowledge from citizens in all positions, including professional, and since citizen knowledge is gleaned from numerous sources, including experience, but also education and media. In addition, citizens frame their use of the tool, and hence their contribution, for the planning context. Thus, they often present positions, arguments,

and evidence rather than simply information and opinions about local spots. This pattern was repeated in our own (in-person) public engagement process (Bliss-Taylor & Hunter, 2012e).

In the Bamberg (2013) study, planners viewed the tool as an information-gathering instrument. They took the information gathered and summarized points offered with a view to including them in plans, framing contributions for planning rather than taking all information as is. This is perhaps understandable. But what is more interesting is that planners did not see any value in participating in discussion via the tool, or in the knowledge that could potentially be created via such discourse. This may be at least partially related to the study's focus. The study itself, also framed the utility of such a tool as information-gathering and informational contribution to planning, and did not mention the empowering aspects of resident inclusion in planning.

Finally, some criticisms of participation centre on whether the process does enough for participants. Especially in advocacy-based PGIS, criticisms often surround who benefits from and who has access to participation, as well as experts' roles in overlooking local ability and knowledge (Chambers, 2006). Without access, groups within the community will not be heard (Elwood, 2006). Participation cannot equalize if those who are already marginalized have no chance to partake. Even with full access, it is possible that the benefits of participation could be reserved exclusively for those already in positions of power, either in terms of decision making, ownership of information, or profit. As such, participation should be designed to be inclusive. It should also pay special attention to introducing more balance to the power relationships involved. It should ensure that the products of the exercise benefit everyone who participated (Chambers, 2006).

2.3.2 Participation in this Research

There are many degrees of participation, and their differences matter in terms of governance, sustainability of process and products, and local satisfaction. These degrees are often described in terms of rungs on a ladder. Arnstein's (1969) ladder, seen in Figure 2.3, is the original. It describes a range of types of participation. These vary from the lowest forms, grouped as nonparticipation, which includes manipulation and therapy. The middle range includes degrees of tokenism, which are informing, consultation, and placation. Finally, the highest level of participation, degrees of citizen power, includes partnership, delegated power, and at the top, citizen control.

Degrees of Citizen Power	Citizen control
	Delegated power
	Partnership
Degrees of Tokenism	Placation
	Consultation
	Informing
Nonparticipation	Therapy
	Manipulation

Figure 2.3: Levels citizen participation, adapted from Arnstein's (1969) ladder.

Since the advent of Arnstein's ladder, numerous adaptations have been created. From a ladder of children's participation (Hart, UNICEF, & International Child Development Centre, 1992) to an e-participation ladder (Smyth, 2001), the many variations cover a range of specific cases.

However, this research, again, uses the original as the measure, classifying participation according to Arnstein's ladder. This is viewed as adequate and appropriate. Firstly, urban planning engagement can comfortably use this gradation (Hodge & Gordon, 2008, p. 312). And secondly, adoption of the original that was sound enough to produce so many offshoots is considered preferable to choosing a potentially narrower conception.

The desired level of participation is characterised by citizen involvement, not just in selecting from among alternatives, and not just in being allowed to have a brief say about externally-driven plans for communities, but in co-defining issues, co-developing visions, plans, and strategies, and operating at more of a partnership level with the city and private developers. As such, this research aims to support participation that at least qualifies as *partnership*, if not higher, in the *degrees of citizen power* range. While the tool itself, as a support, simply *informs*, it seeks to do so in a manner that leaves "space" for users to operate at the higher levels identified. For example, this is done by making it possible for users to select the issues that are important to them in their locality. I also strive to support inclusive participation, in order to balance power relationships. This is based on PGIS best practices (Corbett, 2009), and the knowledge that low levels of participation can be disempowering to the point that residents feel discouraged from engaging (Bliss-Taylor & Hunter, 2012b). This research tries to bear in mind that reversing this will require empowerment and an inclusive frame of mind. Empowerment with respect to the support tool is recognized as increasing feelings of confidence and ability to effect change. Though increasing authority and strength is also included in definitions of empowerment, the current research is not in a position to impart these, and as such, these elements of the usual definition are beyond the current scope.

A high level of participation also supports the need for good governance, as it tends to contribute to all of the listed requirements of good governance. In this case, accountability, transparency, responsiveness, participation, and equity are especially supported. This is due to the shared and open nature of negotiation, the balancing of power. It is also due to the structures in place to ensure citizen input is accepted and seriously considered by those in positions of power (Arnstein, 1969).

Lower levels of participation may undermine the process of engagement. Participants are aware of situations that reduce their ability to engage, such as poorly advertised meetings, inadequate notice of feedback opportunities, meetings that inform rather than soliciting input, and processes that ignore input that is solicited (Bliss-Taylor & Hunter, 2012b, 2012c). These are examples of participation at lower levels of the ladder, or of obstructions to a higher level of engagement. Participants may react to these tactics with frustration, by losing respect for public and private decision makers, by losing faith in the process, and/or by removing themselves from what may feel like a futile exercise (Arnstein, 1969; Bliss-Taylor & Hunter, 2012b, 2012c).

This research focuses on participation in the urban planning context. This means that the public involved are weighing in on planning and development schemes. Or, they could be pointing out elements of their environment that are or are not working for the community, also known as labeling strengths and weaknesses, or identifying issues. Further, urban planning participation could mean members of the community organizing to promote their interests and respond to development proposals, either on a formal or informal basis. Participation in urban planning may be solicited by the municipality or developer, or be spearheaded by the public themselves.

Community is often referenced in both participation and urban planning. It is used in this research to mean both the geographical entity that forms the basis of Calgary urban planning, and any group of people living in that entity. It is also used in a more general sense, for example, to mean a group of users interested in a planning initiative. Its use when applied to groups of people can at times give the impression of a unified group of people sharing ideas and vision for their living place. This is not intended here. Divisions within communities can occur either based on demographic differences such as income, relationship to housing (either owner or renter), age, or cultural background, or arising from less immediately apparent differences, such as political persuasion or opinion on urban development. It is also likely that there will be other differences within the support tool's intended user group that have not been anticipated. Throughout the research, I bear this in mind, and strive to design a tool that can respond to all kinds of difference, both anticipated and unexpected.

I refer to the public and the general public, throughout the thesis. These terms are used to describe any individual in the population at large (though those who are geographically closer are more likely to be relevant to any planning or engagement exercises). More specifically, the lay public refers to those who are not involved in the urban planning and real estate development industries. Further, residents refers to individuals who live in a subject area, and finally, participants refers to those who choose to become involved in engagement programs.

The research also focuses on online participation. This means participation activities as described above, but in particular those in which participants access information, discussions, and tools for analysis via the Internet. Although in-person participation remains an important component of engagement efforts, online participation is viewed as an important, logical, and sensible additional element. Most importantly, the research is specifically designed to respond to online

participation problems. As such, online participation is the type considered in this research, and is where I focus my efforts.

2.4 Calgary Regional Planning

For additional context, a brief look at Calgary's regional planning is useful. But first, a caveat: though the planning landscape in Calgary is examined as it relates to the proposed research, the research is not intended to be policy-driven. Indeed, were existing policies not in support of public engagement or sustainability, this research would still pursue the same questions, and be guided by the same concepts. This is because these are recognized as valuable, and independent of local policy. Thus, this section is presented simply to explore the position of the research in the regional context.

Calgary's regional planning arena encompasses a wide area stretching from the Rocky Mountains to the Prairies, all under the name of the Calgary Regional Partnership. However, it is also possible to think of the City of Calgary itself as a region, since the city is quite large (geographically), and has annexed smaller municipalities as it expanded outward, rather than co-existing with other municipalities, as many other (Canadian) metropolitan regions do.

The wider region, under the Calgary Regional Partnership, is governed by the provincial Land Use Framework (2008), and by the Alberta Land Stewardship Act (2009). The primary plan governing this area is the Calgary Metropolitan Plan (2009). At least that is the intention. The plan was completed in July 2009, and sent to the province for approval, but was not well received in rural municipalities, who had concerns with the development pattern proposed. The

restrictions imposed were perceived as an infringement on property and development rights (B. Miller, pers. comm. November 8, 2011).

Water rights and development patterns have been sticking points in the debate surrounding regional planning (B. Miller, pers. comm. November 8, 2011). The development pattern proposed by the Calgary Metropolitan Plan (2009) seeks to house future population growth (of an estimated 1.7 million people) in specific development nodes, rather than spread it over the whole region (Calgary Regional Partnership General Assembly, 2009). This was done to preserve farmland and open space, and to make provision of transportation, infrastructure, and local services more efficient and cost effective (Calgary Regional Partnership General Assembly, 2009). According to the plan, water licences will only be granted for development that fits this pattern. This is viewed as infringing upon the landowners' rights to develop in areas that do not fall in the development nodes (B. Miller, pers. comm. November 8, 2011).

As a result of the political squirmish, the plan was not passed by the province, and was sent back for review. An updated version, released in spring 2012, states that it has been "updated to better meet the needs of the region" (Calgary Regional Partnership, 2012). The plan notes that priority growth areas are being reviewed between 2012 and 2014. A mediation process conducted in the summer of 2013 resulted in some changes (Calgary Regional Partnership, 2014). At the time of writing (February 2014), the Calgary Regional Partnership was awaiting an official letter from Alberta Municipal Affairs acknowledging the mediation results (Calgary Regional Partnership, 2014). Following this, there remains the question of how to legislate the regional plan (Calgary Regional Partnership, 2014). Because of all this, the region's governing plan remains somewhat in limbo.

Despite a state of limbo while awaiting further review and provincial seal of approval, some themes emerge in Calgary's regional planning. First, there are ongoing attempts to secure regional cooperation among municipalities. Even though this has been strongly encouraged by the province, and has not yet been fully successful, these are encouraging trends. In addition, the restriction of water licensing can be seen as positive, since water is critical to agriculture, ecology, and human settlement in the area. Conserving this supply should be an important tenet of all plans. While these might be strange assertions the year after dramatic and historic flooding in Southern Alberta, the region, as part of the Palliser Triangle, is highly susceptible to drought (Khandekar, 2004). A final encouraging sign is the node-style of development in the plan. Efficient provision of transportation and services (including services such as shops and community facilities, as well as water/sewer, gas, and electricity), through nodal development is indicated by most sustainable urban planning guides. This signposts that the region has a view to developing with efficient use of land, materials, funds, and energy. All of the trends above can be seen as positive steps toward sustainability.

2.4.1 Sustainable Development in Calgary

Calgary's regional planning has been largely affected by the oil and gas industry, its boom and bust cycles, and the labour pressures that result (Miller & Smart, 2011). These labour pressures draw migrant and immigrant populations to the area. This has caused housing shortages, resulting in high housing costs (which exacerbate labour shortages), and a homelessness problem (Miller & Smart, 2011). This in turn has resulted in declining quality of life in the city, with immigrant populations in particular reporting being unhappy with the city (Miller & Smart, 2011). This is problematic, as migrant and immigrant populations are important to relieving

labour shortages (Miller & Smart, 2011). The City of Calgary has had trouble keeping pace with boom and bust driven development (Miller & Smart, 2011). Infrastructure has been high on the list of citizen concerns for many years, and infrastructure costs rose as the bulk of new housing was built on the city's outskirts in greenfield developments throughout the 1980's and 1990's (Miller & Smart, 2011). These costs remain unsustainable, even though multi-family housing starts rose in relation to single family housing starts beginning in 1999 and through the 2000's, rising from one third to two thirds, and even exceeding single family starts in 2008 (Miller & Smart, 2011).

However, development in the Calgary region is changing, and may alleviate pressure on revenues (Miller & Smart, 2011). Multi-family housing is becoming more popular, likely due to rising housing costs (Miller & Smart, 2011). In addition, the recently passed land-use and transportation plan, PlanIT Calgary, mandates that half of all new growth be infill. Finally, Calgary's election of Naheed Nenshi in 2010, and his re-election in 2013, indicate that the city is ready for a change; his platform was reformist, advocating more money for transit, citizen engagement, and alleviation of poverty (Miller & Smart, 2011).

An integrated Calgary Municipal Plan (2009a) and Calgary Transportation Plan (2009b) were recently created by the PlanIT Calgary process (City of Calgary Land Use Planning & Policy, 2011). These plans were created following an extensive engagement process including 18,000 Calgarians called imagineCalgary (2006), which has advanced many policies that fit under the sustainable urban development umbrella. These can be found in the adopted planning documents in such examples as intensification of development within current boundaries, a shift in transportation toward sustainable modes such as walking, cycling, and transit, and mixed land uses in support of walkability (City of Calgary, 2009a, 2009b). The plans' integration also

signals a shift away from reductionist approaches. The plans are another encouraging step in the direction of sustainable development.

In fact, Calgary has no shortage of talk surrounding sustainability, and has numerous sets of guidelines to reach it. The City of Calgary has adopted 11 sustainability principles as part of PlanIT Calgary (“Sustainability Principles for Land Use and Mobility,” 2007). These call for choice in housing and transportation, walkability and quality transportation, sense of place, mixed use and compact development, redevelopment within existing areas, green infrastructure and buildings, preservation of open space, agricultural land, and environmental areas, and “connecting people, goods, and services locally, regionally, and globally”. The City also has a 2020 Sustainability Direction (City of Calgary, 2013a). This document does not appear to be based on the 11 Principles of Sustainability, but it does include specific and measurable indicators and targets, as well as base-year performance for comparison, and lists existing strategies. For example, under the 2020 objective “Equity”, a target is set to have improved access to low-income programs and services for 100% of eligible low-income Calgarians. As a strategy toward this, the document lists assessing low-income subsidy programs for accessibility. imagineCalgary (2006) lists 100-year goals in five areas of interest, including the built and natural environments, economy, governance, and the social sphere. Goals have associated targets, which set out measurable benchmarks to meet. For example, under “Built Environment”, there is an “Energy” goal that emphasizes diversifying energy sources, using renewables, using energy efficiently and responsibly, and reducing environmental impact. As a target toward this, it is suggested that by 2036 30% of energy used in Calgary should be derived from low-impact, renewable sources. Little in the way of concrete information concerning progress toward goals and targets, for any of the guidelines discussed above, is readily available.

As for greenhouse gas reduction, the city commissioned a study about potential strategies and their contributions toward reduction targets. As it turns out, it is likely that most, if not all, of the available greenhouse gas reduction strategies will need to be employed to sufficiently reduce emissions (Row, Whelk, Lemphers, & Cobb, 2011). In the Calgary context, these strategies include: working toward energy efficiency in buildings, vehicles, and industry; using more passive, active, and photovoltaic solar energy; transportation mode shifting; combined heat and power generation; behaviour change; fuel switching (for example, to ground-source heat pumps); landfill gas capture; and new sources of electricity in the province. Portions of all of these can occur in the urban environment and be facilitated by good urban planning. As such, Calgary's urban development should reflect this by looking for ways to reduce greenhouse gas, such as through reduced transportation emissions and energy efficient buildings. These strategies will, among other things, help guide the formulation of the proposed tool. It must be noted, however, that provincial electricity production must shift from coal-fired to either coal with carbon capture and storage, or to other energy sources. If Calgary were to implement all available greenhouse gas reduction strategies within its borders, but provincial electricity generation remains coal-fired, the city would not meet reduction targets (Row et al., 2011).

2.4.2 Participation in Calgary

Participation in Calgary ranges in quality. Though it is a legislated requirement in Alberta (Alberta - Municipal Government Act, 2000), the act only actually requires limited participation, when compared to Arnstein's ladder (see Figure 2.3 above). There are also reports of frustration from residents and community associations, both with the development industry and the city (Bliss-Taylor & Hunter, 2012b). Participants express concern with the participatory process,

such as poorly advertised meetings that offer little opportunity to attend. Most of all, however, a strong sense of being ignored is communicated. Even when they can participate, or offer their thoughts, most appear to feel that their input does not affect outcomes, and even that they are unheard victims of the planning process. This feeling appears to discourage participation.

Despite this, participation is improving in at least a few ways. imagineCalgary (2006), itself created through a massive participation process, includes calls for increased participation (City of Calgary, 2006). Under the Governance heading targets include establishing a participatory municipal budgeting process by 2016 and reduced barriers to aboriginal participation by 2020. Under the Social heading, a target geared toward sense of community gauges success in part through resident reports of neighbourhood participation (although it is not clear whether this means participation in urban planning). At present, a participatory budgeting process has been established, in which residents are asked to weigh in on what council budget priorities should be. In addition, Mayor Nenshi has emphasized participation and its important cousin, communication, through such avenues as Facebook and Reddit (“I’m Naheed Nenshi, the current Mayor of Calgary. AMA! : Calgary,” 2013, “Naheed Nenshi | Facebook,” 2014). One campaign asked all Calgarians to weigh in on what should be done with an unexpected extra \$52 million. Other campaigns include road-side signs asking locals to phone the city (311) to provide input on such issues as Crowchild Trail traffic and Nosehill Drive bicycle lanes.

More on this topic can be found in Chapter 3, where Calgarian attitudes toward participation are discussed in greater depth.

2.5 Participant Support

Residents participating in planning will be making decisions that are relatively foreign to them, given most citizens' inexperience with sustainable urban development practices and strategies. In these unfamiliar decision situations, Kellon and Arvai (2011) argue, decision support is necessary to aid participants, as they will be unable to rely on their own pre-existing preferences, and will make untenable, short-lived decisions that only partially reflect their real wishes. This kind of issue also arises in multi-stakeholder negotiation (Edmunds & Wollenberg, 2002), which participatory planning processes often are. Multi-stakeholder negotiations can force consensus and decisions, as participants want to cooperate. However, decisions made like this ultimately are not lasting and can even further marginalize at-risk groups.

The combined pressures of multi-stakeholder negotiations and unfamiliar decision environment make it doubly likely that the group may arrive at decisions they are later unhappy with. Decision support can help avoid this. However, it remains possible even with decision support that communities will have to revisit their decisions periodically, either to improve them or update them to respond to new conditions (Edmunds & Wollenberg, 2002). The use of participatory methods can help with this, as one of the aims is to impart the process to the community, so that they can repeat as needed. It is also helpful to make this point explicitly during the exercise – by stating that the decisions made may need to be revisited, and the participation process can (and should) be used each time.

A good support process could help reach a more generally satisfying decision to begin with, and presents a good process to repeat in the future. Kellon and Arvai (2011) suggest structured decision support comprising (i) clear definition of the problem, (ii) identification of objectives,

(iii) explained alternatives to address the objectives, (iv) predicted consequences of each alternative, and (v) confrontation of trade-offs made when choosing between alternatives. Education is an important component of this and crops up in all steps, but particularly, (iii) and (iv), in which alternative solutions and their expected outcomes are explored. Education components will feature in the support tool.

Mackenzie et al. (2006) created a decision support tool and process with the express purpose of managing wicked problems. Their process, designed for professionals in software engineering, uses incremental formalism, and follows three steps: (i) brainstorming, which allows the group to come up with a macro view of the problem; (ii) cognitive mapping, allowing the group to explore micro views of the problem; and (iii) dialogue mapping, which explicitly maps the disagreements within the group on each issue. The first two encourage divergent thinking and avoid groupthink, while the third diagrams and makes explicit the differences within the group.

The Mackenzie et al. (2006) process was explicitly created for wicked problems, but for professionals. Kellon and Arvai's (2011) recommendations are more suited to lay participants. Both processes have merit, though they are suited to slightly different circumstances. Kellon and Arvai's (2011) recommendations could also be made to apply to wicked problems. However, the process attempts to remove some of the "wickedness" through the initial clear definition of the problem. As such, neither process combines the goals of public participant support in urban planning (often wicked problems), and neither directly addresses online participation (or support).

In general, support tools are created to assist policy makers (Condon et al., 2009). They are often complex models of land use decision impacts, and though informative, are usually too

specialized and dense for lay interpretation. They also generally require a high level of expertise to set up and run. This tends to exclude lay participants, and exacerbate the issue raised in the introduction – namely that “sustainable portions” of planning are added after participation, without participation, and as a result are often rejected by the excluded community (Kearney & Smith, 1994; Schwilch et al., 2012; Tippet et al., 2007).

In-person participatory processes often incorporate support for participants (Rambaldi, Muchemi, Crawhall, & Monaci, 2007; Tippet et al., 2007). But, this is in the form of experts present, and input structures designed to elicit information from participants exhibiting a range of comfort levels with the process (Edmunds & Wollenberg, 2002; Rambaldi, 2008). However, these supports are part of an in-person process, and would not be built in to online participation processes.

One way of addressing the lack of face-to-face expert feedback online would be to make experts available online. While this is an important potential component of an online participation platform, it restricts the anytime-availability that represents one of the primary benefits of online support (Bliss-Taylor & Hunter, 2012a). This could lead to frustration from participants, who may not be inclined to visit the engagement site repeatedly while waiting for feedback, or schedule their engagement at a specific time to accommodate expert availability. Always-available support provides a bridging solution between having no support and having intermittent support dependent on availability of experts. It does not preclude the online presence of experts to provide feedback, but rather fulfills another function by providing continuously available feedback and information to increase participant comfort and empowerment.

There appears to be little literature about replicating these supports in an online process. This could be due to the relative novelty of online participation efforts. Because there is little in the way of directly related work, reviews of related work have been confined to reviews of participant support in general, including PGIS and decision support, especially as they relate to urban or ecological planning. However, these can only guide the design of an online participant support tool, rather than prescribe specific methods or elements to be tested.

Table 2.1 contains a selection of participant support tools whose use context is similar to that of the present research. Study authors are listed, followed by a brief description of the study's objectives, methods, and results. The present work adds to the body of literature illustrated by Table 2.1 by addressing a different context. As such, in the last column, four characteristics of the current research's context are listed, and each tool is assessed for its similarity to the context. "Broad scope of issues" refers to the ability of the proposed tool to support participation at high levels, at which participants contribute to definition of issues and problems. Tools that do not have a check mark for this item limit the scope of issues that can be considered. For example, tools that only assist with one aspect of urban planning, such as da Silva's (2011) urban design tool, or tools that require the construction of scenarios prior to participation, such as game-based tools (Foth, Bajracharya, Brown, & Hearn, 2009; Poplin, 2012), which are limited if participants are concerned about issues that are outside the realm of the pre-built scenario. Though no tool fits with all four criteria, between them, they do address all four. As such, illustrative work is available for each characteristic of the context.

Table 2.1: Selection of similar participant support tools

Author(s)	Objectives	Results	Similarity to Research Context
(Schwilch et al., 2012)	<p>A moderated/facilitated decision support tool to help locals participate in choosing from among sustainable land management strategies. Supported by a global database of strategies, the method includes ranking the sustainability of each strategy.</p> <p>Tested in 14 2-day, facilitated workshops concerning 14 different sites.</p>	<p>The tool was judged to be useful, interesting, and helpful with comparison of alternatives and visualization. It exhibited good presentation and scoring techniques, and balanced consideration of sustainability. It was well structured and holistic, and enabled understanding other stakeholders' viewpoints.</p> <p>Critiques included: the process is time consuming and confusing for some. Interest waned for some due to long timelines or large volume of information. Finally, some thought it lacked transparency.</p>	<p>✓ For lay citizens</p> <p>☒ Users online</p> <p>☒ Users not assisted</p> <p>✓ Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(Foth et al., 2009)	<p>The authors investigate the utility and potential of Second Life for participation in urban planning and uncovering narratives concerning the local environment.</p> <p>Methods included Second Life-based 3D visualization of a redevelopment lot. This was tested in facilitated workshops that asked how the redevelopment lot should be planned. The tool exhibits and tests one element of support – computer-based 3D visualisation.</p>	<p>3D visualization of the lot and surroundings demonstrated the consequences of users' redevelopment suggestions.</p> <p>Test subjects intrinsically built sustainability into their decision-making (it was not part of the tool).</p> <p>Visualisations would have to be constructed for each new planning engagement exercise.</p> <p>Facilitation and training with Second Life are required to use the tool.</p>	<p>✓ For lay citizens</p> <p><input type="checkbox"/> Users online</p> <p><input type="checkbox"/> Users not assisted</p> <p><input type="checkbox"/> Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(daSilva, 2011)	<p>Seeks to involve lay citizens in design of their environment. Creates an easy-to-use 3D model/visualization tool to assist lay participants engaging in urban design.</p> <p>Constructed a SketchUp plugin based on neighbourhood assessment and combining and arranging neighbourhood buildings blocks. An interface walking people through the exercise was also created.</p> <p>No discussion of how to combine users' actions in the tool as participatory input.</p>	<p>The tool is not tested with users. The results presented are simply the interface and supporting functions of the tool, and the steps a user or group of users is walked through to use the tool. The tool appears promising for practical use, based on the presented results.</p> <p>Simplicity and ease-of-use result in reduced flexibility.</p> <p>The tool alone cannot achieve wider participation, and should be combined with awareness and education.</p>	<p>✓ For lay citizens</p> <p>✓ Users online</p> <p>✓ Users not assisted</p> <p>☒ Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(Poplin, 2012)	<p>Hypothesize that serious games will support public participation, especially by motivating participation through the potential for playfulness and joy.</p> <p>Authors test hypothesis by creating a serious game called NextCampus for a specific scenario. The game is tested using physical and computer-based 3D models, including the use of the physical model-based game by two classes of undergraduate students and interviews of two experts based on their exposure to the game. Little presented about how the game results will be used.</p>	<p>Results included generally positive feelings about the potential of the concept.</p> <p>Critiques include problems with the complexity of the game and the dubious cost-benefit potential, given the resources needed to implement a 3D visualization-based game online. May not be worth it given the intended use to support participation (especially without clarity on how to support participants, beyond providing motivation).</p>	<p>✓ For lay citizens</p> <p><input checked="" type="checkbox"/> Users online</p> <p><input checked="" type="checkbox"/> Users not assisted</p> <p><input checked="" type="checkbox"/> Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(Code for America, 2013)	<p>Streetmix.net is an online drag-and-drop visualization tool that teaches lay citizens about the possibilities for their streetscape, with a focus on illustrating complete streets. However links to participation avenues are not apparent, nor are they described. It appears to be up to practitioners to take advantage of the support offered by incorporating it into their engagement programs.</p>	<p>To the best of my knowledge, academic research on the tool has not been conducted. As such, results are not available in the same format as other tools.</p> <p>However, the site's related blog asserts that positive feedback is received from both lay and expert voices in urban planning.</p>	<p>✓ For lay citizens</p> <p>✓ Users online</p> <p>✓ Users not assisted</p> <p><input checked="" type="checkbox"/> Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(Calthorpe, 2011)	<p>Argues a case for urbanism as part of the solution to climate change, based on 50-year forecasting based in California.</p> <p>As support for this case, an impact assessment tool is produced that communicates impacts of different urban planning styles (such as sprawling and compact) graphically, and based on bracketing. Employs simple presentation of impacts in order to communicate consequences of urban planning decisions.</p>	<p>The tool is not tested with users, but rather, its impact results are used as persuasive arguments for green urbanism. Results are communicated in terms of impacts of four different scenarios, rather than the tools' effect on users</p>	<p>✓ For lay citizens</p> <p><input checked="" type="checkbox"/> Users online</p> <p><input checked="" type="checkbox"/> Users not assisted</p> <p>✓ Broad scope of issues</p>

Author(s)	Objectives	Results	Similarity to Research Context
(Cinderby, Bruin, Mbilinyi, Kongo, & Barron, 2011)	<p>Describes three case studies implementing rapid appraisal participatory GIS (RAP-GIS).</p> <p>This method of rapid spatially-enabled participation is employed in the service of urban planning, in in-person, facilitated, on-site rapid workshops. In the cases described, it was used to gather information from the “hard-to-reach”, as a mechanism for increased inclusivity in participation.</p>	<p>The authors found they were able to gather comments from diverse groups, and that the method has strong potential for improving inclusivity in participation.</p> <p>Responses received were comparable to those generated by PGIS, but lacked the level of depth. The method does not fully satisfy PGIS best practice criteria (Rambaldi, Chambers, McCall, & Fox, 2006), but may improve the ability to reach the hard-to-reach. It is also more time and cost effective than PGIS.</p>	<p>✓ For lay citizens</p> <p>☒ Users online</p> <p>☒ Users not assisted</p> <p>✓ Broad scope of issues</p>

Two of the studies above explicitly support the foundations of the current research, either in their construction of the problem (Schwilch et al., 2012), or in their questions for future research (Poplin, 2012). Schwilch et al. (2012) assert that locals benefit from experts' technical knowledge of available alternatives, but at the same time, must be involved in defining the problem. They also claim that decision support lacks effective support for these. Poplin (2012) asks "How can one create a pleasant virtual environment in which citizens learn about current situations?" This is one of the primary questions of this research. I endeavour to construct a tool that presents meaningful and relatable information, based on the assumption that this will make the information easier for users to assimilate and employ. As such, I strive to create a pleasant online support environment. This is one of the primary subjects of Chapter 3, which seeks to understand how the intended user is likely to understand issues related to planning engagement currently, such that support can be tailored to users' present understandings and mindsets.

2.6 Implications for Support Tool Design

Though numerous tools exist that approach the issue of planning support, participant support, and computer-aided or online supports, none of the tools identified above wholly fits the context of the current research. Each fits some part of the context, however, and as such can provide some direction: Providing information about the available alternatives, including assessment of their sustainability is considered helpful (Schwilch et al., 2012), ease-of-use is important (daSilva, 2011), as is the ease with which information can be absorbed (Calthorpe, 2011). Games and (3D) visualizations are potential methods to aid absorption of information, though they may restrict the tool to the constructed situation (Code for America, 2013; Foth et al., 2009; Poplin, 2012). On the whole, research concerning computer-aided tools provides much insight, but

because it is based on newer technology, it is a newer field. Research concerning the supports available in in-person engagement can be used as a supplement (Cinderby et al., 2011).

In-person support parallels can guide the research by showing what aspects of support are important, such as increasing empowerment and addressing participants' comfort level with the process. Addressing these important items then becomes a priority aim while designing the tool. In-person support examples also provide strategies that can be mimicked online, to test whether the strategy itself, or the way it is mimicked, is effective online. Finally, the processes used in in-person participation, such as familiarizing with the subject population, conducting process with transparency and integrity, and working toward high-quality levels of participation on the participation ladder (Corbett et al., 2006), can also be guides in the online process.

The processes followed by in-person support point to activities that can guide the design of the online support tool. Familiarization with the target population, in this case the public, especially in Calgary, will help design the tool. The tool itself should provide high-quality support, for example with information from reliable sources, with sources made available for transparency. High levels of participation should be supported, by structuring the support while bearing in mind the activities that participants would engage in at that level. This would include such things as co-defining issues and co-creating solutions. This would mean participants would be providing all kinds of information and raising all kinds of issues, not just simple answers to pre-defined questions reflecting only a scope defined by outside professionals. As such, the support tool should be designed to allow room for this kind of thinking by participants. It should not preclude the potential for participants to define their own issues or priorities, for example by restricting support to single issues. It should attempt to provide support in numerous areas, recognizing the potential for any number of areas of interest to crop up within participants'

scope. It should recognize that it is impossible to guess what every participant will be concerned with, and as such recognize its own limitations and take steps to fill in inevitable gaps.

All of these considerations help to provide design direction, and guide the design process. Chapter 3 delves into the points raised here in more depth. Literature is reviewed to familiarize with the subject population. The review also looks at what motivates the public to choose sustainable routes. Tool design is shaped around the resulting picture of participants, the impetus to support citizen power-sharing levels of participation, and the need to increase comfort levels and empower participants.

2.7 Chapter Summary

This chapter has reviewed basic concepts underpinning the current research, including sustainability, sustainable urban planning, and participation. In order to contextualize these, their application in Calgary is reviewed. This also provides contextual information about the geographic setting of the research, as well as historical influences and the current state of urban planning and participation in Calgary. This is followed by a summary of related work in participant support. Finally, I conclude by discussing how the sum of the concepts discussed and their practical application all contribute to the research direction and design process.

The major outcomes from this review include the adoption of the Brundtland definition of sustainability (UN World Commission on Environment and Development, 1987), including broad views of environment and economy. This is applied to urban planning through guidelines such as the Melbourne Principles (United Nations Environment Programme et al., 2002). Participation is defined using Arnstein's ladder (Arnstein, 1969), and the research strives to

support high levels of participation. The application of sustainability and participation principles in Calgary is explored, and it appears that despite early frustrations, the City is making strides toward both (Miller & Smart, 2011). Finally, online participant support tools are examined, and none fit the context of the current research to the desired extent. As such, the research works to provide a support tool that meets the need identified, and is designed for lay participants, acting largely on their own via online channels, and with the space to define their on priority issues.

Chapter Three: Background Specific to Tool Development

In this chapter I present the literature review that informs the support tool framework and design. The previous chapter identified that having some knowledge of what potential participants think is an important part of in-person engagement processes. It makes it easier for the practitioners present to provide a process that supports the unique needs of the group involved. As such, the design of the online support tool mimics this process by becoming familiar with the mindset of the public expected to use the tool.

In particular, I address public conceptions of sustainability and urban planning, both in general and locally. Using this information allows me to design a support tool that responds to existing conceptions, and as such is meaningful and relevant to the intended users.

First, I address the current state of research about public understanding of sustainability and issues related to sustainability. Then, I look at work done concerning local community priorities for urban planning. I use this to augment and compare with information concerning the views of the general public. Following this, I delve into strategies for improving public understanding of sustainability. Finally, I investigate stakeholders' requests for features and characteristics of an online participation platform, and extract the pieces relevant to a complimentary support tool. The sum of these creates a framework for the support tool that serves to inform its design and content. I conclude by discussing the implications of the above findings for the research.

3.1 Public Understanding of Sustainability

Public understanding of sustainability varies in a number of ways. For example, different people will consider different scales of the issue (Macnaghten & Jacobs, 1997). These variations in

perspective range from local, immediate, and personal, as when viewing environmental issues as they relate to local pollution, exhaust fumes, or loss of countryside. Correspondingly, on the other end of the spectrum, one would find global issues such as ozone depletion and global warming.

Understandings of sustainability among the public can also vary in terms of the extent of engagement with the concept, and the resulting appreciation of sustainability's implications. In this sense, public understanding (as exhibited by research subjects that included both university students and lecturers) can be grouped into three levels (Reid et al., 2009; Reid & Petocz, 2006):

1. The first level confines understanding of sustainability to simple definition. Those at this level of understanding use the definition of the word “sustainable” to avoid actually engaging with all that the concept of entails.
2. The second level is broader, and is characterized by an appreciation of resource use issues, and the implications of these for sustainability.
3. The third level is broadest. It includes recognition of concepts of equity and justice within and between generations.

Each of the broader levels includes an understanding of the levels below, but not the other way around. So, a person who understands sustainability at the second level will both define the concept and engage with the idea to the extent of recognizing implications for resource use. However, this person would not think about issues related to equity, such as ensuring that the needs of future generations can be met. Most research subjects were in the narrowest group, with

fewer in the second, and fewer still exhibiting understanding at a level that includes equity and justice.

In addition to these three levels, public understanding of sustainability is often viewed in terms of specific areas of interest. A study by Kilinc and Aydin (2011) identified seven ways in which student science teachers understand sustainability: in terms of the environment, in terms of social aspects, with respect to the political, with a view to energy issues, in an economic sense, in terms of educational implications, and with respect to technology. Context-based variables also affected understandings of sustainable development, including, for example, the economic development of the country, or current politics. Each individual could understand sustainability in terms of a number of the seven topic areas listed. A similar study of San Francisco Bay Area municipal economic development officials found that conceptions of sustainability rest on three different areas of interest (Zeemering, 2009). Some prioritized urban design-based sustainability initiatives, others placed more importance on sustainability initiatives relating to traditional economic development, and a last group prioritized civic engagement-based initiatives. In general, all of the studied groups placed less importance on environmental initiatives, with the exception of subjects related to green building.

The public grasp of sustainability, as discussed above, can also be represented by Figure 3.1. The figure shows the levels of understanding nested, as each higher level contains the other. The nine topics that subjects associated with sustainability are also listed.

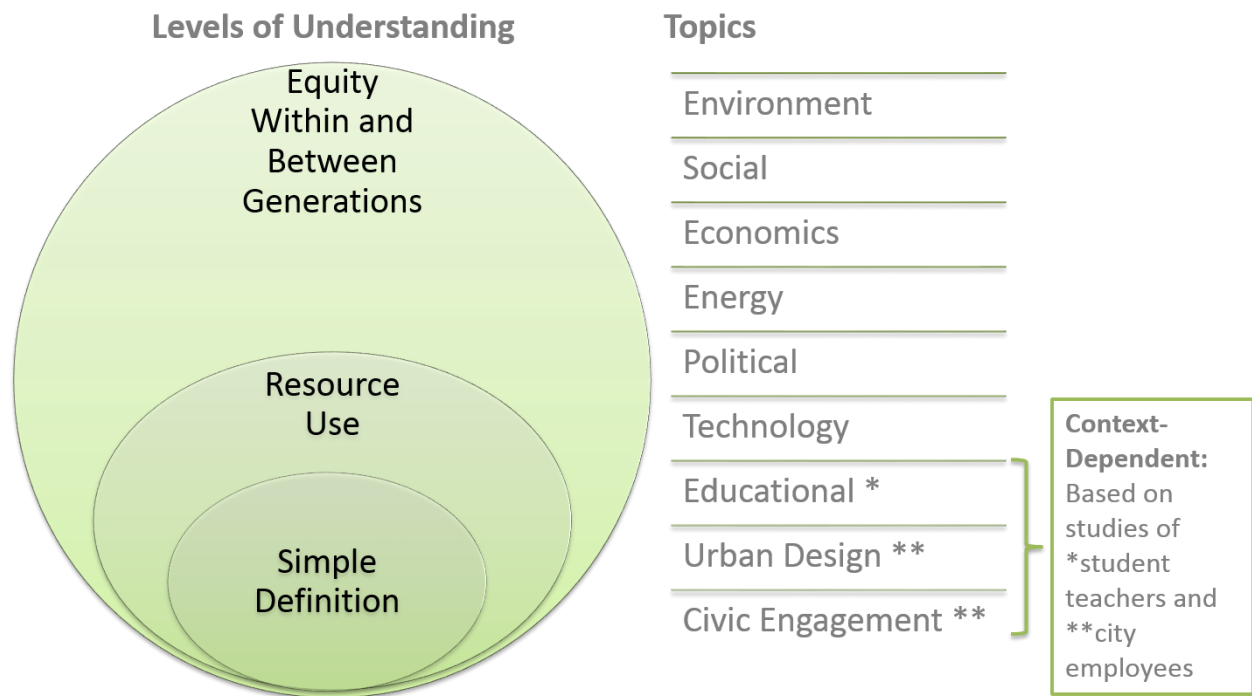


Figure 3.1: Public understanding of sustainability, including levels of understanding and topics raised.

Applicability of the Above Studies

Unfortunately, the picture of public understanding of sustainability is based on relatively little literature. The literature reviewed concerning public understandings of sustainability deals mainly with the educational context; students', instructors', and student teachers' conceptions of sustainability have been studied (Kilinc & Aydin, 2011; Reid et al., 2009; Reid & Petocz, 2006). It is possible that the focus on understandings in the educational context arises from the UN call

for sustainability to be taught pervasively (UN World Commission on Environment and Development, 1987).

However, this research aims to support an inclusive participation program, in keeping with an impetus to empower marginalized groups, and reach high levels of engagement on the participation ladder. As such, the aim is to reach a wider general public and support users that emerge from this pool. Many in the community at large may not have had post-secondary education, or may have attended post-secondary some years ago. As a result, the post-secondary student and instructor populations in the understanding-of-sustainability studies available may not reflect the understanding of the intended user.

It is possible that the wider public may have similar understandings of sustainability. They may conceptualize in narrower to broader terms, and they may understand it in terms of any of the topic areas (and perhaps others) identified above. However, it is also possible that they do not think about sustainability much at all, or they may make claims to it to deflect changes that they fear may come of sustainability programs (Bliss-Taylor & Hunter, 2012d).

In order to further understand how and to what extent the intended support tool users may be thinking about sustainability, further review is necessary. This can be used to triangulate potential attitudes and views, to achieve a more complete and verified picture of the potential user. To this end, I supplement the review above by looking at studies of public understanding of a major issue within sustainability.

3.1.1 Public Understanding of Issues Related to Sustainability

Because there is little literature on public understanding of sustainability, I also review public understanding of a major issue within sustainability. The issue selected is climate change. There are a number of reasons for this. Firstly, it is an important global environmental challenge and a symptom of numerous unsustainable practices. Secondly, working toward sustainability is often suggested as part of the solution to global warming, and conversely, global warming is a compelling reason to work toward sustainability. Finally, there is considerable literature available on public thoughts about, reactions to, and conceptions of climate change. The argument can be made, then, that the way the public view climate change reflects and illuminates their views of sustainability. In turn, understanding their views of sustainability contributes to the support tool's ability to communicate meaningful and relatable information, as it hints at what is currently meaningful and relatable to intended users.

Different understandings of climate change can be classified similarly to understandings of sustainability, by level of engagement with the concept and the topics considered. In addition, belief in the phenomenon and support for personal and public mitigation are major differentiating factors. Using these (among other factors), the Yale Project on Climate Change Communication's work has identified six groups of climate change attitudes among the American population (Maibach, Roser-Renouf, & Leiserowitz, 2009). Table 3.1 shows the groups, as well as characteristics describing each. The groups are ordered from greatest belief in climate change to least. Each group views the issue differently enough to warrant different communication strategies concerning climate risks and mitigation options. The number in brackets represents the proportion of the American population that fit the description of that

group, based on surveys of 1000 Americans done in November 2011, and 1008 Americans done in March 2012 (Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2012).

Table 3.1: Attitudes toward climate change in the American population

Group	Proportion of Population*	Description**
Alarmed	13%	“Alarmed” people are the most convinced that climate change is happening, the most involved with the issue, recognize scientific consensus around the issue, and believe it is anthropogenic. They are the most likely to view the issue as personally threatening. They are also the most supportive of action to mitigate it. They personally engage in consumer and interpersonal mitigation activism, but interestingly, report little political activism.
Concerned	26%	Those classified as “Concerned” are less involved with the issue and less likely to see it as a personal and immediate threat. Otherwise, they are similar to those in the “Alarmed” group, including reporting low political activism.

Group	Proportion of Population*	Description**
Cautious	29%	Members of the public who fall in the group “Cautious”, generally believe in climate change but view themselves as poorly informed, and would be easily willing to change their minds. A third of this group believe scientists disagree a great deal about the issue. They do not perceive a threat to themselves or others now, and only view threat as a future possibility, or as it relates to non-human nature. In general, though, they support mitigation action, though it is not a high priority for them.
Disengaged	6%	Those who are “Disengaged” do not know whether global warming is occurring or if it will be a threat. They reporting giving the issue little thought. They do not support mitigating action. In fact, when asked what their highest priorities are for energy policy, they select offshore drilling and arctic wildlife refuge drilling.
Doubtful	15%	“Doubtful” people split between belief in global warming, disbelief, and not knowing. However they do not see it as a threat to people or as anthropogenic. They view mitigation action as a low policy and personal priority.

Group	Proportion of Population*	Description**
Dismissive	10%	Finally, the “Dismissive” segment of the public are certain global warming is not occurring, or not anthropogenic. They consider themselves well informed. They believe scientists either disagree, or agree that global warming is not occurring. They not only see no threat from climate change, but also think it will have no effect. They expect mitigation policy or action to have negative consequences. They are personally involved in the issue in the form of socially discussing it and giving advice about it, more so than any other group.

* +/- 3% at 95% confidence level for each sample (Leiserowitz et al., 2012)

** (Maibach et al., 2009)

Percentages reflect the most recent distribution of the population within the six different attitude groups. However, these numbers have been tracked since 2009, when the initial groups were identified. This research uses the group descriptions more so than the population distribution. Descriptions are used to understand potential users’ mindsets, since the tool is intended for use by a wide cross-section of the community. The research also uses both only to extent that they shed some light on the overall issue of public understanding of sustainability. As such, detailed examination of changes over the years is not critical for this review. It is sufficient to note that between 2009 and 2012 the population has shifted “down” the scale in terms of belief in climate

change, toward less belief. There are more people classified as “Cautious”, “Doubtful”, and “Dismissive” in 2012 compared to 2009, and fewer classified as “Alarmed”, “Concerned”, or “Disengaged” (Leiserowitz et al., 2012; Maibach et al., 2009). While this is considered a move in the wrong direction from the perspective of motivating action on sustainability, there are at least fewer people in the “Disengaged” group. That indicates there are fewer who are characterized by barely engaging with the concept and being ill-informed.

In a similar study, Lefsrud and Meyer (2012) found five groups of climate change constructions among members of the Association of Professional Engineers and Geoscientists of Alberta (APEGA). APEGA conducted a study to understand members’ conceptions of climate change. The study also specifically asked respondents’ opinions about Kyoto compliance. As part of the study, professionals provided written comments about their views. Lefsrud and Meyer (2012) examined these to understand how professionals view climate change, how they construct their own climate science authority, and how they deconstruct that of others. The five categories of respondents are listed in Table 3.2.

Table 3.2: Attitudes toward climate change among APEGA professionals

Group	Proportion of Respondents	Description
Comply with Kyoto	36%	These people view climate change as human-caused, a risk, and believe it should be mitigated. People in this group are more likely to be lower in their organizational hierarchy.

Group	Proportion of Respondents	Description
Responsibility	5%	Those in this group do not express strong feelings about climate causes, science or risk, but see mitigation as a responsibility. They evoke emotions mainly to talk about responsibility, and believe action should be taken to mitigate climate risk.
Fatalists	17%	This "surprisingly large group" (Lefsrud & Meyer, 2012) see climate as both human and naturally caused, but perceive little risk, and see Kyoto as being too late or irrelevant. They are less likely to support regulation, but also do not care about the economy. They are also less likely to express emotions or use symbolism and metaphor, and do not think involvement will make a difference.

Group	Proportion of Respondents	Description
Natural Causes	24%	Climate change is natural (not human caused). Of all groups, people in this one most strongly disagree that climate change is a risk, and are most likely to think the focus should be on reducing other pollution, dealing with other issues, and adapting to climate change. Along with the economics first group, this group is more likely to be higher in the organizational hierarchy.
Economics First	10%	Those in this group think the real cause of climate change is unknown, that climate change is not a risk, and that Kyoto will harm the economy. They are most likely to position themselves as experts, and delegitimise others, as well as most likely to use symbolism and metaphors in their language surrounding the issue.
Not Categorized	8%	These respondents did not provide enough information to be categorized.

The attitudes toward climate change listed above, and the distribution of each subject population among groups can be seen in Figure 3.2. The figure shows the groups organized by highest belief in climate change or regulatory compliance to lowest level from left to right.

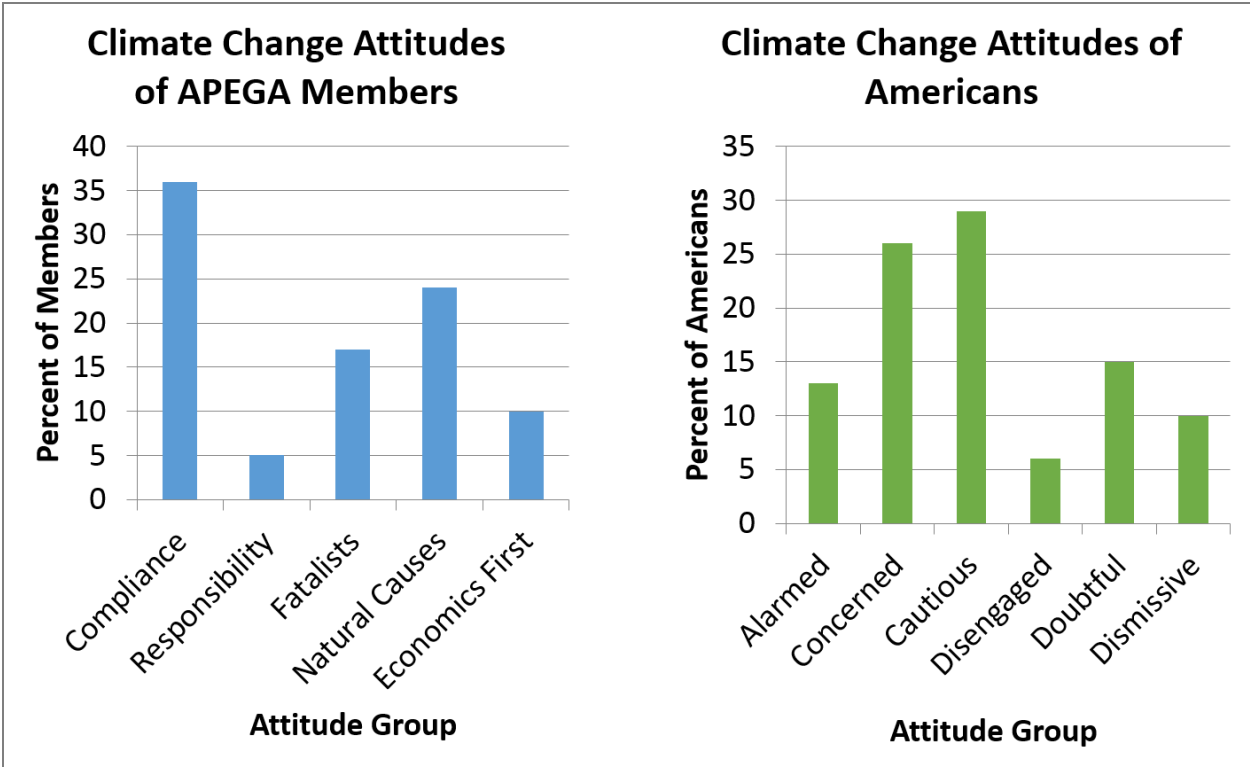


Figure 3.2: Groups of attitudes toward climate change and subject population distribution within groups.

It is interesting to note that senior executives, especially in the petroleum industry, are overrepresented in the anti-mitigation categories (Lefsrud & Meyer, 2012). Lefsrud and Meyer (2012) conclude that professionals’ views of climate are influenced by their (working) environment. This suggests that Canada-wide professional views may be different, due to differences in the prevalent industries across provinces. Despite this, there may be common ground among professionals in risk management. Most industries recognize the need to mitigate

risks (especially risks associated with weather, security, etc.). Motivating action from this perspective would bypass the debate about whether climate change is real and/or anthropogenic. Though opinions differ on the severity of the issue and what should be done, 99% of the professionals surveyed believe climate change is happening, and 41% support regulation for mitigation. The study does not mention whether the other 58% believe no mitigation should occur, or simply do not want mitigation to be enforced by regulation. Given the risk management training of APEGA professionals, it is unlikely that such a high proportion believes no mitigation should occur.

APEGA members represent a stakeholder group in urban planning and sustainable development in Alberta. In addition, many are local to Calgary, where most Albertan oil and gas firms are headquartered, and as such would also qualify as residents. As such, the five conceptualization types above will be helpful in understanding the attitudes that tool users may have. However, as APEGA members represent only one segment of society, it is entirely possible that lay users or users with other backgrounds will have different and additional conceptualizations.

In the absence of similar information on groups of climate attitudes among lay Canadians or Calgarians, and given the scarcity of literature about attitudes toward sustainability in general, I cautiously extend the above general breakdowns of opinion to our intended users. This is certainly reasonable to the extent of acknowledging that there will be different attitudes requiring different communication approaches. In order to further vet reviews on understanding of sustainability and attitudes toward climate change, I add one final element to the triangulation. In the following section, I review the information available concerning a group of local, lay Calgarians' understandings of sustainability and priorities for urban planning in their area.

3.2 Local Understandings and Priorities

As a final supplement to my familiarization with the tools' intended users, I examine understandings of sustainability and urban planning priorities among lay Calgarians. In this section I explore the perspective and understandings of local residents participating in an engagement process. I review participatory work designed to ascertain the community's understandings of sustainability and priorities with respect to planning. I consider what participants mentioned about sustainability directly, and what related issues they mentioned without connecting the issues to sustainability. I supplement this by considering what they viewed as important in their community in general. I use this to triangulate with the above information about public understandings of sustainability and related issues. Using these three investigations, I form a reasonably complete and vetted picture of the intended users' current frame of mind.

The participatory work was conducted as part of a broader research project. Information about local views was collected in the Calgary community of Glamorgan through workshops and focus groups concentrating on community-driven planning and sustainability (Bliss-Taylor & Hunter, 2012c). Three open-invitation workshops and three focus groups for smaller sub-groups within the community (single-family housing areas, multi-family housing areas, and local businesses and institutions) were conducted. Each of the meetings was summarized in reports and provided to the community, who opted to keep the information private. Summarized findings are reported here for their capacity to shed light on the local and general population's views of sustainability and sustainable urban development specifically. However, they are not the subject of the thesis.

3.2.1 Local Understanding of Sustainability

Discussion surrounding sustainability was most notable for its absence (Bliss-Taylor & Hunter, 2012d). It was rarely raised without prompting, and when prompted, participants were more inclined to ask what to say than to volunteer information. Prompting elicited some limited examples of sustainability in the community, such as xeriscaping¹.

Participants did express a need for a community vision to rally residents and activities toward a common goal (Bliss-Taylor & Hunter, 2012c). Some sustainable development elements were suggested, including connecting with neighbours regarding community issues, gaining a sense of unity and focus, and an environmental sustainability plan.

However, on the whole, it appears that participants primarily associated sustainability with environmental issues, and even then only a small subset of these (Bliss-Taylor & Hunter, 2012d). Walkability and densification were the primary topics mentioned without prompting. Densification appears to be linked to fears that the neighbourhood will be changed beyond recognition without resident input or consent. As such, sustainability, or rather issues participants relate it to, appears to generate feelings of animosity, and an urge to defend their community to avoid change.

Participants view the community as sustainable as-is (Bliss-Taylor & Hunter, 2012d). This was despite the fact that the neighbourhood is on the edge of the city, exhibiting mainly single-use zoning and single-family homes, and bordered on two sides by highways. They view the place as

¹ Environmental design of residential and park land using various methods for minimizing the need for water use (Dictionary.com, <http://dictionary.reference.com/browse/xeriscape>).

both walkable and diverse. They pointed to different land use blocks within the community as mixed use, noting that multifamily housing provides a range of residency options in their community. The commercial areas in and near the community were also mentioned, based on claims these decrease reliance on the car and increase walkability.

Participants' assessment of their community as walkable and sustainable is in conflict with expert opinion of the same neighbourhood (Sandalack & Uribe, 2011). The main difference appears to be one of scale. Where lay participants pointed to large-scale granularity in land uses as mixed-use, experts saw large single use blocks that do not offer sufficient mixing to be walkable. Expert opinion views the community as auto-oriented.

Residents also mentioned public transit as contributing to the community's sustainability, despite also saying that it is infeasible for them to use it (Bliss-Taylor & Hunter, 2012d). Public transit was not seen as a viable option for community residents, because it is slow in general. In addition, service to locations relevant to locals is poor. Locations such as West Hills shopping mall and southeast industrial areas are frequently visited and important to the community, but are only served by slow community busses. Transit is also viewed as inconvenient for errand trips.

Apart from asserting that the community is sustainable, for the most part little was said about sustainability (Bliss-Taylor & Hunter, 2012d). Only one related issue, participation, generated much comment, although the connection to sustainability was not made. This indicates that participants were unsure of the scope of issues that could be related to sustainable urban development. Based on this, their understanding of sustainability appears to be relatively narrow.

The above raises the question, why do participants seem to focus little on sustainable development? I speculate that the issue may be too broad, ill-defined, and hard to achieve for

residents to bother wading in to. It may also be due to a perceived lack of problems in the immediate area. These possibilities lead to further questions about what could be done to define sustainability and make the concept relevant, and what other forms of support would be appreciated?

In terms of their dialogue surrounding participation, participants expressed a desire to encourage more people to participate (Bliss-Taylor & Hunter, 2012c). They asked for elements of higher-level participation, most directly by asking for co-decision making and by rejecting tokenism. Lay participants expressed a high level of frustration with the current engagement process. It appears some choose not to engage in urban planning as a result of feeling that their input will be ignored (Bliss-Taylor & Hunter, 2012c). Participants expressed feeling ignored in a number of different ways. Either their input is requested too late, when decisions appear to have already been made, or it is incorporated in plans in earlier stages, but then later scrapped due to project changes, or simply no longer present. There is an impression that the City's requests for input provide very little notice, both in terms of written (email) requests, and when it comes to public open houses. Taken together, these indicate a lack of trust and a strained relationship between the participants and the City of Calgary.

Participants expressed a desire to improve the relationship with the City of Calgary, as well as a desire to have a say in the development of their community (Bliss-Taylor & Hunter, 2012c). The need for education to help residents engage was articulated. Residents would like a better understanding of how they can affect change in their community, especially in partnership with the City of Calgary. They would like a source of information regarding planning.

The City of Calgary's "Transforming Planning" program, which seeks to improve the overall process of planning in Calgary through improved communication and collaboration between stakeholders and City staff, and between City departments, may have the potential to improve the situation (City of Calgary Planning, Development & Assessment, 2013). However, the engagement that produced the responses discussed above was conducted from April to June of 2012, while the City's program did not begin until June 2012. As such its impact and presence were not yet apparent.

Finally, some participants also feel that they do not have the knowledge necessary to participate, or that their input is not valuable (Bliss-Taylor & Hunter, 2012c). This could indicate that residents feel overwhelmed by the subject, or the planning process. It could also indicate that they are not confident in the value of their own knowledge of the community, and their experience of it. This possibility supports the indication that the support tool should strive to empower, as well as inform.

3.2.2 Local Urban Planning Priorities

Participants said little about sustainability other than to assert that it has been achieved and walkability is present (Bliss-Taylor & Hunter, 2012c). This indicates that participants and perhaps all residents, spend little time thinking about it. This revelation came as somewhat of a surprise, since sustainability is (in my experience) a prevalent topic in the media and marketing, as well as in industry, and research, not to mention a key pillar of City of Calgary planning (City of Calgary, 2013a).

At any rate, it is useful to ask what participants *are* thinking about, that is, their priorities with respect to urban planning. Traffic is a major issue in many forms: safety, crosswalks and lights, congestion, speeding, and short-cutting through the community (Bliss-Taylor & Hunter, 2012b). This is corroborated by the City of Calgary's satisfaction survey, which found that "infrastructure, traffic, and roads", was most frequently mentioned as the City's most pressing issue (Ipsos Reid, 2013). Another favourite issue was neighbourhood preservation, with many expressing how much they like the current form of the neighbourhood. Related to this was a discussion of neighbourhood change such as infill or secondary suites. Opinions on this were quite polarized, with some expressing support, and others strong opposition. This is in part because of traffic and parking concerns. It also appears to be motivated by concern about aesthetics and engagement in the neighbourhood, as it is supposed that renters are less concerned about both. Further, concern about infill and secondary suites appears in part because of suspicion that either private or city interests will hijack any renewal to their own ends, rather than to meet community preferences. While this stance may resemble NIMBYism, the debate surrounding this genre of local response tends to indicate that the issue is more nuanced than this simple characterization suggests (Futrell, 2003; S. Hunter & Leyden, 1995; E. R. Smith & Marquez, 2000). At any rate, wading into the NIMBY debate is beyond the scope of this research, so no position is taken regarding its presence in this particular case. Finally, participants raised the issue of park space preservation, in addition to safeguarding single-family housing.

Other subjects mentioned, though not as often as those above, included urban agriculture (Bliss-Taylor & Hunter, 2012d). This was viewed positively, though municipal bureaucracy is seen as an obstacle. Participants also acknowledged that they would like to make it possible for more

seniors to age in place (Bliss-Taylor & Hunter, 2012d). Economic hindrances were the main obstacles identified. Apparently, in order to retire, many cannot afford to stay in the city.

On the whole, the review of local understandings and priorities indicates that locals' focus in terms of community planning and their neighbourhood is not on achieving sustainable development. It suggests that information surrounding their concerns, or couched in the terms they use, will be the most meaningful to the community. Therefore, it is recommended that support tool communication should focus on issues that participants have indicated are important to them. Rather than presented in terms of community planning, support information may also be more effective when geared toward individuals' and groups' day-to-day lives, and direct effects on them. These were often the types of topics raised, and so appear to be the most compelling and relevant lens. For example, information could include planning strategy effects on driving time, or on the type and amount of green space. This may better respond to residents' apparent priorities and concerns.

The case study reports reviewed do have some limitations (Bliss-Taylor & Hunter, 2012b, 2012c, 2012d). There were a small number of participants, from only one community in Calgary. As such, it is possible that participants represented only one or a small range of views, rather than reflecting what would be said by all the diverse groups expected in the community. In addition, it is possible that if other communities were also studied, still more perspectives would emerge. However, when used in conjunction with the reviews of the general public's views on climate change, and select public's understandings of sustainability, the local works reviewed can be informative.

Bearing this in mind, I find that it is reasonable to use the combined results of the reviews to help understand the mindset of intended users. Thus, the support tool communication and content indications gleaned from the combined reviews will be serviceable.

3.3 Expanding Public Understanding of Sustainability

In this section the focus turns from public understandings to measures that can be taken to render sustainability, participation, and climate change initiatives compelling and relevant. I combine recommendations for participatory planning processes, and for generating support for climate mitigation. Based on findings in the above reviews, strategies focus on addressing the public's existing values, empowering them, and helping them ensure their contribution is worthwhile. Strategies can be implemented as either support tool features, or information that should be provided.

To help address conflict in participatory planning processes, Crance and Draper (1996) suggest combining structural and behavioural solutions. Structural (top-down) solutions alone do not address individuals' tendency to act in their self-interest, and as such run into three problems: instability, uncertainty, and conflict. This is corroborated by Schwilch (2012), who found that top-down solutions, those imposed by decision makers, could be unacceptable to the community. This would lead to conflict, and uncertainty as to implementation, and resulting instability. While these three problems cannot be completely removed (especially uncertainty), they can be mitigated by incorporating behavioural solutions. These include:

- Promoting networking and interactive communication, and
- Incorporating ideas and expectations of affected parties into management objectives,

The latter is one of the main aims of participation, while the former is an important component of participatory processes (Hodge & Gordon, 2008, Chapter 12). The latter is also an important part of respecting locals' existing values, ideas, and experience.

It is also important to address fear and distrust within the community and in their relationships with decision makers, as well as the competing values participants consider (Crance & Draper, 1996; Kearney & Smith, 1994). The following are important measures:

To address mistrust,

- Promoting awareness of existing levels of cooperation,
- Highlight common interests, attitudes, values and goals of the group;

To address self- interest,

- Reducing the scope of the problem,
- Emphasizing the importance of individual contribution,
- Segmentation strategies (in which individuals spread the word on environmental conservation),
- Encourage social responsibility through education; and

To address variable perceptions of resource amenity,

- Ensuring that those closest to the resource understand the need for its management and are able to afford the management strategies (Crance & Draper, 1996).

These strategies explicitly address existing values. They strive to emphasize and work with areas of common interest. They also reveal value conflicts to make them explicit and open, and in doing so, make them easier to address as part of a deliberation process.

To empower participation, easily accessed information such as visuals and maps are recommended. Al-Kodmany's (1999) studied the use of visuals in participatory planning, including sketching, GIS, and photos manipulated to show what development would look like. Using sketch artists, such as during a Charette², can generate enthusiasm as participants see their proposals coming to life in the form of drawings. These sketches also reflect input back to participants. Photo-realistic images showing how a development would look in-situ have a similar effect. Further, GIS can help participants by providing data and a common grounding of context and information. Overall, the visuals empowered participants to be involved in planning.

These lessons can be adapted for the online tool: For background, **GIS** capability can be provided, while **sketched or cartoon images** can be provided to choose among, in lieu of a sketch artist, and **example** photos can be used in lieu of and as well as **photo-shopped images** showing potential development. While two of the three of these are just approximations of the visuals studied by Al-Kodmany (1999), they are appropriate to the online context of the sustainability support tool.

In addition, feeling gratified by receiving recognition for creating user-generated content online leads to a person's feeling more psychologically empowered (Leung, 2009). Thus, it may be possible to increase feelings of empowerment that encourage public participation and support for

² An intense period of design or planning activity, resulting in a design solution.

action on sustainability. The tool could accomplish this by **providing opportunities for users to generate content that can be viewed and responded to by peers and experts.**

In terms of support for climate action, research from the Yale Project on Climate Change Communication (Leiserowitz, 2006) also suggests addressing **values, feelings (“affect”), and affective imagery.** “Affect” refers to positive and negative feelings about specific objects, ideas, or images, and “affective imagery” refers to the sights, words, and ideas to which these feeling states have become attached through learning and experience (Leiserowitz, 2006). Values, feelings, and imagery, and experiential processes strongly predict public risk assessment. Perception of climate change risk and support for mitigation is more strongly associated with these than with other factors such as sociodemographic factors.

Lieserowitz (2006) also finds that, though many support broad policies for climate mitigation, when faced with concrete suggestions to increase fossil fuel taxes, fewer are on board. It is suggested that this reflects a belief that climate risks primarily affect other people, and non-human nature, but not the local area or individuals questioned. Thus, broad measures are supported, but “direct pocketbook” implications are not. This issue is further addressed in Leiserowitz, Kates, and Parris (2006), who acknowledge that action on climate lags related values. The authors suggest a number of reasons for this gap, which the following strategies address:

- Make explicit the conflicts between values, including those within each person’s own value system, and between people;
- Address lack of knowledge, perceived efficacy, skills and power (i.e. empower and educate);

- Acknowledge and if possible, address, structural impediments such as practices, bylaws, subsidies, and infrastructure that impede action and change;
- Acknowledge and if possible address the habitual behaviours (that are often hard to change) that contribute to lack of action.

Communication of risks should also bear in mind that lay considerations of risk are often different to expert considerations of risk (Plough & Krinsky, 1987). The public tend to understand risk in context, from an experiential perspective, taking many more considerations into account than experts do, or perhaps are able to from a critical-pragmatic (Forester, 1989) or a pragmatic communicative (Innes, 1995) planning perspective. Understanding this is a key to moving toward mutual understanding, rather than simply trying to persuade the public that the experts are in the right. As such, **technical language should be avoided**, as it can reduce the possibility of generating the necessary public dialogue surrounding views of risk.

Support for both climate policy and action are related to the public's perception of scientific agreement (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011). That is, the public, faced with the perception of scientific disagreement over climate change, is content to let experts come to an agreement, and then act. As such, it is important to **clearly communicate that the majority of experts agree on climate change**. This communication could also indicate that the disagreement among experts is more perceived than real.

It may also be beneficial to communicate that sustainable urban development does not have to entail living in huts (or other drastic lifestyle changes and inconveniences). Smil (2005) provides guidance in this area: The well-respected author on energy posits that the things that are truly important to life, including personal freedoms, opportunity for intellectual advancement, and

mental and physical pastimes, can be had for 50-70 GJ per person per year (Smil, 2005, p. 351). The lifestyle that this amount of energy affords is roughly equivalent to that enjoyed in France and Japan in the 1960's (Smil, 2005, p. 353). Further, if global energy use were equitably shared, all people could enjoy this level of consumption and this lifestyle for a total energy use equal to that of the beginning of the twenty-first century (Smil, 2005, p. 352). This would mean vastly improving the lives of many of the world's poor. In addition, in terms of technological capacity, we are more than capable of making considerable improvements in our energy use (Smil, 2005, p. 331).

The above recommendations for participant support seek to render sustainability, related issues, and urban planning relevant and meaningful to participants. They seek to communicate on a level that is understandable and compelling. These recommendations will be incorporated into the support tool design along with, and bearing in mind, the review of participant understandings of sustainability.

3.4 Stakeholder Design Requests

As part of a broader research project, two workshops attended by stakeholders in the planning field in Calgary were held to guide design of a participatory planning platform. Representatives included people from the Calgary Regional Partnership, Federation of Calgary Communities, the Pembina Institute, as well as City of Calgary staff, University of Calgary students and academics, and project sponsors, including The Neptis Foundation (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011; A. J. S. Hunter, Sandalack, Liang, Kattan, Shalaby, et al., 2011). The workshops asked what participants would like to see from an online participation tool in general. Since the support tool is designed to form part of an online participation platform,

feedback from these workshops is informative to the research. Here I summarize the portions of the major outcomes of the feedback that are relevant to the support tool component of the online participation platform.

The stakeholder workshops are reviewed for three things:

1. Requirements of the online participation platform that should be largely fulfilled by the support tool,
2. Requirements of the online participation platform that the support tool can assist in accomplishing,
3. Requirements that should govern the support tool as well as the online participation platform.

Characteristics that are not directly relevant are not listed here.

On the whole, the review identified that users should be able to **evaluate proposed plans** and **inform themselves of and discuss community issues** (A. J. S. Hunter et al., 2012). This is done partly with the hope of informing “better” planning, development and infrastructure decisions. Specific ideas concerning how this should be done were also raised. These entail:

- Helping users learn abstract planning principles, about interconnections in urban planning, and about the impacts of different approaches;
- Presenting alternatives to current practice, and
- Making it possible to compare different approaches, such as through comparison of current and future neighbourhoods;
- Including social and economic facets of issues;

- Helping users understand how their community evolves, what shapes its future, and generating appreciation for the forces and needs that create change;
- Helping users understand the impacts of changes, and clearly communicating the implications of decisions or scenarios (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011).

Helping users understand the numerous facets of urban planning in the above list entails the provision of information. The support tool should cover numerous topics including:

- Incorporating the cost of services, to communicate the true costs of developments;
- Illustrating how land use changes also change transportation needs;
- Demonstrating both positive and negative aspects of all transportation mode choices;
- Educating users about the full costs of transportation;
- Discussing costs of maintaining low-density neighbourhoods, to the community, homeowner, and city, for example, unit costs per person for running a school, public transit, and maintaining parks, libraries and streets, etc., should be calculated for different neighbourhood densities;
- Exposing residents to a range of housing options, including more than just what can currently be found in Calgary (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011).

Given that diverse perspectives are present in the lay public, and among planning stakeholders, the information provided should be understood from a number of perspectives. The tool should consider all perspectives, and strive to include those perspectives in the support tool. In addition,

the tool should consider what types of information those with differing perspectives would be interested in. These include:

- Qualitative aspects, ensuring they are represented as well as quantitative;
- Short- to long-term timelines;
- Small-scale and whole-system approaches;
- All spheres of influence, including the political, economic, social, and environmental;
- Conversion between metrics, such as by converting travel distance to cost, or including the cost of transportation in the cost of housing, or demonstrating how car-independence increases available income, widening the range of accessible housing options (Keough, 2011);
- Emotional factors, since decisions are not always made for economic reasons; or more broadly, are not always made strictly rationally;
- Highlighting interconnections and feedback mechanisms, for example how public transit both requires and supports density (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011).

Because of their potential to aid understanding, visualizations were a much-discussed topic. In particular, these can help people understand effects of commonly heard terms such as densification. The aim is to allow decision-making informed by knowledge of the full range of possibilities available, rather than through reactions that may be driven by misconceptions. For example, many associate negative effects with increased density, such as less parking space, more road traffic, less green space, lower land values, and unpopular styles of housing. Visualization could improve understanding by presenting numerous ways of achieving higher

density. Because this would allow users to view potential effects, the range of alternatives presented would be accessible and meaningful, rather than being numbers or buzzwords. In addition, visualizations would allow users to view the effects of their own planning ideas, thus helping them evaluate their own contributions.

Visualizations of the following were requested:

- Possible future developments;
- Planning elements and influences;
- Alternatives to current practice, and different planning approaches in general
- Contrasts of how a neighbourhood may look in the future if nothing were to change, and how it might look with ongoing development (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011).

Visuals themselves could include maps of the city and community, sketches of neighbourhoods and streetscapes, example photos, graphs, flowcharts showing processes or feedback loops, and existing locations photo-shopped to show what potential developments could look like.

All the ideas above would be of little use without participants willing and able to speak up. As such, the support tool must also strive to empower users. The provision of accessible support and information is part of this, as is valuing individual knowledge and experience. As part of this, the tool should ask questions about community problems (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011). This step is also part of higher-level participatory processes, since it allows participants to state what they feel are the important issues.

Finally, ease of use was another much-discussed item (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011). The tool must strive to include all potential participants to support broad engagement. It should be user friendly and intuitive, and inclusive to those with non-technical backgrounds. It should not require special knowledge to operate. Further, it should be easily found. In short, it should be accessible to all levels of technical ability and knowledge.

3.5 Implications for the Research: Support Tool Framework and Design

Understanding the public mind-set can help devise a way of communicating about sustainability and urban planning such that the message is meaningful, relatable, and useful to participants. It is hoped that this will help residents make use of sustainable urban design strategies and principles.

Sustainability appears to be understood in relatively limited ways, and issues within it appear to be misunderstood. As such, the support tool should expand existing conceptions of sustainability, by building upon them. It should also present information about related issues. Information should be presented such that it is meaningful and relatable.

Communication should be tailored to the issues that the public prioritize within urban planning, and/or the issues that they associate sustainability with. This will allow the support to begin from a familiar understanding, and expand upon that. This strategy is also designed to make the support more meaningful and relevant to users. This also has the potential to ease the introduction of new topics, broader conceptualizations, and new applications of sustainability in urban planning.

In addition, participant support should address the sentiment among lay participants that they have little to offer the process. By familiarizing them with terminology and concepts, support can

increase participants' comfort level. In addition, reading about issues may remind participants of knowledge or experience they have about it, hopefully showing participants that their experience of the place is both valid and valuable information.

The support tool should take into account stakeholder expectations for a participation platform by incorporating those that are relevant. This will entail designing in the features listed in the section above, and presenting the requested information.

3.6 Chapter Summary

This chapter presented the literature review that informs the support tool framework and design. This comprised a review of public understanding of sustainability and issues related to it, as well as investigating the local understanding of sustainability. Both indicated that understandings of sustainability can be limited, and that engagement with the concept itself and issues within it can vary quite widely. In order to understand what potential tool users think about when considering urban planning, a review of local planning priorities was also conducted. Traffic and commuting issues are foremost, followed by neighbourhood preservation, and improving community relationships with the City.

Following this, literature was reviewed concerning strategies for expanding public understanding of sustainability (and related issues). Numerous techniques have been the subject of many studies, and can be briefly summarized as requiring respect for values, habits, and conflicts within these, and providing education that is accessible and manageable. Finally, a review of stakeholder requests for a participatory planning platform was assessed, and the portions relevant to participant support were extracted. In brief, these ask for inclusiveness, and to support it, usability, as well as catering to different communication styles and perspectives.

I conclude by discussing the implications of the above topics for the research direction and design process. Ultimately, the tool will require information that responds to the understandings of sustainability and priorities for planning. This will have to be presented such that it is manageable and accessible, includes those who are not technologically adept, and caters to a broad range of viewpoints.

Chapter Four: Methods

This chapter presents the methods used to solve the research problem. I start with the worldview and strategy of inquiry. Following this, I briefly explain the methodology used to create the support tool design: design science. I explain my reasons for choosing it, and the research and evaluation methods involved. I then describe the support tool design by defining the characteristics of the technical artifact composed to address the research problem. This is done through the construction of the problem, the conceptual design, a list of components, and finally a shortlist of components immediately ready for web development. Following this, I describe the survey process used to test the prototype that was constructed based on the tool design. As part of this I describe the subjects, recruitment process, survey instrument, and analysis involved.

4.1 Worldview and Strategy of Inquiry

I adopt a pragmatic worldview. Pragmatic research is outcome focused, generally bypasses debate about what constitutes reality, and uses the conceptual ideas, inquiry strategies, and data collection that correspond best to the situation at hand (Creswell, 2007, p. 22). These characteristics describe the approach taken in the research. That is, I am primarily focused on generating an outcome – a support tool design – that could address the identified problems in online participation (see Chapters 1 and 2).

The research is underpinned by both theories and best practice guidelines in sustainability, sustainable urban planning, and participation, particularly participatory GIS. I focus on participation as it occurs in the context of the urban planning process. The methods I use are guided by theories in information systems research, design science in particular.

Pragmatically driven research often uses mixed methods (Creswell, 2007, p. 22), and this research is no exception. I combine design and behavioural science methods concurrently as “concurrent evaluative research design”, or “DESIGN + behavioural” (Huysmans & De Bruyn, 2013). This combination uses behavioural science in the evaluation phase. Design research methods, also known as design science (Gregor, 2006; Hevner et al., 2004; Huysmans & De Bruyn, 2013) were used to design the support tool and evaluate the design, while surveys were used to evaluate a prototype of the tool. Qualitative and quantitative methods were used to evaluate survey answers.

4.2 Design Science

The research methods and tool construction make use of design theory, a type of theory within information systems research (Gregor, 2006). Design theory is also known as design science (Gregor, 2006; Hevner et al., 2004), or design research (Huysmans & De Bruyn, 2013). Design science is used in development of information systems (including decision support systems), and concerns principles of form, function, and methods, as well as theoretical justifications of any of the above (Gregor, 2006). It is essentially a theory that prescribes how to *do* (Gregor, 2006). Within information systems research, this type of theorizing is done quite frequently, and represents a significant portion of the research. For example, design science is often used to address wicked problems (Hevner et al., 2004), as defined by Rittel and Webber (1973). Since urban planning problems are by and large wicked problems, and since the support tool resembles decision support tools in a number of respects (more so than it resembles any other information systems artifact), the application of design science to the research problem is considered appropriate.

Contributions to knowledge that fit the description of design science are judged by their “**utility to a community of users, the novelty of the artifact, and the persuasiveness of claims that it is effective**” (Gregor, 2006, emphasis added). These requirements are expanded upon by Hevner et al. (2004), in their list of requirements for conducting design science research. The requirements are designed to ensure that valid design science research is conducted that can make a contribution to literature and practice. Since these requirements cover the same ground as Gregor’s (2006) while being more detailed, fulfilling the Hevner et al. (2004) requirements also ensures that the Gregor (2006) requirements are met. Seven requirements must be met to conduct effective design science research:

1. Design as an artifact, meaning that an artifact consisting of either a construct, model, method, or instantiation must be produced;
2. Problem relevance, that is, the research must respond to important and relevant problems;
3. Design evaluation through well-executed evaluation methods must demonstrate the utility, quality, and effectiveness of the artifact;
4. Research contributions in the form of the artifact, design foundations, and/or design methodologies;
5. Research rigour in both construction and evaluation of the artifact;
6. Design as a search process, which means that the research must search for a solution to the problem using available means while recognizing design as an inherently iterative process; and
7. Effective communication of research to both technical and managerial audiences (Hevner et al., 2004).

An artifact can be a construct, model, method, or instantiation, and must be produced by effective design science research (Hevner et al., 2004). My research produces a model in the form of the support tool design, detailed in section 4.3. An artifact in the form of a method normally involves technical improvements to IT artifacts (Hevner et al., 2004). This research focuses on proof of concept, that is, on showing that it is indeed possible to provide the type of support envisioned. As such, it is not yet practical or reasonable to explore technical improvements to the implementation. A construct provides the vocabulary and symbols used to define the problem (Hevner et al., 2004). A framework of the construct is produced in the formation of the problem (see section 4.3.2). However, this research deals with the first iteration in the design-test cycle, so the construct is unlikely to be completely formed. As such, the construct will likely evolve beyond its current state in future iterations. Finally, an instantiation is provided and tested in the form of the prototype.

I make use of these guidelines in my research in order to conduct effective design science research. I show the relevance and importance of the problem these address by establishing both the research need and gap (refer to Chapter 1, and supporting material in Chapters 2 and 3). I evaluate the design using the evaluation framework proposed by Hevner et al. (2004) and, as part of that, experimental evaluation using a survey (refer to sections 4.6 and 5.3). I contribute to the research by producing design foundations and an artifact that responds to the research problem, questions, and goals, and by testing to determine the calibre of the solution. I demonstrate research rigour by addressing the design science requirements above, and through my evaluations. My design is conducted as a search process; the search began with inquiry into the problem in Chapters 1 and 2. It continued by delving into the problem space (i.e. the constraints and requirements) with my review of factors affecting intended users' views, in Chapter 3. The

search continues with the design and with prototype construction, described in sections 4.3 and 4.4. Finally, for the last requirement, communication, the research is communicated to a technical audience primarily through this thesis, a journal publication, and associated presentations, and to a broader expert and lay audience through research communication channels such as Twitter, as well as informally, such as verbally to interested colleagues.

4.3 Support Tool Design

In the following sections I describe the support tool design, starting with the methodological background and the construction of the problem. Then, I present the conceptual design that developed from the literature review. Following this, I explain in detail the design components that emerged from the problem construction and conceptual design. This is further distilled into a shortlist of developable components. Combined, the conceptual design of the tool, the list of components, and the developable components comprise the design of the support tool.

4.3.1 Methodological Background

In design science, the design process is situated in the problem environment, has set goals to achieve and constraints to respect, and utilizes a collection of actions and resources to construct a solution, all as an iterative process (Hevner et al., 2004). For wicked problems, which are understood only gradually as the problem and potential solutions are explored (Rittel & Webber, 1973), this design process is wholly appropriate; as the solution is explored, and new designs emerge, the problem is better understood, and the design can be modified in an iterative process. In addition, when the solution space is too large to examine every potential option to find the optimal solution, as is the case in this research, heuristics are often used to produce adequate, if not optimum, solutions (Hevner et al., 2004).

Figure 4.1 depicts the current understanding of the problem environment, goals, and constraints. The problem environment is shown by rectangles – I am working within the fields of sustainability, participation, online participation in particular, with a focus on urban planning. Each new field narrows the focus. In addition, the research takes place within the capacity of a master’s thesis. This imposes constraints, as shown by the white pentagon, including not having experts at my disposal to contribute to online planning discussions, and resource constraints as listed. As additional constraints, the review of participation best practice and theory indicated that the support tool should enable high levels of participation, entailing the characteristics listed, as well as inclusiveness, which demands encouragement and empowerment. Finally, the checklist in the centre of the problem environment is a list of design goals, as taken from the research goals and purpose. Defining the design environment this way focuses design efforts on sustainability — and community support — based goals, as recommended by Hovorka and Auerbach (2010).

The collection of actions and resources used to construct the solution within the design space pictured include the literature review in Chapter 2, which established conceptual underpinnings, and the review of Chapter 3, which provided information concerning users’ current mind-set. The primary resource in this case is existing literature including journal article and reports. Following this, a design was established that achieves the goals within the constraints. The design was selected from among alternatives using heuristics. At this juncture I added the additional resource of my own professional experience in urban planning and with in-person engagement programs. Then, a prototype was constructed, requiring additional resources in the form of web-development experience and peer support. Finally, the design was evaluated as

described in the evaluations sections (4.5 and 4.6), below, requiring the addition of a final resource – test subjects.

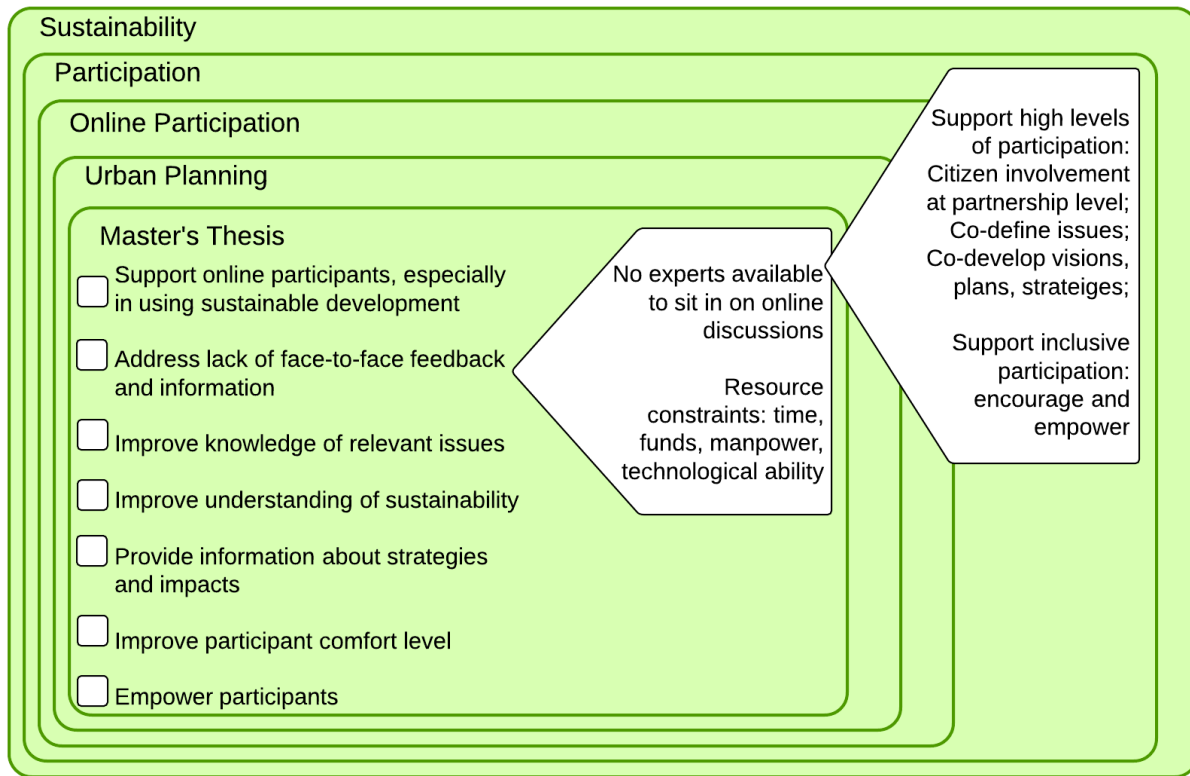


Figure 4.1: Design environment of the research problem. Rectangles represent the environment, the checklist within the environment represents the goals, and the pentagons contain constraints. Together, these represent the design environment.

Since the design process is iterative, and the problem is a wicked problem, the design space and corresponding actions and resources will continue to evolve. Evaluation will provide some indication as to which direction should be taken. The discussion of future research in Chapter 7, “Conclusion”, will elaborate on this.

The major influential factors in the tool design were the literature reviews of (i) the conceptual background, including sustainability, planning, and participation; (ii) public perceptions of sustainability, climate change, and local urban planning priorities; (iii) the review of techniques for expanding public understanding of sustainability and climate change; and (iv) relevant extractions from stakeholder requests for an online participation platform. Below, I describe in detail the conceptual structure and components of the tool as designed and evaluated. I also point out how the major influences above shaped the tool.

The conceptual background provided requirements for tool performance and design, including supporting high levels of participation, empowering users, and supporting their use of sustainable urban planning strategies. These are built in to the research purpose and goals (Chapter 1), and the design environment. Together, these inform the problem construction (section 4.3.2).

Information about public perceptions and priorities pointed to the need for further review in order to identify strategies for expanding narrow and incomplete perceptions and understandings of sustainability, issues within it, and sustainable urban planning. The current state of public perceptions also informed the core content and features list of the tool design (section 4.3.4) and provided additional direction in terms of the diversity of communication styles required.

Stakeholder requests further added to the list of requested communication styles, as well as adding evaluation perspectives, scales and approaches to consider, and types of situations to evaluate. These requests are echoes of many of the findings from the review on expanding public understanding, itself derived from a need identified in reviews of planning priorities and public perceptions. As such, the stakeholder requests form a type of global or general view of the tool needs that is compiled as the support tool conceptual design (section 4.3.3).

4.3.2 Constructing the Problem

I construct the problem as societal or situational, rather than organizational. This is in contrast to framing in terms of an organizational issue or business case, as design science research problems are often framed (Davis, 1989; Hevner et al., 2004). That is, the problem arises due to the lack of face-to-face feedback and information from experts during the practice of participation via online channels. This participation can be initiated by numerous organizations, including public institutions, private companies, and grassroots action. As such, the problem is not couched within a single organizational context. Especially when initiated by grassroots action, but also when initiated by different organizations, it is a practice that emerges from collections of individual actions. These are not coordinated or dictated by any single organization (or type of organization), and as such do not have the same internal structure.

This has important implications for users' motivations, and hence for the technology solution. Two primary differences exist between an organizational setting and a societal setting. Firstly, agents of a company, institution, or other formal organization are ostensibly already committed to a set of organizational goals, and to action toward them. For these people, a technology solution is easily thought of as a helpful tool to make a required task easier. This is not the case with the general public acting on their own, often individual, volition. These people do not have the same incentives to use the technology solution. While the solution is intended to make a task easier, the task is in no way required. As such, the solution effectively needs to take on two roles: helping the user perform a task, and encouraging people to perform the task. That is, it takes on a motivational role that a technology introduced into a formal organization would not need to take on.

Secondly, individual, voluntary actors are not just operating in an environment with very different motivations, but in an environment where peer support is not built in, or assured. In an organization, there would be other actors providing incentives or support. This can vary in extent, from direct instruction and training to simply providing the knowledge that the user is not acting toward a goal alone. In their public engagement activities, especially online, the individual public participant does not have this direction, assistance, or assurance. This suggests that the technology solution should motivate, as stated earlier, in place of direction and instruction. It should also be easy to use, to displace the need for training and to encourage user adoption. Finally, it should provide a feeling of being part of a collective effort, something larger than the individual, to imitate the peer support that is absent without the organizational structure. For example, this could be done through visible commenting and discussion with other users (Al-Kodmany, 1999).

The difference between the organizational context typically studied in design science research (Davis, 1989; Hevner et al., 2004) and the situational problem construction adopted in this research has emerged throughout the design processes. However, the design process is iterative, and the current research represents a first iteration and testing phase. As successive iterations are undertaken, it is quite likely that an augmented understanding of the problem environment will reveal additional implications of the difference between situational/societal and organizational problem constructions.

4.3.3 Support Tool Conceptual Design

A conceptual model of the support tool emerged from the reviews of Chapters 2 and 3. The reviews culminated in stakeholder requests for a participatory platform. As explained above,

these requests have a lot in common with many of the findings from the review of expanding public understanding, which arose from the need identified in reviews of planning priorities and public perceptions. As such, the stakeholder requests provide a global or general view of the tool needs. These are compiled in Figure 4.2 as the support tool conceptual design.

The relevant extractions from these requests primarily focus on different ways of framing information (e.g.: different perspectives and scales), and important tool properties (e.g.: inclusive, interactive). These resulted in the following being included in the support tool design:

1. Presentation of information from different scales, and explicit reference to these different scales, including:
 - a. Large and small spatial extents;
 - b. Long-range and short-term temporal extents;
 - c. Whole-system approaches and reductionist, or single-component based approaches;
2. All of the sustainability spheres:
 - a. Economic;
 - b. Social;
 - c. Environmental;
3. Different stakeholder perspectives;
4. Consideration for emotional decision making factors;
5. Functionality for:
 - a. Analysis;
 - b. Sharing;

6. The following properties:
 - a. Responsive;
 - b. Dynamic;
 - c. Engaging;
 - d. Inclusive, usable, accessible;
 - e. Interactive;
7. Visualization; and
8. Tailoring for different communication preferences.

A number of types of situations were identified, such as existing, planned, user suggested, and (tool-proposed) potential alternatives. These were conceptualized as items to be examined. They are represented by circles in Figure 4.2. The inclusion of “User Suggestions” is due to the need to support a level of participation that permits participant definition of issues. This was identified in the review of participation. Further, “Potential Alternatives” is included because the review of decision support indicated that it is important that participants understand (predicted consequences of) the alternatives they are considering.

Numerous lenses through which to view these situations were examined. These are grouped based on similarity. For example, the scale-related lenses include scales from short- to long-term, from small to large (geographic) sizes, and from piece-wise or reductionist approaches to the whole-system or holistic. These are represented in Figure 4.2 by arrows showing each continuum.

Perspective-related lenses, such as sustainability spheres, include the economic, social, and environmental perspectives. These are depicted as different angles, along the top three sides of

the octagon in Figure 4.2. Additional stakeholder perspectives are shown along the bottom three sides of the octagon. These include regulatory, business, and emotional motives for decision-making. Regulatory perspectives comprise those of politicians and staff, the policy- and decision- makers of the relevant jurisdiction. In urban planning, this is most likely to be the municipality or region. Business perspectives include those held by people and organizations such as real estate, urban development, and building professionals. These perspectives are included because they were requested by stakeholders, as reviewed in Chapter 3. Emotional perspectives are included because these were identified as important in the review of public perceptions of climate change and priorities for local urban planning (Chapter 3).

The octagon is used to create the image of an arena, in which the circles/situations are witnessed at different scales (arrows) from the point of view of spectators/perspectives “seated” around the ring in an octagon formation, so that each views the issue from a different angle. This is the evaluation “forum”, as depicted in Figure 4.2.

This evaluation is communicated via the tool interface. The communication framework uses the perspectives in the evaluation framework to present information from different viewpoints, in order to be meaningful and relatable to the different groups within the public. This was identified as important in the review of attitudes toward sustainability and related issues (Chapter 3). It was also requested by stakeholders, both when they asked for different perspectives, and when they asked for inclusiveness.

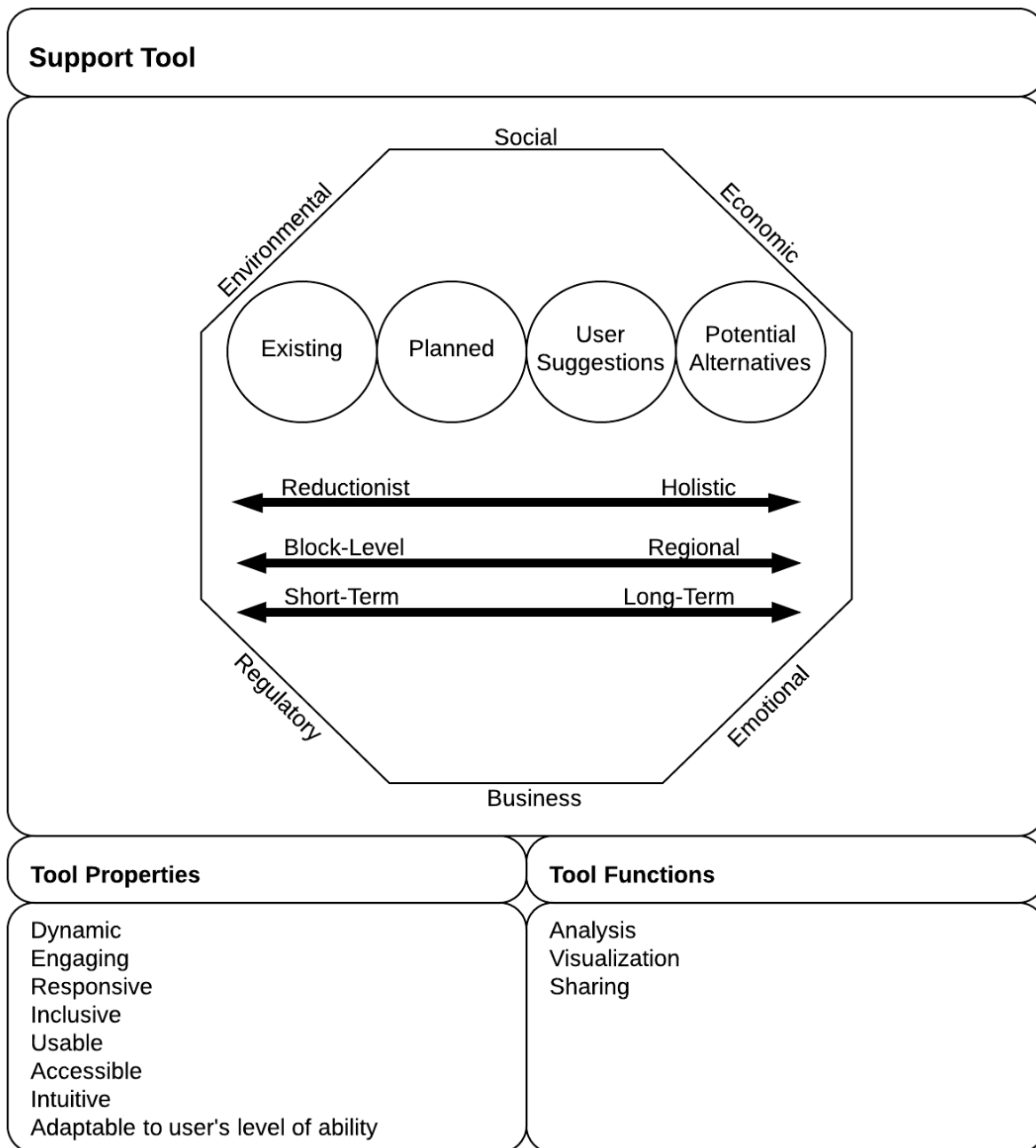


Figure 4.2: Conceptual model of the support tool: the evaluation “forum”. Subject situations (planning alternatives) are shown as circles, different scales as arrows, and different perspectives as different “viewing” angles around the "arena", the octagon. Desired tool properties and functions are listed at the bottom.

The communication framework is also made up of the tool properties and functions. The lists are composed of numerous qualities or features. These were requested directly or indicated indirectly by stakeholders (Chapter 3). The ability to analyze, share, and visualize are included in this list. Properties such as dynamism and responsiveness, and interface requirements such as usability and intuitiveness are listed as well. The combination of communication and interface provide the experience for the tool user.

All of the elements described above are shown together in Figure 4.2. The combination of elements and the manner in which they are assembled forms the conceptual design of the support tool.

4.3.4 Support Tool Components

The review of techniques for expanding public understanding of sustainability and climate change resulted in the identification of the list of important tool features found in Table 4.1. Next to each feature, the primary reasons for including it are listed, with associated citations. The list sets out a number of concrete features derived from the more conceptual elements presented in the conceptual design. This represents a further step on the way from literature review through conceptual design to eventual tool development (or in this research, prototype tool development).

Table 4.1: Support tool features suggested by the review of techniques for expanding public understanding and appreciation of sustainability, related issues, and local urban planning

Tool Feature	Primary Reasons for Including
Input boxes for user generated content, to allow users to add to the list of topics and strategies discussed.	<p>Empower through the gratification of seeing one's content online and recognized by peers (Leung, 2009).</p> <p>Allows user to define issues, rather than passively receive pre-defined issues (Arnstein, 1969).</p> <p>Support bottom-up solution-finding (Crance & Draper, 1996; Schwilch et al., 2012).</p>
Interactive maps/GIS.	<p>Shared spatial context to get everyone on the same page (Al-Kodmany, 1999).</p> <p>Visualization to generate enthusiasm and empower (Al-Kodmany, 1999).</p> <p>Capability for spatial analysis (A. J. S. Hunter et al., 2012).</p>

Tool Feature	Primary Reasons for Including
Drawings, photos of example locations, and photos modified to show what potential developments would look like in-situ.	<p>Shared context to get everyone on the same page (Al-Kodmany, 1999).</p> <p>Visualization to generate enthusiasm and empower (Al-Kodmany, 1999).</p>
Visible and easily joined discussion, with other users and their contributions visible.	<p>Empower through the gratification of seeing one's content online and recognized by peers (Leung, 2009).</p> <p>Promote networking and interactive communication for bottom-up solutions (Crance & Draper, 1996; Hodge & Gordon, 2008).</p> <p>Address self-interest through segmentation strategies (Crance & Draper, 1996).</p>
Share buttons.	<p>Promote networking and interactive communication (Crance & Draper, 1996).</p> <p>Address self-interest through segmentation strategies (Crance & Draper, 1996).</p>

Tool Feature	Primary Reasons for Including
Information about existing levels of cooperation in sustainability initiatives.	<p>Address distrust within the community, and in their relationships with decision makers (Crance & Draper, 1996).</p> <p>Address lack of knowledge to address the gap between values about climate change and (support for) mitigation action (Leiserowitz et al., 2006).</p>
Information about existing levels of expert agreement on the need for resource and waste management.	<p>Address and reduce the tendency to defer to experts in the event of expert disagreement (Ding et al., 2011).</p> <p>Address lack of knowledge to address the values-action gap (Leiserowitz et al., 2006).</p>
Information about the nature of collective interests involved in the planning exercise.	Highlight common interests of the group (Crance & Draper, 1996).
Information about social values and responsibility.	Address self-interest and encourage social responsibility (Crance & Draper, 1996).

Tool Feature	Primary Reasons for Including
Information about the need for resource and waste management.	<p>Address variable perceptions of resource amenity (Crance & Draper, 1996).</p> <p>Address lack of knowledge to address the values-action gap (Leiserowitz et al., 2006).</p>
Information and perspective on the costs of resource management strategies, through examples, comparisons, and discussion of trade-offs.	<p>Address variable perceptions of resource amenity (Crance & Draper, 1996).</p> <p>Address lack of knowledge to address the values-action gap (Leiserowitz et al., 2006).</p>
Information and acknowledgement of the structural and habitual impediments to change.	Address the gap between values about climate change and mitigation action (Leiserowitz et al., 2006).
Information, examples, and encouragement showing the importance of users' contributions and similar contributions.	<p>Address self-interest (Crance & Draper, 1996), by demonstrating the value of individual efforts.</p> <p>Address perceived lack of skill, power, and efficacy, (i.e. empower) (Leiserowitz et al., 2006).</p>

Tool Feature	Primary Reasons for Including
Feedback from decision makers, demonstrating that users' input is taken into account and valued.	<p>Empower through the gratification of seeing one's content online and recognized (Leung, 2009).</p> <p>Address perceived lack of skill, power, and efficacy, (i.e. empower) (Leiserowitz et al., 2006).</p>
Different lenses or perspectives from which to view the sustainability impact (as described in the conceptual design, above).	<p>Address stakeholder requests (A. J. S. Hunter, Sandalack, Liang, Kattan, & Shalaby, 2011; A. J. S. Hunter, Sandalack, Liang, Kattan, Shalaby, et al., 2011).</p> <p>Address different perspectives and understandings among the public (Kilinc & Aydin, 2011; Lefsrud & Meyer, 2012; Maibach et al., 2009; Reid et al., 2009; Reid & Petocz, 2006; Zeemering, 2009).</p>
Imagery addressing the values and affect involved in perspectives on sustainability.	Influence perceptions on sustainability issues and generate support for action (Leiserowitz, 2006).

Tool Feature	Primary Reasons for Including
Information and visual aids to address the value conflicts (internal and inter-person) present in perspectives and action on sustainability.	<p>Reveal value conflicts and them make explicit in order to bring them into the discussion (Crance & Draper, 1996; Leiserowitz et al., 2006).</p> <p>Address lack of knowledge to address the values-action gap (Leiserowitz et al., 2006).</p>
Clear presentation of issues, and presentation of issues such that scope is manageable	Address self-interest by reducing the scope of the problem (Crance & Draper, 1996).
Simplify issues with many facets, such as by categorizing into “status-quo”, “better”, and “worse” brackets (“bracketing”).	<p>Address self-interest by reducing the scope of the problem (Crance & Draper, 1996).</p> <p>Based on successful implementation in Calthorpe’s Urban Footprint model and communication (2011).</p>
Define and present the boundaries of an issue explicitly.	<p>Address self-interest by reducing the scope of the problem (Crance & Draper, 1996).</p> <p>Focus deliberations in order to reach durable resolutions (Kellon & Arvai, 2011).</p>



Figure 4.3: Shortlist of developable components for the support tool, distilled from design requirements, conceptual design, and components list.

The tool features listed in Table 4.1 can be distilled to produce a list of components capable of being developed into an online support tool. In Figure 4.3 these “developable components” are presented. They are organized based on whether they are visual triggers and aids, website features, specific pieces of information, or framing strategies. The first three categories are largely derived from Table 4.1, while the fourth, “Framing Strategies”, is largely taken from the conceptual design of the tool. Framing strategies is simply used to refer to a group of developable components whose main common characteristic is that they position the information

provided by the tool in certain ways. This is done to make the information relatable and meaningful, for example by making it easier to absorb, or approaching it from different perspectives, or by encouraging users' efforts (since the information has little value or impact if the user feels their efforts at participation will be futile). The list in Figure 4.3 can be used as a type of checklist for development and implementation of the tool design.

4.3.5 Deployment Notes

The conceptual design and components listed above form the bulk of the support tool design. Below, some notes as to the particulars of deployment further explain the design terms and vision. For the most part, however, implementation possibilities including the style and configuration of elements, and the way they work together, are left as open as possible. This is intentional, as different participatory scenarios may warrant different styles. An example of this is the likely difference between participatory processes targeted toward seniors, versus those tailored for children.

However, style, configuration, and relationship choices were necessarily made in construction of the prototype. These may be used as illustrations of the terms used as well as the design vision of the tool. The examples in the prototype are not presented in order to limit, but can provide a starting point from which to springboard and consider various options. The description of the prototype can be found in section 4.4. Feedback from survey respondents concerning the style, configuration, and relationship choices, as well as the prototype in general can be found in section 5.3.

When fully deployed, the support tool should be integrated into the participation platform. Participants will then be able to link to support from any topic they were investigating. This will provide participants with information about sustainability that is anchored in something they have already seen and are presumably interested in, because it is directly applicable to what they were working on when they linked to support (Bliss-Taylor & Hunter, 2012a). This is preferable to presenting disconnected and theoretical ideas, whose relevance may not be recognized, and which leave the task of interpretation and application to the user – tasks that may not be undertaken.

To attract interest, while also managing the scope of information presented to the user, small “snippets” of information and visual representations of content can be used. In this capacity, these would attempt to catch the attention of online participants for long enough to pique their interest in a topic, while allowing the user control over the extent to which they engage, and the scope of the issue they are willing to consider at the moment. These can also be designed to aid the communication of core content by inducing the user to think further about the material. They may also be designed to aid understanding, relatability, and absorption of information.

A caveat is necessary when discussing scope management and related components, such as the explicit definition of issues, determination of problem boundaries, and simplification or “bracketing”. While these are useful devices, they should leave intact any information about the interconnections between problems, and the difficulties inherent in defining urban planning (wicked) problems. This could be done by showing visually what is inside and outside the problem scope. This visualization could serve as a reminder that the problem has been limited by being defined, that parts have been left out, and that despite this, interconnections remain.

To demonstrate the interconnected and holistic nature of urban planning and sustainability, situations and impacts should be presented in such a way that the links between them are retained. It also serves to hint that the system-thinking approach is appropriate with topics in planning and sustainability. For example, when presenting the impacts of housing choices, a visual link to transportation, cost, or energy use impacts could be visible. This could be implemented by presenting one issue in focus, while using lines to point to other affected issues. These would be visible but not in focus. This would allow interested users to follow the link and understand the connections, while leaving the option of pursuing the new topic to them. Preserving their option to choose allows the user to keep issues within the bounds of what he or she considers a manageable scope, without losing sight of the fact that many issues are connected.

Similarly, value conflicts and trade-offs should not be overlooked. These are prevalent in urban planning and sustainability, and should be made explicit in order to bring them into discussion (Crance & Draper, 1996; Leiserowitz et al., 2006). For example, trade-off matrices (Markus, Majchrzak, & Gasser, 2002) could be used to make these conflicts explicit and help users understand and deliberate in these situations. These matrices provide a structure that clearly and unambiguously details the elements in conflict. This provides a map of value-conflicts and trade-offs involved in the decisions at hand, and hence, the influences on the decisions. This openly presents important background information that could have remained unstated, such that it is clear, accessible, and open to discussion.

4.4 Prototype Construction

I constructed a prototype of the support tool in order to conduct an experimental evaluation by simulation, to further examine whether the support tool design and concept would fulfill the research goals. The prototype incorporates and illustrates many of the design elements, as well as demonstrating one of the ways that these elements can be combined in an instantiation.

In the sections below, I first describe which components of the support tool design were selected for prototype development, and explain why each was chosen. I then explain the informational content the prototype is built around, describing its origins, content, and how it is presented in the prototype. The information is used to flesh out and unify the components. Next, I detail the physical architecture of the prototype. Finally, I describe the interface and functionality that the user experiences.

4.4.1 Components Selected for Development

The prototype is composed of selected features and information from the list of developable components presented in section 4.3.4. Components were selected based on their ability to provide as seamless a user experience as possible, essentially mimicking full development in that respect. They were also selected to maximize potential impact. That is, they were selected to provide as many of the benefits designed into the support tool as possible, without committing to full development prior to testing the concept. In Figure 4.4 the list of developable components is repeated, with those chosen for prototype development highlighted in red.

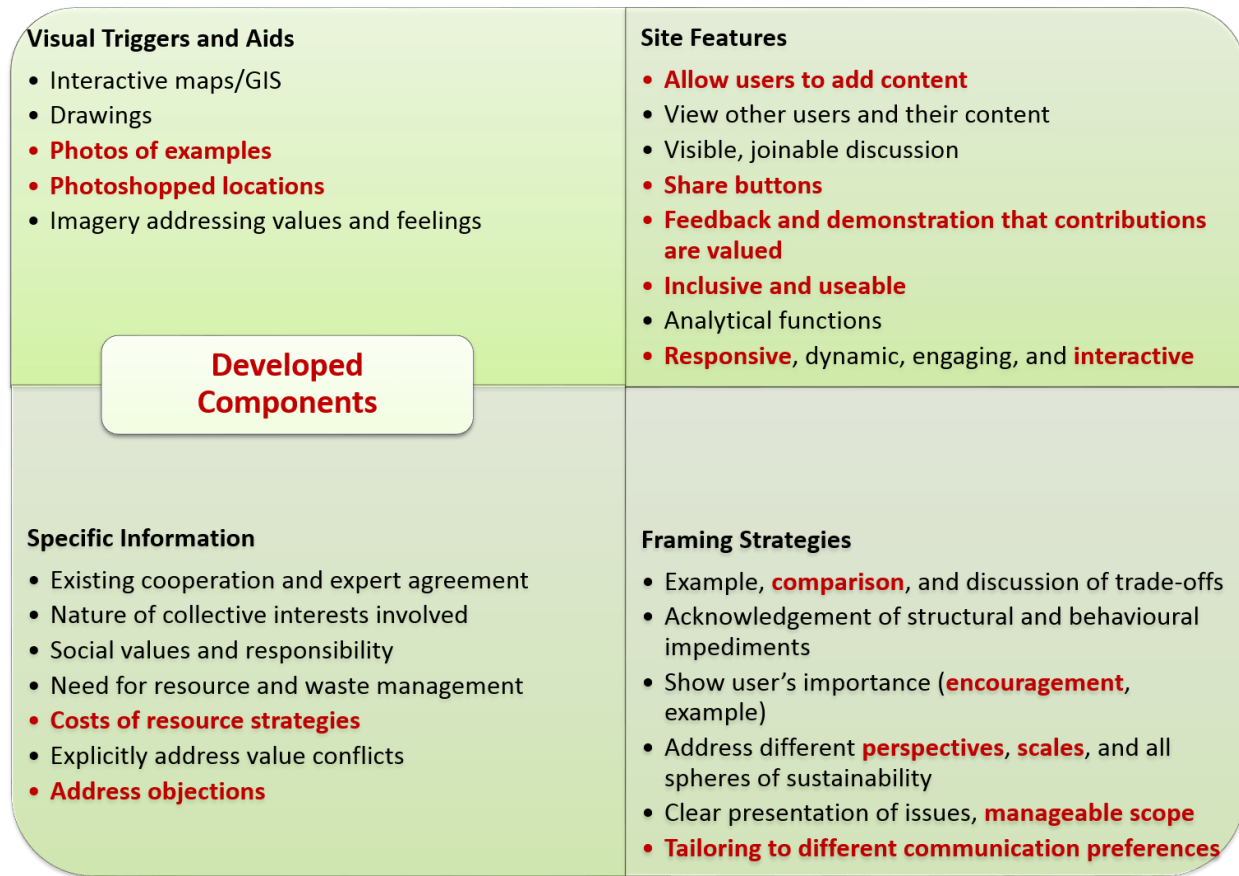


Figure 4.4: Support tool design shortlist of developable components, with those chosen for development in the prototype shown in red.

Visual Triggers and Aids

Example photos and photo-shopped locations were chosen as visuals, since these were expected to have the greatest impact. Illustrative imagery was also employed, such as outlines of City of Calgary boundaries and Nose Hill park boundaries, which were used as visualization of land use. Drawings of participant ideas and on-the-fly illustration of potential alternatives were not chosen for prototype development. This is because example photos and photo-shopped locations fulfil much the same function. In addition, these drawings are likely more impactful live, such as when used in a Charette, since this was the context in which their empowering effect was studied (Al-

Kodmany, 1999). Similarly, imagery addressing values and feelings were not specifically included because photos, photo-shopped locations, and illustrative images were already being used. Since these fulfill similar functions, only one group was prioritized for prototype development. Since the tool is designed to complement an online participation platform that would likely include maps and GIS, these were not included in prototype development. For full development, it will likely be most efficient and streamlined to take advantage of the presence of these in the participation platform and simply integrate the relevant support functions with the exiting spatial infrastructure.

Site Features

Inclusiveness and usability were included as site features, to ensure support would be open to all technical abilities and interests. In addition, this fulfills stakeholders' request that the site respond to users' level of computer literacy.

The ability to add content, and encouragement to do so, was also developed, as were share buttons. These were considered two of the more important aspects to include because they empower users to contribute (Leung, 2009), thus directly supporting a research goal. A suggestion box was developed for the prototype that includes a plus (“+”) button that creates more suggestion boxes when clicked. Using this, users can write in as many suggestions as they like. The box is primarily designed for strategies users would like to see in their neighbourhood or on the support website, as it contains the hint text “suggest a strategy”. However, input is not restricted, so users are free to write in whatever they like.

To the extent possible without a live presence on the prototype site or ongoing content updates, feedback and demonstration that contributions are valued were also included. These were

considered important as they contribute to the empowering effect of the ability to add content (Leung, 2009).

The ability to share to a social network also has the potential to provide feedback and support through peer discussion and recognition. It can also contribute to implementing segmentation strategies. The share buttons included access to four prominent social media websites: Facebook, Twitter, LinkedIn, and Pinterest. The first three were used as they are the most popular social networking sites according to eBizMBA's ranking ("Top 15 Most Popular Social Networking Sites," 2013). Pinterest was chosen as the fourth share site despite being ranked fifth below Google Plus+, because the emphasis on visual content in both the prototype and Pinterest made it a more natural match.

Responsiveness and interactivity were also added, as these, too, achieve more than one of the desired design component targets. They are designed to engage the user such that he or she uses the tool long enough to absorb some information, as indicated by research in informal online education (Bliss-Taylor & Hunter, 2012a). In addition, these components of the conceptual design were direct requests of stakeholders. Since the prototype's status as "engaging" cannot be claimed without testing, this item is not highlighted in red.

Visible discussion, viewing other users and their content, and analytic functions were not included in prototype development. This is due to the fact that these can be time-intensive to develop, and will be included in the companion participation platform. So, as with maps and GIS, it will likely be most efficient and streamlined to take advantage of the presence of these in the participation platform. This can be done by simply integrating the relevant support functions with the existing analytical functions and social networking infrastructure. While sharing can

make it possible to discuss the subject matter, there is no guarantee that discussion will occur, and if it does, it will not be visible on the prototype site itself. As such, the item “Visible and joinable discussion” is not directly provided by the prototype, and its occurrence would be somewhat incidental, so the item is not highlighted in red.

As for creating a dynamic interface, since this refers to displaying new or different content each time a user visits, it is more appropriate for a site with ongoing presence rather than a testing prototype. As such, it is more suitably reserved for inclusion upon full development.

Specific Information

In terms of specific information, the costs of the strategies presented were included. Cost-based arguments are frequently raised objections to sustainable development strategies. As such, including cost information satisfies two items from the specific information list: “Costs of resource strategies” and “Address objections”.

The other items listed in the specific information section were not developed in the prototype, or were only very minimally developed. This is because the informational modules (described in section 4.4.2, below) employed for prototype development did not address or include this type of information. However, these items should be prioritized in future development of the tool. This is especially true of communication of existing cooperation and agreement, as these are relatively simple to communicate, and have been found to be important to support for sustainability (Ding et al., 2011). Discussion of social values as well as structural and habitual impediments is also an important conversation (Crance & Draper, 1996; Leiserowitz et al., 2006), and hence a development priority. However, these are more complicated to communicate since values and habits are highly personal, and are constructed, as opposed to related to absolute criteria.

On the whole, the tool is designed to provide support with ideas surrounding sustainability. Information in the tool is presented mainly to support participants' use of sustainable approaches and strategies in their planning suggestions. This means that the information and experiences provided are structured to generate a "feel" for potential impacts of strategies, as opposed to a precise and comprehensive itemization of every potential consequence. As such, precise and exhaustive numerical reports are not provided. Rather, the tool seeks primarily to give participants a general idea of the magnitude, direction, and holistic effects of the potential impacts of their suggestions. References are provided, however, and interested or skeptical users can link to the source of claims made by the tool.

Framing Strategies

For framing strategies, comparison, encouragement, different scales, different communication styles and manageable scope were all used. The informational modules used in the prototype lend themselves to these characteristics. For example, the prototype includes some simplifying devices, such as bracketing (a design component listed in Table 4.1), which provides elements of both comparison and scope management. Brackets are part of the "Different Styles of Urban Planning" module. These were built in to the existing structure of the module content (City of Calgary, 2007), rather than implemented solely in the prototype. Adopting the framing strategies that can be effectively developed provides an efficient way to realise as many of them as possible in the prototype. This also maximizes the number of design targets and developable components addressed.

In addition, the prototype was developed to permit self-direction in terms of topic and volume. This allows the user options in terms of the volume of information, and level of detail they

manage at once, thus allowing them to manage the scope they consider. The effect of this is to tailor the content delivered to each user (to a certain extent). Tailoring site content to users' communication preferences was a stakeholder request. Implementing some ability to tailor topic and scope is a first attempt at fulfilling this request.

Efforts were made to ensure issues were presented clearly, however, as with calling the site “engaging”, clarity cannot be claimed without testing, so this item is not highlighted in red. In the same vein, “show user’s importance” was not highlighted in red, despite attempting this by encouraging and acknowledging submission of suggestions, the effectiveness of this cannot be assured without testing.

An attempt was also made to represent the perspectives of all spheres of sustainability (refer to section 2.1), however, informational content in the prototype was confined to the modules (described in section 4.4.2), so it is possible that the social sphere was not represented as prominently. I endeavoured to include social aspects, but due to the nature of the information contained in the modules, they are minimally present. Most critically, I did not assess the prototype for even representation of sustainability spheres, nor did I define what “even” representation would be for the research. That being the case, though all spheres are represented at least briefly, it is beyond the scope of the research to confirm *even* representation of all spheres. As such, “all spheres of sustainability” is not highlighted in red in Figure 4.4.

Formal discussion of trade-offs and acknowledgement of structural and behavioural impediments to change were not included. Once again, this was due to the informational content of the modules not being suited to the purpose. However, this discussion and acknowledgement is important for further development, as it exposes and makes explicit potential reasons for

resistance to action (Leiserowitz et al., 2006), and in doing so, may help some users understand their own opposition. As such, its prioritized development is recommended for future development of the support tool. This could be manifested as additional modules, or as further development of these topics within the existing modules. This may require in-house modeling.

Finally, examples of strategies, or case studies of their employment, could be further extended in future development. This could be done by developing beyond simple visual representation of possibilities. However, since the current prototype contains (limited) examples in the form of pictures of strategies, this component is partially achieved. As such, more complete examples or cases were not included in this iteration.

4.4.2 Informational Content Selected for Development

The information presented by the support tool prototype is essentially a consolidation of existing impact studies and models. Each uses academic studies or modeling as information. This permits evaluation of the prototype in conditions that are as true-to-life as possible. I included the results of two sets of modelling done for Calgary, as well as results of studies investigating impacts of single planning strategies that could be applied to Calgary. The results are presented as modules, expressed with the intent to be clearer, simpler, more meaningful, and more relatable to lay users. This is intended to make the results more accessible to the expected user.

Three modules comprised the informational component (content) of the prototype. The modules selected were:

1. Planning Strategies,
2. Different Styles of Urban Planning, and

3. Reducing Calgary's Greenhouse Gas Emissions.

“Planning Strategies” comprises programs that can be implemented at small scales. The impact of each strategy is based on one or a few studies or review papers of single, specific phenomena. The studies are not specific to Calgary, but rather to the subject strategy. The section essentially combines many mini-modules. For the prototype, two strategies (mini-modules) were developed: Low impact development (LID) (Hatt, Fletcher, Walsh, & Taylor, 2004; Holman-Dodds, Bradley, & Potter, 2003; US Environmental Protection Agency Low Impact Development Center, 2000), and community benefits of community gardening and urban agriculture (Wakefield et al., 2007). In both cases the user clicks on the image representing the strategy, and short, text-based, qualitative assessments of the potential impacts of the study are displayed. Information about costs is also given where available. Costs are also presented qualitatively, using comparison to existing costs, in order to present a contextual and hence, meaningful, picture of the related costs.

“Different Styles of Urban Planning” compares three potential styles of city-wide urban planning in Calgary. The module is based on a scenario planning exercise commissioned by the City of Calgary and executed by the University of British Columbia's Design Centre for Sustainability (City of Calgary, 2007, Design Centre for Sustainability, University of British Columbia, 2008). The modelling explores the implications of three different potential future development styles, compact, hybrid, and dispersed. The styles are compared from a number of perspectives, including transportation, housing, and land use. When a user clicks on this module, these perspectives are listed. To delve deeper into each, the user may click any or all of the listed items. For example, clicking on “Housing” reveals information about housing distributions in each planning style, and associated change in greenhouse gas emissions in the housing sector.

Pictures, graphs, and words are all used to present the impacts using different communication styles. Costs are also presented. These are the result of a report commissioned by the City of Calgary (IBI Group and the City of Calgary, 2009). The cost study was not part of the initial modelling exercise, and uses a slightly different set of definitions for the planning styles. However, the report essentially models the hybrid and dispersed scenarios, and compares the costs of these. As such, the costs are presented in the prototype support tool as being associated with these. The compact scenario was not included in the cost study.

“Reducing Calgary’s Greenhouse Gas Emissions” includes numerous strategies at all spatial, temporal, and scope scales. This module reports information on potential reduction in emissions, and their costs, for each of a number of identified reduction strategies. The Pembina Institute’s research and modeling of greenhouse gas sources and potential reductions in the City of Calgary, a report commissioned by the City of Calgary, is used to produce the greenhouse gas module (Row et al., 2011). As such, the module provides information specific to Calgary about how the city’s greenhouse gas emissions could be reduced. When the module is clicked, it expands to reveal numerous reduction strategies. Examples of these include driver behaviour modification programs as well as changing electrical generation. For the prototype, the information was presented both textually and numerically, for ease of absorption and to cater to different communication styles. Information about costs is given for each strategy. It is presented qualitatively via comparisons of costs of existing strategies delivering similar services. For example, costs of renewable generation are compared to current ways of generating electricity.

Communicating impacts of existing modeling and studies means that the user has to pick from a list of “canned” options. Users are not able to build their own scenarios for testing. It may emerge in future research that it would ultimately be ideal to provide feedback in the form of predicted impacts of users’ own ideas. However, this was not one of the results of the prototype survey in this design-test iteration. In addition, the literature review indicated that support in general should be prioritized over the technological development required to provide an assessment of the impacts of user-created scenarios.

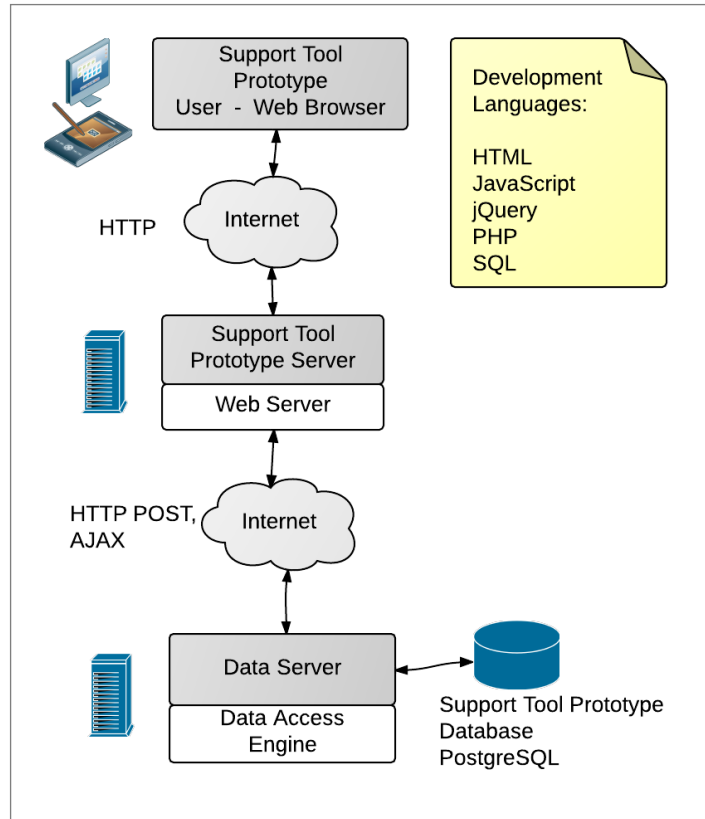


Figure 4.5: Prototype support tool architecture.

Users access the tool via their web browser, which communicates via HTTP with the web server. The website communicates with the data server hosting the PostgreSQL database, using HTTP POST in an AJAX sequence.

4.4.3 Physical Architecture

The physical architecture of the prototype is depicted in Figure 4.5. Beginning at the top and working downward, we first see that the user accesses the support tool via their web browser. The prototype was created for Google Chrome, and briefly tested with Microsoft Explorer and Mozilla Firefox. As the user clicks through the site, new portions of the page are revealed. For

the “Different Styles of Urban Planning” module, information was stored locally in the website file system. This information is accessed via an accordion-style interface built using jQuery.

For the “Planning Strategies” and “Reducing Calgary’s Greenhouse Gas Emissions” modules, information was stored in a PostgreSQL database hosted on a different server to the website. Information in the remote database is accessed using POST requests in an AJAX (Asynchronous JavaScript and XML (eXtensible Markup Language)) sequence. The development languages used were HTML (hyper-text markup language), and JavaScript, for the bulk of the website, and PHP (Hypertext Preprocessor) and SQL (structured query language) for interaction with the PostgreSQL database.

As site and database are hosted on different servers, the prototype employs a distributed architecture in its construction. This was done because the website itself was developed locally in order to expedite development, as transfer to the live server for further development was not anticipated to be a problem. The database, on the other hand, was developed on the remote server because transferring the database would have presented more problems. The participatory platform that the support tool is constructed to complement is also a distributed system.

The database, shown in Figure 4.6, is relatively simple. It combines all strategies in one central table, “supporttool.strategy”. This table is structured so new strategies can be added as new modules are added. The strategy table is queried via an AJAX sequence and uses SQL to produce the clickable items listed when a user selects the “Planning Strategies” and “Reducing Calgary’s Greenhouse Gas Emissions” modules. When one of the items is clicked, a further query, also executed via an AJAX sequence, accesses the relevant results table. Each strategy can be associated with numerous results. As such, the relationships from the strategy table to

either results table is one-to-many. “Planning Strategies” results are stored in the table “supporttool.result_qual” as they are all qualitative results, for the prototype stage of development. This table is set up such that additional strategies and their qualitative impacts can be added. As such, additional mini-modules can easily be added to the planning strategies module.

Greenhouse gas reduction results are stored in the table “supporttool.ghg_result”. This table is quite specific to the result format of the modelling used for the greenhouse gas module. Since this module was designed to be complete without need of additions, it is considered appropriate that the table housing the module is minimally receptive to new information. The query for greenhouse gas results performs a second query to obtain the cost of each result from “supporttool.cost”. This table has the potential to be used for further cost results. Since each cost can be associated with numerous greenhouse gas results, the relationship between these tables is one-to-many.

Finally, “supporttool.source” indicates the source of each strategy, and serves primarily to support the suggestion box. When a user enters one or more suggestions via the website, an insertion query places the text of the suggestion in “supporttool.strategy”, along with source_id “3”, which corresponds to “Online User”. This permits tracking the new strategies so that they can be addressed for further development. The source table is designed to be useable for all new modules. Since each source can be associated with numerous strategies, the relationship between these tables is one-to-many.

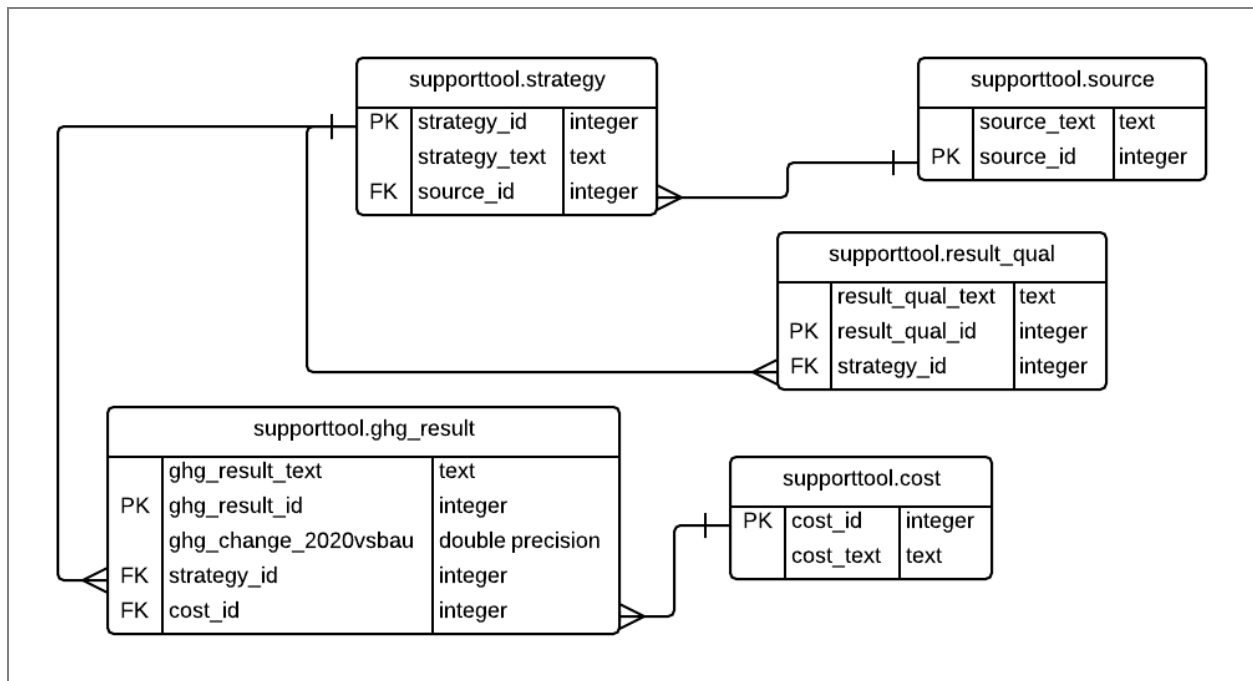


Figure 4.6: Database schema showing the tables used for the prototype support tool.

"supporttool.strategy" houses potential planning initiatives, while their impacts are found in "supporttool.result_qual", "supporttool.ghg_result", and "supporttool.cost". The “crow’s foot” notation describes one-to-many relationships from the strategy table to results tables. From the cost table to the greenhouse gas result table there is another one-to-many relationship. Finally, from the source table to the strategy table there is another one-to-many relationship.

4.4.4 Prototype Interface and Functionality

The components, information, and physical architecture discussed above all contribute to the prototype support tool. However, the user primarily experiences the interface and functionality. The section below describes these, as well as detailing the expected way a user would navigate the prototype support site. The development version of the prototype (as seen in Figure 4.7 to

Figure 4.11) can currently (June 2014) be viewed at <http://136.159.122.150:8080/SupportToolFiles/SupportToolHome.php>.

The prototype interface is pictured in Figure 4.7 as it would first appear upon navigating to it. The three informational modules are presented, as well as a side panel. The user's first step is to choose from the modules. Each provides different informational topics, different scales, and different perspectives. Clicking on each module reveals the sub-options, the strategies. Once the user has expanded a module, the strategies can be clicked in turn for further information.

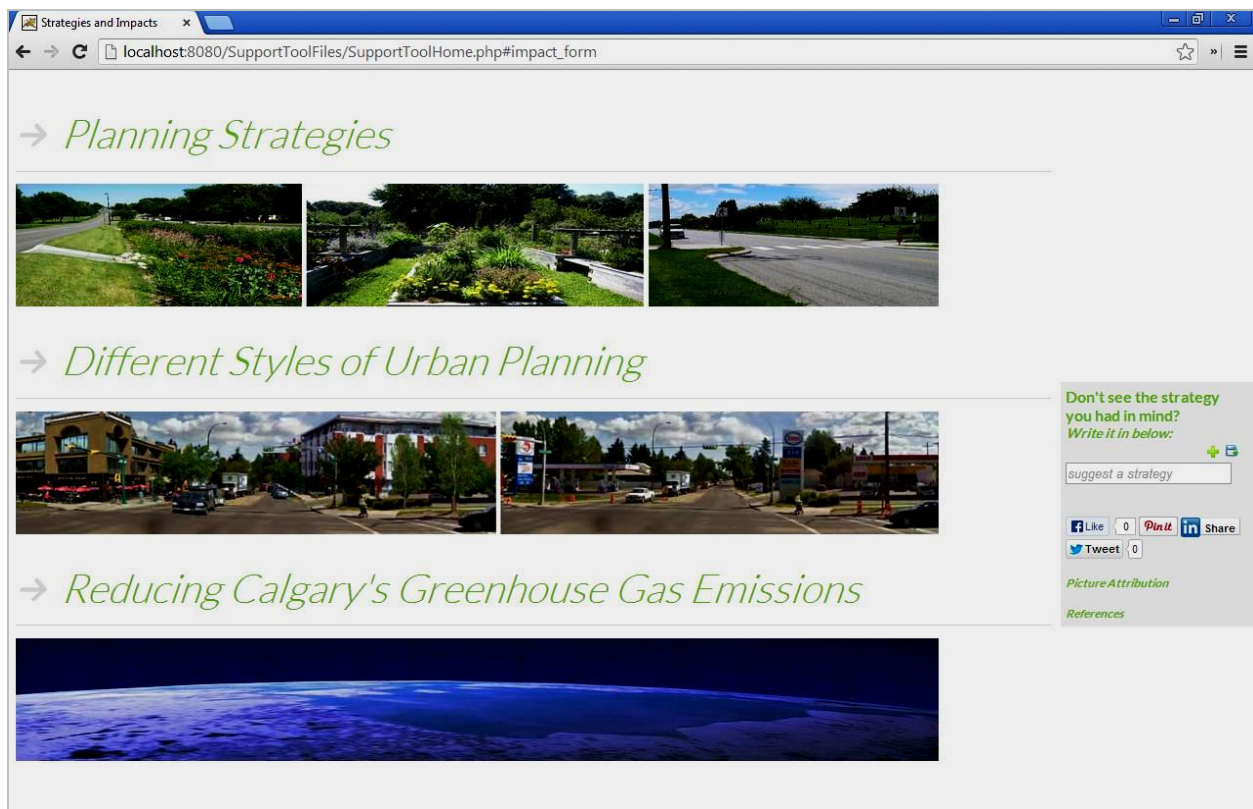


Figure 4.7: The prototype support tool as it appears upon first opening or navigating to it.

Figure 4.8 shows how select design components have been developed into the prototype. Firstly, on the whole, the prototype site is designed to be useable and as such, inclusive. It employs a

simple click-through interface, and presents no features that a user would not normally see on consumer or social media sites.

In addition, the photos on the website show examples of planning strategies. Further, the photo banner under “Different Styles of Urban Planning” shows the existing corner of Richmond road and 37th street (right side), and a photo-shopped version showing what the corner could look like if it were more intensively developed (left side). Each module explores sustainable urban planning from a different scale or perspective, thus providing elements of the framing components.

There is also a side panel, always in view, that features a suggestion box, and additional input boxes can be added as needed. This allows users to add strategies, allowing them to generate content³, fulfilling another requirement. The panel acknowledges and repeats back the added strategy when saved. This both recognizes and encourages user added content, thus attempting to demonstrate that contributions are valued. The same side panel also has share buttons, plugging the tool in to social media for sharing and potential discussion. Finally, references are also accessible on this panel, which allows curious or skeptical readers to pursue their investigation even further.

³ User-generated content is an important feature of Web 2.0, in which users supply some of the content of a website. For example, this may take the form of comments, user reviews, or responses to other users’ comments and questions. In fact, some sites characterized as Web 2.0 are primarily platforms for others’ content, such as EBay.

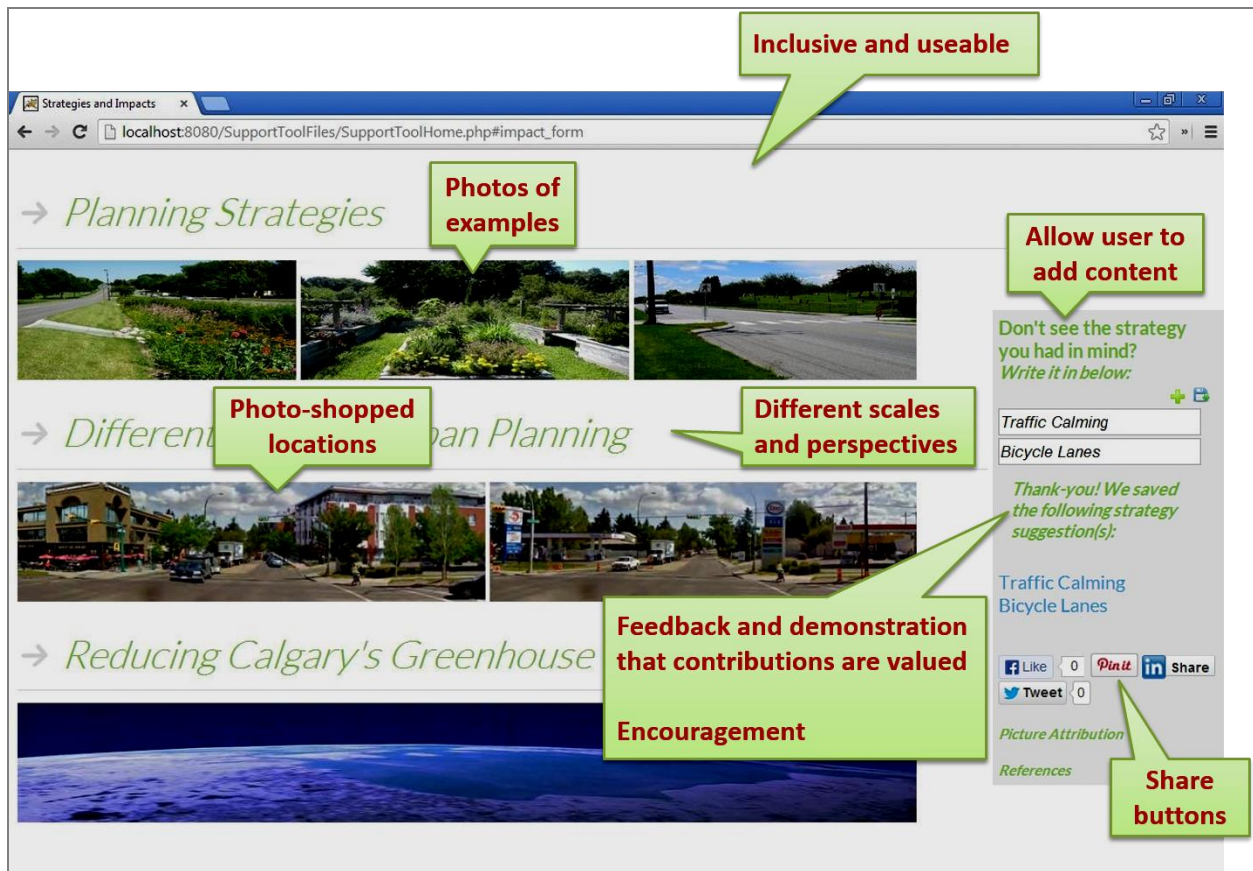


Figure 4.8: The prototype support tool as it appears when the user has added his or her own strategies. Callouts point out some of the design components, as developed in the prototype.

If the user were to choose the “Planning Strategies” module, he or she would then experience a view similar to that shown in Figure 4.9 (with the exception that the side panel is cut off for simplicity in Figure 4.9, it would be visible in actual use). The user can then select a strategy they would like to consider. Clicking on a strategy reveals the impacts that this strategy is most likely to have, based on the relevant modeling or studies. These results are then presented, expressed with the intent to be clear, simple, meaningful, and relatable to lay users.

The modules can be rolled out one at a time or all at once, depending on what the user feels comfortable viewing at once. As noted in the callout in Figure 4.9, this self-selection process allows the user control of the scope of issues they are willing and able to consider. In addition, the click-through interface is designed to provide an element of interactivity, also noted in a callout.

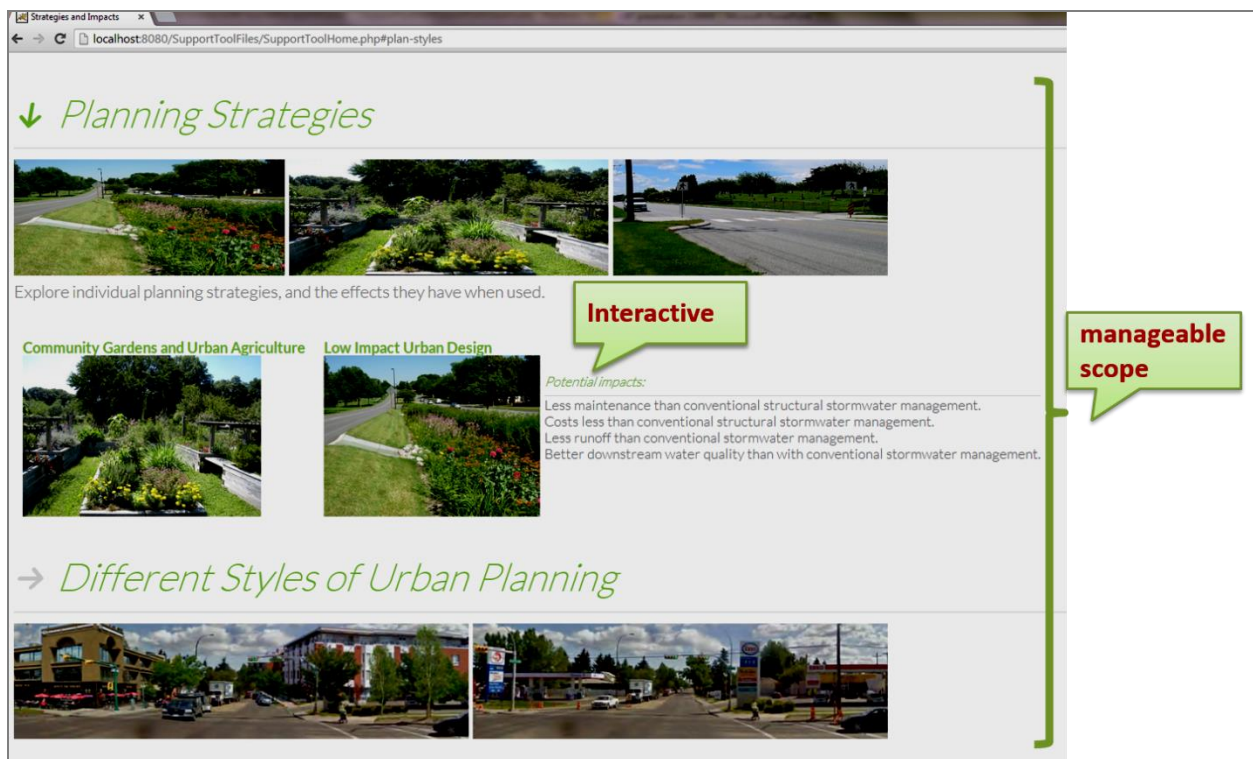


Figure 4.9: The prototype support tool upon selection of "Planning Strategies", and within it, "Low Impact Urban Design". The ability to select what and how much information to view allows users to manage for themselves the scope of information they take in. The click-through interface adds interactivity.

style of presentation is designed to deliver information briefly, while providing sufficient context to make the information meaningful and relatable. In addition, the information is presented textually, graphically, and pictorially to tailor to different communication styles.

The “Different Styles of Urban Planning” and “Reducing Calgary’s Greenhouse Gas” modules share common ground; the Pembina Institute’s report refers to the scenarios examined, and the scenario planning refers to greenhouse gas modeling done by the Pembina Institute. The connections are presented in the prototype. They are expressed by linking items within the urban planning styles module to the greenhouse gas module. For example, city-wide greenhouse gas reductions based on urban planning styles, as reported in the greenhouse gas section, were linked back to the costs of that planning style, under a link titled “but what are the costs?” As another example, greenhouse gas reductions in the residential sector, as reported in the planning styles module, will look impressive at 25%. But, when considering all sectors, as reported in the greenhouse gas reduction module, this reduction will have a much smaller effect, at 1.2%, citywide. The link was made between these two pieces of information in order to inform users of different reduction potentials. It also serves to demonstrate the holistic and interconnected nature of urban planning and the urban environment. An example of this can be seen in Figure 4.11.

4.5 Descriptive Evaluation Approach

Hevner et al. (2004) provide a framework for evaluation of design science artifacts. The framework is made up of evaluation metrics and evaluation methods. Evaluation requirements are established by the design environment (see Figure 4.1). They also take into consideration the need to integrate new artifacts with the technology available or in use in the problem environment.

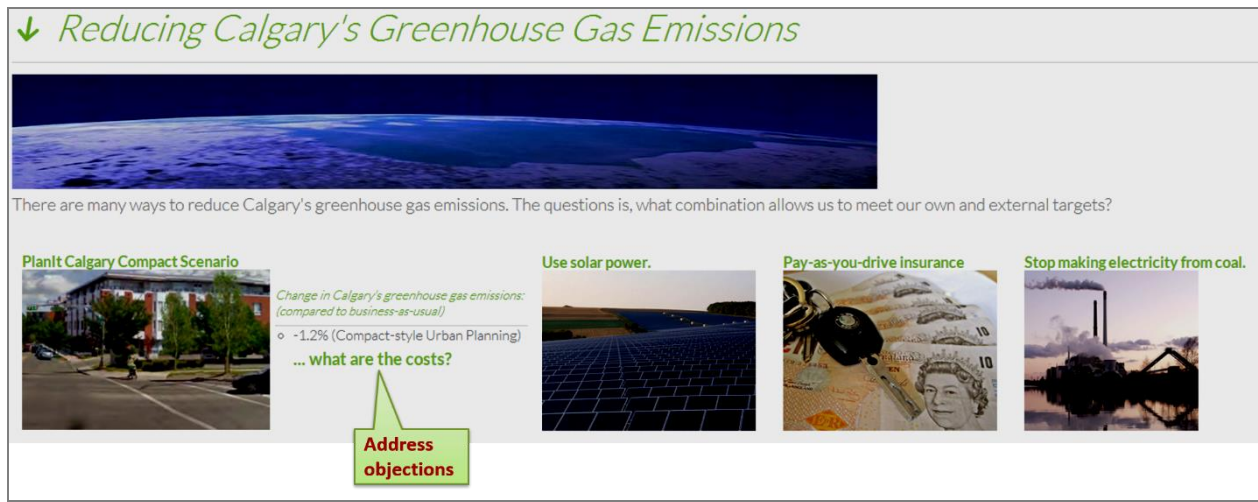


Figure 4.11: A section of the prototype support tool as it appears when investigating greenhouse gas reduction strategies. This particular strategy links back to the styles of urban planning module, emphasizing the interconnected and holistic nature of sustainable urban planning.

Evaluation methods are selected based on their appropriateness for the artifact. The list of available methods includes: observation, including case study or field study; analytical evaluation, such as statistical analysis, architecture analysis, demonstration of optimization, or dynamic analysis, where the artifact is studied in use; experimental evaluation, which includes studying the artifact in a controlled environment, or simulation with artificial data; testing, in which the artifact interfaces or execution paths are tested for defects; and finally, descriptive evaluation, which uses information from the knowledge base, such as relevant research, or construction of detailed potential use scenarios, to demonstrate the artifact's utility (Hevner et al., 2004). Descriptive evaluation is only intended for artifacts that are sufficiently innovative such that other forms of evaluation are infeasible (Hevner et al., 2004).

Hevner et al. (2004) also add that the artifact should be evaluated in terms of style. Though difficult to define, style is described as combining simplicity and efficacy. It should apply to the interface, certainly, but also to the artifact, and even the design process itself.

In terms of evaluation methods, I employed descriptive methods to demonstrate how, why and in what situations the tool would be useful, and in doing so, build an argument as to how the artifact fulfils the requirements of the problem space. The descriptive evaluation is primarily composed of informed argument, which uses information from the relevant research (as summarized in the literature reviews) to build the argument that the artifact is useful (Hevner et al., 2004, p. 86). Evaluation of style will also be by description.

Evaluation can rest on a number of considerations: Functionality, completeness, consistency, accuracy, performance, reliability, usability, and fit with the situation (Hevner et al., 2004). Evaluation metrics are built from these considerations with respect to the problem environment. The evaluation “metrics” I use come directly from the research purpose, goals, and constraints that make up the design environment. In the descriptive evaluation, the metrics are composed of the considerations above, and “fit with the situation” is described in terms of the problem environment (as pictured in Figure 4.1).

Following descriptive evaluation, I built a prototype of the support tool. I then tested this using functional testing. This checks whether the artifact functions without defects by executing the functions within the artifact interface to identify defects (Hevner et al., 2004, p. 86).

Once testing established that the prototype functioned correctly, I used experimental methods: I simulated use of the artifact by asking a wide range of the public to try the prototype, and complete a survey regarding its potential utility to them if they were participating in urban

planning online. In this case, the situation was simulated, rather than the data. This phase of testing is further described in the survey approach section, below.

Since the literature review has established that the type of support tool I proposed has not been used in a similar form and capacity before, I find that descriptive evaluation is appropriate. This is supported by the fact that analytical evaluation, which focuses on technological aspects, is not appropriate, since the research does not focus on technical improvements. Observational evaluation is also not yet indicated. Since in this iteration, only a prototype is constructed, testing is best done by experimentation, in order to first ascertain whether the solution is appropriate and what areas of development should be prioritized for future work. Following this, and upon further development, observation of the full implementation in practice will be more suitable. Since it is common for IT research to create artifacts that are testable, but not yet ready for full organizational deployment (Hevner et al., 2004), the extent to which I develop the support tool artifact appears appropriate to me.

4.6 Survey Evaluation Approach

To further test whether the support tool design would fulfill the research goals, I constructed a prototype. The prototype is composed of a small number of informational modules, and exhibits a small number of the designed features. Both sets were chosen to represent as much of the design as possible in terms of both features and information, while refraining from developing the entire design before testing whether the concept has merit.

This prototype was the subject of experimental testing via simulation. Respondents were asked to browse through the support website (as it was termed for their benefit), and an online survey was

then administered. Recruitment, prototype tool use, and the survey all occurred online. This was done to mimic the online participation process and environment.

By testing the prototype via simulation, the survey contributes to the experimental evaluation of the design, as defined by Hevner et al. (2004, p. 86). The survey evaluation is also part of the iterative process of design. As such, it points to future work as well as speaking to the current state of the design and prototype. In both respects, the survey places the design under further, outside scrutiny.

4.6.1 Analytical Unit

The prototype, as representative of the design, is the unit of analysis. It is the major entity under scrutiny in the survey.

4.6.2 Subjects

The intended users of the support tool, and hence the population for the prototype survey, are members of the lay public. Specifically, they are those who are interested in participating in urban planning, and who might be more inclined to do so online. Because the participation in question is designed to take place via an online platform, it is hoped that the pool of interested public is larger than in traditional in-person participation processes (Fiorina, 1999). It is hoped that this will include a variety of demographics, including renters, post-secondary students, long-term residents, families, seniors, young adults, etc. The participant population should also include a variety of community roles, including community association members and volunteers, and the local business community.

The public in general also includes city planners (either affiliated with a community or a city), municipal politicians, and private professionals such as developers and builders. However, these urban planning professionals are not the tool's intended users. They are free to use it, but it is not designed for them.

The above identifies varied demographics and stakeholder groups within the community. Because of this diversity, it is likely that there will be a variety of opinions about urban planning and sustainable development. The public's views and priorities with respect to these issues may differ within the community based on differences such as personal background. They may also differ by geographic community and community type (inner city, middle ring, outer suburbs, exurbs).

Recruitment

Testing was done with subjects that reflect the tool's target audience – lay citizens likely to engage in urban planning online. Since interest in participating in planning is the primary common characteristic of the tool's intended users, I attempted to reach a wide audience roughly representing the diversity of the lay public, but left the choice to participate up to them. Since self-selection is a characteristic of the intended users, that is, they decide to participate in urban planning online, self-selection was similarly employed in order to obtain a representative sample of the population. This was done in an attempt to mimic the self-selection that online planning participants would do from among the lay public. Since the intended users of the support tool are individuals who have opted to participate in urban planning via online avenues, they would likely exhibit similar interests and profiles. As such, it is likely that a similar range of people would use the support tool, so conclusions based on this sample can reasonably be drawn. I also

employed a passive snowballing technique, in which if people asked if they could forward the survey request, I agreed.

In total, requests to view the tool and fill out the survey were directly posted or sent to approximately 1170 people. This is the total number of friends, followers, and recipients between the Twitter and Facebook accounts used and emails sent. However, social media posts are displayed along with posts from numerous other users. Whether these are actually seen by the intended audience depends on the number of other posts in each audience members' feed, which in turn depends on how many people each person is following (Twitter) or friends with (Facebook), and on how soon after the post they check their feed. As such, posts are not viewed by all friends and followers. In addition, some members shared the survey request with their followers, further exposing the request. In this case uncertainty as to exposure and views are even higher. Finally, there is also overlap in recipients between the lists and accounts used, though it is not possible to know through which avenue a recipient would have seen the request, if at all. For all of these reasons, it is not possible to say with any certainty how many actually viewed the request.

Subjects were recruited via email, both to personal and professional contacts, as well as through the department graduate student email list. One email was sent on Monday to each of these groups announcing the survey and requesting responses. A follow-up email was sent Wednesday reminding both groups that the survey would soon close. A final email was sent Sunday and Monday (to different groups) notifying contacts that that was the last day to do the survey. Responses were tallied after leaving the survey open for one week.

In addition, respondents were recruited via an organizational Twitter account. These followers were first notified via tweets on Monday, and were reminded on Wednesday. A final post on

Sunday notified followers that the survey would be closing at the end of that day. The research group has built up a following on Twitter using social media management techniques. These include tweeting one's own activities regularly, retweeting relevant and interesting tweets, responding promptly to communication, referring to (tweeting) others (especially those with numerous followers), and using hashtags⁴ to connect conversations by topic. These techniques are especially effective connecting much-discussed topics or people. As such, our research groups' mapping efforts during Calgary's 2013 flooding contributed to the number of followers. This builds a following of people and organizations who are interested in the PlanYourPlace project, the parent project of this research, and its activities, based on its Twitter presence. These followers are more likely to be the type to use social media in general and as such to be engaged in online activity. As relatively active social media users, this group would likely be more inclined to engage in urban planning via online channels. As such, they represent a group who are more likely to use the support tool.

Personal contacts were also asked to fill out the survey through social media. They were recruited via Facebook status updates and personal account tweets (Twitter) beginning on Monday. Reminders were posted on Wednesday, via both status updates and tweets. On Sunday a post notified followers that that was the last day. Requests were sent out at different times of the day to capture different people (the assumption being that different lifestyles would permit social media browsing at different times of the day). Though they all have me in common, both

⁴ Hashtags (#) are added to the front of words, or an un-spaced phrase such as #yycplan, to identify them as keywords or topics in a tweet, and enables tweets to be searchable (Twitter, 2014).

sets of followers represent a relatively diverse group of people in terms of geography, age, ethnic background, interests, and level of education. As such, this group represents a passable approximation of the general public.

Social media requests were sent out more frequently than email requests. Email is a more direct form of communication that essentially obliges at least some attention (though the group emails sent out are not as direct as a personal email to a single person), while social media is less direct, and puts the onus on the recipient to decide whether to pay attention to the communiqué. As such, it is appropriate to post numerous updates, whereas it would not be appropriate to send the same volume of requests in emails.

4.6.3 Survey Instrument

In the survey questions were designed to determine whether the research goals had been achieved. That is, they are designed to inquire as to whether the tool (as represented by the prototype), would be a functional and effective solution to the research problem. I pose questions addressing the metrics described in section 4.5, above, as well as posing questions that would expose design weaknesses and point to priorities for future work.

Questions ask principally whether the tool “works”, in the sense that it fulfills the research goals and addresses the research problem. They essentially ask, does the tool have the potential to mimic face-to-face feedback and information to the extent that the absence of these in online participation is not problematic? Fundamentally, could it help participants engage online? Does it increase participant comfort level, does it empower, does it inform? As part of “does it inform”, does it help choose among alternatives, and identify problems? Does the tool introduce

and support the use of sustainable strategies in urban planning? Does it leave enough “space” for participants to engage at high levels of participation, for example, by allowing them to choose the issues they consider important, and inform their co-creation of solutions. I also employ perceived usefulness and perceived ease of use, as defined by Davis (1989). These are used because they correspond to reported use and reported future use in technology adoption: If IT is perceived as useful, provided it is sufficiently easy to use, it is likely to be used (Davis, 1989). Davis’ (1989) Technology Acceptance Model has been further developed as well as criticized (Iivari, 2007). However, further examination of the model is beyond the scope of the current research. As such, I adopt it uncritically. Combined, these questions serve to test the hypothesis that an application such as this can provide support to online participants in urban planning.

Nine metrics were developed for the long-answer questions. Each question in the survey relates to one or more of these metrics, and each metric relates to one or more of the research goals or purpose, as seen in Table 4.2. The metrics are:

- Behaviour change,
- Comfort level,
- Comprehension of information,
- Deficiencies,
- Engaging features and information,
- Level of support,
- Retention of information,
- Understanding of impacts, and
- Understanding of sustainability.

These were chosen based on their collective ability to test whether the prototype and hence, the support tool, would achieve the research goals and purpose. “Behaviour change” strives to test whether the tool could have an effect on behaviour, thus indicating that the tool could have an impact in terms of empowerment, addressing a lack of face-to-face feedback, and supporting online participants. “Comfort level” seeks to determine whether the prototype could affect users’ comfort levels while participating online, which would directly satisfy the goal of improving comfort levels. “Comprehension of information” endeavours to discover if users have understood and assimilated information presented. “Deficiencies” seeks out areas where the tool has fallen short in order to understand what types of information and features would be beneficial to users for future work, and to examine the issue from a different angle. It is also designed to shed light on whether the design and concept of the support tool are heading in the right direction in general. “Engaging features and information” is included based on the idea that it is important to engage the user in order to transmit information and provide support (Iverson, 2008). “Level of support” speaks directly to the research purpose, to support participants in online planning, by attempting to discern what level of support the prototype can provide and what calibre of engagement it supports. “Retention of information” strives to determine whether users have retained any information in the tool, and to what extent, as retention is necessary to transmit information. Finally, “understanding of impacts” and “understanding of sustainability” both relate directly to research goals to improve knowledge and understanding, and provide information, in order to support participants and address a lack of face-to-face feedback. Links between the metrics and research goals and purpose (split in two parts for clarity) can be seen in Table 4.2.

Table 4.2: Matrix of relationship between research purpose and goals, and evaluation metrics used in the survey. Together, the metrics provide sufficient measures to gauge whether the design fulfils the research criteria.

Metric	Behaviour change	Comfort level	Comprehension of information	Deficiencies	Engaging features and information	Level of support	Retention of information	Understanding of impacts	Understanding of sustainability
Research Purpose									
Support online participants, especially in using sustainable development	X	X	X	X	X	X	X	X	X
Address lack of face-to-face feedback and information	X	X	X	X	X	X	X	X	X

Metric	Behaviour change	Comfort level	Comprehension of information	Deficiencies	Engaging features and information	Level of support	Retention of information	Understanding of impacts	Understanding of sustainability
Research Goals									
Improve knowledge of relevant issues			X		X		X		
Improve understanding of sustainability			X		X		X		X
Provide information about strategies and impacts			X		X		X	X	
Improve participant comfort level		X							
Empower participants	X	X	X			X		X	X

A pilot survey was conducted using a twenty-seven-question survey instrument, including seven Likert-scale questions and eighteen long-answer or combination yes/no and long-answer questions. Three respondents were personally asked to complete the pilot survey. They were chosen based on their distance from the study – they have no previous experience with the research or the support tool. As such, they were capable of responding to the survey without pre-existing ideas or knowledge of the subject matter or questions. The respondents were instructed to answer the questions as they would normally complete any survey. Verbal feedback indicated that the survey instrument was too long and questions were repetitive. Feedback gleaned from their answers echoed these points. Some answers provided little additional insight as the questions had been interpreted very similarly to previous ones. These questions were removed or reworded for the main survey. Four long-answer questions were removed. Five long-answer questions were reworded for simplicity and clarity. In addition, with additional feedback from one of the participants, two sets of two questions were combined, to make four questions into two. This left twelve long-answer questions.

Once the survey instrument had been revised following feedback from the pilot survey, it consisted of twenty-one questions. The first two questions were introductory. They were designed to get the respondent thinking about participation in urban planning (#1 and #2). They asked whether and to what extent the respondent had previously participated in urban planning. Then, brief instructions directed the respondent to click a link to the support website, browse through, and return to the survey. The respondent returned to seven Likert-scale questions asking the user in various ways to rate their expected performance in online planning when using the

tool. These questions were designed to test the tool's perceived usefulness (#3 - #8) and ease of use (#9), using adaptations of scales produced by Davis (1989) for the same purpose.

Following this, the respondent encountered twelve long-answer or combination yes/no and long-answer questions, that explored the prototype's effect in more depth. These questions sought to understand whether users absorbed the information presented (#10 and #11), whether the tool would help the user incorporate sustainable urban planning into their participation (#12 - #14), whether it influenced their (hypothetical) planning intentions (#12), whether it would help them engage in urban planning (#15 - #18), and whether it would make them more likely to engage in urban planning (#21), particularly online. To explore the issue from another angle, questions also asked users what else they would have liked to see in the tool (#14, #19, and #20).

All of the questions discussed above focused more on *whether* the tool works, rather than *why*. In design science, it is whether the artifact works that is the primary concern, and questions as to why are secondary, since these are more in the realm of behavioural science (Hevner et al., 2004). That having been said, the survey was structured such that I explored what went right and wrong, what users thought of the tool, and what was missing. This gives some insight, if not into the question of why, then into the "what". This sheds light on how to proceed with future work by revealing positive aspects to build on and negative aspects to improve, as well as priorities for future development.

The data collected includes interval-level data produced by Likert-scale questions, and written answers to long-answer questions. Written answers were generally between a phrase and a few sentences long. Some written questions included a yes/no portion as well as the written portion.

The survey instrument used can be found in Appendix A: Prototype Survey Instrument. Appendix B: Relationship of Prototype Survey Long-Answer Questions to Evaluation Metrics, houses a table demonstrating the relationships between each long-answer question and the evaluation metrics in Table 4.2, above.

4.6.4 Analytical Approach

Survey data were analyzed both quantitatively and qualitatively. Quantitative analysis included coding for content analysis. This meant identifying and counting respondent references to certain existing or missing aspects of the prototype. In addition, Likert-scale questions were analyzed by summing the six responses within the perceived usefulness set of questions for each user (Robson, 1993, p. 256), and simply taking the single ease-of-use response as-is.

In my qualitative analysis, user responses to long-answer questions were coded (Hay, 2010). Qualitative approaches are used to examine human experiences (Hay, 2010, p. 5), and the associated coding process seeks connections between ideas (Hay, 2010, p. 283). In this research, descriptive codes were identified first, based on commonly-mentioned aspects of the tool or tool experience. A detailed codebook was produced beginning with descriptive codes. It was refined as codes were grouped, and as analytic themes (codes) were developed.

Then, categorical aggregation was used to group codes into broad categories. This is typically based on substantive content, which includes perceptions, representations, and associations referenced by respondents (Creswell, 2007, p. 164). This coding technique was used to draw out broad themes from long-answer responses; collections of instances were sought in order to gather meaning from the data.

Following this, analytic codes were developed. This is typically done by inferring from context, including identifying either strategies, tactics, or consequences that subjects mention, and/or by identifying patterns that show correspondence between categories (Hay, 2010). These themes provided a further aid in understanding users' views of the prototype. To reveal themes, I primarily identified patterns concerning what was mentioned, and tactics surrounding the way issues were addressed. In addition, cross-referencing was employed in order to understand what was viewed positively and what indicated further work. This permitted coherent organization of the themes such that their implications could be further examined. Ultimately, the analysis sought to determine whether the research goals were met by the tool, and as such, test the hypothesis that such a tool can provide support to online participants.

Rudimentary computer aid was used in coding; Microsoft Excel was used to tabulate data and assign codes to relevant passages. Excel was also used for spreadsheet based searching and filtering, to help further analyze the data following the coding process.

4.6.5 Survey Validity

The rigour, or trustworthiness (Hay, 2010, p. 351), of the survey, and my interpretation of responses, rests on my use of triangulation and rich, thick description (Creswell, 2007, pp. 208–209). Rich, thick description provides transparency by making the relevant information and interpretation of it clear. Transparency can make constraints on interpretation and the limitations of textual staging more apparent (Hay, 2010, p. 348). This permits evaluation of both the context and interpretations made, to the extent that others may judge if the results are transferable to their situation.

In terms of triangulation, I employed two different sets of survey questions, three separate evaluations of the design, and literature and document review. This serves to check the consistency of messages received from respondents, between survey responses and other evaluations, and between the interpretation of results and their implications versus the existing literature.

4.7 Chapter Summary

This chapter described the methods used to answer the research question. I approached the research from a pragmatic stance, and adopted design science, and within it, survey, as research methods. Design science research was briefly described, including why I chose this method, how this type of research is best conducted, and how it can be evaluated. Following this, the support tool design was explained by first describing the problem construction, then tool's conceptual design, and finally the design components.

Then, the chapter explained the construction of the prototype tool, including the design components selected for development and the informational content employed to provide the structure upon which to build the components. The physical architecture of the instantiation was then described, as was the interface and functionality that the user actually encounters.

Finally, I described the survey approach used to further evaluate the tool design. Subjects were recruited from among the general public to browse through the prototype support tool and then fill out an online survey. The survey was analyzed both quantitatively and qualitatively.

Chapter Five: Results and Analysis

This chapter presents the results of the research. First, I perform and present a descriptive evaluation of the design. I then discuss the results of the prototype evaluations, including evaluation by testing, and experimental evaluation by simulation using a survey. The three evaluations test the tool design to ascertain whether it achieves the research goals and satisfies the research purpose. Ultimately, this allows me to test the hypothesis that providing participants with accessible and meaningful information related to their engagement in urban planning can help provide some of the missing feedback and support in online participation.

5.1 Descriptive Evaluation of Support Tool Design

The descriptive evaluation performed here checks the artifact's internal consistency, to ensure the design is sufficiently developed to warrant construction of the prototype. As such, it serves as a preliminary evaluation, prior to experimental evaluation conducted via the prototype survey.

Descriptive evaluation uses relevant research and use situations to demonstrate the artifact's utility. Hevner et al. (2004) recommend evaluating IT artifacts in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, style, and fit with the situation. These evaluation points are listed in Table 5.1.

As for fit with the situation, in this research, it is characterised by the fit with the design environment. This is made up of the conceptual framework as determined in the literature review, including participatory requirements, research goals, and research context. These were depicted together in the design environment diagram (Figure 4.1). The unique elements of the

design environment are listed as further evaluation points in Table 5.1. The research purposes (“Support online participants...” and “Address lack of face-to-face feedback...”) are not included in the evaluation points listed in Table 5.1 because the research goals contribute directly to them. For the same reason, the literature review topics are not individually presented, as they contribute to the understanding of the problem, as expressed in the research goals. For example, the review concerning public understandings of sustainability is not listed in Table 5.1 as it is addressed through the inclusion of the research goals “Improving understanding of sustainability” and “Improving knowledge of relevant issues”. Similarly, not all constraints identified in the design environment are listed. Resource constraints are inherently addressed in the research process, and the lack of readily available experts is addressed in the research purpose, which is in turn addressed in the research goals. This leaves supporting high levels of participation and supporting inclusive participation. The result is that seven items are evaluated for their contribution to “fit with the situation”: (i) improving knowledge of relevant issues; (ii) improving understanding of sustainability; (iii) providing information about strategies and impacts; (iv) improving participants’ comfort level; (v) empowering participants; (vi) supporting high levels of participation; (vii) support inclusive participation, encourage, and empower. Collectively these make up the evaluation of the artifact’s fit with the situation.

The design’s performance with respect to each of the evaluation points is discussed in Table 5.1 next to each point. Together, these evaluations compose the evaluation by description. The table describes how and why the design works for the problem situation and the evaluation points, and in doing so demonstrates the artifact’s utility. Many design components and features address more than one of the evaluation points in Table 5.1. Because of this overlap, only the most

directly relevant design features were discussed under “Design Performance”, and other features were mentioned elsewhere in the evaluation table, where they are most relevant.

Table 5.1: Descriptive evaluation of the support tool design

Evaluation Point	Design Performance
Functionality ⁵	The tool is designed to function as support, and its numerous parts respond to the functional requirements as determined through the review of decision support, PGIS, and foundational concepts. Figure 4.2, Table 4.1, and Figure 4.3 depict and list the design components, each of which responds to identified requirements. Table 4.1 in particular lists components directly derived from the literature review, and cites the functional requirement as identified in the review. Figure 4.2 is directly derived from the reviews as well, as the explanation of the figure in the text attests. This item is also further evaluated as part of the prototype survey.

⁵ The sum of what the artifact can do for the user (“Computing Fundamentals Definitions - Glossary,” 2014).

Evaluation Point	Design Performance
Completeness	<p>Together, the design elements in Figure 4.2, Table 4.1, and Figure 4.3 comprehensively address the functionality needs of a support tool as identified in the literature review, thus providing a complete solution.</p> <p>The functional needs were refined and arranged to be direct predecessors of the design. As such these requirements are all addressed in the design.</p> <p>This item is also further evaluated as part of the prototype survey.</p>
Consistency	<p>The design envisions a single “forum” in which different scales, perspectives, communication styles, and tool functions and properties are all addressed. The unifying element of the forum is designed to provide consistency in style and point of communication despite the range of issues presented.</p>
Accuracy	<p>The tool presents information based on expert agreement, existing levels of cooperation, and (sustainable) urban planning practice. As information is based on expert and practice-derived information, it is deemed accurate.</p>

Evaluation Point	Design Performance
Performance ⁶	Throughput and response time both refer to technical specifications that are not tested for this design iteration. However, availability is part of the tool design: It is designed to be integrated with an online participation platform, as such it will be available at the point where it is most needed. In addition, it is designed to be available at any and all times (as opposed to support based on online discussion with experts, which would rely on their intermittent presence).
Reliability ⁷	The technical aspects of reliability are either not evaluated in this design iteration, or not evaluated by this descriptive evaluation. However, the design calls for comprehensive informational coverage, which will make support available for a wide range of online participation activities and questions. In addition, it is designed to cater to different communication styles, different levels of engagement with issues, and different appetites for technical information. As such, the tool as designed can be considered reliably available to a wide variety of users. Prototype testing was also used to evaluate parts of this characteristic.

⁶ Effectiveness of an artifact, including throughput, response time, and availability (“Computing Fundamentals Definitions - Glossary,” 2014).

Evaluation Point	Design Performance
Usability	The tool is designed with usability and inclusiveness as central design elements. These are present in both the conceptual model, and the listed components. This item is also further evaluated as part of the prototype survey.
Style	Despite the requirement to address varied issues at numerous levels of detail from different perspectives, the design attempts to unify these with the “forum” device. This provides some simplicity, while still effectively meeting the requirements. As such the design can be said to incorporate style. The style of the interface is also further evaluated as part of the prototype survey.

⁷ Consistently performs according to its specifications, and is free of technical errors (“Computing Fundamentals Definitions - Glossary,” 2014).

Evaluation Point	Design Performance
Fit with the situation, as characterised by the research goals:	
Improving knowledge of relevant issues	The tool is designed to provide comprehensive information about planning alternatives, both specific to Calgary and in general, from a number of perspectives and at a range of scales. It is also designed to provide information about the need for resource management, potential costs, levels of cooperation and expert agreement, and collective interests and values involved. As such, it is designed to provide information about issues in many ways.
Improving understanding of sustainability	The tool presents information related to sustainable urban planning as well as issues within it. It is designed to examine from the perspectives of three spheres of sustainability, as well as taking holistic and long-term views, both conducive to sustainable thinking. In addition, it is designed around findings from the reviews of public understanding of sustainability and expanding public understanding. As a result, it incorporates numerous specific tactics designed to expand understanding of sustainability, including the emphasis on values and the collective.

Evaluation Point	Design Performance
Providing information about strategies and impacts	The tool is primarily designed for, and centres on the examination of planning strategies from different viewpoints and scales, in order to improve understanding of potential impacts.
Improving participants' comfort level	The design emphasizes presenting useful information such that participants are informed and versed in the types of issues and terminology often present in urban planning. This is to help them feel comfortable discussing planning issues. It is also designed to introduce no new discomfort in the way of difficulties with operating the tool or understanding the information. It further permits tailoring the experience to the scope of the issues that the user is willing and able to digest at the moment. All of these are intended to help the user feel more comfortable.
Empowering participants	The tool is designed to provide participants with topical information and communication aids such as visuals and mapping capabilities. It is also designed to improve their comfort level, as well as make it possible to suggest and share content. These tactics are all intended to empower the individual by addressing perceived lack of ability, generating enthusiasm, and providing the gratification of recognition.

Evaluation Point	Design Performance
Supporting high levels of participation	The tool design supports high levels of participation in urban planning by allowing users to self-direct in terms of what topic they explore. It also makes it possible for users to add their own suggested strategies if not found on the site. This allows users to select the issues that matter to them, or raise those that aren't listed. This leaves room for co-definition of issues, as required at higher levels on the participation ladder (Arnstein, 1969).
Support inclusive participation, encourage, and empower	The tool is designed to be useable to the majority of online planning participants, also discussed in "Usability", above. This serves to include users with all levels of technical proficiency. Finally, the tool is designed to empower, as discussed in "Empowering participants", above. This is done to include those who are unfamiliar and unsure of themselves in their public engagement, as well as those who already feel comfortable participating. Both usability and empowerment are designed to encourage users, as is the ability to view and add to discussion, and the emphasis on the value of each user's contribution.

In summary, the tool design comprehensively meets the functional requirements as established in the research problem and by the reviews (of intended users' understandings of sustainability, priorities with respect to urban planning, mechanisms to expand public understanding of sustainability, and relevant stakeholders' requests for a participation platform). The design

provides for consistency despite respecting numerous perspectives and communication preferences, and provides accurate information. This consistency also provides simplicity, which contributes to style. The tool is available at any time and from any device connected to the Internet, and is designed to address the needs of a wide variety of users, while being usable and inclusive. This allows it to reliably provide support to intended users.

The tool addresses the research goals related to improving knowledge and understanding by providing information regarding sustainability, related issues, and planning strategies and impacts. It also introduces terminology and strives to increase a feeling of comfort by being easy to use, while encouraging and recognizing contributions, all in order to address comfort level and empowerment goals. Finally, it is structured to allow users to pursue their own interests, thus defining their own priorities, which leaves space for higher levels of participation.

5.2 Prototype Evaluation by Testing

After development, the prototype was evaluated by testing to ensure it functioned as intended. Extensive testing was performed in the Google Chrome browser, with more perfunctory testing in Mozilla Firefox and Microsoft Internet Explorer. Testing consisted of clicking every link/clickable item to ensure each one functioned and appeared as intended.

Some links did not perform as intended, so the code was updated until they all did. Once this phase was completed, modules expanded as expected, as did the sub-strategies within them. The text-box accepted suggestions and stored them in the database strategies table along with the source code “3” for “Online User”, as intended. The associated plus (“+”) button added textboxes as planned, and the text entered in these was likewise stored, while empty boxes were

ignored, all as intended. Picture attribution and reference links both opened their respective pages in new tabs and the links within those pages opened successfully. Many of the referenced sources are freely available upon clicking the link. However, some require payment. Unfortunately, it is not possible to circumvent this condition due to copyright issues. Negotiating free access for the public was beyond the scope of this research.

During the pilot survey a slight bug affecting the appearance of the greenhouse gas strategies was brought up. The oversight occurred because the strategies' appearance had only been checked on one computer monitor. As such, they worked as expected, but only on monitors of that size. This was immediately fixed by repairing the site styling and checking strategies' appearance over a range of window sizes.

After the survey, a bug in the share buttons was identified and corrected. Three of four share buttons had been set to link to an old web address (URL). As a result, when shared, the link appeared on the social networking sites as "not found" in two cases, and was unable to link back to the site in all three cases. The web address was corrected and the problem stopped. Share buttons were checked again, and all successfully posted to the related social media site. None of the survey responses mentioned this bug, so it is presumed that it was not noticed.

5.3 Prototype Evaluation by Survey

The prototype was evaluated using an online survey, in order to mimic the conditions the tool was designed for. The results of the survey provide insight into users' perceptions of the tool, including what they noticed, what they liked, what they did not like, and what they would like to see in the tool in the future. This provided feedback about the prototype and the design, as well

as pointing to future work. More to the point, the responses contributed to testing the research hypothesis, by revealing whether the online support tool is a feasible solution to the lack of face-to-face feedback and support in online participation.

Twenty-eight survey responses were submitted, though of these only 13 comprised complete answer sets. Complete answer sets were defined as responses containing an answer to each question. However, a number of the combination yes/no and long-answer questions had answers in only one of the available forms (for example, the respondent would only select yes or no, or the respondent would only answer via long-answer). Of the 15 incomplete surveys, 2 respondents only filled out the Likert-scale-based questions or yes/no answers, and a further 12 only filled out some long-answer questions. Finally, 1 survey was rejected due to inadequate answers (the respondent could not find the link to the site, and as such did not view it).

Of the 27 surveys retained, 11 described having been involved in urban planning in some capacity previously, while 16 said they had not previously been involved. Most of the 11 who had participated had attended public meetings. For the most part, they had also had some degree of contact with decision makers, from asking questions and providing input to conversations with city councillors. Some had also filled out surveys, though only one mentioned doing so online. Other activities such as teaching and membership of an association (though not a community association) were mentioned in single instances.

Likert-Scale Questions

In terms of perceived usefulness, the survey revealed that 83% of respondents agreed or strongly agreed that the tool would be useful when participating online in urban planning, while 11%

neither agreed nor disagreed, and 6% disagreed. Detailed responses to each perceived usefulness question can be seen in Figure 5.1 (questions 3 to 8). This indicates that, for the most part, the tool is perceived as useful. Perceived usefulness is a direct predictive factor of whether new IT will be adopted (Davis, 1989). This indicates that the tool is likely to be adopted, as it is perceived as useful.

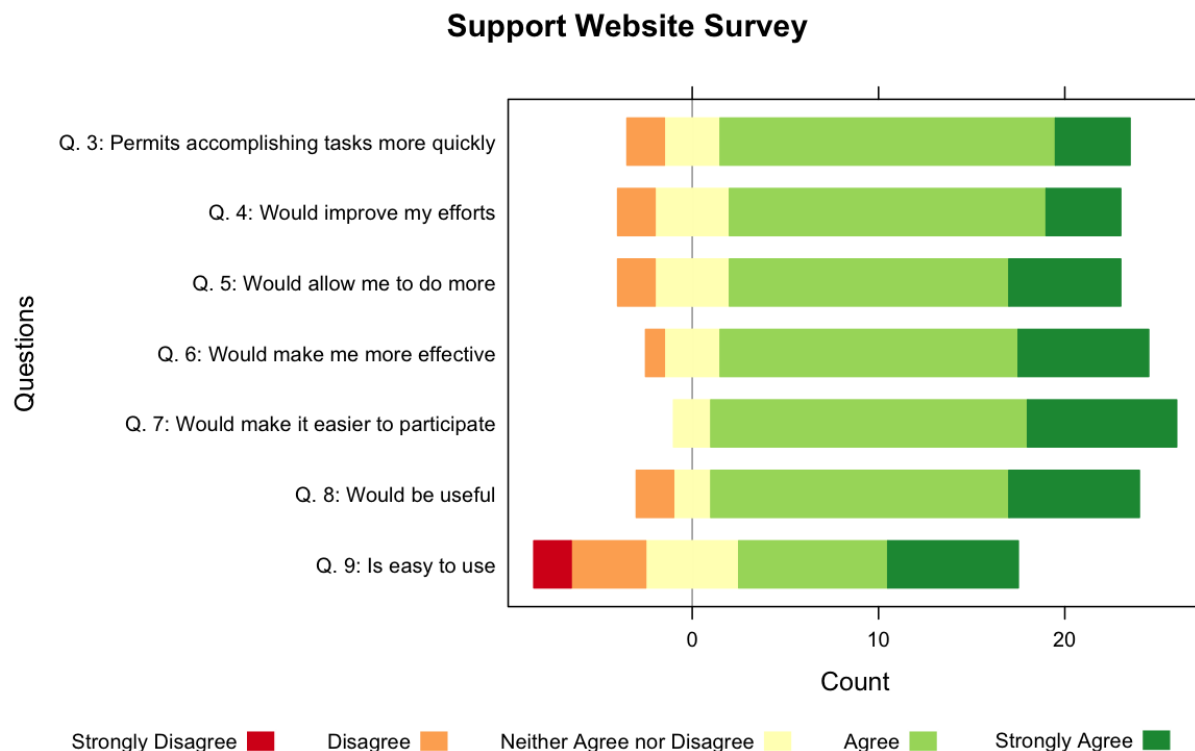


Figure 5.1: Likert-Scale reponses indicating percieved usefulness of the support tool (questions 3 to 8) and perceived ease-of-use of the support tool (question 9).

However, when it came to perceived ease-of-use, 58% of respondents either agreed or strongly agreed that the tool is easy to use, while 19% neither agreed nor disagreed. A further 15% disagreed that the tool was easy to use, and 8% strongly disagreed. These responses are visualized in Figure 5.1 (question 9).

Ease-of-use was an important design goal, especially as it aids in making the tool accessible and inclusive to a wide range of users with a wide range of technological abilities. As such, improving ease-of-use should be emphasized in any further development. Given that the design and prototype were originally intended to be easy to use, but were not judged as such by 42% of respondents, it is likely that further usability testing will also be necessary. Minor modifications may be adequate, however. Responses concerning ease-of-use centred on difficulties in determining which pictures were clickable, compatibility issues (Windows RT tablet), and a lack of one or more of information, text, supporting information, balance of views. Removing pictures from the banners (which when clicked did not reveal information about the picture, but rather unrolled the general topic they illustrated), or providing clearer pictures, may alleviate confusion. Using pictures rather than text in the “Different Styles of Urban Planning” section may also help. If these were similar in format to those in the “Planning Strategies” and “Reducing Calgary’s Greenhouse Gas Emissions”, consistency of style would be maintained between the modules.

Long-Answer

On the whole, respondents voiced positive responses to the prototype. These included favourable views about the information presented, appreciating the tool’s presence and purpose in general, and a sense of being supported by the tool. There were some exceptions, however. In various ways, a number of respondents specifically asked for three categories of items to be added to the site:

- The need for integration with an online participation platform;

- The need for more information, including support for claims, information about the planning and participation process, information about specific proposals, and timelines including deadlines for both planning projects and engagement opportunities;
- Presentation of information in more ways, such as at more scales, especially local; more comparison, especially with other cities; and more interaction with the information, such as with sliders and polls.

Eight broad themes emerged from the coding. Fifty-eight comments requested additional information or features, either in general or specifically. These comments were coded with the **“Information requested”** theme. Ten comments volunteered information, such as raising issues not covered by the tool, and in some cases suggesting implementation measures such as policy. These were coded with the **“Information volunteered”** theme. Forty-seven comments mentioned either a specific or general item of information that *was* contained in the support site, which I infer had been noticed while browsing the support site. These were coded with the **“Information noticed”** theme.

Thirty-two comments gave some indication of the respondent having felt helped by the tool, including direct or inferred references to feeling heard, empowered, engaged, motivated to contribute, or more comfortable participating. These were coded with the **“Felt helped”** theme. Six comments indicated some level of existing disempowerment, and were coded with the theme **“Disempowered”**. These centred on one of two ideas: either the respondent thought the City would not accept his or her input, or that he or she had nothing valuable to add to the discussion.

Twenty-six comments indicated a general support for sustainability or related measures, each coded with the theme **“In favour of sustainability”**. On the other hand, five comments indicated the theme **“Objections to sustainability”** or related measures. For example, some mentioned that the costs of taller buildings would offset the savings in infrastructure costs in more compact development.

In addition, respondents indicated through their answers that elements of the site had caused confusion. They indicated this either directly or indirectly by reporting erroneous impressions of the tool. A number of answers asked for features or information that were present, or mentioned seeing some that were not. This indicated that the respondent had **“Missed something”**, which points to future work in terms of clarity. For example, numerous answers indicated having missed the references link.

Note that a number of responses were coded with multiple themes. As such, these are counted more than once above. Still others were not coded with any of these labels, and as a result were not counted. Thus, any totals do not represent the number of responses received.

These broad themes were further refined by classifying the related responses in two groups. Comments that were approving were in the first group, denoted as **“Good”**. The second group included comments indicating **“Future work”** by mentioning a difficulty, objection, or directly requesting more information or features. This form of qualitative coding and analysis has been used in similar studies of support tools (Poplin, 2012; Schwilch et al., 2012). In some cases these elements were developed in the prototype but not noticed, in other cases they are designed into

the tool but not developed for the prototype, and in further cases they should be added to the design as future work.

Comments in both groups were then categorized as **“Information”**, **“Features”**, **“Integration”**, **“Qualities”**, or **“Feelings”**. This created broader groups while permitting cross-referencing, thus making it easier to arrange the responses to extract information concerning what worked, and what should be improved in the future.

Both groups of responses shed light on the ability of the tool to respond to the research problem. The two groups and their classifications were cross-referenced to reveal eight different topics: Good information, features, qualities, and feelings; and information, features, integration and feelings indicating future work. The cross-referencing can be seen in Table 5.2, which shows the topics and the number of responses in each. Once again, a number of comments were coded with multiple classifications or categories, and others were not coded. As such, comments may be counted more than once, or not at all, in the table. Thus, any totals from the table do not represent the number of responses received.

The values in Table 5.2 indicate that information was by far the most talked-about category. The tool centres on information since it is designed to communicate in order to supplement missing feedback and information. The features and qualities of the tool simply exist to aid this communication. The request for integration essentially supports a key design intention that could be considered a feature, to integrate with a participation platform. Finally, the feelings mentioned are reactions to the other categories. As such, it is deemed appropriate that the responses should

centre on information. Further, this is taken as suggesting that the devices used to communicate are not too obtrusive.

Table 5.2: Cross-referencing of code groups and categories, indicating whether the information, features, integration, qualities, or feelings mentioned in responses indicated a positive reaction or a direction for future work

	Information	Features	Integration	Qualities	Feelings
Good	64	8	none	6	14
Future work	57	19	7	none	6

The next section explores each of the eight topics in Table 5.2 in order to discern whether the prototype, and by extension, the support tool, can achieve the research goals and fulfill the research purpose. The remaining analysis employs qualitative methods. Qualitative approaches do not rely on counts but rather on identifying connections between ideas (Hay, 2010, p. 283) in order to decipher the human experiences contained (Hay, 2010, p. 5). As such, deciphering the ways that the prototype is experienced employs qualitative methods rather than simple counts of instances. In any case, counts could be misleading since the surveys returned a relatively small set of responses. Hence, a qualitative approach was taken in connecting the various views concerning the prototype with its elements (information, features, etc.). These were then extended where appropriate to apply to the support tool design.

For example, while Table 5.2 records that there are 64 instances among responses that favourably mention information within the tool, or informational motivations for choosing

sustainability, fewer topics than this are enumerated in the list below. The list simply contains the unique items mentioned, rather than counting the times they were mentioned. The ensuing discussion of the topics present in Table 5.2 maintains this emphasis on qualitative analysis.

5.3.1 Qualitative Analysis of Survey Results

In the analysis below I discuss the survey responses, as well as interpreting their meaning and implications for the research goals. Following this analysis, final results are presented based on the interpretations and implications of results. In Chapter 6, I discuss the interpretations I have made, consider potential alternatives, and judge the strength of the claims made based on my interpretations.

There were a number of items within the information category that were mentioned favourably. These are listed below, generally ordered from broadest to most specific:

- Knowledge that participation in planning is possible;
- Common terms of reference to use while participating;
- Being better informed about options and impacts in general;
- Appreciated sources linked in the “References” section;
- Styles of urban planning and impacts on energy, environment, urban footprint, transportation, and costs;
- Understanding of planning and why planners make the decisions they do;
- Liveability, quality of life, green space, and fun in the city;
- Social health as a value;

- Relative greenhouse gas impacts;
- Environmental impacts;
- Costs/economic impacts/taxpayer impacts;
- Relative costs of planning styles;
- Costs of sprawl, especially road capital costs;
- Density and housing style distribution;
- Transit planning;
- Reducing driving, improving infrastructure, improving vehicle fleet efficiency;
- Pay as you drive insurance;
- Phasing out coal-based electricity;
- Landfill gas capture; and
- Community gardens and urban agriculture.

That these informational items were noticed and appreciated indicates that the prototype communicated information successfully. This addresses three research goals related to information, as it can help improve knowledge of issues, improve understanding of sustainability, and provide information about strategies and impacts. This can be extended to the tool design, since the information in the prototype would be present in the completed tool, along with additional information, all similarly communicated. As such, it is possible to infer that the tool has the potential to address the same research goals. This, in turn, addresses the research purpose, as it serves to supplement a lack of information.

In terms of information requested for future work, the topics included can be grouped into three main areas: Comments requesting more information, especially in certain formats; comments

about specific items; and requests for information about how to participate. The topics within these groups are presented below, arranged together based on which of these they best represent.

Comments requesting more information, especially in certain formats included the following:

- More information in general, basic background information about urban planning, more text-based information, and/or more detail and description;
- “Appropriate” background knowledge (this would be different for each planning situation);
- Information about the negative impacts of current practices;
- Information about why current practices are used or pursued, in order to understand why alternatives are not chosen or why “the City” made a given decision;
- More information on the problems with each planning style or strategy;
- Information at different scales, especially about local initiatives;
- Demonstration of the connected nature of sustainability and the need for multiple strategies toward it, and/or more connection between ideas;
- Impacts phrased as pros and cons of choices, including current and “unsustainable” choices;
- Cumulative impacts of greenhouse gas reductions;
- Information about individual planning proposals, initiatives, or projects, their goals, the alternatives within them, and expected consequences of these alternatives, as well as the associated timings and locations, with follow-up information as the process progresses;
- Clarity about what is proposed;
- Clarity about the choices available;

- More information on costs and benefits of each strategy;
- Information about specific problem areas;
- More support for the impacts presented, including references, technical information, and numbers; and
- Examples of strategies, especially case studies of their deployment (Calgary- and Canada-based sometimes specifically requested), as supporting information and comparison.

Comments about specific items discussed:

- Environmental impacts;
- Health care impacts;
- Lifestyle changes required;
- Feeling safe in the city;
- Implications of suggestions on (already high) housing costs;
- Objecting that, if unable to build “new” (often used to mean greenfield) housing, housing costs would soar, because redevelopment takes longer;
- Cost of building high rises;
- Economic viability, costs in general, costs of services, costs of transportation;
- Information about, and modelling of, multi-centric planning and its implications including costs and footprint;
- Transit oriented development (TOD) and more support for transit;
- Encouragement for biking and bike rentals;

- Increasing greenery/gardens; and
- Support for and suggestion of tree-centred policy making and incentives for tree retention.

Finally, comments about how to engage in planning included the following topics:

- Information about how to participate;
- Information about the participation process (sometimes requested on a per-project basis);
- Awareness of participation opportunities;
- Where and how to engage in planning, including schedules and reminders of events;
- Decision-making timelines and reminders;
- Encouragement to get involved (including an inviting climate that welcomes participation, consideration of user input, and showing the impact user of input); and
- Clarification that the support tool prototype itself is not a participation platform.

These requests for information indicate a few things. Firstly, that many missed the references link or did not consider it adequate. Alternatively, they may like to see more information supporting the claims presented, and/or a different form of explanation of claims. It also seems some simply did not believe what was being presented, and were suspicious of bias and unstated downsides of the strategies and impacts presented. This would be partially addressed by the addition of further explanation and information supporting the claims made. Some users may still object, however. This is further explored in discussion in Chapter 6. In any case, it appears that to satisfy a wide range of users, the support tool must include examples and case studies.

On the whole, however, the primary sentiment behind requests for information appears to be requests for more. This is in line with the tool design, from which only certain informational elements were selected for prototype development. However, requests, for the most part, do not reflect the informational elements that were not developed. The information not developed includes items surrounding values and value conflicts, existing levels of agreement and cooperation, and the need for resource management. While some of the requested information addresses this, much simply responds to the information presented. This is not taken to mean that the specific information in the design should not be developed. Rather, it is taken to mean that the informational elements that are developed at any stage should be further developed than in the prototype. This is concluded because the requests responded to what was present. Thus, the information that is present at any point in development is likely to be what users respond to. In order to address this apparent propensity, any information presented should be developed to the extent demanded in the surveys. However, the content themes still requiring development are not likely to be irrelevant. They are simply were not present to generate response.

In any case, the requests for more information and the fact that informational codes in general are prevalent, both support the conceptual underpinnings of the research. They indicate that the intended tool users are likely to be as interested in the tool content as those surveyed. Thus the tool's presence and its provision of information are likely to support users, if only in their curiosity.

The second column in Table 5.2 concerns prototype features. Those that were mentioned positively included:

- Appeal to both experienced and new users
- Formatting, including images and concise, simple text;
- Graphics including graphs, maps, and numerical representation;
- Easy comparison and assessment of options;
- The tool permits a broad view;
- Anonymity;
- The option to make suggestions; and
- The references section.

In addition, one person made use of the “suggest a strategy” input box on the prototype site. This indicates that it was noticed and considered useful at least once.

A number of these responses indicate that the prototype contributed to the research goals, especially improving participant comfort level. Participants noted that they found comparison and assessment easy, which indicates a certain level of comfort. Anonymity was noted as a positive because it permits sharing opinions, especially controversial ones, without fear of backlash.

In addition, since the list also mentions that the prototype appeals to experienced and new users, the design environment constraint requiring inclusiveness is addressed. That users noted the option to make suggestions and in fact made a suggestion indicates that the prototype supports the design environment condition to permit high levels of participation.

As design environment conditions have been met, the prototype can be said to fulfil a fundamental requirement of design science. Additionally, as the research goal concerning comfort level appears to have been addressed by the features mentioned positively, the prototype can be said to contribute to the research purpose to support participants. Since the prototype is composed of features that would be included in the fully developed support tool, these conclusions can be extended to indicate that the support tool design is likely suited to its intended purpose.

Features requested for future work included:

- Greater interactivity;
- D3 (a JavaScript library that aids visualization: <http://d3js.org/>) map visualization;
- “Sliders” along the planning style spectrum, linked to cumulative impacts, or comparisons, for example;
- Emphasis on key phrases such as “costs less”;
- Voting;
- Polls with visible tallies of other’s opinions;
- Social media (which was taken to mean the ability to discuss and comment);
- Links to websites providing further information.
- Games;
- Video clips;
- Visual continuity of graphics;
- An easier to read font;

- A button to close everything clicked; and
- Clarity about which images are clickable.

The features requested for further development would likely be present in a participation platform. Thus, the above list suggests that respondents would like the support tool to be integrated with a participation platform. This supports the design intention to integrate. The requested features also include the ability to discuss, directly, and with devices such as voting and visible results. This also lends support to design intentions, which included these.

The support site is designed with the intention of complementing an online participation platform. As such, it is not sensible to duplicate the functionality by providing the support tool with features of a participation platform. However, in order to use the prototype in engagement activities, and for full development of the support tool design, it is recommended that the support site be integrated with an online participation platform. When integrated, support will be available as participants work their way through engagement activities in the participation platform. As such, features such as discussion, which will be present in a participation platform, will be available, and the support will be situated with respect to the topics the user is currently considering. This was part of the original design, and based on survey results, should be made a priority.

Further, the list also includes direct requests for greater interaction with the information presented, and indirect requests for the same, in the form of demands for devices including sliders, D3 visualizations, and games. This tends to support the conclusion taken in the section concerning information requested, which is that the requests amount to asking for more. Once

again, this supports design intentions, which include more features than those developed in the prototype. Asking for more also supports the notion that respondents see value in the tool concept.

In terms of direct integration requests, a number of responses indicated a desire to participate online, as well as asking that the support site include the opportunity to provide planning input. Note there are no positive comments associated with integration, since the prototype was not integrated with a participation platform. The comments included numerous specific requests:

- Open the support site to participation, meaning the ability to provide feedback, annotate, inquire and comment, and view this activity from others;
- A central, simple, and/or convenient point for participation;
- Evidence that user input is appreciated and used and that it will affect plans, including evidence of the City listening, considering, and implementing citizen suggestions; and
- Make it fun to get involved.

The list above supports the design intention to integrate with and complement a participation platform. It also supports elements such as the intention to include information about existing levels of cooperation, since these could be used to demonstrate where public input has had an effect in the past. This could provide the requested evidence that participation can have an impact. The design intention to provide an engaging interface is also supported by the request to make it fun to be involved. Finally, usability is also requested, supporting another design intention.

Some thought the tool was a participation platform, or stated that it should have the features of a participation platform. Another response asked that it be made clear that the site is a support tool rather than a participation platform. Based on the responses that either missed that the support site was not a participation platform, or the responses that asked for the features of a participation platform, it appears that, until the tool is integrated, it is indeed important to make the distinction.

Finally, some users made planning suggestions in the prototype evaluation survey. This suggested that they were looking for a place to do so. It could also suggest that they misinterpreted the purpose or scope of the survey, and thought it was intended to gather urban planning input. They may also have misinterpreted the purpose of the support site to the same effect. Even if one or both of these misinterpretations were present, their volunteering input as to how urban planning should proceed can still be taken as an indication that they want any or all of the following: to discuss their opinions, to provide that input, and likely, a place to provide that input.

The support tool qualities mentioned positively included:

- Ease of use;
- Ease and convenience of access due to being online;
- Stimulates thinking/provokes thought;
- Makes it more interesting to participate; and
- Helps with prioritization.

Responses indicated that the prototype stimulates thinking and helps with prioritization. This indicates that it provides information worthy of considering, and that it has the potential to address the research goals concerning improving knowledge and understanding. Addressing these research goals also speaks to the research purpose concerning lack of information. Further, the design constraint requiring high levels of participation is addressed, as participants who find prioritization easier are better able to participate at a higher level, since they are in a position to co-define priority issues.

There were no negatively mentioned qualities. This is because any such reference was translated into an associated request, because that format points more directly to the future work required. For example, some responses simply indicated that the tool was hard to use. However, instead of being listed as a negative quality, the problems identified were grouped under features for future development. For example, one such problem was difficulty determining what images were clickable. Clarity surrounding this is listed under features for future development.

A number of positive feelings associated with the prototype were mentioned:

- Feeling more confident contributing to planning due to being better informed or prepared;
- Finding it easy to feel informed, leading to being more motivated to engage in planning;
- Finding it easier to contribute because of information available;
- Helped with prioritization and evaluation;
- Felt helped by the simple presentation of information through charts and statistics;

- Surprise at learning of unanticipated impacts (this was considered positive since it indicates the information was new to the user, and hence, potentially helpful);
- Easier to present and advocate positions, and more comfortable doing so;
- Surprised at learning participation is possible;
- Encouraged and motivated to participate;
- More likely to submit suggestions; and
- Less intimidated.

Some users expressed positive feelings that could suggest they have no use for the tool. These included never having felt uncomfortable engaging in planning, and already intending to suggest sustainable alternatives when participating. However, these types of responses were not the norm. In addition, these responses included references to other needs that were or could be met by the tool. For example, some said they would be more likely to participate if given feedback concerning their input, especially assurance that it was considered and that it had an impact. Some also mentioned that having the additional information the tool presents could help them defend their positions better.

On the whole, the responses communicating positive feelings about the prototype indicated that it generated confidence, made respondents feel more informed, and would make them more likely to engage in urban planning. This supports all of the research goals, since it concerns improving knowledge and understanding, providing information, improving comfort level, and empowerment. Empowerment is doubly addressed, since responses indicate feelings of increased confidence, and since being more likely to engage in urban planning speaks to respondents' ability to effect change, and their perceptions of this ability. This indicates that the research

purpose is satisfied as well. Both inferences can be extended to the support tool design, since the information, features, and qualities mentioned as contributing to these feelings are included in the design, and since the design includes additional information and features.

Most negative feelings centred on feeling disempowered. This supports the conceptual underpinnings of the research, and the importance of the research goal to increase empowerment.

These types of instances included responses such as:

- “Leave it to the experts”, which discount the value of local experience and knowledge;
- “I have nothing valuable to add”, also stated as “I am not an expert”, which is another way of discounting the value of local experience and knowledge;
- The public is not asked for feedback, or they have no adequate venues to provide feedback;
- The process of talking with city planners, developers, and councillors is cumbersome and akin to a wild goose chase, which discourages involvement;
- Public meetings are intimidating, especially when voicing unpopular positions;
- The time and input given in participation are not appreciated; and
- The participant has no control over what is built, despite providing feedback, since the decision is not theirs, nor the public’s.

One final negative feeling raised in the survey responses was not related to feeling disempowered. Some expressed suspicion that the site exposed only the good side of the strategies and impacts presented. The requests for more information and features, discussed

above, address this suspicion more specifically, by detailing elements that would address this suspicion. This is also further discussed in Chapter 6.

The above discussion of the survey details what was mentioned in the responses. However, what was not mentioned is equally informative. The fact that the purpose and presence of the tool were essentially taken for granted, and that it was the information contained, or the features available that were the main topics found in the responses, could indicate that the respondents viewed this kind of support as natural. Its provision online was not questioned. Further, the responses indicating that it should be integrated with an online participation platform, echo design intentions, and lend additional support to the idea that the tool is viewed as having a natural presence online.

In summary, responses indicated that the prototype was accessible, both in terms of online availability and usability. In addition, numerous comments indicated the information provided was helpful, either directly, or indirectly through the focus on informational elements. Further, responses indicated feeling confident, informed, and helped in general.

Numerous responses also indicated that more information or features would be beneficial. These were in some cases already part of the tool design, but had not been developed in the prototype. In other cases, the requested features and information were not part of the design, but instead are recommended for inclusion in future work. In either case, requests should be developed in future instantiations. Though they can be perceived as reflecting negatively on the prototype, these responses essentially ask for more of the same. As such, they tend to suggest that the tool itself could be beneficial.

Together, these findings indicate that the prototype supports the hypothesis that providing accessible, relevant information can help deliver some of the missing feedback and support in online participation. This can be extended to the support tool design since the prototype represents a sub-section of the designed components. Additional features and information requested are indicative of acceptance of the concept in general. These requests are often supported by the existing design, and if not, are noted for future work.

5.4 Final Results and Chapter Summary

This chapter explained the descriptive evaluation of the support tool. The evaluation revealed that the tool addresses the numerous requirements of the problem situation and the evaluation points, and in doing so demonstrates the artifact's utility.

Following this, the chapter describes the prototype's evaluation by two additional methods. The first was testing, to ensure the prototype functioned as intended. Following this, the prototype was experimentally evaluated by simulation, via a survey intended to test the tool's use in conditions as true-to-life as possible. The survey revealed a number of positive and negative reflections. Most negative reflections indicated a desire for more features or information, or a general feeling of disempowerment. Positive reflections indicated that the information and features that were provided were appreciated, and that the tool helped users feel informed, confident, and more inclined to contribute to planning.

These findings can be extended to the tool design, as the prototype represents a small portion of it. On the whole, the survey results indicate that the support tool has the potential to empower, improve participant comfort levels, provide information, and improve understanding and

knowledge, thus satisfying the research goals. This confirms the hypothesis that it is feasible to provide this kind of support online.

Chapter Six: Discussion

This chapter discusses some of the research results and addresses the validity, or strength, of the claims made. First, the research is examined using design science requirements (see section 4.2) to demonstrate that this work has been compelling information technology research. I then discuss the reliability of survey results, and perform a critical review of my interpretation of them, to assess the strength of the resulting claims. Ultimately, I aim to show that my earlier claim – that the support tool design is an effective solution to the research problem – is reasonably sound. In keeping with the design science method used throughout the research, the discussion includes a focus on the artifact and its potential, in addition to discussing interpretation of qualitative and quantitative results.

6.1 Validity

Validity is commonly applied to quantitative research, and terms such as transferability and credibility are used as well as validity in qualitative research (Creswell, 2007, Chapter 10; Hay, 2010, Chapter 17). Design science research, as explained in Chapter 4, assesses contributions to knowledge by their “**utility to a community of users, the novelty of the artifact, and the persuasiveness of claims that it is effective**” (Gregor, 2006, emphasis mine). In addition, the seven design requirements proposed by Hevner et al. (2004) are also used (Pries-Heje & Baskerville, 2008). Of these, evaluation and research rigour in particular contribute to claims of validity.

In this research, validity and rigour are demonstrated by meeting the seven design science requirements set out by Hevner et al. (2004). That this was done is shown in Chapter 4, and is

briefly summarized here in Table 6.1. In addition, as part of this process, three evaluation methods were used. These evaluations further contribute to the validity of the research.

Table 6.1: Satisfaction of design science requirements (Hevner et al., 2004) in the current research

Design Science Requirements	Research Response
Design as an artifact	I produce both a design and a prototype as an instantiation.
Problem relevance	The relevance and importance of the problem is established by both the research need and gap, in Chapter 1. Though online participation has benefits in terms of accessibility and convenience, it lacks face-to-face feedback and support from experts. Since lay participants tend to need some sort of support (Kellon & Arvai, 2011; Kilinc & Aydin, 2011; Laurian, 2003; Lefsrud & Meyer, 2012; Leiserowitz, 2006; Reid et al., 2009; Schwilch et al., 2012), and since existing support is largely limited to in-person exercises or targeted to expert decision-making (Condon et al., 2009; Mackenzie et al., 2006; Schwilch et al., 2012; Tippet et al., 2007), this research undertakes design of support for lay participants acting online.

Design Science Requirements	Research Response
Design evaluation	I evaluate the design based on the evaluation framework proposed by Hevner et al. (2004), using description, testing, and experimental evaluation by survey.
Research contributions	I contribute to the research by producing design foundations and an artifact that responds to the research problem, questions, and goals, and by testing to determine the calibre of the solution. Contributions are further discussed in below.
Research rigour	I demonstrate research rigour by addressing the design science requirements, and through my evaluations.
Design as a search process	The design was conducted as a search process, beginning with inquiry, then followed by formulation of the problem space, design and prototype construction, and ended with evaluation and recommendations for future design-test iterations.
Effective communication of research	The research is communicated through this thesis, a journal publication, associated presentations, through research communication channels such as Twitter, and informally.

Whether the evaluation methods are well-executed, and whether they demonstrate the utility and effectiveness of the artifact, is the subject of the remainder of this chapter. It is also the subject of

Gregor's (2006) three requirements. As such, this question can be answered by addressing those requirements.

To address Gregor's (2006) requirements, the experimental evaluation (the survey) indicates that the support tool will be useful to the intended users. Results indicated that the information and features provided were appreciated, and that the tool helped users feel informed, confident, and more inclined to contribute to planning. Results also indicated that more information and features would improve the tool, indicating that full development of the design would be appreciated.

Claims that the artifact is effective are supported by the outcomes of all three evaluations. Firstly, the descriptive evaluation shows that the requirements discovered through the literature review have been met by the design features. Secondly, testing showed that the features selected for prototype development performed as expected. Thirdly, the survey results suggest that the prototype showed promise in meeting research goals to provide information, improve knowledge and understanding, improve comfort, and empower, and will be more effective when fully developed.

Finally, Chapter 1 established that the artifact is novel by identifying a research gap. Novelty was further established through the literature review (section 2.5), which indicated that tools for this specific purpose do not yet exist (Foth et al., 2009; Kellon & Arvai, 2011; Mackenzie et al., 2006; Poplin, 2012; Schwilch et al., 2012; Tippet et al., 2007). Essentially, the tool is novel as it seeks to provide support in a new context, to lay persons engaging in urban planning online, at a high level of participation, and acting largely on their own. Though similar decision aids have been used, for example in forest management, tourism planning, and other public planning

initiatives, none, to the best of my knowledge, have been targeted at lay planning participants acting online. As such, the research constitutes design and evaluation of a new artifact.

As for the persuasiveness of claims that the artifact is effective, these can be judged by the quality of the survey and interpretation of its results. This is examined in the following sections.

The rigour, or trustworthiness (Hay, 2010, p. 351), of the survey, and of my interpretation of responses, rests on my use of triangulation and rich, thick description (Creswell, 2007, pp. 208–209).

Rich, thick description provides transparency by making the relevant information and interpretation of it clear. Transparency can make constraints on interpretation and the limitations of textual staging more apparent (Hay, 2010, p. 348). In this research, the description of the survey results is provided through the inclusion of summaries of relevant responses, as coded, prior to the explanation of their interpretation. In addition, the coding process used to arrive at the arrangement and interpretation of results is explained, in order to provide further transparency. This allows the reader to understand the context and hence, provides the reader with the opportunity to assess the interpretation of results and the claims made.

In terms of triangulation, I employed two different sets of survey questions, three separate evaluations of the design, and literature and document review. Comparison can be made between the different types of survey questions, between the evaluation results, and between the literature review and the results of this study. This serves to check the consistency of messages received from respondents, between survey responses and other evaluations, and between the interpretation of results and their implications versus existing literature.

The Likert-scale questions revealed that most users found the tool useful, as 83% of respondents agreed or strongly agreed that the tool would be useful when participating online in urban planning. This was echoed in long-answer responses and the qualitative analysis of them, in which numerous comments indicated that the information provided was helpful. Further, responses indicated feeling confident, informed, and helped in general. Since these outcomes also indicate that the tool can be useful to participants, this comparison reveals agreement between the types of questions, and as such, indicates a reliable result.

The second Likert-scale metric, ease-of-use, revealed mixed results: 58% of respondents either agreed or strongly agreed that the tool was easy to use, but 42% did not find the tool easy to use. Long-answer questions revealed a similar result, some respondents commented that the tool was easy to use, others noted difficulty. For example, this resulted in requests for clarity surrounding which images could be clicked, or a single button to close all strategies. Since these results corroborate each other, the result is likely reliable.

The results of the three separate design science evaluations can also be compared. The descriptive evaluation was used to determine whether the tool design met numerous criteria set out by Hevner et al. (2004), including functionality, completeness, consistency, accuracy, performance, reliability, usability, style, and fit with the situation. Fit with the situation is described by the research goals and problem environment criteria. The descriptive evaluation established that each of these criteria was met. It also determined that the tool features demanded by the review of public needs were present. Both results suggest that the tool is an effective response to the research problem, likely to be viewed as useful by the intended users. The survey results, including the Likert-scale and long-answer results described above, are in harmony with

this. This provides further support for the conclusion that the survey results and interpretations are reliable.

The testing evaluation simply checked that the prototype functioned correctly in terms of technical aspects. Results of this evaluation were positive, confirming the tool was functional. Survey results agreed with this by and large (as indicated by an absence of technical complaints), with the exception of noted compatibility issues with the Windows RT tablet. Since performance of the tool on that specific device was not evaluated, the survey results do not contradict evaluation results. As such, survey results can continue to be deemed reliable.

Finally, comparison with literature and document review also suggests reliability. The literature, in so far as it concerns decision-making or support tools in general, indicates that these are sufficiently effective and valuable to sustain a body of inquiry surrounding their design, construction, and use (Foth et al., 2009; Kellon & Arvai, 2011; Poplin, 2012; Schwilch et al., 2012). Decision support tools can support professionals (Condon et al., 2009; Mackenzie et al., 2006) and those in developing areas⁸ (Kellon & Arvai, 2011), and numerous in-person supports ease the participation process (for example: Rambaldi, Muchemi, Crawhall, & Monaci, 2007; Rambaldi, 2008). The extension of the principles and methods behind these bodies of work to include a support tool geared to lay participants in urban planning was therefore expected to be

⁸ Kellon & Arvai (2011) use the term “developing areas/communities” to mean both developing countries as well as communities within developed nations (e.g., the Inuit in the Canadian Arctic) that, because of their local or cultural customs, or socio-economic situation, are largely detached from their post-industrialized parent nations.

practicable. Survey results indicate provision of online support and feedback is indeed possible, and that the support tool design effectively delivered this. As such, based on the literature, the survey results are reasonable.

In addition to the above, the reliability of the survey results can be further examined in terms of the sample, the questions asked, and the interpretations made. As described in Chapter 4, the population for the survey was the general public, but particularly those likely to be interested in online involvement. As such, the sample was self-selected, to mimic the self-selection process in online involvement. To further mimic the online engagement environment, respondents were recruited via online channels including social media and email. This recruitment strategy is deemed reasonable, and likely to have provided an appropriate sample.

The questions asked in the survey addressed all research goals and the research purpose (split in two parts), as described in Chapter 4. Though respondents often did not answer the question directly, responses were nevertheless adequate for the coding and qualitative analysis processes employed. The answer sets generated responses that, when checked against themselves (as in triangulation of the different types of questions), against the other evaluation methods used, and against expectations based on the literature, proved reasonable. That is, the interpretation of responses based on the coding yielded results that were corroborated by triangulation. As such, the fact that responses were not always directly related to the questions does not undermine the reliability of the qualitative analysis.

The same argument can be made in favour of accepting the small number of responses received. The sample did not generate very many responses, at 28 in total, and 13 complete response sets.

However, the results, as shown, were reasonable based on the triangulation. In addition, the last sets of responses coded did not add new descriptive or analytical codes to the codebook, thus suggesting that saturation was reached. This indicates that sufficient responses were obtained.

Finally, the results of the long-answer questions have been interpreted as part of the qualitative analysis. But, there may be other potential ways to interpret the results. Below, I discuss a selection of the primary interpretations made while analyzing survey results. Potential alternatives are considered, and the strength of the claims made based on the adopted interpretations is assessed. I also consider some of the questions that arise from the responses.

6.1.1 Acceptance of the Support Tool

I interpreted requests for more information and features as indicating that the support tool was accepted, and that respondents would like to see more of the same. But, other interpretations are possible. The fact that the purpose and presence of the tool were essentially taken for granted, and that it was the information contained, or the features available that were the primary topics found in the responses, could indicate that the respondents viewed this kind of support as natural. Its provision online was not questioned, nor were its motivations or purpose. Some responses indicated that the tool should be integrated with an online participation platform, echoing design intentions. Integration necessitates the presence of both the participation platform and support tool online, so this lends further support to the notion that the tool is viewed a natural online utility.

However, the lack of responses questioning the purpose, utility, or existence of the support tool could also indicate faults with the survey instrument. Although the instrument was pre-tested in a

pilot survey, the primary feedback from this was that the questions were repetitive and excessive. The survey was re-worked in response to this, and the new instrument was not pilot tested, but rather immediately used in the survey. This was done in order to respect timelines and avoid exhausting respondents' willingness to participate.

As it turned out, numerous survey responses did not directly answer the questions posed. Some respondents were very focused on repeating what they thought the tool was missing, while others focused on suggesting planning alternatives. In either case, this indicates that the survey instrument was not perfectly tuned. It is possible that this is the reason no respondents questioned the underlying motivations for constructing such a tool, or the need for it.

On the other hand, the questionnaire was written to expose these possible weakness from a number of different angles. This included questions about what else would help, which resulted in responses mainly concerned with more information. It also included questions about whether the user could identify specific things such as alternatives or problems that would indicate that they had absorbed material from the tool, which they could. This deliberate intention in the questionnaire structure makes it possible that the implicit acceptance of the tool as natural indicates that it may indeed have a place.

Unfortunately, because there is some ambiguity, the present research cannot conclude decisively on this point. As such, further testing is suggested. This should be done once the bulk of the responses requesting further work have been addressed, and the tool has been fully developed to the design specifications. In this case, further evaluation would represent another iteration of the design-test cycle. Once this is done, the survey could then be structured differently, to further

draw out the true value or lack thereof of the support tool. Upon full development, integration into a participation platform would be completed, so surveys focusing on the participation platform could then include questions about whether the supporting information had been utilized, and how. If participants had noticed and made use of the support, it would imply that the support had an impact and was useful. This type of indirect questioning might prove to be a better evaluation than simply asking if users felt the tool could help them. A test such as this would provide a good cross-check as to whether the support tool could benefit users.

6.2 Further Implications of Requests for Additional Information

The requests for additional information have further implications for the research. A number of responses indicated some desire for more support, or skepticism related to the claims surrounding sustainable alternatives. This section explores the implications of these lines of response.

6.2.1 References and Support for Tool Claims

Many did not see the “References” link in the sidebar. This could be because the text was too small, or too far from the information being considered. It is also possible that users expected each strategy to have a reference link within the strategy text. Because of this, it is recommended that supporting information be more closely integrated with the related claims.

One possible solution to this is to place the relevant reference link in the strategy. When clicking through a module, each clickable sub-picture and strategy text could contain beneath it a link to the supporting literature. There are two likely problems with this approach, however. Firstly,

since the modules were primarily based on a small number of reports concerning one set of models and each sub-item would refer to the same model, nearly all source links would be the same. As such, it would be somewhat redundant to continually re-present the link. Secondly, and more importantly, the literature could be too dense for the intended user, and some of the literature requires payment as it is copyrighted.

As such, it is recommended that an interim step be developed, detailing the “numbers” or other support, from the related literature in a simple and straightforward way. This would be the supplemental material revealed if a user clicked on “more information” links. If the user desired still more information, a link to the relevant study or studies would be provided following this.

Adding another level of depth in terms of supporting material would add another level of complexity to the tool. It would essentially add a fourth scale to the conceptual design model. The fourth scale would deal with scope, and would range from surficial introductory information about each planning alternative through brief descriptions of impacts, in-depth treatment of the supporting information, and finally to source literature. In addition, it would be necessary to add a table to the database to house the additional support level envisioned. The physical architecture of the tool would likely be unaffected, as the PHP and SQL methods currently employed could simply be replicated.

6.2.2 Objections

It is also possible that efforts to develop responses for users objecting to sustainability would have little effect. This is suspected because the objections raised were not always commensurate with the information that spurred the objection. For example, an objection related to costs

savings was raised: The respondent pointed out that despite billions in potential public savings on publicly provided services in a compact scenario, these savings might be offset by the increased costs to build taller buildings. Firstly, this compares public and private expenditures. Secondly, considering the relatively low height of the majority of residential buildings expected in the compact scenario (apartments 4 stories and under make up the bulk of the predicted housing stock), and the relative costs of multi-family housing units versus single-family units, it is likely that these costs would not be prohibitive.

Objections like these could be due to the fact that this type of order-of-magnitude assessment is not within expected users' comfort zone. In this case, the tactic described above in section 6.2.1, would likely help users assess this type of discrepancy. That is, providing more detailed information in support of claims, would help users critically examine their own objections.

However, it is also possible that objections such as the one described above suggest that some may raise issues reflexively, out of habit, and using information of dubious relevance. In this case, they may not be influenced by further explanation and supporting information. If this is the case, their resistance may stem from other areas, such as value conflicts (Leiserowitz, 2006), fear of lifestyle changes (Smil, 2005, Chapter 6), or an unwillingness to consider overcoming habitual and structural impediments (Leiserowitz, 2006). Making these unspoken conflicts explicit (as designed), could do more to help address objections than information specific to the objection itself.

In addition, it seems many simply didn't believe what was being presented, and were suspicious of bias and unstated downsides of the strategies and impacts presented. It is true that

sustainability is emphasized in the tool. However, this is due to its being emphasized in urban planning, by the United Nations, and by other multi-national organizations, as outlined in the literature review (for example, Hodge & Gordon, 2008; ICLEI European Secretariat, 2011, 2011; UN World Commission on Environment and Development, 1987; United Nations Environment Programme, ICLEI, & EPA Victoria, 2002).

This suspicion of bias raises interesting questions about how the public understand lack of bias and balanced examination of issues. In general, simply noting the “sides” of an issue without considering other factors would likely lead to oversimplification and polarization. Simply looking at two sides of an argument does not consider how many facets there might be, what vested interests might be present, what metrics might not be considered, which position might carry more weight with a majority of experts, whether the argument asks the right (or all) the questions, etc.

However, questions surrounding the nature of public understanding of conflict within issues are beyond the scope of this research, although they would certainly be interesting lines of inquiry. The current work is restricted to managing any potential effects of this in the support tool. The design accounts for this with information about strategies’ impacts, and with numerous presentation styles geared at different communication preferences. In addition, it could be addressed with the provision of further support as discussed above.

On a broader scale, these kinds of objections point to one of the chief challenges of the support tool. Objections raised in person with experts can be more easily addressed, as the expert simply accesses the pertinent information from their own experience, and explains it. As the objector is

present, the fit of the explanation can be ascertained by the objector's reactions and further objections. However, the online tool cannot react to a user's look of confusion, skepticism, or dismissal. As such, it cannot judge whether the objection is inquisitive or dismissive. In addition, for the information relevant to an objection to be presented, it must be accessible to the tool. Not all objections can be thought of and prepared for in advance.

However, similar objections that tend to be raised over and over could be addressed. The tool could collect information concerning objections. To do this, the "suggest a strategy" text box could be paired with a text box asking for concerns or questions to gather information about typical objections. Objections could then be stored in a database table as strategy suggestions are now. Common objections could be identified, and responses crafted and added to the tool. This capacity could be added upon further development of the tool.

Finally, when the support tool is paired with a participation platform, general discussion and comment topics could be used to find common objections. This could potentially be done using similar algorithms to those currently used by social media sites such as Facebook and Twitter to identify trending topics.

Until these functions are developed and begin to generate information about common objections, the objections most commonly raised in the survey can be addressed in future development as a stop-gap measure.

6.3 Chapter Summary

This chapter discussed research results and addressed the validity or trustworthiness of the claims made. The research was examined according to design science requirements to demonstrate that it meets the requirements of the method. I then discussed the reliability of survey results, and performed a critical review of my interpretation of them.

I claim that the results show that the support tool, as designed, is an effective solution to the research problem. The discussion above establishes that the research meets the requirements of design science research, and can be judged positively against design theory criteria. It also shows that my interpretation of survey results can be considered reasonable, based on triangulation between survey questions, between evaluation methods, and between results and expectations derived from the literature. Thus, it appears trustworthiness is achieved to the extent necessary for this research. That is, based on the methods used, it is reasonable to state that the results reliably reflect the utility and appropriateness of the tool for its purpose.

Chapter Seven: Conclusions

This chapter presents the conclusions of the research, discusses its limitations and contributions, and suggests areas for future research. A short summary of the research problem, methods and findings is first presented to situate the concluding discussion. Following this, conclusions are drawn from the findings. Essentially, the research goals were achieved and the purpose is satisfied. This confirms the hypothesis that support and feedback can be effectively provided to online participants in urban planning by a web-based utility. The limitations of the research are then discussed in order to clarify what can and cannot be claimed. Next, the contributions of the research are detailed, including both practice-based and academic implications. Finally, directions for future work are explored.

7.1 Summary of Findings

7.1.1 Research Problem and Method

The research began with the purpose: to address the issue of lack of face-to-face feedback in online participation, in order to support online planning participants, especially in their use of sustainable development concepts and techniques. This resulted in the hypothesis that providing participants with accessible and meaningful information about sustainability and related issues, sustainable urban development, urban planning, and potential development impacts, would help provide some of the missing feedback and support. As such, the research objectives include developing a tool to provide lay participants with support when engaging in urban planning via online avenues, and testing the tool to determine its suitability for the situation and provide

direction for further development of both the concept and the support tool. To address the problem and test the hypothesis, the following goals were developed:

1. Improve participants' knowledge of relevant issues;
2. Improve participants' understanding of sustainability and sustainable urban planning;
3. Provide participants with information about the range of possible land development strategies and patterns, and their potential impacts;
4. Improve participants' comfort level while participating online in urban planning; and
5. Empower participants to engage in urban planning online.

A review of sustainability, sustainable urban planning, participation, and related work in participant support provided a conceptual foundation. Further, it indicated (among other things) that providing online support to the public requires familiarization with their mindset and needs. Understanding the public mind-set can help devise a way of communicating about sustainability and urban planning such that the message is meaningful, relatable, and useful to participants. Thus, additional review was undertaken to uncover public understandings of sustainability and related issues, local planning priorities, stakeholder requests for a participant support tool, and strategies for expanding public understanding of sustainability. This helped frame the problem environment and yielded numerous tool requirements.

The research was undertaken pragmatically, and adopted design science for information systems as the research methodology. Within design science, description, testing, and experimental evaluation by survey were used to evaluate the artifact created.

7.1.2 Support Tool

A design science artifact was created in the form of the support tool design. This was presented beginning with the problem construction, followed by the tool's conceptual design, and finally, the design components. The problem is constructed as societal or situational, rather than organizational. This results in different motivation and support structures among users, and as such, has important implications for the artifact design.

The conceptual design consists of a planning forum, made up of four types of planning scenarios (existing, planned, user suggested, and potential alternatives). These are examined along four different continuums: reductionist to holistic, block-level to regional, and short-term to long-term, as originally designed, and highly-detailed to general in scope, as suggested by survey results. Six examination perspectives complete the forum: environmental, social, and economic angles within sustainability; and regulatory, business, and emotional views on planning or decision-making perspectives. The conceptual design is completed by sets of tool properties (such as engaging and inclusive), and tool functions (such as analysis and visualization).

The design components render the conceptual design more concrete by listing tangible items to be included in a support tool. A list of developable components further solidifies this by listing items that can be immediately developed into an instantiation. These are grouped into four categories: visual triggers and aids, site features, specific information, and framing strategies. Both lists are extensive and can be found in Chapter 4. As such they are not repeated here.

A prototype of the support tool was constructed. Design components were selected for development based on their ability to reflect the design vision. Three modules were selected to

provide the informational content around which to build the components. The prototype was evaluated by two methods: Firstly, testing ensured the prototype functioned as intended. Secondly, experimental evaluation by simulation, via a survey, was employed.

7.1.3 Evaluation by Description

Descriptive evaluation of the support tool design indicated that it addresses the numerous requirements of the problem situation and research goals, suggesting that the tool is an effective response to the research problem.

The design includes numerous informational components, which provide wide-ranging information about planning alternatives from a number of perspectives and at a range of scales. It also includes information about the need for resource management, potential costs, levels of cooperation and expert agreement, and collective interests and values involved. These satisfy the first research goal.

To achieve the second, the tool presents information related to sustainable urban planning as well as issues within it. It is designed to examine from the perspectives of three spheres of sustainability, as well as taking holistic and long-term views, both conducive to sustainable thinking. In addition, it incorporates numerous specific tactics designed to expand understanding of sustainability, including the emphasis on values and the collective.

The tool is primarily designed for, and centres on, the examination of planning strategies from different viewpoints and scales, thus meeting the third research goal.

As for improving comfort levels, the design emphasizes presenting useful information such that participants feel informed and versed in the types of issues and terminology often present in urban planning. It strives to introduce no new discomfort in the way of difficulties with operating the tool or understanding the information. Finally, it permits tailoring the experience to the scope of the issues that the user is willing and able to digest at the moment. All of these are intended to help the user feel more comfortable.

The fifth research goal, empowering participants, is met in part through increased comfort level, as well as through the ability to share content, the encouragement to do so, and acknowledgement of contributions. Integration with a participation platform will reinforce these. Topical information and visual depiction of possibilities are used to increase interest. These tactics are all intended to empower the individual by addressing perceived lack of ability, generating enthusiasm, and providing the gratification of recognition.

7.1.4 Prototype Evaluations

The prototype survey revealed that respondents viewed the tool as useful – 83% agreed or strongly agreed to a series of perceived usefulness questions. Since perceived usefulness is correlated with adoption of IT (Davis, 1989), this indicates that a similar proportion of participation platform users are likely to make use of the support functions offered alongside. In addition, 58% of respondents reported they found the tool was easy to use.

Long answer questions garnered a number of positive and negative responses. Most negative responses indicated a desire for more features or information, or a general feeling of disempowerment. Positive reflections indicated that the information and features that were

provided were appreciated, and that the tool helped users feel informed, confident, and more inclined to contribute to planning.

Survey respondents noticed numerous informational elements, indicating that the three research goals related to information (#1, #2, and #3) are addressed, as users noticed these items and repeated them with a favourable tone. Addressing these research goals also speaks to the research purpose concerning lack of information.

The survey also indicated that the tool improved comfort levels, and contributed to empowerment. Some statements noted that users found comparison and assessment easy, which indicates a certain level of comfort. Others indicated that the tool generated confidence, made respondents feel more informed, and would make them more likely to engage in urban planning. Answers such as these indicate empowerment. These findings also suggest that the research purpose to support participants is addressed.

Further, responses indicated that the prototype stimulates thinking and helps with prioritization, addressing the desire to facilitate a high calibre of engagement. The design environment constraint requiring inclusiveness has also been addressed, as responses mentioned that the prototype appeals to experienced and new users.

The utility, effectiveness and novelty of the tool, as well as the persuasiveness of these claims, were demonstrated in the results, then tested and verified in discussion.

7.2 Contributions

The research contributes a support tool design and prototype, which can help residents engaged in local urban planning via online channels, and that is structured to respond to public understanding of planning, sustainability, and related issues. The tool operates in a new context. In addition, I have tested users' responses to the new tool. This testing has provided feedback on the tool, and users' needs respecting this type of tool in general. The sections below explore the contributions of the tool, evaluations of its effectiveness and utility, and users' responses to it.

7.2.1 Support Tool Design

As an instance of the use of design theory/science, the research solves an important and relevant problem (Hevner et al., 2004). In addition, throughout the process of building the assessment tool, knowledge and understanding of the problem were improved, enabling the utility of the proposed approach in solving the problem to be assessed (Gregor, 2006; Hevner et al., 2004). This in turn provides the potential to build upon the tested solution based on that improved understanding and the assessment of the solution.

This tool responds to calls for support (Edmunds & Wollenberg, 2002; Kellon & Arvai, 2011; Poplin, 2012; Schwilch et al., 2012) and addresses some of the conditions applied. For example, the tool design responds to Kellon and Arvai's (2011) recommendations toward strong decision support (though without taking on the charge of supporting specific decisions but rather supporting participants' decision making in general), by providing assistance determining the impacts of planning strategies and alternatives. It produces a tool for the public participant in online planning, complimenting the body of work that supplies these tools either for experts or

for single issues (Code for America, 2013; Condon et al., 2009; Foth et al., 2009; Mackenzie et al., 2006; Poplin, 2012).

In terms of contribution to the literature, this tool complements the set of tools already available, by filling a gap in function and audience through support for online lay participants. This contributes to the body of literature concerning support and engagement tools in general. Thus, the research can be of value to researchers who wish to evaluate participant support and decision aids exercised in new situations.

The tool complements the body of literature surrounding in-person support (Rambaldi et al., 2007; Tippet et al., 2007), by adding an online alternative to the discussion. It does so without the need for an expert presence online (though it does not preclude this possibility). This is beneficial since experts may be reluctant to involve themselves in online participation tools (Bamberg, 2013), and since at any rate their presence would not be available at any time (and asynchronous availability is one of the primary benefits of online support (Bliss-Taylor & Hunter, 2012a)). For example, the tool may be of value in the field of PGIS, as researchers in that field may wish to examine the utility of online support in addition to in-person support (with the exception of process in locations where Internet access is limited).

In practice, the tool can provide a service to users, as it can support their participation online in urban planning. If adopted, the tool could also contribute to sustainable development in the communities where it is adopted. For one thing, it aids participation, an important element of sustainability (Hodge & Gordon, 2008). For another, it could result in participants being more receptive to sustainable alternatives proposed by professionals (Schwilch et al., 2012). The tool

may also be useful to professionals in planning, should they choose to adopt online participation as part of their engagement, in that it can help provide support to their participants, thus facilitating the engagement. Essentially, the tool provides a more supportive online participation environment for lay users, and a potentially easier engagement process for professionals.

If, as some survey respondents indicated, the tool encouraged people to contribute to planning, it could temper criticisms that participation only attracts extreme views, as the proposed solution to this is calls for more widespread participation (Fiorina, 1999). Despite the limitation that some do not have Internet access, facilitating and supporting online participation has the potential to broaden access to participatory opportunities, thus acting toward equalization of marginalized communities (Chambers, 2006; Elwood, 2006).

7.2.2 Confirmation of Feasibility

The research also provides confirmation that this kind of feedback and support can be provided by an online utility. In terms of the literature, this confirmation responds to the identified research gap (Kellon & Arvai, 2011; Mackenzie et al., 2006; Schwilch et al., 2012; Tippet et al., 2007). Essentially, the literature says little about online support for lay urban planning participants, beyond indicating that support was necessary (Kellon & Arvai, 2011; Kilinc & Aydin, 2011; Laurian, 2003; Lefsrud & Meyer, 2012; Leiserowitz, 2006; Reid et al., 2009; Reid & Petocz, 2006; Schwilch et al., 2012; Zeemering, 2009). My research shows that the support can be provided in an online participation environment. This essentially introduces the tool as a viable solution, and provides claims to respond to. For practice, this provides the grounds to use the tool, and the knowledge about how to deploy it and what to expect.

7.2.3 Survey-Based Indications of User Needs

User needs were investigated in Chapter 3 in order to design the tool. However, the profile was developed based on numerous studies in related environments (Kilinc & Aydin, 2011; Leiserowitz, 2006; Reid et al., 2009), rather than based on directly related responses to an online support tool. The current research provides this type of feedback through the prototype evaluation survey. This contributes knowledge upon which to further develop the existing design, to create new designs, or to develop new ideas about online participants' needs in general.

7.3 Future Work

A second design-test iteration is recommended based on the results of the work. This should include further development, to expand the prototype to include the full list of developable components (see Figure 4.3, Chapter 4). The resulting tool would be integrated into a participation platform, as requested in survey responses, as well as including more information and features, also requested.

To complete the design-test iteration, the tool should be evaluated again upon full development and integration. It is recommended that further evaluation of the tool should be in the form recommended in discussion (Chapter 6): a survey concerning the participation platform, which would include questions concerning whether the support tool was used and considered helpful by participants.

In addition to fully developing the existing design, a number of specific and additional requests arose based on survey results. These have been discussed previously, and as such, they are simply re-iterated as a consolidated list here:

1. Ease-of-use should be emphasized in any further development, such as by removing pictures from the banners (which confused some users), or being clearer about which pictures unroll strategies when clicked. This may also include using pictures rather than text in the “Different Styles of Urban Planning” to provide consistency of style.
2. As the concept has been proven through the first design-test iteration, technological improvements can now be considered. Speed should be emphasized, especially in AJAX sequences.
3. The addition of the scope scale to the conceptual model, and the addition of another level of information containing more detail, to further support the claims made in the tool. This will require changing the database structure.
4. Provide more information concerning the urban planning and participation process, information about specific proposals and decision-making timelines, and participation timelines, deadlines, and event reminders.
5. Information about how to participate, including where and how to engage in planning, and notification of participation opportunities.
6. Information about the reasons behind current decision-making, and the trade-offs made in sustainable alternatives suggested.

7. Presentation of information in more ways, such as at more scales, especially local, or making more use of comparison, especially with other cities and case studies. Greater interaction with the information, such as with sliders and polls, games and video clips.

Finally, the research raised questions about the thought and evaluation processes of lay participants. Many of these were explored in the Chapter 3 literature review (see, for example, Ding et al., 2011; Leiserowitz, 2006; Reid et al., 2009). However, the survey responses raised questions that were addressed by the literature reviewed. This included questions about potential thought processes behind objections to sustainable initiatives, and the implications of these concerning the way conflicts are viewed and evaluated (see Chapter 6). It further raises questions about how online utilities should respond to objections. Inquiring as to whether some members of the public examine the multiple facets of complex issues too simply, and potential implications and effects of this would be an interesting line of inquiry, as would uncovering potential strategies to avoid this tendency if indeed it does exist.

7.4 Chapter Summary

A support tool designed to help lay participants engage in urban planning online, at high levels of participation, was constructed and evaluated. On the whole, the descriptive and survey evaluation results indicate that the support tool can empower, improve participant comfort levels, provide information about planning strategies, and improve understanding and knowledge of sustainability and related issues. Results also indicated that 83% of respondents found the tool useful, and as such would be likely to use it while participating in planning online. This satisfies the research goals, which in turn addresses the purpose of the research.

These evaluations indicate that the tool provides participants with accessible and meaningful information about sustainability and related issues, sustainable urban development, urban planning, and potential development impacts. The survey further demonstrates that the tool can help provide some of the missing feedback and support.

As such, it is possible to conclude that the support tool, as designed, and with the additional elements requested from the survey, can provide some of the missing feedback and support in online participation. This confirms the hypothesis that it is feasible to provide this kind of support online.

The above chapter concluded the research by first summarizing the research problem, methods and findings. Based on these, the contributions of the research were detailed, including both academic and practice-based implications. Then, directions for future work were explored based on the research findings, including suggestions for further tool development, and questions as to the thought and evaluation processes lay participants employ. The scope and limitations of the research were then discussed in order to clarify what can and cannot be claimed.

Following this, conclusions were drawn from the findings that indicated the achievement of the research goals, satisfaction of the purpose, and confirmation of the hypothesis that support and feedback can be effectively provided by a web-based utility to online participants in urban planning.

The principal implications of the research findings are that this kind of support and feedback is feasible for online urban planning participation. As a result, this type of support, or the support tool as designed, can be reliably, and should be, adopted in practice.

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Appendix A: Prototype Survey Instrument

Please note that by completing or partially completing the survey, and by selecting "Agree", below, you are indicating your consent as a participant in this research study.

The purpose of this survey is to determine if the Support Website could be useful to potential online planning participants. The research is part of a larger study, the purpose of which is to build a comprehensive online tool that lets residents be involved in community planning online.

Participation consists simply of filling out the web-based survey that follows this message. The survey is anonymous and collects no identifying information.

Participation is voluntary; you may withdraw at any time. Any data collected prior to your withdrawing will be retained for use in the study (as your anonymous survey will not be identifiable for removal).

Results from the surveys may be reported in academic journal papers, at academic conferences, in student theses, or in project reports.

Surveys will be stored indefinitely at the University of Calgary in the student's or the principal investigator's office. Results transcribed electronically will be stored on secure servers. Because the survey is hosted by toofast.ca, data will be stored on their servers. Toofast.ca's servers are located in Calgary, Alberta.

The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study.

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Survey: Support Website Survey

Question 1

Have you participated in urban planning in the past? That is, have you been involved in urban planning or development projects by either attending public meetings, writing letters to private or public officials, or offering your opinion or knowledge either in person or online? This could be in either your smaller community, on a city-wide basis, or in a larger region.

☐ Yes ☐ No

Question 2

Please describe the extent of your participation.

Please click the following link to the Support Website, and spend some time browsing and clicking through the site: [Support Website](#)

Then, return to this survey and answer the questions below based on the Support Website.

Question 3

Please rate the following statement:

"Using the support website while participating online in urban planning would enable me to accomplish tasks more quickly."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 4

Please rate the following statement:

"Using the support website would improve my online planning efforts."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 5

Please rate the following statement:

"Using the support website would allow me to do more while participating online in urban planning."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 6

Please rate the following statement:

"Using the support website would allow me to be more effective when participating online in urban planning."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 7

Please rate the following statement:

"Using the support website would make it easier to participate online in urban planning."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 8

Please rate the following statement:

"I would find the support website useful when participating online in urban planning."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 9

Please rate the following statement:

"I find the support website easy to use."

☐ Strongly Agree

☐ Agree

☐ Neither Agree or Disagree

☐ Disagree

☐ Strongly Disagree

Question 10

What features and information stood out most in the support website, and why?

Question 11

While browsing the support website, what did you learn about urban planning options and impacts?

Please describe.

Question 12

After browsing the support website, would you be more likely to suggest sustainable strategies while participating online in urban planning?

Why? / Why not?

☐ Yes ☐ No

Question 13

If so, which sustainable strategies would you suggest? What would you predict their impact would be?

Question 14

What would make you more inclined to suggest sustainable initiatives in your community or city?

Question 15

Would the support website help you chose between alternatives in urban planning?

Question 16

Would the support website help you identify problems in local urban planning?

Question 17

Would the support website help you participate online in urban planning?

Why? / Why not?

☐ Yes ☐ No

Question 18

Would the support website make you feel more comfortable participating online in urban planning?

Why? / Why not?

☐ Yes ☐ No

Question 19

What, if anything, would make you feel more comfortable participating online in urban planning?

Please describe.

Question 20

What additional information, if any, would help you participate online in urban planning?

Question 21

Would having this support website available make you more likely to participate in urban planning?

Why? / Why not?

☐ Yes ☐ No

Submit

Like

7

Share

7

8+1

2

Best viewed at 1024x768 or greater • AJAX compatible browser required (IE7/Firefox 3.5 or greater)

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Appendix B: Relationship of Prototype Survey Long-Answer Questions to Evaluation Metrics

Question	Question Text	Reason for Asking	Metric
10	What features and information stood out most in the support website, and why?	Checks for retention of information	Retention of information
		Checks for most noticeable features and information	Engaging features and information
		Opens survey with an easy question	
11	While browsing the support website, what did you learn about urban planning options and impacts? Please describe.	Checks for retention of information more specifically	Retention of information
		Checks for comprehension	Comprehension of information
12	After browsing the support website, would you be more likely to suggest sustainable strategies while participating online in urban planning? Why? / Why not?	Check whether the support website prototype and information contained would make a difference in users understandings of sustainability	Understanding of sustainability
			Behaviour change
13	If so, which sustainable strategies would you suggest? What would you predict their impact would be?	Separate check of what information was most noticeable	Engaging features and information
		Check if users absorbed any information about potential impacts	Retention of information
			Understanding of impacts
14	What would make you more inclined to suggest sustainable initiatives in your community or city?	Check for missing information in the prototype to highlight through contrast how the information in the prototype was absorbed and understood	Retention of information
			Comprehension of information
			Deficiencies
		Understand what and what types of information are considered useful for future work	

Question	Question Text	Reason for Asking	Metric
15	Would the support website help you choose between alternatives in urban planning?	Check whether the prototype would help users participate in urban planning	Level of support
16	Would the support website help you identify problems in local urban planning?	Check whether the prototype would help users participate in urban planning at a high level of engagement	Level of support
17	Would the support website help you participate online in urban planning? Why? / Why not?	Directly check whether the prototype would help users participate in urban planning online	Level of support
18	Would the support website make you feel more comfortable participating online in urban planning? Why? / Why not?	Directly check whether the prototype would improve participant comfort level while engaging in urban planning online	Comfort level
21	Would having this support website available make you more likely to participate in urban planning? Why? / Why not?	Check whether the prototype could have an empowering effect on users	Level of support
19	What, if anything, would make you feel more comfortable participating online in urban planning? Please describe.	Check for missing information and features	Retention of information
		Check for the types of things that can increase comfort level for future work	Comfort level
		Shed light on what does increase user comfort level through contrast	Comfort level
			Deficiencies
20	What additional information, if any, would help you participate online in urban planning?	Check for missing information, features, or conceptual ideas in the prototype and support tool theory, for future work	Retention of information
		To highlight design and concept deficiencies	Deficiencies
		To understand through contrast what did contribute to the research goals	
		End the survey with a catch-all question in case respondents had any comments left	