Co-designing Smart Cities: a Case Study in the New Zealand Context

Jessica Turner
University of Waikato
Tauranga, New Zealand
jessica.turner@waikato.ac.nz

Ben E Jones
University of Waikato
Tauranga, New Zealand
ben.j@waikato.ac.nz

Aluna Everitt
University of Canterbury
Christchurch, New Zealand
aluna.everitt@canterbury.ac.nz

Jemma L König
University of Waikato
Hamilton, New Zealand
jemma.konig@waikato.ac.nz

Abstract

Designing smart cities that align with community needs requires both innovation and active participation. However, engaging the community can be challenging due to the diverse range of stakeholders, their requirements and hesitation to participate. Co-design offers a collaborative solution, involving the community from the outset, and ensuring designs meet expectations. This research explores the feasibility of co-design approaches for smart city development in New Zealand, using a local council as a case study. We conducted an online survey with 248 participants to assess public attitudes. Survey results highlighted strong interest in addressing traffic congestion, environmental monitoring and public safety. Using these results we conducted a co-design workshop (n=13) to encourage ideation. The co-design process generated innovative concepts, evaluated based on cost, deliverability, and novelty. Findings demonstrate the potential of co-design methodologies to bridge the gap between community needs and smart city technology, offering a foundation for future urban development initiatives.

CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**; *Participatory design.*

Keywords

Smart cities, Internet of Things, Co-design process, Community Engagement

ACM Reference Format:
Jessica Turner, Ben E Jones, Aluna Everitt, and Jemma L König. 2025. Co-designing Smart Cities: a Case Study in the New Zealand Context. In *37th Australian Conference on Human-Computer Interaction (HCI) (OZCHI '25), November 29–December 03, 2025, Sydney, Australia.* ACM, New York, NY, USA, 13 pages. https://doi.org/10.1145/3764687.3764707

ACM ISBN 979-8-4007-2016-1/25/11
https://doi.org/10.1145/3764687.3764707

1 Introduction

Smart cities leverage the Internet of Things (IoT) technology to connect infrastructure, services, and utilities. Increasing urbanisation is leading to higher energy, food, and material consumption and greater carbon emissions, negatively impacting residents and overall environmental health. Local Governments seek to utilise IoT to improve operations, make cities smarter and more efficient to better serve their residents [41].

Smart cities rely on technological innovation to enhance urban living, yet ensuring these advancements align with community needs remains a challenge. Traditional top-down planning approaches often overlook public concerns, leading to solutions that may not fully address local priorities. Effective community engagement is essential for smart city development, but achieving meaningful participation can be difficult due to barriers such as lack of technical knowledge, limited access to decision-making processes, and varying stakeholder interests.

Co-design offers a collaborative approach to addressing these challenges by actively involving community members in the design process. These techniques allow us to design *with* the community rather than *for* the community by incorporating user perspectives from the outset. Co-design ensures that smart city initiatives are relevant, feasible, and more likely to be adopted. Various tools have been developed to facilitate co-design, including surveys and rapid prototyping kits, which help capture stakeholders needs through ideation and translate them into actionable solutions [13, 20].

In their recent scoping review, Rocha et al. [33] found only 1 study which included co-design in a smart city context in Australia, while in New Zealand Mark and Hagen [23] highlight the need for evaluation of co-design techniques and the potential of these approaches in upholding the principles of Te Tiriti o Waitangi by enabling connection with indigenous practices such as kaupapa Māori or tikanga Māori techniques. Similarly in Australia, further exploration of co-design with Aboriginal and Torres Strait Islander knowledge systems in smart city contexts is required. This is in contrast with the international community where the use of co-design to develop smart city environments is well explored [37].

As a first step, in this research we investigate co-design techniques to explore the feasibility of using these for smart city design in Australasian contexts. Using a local City Council in New Zealand as our case study, in this research we investigate a set of co-design tools and approaches for ideation with the community to develop localised smart city technology-based concepts. Our research uses an online survey to gauge community perceptions of existing technologies as well as understanding public attitudes towards those technologies. This defined the scope and topics for a workshop where we employed two distinct toolkits, the Tiles IoT Inventor Toolkit [27] and the Futurice IoT Service Kit [11], to stimulate ideation among participants from the community.

The primary contribution of this work is an approach for engaging in co-design practices and techniques for smart city development in an Australasian context. We demonstrate how the collaborative process produced several innovative and feasible concepts which were evaluated against existing council-based criteria to determine feasibility. Our findings underscore the potential of co-design methodologies to bridge the gap between community needs and smart city technology, providing a starting point for future urban development work.

First, we discuss related work on co-design and smart city techniques, followed by our study design. Next we introduce our case study and present the results of each phase of our co-design process, namely the survey, workshop and analysis of concepts produced. This is followed by a discussion centred on community engagement and collaboration with local government, elaborating on lessons learned and the implications of our approach. Lastly, we finish with concluding remarks and next steps for future work.

2 Related Work

2.1 Smart Cities

IoT has transformed how we conceptualise smart environments, from individual smart homes to comprehensive smart city initiatives [15]. While smart homes focus on automating individual living spaces, smart cities represent a broader vision where technology improves urban infrastructure and public services at scale. This area is particularly relevant in rapidly growing urban centres, where smart city technologies could address emerging challenges.

IESE Business School [17] discusses cities that are at the forefront of digital innovation to improve sustainability and quality of life, such as London, New York, and Paris. In addition, Barcelona has been working on smart city initiatives for some time [2], focusing on open access to information that enables informed decision making [36]. Christchurch, in New Zealand, has also embraced open data as part of its rebuilding after the 2011 earthquakes [22], leading the way for open communication with cities in New Zealand. The authors in [26] support this, stating that councils should adapt the way they operate to improve their urban environments.

2.2 Co-Design & Smart Cities

Co-design as an approach emphasizes design *with* people rather than *for* them [38]. It encourages individuals with lived experience to actively participate in the design process [25], fostering what Sanders and Stappers [35] describe as *"collective creativity applied across the entire design process"*. In the context of smart cities, traditional top-down design approaches have not been able to meet citizens' real-life needs. Specifically because of the increasingly complex and integrated relationships between technologies and human experiences [39].

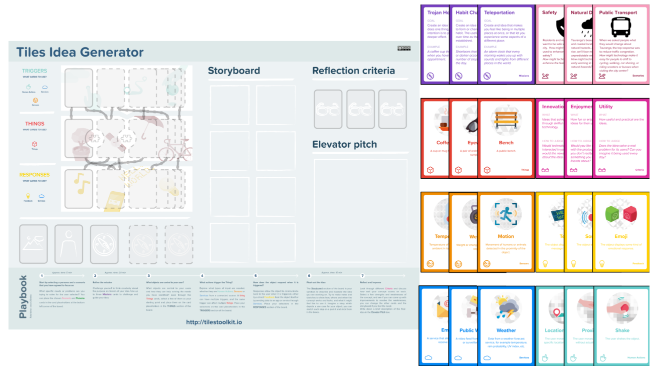


Figure 1: Tiles IoT Inventor Toolkit Components

Within smart city design, co-design is a promising approach as its focus is not on the involvement of citizens in city governance, but rather to make them participate in the co-production of public services [21]. Fu and Lin [10] propose a practical co-design framework for smart city planning, where citizens contribute meaningfully to planning, design, and evaluation based on their everyday urban experiences. Building on this work, our co-design approach utilises a crowd-sourced survey to identify urban challenges that are relevant to the community. This then guides the scope of our workshop with co-design toolkits that support ideation which better reflects the needs and perspectives of everyday citizens.

2.3 Co-Design Toolkits

Co-design toolkits support design thinking and encourage citizen participation for developing smart city initiatives [37]. Co-design toolkits typically involve card-based activities [28]. Figure 1 shows the Tiles IoT Inventor toolkit, which uses card-based activities to encourage community led design [12]. The relatively simple development and implementation of card-based toolkits has resulted in their popularity and common use throughout design processes. These kits allow for design to be conducted in a visual and tangible nature, while minimising previous experience required to participate [14]. Often cards are used in a structured way with an accompanying instruction worksheet [7, 9, 27, 40].

In addition to card-based activities, some kits use digital elements such as sensors and web interfaces. The Shoebox Co-design Toolkit [6] for example incorporates; an *activities booklet*, as well as *prompt cards*, and a *digital reflective journal* which is used to document activity outcomes and encourage ongoing development. While digital elements provide another layer of interaction, card-based only activities tend to be cheaper and simpler to implement. However, it should be noted that card-based solutions do not result in functional prototypes but rather encourage conceptual ideas.

Co-design toolkits can also use physical tokens to replicate creative play and support connection with real-world objects. The Karakuri IoT toolkit [19] incorporates origami objects as physical tokens to lower the barrier to entry, especially for those who are not domain experts. This approach mimics how board games combine cards and tokens to gamify the experience and make the process engaging, particularly for children. Futurice [11] (figure 2) allows children to take on the role of designers, creating smart objects for

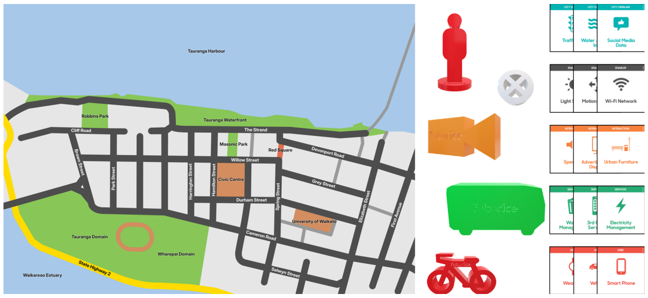


Figure 2: Futurice IoT Service Kit Components

a park. Players collaborate by collecting cards and refining their ideas based on feedback from teammates. This illustrates a board game approach using cards and tokens can serve as an effective co-design tool for involving and engaging community stakeholders in collaborative design and problem-solving.

2.4 Co-Design Toolkits for Smart Cities

Schulders [37] investigated the applicability of design-thinking principles, including co-design, to allow community participation in smart city initiatives. They found that the use of co-design significantly increased community participation as well as encouraged agency and ownership over initiatives led by public organizations. While co-design is showing promising results supporting the smart city environments, little has been done in the Australian or New Zealand context [33]. Recent work investigated co-design techniques for the ideation of smart solar urban furniture [30] and there is some discussion of co-design facilitated by the New Zealand Transport Agency to reduce carbon emissions using alternative transport [29]. In addition, there is some work on the use of co-design for indigenous data sovereignty in the context of IoT [4]. Yet, to our knowledge, none have investigated the use of co-design for smart city ideation in New Zealand.

The use of co-design kits for smart cities is also often tailored toward specific environments and contexts, such as smart homes [9, 16], factories [19] or lighting [1]. Many kits are not generalised to the broader smart cities context[1]. Nevertheless, we have chosen to use the Tiles kit [12] as it can be generalised to many contexts and has proved popular for co-designing technology. The use of the Futurice kit [11] in our work also helps incorporates physical tokens as elements alongside ideation cards to provide a common language between an engaging experience between different community demographics [32].

3 Methodology

In this work we used a mixed-methods approach, integrating a survey to understand community awareness of existing technologies and identify key challenges (Phase 1) followed by a co-design workshop (Phase 2). Results from the workshop were then analysed (Phase 3) using a ranking matrix provided by the local council to determine feasibility with selected concepts chosen for further development. Participants were recruited using the council's monthly newsletter to ratepayers via email. All participants provided informed consent before taking part in the study, personal data was anonymised, and individuals could withdraw within two weeks. This study received approval from the Human Ethics Committee for the Division of Health, Engineering, Computing and Science at the University of Waikato (Approval no. HREC(HECS)2024#52).

Phase 1 consisted of an online survey (n=248) which was developed in consultation with local council (see Appendix A.1). The survey was also shared with business communities in the central business district (CBD). There were no restrictions on participation as we wanted to capture a wide range of demographics. The survey was used to assess: public awareness of council-provided technologies already in the city such as smart bins or information kiosks; preferences for new community technology solutions; perceived barriers to technology use; and the importance participants placed on smart city initiatives. Quantitative survey data was analyzed using Qualtrics Stats iQ, employing statistical tests for significance where applicable. Open-ended survey responses were processed using natural language analysis techniques, including topic modelling and text visualisation tools. Key challenges were identified and used to facilitate the design of the workshop.

In Phase 2, participants (n=13) were selected from those who expressed interest in a workshop. While we could have had a higher number of workshop participants, the final group was balanced across demographics to ensure diverse representation. To encourage participation, workshop attendees received a small incentive ($50 prezzy card). During the workshop participants were divided into groups and assigned predefined challenges derived from the survey results, such as traffic congestion, environmental monitoring and public safety. Each group was also given a persona representing a typical community member affected by the provided challenge. This was to ensure they did not only solve the challenge for themselves but would consider the challenge from a wider community perspective.

The workshop was structured as follows: a short introduction provided an overview of the research and an icebreaker activity where participants were asked to draw their perceptions of a smart city was used to ensure each participant knew each other. This was followed by the first co-design activity where participants used the Tiles IoT Toolkit to ideate solutions to their challenge. Ideation toolkits were chosen as a proven method used to facilitate engagement and creativity [34].

The Tiles IoT Toolkit was used following standard procedures. The storyboard allowed participants to place cards related to their challenge in the appropriate slots on the worksheet. While the toolkit provided personas, we replaced these with our community specific personas. Similarly, the kit is centred on the UN Sustainable Development goals, these were replaced with the challenges specific to the area from the survey. A facilitator worked with each group to help them complete the activity, answering any questions they may have about the toolkit and cards available. Initial ideas were presented for peer feedback and refinement.

Between each design session there was a short break before repeating the process with the Futurice IoT Toolkit. This toolkit was designed to be used with generic floor maps such as a supermarket or town centre. In our workshop we used a simplified map of the local CBD. To help guide the session we also provided a different

[1]The Shoebox Co-design Toolkit [5] was created specifically to design smart cities with community members but it is not publicly available.

challenge and persona to enable discussion amongst the group. The rest of the kit was used out-of-the-box, where participants used tokens, cards and post-its to define a series of interactions to address their challenge. The cards enabled them to include smart city technologies. As in our first session, a facilitator was available to help answer any questions they may have. At the end of the workshop groups presented final concepts followed by a short feedback survey about the toolkits. Workshop discussions and outputs were analysed thematically, focusing on common ideas, feasibility, and participant engagement.

Lastly, in Phase 3 the concepts designed during the workshop were analysed using a ranking matrix provided by the city council. The matrix is used to determine which projects are feasbile to move forward with and help align priorities before presenting ideas to councillors. This provided an appropriate mechanism with which to judge the ideas generated from the workshop and determine if they could be implemented in future.

4 Case Study: Tauranga, New Zealand

Tauranga is a coastal city in New Zealand with a diverse population in one of the country's fastest growing regions. At present the CBD is undergoing significant revitalisation to become a more vibrant and people-focused space including modernised public spaces, increased walkability and green infrastructure. With this redevelopment, new 5G and Wi-Fi internet is being installed, enabling the use of smart technologies in the area and increasing connectedness.

The Tauranga City Council is tasked with a difficult challenge, they must attract business, residents and visitors back, restoring the CBD to a vibrant hub in the heart of the city. Key aspects of this plan include shifting residents attitudes towards the CBD and restoring the area as a community, civic and cultural focal point for the people who live in and visit the city. Furthermore, the council recognises that engaging the community is essential to ensure that their voice is heard and that the challenges they face can be identified and addressed [8]. This provides unique research opportunities to investigate how technology can be used in smart city environments to support wider initiatives to engage communities and allow residents to influence future developments for the city.

Throughout this research council staff were engaged as collaborators as opposed to passive stakeholders. They contributed to initial planning discussions and helped to develop each phase of the co-design process, also providing key information about existing smart city technologies (see figure 4) as well as council priorities. This was essential in aligning the process to the wider development of the CBD and ensuring concepts co-designed with the community would integrate with the broader city initiatives. This partnership enabled co-development of: the survey questions, to ensure we gathered useful perspectives for both our research but also council objectives in phase 1; the challenges, personas and workshop protocols in phase 2; and lastly, the analysis methods used in phase 3. Next, we explore each of these phases, highlighting key results and outcomes for this case study.

5 Phase 1: Survey

As discussed in Section 3, the first step of our co-design process was to develop and conduct a survey to gather information about citizens perceptions and attitudes towards smart city technologies. An online version of the survey (see Appendix A.1) was created using the Qualtrics platform [31], and primarily distributed through the *Kōrero Mai - Let's Talk Tauranga* email newsletter by the Tauranga City Council. The survey aimed to understand how residents view technology such as information kiosks and public Wi-Fi, as well as how and where it can make a difference in the community by improving services and livability. The survey was expected to take 10 minutes to complete and included questions on demographics, usage of existing technology in the community, and what the council can improve using technology.

Table 1: Age Brackets of Survey Respondents

Age	n	Percentage
Under 16	1	0%
16-24	25	10%
25-34	17	7%
35-44	33	13%
45-54	26	10%
55-64	29	12%
65-74	71	29%
75-84	34	14%
85+	8	3%
Prefer not to say	4	2%

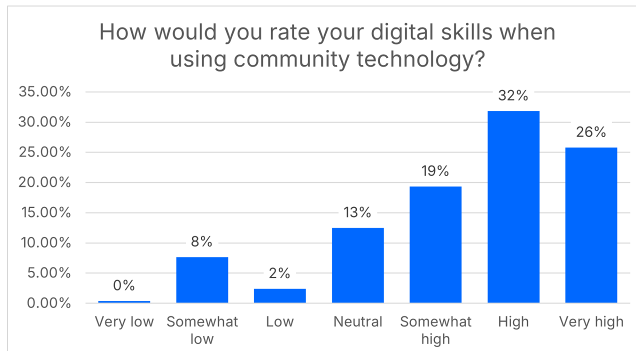


Figure 3: Survey Self-rating of Digital Skills

5.1 Demographics

There were a total of 248 responses to the online survey. The largest group of respondents were in the 65-74 age bracket as shown in Table 1, however there was a spread of ages, including several in the 16-24 bracket which are typically difficult for the council to reach. In terms of gender 122 respondents were female, 116 respondents were male, 1 identified as non-binary, 1 identified as other, and 8 respondents preferred not to disclose their gender. This wide range of participants provided a strong base from which to understand the residents' familiarity and perceptions of smart technologies.

5.2 Use of Existing Technologies

The majority of respondents rated their digital skills as high or very high (Figure 3), illustrating that the use of existing technologies

Table 2: Awareness of Existing Council-provided Community Technology

Which of the following are you aware of?	Percentage
Free Wi-Fi at the city libraries	81%
Digital signs showing parking availability at council carparks	73%
Digital signs showing bus arrival times at bus stops	61%
Payment kiosks at libraries	29%
Traffic counters	28%
Information kiosks in outdoor spaces	20%
Free Wi-Fi at the Mount	19%
Smart street lights that we can dim remotely to save energy	16%
Smart bins that tell us when they are full	14%
Smart seats in the City Centre with charging stations and free Wi-Fi	10%
None of the above	6%

Table 3: New Technology Preferences

What technology would you like to see more of in the community?	Percentage
Environmental monitoring and emergency response systems	65%
Digital community messaging and signage in outdoor spaces, such as what's on listings, maps, transport information	51%
Interactive learning and technology for kids	46%
Free public Wi-Fi in other areas outside of existing locations	45%
Urban planning technology to view 3D city models and give feedback on the future of our city	41%
Smart council infrastructure, such as smart bins	38%
Digital art, culture and history displays	30%
Technology that fosters community innovation, such as open data for research	30%
Other	15%

(a) Solar Smart Bench [18]

(b) Bus Arrival Information

(c) Information Kiosk

(d) Smart Bin [3]

Figure 4: Existing Technology Examples

is prevalent within the survey participants. This is higlighted by the results shown in Table 2 where the majority of respondents are aware of the existence of free Wi-Fi at libraries, digital parking availability signs, and digital bus arrival signs. However, the majority were not aware of the other existing community technologies such as smart benches or smart bins. Figure 4 shows examples of existing community technologies in the city.

The majority of participants (43%) indicated that there were no barriers preventing them from using this technology, meaning that when technology was installed uptake and use was high. However, 40% of participants also indicated that they had privacy concerns or were wary of being scammed. A further 36% of participants said they already had all of the smart technology they require in the city, while 18% indicated that they had no need to use any smart city technology. 8% were not interested in using this technology at all, while 6% said they would not be confident in using it. Only 2% of participants did not have a device to connect to with integrated technology and similarly 2% also said the technology was not designed to work with their disability. Lastly, 9% provided other reasons for prevention of use. Overall, this demonstrates that technology in the city is well used when installed and if privacy concerns can be addressed further investment in these technologies will be beneficial to residents.

5.3 Smart City Improvements & Challenges

As the survey was designed directly with council, we were able to ask residents about new smart city technologies they would like to see in future based on council priorities. In Table 3 respondents reported that they primarily would like to see more environmental monitoring and emergency response systems, as well as messaging and signage. 16% and 56% of respondents indicated that they would be very likely or likely to use this new technology, signaling strong community support. Out of the remaining respondents, 15% were neutral, 6% unlikely and 8% very unlikely to use the suggested technology, demonstrating that only a small number of residents would not be interested in the implementation of new technologies.

Participants were asked to rank different council services where technology could be used to improve those services, using a scale of 1 to 7 where 1 is the most important and 7 the least important. That is, higher scores denote lesser importance than lower scores with respect to a given service. In Table 4 the average rankings are given for each of the services surveyed. Roadways were ranked as the most important council service to improve with technology,

Table 4: Average Ranking of Importance of Improving Council Services

What Council services would you like to see improved through the use of technology?	Average ranking
Roads, footpaths, and cycleways.	3.23
Drinking water, wastewater, and stormwater services.	3.73
Rubbish and recycling services.	4.19
Building and planning.	4.39
Public facilities, such as community centres.	4.55
Outdoor spaces, such as parks.	5.06
Community services, such as events.	5.36
Business licensing and compliance.	6.09

followed by water and waste services. This emphasises the importance of mobility and concerns for the local environment as key issues at the forefront of residents minds.

6 Phase 2: Workshop

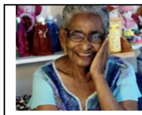
Phase 2 consisted of two key tasks, the first was the development of the workshop as outlined in section 3 including protocols, challenges and personas based on the survey information. The second was conducting the co-design workshop with participants (n=13) to ideate and design concepts to address the survey challenges.

6.1 Smart Technology Challenges and Personas

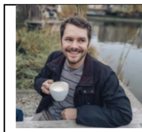
Number	Title	Description
1	Natural Hazards	Our city's beautiful landscape and coastal location expose us to natural hazards. As temperatures rise, we'll face more extreme and unpredictable weather events. How might technology provide early warning in the city centre for natural hazards?
2	Mode Shift	When we asked people what they would change about our city, the top response was to reduce traffic congestion. How might technology make it easy for people to shift to cycling, walking, car sharing, or riding scooters or buses when visiting the city centre?
3	Protecting the Environment	Our community feel it's important council prioritise nature. How might technology help protect, preserve, and enhance our city centre's natural environment?
4	Safety	At night, less than three in ten residents feel safe in the city centre. How might we use technology to improve safety in our CBD?
5	History	Our city centre has a rich and diverse history, from its Māori heritage, through to European settlement and beyond. How might technology tell the stories of our city centre?

Figure 5: City Challenges

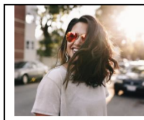
Using the survey results as a guide, materials for the co-design workshop were developed between the researchers and council stakeholders to enable efficient use of the Tiles IoT Inventor Toolkit and Futurice IoT Service Kit. In both toolkits, the purpose is to facilitate ideation and concept development by those unfamiliar with IoT and related smart technologies. A key requirement of council involvement was that the ideas developed are relevant for the city and residents, therefore, we worked first on developing challenges and personas that could be used in the workshop to potentially



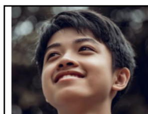
Jane is a 66-year-old retiree who lives in Matua. She regularly visits the new Waterfront playground at The Strand with her two grandchildren. She also loves to take them to the library to take out books and the cheaper cinemas in town to see the latest movies. Occasionally she will also visit the optometrist to update her glasses or the Pathlab for blood tests.



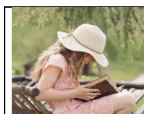
Daniel is a 47-year-old manager who works in the CBD. He uses the new cycle on Cameron Rd to get to and from his home in Greerton. Daniel has 3 primary school aged children who attend Tauranga Primary School. He and his wife share responsibilities in dropping and picking the kids up from school. When it's his turn he alternatively takes his car to work and struggles to find cheap parking in the CBD.



Aroha is a 20-year-old university student who studies Law at the University's Tauranga CBD campus. Living out at Papamoa, she very rarely visits the CBD unless she must come in for classes, tests or exams. When Aroha visits campus she gets her older brother to drop her off so she can get to class on time and avoid parking fees.



Hamish is a 15-year-old college student who lives in Bethlehem. He and his mates regularly visit The Strand in summer to practice manu jumps off the wharf. During winter they might occasionally visit the cinema or Farmers to go shopping for Lego but they spend much of their time at school or home. Hamish is looking forward to getting his learners licence so he can learn to drive and stop having to rely on the buses.



Fiona is one of Daniel's children and is 10 years old. She comes into the CBD for school and loves it when Mum takes her and her friends to the library to find out information for school projects. She is currently learning about the history of Tauranga as well as environmental impacts. Fiona loves turtles, Finding Nemo is her favourite movie, and she worries about the impacts of plastic bottles on the ocean.

Figure 6: Workshop Personas

address the improvements outlined in Table 4 and consider the preferences for new technology as discussed above in Table 3. 5 challenges were developed as outlined in Figure 5. We explore each of these challenges next.

Challenge 1, Natural Hazards, centred on exploring how technology could provide assistance with mobility during extreme weather events. This tied into residents concerns around roadways in terms of being able to move about the city, but also their preference for new technology to provide better emergency response systems as well as community messaging and signage in outdoor spaces. As Tauranga is in a low lying coastal area, such systems are imperative to ensure resident safety during extreme weather events such as flooding or tsunamis.

Due to the topography of Tauranga and inland coastal areas there are several bottlenecks in the existing roading network which cause significant congestion at peak times. As a result, challenge 2 asked participants to address the number one identified council service that could be improved with technology, in this case mode shift. The challenge specifically asked workshop participants to think about alternatives to single occupant vehicle transport and ways in which they might be able to move around the city.

In challenge 3 we wanted participants to consider protecting the natural environment, tying in with survey participants preference for new technology for environmental monitoring and improved water, rubbish and recycling services. In contrast challenge 4 looked at the safety of residents in the CBD. While not directly reflected in the survey results, resident safety was identified by council as

Figure 7: The Manu Meter

Figure 8: Transport Tracking

a key challenge from previous surveys that they would like to investigate further, we therefore included this challenge in our workshop. Lastly, challenge 5 asked participants to consider the rich and diverse history of the city, aligning with the survey results on a preference for interactive learning and technology for kids and the importance of improving public facilities and outdoor spaces.

With each of the challenges developed 5 personas were created for use in the workshop (figure 6). The personas were developed by the researchers and reviewed by council stakeholders before the workshop took place. It was important not only to develop personas which would work for the identified challenges but were also representative of city residents. The demographic information from the survey and responses were useful in creating realistic personas for the city, taking into account key areas in the CBD.

6.2 Ideation and Concepts

As outlined above in section 3, participants were split into groups and asked to address a challenge for a specified persona, first with the Tiles IoT Toolkit and in the second session with the Futurice IoT Service Kit. Next we explore each of the 6 concepts generated.

6.2.1 Manu Meter. The Manu Meter was designed using the Tiles IoT Toolkit to address challenge 3 in figure 5 using Hamish as their persona. The final concept from the toolkit is shown in figure 7. The purpose of the Manu meter is to score *Manus*, a type of bomb or dive into the water where the jumper aims to create the biggest splash possible, that is a popular water-based activity among teenagers using the wharf located within the CBD. The concept involves a centralised app and information kiosks that connect residents with their environment. The group chose to focus on the waterfront as a key community space while expanding to cover broader city activities and information. The app provides a singular source of information, and kiosks are used as a live feed to display data such as weather information, water quality, swimming conditions, and most importantly jump scores. This concept ensures that the information is accessible and raises awareness around water quality and swimming conditions to ensure it is "safe to Manu".

6.2.2 Tsunami Alert. Also using the Tiles IoT Toolkit, the Tsunami Alert system was designed to address challenge 1 in figure 5, with a focus on natural hazards for the persona Jane. The group envisioned a city-wide emergency communication system that would transform existing CBD infrastructure, such as digital displays, into an emergency broadcast network during natural disasters. This would allow first responders to coordinate a tsunami response and redirect public transport to assist evacuation. This would be particularly important for people like Jane who may have limited mobility and need help to get out of an area quickly in an emergency situation.

6.2.3 Safety Lighting. The last concept designed using the Tiles IoT Toolkit was investigated by our third group to address challenge 4 in figure 5 for our persona Aroha. The purpose of the Safety Lighting system was to provide intelligent lighting that would combine decorative elements, such as garden lighting or existing artwork installations, with safety features to discourage antisocial behaviour at night. By lighting up the CBD in centralised areas where people are it would enable the council to help protect residents and increase their perception of safety while conserving energy.

6.2.4 Transport Tracking. After the workshop break participants were regrouped and asked to use the Futurice IoT Service Toolkit to explore the next set of challenges. The first group investigated challenge 2 in figure 5 where they wanted to encourage mode shift for our persona Daniel. The final concept is depicted in figure 8.

The purpose of the Futurice IoT Service Toolkit was to describe a story or journey throughout the mapped area to demonstrate how smart technology may be used along those routes. The group paid particular attention to the fact that our persona Daniel had children and therefore investigated smart tracking options, such as perks for him and his family for using alternative modes of transport like buses or cycling. They prioritised safe student travel and the use of engaging incentives, such as Daniel riding free each time his children used the bus, to encourage mode shift.

6.2.5 Cultural Tour. The Cultural Tour concept was also developed using the Futurice IoT Service Toolkit where the participants in the group addressed challenge 5 in figure 5 for our persona Fiona. The group focused on Fiona's interest in history as well as her love of the ocean in developing their concept. Their final concept described an interactive art trail through Tauranga's CBD that brings history to life through a mix of physical and digital installations, weaving together cultural narratives, historical collections, and new artworks in collaboration with local iwi.

6.2.6 End-of-Journey Facilities. The final concept generated from the workshop focused on end-of-journey facilities to address challenge 2 in figure 5 for persona Jane. Considering how Jane may travel during non-peak times, the group considered a system which would prioritise sustainable transport options by using: connected infrastructure such as the existing smart benches for charging e-scooters or priority traffic signals for buses, cyclists and pedestrian crossings; smart facilities for end-of-journey such as bike storage, charging stations, and bicycle repairs; and real-time journey optimisation, including live updates on facility availability and traffic conditions; to make car-free travel the most attractive option for accessing the CBD.

7 Phase 3: Analysis of Concepts

At the conclusion of the workshop, photos and detailed notes were made about each of the concepts generated by the participants as outlined above. A short survey was also given to participants to ellicit their feedback on the workshop process. However, the feasibility of the concepts produced required further evaluation to determine which aligned with council priorities for future investigation. The council stakeholders provided a ranking matrix usually used to score and evaluate future projects (see appendix A.2) in the digital technologies space. The ranking matrix includes 9 scoring items for consideration, namely:

- ***Cost*** - the estimated cost to complete a project.
- ***Budget Line*** - whether there is an existing budget available to fund each project.
- ***Time*** - estimated duration required to complete a project.
- ***Deliverability*** - considering delivery models, involvement of partners and internal or external resources required.
- ***Effort*** - measuring the overall complexity, resource requirements and risk level.
- ***Benefit*** - expected positive outcomes of each project, such as improvements in services, infrastructure, or community well-being.
- ***Outcomes*** - evaluates how well the project aligns with broader community and organisational goals.
- ***Strategic Fit*** - how well each project aligns with the council's Community Outcomes, such as promoting an inclusive city, protecting the environment, and supporting business and education.
- ***Novelty*** - evaluate the creativity and innovation of a concept.

Higher scores for a specific criterion emphasise projects that are more desirable for council. For example, a project which costs less will receive a 5 while a project which costs more will receive a 1. For this research we also added novelty as a key criterion from the workshop to the existing ranking matrix. We wanted to prioritise projects that introduce new, unique, or exciting ideas, while projects making use of existing technologies to score lower. The purpose of this was to be able to eliminate ideas that already exist within the city's current smart technologies and to highlight the creativity of the ideation process.

Project Scoring Criteria	Manu Meter	Tsunami Alert	Safety Lighting	Transport Tracking	Cultural Tour	End-of-Journey Facilities
Cost	5	3	4	4	5	3
Budget line	2	2	3	2	3	2
Time	3	2	3	3	3	2
Deliverability	3	2	5	2	4	3
Effort	4	2	4	3	4	3
Benefit	4	5	4	3	4	3
Outcomes	4	3	3	3	4	3
Strategic fit	4	4	3	4	4	4
Novelty	4	3	3	2	3	2
Total	32.3	24.8	30.5	24.8	32	24.8

Figure 9: Concept Ranking

With the use of the matrix established, 2 researchers and 2 council staff members scored each concept against the above criterion. This balance of scorers enabled the ranking to reflect concepts which were both novel but also likely to be considered for investment by council to be ranked more favourably. With the addition of novelty, the maximum score a concept could receive is 45. The average of the scores was taken for each criterion as is shown in figure 9. Concepts with a higher average total score are considered more feasible and innovative and therefore should be investigated first, while those with lower scores are considered more difficult and costly to implement.

The concepts which received the highest scores were the Manu Meter and Cultural Tour. Note that each of these concepts was designed using a different ideation toolkit, highlighting the importance of the survey in determining key challenges to address during the workshop regardless of the co-design tool used. This emphasises the importance of the process followed but that different ideation kits may be used provided the workshop is tailored to the needs of the local area. Notably, the Manu Meter concept is being explored further by the Tauranga City Council in collaboration with the researchers to develop a proof-of-concept prototype.

8 Discussion

8.1 Smart Technologies and Community Engagement

Our co-design approach provided insights into community attitudes to smart city technologies. The survey responses demonstrated how the community is receptive to technology being introduced to address challenges relevant to them and improve council services. There was no statistical difference in preference on age group or gender, implicating that technology-focused solutions would be supported by all demographic groups. However, the council newsletter containing the survey was distributed primarily to ratepayers, who make up a large proportion of its subscribers. This may explain the older age demographic among survey respondents. To obtain a more diverse and representative sample, the survey was also shared within the CBD and among students at the local university campus. Similarly, to ensure a range of demographic perspectives were included, the selection of workshop participants was carefully considered in alignment with the developed personas.

While the survey results helped identify primary challenges to explore in the co-design workshop and informed the development of appropriate personas, we found that many responses were heavily fiscally focused, even when this was not directly relevant to the question asked. The survey did make it clear that the research aimed to gather opinions on technologies and related issues, rather than signal any commitment to future projects or expenditures. This reflects one of the key challenges councils face when engaging with communities: ratepayers are often concerned about potential wasteful spending on unsuccessful or non-essential projects.

By adopting co-design processes such as those presented in this paper, these concerns can be partially mitigated by demonstrating genuine community involvement. This way, technologies are developed collaboratively with the community, for the community, building trust and addressing both council and resident concerns.

8.2 Ideation Toolkits, Innovation and Creativity

During the workshop, both the Tiles IoT Inventor Toolkit and the Futurice IoT Service Kit proved to be useful methods of allowing the community to design smart city solutions to meet their needs, especially without advanced technological knowledge of IoT solutions. Participants stated that they felt their ideas were realistic, unique, and something they would use.

The timing of the workshop was kept short to be respectful of the limited time people had available as well as to ensure high workshop engagement. This allowed the groups to develop initial concepts suitable for further refinement as seen in [24]. This was useful leading into phase 3 as it provided enough information to allow a ranking to take place but also demonstrated to workshop participants the conceptual nature of the toolkits, in that ideas would be considered carefully and only those which ranked highly would be explored for further development. Working closely with the university also helped with this engagement as it was clear that the workshop process was beneficial to the students involved in learning about co-design.

8.3 Collaboration with Local Government

By incorporating council processes into phase 3 through the use of the ranking matrix we were able to determine which concepts should be investigated for future development. As mentioned previously in section 7, the Manu Meter concept has been chosen by council to develop as a proof-of-concept prototype in partnership with the University. This outcome is beneficial in three key ways: firstly, it enabled council to engage meaningfully with the community to design technology for the community with the community; second, it demonstrates that the co-design approach produced concepts that are feasible from a council perspective as well as relevant to the local area; and lastly, it requires minimal investment from the council to have an innovative smart technology developed with the University reducing the overall cost to the ratepayers.

8.4 Limitations & Future Work

In future iterations of the process, we aim to provide more examples of existing smart technologies to help participants think more creatively about the possibilities within the IoT space. Participants' ideation was often limited by the technologies included in the toolkit and their own prior knowledge or experience. While facilitators guided discussions beyond familiar technologies, such as smartphone applications, this constraint influenced the range of concepts generated and highlights the need for more comprehensive and diverse emerging technology co-design toolkits in the smart city domain.

The toolkits chosen were applicable for developing IoT solutions in smart environments. Of the two toolkits explored, participants expressed a preference for the Tiles IoT Toolkit, as its structured approach better supported their design process. In contrast, some participants found the Futurice toolkit's tokens confusing, particularly when the tokens did not directly relate to the specific challenges being addressed. This may have been influenced by the structure of the workshop. In future workshops, mapping tokens directly to the identified challenges may help reduce confusion and better support participant engagement.

Moving forward, our work will focus on further refining both the co-design process and toolkits, as well as advancing the Manu Meter concept in collaboration with the local council. Overall, these toolkits offer a valuable opportunity for community stakeholders to actively contribute to the development of technologies that address their city's unique challenges.

9 Conclusion

We present an approach for engaging in co-design practices and techniques for smart city development in an Australasian context, using Tauranga as a case study. The process involved three key phases: a *survey* to gather community perceptions and challenges for the city; a *co-design workshop* informed by the survey results, where participants designed concepts to solve challenges for their local community; and lastly, *analysis of these concepts* to select those feasible for further development with council.

The survey revealed strong community interest in technological solutions to urban challenges and produced design concepts unique to the city's needs. Participants' positive feedback to the workshop highlights the success of our co-design approach in facilitating meaningful engagement with the community for councils, effectively bridging the gap between needs and solutions. We also saw that highly scoring concepts (the Manu Meter and Cultural Tour) included elements distinctive to Tauranga such as: a particular type of water bomb originated in New Zealand, the Manu; or the rich history of Māori in Tauranga-Moana. These outcomes reinforce the need for localised co-design techniques to develop smart city technologies that are respectful and meaningful to community stakeholders.

Acknowledgments

We would like to acknowledge the University of Waikato's strategic partners at the Tauranga City Council for supporting this research. We appreciate the collaboration of Holly Simons and Dave Parsons on this project and thank all participants for their valuable contributions.

References

[1] Alvaro Aranda, Yuji Yamamoto, and Kristian Sandström. 2024. The Karakuri IoT toolkit: a collaborative solution for ideating and prototyping IoT opportunities. 4 (2024), 185–194. doi:10.1017/pds.2024.21

[2] Tuba Bakıcı, Esteve Almirall, and Jonathan Wareham. 2013. A smart city initiative: the case of Barcelona. 4, 2 (2013), 135–148. doi:10.1007/s13132-012-0084-9

[3] Big Belly. [n. d.]. *Big Belly*. https://bigbelly.com/

[4] Judy Bowen and Annika Hinze. 2022. Participatory data design: Managing data sovereignty in IoT solutions. *Interacting with Computers* 34, 2 (2022), 60–71.

[5] Kyungah Choi, Taesu Kim, and Hyeon-Jeong Suk. 2020. Lighting user experience (LUX) cards: a card-based tool for the design of smart lighting solutions. 33, 1 (2020), 55–65. doi:10.15187/adr.2020.02.33.1.55

[6] Monique De Costa, Nadia Anam, Jiayi Shi, Diego Muñoz, and Sonja Pedell. 2022. Walking in my shoes: Creating a toolkit for co-designing a shared vision for city development. (2022). https://dl.designresearchsociety.org/drs-conference-papers/drs2022/researchpapers/97

[7] Dries De Roeck, Pieter Jan Stappers, and Achiel Standaert. 2014. Gearing up! a designer-focused evaluation of ideation tools for connected products. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (New York, NY, USA, 2014-10-26) *(NordiCHI '14)*. Association for Computing Machinery, 521–530. doi:10.1145/2639189.2639204

[8] Ágatha Depiné, Clarissa Stefani Teixeira, Vanessa Eleutheriou, and Ingrid Azevedo. 2017. Smart cities and design thinking: sustainable development from the citizen's perspective.

[9] Massimiliano Dibitonto, Federica Tazzi, Katarzyna Leszczynska, and Carlo M. Medaglia. 2019. The IoT design deck 2.0: improving the tool for the co-design of connected products. In *Human-Computer Interaction. Perspectives on Design* (Cham, 2019), Masaaki Kurosu (Ed.). Springer International Publishing, 63–74. doi:10.1007/978-3-030-22646-6_5

[10] Zhiyong Fu and Xu Lin. 2014. Building the co-design and making platform to support participatory research and development for smart city. In *International Conference on Cross-Cultural Design*. Springer, 609–620.

[11] Futurice. [n. d.]. *The IoT Service Kit*. https://www.futurice.com/toolkits-and-frameworks/iot-service-kit

[12] Leeladhar Ganvir, Pratul Kalita, and Sachin Jansari. 2023. Shaping smart home product service system (SH-PSS) reflection criteria cards for 'Tiles IoT Inventor Toolkit'. In *DS 123: Proceedings of the International Conference on Engineering and Product Design Education (E&PDE 2023)* (2023). doi:10.35199/EPDE.2023.113

[13] Rosella Gennari, Maristella Matera, Alessandra Melonio, and Eftychia Roumelioti. 2019. A board-game for co-designing smart nature environments in workshops with children. In *End-User Development* (2019). Springer, Cham, 132–148. doi:10.1007/978-3-030-24781-2_9 ISSN: 1611-3349.

[14] Rosella Gennari, Maristella Matera, Diego Morra, and Mehdi Rizvi. 2022. A Phygital Toolkit for Rapidly Designing Smart Things at School. In *Proceedings of the 2022 International Conference on Advanced Visual Interfaces* (New York, NY, USA, 2022-06-06) *(AVI '22)*. Association for Computing Machinery, 1–5. doi:10.1145/3531073.3531119

[15] Carles Gomez, Stefano Chessa, Anthony Fleury, George Roussos, and Davy Preuveneers. 2019. Internet of Things for enabling smart environments: A technology-centric perspective. 11, 1 (2019), 23–43. doi:10.3233/AIS-180509 Publisher: IOS Press.

[16] Benedikt Haupt, Christian Pentzold, Alexa Becker, and Arne Berger. 2023. *Designing alternative future home stories*. Gesellschaft für Informatik e.V. https://dl.gi.de/handle/20.500.12116/43224 Pages: 893-898.

[17] IESE Business School. 2024. IESE cities in motion index 2024.

[18] Include. 2025. *Steora Cycle*. https://include.eu/b2g/steora/cyclo/

[19] Jane Vita. [n. d.]. *Service Sandbox*. https://www.servicesandbox.net

[20] Lee Jones. 2019. A co-design toolkit for wearable e-textiles. In *Adjunct Proceedings of the 2019 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2019 ACM International Symposium on Wearable Computers*. 363–366.

[21] Hiroko Kudo. 2016. Co-design, co-creation, and co-production of smart mobility system. In *Cross-Cultural Design: 8th International Conference, CCD 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17-22, 2016, Proceedings 8*. Springer, 551–562.

[22] Lukas Marek, Malcolm Campbell, and Lily Bui. 2017. Shaking for innovation: The (re)building of a (smart) city in a post disaster environment. 63 (2017), 41–50. doi:10.1016/j.cities.2016.12.013

[23] Simon Mark and Penny Hagen. 2020. Co-design in Aotearoa New Zealand: a snapshot of the literature.

[24] Anna Mavroudi, Monica Divitini, Simone Mora, and Francesco Gianni. 2018. Game-based learning for IoT: the Tiles Inventor Toolkit. In *Interactive Mobile Communication Technologies and Learning* (Cham, 2018), Michael E. Auer and Thrasyvoulos Tsiatsos (Eds.). Springer International Publishing, 294–305. doi:10.1007/978-3-319-75175-7_31

[25] Kelly Ann McKercher. 2020. Beyond sticky notes: co-design for real: mindsets, methods and movements. *(No Title)* (2020).

[26] Peter McKinlay. 2017. Make way for smart cities: opportunities, challenges and capacities of New Zealand local governments. 39, 4 (2017), 297–303. doi:10.1080/23276665.2017.1405627 Publisher: Routledge _eprint: https://doi.org/10.1080/23276665.2017.1405627.

[27] Simone Mora, Francesco Gianni, and Monica Divitini. 2017. Tiles: a card-based ideation toolkit for the Internet of Things. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (New York, NY, USA, 2017-06-10) *(DIS '17)*. Association for Computing Machinery, 587–598. doi:10.1145/3064663.3064699

[28] Dorian Peters, Lian Loke, and Naseem Ahmadpour. 2021. Toolkits, cards and games – a review of analogue tools for collaborative ideation. 17, 4 (2021), 410–434. doi:10.1080/15710882.2020.1715444 Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/15710882.2020.1715444.

[29] Kathleen Planckaert. [n. d.]. Exploring sustainable transition impact on public participation in Tactical Urbanism experiments in New Zealand. ([n. d.]).

[30] Alessandro Premier, Sameh Shamout, and Yusef Patel. 2023. Smart Solar Urban Furniture: A Co-Ideation and Design Process to Help Enhance the Urban Resilience of Auckland, New Zealand. In *International Conference on Resilient and Responsible Architecture and Urbanism*. Springer, 159–168.

[31] Qualtrics XM. 2025. *Qualtrics*. https://www.qualtrics.com/

[32] Mehdi Rizvi. 2021. Supporting end users in designing IoT SmartThings with the IoTgo toolkit: 2nd international workshop on empowering people in dealing with internet of things ecosystems 2021. 3053 (2021), 11–16. http://www.scopus.com/inward/record.url?scp=85122858443&partnerID=8YFLogxK

[33] Nelson Pacheco Rocha, Rute Bastardo, and João Pavão. 2022. Citizens' Participation in the Co-Design of Smart Cities' Applications, a Scoping Review. In *Proceedings of the 10th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion*. 172–177.

[34] Nelson Pacheco Rocha, Rute Bastardo, and João Pavão. 2022. Citizens' Participation in the Co-Design of Smart Cities' Applications, a Scoping Review. In *Proceedings of the 10th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion* (Lisbon Portugal, 2022-08-31). ACM, 172–177. doi:10.1145/3563137.3563141

[35] Elizabeth B-N Sanders and Pieter Jan Stappers. 2008. Co-creation and the new landscapes of design. *Co-design* 4, 1 (2008), 5–18.

[36] Iqbal H. Sarker. 2022. Smart City Data Science: Towards data-driven smart cities with open research issues. 19 (2022), 100528. doi:10.1016/j.iot.2022.100528

[37] Maria Schulders. 2022. Co-Creating Smart Cities – Design Thinking for 21st Century Urban Planning. XXV, 2 (2022), 301–315. https://ersj.eu/journal/2922

[38] Benjamin Stelzle, Anja Jannack, and Jörg Rainer Noennig. 2017. Co-design and co-decision: Decision making on collaborative design platforms. *Procedia computer science* 112 (2017), 2435–2444.

[39] Anthony M Townsend. 2013. *Smart cities: Big data, civic hackers, and the quest for a new utopia*. WW Norton & Company.

[40] Ilaria Vitali and Venanzio Arquilla. 2018. Developing a design toolkit for the Internet of Things. (2018). https://dl.designresearchsociety.org/drs-conference-papers/drs2018/researchpapers/90

[41] Fang Zhao, Olushola I. Fashola, Tolulope I. Olarewaju, and Ijeoma Onwumere. 2021. Smart city research: A holistic and state-of-the-art literature review. 119 (2021), 103406. doi:10.1016/j.cities.2021.103406

A Appendix

A.1 Community Technology Survey

Technology can help improve our services and make our city more liveable. We want to hear your views on community technology, like information kiosks and public Wi-Fi, to understand where it could make a difference. Join the University of Waikato and Tauranga City Council in a research project exploring co-designing community technology by completing this 10-minute survey.

A.1.1 Awareness. We already have some council provided community technology in place. Which of the following are you aware of? Please tick all that apply. [MULTIPLE CHOICE]

- Free Wi-Fi at the Mount.
- Free Wi-Fi at the city libraries.
- Information kiosks in outdoor spaces.
- Smart bins that tell us when they are full, so we don't need to check them as often.
- Digital signs showing parking availability at council carparks.
- Digital signs showing bus arrival times at bus stops.
- Payment kiosks at libraries.
- Smart street lights that we can dim remotely to save energy.
- Traffic counters.
- None of the above. [EXCLUSIVE ANSWER]

A.1.2 Interest in Future Technologies. What technology would you like to see more of in our community? Tick all that apply. [MULTIPLE CHOICE]

- Digital art, culture, and history displays.
- Free public Wi-Fi in other areas outside of the Mount and the city libraries.
- Smart council infrastructure, such as smart bins.
- Urban planning tools to view 3D city models and give feedback on the future of our city.
- Digital community messaging and signage in outdoor spaces, such as what's on listings, maps, transport information.
- Environmental monitoring and emergency response systems.
- Technology that fosters community innovation, such as open data for research.
- Interactive learning and technology for kids.
- Other, please specify: [OPEN TEXT]

A.1.3 Likelihood of Use. If these types of technologies were made available to the community, how likely would you be to use them in your daily life? [SINGLE CHOICE]

- Very unlikely.
- Unlikely.
- Neutral.
- Likely.
- Very Likely.

A.1.4 Technology and Community Outcomes. How important is it to you that technology helps provide the following outcomes for our community?

Technology should be accessible and help people feel included, safe, and connected. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Technology should help preserve and protect our environment and make council operations more sustainable. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Technology should enable council to plan thriving town centres, resilient infrastructure, and suitable community facilities. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Technology should make it easy to move around our city and use sustainable transport choices. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Technology should drive business growth and education opportunities, creating jobs, and a skilled workforce in Tauranga. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

A.1.5 Technology and Issues. How important is it to you that technology helps improve the following issues in our community? Traffic Congestion. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

A revitalised city centre. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Reliable and timely public transport. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Public Safety. [SINGLE CHOICE]

○ Not at all important ○ Not important ○ Neutral ○ Important ○ Very important

Visibility of available parking. [SINGLE CHOICE]

○	○	○	○	○
Not at all important	Not important	Neutral	Important	Very important

Staying informed and providing feedback on council decisions. [SINGLE CHOICE]

○	○	○	○	○
Not at all important	Not important	Neutral	Important	Very important

Other. [OPEN TEXT] [SINGLE CHOICE]

○	○	○	○	○
Not at all important	Not important	Neutral	Important	Very important

A.1.6 Council Services. Thinking about the following council services, in which order (from first to last) would you like to see them improved through the use of technology? [RANK]

- Roads, footpaths and cycle ways.
- Rubbish and recycling services.
- Building and planning.
- Outdoor spaces, such as parks.
- Public facilities, such as community centres.
- Drinking water, wastewater and stormwater services.
- Business licensing and compliance.
- Community services, such as events.
- Other, please specify. [OPEN TEXT]

A.1.7 Prevention of Use. Is there anything preventing you from using technology in our community's outdoor spaces or public facilities? Please tick all that apply. [MULTIPLE CHOICE]

- I have no need to use these technologies.
- I already have all the technology I require.
- Not interested in using technology/it doesn't appeal to me.
- Concerned about privacy or scams.
- Not confident in using technology.
- Technology is not designed to work with my disability.
- I do not have a device to connect to this technology.
- Other, please specify. [OPEN TEXT]

A.1.8 Examples & Feedback. Do you have any ideas for new technology or examples you've seen from other cities that could benefit our community? [OPEN TEXT]

Do you have any other feedback or comments you would like to make about council or community technology? [OPEN TEXT]

A.1.9 Digital Skills. How would you rate your digital skills when using community technology?

By digital skills, we mean how well you can connect to public Wi-Fi, use a kiosk to get directions, and find and pay for parking via an app. [SINGLE CHOICE]

○	○	○	○	○	○	○
Very low	Low	Somewhat low	Neutral	Somewhat high	High	Very high

A.1.10 Demographics. What is your age? [SINGLE CHOICE]

- Under 16.
- 16-24.
- 25-34.
- 35-44.
- 45-54.
- 55-64.
- 65-74.
- 75-84.
- 85+.
- Prefer not to say.

What is your gender? [SINGLE CHOICE]

- Female.
- Male.
- Non-binary.
- Other, please specify. [OPEN TEXT]
- Prefer not to say.

A.1.11 Workshop Participation. The University of Waikato and Tauranga City Council are undertaking a research project aimed at co-designing technology solutions with our community. This involves attending a two-to-three-hour workshop at the University of Waikato campus in the city centre. All collected information will remain confidential and you have the right to withdraw from the study up to two weeks after data collection. Your input may help shape future community technology in our outdoor spaces.

Would you like to participate in this project? [SINGLE CHOICE]

- Yes.
- No.

If yes, the following is displayed on the next page:

- First Name. [OPEN TEXT]
- Last Name. [OPEN TEXT]
- Email. [OPEN TEXT]
- Phone. [OPEN TEXT]

A.2 Ranking Matrix

Figure 10: Ranking Matrix

Project Scoring Criteria		Idea Scores 1-5
Cost	Estimated cost to deliver project: * $200k - 500K * $500k - 1m * $1m - 2m * $2m - 5m * $5m +	
Budget line	Is there existing budget available?	
Time	Estimated time required to complete project: * less than 5 months * 5 - 7 months * 7 - 9 months * 10 - 12 months * more than 12 months	
Deliverability	* Delivery model * Partners involved * Internal/external	
Effort	* Complexity * Resources required * Risk level	
Benefit	How significant is the benefit to the community or council operations?	
Outcomes	Smart Community outcomes the project will realise: * help to share stories about our community, history, and organisation * inform, engage, and activate our residents and visitors * facilitate the use of multimodal transport * create capacity for innovation across the community and organisation * improve council operations.	
Strategic fit	Community outcomes the project aligns with: * An inclusive city * Valued, protected and enhanced environment * A well-planned city * Moving around our city easily * Supporting business and education	
Novelty	Is it creative, innovative, new, unique, or exciting?	
	Total	