The Ethical Smart City Framework & Toolkit: An Inclusive Application of Human-Centered Design and Public Engagement in Smart City Development

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Abstract. The Ethical Smart City (ESC) framework and toolkit were developed in direct response to municipalities interested in transforming into inclusive, sustainable smart cities but did not know how to begin. Presented here, the developed online ESC toolkit and virtual workshop are novel methods for data collection, analysis, and impact assessment for smart city projects. This paper documents our approach and findings for developing the online public engagement tool and its execution, the workshop, for the co-design of smart city projects. We evaluate both the toolkit and workshop using usability heuristics and discuss how the heuristics achieve the three characteristics of an Ethical Smart City workshop.

Keywords: Smart City, Co-design, Participatory Design, Public Engagement, Smart City Framework, Smart City Development

1 Introduction

Information Communication Technology (ICT) is changing almost every aspect of our lives. This places great emphasis on the opportunities for increased quality of life, education, employment, and general prosperity [1]. DiMaggio et al. [2] point out that the internet is changing society with little agreement amongst researchers about what those changes are. It is uniquely capable of integrating modes of communication and forms of content. Subsequently it will have a wider impact on society (i.e., moving from an industrial to information society) [3]. What does this transformation mean for society and how can we prepare the existing infrastructure to not only accept but also benefit from these technological advancements?

Smart cities promise a drastic change to how we will live in the future. The smart city is defined as “the effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its residents” [4]. The introduction of technology to city services and infrastructure is assumed to solve city challenges. Automated garbage collection, snow-melting sidewalks, self-driving taxibots, and park benches that capture air quality are amongst many smart city projects that are promised. Despite this promised utopia, there are huge clouds of doubt and mistrust amongst members of the public, lawmakers, and urban planners. The role of the community in city-building and urban solutions has

become secondary to technology projects and the relevance of these solutions is only tested or confirmed once they are implemented. Early smart city developments have often been top-down approaches, influenced by technological industry giants advertising the latest technology [5]. Greenfield observes that the promise of 'perfect', clinically efficient cities is reduced to over-simplified data-driven ideals that do not take citizens into account [6]. Interviews with smart city experts corroborate the use of irrelevant technology solutions and highlight their associated issues with inequity and privacy [7] as the main problems created by smart cities today [8].

The impact of smart city solutions not only affects city infrastructure and operations but also how people live their everyday lives. Smart city solutions impact availability of services, community interaction, and inclusive access to public services. In Hoehner et al.'s [9] approach for designing health-promoting spaces, urban planning and public health professionals joined forces to develop a new framework to create active community environments. This framework lacked public engagement as it included gathering research but failed to further involve communities in the development process. Contemporary smart city discourse argues for a focus on the citizen [10] yet in reality still employs top-down 'citizen engagement' practices that fail to achieve true inclusion and engagement [11,12]. That said, smart cities in developed countries are slowly shifting their focus from technical indicators and instead learning to evaluate social impact [13]; taking into account their community's needs [14]. For cities to implement human-centered, smart city solutions, they must understand said needs, first. This highlights the shift in the smart city paradigm toward the need for citizen inclusion, engagement, and active participation in the decision-making process, such as participatory design or co-design, in smart city development [15,16,17]. On the one hand, achieving true engagement and co-design is difficult and Frame's analysis of Auckland, NZ, reiterated that cities' unguided attempts "will involve highly `messy' approaches...that require lengthy forms of engagement which may not result in convenient consensus-based results with single lines of action but will result in far 'clumsier' solutions," [18]. On the other hand, efforts to design smart city solutions may not reach true co-creation, regardless of attempts to de-silo the process. Nevertheless, smart cities must shift their governance toward the citizens because communities need sustainable and resilient solutions [19].

Despite these commonalities in smart city development needs, building smart city solutions is not linear nor prescriptive. There is no clear starting point for cities, as seen in Mora et al.'s [20] discussion of four dichotomous frameworks in smart city approaches: (1) technology-led or holistic thinking, (2) double or quadruple helix, (3) top-down or bottom-up, and (4) mono-dimensional or integrated intervention logic. Further evidence of the dichotomies emerged in the review of over 100 case studies of existing smart cities [21]. The smart urban governance framework, which aligns with the current smart city paradigm, argues for socially conscious, 'smart' solutions which must be context-specific and tailored in response to 'urban' issues [22]. However, without a clear starting point, municipalities must navigate building smart city solutions on their own. Cities are left to create smart city projects in an ad-hoc, and sometimes inefficient fashion, without a clear method for gaining consensus. Left to navigate initiation of important and expensive smart city projects, cities may spend much of their time and resources on developing a suitable approach to these projects.

Frame [18] highlights that "the level of commitment in terms of time and energy and the hazards of messy approaches should not be underestimated." What cities need is a clear, flexible, guiding framework for equitable inclusion, open participant engagement, and consensus building so they can efficiently and effectively focus their resources on smart city solution building.

This paper presents the ESC framework that city planners can adopt to engage effectively with community members to derive sustainable smart city solutions. The objective of this paper is 1) to demonstrate the application of the ESC framework, 2) to evaluate the usability of such a framework, and 3) to provide best practices in effective user engagements and consultations.

2 Study Context

The 2019/20 Institute without Boundaries (IwB) cohort of post-graduate students in the Interdisciplinary Design Strategy program at George Brown College (Toronto, Canada) first investigated the current landscape of international smart city development. To explore possible answers to the question of how to create more resilient, sustainable, inclusive smart cities, a series of secondary research activities ensued. First, 100 case studies [21] were compiled and succinctly presented in a digital publication. Cities and communities from six of the seven continents were analyzed to gain an understanding of smart cities, how they were established and operate today, to provide insight and foresight into the future of smart city building. Another set of case studies was presented in the Ethical Smart City Playbook [8], digitally published in May 2020, as precedents for the stages of the Ethical Smart City Framework.

To deeply understand how equitable participant inclusion, open participant engagement, and consensus-building are essential for creating ethical smart city solutions, primary research and gathering of first-hand accounts in smart city building were imperative. This research took the form of several project initiatives such as an exhibit, interviews, and workshops. A participatory exhibit, Playroom.TO, was open to the public as part of the DesignTO festival in 2020, for Toronto community members to interact with the elements of the Ethical Smart City through gameplay. The exhibit was a litmus test and provided insight into how the public understood and interacted with an early iteration of the ESC Framework. The results of the exhibit were then fed back into the ESC's conceptual reframing. For detailed accounts of their unique experiences including pain points when initiating smart city projects and bringing them to fruition, students interviewed 6 smart city project leads from the Canadian municipalities of Hamilton, Mississauga, Caledon, Kelowna, Markham, and Stratford and 9 smart city experts. Workshops such as the Ethical Smart City International Charrette in February 2020 were a source of insight into how smart cities can be made more ethical, equitable, and sustainable through human-centred, interdisciplinary design. A suite of resources was launched in May 2020 to help municipalities interested in developing resilient urban environments define and implement tailored Ethical Smart City solutions.

2.1 An Ethical Smart City

Interviews with smart city experts clearly show that municipalities are committed to solving community challenges and are open to using technology to solve them. They highlight common steps when sharing their past projects – (1) define principles of the community, (2) prioritize problems to solve, and (3) identify the best solutions [8]. Starting with a community's principles allows experts to use them as navigators, ensuring a range of stakeholder requirements and long-term impacts are considered. A focus on ethics to incorporate community values as part of a core strategy is another gap that was identified. Our research has found no existing guides or tools that specifically equip municipalities to empower communities, embed their values into smart city planning, and co-create smart city solutions. With a clear need for an accessible, standard process for smart city-building that allows flexibility for use by different municipalities and guidance for effectively engaging communities, the 2019/2020 IwB cohort responded with a solution that was influenced by the human-centered design thinking process. The result is a set of guiding principles to define the Ethical Smart City, a framework, and a toolkit for municipalities to confidently and effectively begin a smart city project.

We define the Ethical Smart City through four guiding principles outlined in Figure 1. The principles serve as the baseline to define what is ethical in smart city development, to enable the community's values to be prioritized in the design, planning, and implementation of smart city projects, and consequently to facilitate the potential long-term impact of sustainable and ethical Smart Cities.

Fig. 1. The Ethical Smart City guiding principles.

2.2 The Ethical Smart City Framework & Toolkit

Broken into five major steps, the ESC framework guides municipalities to co-create solutions with their communities. It is a strategic and iterative process, which leverages the communities' values to develop solutions that address their challenges. Every step allows for the evaluation of its generated outputs, creating multiple feedback loops within the framework. The output from each step feeds into the next, which enables the co-creation of ethical, sustainable, inclusive, and intelligent solutions with and for communities. Once the five–step process is completed, lessons learned from implemented projects are fed back into the first step to reinforce the ethical baseline for the municipality's future and ongoing smart city projects. The framework's five-step process is described in Appendix A.

The ESC toolkit was created as a tangible product to aid municipalities in applying the ESC framework to create Ethical Smart City solutions. The initial research, process, and development of the ESC framework and toolkit were published on the ESC website and in the Playbook [1]. Further testing, outlined in this paper, provided an opportunity to develop and iterate the toolkit based on its intended use in an online form. There are six tools; the first five are for each step of the framework and the last is a 'report card' to use as a dashboard and final assessment. These tools are designed with essential prompts and specific activities (e.g., systems mapping, foresight, evaluation criteria) to guide municipalities to co-create strategies for tailored smart city solutions while empowering members of the community. For a closer look at a sample of the latest iteration of the first and last tool of the toolkit, please refer to Appendix B.

3 Methods

In the fall of 2020, understanding that the project had the potential to guide municipalities to begin Ethical Smart City development through human-centered design practices, the project was funded by a grant through the Social Science and Humanities Research Council (SSHRC) Partnership Engage program. This allowed for further testing and refinement of the existing ESC framework and toolkit in the 2020 Unexpected Solutions Conference, hosted by our project partner, Evergreen, Toronto. This included four stand-alone, 2-hour workshops titled "Let's Create an Ethical Smart City." The workshops were used to test usability, determine best practices, use participatory design to redesign a novel method of data collection, and ultimately, understand the toolkit's ability to foster equitable inclusion, open participant engagement, and consensus building when creating smart city solutions.

Through these workshops, we tested the full ESC framework and toolkit experience with a total of 25 participants, resulting in a design sprint-like workshop. Workshops were intended for those knowledgeable in smart cities, and interested in creating sustainable, urban environments, matching ESC's target audience. This ensured that the entire toolkit was properly tested and iterated with its target users. The tools were originally designed for analogue exercises but were adapted for virtual workshops in response to the COVID-19 pandemic. Design changes to the ESC tools and workshop considered the overall user experience, facilitation, organization, virtual format, and delivery.

3.1 ESC Toolkit and "Let's Create an Ethical Smart City" Workshop Users

The ESC toolkit was designed for use by both participants and facilitators. From the total of 25 participants, workshop 1 had 5 participants while workshop 2 had 6, workshop 3 had 8, and workshop 4 had 6. The majority of participants tuned in from across Canada with at least 2 participating from international cities such as Barcelona and Hong Kong. Of those who shared their professional background, 4 participants were in academia, 6 in design and technology, and 10 worked in city-building with

the majority focused on public sectors versus private sectors. Participant contributions in workshops consisted of direct feedback through knowledge of their cities and observational feedback on their experiences of the workshop. The three facilitators were members of the original ESC Project team whose task was to guide participants through the ESC framework and toolkit and use data collected from workshops for toolkit and workshop iteration. The user experiences of both groups were considered when designing and modifying workshops.

3.2 "Let's Create an Ethical Smart City" Workshop Methodology

Methodology to explore the toolkit focused on how workshops were planned, executed, and reviewed to improve the experiences of both user groups (Figure 2).

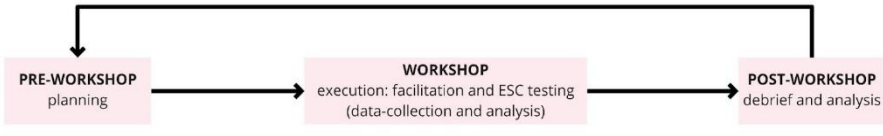

Fig. 2. An illustration of the methodology used to test and improve upon "Let's Create an Ethical Smart City" workshops. Considerations in planning, experiences, and observations from workshops were discussed during debriefs and fed back into the planning and preparation for subsequent workshops.

Pre-workshop. Facilitators planned workshop execution considering the following constraints:

Virtual facilitation: The COVID-19 pandemic meant that all work was to be conducted virtually.
Participant recruitment: Restricted to attendees of the Unexpected Solutions Conference
Workshop duration: Each workshop was limited to two hours.
Tools that fit the facilitation approach: An interactive online platform was needed to best showcase, teach, and test the ESC framework and toolkit.
Data collection: An appropriate mechanism was designed to effectively guide data collection and workshop recordings.

To ensure the workshop experience quality as well as adherence to Research Ethics Board guidelines, online platforms were selected based on the following criteria: function in workshops, quality and availability of important features, accessibility, interoperability, ease of use and learning, and affordability.

Workshop flow was split into 3 major sections (Figure 3) and the following materials were created: (1) Facilitator guide which served as a script for facilitators and blueprint for the workshop flow, (2) Observer's guide for recording user behavior and interaction with tools, (3) Presentation deck and materials for participants to read

prior to the workshop, (4) Participant surveys for post-workshop feedback, and (5) Documents for debrief and data analysis.

Fig. 3. A diagram showing the most recent iteration of the flow of content and agenda designed for the "Let's Create an Ethical Smart City" workshops. During the workshop, there is overlap between context setting and ESC testing since framework steps are introduced prior to each corresponding tool.

Workshop. Diligent facilitation was imperative to the workshops. Responsibilities were defined and assigned to four roles based on the primary and secondary responsibilities of each role, the interactions each role had with users and the materials for the duration of workshops (see Appendix C). An openness to revise definitions was maintained throughout the process.

Post-workshop. Gathering and analyzing participants' survey responses were part of the post-workshop review. Survey questions centered on session duration, ease of use of the ESC toolkit, and clarity of ESC concepts. Responses were analyzed and compared to information discussed in the debrief to reinforce, validate, or add to the observations of the research team.

Debrief sessions were conducted to review the perspectives of the facilitators on what went well and challenges versus opportunities for improvement. The usability of the ESC toolkit, its facilitation, and user experience in a virtual environment was critiqued. Perspectives were recorded and reviewed to organize the areas of improvement into actionable tasks for the next workshop.

Upon completing all four workshops, data was collected from completed observer's guides, participant feedback, and debriefs and thematic analysis was completed to understand which factors affected workshop success and completion. In addition, all workshop recordings were reviewed to address gaps in the quantitative data such as the time to complete the steps within the toolkit and the frequency of participant interactions. Using a review approach allowed the team to identify improvement points from many perspectives and led to rich observations and analysis.

4 Findings

A wealth of information regarding the toolkit design and content, facilitation, participant experience, and the virtual environment was collected upon completion of the four workshops. Feedback from participants was rich, and included insight into time management's role in toolkit completion during sessions. A participant from Workshop 1 commented on the pace, "I liked having enough time to dig into the

answers in each section, but maybe you need to keep the activity moving along just to get through the tools." Another participant brought up the duration of the session, "More time would be useful. Perhaps the session could be 3 hours long. We didn't have time to go through the case, which would've helped." There was a general consensus for longer or segmented sessions as user experience from the first workshop provided insights on how to prioritize activities in a virtual workshop.

Another stand-out theme within participant feedback was that digital resources for online facilitation should support the needs of both facilitators and participants. Participants commented on their experience with the digital tools and compared it with tools they are used to. "Towards the end things waned off a bit and I got a bit distracted by chat features [in Microsoft Teams]. Zoom has a tool that separates chat from questions to facilitators. I find it reduces the number of distracting conversations. The conversation is good but presenters may lose participants that get sidelined on a thought or conversation." There was also feedback on effective digital tools given the nature and objective of the workshops. A participant mentioned "For me, using Miro and Teams was tricky at first, but it was fun to use Miro directly, not just type answers into the chat window."

Much of the feedback pertained to the ESC Toolkit's potential to support community building while applying a design thinking approach, "I believe that this toolkit and online sessions would be very useful for participation at the community level through neighbourhood Business Improvement Areas and local Resident Associations. These sessions would be a valuable input to the City of Toronto's Digital Infrastructure planning process." Another participant commented, "Love seeing design thinking applied to developing smart city solutions."

Since the approach was iterative, the outcomes of each workshop were different. Improvements were identified after each workshop and the corresponding changes were implemented in the next. Its changing nature enabled each workshop to tackle different aspects of the toolkit and its facilitation (e.g., proper facilitation, pacing, and consensus building). For ease, these findings have been organized using Jakob Nielsen's Usability Heuristics [24]. Since the ESC toolkit design and workshop experience are inextricably linked in the sense that a design element of the tool and its content directly affects the workshop experience, we do not separate the findings between the two.

4.1 Heuristic Analysis: ESC Toolkit & Workshop Design

Meant as a system for quickly evaluating the usability of information artefacts, Nielsen's Usability Heuristics, an established method for interaction design projects [24], was used to explain and present our design choices and iterations as they were incorporated into both the workshop experience and ESC tool. The heuristic and its criteria were slightly modified to include an evaluation in workshop service design in addition to evaluating the ESC toolkit.

Heuristic Principle #1: Visibility of System Status. This is characterized by the facilitator's action or ESC tool that keeps users informed about their progress through multiple modes of communication such as visual cues, verbal instruction or updates

and feedback. Communication must be open, transparent, and done in a timely manner to provide users with enough information to enable a sense of control. To keep participants informed about their progress, visual and verbal communication methods were employed:

- Displaying the toolkit in its entirety with the navigation explained prior to the activities allowing participants to use the online collaboration tool as a visual cue to evaluate progress
- Facilitators provided verbal instructions and real-time feedback as participants interacted with the tool (e.g., Facilitator 3 shifted from an observer role to take on time-keeping, providing frequent updates for pacing).
- The 3rd facilitator role was further developed to provide real-time feedback when observing a miscommunication between facilitators and/or participants.

Heuristic Principle #2: Match between System and the Real World. This ensures the user intuitively comprehends their environment which in turn prompts expected behaviors. When the workshop experience and visual language resemble other similar environments, it allows users to easily translate skills and learned behaviors from other parts of life. In the ESC workshops, a logical sequence of action was promoted by facilitators employing jargon-free language and using familiar, visual design when presenting ESC tools. When translating the ESC toolkit to a virtual workshop, additions and changes were made to provide a comprehensible experience:

- Features with familiar, corresponding activities to an in-person workshop, such as placing sticky notes and voting, were employed in the online activity.
- Instructions and format of the virtual toolkit were jargon-free and did not assume participants were acquainted with ESC concepts.
- Facilitators' instructions were adapted to assume participants had only the most basic experience with technology.
- The workshop's flow was iterated to mimic in-person public engagement sessions (e.g., a case study was initially introduced to help participants focus on a community challenge, which caused confusion since the toolkit was designed for a community to first reflect on a range of their own challenges. The case study was removed in future workshops).

Heuristic Principle #3: User Control and Freedom. This is characterized when a facilitator's action or the ESC tool allows the user the freedom to change direction by altering previous decisions, opting out, or stopping an interaction. The following illustrates how the ESC workshops altered the experience to allow for more user control and freedom:

- Workshops were adjusted to provide safe spaces for participants preferring non-verbal modes of communication and opt out of speaking or sharing their video.

- A designated section was provided with time set aside to summarize and come to a consensus regarding each tool's output. This provided the participants control and the opportunity to backtrack and change their decisions.
- Changes to the way facilitators introduced prompts emphasized the amount of freedom to skip or answer as participants so chose.

Heuristic Principle #4: Consistency and Standards. This highlights the need to define conventions that help predict or direct certain user actions. In the ESC Workshops, these standards aimed to eliminate confusion when interacting with the tools. Design changes that reflect this principle were the following:

- Use of consistent colors, shapes, and icons to guide users through tool activities (e.g., pink fields for brainstorming, blue squares for generative, etc.).
- Consistent content delivery by facilitators led to a predictable flow for participants.
- Standardizing a schedule for each section of the tools (i.e. brainstorm, generate, and evaluate) contributed to the completion of the workshop and its goals within the allotted time.

Heuristic Principle #5: Error Prevention. This ensures that during the design of workshop elements, consideration for things that could go wrong and plans to mitigate these concerns are addressed. When designing the user experience of the workshops, identifying scenarios where users could make mistakes was a focal point for improving the execution of these workshops. During workshops, user errors were prevented either through user interface design (Miro board) or facilitation. Potential errors and their preventative solutions included but were not limited to:

- Disabling participant screen sharing capabilities prevented the risk of participants using the share screen function.
- Troubles with voting on Miro were met with extra time spent on online tool instruction, clearer instructions, and facilitators developing workarounds.

Heuristic Principle #6: Recognition Rather than Recall. This aims to lessen the memory load of users by using visual cues to prompt action and show options. It was applied in designing materials for facilitator support processes. Since the ESC toolkit builds on each step, it was important to reference outputs of earlier steps in the following steps. Design decisions depended on the information needed to be permanently placed on the tools versus mentioned through facilitation. The following changes were triggered by variables in facilitation during workshops:

- Toolkits were updated with space to highlight outputs from past tools for participants.
- Prompts were added to emphasize the community, their needs and the problem being addressed.

- A support system was created, consisting of a script and decision tree for facilitators, enabled clarity of roles, and ease of on-the-fly decision making.

Heuristic Principle #7: Flexibility and Efficiency of Use. This encourages preparation to adapt to different potential scenarios during workshops. As every group of participants had differing needs, knowledge, and abilities, changes to support success were made by facilitators before, during or after workshops. Notable changes included:

- Facilitators adjusted content delivery based on participant responses.
- Use of a timeline in place of the implementation plan.
- Addition of definitions for terms (e.g., Ethical Smart City) in the toolkit.
- Addition of a recap tool, the Report Card, after the framework tools were completed.

Heuristic Principle #8: Simplicity by Design. This encourages simplification of tools and instructions, removal of any unnecessary or confusing materials and the merging of materials to adjust formatting wherever possible. When adapting to a virtual workshop, it was necessary to simplify the toolkit and experience:

- Sections of the toolkit were streamlined to reduce the mental load and number of actions required by both participants and facilitators when evaluating each step's output.
- Instructions given by facilitators and design elements were modified to lessen competing information, which previously caused confusion for participants.

Heuristic Principle #9: Recognize, Diagnose and Recover from Errors. This highlights the need for a recovery plan when users encounter unforeseen circumstances during workshops. It meant designing the user experience to recognize errors, know how to solve them or ask for help when they cannot. The improvements on the design that reflect this principle defined support materials and processes for users:

- During workshop preparation, scenario building exercises on all possible issues enabled facilitators to practice tactical ways to recover during workshops.
- Facilitators informed and reminded participants of potential issues and their resolution process throughout the workshop, including access to different communication channels for help.

Heuristic Principle #10: Access to Help. This encourages lowering barriers for user expression, specifically for the acquisition of help. Preparation to explain complex ideas in a multitude of ways while remaining cognizant of the potential to overload or confuse participants was imperative. Considerations to reduce the learning curve for participants included:

- Understanding of participants' inexperience with the virtual platforms used for workshops.
- Detailed how-to for tools and ESC resources provided prior to and at the start of workshops.
- The use of the chat function on Microsoft Teams to provide participants who experienced difficulties in Miro.
- For facilitators, filling the facilitator's script with reminders to relay to participants to reduce the need to multitask in a fast-paced environment.

5 Discussion

To align with the guiding principles of ESC, changes were made to the design of the toolkit and workshop to eliminate barriers and provide opportunities for users to design Ethical Smart City solutions. The following sections describe how design choices directly contributed to the three characteristics of what makes an Ethical Smart City workshop: equitable inclusion, open participant engagement, and consensus building. In outlining and understanding these three major characteristics of an ESC workshop, it was evident they were fulfilled through the use of human-centred design and usability heuristics.

5.1 Equitable Inclusion

To ensure the workshops were aligned with goals for Ethical Smart City building, equitable inclusion of participants was addressed as it stresses the need for barrier-free representation of stakeholders. Participants of workshops were not limited by geographical location or the logistical planning required when attending an in-person event and consideration was given to whether participants had the access and skills needed for virtual workshops.

By addressing barriers to participant engagement, considerations were divided into two categories: (1) digitally related barriers and (2) communication barriers. To address the digitally related barriers, platforms used in the workshop needed to be easily accessible and simple to use. For example, platforms chosen require only an email account, internet connection and a browser. Analysis of workshops and following design and facilitation alterations were guided by Heuristics #2 and #7.

To alleviate communication barriers, resources must be provided to participants. Workshop outcomes benefited from providing learning materials ahead of time, demos, extra time on instruction, and identifying participants having difficulties for targeted instruction. In addition, providing alternative methods of communication (e.g., online chat) promoted engagement and discussion especially for participants that preferred non-verbal communication. Heuristic #10 proved useful when incorporating access to help for participants. Indeed, the virtual format can support multiple simultaneous streams of conversation and provide the opportunity to explore digital access when designing successful virtual workshops. Future Ethical Smart City workshops not assisted by participation in a virtual conference, hoping to reach the

general public, will need to consider the depth and breadth of representation within their community. As well, beyond the scope of this paper but related to the conversation and imperative for municipalities to consider, is the issue of accessibility to technology and internet service for equitable stakeholder inclusion.

5.2 Open Participant Engagement

When co-creating with a community, facilitators must ensure there are adequate communication channels for participants to interact with the facilitator, toolkit, and other users. A successful design element, led by Heuristic Principle #4, was the placement of visual cue/s highlighting actions such as brainstorming, generating and evaluating outputs in the toolkit. It allowed minimal supervision in terms of what was intended to be done at a particular section of the tool. Participant engagement was also impacted by comfort level in sharing ideas with the entire group. Facilitators then utilized Heuristics #3, #7, #9, and #10 to create a safe environment where participants were comfortable sharing and discussing ideas.

Due to the two-hour time limit, workshops were paced like a design sprint, influencing facilitators' decisions. Facilitators had to balance when to pause, provide encouragement, and ask probe questions. Throughout the four workshops, facilitator challenges that emerged were analyzed and improved using Heuristic #9 and #10. The first was deciding which action to prioritize and the second was managing different avenues of participant engagement in a virtual space. The primary facilitator's main objective was to lead the completion of tools, while enabling open participant interaction came second.

Although different communication channels enabled participation and engagement, there were more opportunities for facilitation to encourage interaction through prompt questions and creating opportunities for participants to build on or challenge others' ideas. Participants voiced points of view through the chat, sticky notes, or making comments. With the challenge of not being able to read the room in virtual workshops, facilitators continuously reiterated these features of the digital tools to encourage interaction from and among participants.

5.3 Consensus Building

The act of facilitating opportunities for a group to come to a general agreement for tool outputs constitutes consensus building in the context of ESC workshops. Consensus building with participants during workshops was crucial to the completion of each tool before moving to the next. Ultimately, consensus was achieved more effectively with each consecutive workshop.

Continuously building consensus for each tool in a virtual setting was not an easy feat as the virtual workshops lacked innate opportunities for discourse that in-person settings typically provide. Barriers to achieving this aspect of successful ESC building were identified as struggles with or ties in voting, low engagement in terms of speaking and having videos on due to level of comfort with the group and fast paced nature of the workshop, and confusion around the community being solved for meant

participants struggled to relate to their solution's target stakeholders. Enablers of consensus building were subsequently built into the workshops' structure with the aid of reflection and integration of usability heuristics. Facilitators managed consensus by incorporating seven of the ten Heuristic Principles into facilitation and design of the toolkit: #2, #3,#4, #6, #8, #9 and #10.

6 Conclusion

The Ethical Smart City toolkit and workshop is different from traditional community engagement processes. Instead of a 'top-down engagement' process typically seen in many smart city projects [12], ESC supports the involvement of communities in a city-building project from the start and throughout. It embeds their values and unique challenges to co-create more resilient smart city projects.

Specifically for this research, testing the toolkit was important to understand the needs of users in the virtual environment, evaluate the effectiveness of the framework, and refine the toolkit for use in municipal smart city projects. By supporting and enabling equitable inclusion, open participant engagement, and consensus building, users are encouraged to co-design projects that support their values, needs and challenges, while using technology only as an enabler toward successful, resilient solutions. As the first real-world tests on the ESC toolkit, this research shows that the ESC framework and toolkit can be easily understood by participants with no prior knowledge of ESC concepts. It also shows that using the ESC toolkit needs to be facilitated in order to effectively co-create smart city solutions with communities.

The ESC framework and toolkit show promise to produce innovative solutions with communities. There is also much potential for further refinement of the workshop and toolkit to support smart city solutions that are more resilient, sustainable, inclusive, and ethical.

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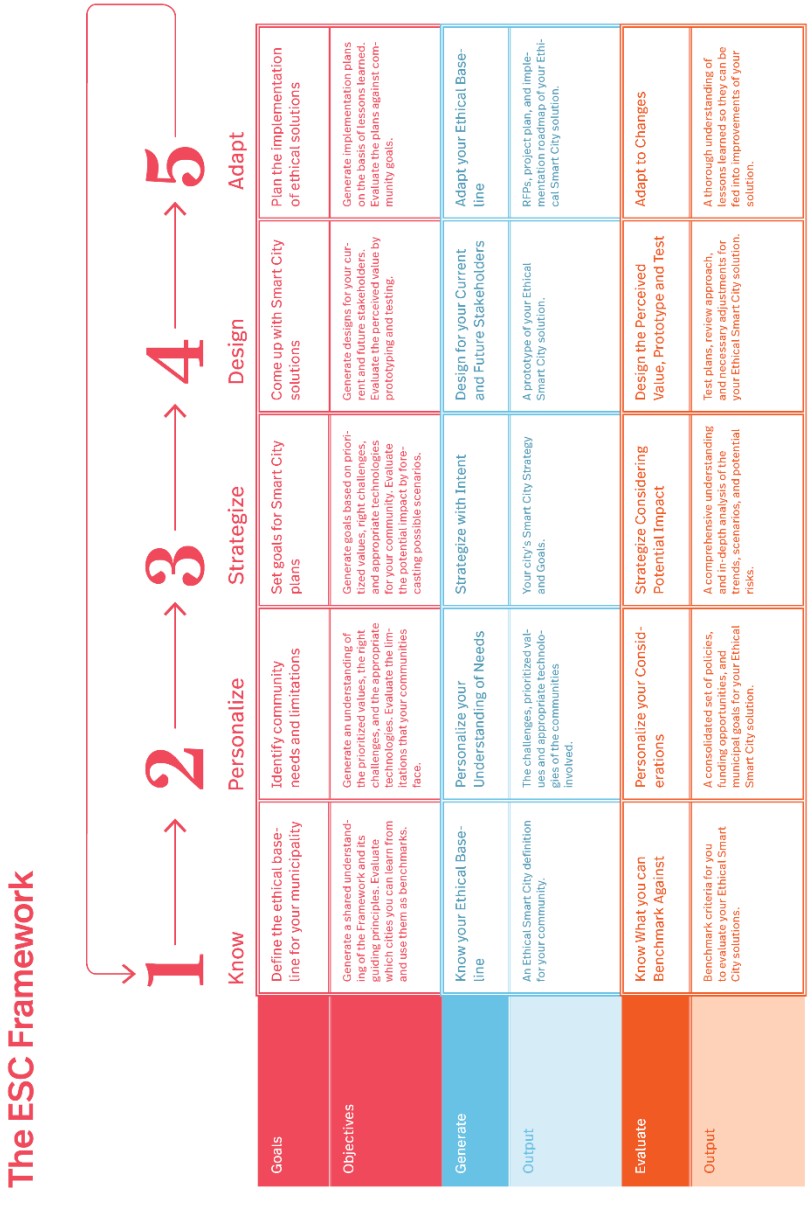
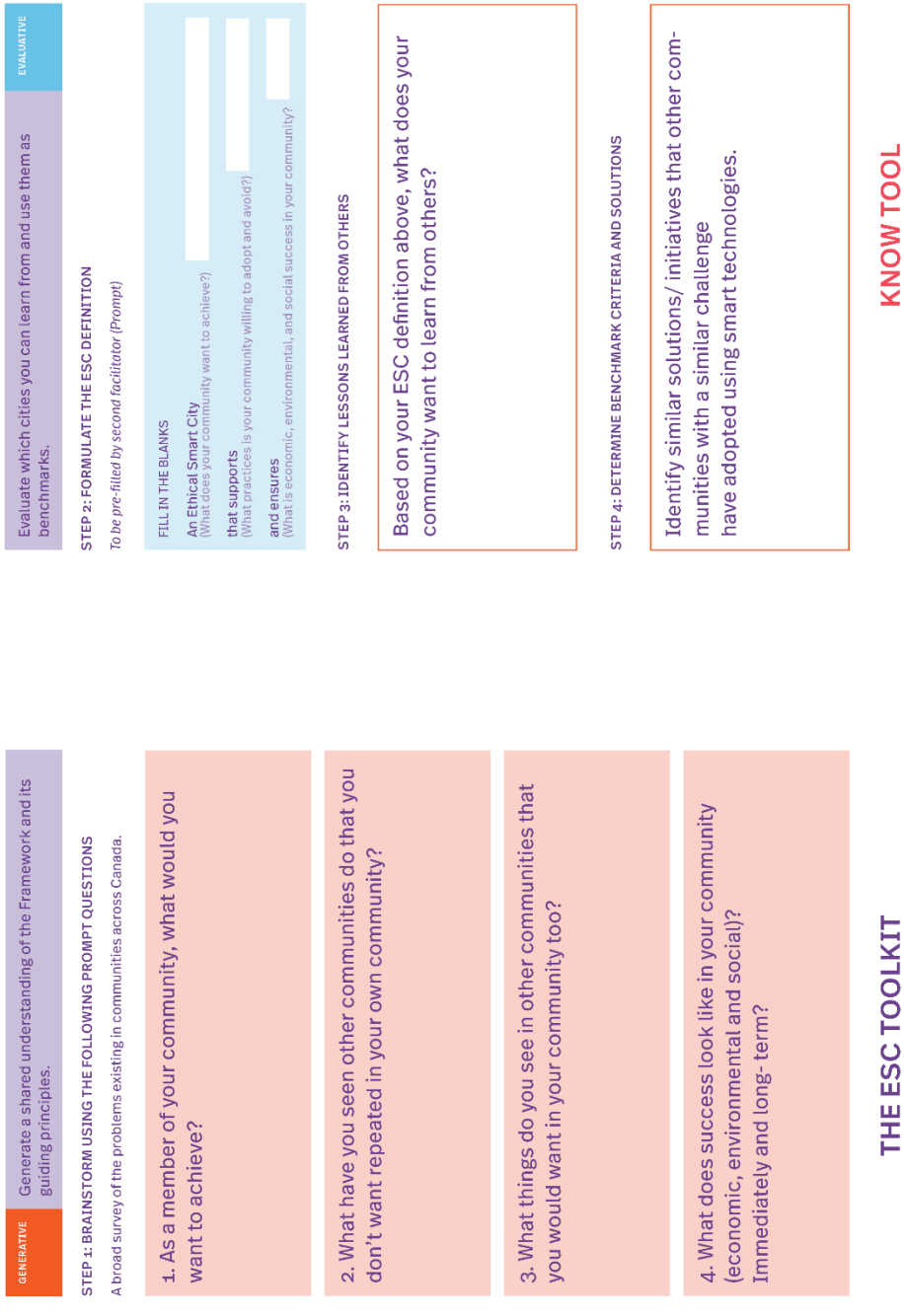
Appendices

Appendix A

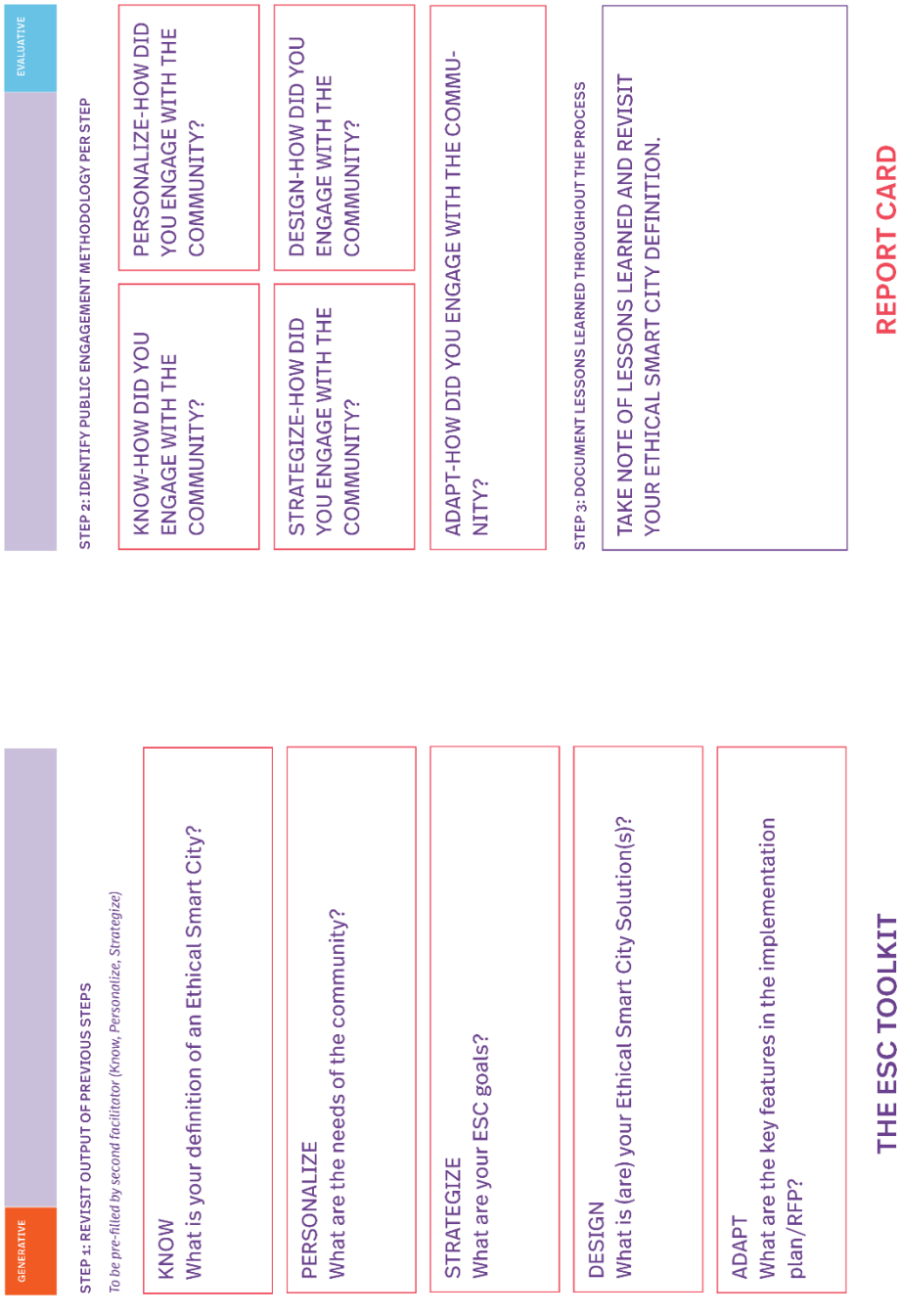


Appendix B

Know Tool. First ESC tool in the ESC Toolkit



Report Card. Last ESC tool in the ESC Toolkit



Appendix C

Facilitator Roles. Finalized roles for virtual "Let's Create an Ethical Smart City" workshops based on their responsibilities and levels of interaction with other users.

Role	Primary Responsibilities	Secondary Expectations	Interaction with participants	Interaction with other roles	Interaction with materials
Facilitator 1	Primary lead in workshops, provides explanations of materials in toolkit, encourages participation, converses with participants and other roles	Calls/reads out participant contributions from sticky notes on Miro (online collaboration tool),	Very High	High	High
Facilitator 2	Secondary support to Facilitator 1, synthesizes participant work within toolkit on stickies based on voting patterns, converses with Facilitator 1	Assists in clarifying instructions, back up for facilitator 1 if stuck or experiencing technical difficulties	High	Medium/ High	Very High
Facilitator 3	Support for both Facilitators 1 & 2, assists with pacing and communication, makes on-the-fly behind the scenes decisions (e.g., technical difficulties)	Takes notes in the observer's guide during workshop(s)	Low/None	Medium	None
Chat Moderator	Answers to participants in the chat of video conferencing platform (Microsoft Teams), places relevant links in the chat for participants to follow	Verbalizes participant questions or input from the chat, adds participant's ideas on Miro when they use the chat function in Teams to contribute	High/ Medium	Medium	Medium