University of New England

School of Science and Technology

Public perceptions and user experience study on the use and adoption of a mobile internet e-Voting smartphone app within the Australian context

A portfolio submitted for the degree of

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Abstract

The Doctor of Philosophy (Innovation) (PhD.I) is a project-based higher research degree in which professional and industrial expertise combine with academic theory in the identification and creation of innovation. This innovation portfolio project is the culmination of a five-year journey on the first Australian university study on public perceptions and user experiences of using mobile internet e-Voting in the Australian context. This innovation portfolio project has produced baseline data on the perceptions of the Australian public, a prototype mobile voting smartphone app (the innovation), which allows for secure registration, casting a vote in a federal election and submitting a response to a national survey, and a user experience study on the app and A/B tests of various features.

Trust is a core foundation of user adoption and, as such, is the underlying theme of the portfolio. Guided by the technology acceptance model (TAM) (Davis, 1989), data collected from an anonymous survey on perceptions of the Australian public towards using a mobile internet e-Voting platform (N = 295) are presented and analysed. Of the respondents, 72.88% either Completely Trusted or Slightly Trusted government and commercial systems as opposed to 15.93% who either Completely Distrusted or Slightly Distrusted government and commercial systems. The survey also found that 75.25% of respondents were in favour of using mobile internet e-Voting, with 15.93% of respondents requiring greater information about the technology and 8.82% being against its utilisation. The top appeals of the platform were its mobility (91.40%), verifiability (72.90%) and

speed (72.50%), with the top concerns being manipulation (75.10%), retrieval (65.30%) and monitoring (63.20%) of cast votes by malicious parties or software.

This portfolio also provides a chronologically documented development journey of the “mobile voting app” project. Utilising the Scrum methodology, this portfolio documents the beginning of the development project (envisioning session), the product backlog construction, sprint cycles, retrospectives and features details. Next, the mobile voting app is user tested by way of qualitative in-depth interviews to gather perceptions of five participants from a young and tech savvy cohort who are likely to be early adopters (Rogers, 2010). This user experience study found that participants were pleased with the usefulness and simplicity of the app. Most participants stated that they would use the mobile voting app if it were made available in the next election. These findings correlate with the constructs of the TAM (Davis, 1989), which state that perceived ease of use (PEOU) and perceived usefulness (PU) directly influence a user's attitude towards new technology (A). Those who would not use the app in the next election were either those who had not voted in an Australian election previously and stated they would like to vote using paper ballots first then would use it in the following election or were those who has reservations about the technology and its usefulness, primarily around government support. These findings correlate with the unified theory of acceptance and the use of technology model (UTAUT) by Venkatesh, Morris, Davis, and Davis (2003), which states that the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system (facilitating conditions), directly influences the use behaviour and the moderating variable of experience.

This portfolio concludes with a personal reflection on the findings and process of the works undertaken, the anticipations for this research and potential pathways for further development and application. Commentary is also provided on public events that occurred during the time of the research that widely impacted on public perceptions of the technology, including the 2016 census debacle, the 2015 NSW iVote hacking report and the Russian interference in the 2016 US presidential elections.

Certification of Dissertation

I certify that the substance of this portfolio has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this portfolio and all sources used have been acknowledged in this portfolio.

[redacted]

Phillip Zada

Acknowledgments

This innovation portfolio project is the culmination of a five-year journey. Originally earmarked for a PhD and later migrated to a PhD.I, this scope of work provides insight into said journey, experiences, milestones and achievements. Although the journey has not been without its bumps, there are key people who have helped guide me to this point whom I wish to acknowledge.

Firstly, my thanks go to my supervisory team, Dr Greg Falzon, Professor Paul Kwan and Mr Ian Brightwell. Thank you for accepting to come along with me on this journey. I greatly appreciate the time, wisdom and support network that you all devoted to me and this portfolio. This portfolio (and my personal growth) would not be what it is without all your tutelage.

I would like to extend a special acknowledgement to Dr Greg Falzon for the years of late-night calls when you were ready to answer my questions, weekends spent reviewing and providing feedback on the portfolio, collaborative discussion and especially the talks of encouragement to keep going in the trying times. You have been a true mentor, scholar and good friend.

Thank you to Dr Philip Thomas for supporting me through my transition to a PhD.I. Your advice and support really helped to direct me and the project to an outstanding outcome. I especially appreciate the advice to lighten up and to just have fun with it. Thanks also to Ms Susan Jessop, whose assistance with refinement of the final output really gave this portfolio the Midas touch. Your open collaboration and guidance, quick response, extensive knowledge and patience was greatly appreciated. You are a true master of your craft.

Special thanks go to my parents, Elias and Chafica Zada. I will never forget the sacrifices you have made raising me. You instilled in me lessons about working hard, family values and reiterating that a great education is the key to a great life. I love you very much and this doctorate is as much a salute to the both of you as it is an achievement for me.

Thank you also to my little ones, Eli Thomas and Selina Rose Zada. You are my heart and the drive in my life. Whenever I felt stressed or drained, I just think of your smiles and the world brightens. This journey would not have been what it is without the memories of you coming to me half asleep in the middle of the night and sleeping in my arms whilst I worked. Let's not forget the multiple times where I found both of you contributing to work; thank you for that, it was greatly appreciated.

Finally, I would like to acknowledge my love, soulmate and wife, Anna Melhem Zada. You have stuck by me through thick and thin. Your encouragement and support to continue my master's and later my doctorate will never be forgotten. I can never repay you for all you have done to support me through this journey, and the sacrifices you have made. You have blessed me with a beautiful family and have been the constant drive; you are my wonder woman. I love you very much and hope that one day I can do for you what you have done for me.

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List of Terms

Agile methodology / Agile software development methodology
A globally recognised and implemented standard by which many organisations conduct an iterative, collaborative, incremental approach towards project management, primarily software development.

Agnostic app / Device agnostic app
A mobile app that can be used on any modern Smartphone device regardless of operating system.

Air-Gapped Server
A server without an internet connection and therefore not susceptible to outside attack.

Backlog construction / Product backlog construction
The process of creating high-level product backlog item definitions. A backlog is a list of tasks (user stories) which need to be completed as part of a project.

Cryptographic Voting Protocol
The process involved utilising cryptography to provide trust and integrity to a voting system.

Development technology stack
A combination of programming languages and software products used to create a software solution.

Distributed trust
Using multiple independent distributed systems to perform trusted tasks that then form part of an overall process or workflow.

Epic (in relation to scrum)
An epic is a large user story that can span multiple sprints. Epics, in turn, are broken down into features and then further into user stories.

Facilitating conditions
A construct of the unified theory of acceptance and use of technology. It is the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system.

Feature (in relation to Scrum)
A feature is a set of user stories encompassing functionality available by a product or system.

Internet e-Voting
An election or referendum that involves the use of the internet for at least the casting of a vote.

Mobile internet e-Voting
An election or referendum that provides at least the casting of a vote, either during advanced polling or on election day(s), via any mobile Smartphone device that is connected to the internet.

Preference selection
The action of a voter individually numbering and ranking candidates according to their preferences.

Retrospective
A meeting that is held at the end of an iteration (or sprint cycle). During this time, the team reflects on what happened during the period of work, what worked well, what did not work well and what improvements could be made moving forward.

Scrum
An implementation of the agile methodology, Scrum is a lightweight process for managing and controlling software and product development in rapidly changing environments (Cervone, 2011).

Sprint cycle
A sprint cycle is an allotted fixed period of time in which user stories are completed.

User story
A user focused non-technical descriptive unit of work. A user story encompasses information for a team on why the unit of work is required and what value it provides to the user.

The Nature of an Innovation Portfolio Project

The Doctor of Philosophy (Innovation) (PhD.I) is a project-based higher research degree in which professional and industrial expertise combine with academic theory in the identification and creation of innovation. The program consists of two phases: (1) Research Learning Program, and (2) Innovation Project Portfolio.

An innovation portfolio, as opposed to a dissertation, is a journey. When originally enquiring about this doctorate, as later discussed throughout this portfolio, I was quite intrigued by that term, “a journey”. What kind of journey would this breadth of works take me on? To answer that question, I started at the beginning.

Planning the journey is the first task. It involves meticulous research within the realm of academic, scholarly literature, undertaken within an industry or professional context. This plan also involves understanding the context within which the journey unfolds. Once this baseline context and scholarly research is understood, the path is made clearer. Once understood, the works continue based on the conceptualisation of the innovation, its development, impact and evolution, and self-reflection on the work undertaken.

A PhD.I (formerly known as a Professional Doctorate) is suited for candidates who have considerable industrial experience and wish to have qualifications that represent both academia and industry.

This innovation portfolio project addresses the feasibility and application of a mobile internet voting platform in the Australian context. The research into mobile voting was undertaken originally as part of a PhD to academically solve the question, “why aren’t we voting online in Australia yet?”. Throughout my PhD research, I uncovered a plethora of research on internet e-Voting internationally but there was not much research within the Australian context. A transition to a PhD.I was a key decision that I stand behind, as it allowed me to take the research further and produce a tangible innovation.

This innovation portfolio project documents the journey from the initial conception through to the development of a prototype mobile voting app. Although in its infancy, the application that is developed as part of this project incorporates identified theories and functionality and is then user tested.

My personal goal with this project is not just to build another app, but to combine academic and industrial learning to build an application that potentially evolves or makes way for the implementation of mobile internet voting in Australia.

Portfolio Compilation

This innovation portfolio comprises three distinct knowledge pillars:

1. **Innovation Conception and Development History**, focusing on research conducted both in Australia and internationally.
2. **Innovation Impact and Change Evidence**, focusing on a short-fall of evidence that leads to an Australian university national survey, followed by the development of a public response.
3. **Reflections and Anticipations**, focusing on the innovation portfolio works and future implications, outcomes and challenges.

The first pillar sets out to convey an integrated critical analysis of the development history of the innovation. This pillar will provide a descriptive narrative of the research undertaken, which provided the scholarly research and context upon which the innovation was based. In this part of the portfolio, I also set the quality criteria used to guide the development process and set the approach to the analysis of the innovation.

The second pillar provides the development of the innovation through academic research. There are two components. The first half of the innovation was the first Australian university national survey of its kind. This survey lead to the second half of the innovation, which is the design and implementation of a prototype mobile voting application, through which the previous findings could be tested in a simulated real-world scenario by members of the public during focused interviews. The findings are then assessed to determine user experience and trust.

The third pillar is where I can step back and reflect on the research. Through various lenses, I consider what the innovation means for me as a candidate, what it means from a professional/industry view and what this innovation means from a wider social standpoint. Limitations of the innovation and future transitions will also be discussed.

Chapter Outline

Chapter 1 – Context

Chapter 1 introduces the author, the context of internet e-Voting, properties of electronic voting, high-level trial analysis and the literature review on technology acceptance models and agile methodology. The literature review was originally quite extensive, and only certain components were chosen to be included in this innovation portfolio project. The literature review was revised because I felt that the portfolio needed to focus solely on scholarly research that directly set the context and shaped the development of the innovation.

Chapter 2 – Research Configuration

Chapter 2 continues from the first chapter and fleshes out the design concepts for the national public survey, the development methodology and the application development process undertaken to build the application. The chapter concludes with the ethical considerations that were identified prior to building the innovation.

The overall aim of the research configuration is to present the methodology used for the development of the innovation.

Chapter 3 – Innovation Portfolio Project

Chapter 3 presents the innovation portfolio project. It has three key components:

1. Public survey
2. Application development
3. In-depth interviews.

To illustrate the three components, and to provide an immersive journey for the reader, each component of this project is provided as an interactive experience in the appendices indicated.

The first component, the public survey, was developed as a result of identifying a knowledge gap within the Australian context when I was researching mobile internet voting. A national public survey was designed and conducted to discover what Australian opinions and thoughts were about mobile internet voting. Although this piece of research was intended to be used as part of a PhD, I believe it to be a key part of the innovation rather than a precursor.

Survey Interactive Experience: See Appendix 11 for instructions.

The application development section describes the development process and undertakings required to build the prototype application. This component shows how the application was developed based on data gathered from the public survey and some industrial experience related to the design aspects.

Mobile Voting App Interactive Experience: See Appendix 12 for instructions.

The last component is the conduct of in-depth interviews to capture public feedback on the prototype application. This component presents findings from the interviews and analysis of the results. This section includes reflection on the findings, including potential evolution of functionality.

In-depth Interview Interactive Experience: See Appendix 13 for instructions.

Chapter 4 – Reflections and Outcomes

Chapter 4 presents the learning outcomes of the innovation portfolio project. Within this chapter, I provide reflections on the works undertaken, discuss and comment on various public events that occurred during the time of this research and present anticipations for the research. This chapter concludes with a final reflection and the conclusion of the innovation portfolio.

Chapter 1 Context

1.1 Author in context

I have always found myself drawn to creating solutions to improve on the current. As an example, while working as a sales executive in 2006, I found myself in a situation where I was required to find an alternative method for interacting with our affiliates and their customers. The process being used at the time involved the affiliates printing, hand writing and faxing documentation to complete a purchase. At the time, I had next to no skills in software development (other than basic programming classes at school between 2000 and 2002), but I took it upon myself to learn Adobe Forms programming. Within weeks, the new forms had improved the affiliate experience, reduced human error and provided an overall more pleasant experience.

At the time, I was in my first year of a Bachelor of Business degree, and the rewarding feedback from my programming efforts encouraged me to switch to a Bachelor of Computer Science. Since then, I have never looked back. Fast forward four years, the Adobe Forms evolved to web-based procurement and a customer management application that controlled all interactions with affiliates and their orders from start to finish.

In early 2011, I decided to step out on my own, get married, move to a new state and start my own company. Z Ware Development (www.zware.com.au) was born, and as technologies (specifically web technologies) have kept evolving, my team and I have helped organisations keep up with the technologies, achieve automation and systematisation of current tedious operations and provide better experiences for their staff and customers.

In 2012, I decided to continue my academic research and, having completed a Master's in Computer Science, a PhD was the next logical step. After spending some time digging around on top topics, it suddenly came to me, "wouldn't it be great to be able to vote online?" Therefore, I scheduled a meeting with an Australian Electoral Commission officer at a Melbourne branch office and went to find out what was happening in the space and to present my proposal. After a 20-minute discussion, the officer told me that she had met with two other people that morning with the same sort of idea and they were from an international organisation: in other words, I was a small fish in a very large pond.

After discussions with multiple universities and a few rejections, I had a meeting with a lecturer at the University of New England, where I was provided with an opportunity to tell my story, and I decided on a title for my research: *Developing a viable remote e-Voting solution for Australia*.

I started my research in late 2012, and I was surprised at how much had been done on the topic of online e-Voting solutions. This was a challenge for me as I did not want my research to be reinventing the wheel. I looked at many different angles, including cryptography, protocols and methodologies, but all had been extensively researched. However, I was not deterred. I continued with my investigations to find out how I was going to approach my research.

Everything changed in 2013, as my supervisor at the university had left and I was in the wind about what to do. I had been in discussions with the university about continuing my research, and I met with my current supervisory team. They agreed to take on the task, and we spent a couple of months trying to pinpoint the angle from which I would approach the research.

We found that one of the underlying factors in this area of research is that no matter how much research is done on a technology/protocol and it is proven to work, if the stakeholder does not trust that it is secure and reliable, then it will not be utilised. Hence, my research was retitled: *A vulnerability analysis on the adoption of internet e-Voting in Australia.*

The birth of my son, Eli, in 2013 was also a special year for me. Eli not only changed by life, but also gave it a new purpose and provided me with frequent opportunities to hone my solution-finding skills. On the day of the 2014 Victorian State Election, my wife and I were getting ready to go to the local school to cast our vote, but my son was quite ill that day, so there were some challenges. After spending 20 minutes trying to find a place to park, then getting Eli out of the car, setting up the pram, pushing through the bombardment of the party faithful and waiting in a queue of about 100 people for at least 30–45 minutes, it came to me that there must be a better way to do this.

After discussions with the research team, the research was refocused (again) on a mobile e-Voting solution and retitled: *A vulnerability analysis on the adoption of mobile internet e-Voting in Australia.*

The first step was to develop a baseline for the Australian context of a mobile e-Voting platform. To achieve this, we conducted a survey of the public during the NSW 2015 State General Election. The resulting paper, "Perceptions of the Australian public towards mobile internet e-Voting: Risks, choice and trust", was published in 2016.

In 2016, my wife and I were blessed with a second bundle of joy, our daughter, Selina. Having two children and running my own business, on top of mounting pressures at work, meant I had to suspend my candidature until the dust settled.

Coming back to the research in 2017, much had happened in the technological arena in the interim that would make my research more challenging. There had been the census debacle, and international hacking (or the threat of) was occurring on a regular basis (discussed in Chapter 4), so trust was going to be harder to achieve. I was then introduced to the PhD.I program, which I felt was the perfect fit for what I needed to achieve. As an individual, and because of the experiences in my journey thus far, I knew the only way for my research to have a real effect was to combine what I do in my day-to-day work and the academic word.

1.2 Internet e-Voting context

After reviewing and collating a plethora of academic research in the area of internet e-Voting, I needed to put into context what I was trying to achieve with my research. More to the point, I needed to hone my research to be able to place it in its categorical niche. Early into my research, my academic supervisors asked me what internet e-Voting was and to describe it; I must admit, I stumbled.

Certainly, I was able to explain the concept and the intended outcome, but I could not provide sufficient detail to "discuss" it.

Taking advice from the team, I went back to the drawing board. I needed to understand the underlying concept of e-Voting, the various types of internet e-Voting and what e-Voting needs to deliver, but, more importantly, I needed to put it into an Australian context.

E-Voting refers to an election or referendum that involves the use of electronic means for at least the casting of the vote (Caarls, 2010). Even though variations of electronic voting has been available and in use since the 1960s, internet e-Voting is still a relatively new area. Since its first use during the 1996 United States Reform Party Presidential primary election (Holmes, 2012), there have been many trials and implementations of internet e-Voting (Allen Consulting Group Pty Ltd., 2011; Barry et al., 2013; Brightwell et al., 2015; Estonian National Electoral Committee, 2010; E-voting experiments end in Norway, 2014; Huycke et al., 2012).

It is always prudent to identify variations (or alternatives). Internet e-Voting variations can be broken down into three different types (Caarls, 2010; Electoral Council of Australia and New Zealand, 2013; Victorian Parliament Electoral Matters Committee, 2017):

1. **Kiosk voting:** The ability to cast an online ballot via a designed electronic polling booth. Kiosk voting falls under the category of a non-remote-controlled environment.

2. **Mobile internet voting:** The ability to cast an online ballot via a device that is managed and delivered by the election body. An example could be the use of a portal device that is delivered by an official to an elector to cast a ballot. This form of internet e-Voting falls under the category of a remote-controlled environment.
3. **Remote internet voting:** The ability of an elector to cast a vote, either during advanced polling or on election day(s), via any computing device that is connected to the internet, which can be a personal computer or a mobile device. This form of internet e-Voting falls under the category of an uncontrolled environment.

For this innovation portfolio project, I will be presenting findings within the context of mobile internet e-Voting, as a subset of remote internet voting.

The environmental classifications of uncontrolled, non-remote-controlled and remote-controlled can also be applied to categorise the system further. The subsections below provide information on these environments from Cetinkaya and Doganaksoy (2008), Electoral Council of Australia and New Zealand (2013), Esteve, Goldsmith, and Turner (2012) and Peacock, Ryan, Schneider, and Xia (2013).

1.2.1 Uncontrolled internet voting

An uncontrolled internet e-Voting system allows electors to cast an online ballot via their own internet-connected device. This system can be a computer, smartphone, tablet, etc. The main concern with uncontrolled internet voting is that the device used by the elector could be compromised and the principles of internet e-Voting could be put at risk. For example, an elector might have malicious software on their device that takes screen grabs of internet sessions and distributes them to a third party. This malware could capture how the person voted, hence failing the requirement for secrecy.

There are also positives in an uncontrolled internet e-Voting environment, such as not having to attend a polling station on election day and being able to cast one's vote anywhere an internet connection is available. This ease of access could potentially assist with increasing voter turnout and assist people with disabilities who cannot attend a polling station.

1.2.2 Non-remote-controlled internet voting

Non-remote-controlled internet e-Voting is the ability to cast a vote at a designated location on a device that has been provided and maintained by the election body. As mentioned earlier, a kiosk voting system is a perfect example of this technology.

The downside of this type of system is that even though it does replace paper and pencil voting, it is still necessary to attend a polling station. The positive is that the user can be confident that the device is free of any malicious software and that the vote has been cast successfully.

1.2.3 Remote-controlled internet voting

Remote-controlled internet e-Voting is the ability of an elector to cast a ballot on a device that is controlled and maintained by the election body. This device as mentioned in the example of mobile internet voting can be delivered by an official to the elector to cast a ballot. This type of environment is beneficial for people with disabilities who cannot attend a polling station.

The uncontrolled internet e-Voting environment will be the primary focus of this portfolio. It is also important to mention there are forms of voting that do not fall into the category of internet e-Voting but have been used in the past to capture votes. These include:

- fax voting
- voting through a call centre
- remote telephone voting
- SMS voting
- voting on a designated voting device (or computer) within a closed, isolated network and not connected to the internet (Electoral Council of Australia and New Zealand, 2013, p. 14).

1.2.4 Properties of electronic voting

A secure and robust design is critical for the implementation of any e-Voting protocol. For e-Voting to be a successor to paper-based ballots, it must meet, if not surpass, the security requirements (i.e. guarantees) currently provided by paper-based ballots (Fouard, Duclos, & Lafourcade, 2007). Fouard et al. (2007) stated these guarantees as:

- the votes are counted as cast (Accuracy)
- only authorised voters by law can participate in the election (Eligibility)
- no participant in an election can gain any knowledge of the tally before the end of the voting period to ensure that all candidates are given a fair decision (Fairness)
- votes are kept a secret and that no participant (excluding the voter) should be able to link the vote back to the voter before, during and after an election (Privacy)
- a voter cannot be able to obtain or construct a receipt that can prove the content of their vote during and after the election ends (Receipt-Freeness)
- n[1] parties or authorities cannot disrupt or influence the election, including the final tally (Robustness)
- the voting process is transparent (Transparency)
- only one vote per voter is counted in the final tally (Uniqueness)
- a coercer should not be able to extract the value of a vote and should not be able to pressure the voter to cast a vote in any particular way (Uncoercibility)

[1] n denotes any number

- voters and authorities can verify, independent of the election system, that votes have been recorded, tallied and declared correctly (Verifiability).

The following sections elaborate on the guarantees of paper-based voting, illustrating how they can be applied to the requirements of an e-Voting system.

Accuracy

> *Accuracy is the ability of an e-Voting protocol to ensure that the votes are counted as cast.*

Benaloh and Yung (1986) and Fouard et al. (2007) synonymise accuracy as correctness, while Fujioka, Okamoto, and Ohta (1993) use the term completeness. Fouard et al. (2007) provide the definition "If all the election's participants (voters, authorities, ...) are honest and behave as it is scheduled, then the final results are effectively the tally of casted votes" (p. 6). Cetinkaya and Cetinkaya (2007) clarify accuracy to mean that "Any vote cannot be altered, deleted, invalidated or copied. Any attack on the votes should be detected. Uniqueness should also be satisfied for accuracy" (p. 119).

Eligibility

> *Eligibility is the ability of an e-Voting protocol to ensure that only authorised voters by law can participate in the election.*

Cetinkaya and Cetinkaya (2007) and Gritzalis (2002) suggest that eligibility can be achieved through the registration of eligible voters before election day, with only registered voters being able to cast a vote. By having voters register, their eligibility can be verified and their attendance during an election can be "marked off'. Gritzalis (2002) also states that registration of voters can ensure that the property of Uniqueness is addressed; that is, no one would be able to vote more than once.

Fairness

> *Fairness is the ability of an e-Voting protocol to ensure that no participant in an election can gain any knowledge of the tally before the end of the voting period, which, in turn, ensures that all candidates are given a fair decision (Cetinkaya & Cetinkaya, 2007; Fouard et al., 2007; Gritzalis, 2002; Juang, Lei, & Yu, 1998).*

Knowing the tally during the polling period could potentially change the outcome of an election by affecting the intentions of any voters who have not yet cast their vote (Juang et al., 1998; Rjašková, 2002).

Privacy

> *Privacy is the ability of an e-Voting protocol to ensure that votes are kept a secret and that no participant (excluding the voter) should be able to link the vote back to the voter before, during and after an election (Cetinkaya & Cetinkaya, 2007; Fujioka et al., 1993; Juang et al., 1998; Rjašková, 2002).*

Privacy can also reinforce the Robustness requirement. Fouard et al. (2007) distinguish two levels of privacy:

Perfect privacy: No coalition of participants (voters or authorities) that does not contain the voter themselves can gain any information about the voter's vote.

n-Privacy: No "n-coalition of participants" that does not contain the voter themselves can gain any information about the voter's vote (an "n-coalition of participants" means a coalition of at most n authorities and any number of voters).

Receipt-Freeness

Receipt-Freeness is the ability of an e-Voting protocol to ensure that a voter cannot obtain or construct a receipt that can be used to prove the content of their vote to a third party either during the polling period or after it ends.

The purpose behind this requirement is to prevent vote buying or vote selling (offering rewards in exchange for vote choices (Nichter, 2008)). It is worth mentioning that even though receipt-freeness prevents vote buying/selling, Oppliger, Schwenk, and Helbach (2008) identify that another special form of vote selling remains, in which a voter may sell his/her voting credentials to a third party who can then use said credentials to cast a vote as the selling voter.

Robustness

Robustness is the ability of an e-Voting protocol to ensure that N parties or authorities cannot disrupt or influence the election, including the final tally.

Synonyms of robustness are n-Robustness (Fouard et al., 2007), soundness (Fujioka et al., 1993) and coercion-resistance (Weber, 2006). There are numerous ways in which an e-Voting protocol can be compromised (e.g. a majority of dishonest authorities (Cetinkaya & Cetinkaya, 2007) or cheating voters (Rjašková, 2002)), but these circumstances can occur with most election protocols. Preventative measures can be put in place to attempt to ensure the robustness of an e-Voting protocol. These robustness measures should aim to ensure that an e-Voting protocol can tolerate a certain number of dishonest participants (Lee et al., 2003).

Transparency

> *Transparency is the ability of an e-Voting protocol to ensure that the voting process is transparent.*

Transparency inspires confidence and ensures trustworthiness. Transparency is crucial as it will influence whether the election results are accepted (Enguehard, 2008). Enguehard (2008) states that "the election system should provide sufficient evidence to convince the losing candidate that he or she lost" (p. 3). Bulletin boards have been presented as appropriate mechanisms for publicising the election process (Cetinkaya & Cetinkaya, 2007; Ryan & Teague, 2009) and providing the public with the ability to conduct their own tallies without revealing who cast which vote. Transparency is a requirement that can be achieved in part by Verifiability.

Uniqueness

> *Uniqueness is the ability of an e-Voting protocol to ensure that only one vote per voter is counted in the final tally.*

Uniqueness is a "synonymisation" of prevention of multiple voting/double voting (Lee et al., 2003; Rjašková, 2002). Uniqueness should not mean un-reusability, as reusability is the ability for voters to cast multiple votes; however, when ensuring the uniqueness requirement, only one of a voter's votes should be counted in the final tally. Reusability is further clarified with the requirement of Uncoercibility.

Uncoercibility

> *Uncoercibility is the ability of an e-Voting protocol to ensure that a coercer is not able to extract the value of a vote or pressure a voter to cast a vote in a particular way.*

As defined, the requirement of Receipt-Freeness removes an avenue through which a voter can be coerced. Oppliger et al. (2008) present protection measures that can potentially address this requirement, such as recast ballots and multiple code sheets (when code voting is a component of an e-Voting protocol).

Verifiability

> *Verifiability is the ability of an e-Voting protocol to ensure that voters and authorities can verify, independent of the election system, that votes have been recorded, tallied and declared correctly.*

Kremer, Ryan, and Smyth (2010) and Sako and Kilian (1995) provide two categories for verifiability: individual and universal. Universal verifiability is where "Anyone can independently verify that all votes have been counted correctly" (Cranor & Cytron, 1997), and individual verifiability is where "Every eligible voter can verify that his vote was counted" (Rjašková, 2002, p. 9).

1.2.5 Australian context

An interesting commonality of the research material I had discovered was that despite a few Australian-based reports and research materials (Australian Electoral Commission, 2007; NSW Electoral Commission, 2010; PwC, 2011), most published works were based within respective international contexts and there appeared to be a lack of research in the Australian context. Therefore, as this research involved the Australian context, I had to further grow my research foundations and understand internet e-Voting within the Australian context, including its constraints and what achievements an internet e-Voting platform could potentially provide.

Australia (more specifically Victoria) introduced the secret ballot in 1856 and was the first country to do so. It was a revolutionary move for its time and presented Australia at the forefront of democratic innovation (Dryzek, 2009). This secret ballot was later known as the Australian Secret Ballot (Australian Electoral Commission, n.d.). The system worked on the basis that the government printed the paper ballot with the candidates' names in a fixed order. The ballots were then counted by hand.

One of the pushes internationally for the implementation of technology in the electoral process is to address a reduction in voter participation and a loss of interest in the democratic process (Goodman, 2014). In Australia, voting has been compulsory since it was introduced into federal elections in 1911 (Australian Electoral Commission, 2016). As of 2006, Australia was one of 32 countries with

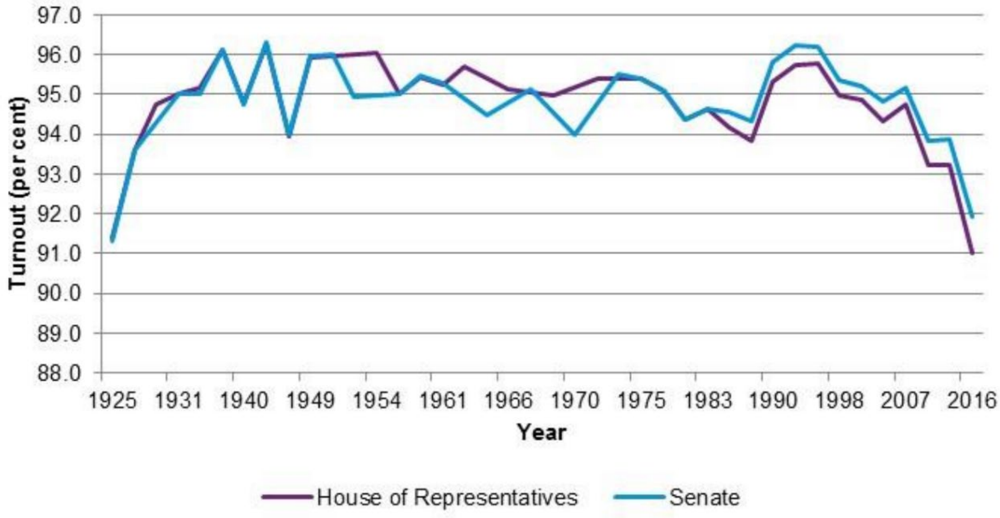


Figure 1-1 Voter turnout, 1925-2016 House of Representatives and Senate elections (Australian Electoral Commission, 2016)

compulsory voting and one of 19 that pursue it through enforcement (Evans, 2006). Due to this enforcement of compulsory voting in Australia, voter turnout has not fallen below 90% since 1924 (Goodman, 2014), with 2016 recording one of the lowest recorded turnouts since 1925 (Australian Electoral Commission, 2016)(Figure 1.1). As of March 2018, 96.3% of eligible Australians were enrolled to vote.

A report published by the Australian Electoral Commission (2016) found that the record low level of voter interest in the 2016 Federal Election may have correlated with a record low level of satisfaction with democracy and trust in government.

A paper released by Australia Post (Australia Post, n.d.) stated various factors such as timing or choice could have also had a negative impact on turnout, and a more convenient channel for voting could have improved the number of ballots and the speed of delivery of a result.

In Australia, the iVote 2011 and iVote 2015 implementations conducted by the NSW Electoral Commission have been the most extensive to date within Australia, and these will be analysed in Sections 1.3.1 and 1.3.2, respectively. The Australian Defence Force conducted a remote electronic voting trial of 1511 personnel in 2007 (Electoral Council of Australia and New Zealand, 2013).

As mentioned previously, uncoercibility is one of the primary protocols of an internet e-Voting platform. With regard to the Australian context, risk of voter coercion is considered low (Brightwell, Cucurull, Galindo, & Guasch, 2015), which allowed the NSW Electoral Commission the opportunity to both provide receipts and publish all the preferences made by voters after the election during the 2015 iVote implementation (Brightwell et al., 2015).

1.3 Trial analysis

Having completed my preliminary discovery and put the research objectives and constraints into context, I was prepared to address the question, "what is internet e-Voting?", during our next team discussion. This time I was able to not only define what it was from an academic perspective but also comment and present arguments about each categorisation.

Naturally the discussions that followed were in relation to where the research would go from that point. I still felt there was something missing from my research, and I needed to understand more. Rather than jumping in head first, I wanted to establish a strong foundation and apply a key principle that I have applied in my professional career as a rule of thumb when beginning a new project, which is "do not reinvent the wheel".

With that in mind, I wanted to investigate and undertake a mini-analysis on what had already been done in the area of e-Voting. I wanted to keep the premise of the Australian context and the best example of this was the iVote 2011 trial (PwC, 2011) and the 2015 iVote implementation (Brightwell et al., 2015). However, the research team suggested I also investigate a few international implementations and trials. There was a wide selection, so I chose the Estonian 2005–2014 trial, the Canadian Markham 2003, 2006 and 2010 trials and the Norwegian 2013 trial.

There is a plethora of source material on other e-Voting trials and implementations around the world, which include, but are not limited to, Switzerland, France and the United States. The trials selected for closer review provided information on issues that were considered relevant to this study. The Australian iVote 2011 and 2015 implementations were chosen as they apply to the Australian context, Estonia was selected as it offers internet voting for the entire electorate, while the Canadian trial was implemented on a smaller scale, and Norway was selected as it was a trial that has since been abandoned.

The following sections provide brief reports on each trial/implementation, including implementation and outcome overviews.

1.3.1 iVote Australia 2011

1.3.1.1 Introduction

According to the NSW Electoral Commission (2010), on 16 March 2010, the NSW Premier requested that the NSW Electoral Commission (NSWEC) investigate in the form of a feasibility study the possibility of remote electronic voting (e-Voting) for vision-impaired and other disabled persons, with the main outcome being to enable people to cast secret ballots (the same principle as the "Australian Ballot" (Australian Electoral Commission, n.d.)). This action came about after the New South Wales Electoral Commission was found to have discriminated against a visually impaired man who was not able to cast a secret ballot in Braille during the 2004 local government elections (Disabled "deserve secret ballot", 2008).

The report stated that after initial consultations, it became apparent that an electronic voting system would benefit not only visually impaired and disabled people but also a broad range of stakeholders. This change of focus redefined the stakeholder group for the investigation to:

- people who are blind or vision-impaired (approx. 70,000 electors)
- people with other disabilities (approx. 330,000 electors)
- people in remote locations (approx. 6500 electors).

After assessing the number of stakeholders, it was presumed that the potential uptake rate for votes cast using the remote e-Voting system would be about 1% to 3% (approximately 5000 to 15,000) if introduced for the 2011 State General

Election (SGE 2011). While the bill to implement iVote was being debated the then opposition moved a motion to expand the eligible voters to include electors outside NSW on election day. This turned out to be the most dominant group of voters (Allen Consulting Group Pty Ltd, 2011).

During the research and consultations, it was identified that the word “electronic” had been a barrier to the adoption of e-Voting in previous trials. It was recommended that branding be used to identify any remote e-Voting system, and hence iVote was selected. The iVote system would open 12 days before election day to allow registered voters to be able to cast their vote (NSW Electoral Commission, 2010).

1.3.1.2 Implementation

Following the 2011 NSW State General Election, the Allen Consulting Group Pty Ltd (2011) provided an independent evaluation of the implementation of the iVote system. The report stated that the iVote system allowed electors to cast their vote from any computer that had access to the internet or a phone. Eligible voters who wanted to use iVote were required to pre-register via phone or internet. Eligible voters were also required to provide the reason for registration. Upon registration, a six-digit passcode (PIN) was provided by the eligible voter. After registration, an eight-digit voter ID (VIN) that was generated by the NSW Electoral Commission was sent by mail to the home address. The use of the eight-digit voter ID and the six-digit password provided a form of two factor authentication (NSW Electoral Commission, 2010).

When the election period opened, the voters used their eight-digit voter ID and six-digit passcode to cast a vote. Once the vote was successfully cast, the voter was provided with a receipt number that could be used to confirm receipt of the vote. This receipt number, however, could not be used to confirm how the elector cast their vote (Allen Consulting Group Pty Ltd, 2011). The electronic ballot box was also taken offline and processed on an air-gapped server.

1.3.1.3 Outcome

When pre-registration was made available, 84% of eligible voters registered via the internet and 16% of eligible voters registered via the call centre (Allen Consulting Group Pty Ltd, 2011). The following figure presents a percentage comparison of the people registered for iVote by reason for registration and registration method.

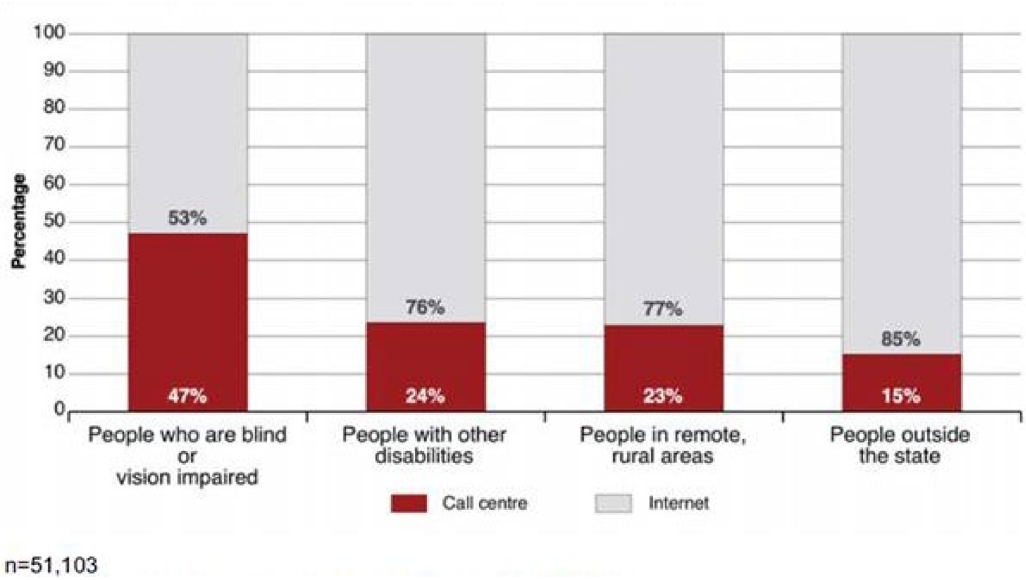


Figure 1-2 Comparison of people registered for iVote by reason for registration and registration method, Per Cent (Allen Consulting Group Pty Ltd, 2011)

During the usage of the iVote system in the SGE 2011, there were 51,103 registered iVote voters, 46,864 (91.7%) of whom used the service. The following table represents the estimated and observed iVote take-up rate of people for the NSW 2011 State General Election.

Table 1-1 Estimated and observed iVote take-up rate for NSW 2011 SGE, number of people

Group	Average estimated take-up	Observed take-up	
		Registrations	Votes using iVote
People who are blind or vision impaired	7,000	778	668
People with other disabilities	3,300	1,457	1,296
People in remote, rural areas	650	1,830	1,643
People outside NSW	N/A	47,038	43,257
Total	**10,950**	**51,103**	**46,864**

Source: Allen Consulting Group Pty Ltd (2011)

Evaluation and audit reports on the effectiveness of the iVote system commissioned by the NSW State Government were undertaken after the SGE 2011 (Allen Consulting Group Pty Ltd, 2011; PwC, 2011). Overall satisfaction levels with the iVote system were high. A survey (sample size, N = 530) that was taken found that 94% of respondents were very satisfied or somewhat satisfied with the iVote system, and only 5% of respondents were dissatisfied or very dissatisfied with the iVote system overall (Allen Consulting Group Pty Ltd, 2011).

The survey results were included in the findings presented to the NSW State Government (Allen Consulting Group Pty Ltd, 2011). These findings noted that as well as the benefits identified by the survey respondents, there are many wider benefits for the community. Some examples that were mentioned are:

- increased participation rates
- reduced level of assistance required to vote
- indication of intention to use the system in future elections (98% of respondents surveyed directly supported its use).

Further to these findings, the NSW Electoral Commission presented to the NSW Parliament on 20 November 2013 the possibility of using the iVote system in the SGE 2015 (Barry, Brightwell, & Franklin, 2013).

1.3.2 iVote Australia 2015

1.3.2.1 Introduction

Due to the success of iVote at the 2011 elections, the iVote system was again made available for the 2015 NSW State General Elections (SGE 2015). The iVote system provided remote electronic voting functionality. As stated in the 2011 analysis (Allen Consulting Group Pty Ltd, 2011), iVote was implemented to cater to a select stakeholder group:

- people who are blind or vision-impaired
- people with other disabilities

- people in remote locations living more than 20 km away from a polling place.
- people who would be out of the state on election day.

1.3.2.2 Implementation

According to Brightwell et al. (2015), the 2015 iVote system improved on the previous version (2011). At its core, the 2015 iVote system utilised a new cryptographic voting protocol, and through a combination of various parties, was able to provide the following properties:

- vote privacy
- cast as intended
- recorded as cast (verified by a third-party auditor)
- reasonable probability that all votes that contributed to the election of candidates have not been mishandled or miscounted (alignment voting patterns and channels).

Brightwell et al. (2015) stated that the iVote 2015 system expanded on iVote 2011 offering of:

1. remote DTMF (dual-tone multi-frequency aka telephone) voting,
2. remote internet voting,

adding a third voting mode:

3. in-remote-venue internet voting.

The iVote 2011 ecosystem consisted of two independently run subsystems/processes. iVote 2015 added another subsystem/process that allowed for distributed trust:

1. the registration system (2011 & 2015)
2. the core voting system (2011 & 2015)
3. the audit and verification process (2015)

Voters were given the following steps to cast a vote (Brightwell et al., 2015):

1. **Voter registration:** Voters need to register before election week either online or via the iVote call centre. The voter needs to provide a PIN of their choice and they will then receive an iVote number through a different channel, both of which need to be used to access the iVote system.
2. **Vote casting:** Once logged in, the voter is presented with an electronic ballot for completion. Once completed, the vote is encrypted together with a uniquely verified receipt number, which is randomly chosen by the voting device. This approach allows for the iVote system to provide a truly end-to-end encryption protocol.
3. **Cast-as-intended and recorded-as-cast verification:** Once the voter has a receipt number, this number can be used to verify their vote has been cast and recorded correctly. The voter can call the verification server and gain access using their unique iVote number, PIN and receipt number. Once successfully opened, the vote would be read aloud to the voter via a text-to-speech service.

4. **Voter decrypted verification:** Once the election closes, the receipt numbers are uploaded to a receipt number website that allows voters to check that their votes have been included in the count. As with the 2011 iVote trial, the electronic ballot box is taken offline and processed on an air-gapped server.

Figure 1.3 illustrates the voter flow in the 2015 iVote system.

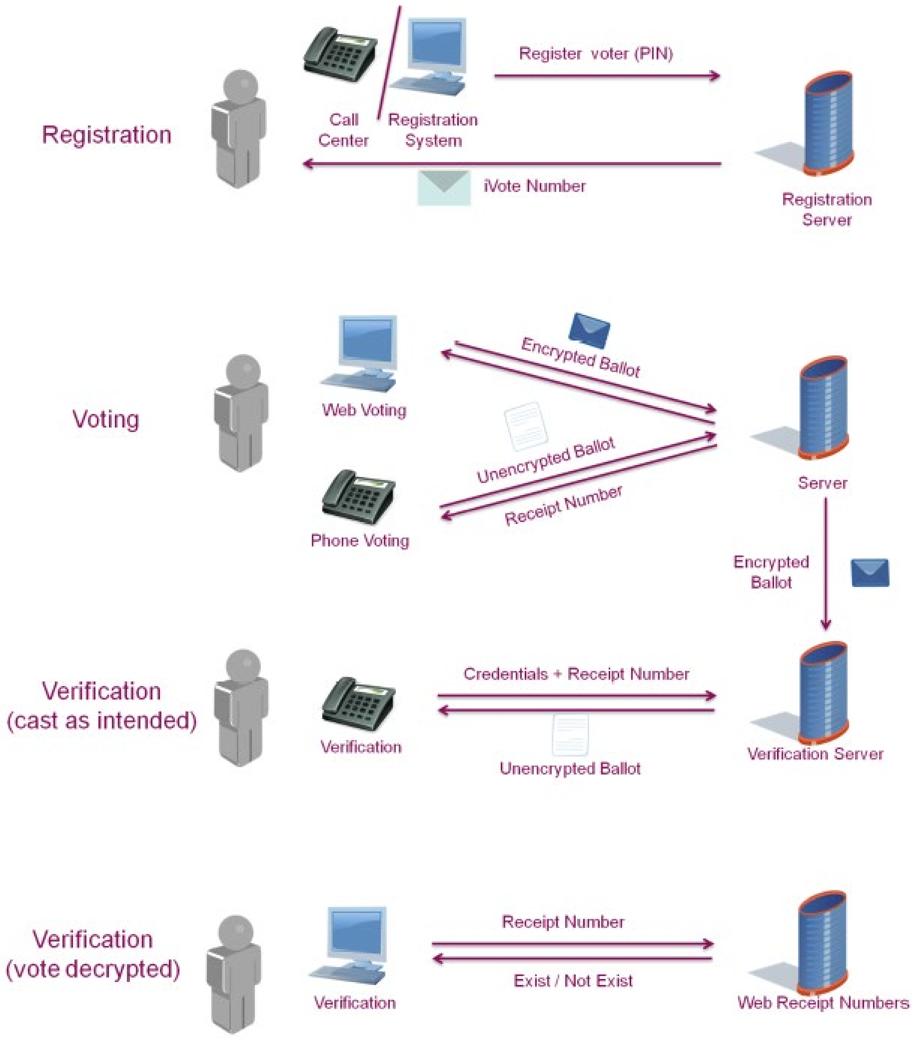


Figure 1.3. Voter flow in iVote core 2015 system (Brightwell et al., 2015)

1.3.2.3 Outcome

Access to register for the 2015 iVote system was made available from 12 February 2015 until 28 March 2015. Registration could be made via a phone operator or through a supported web browser. Registered voters could then cast their vote from 16 to 28 March 2015 (Brightwell et al., 2015). Table 1.2 presents a statistical analysis that compares the implementation of the 2011 and 2015 iVote systems.

Table 1-2 Evolution of electronic voting acceptance in NSW from iVote 2011 to iVote 2015

iVote	**SGE 2011**		**SGE 2105**	
	Votes	%	Votes	%
Registered but voted some other way	2,756	5.4%	10,827	3.6%
iVoted	46,864	91.7%	283,669	94.6%
Registered **but did not vote at all**	1,483	2.9%	5,394	**1.8%**
Accepted iVote registrations	51,103		299,890	

Postal Vote	**SGE 2011**		**SGE 2105**	
	Votes	%	Votes	%
Registered but voted some other way	34,709	11.0%	54,736	18.8%
Postal Voted	245,295	77.8%	203,577	69.9%
Registered **but did not vote at all**	35,178	11.2%	33,122	**11.4%**
Accepted Postal Vote registrations	315,182		291,435	

Source: Brightwell et al. (2015)

As Table 1.2 shows, the percentage of registered users who cast their vote using the iVote 2015 system increased to 94.6% from the 91.7% who used it during the

2011 implementation. It is also worth noting that there was a correlating decrease in registered postal votes from the previous election.

A potential vulnerability was discovered during the voting period as a result of the FREAK malware that affected client computers (Halderman & Teague, 2015) and would allow sophisticated attackers to be able to perform a man-in-the-middle style attack to alter the voting client code on the client's browser (Fogel, 2015). The iVote team publicly disclosed the risk and patched the systems to prevent this vulnerability by the 21 March 2015 (Brightwell et al., 2015).

The implementation of iVote 2015 recorded 283,669 electronic ballots, which set the new world record for the number of electors returning an electronic ballot for a binding parliamentary election (Brightwell et al., 2015).

1.3.3 Estonia 2005–2014

1.3.3.1 Introduction

As discussed by Madise and Martens (2006), in 2005, Estonia was the first country in the world to utilise internet e-Voting nationwide for political elections, and in 2007, it became the first country to use internet e-Voting in a parliamentary election. Estonian internet voting (i-Voting) should be considered a milestone in an overall e-strategy.

Madise and Martens (2006) also stated that Estonia has been widely credited to be a pioneer and leader in e-governance and e-democracy. Proof of this statement can be seen with the constant evolving of their respective e-Voting platform. Estonia provided a unique opportunity to study e-Voting procedures in that it provided internet e-Voting for all voters wishing to use it for all levels of elections (Esteve et al., 2012).

One of the greatest issues facing Estonian elections is election turnout; whether it be local government council or parliamentary elections, voter turnout does not exceed 70%. The aim of the Estonian officials was to increase voter turnout and fight against political alienation (Madise & Martens, 2006).

According to Madise and Martens (2006), two major concerns arose when planning to use internet e-Voting for the 2005 Estonian elections:

1. **Political fears:** Certain political parties feared the possibility that internet e-Voting would bring out electors who otherwise would not have participated. Participation by these electors could threaten the position of the political parties whose voters make an effort to go to the polling stations.

2. **Lack of legitimacy:** The possible lack of legitimacy of the election results due to:

   a. Buying and selling of votes and other means of coercion.

   b. Verifiability of votes, specifically by the elector.

These concerns echo that of any other election that wishes to provide a mechanism for internet e-Voting. The Estonian Government passed legislation for each type of election, known as the Electoral Act ("Riigikogu Election Act", 2002). These acts contain data regarding internet e-Voting; however, they are neither comprehensive nor detailed.

The National Election Commission (NEC) was re-tasked to take on a supervisory role for internet e-Voting in 2012 and it established an Electronic Voting Committee. The committee issued a decree and internal operational guidelines (Estonian National Electoral Committee, 2010).

To date, Estonia has carried out nine elections with the i-Voting system:

- local elections in October 2005
- parliamentary elections in March 2007
- European Parliament elections in June 2009
- local elections in October 2009
- parliamentary elections in March 2011
- local elections in October 2013
- European Parliament elections in May 2014
- parliamentary elections in March 2015
- local elections in 2017.

1.3.3.2 Implementation

Estonian election legislation stipulates that internet e-Voting is to take place from the tenth to the fourth day before election day (“Riigikogu Election Act”, 2002).

The Estonian National Electoral Committee (2010), stipulates the requirements of the internet e-Voting system as:

1. On advance polling days, voters may vote electronically on the web page of the National Electoral Committee. A voter shall vote himself or herself.
2. A voter shall authenticate himself or herself based on a certificate issued regarding the Personal Identity Documents Act.
3. After identification of the voter, the consolidated list of candidates in the electoral district of the residence of the voter shall be displayed to the voter on the web page.
4. The voter shall select the name of the candidate in favour of whom he or she wishes to vote in the electoral district of his or her residence and shall confirm the vote by giving a digital signature.
5. A notice that the vote has been considered shall be displayed to the voter on the web page.
6. The voter may change his or her electronically given vote:
   - by voting again electronically from the tenth to the four day before election day
   - by voting with a ballot paper from the sixth to the fourth day before election day.

The following principles are also defined:

- For voter identification, ID-cards (and from 2011 the Mobile-ID solution) are used.

- The possibility of electronic re-vote – the e-Voter can cast his/her vote again and the previous vote will be deleted.
- The priority of traditional voting – should the voter go to the polling station on the advance voting day and cast a vote, his or her electronically cast vote shall be deleted (Estonian National Electoral Committee, 2010).

One area of the Estonian system that differs from most internet e-Voting implementations is that there is no need to register before being able to cast an online ballot. Estonian electors can cast an online ballot using one of three forms of identification:

1. an ID card with PIN codes (PIN 1, PIN 2) that are issued to citizens;
2. a digital ID or digi-ID, which is like an ID card but does not include a photo and can only be used for e-government services over the internet; and,
3. a Mobile-ID (Solvak & Vassil, 2016), which was introduced in the 2011 election to replace the traditional ID card with PIN codes. A Mobile-ID requires special mobile phone SIM card with security certificates and two pin codes (PIN1, PIN2). This SIM card has to be requested from a mobile telecommunications provider. Along with special security certificates (private keys), a small application is also installed in the SIM card that is used to deliver authentication and signature functionality. The Mobile-ID pin codes are unique to each elector and different to the pin codes of the ID Card (mentioned in point 1 above).

For an elector to cast a vote, the voter needs to follow the relevant steps for the ID they are using. Table 1.3 compares these voting process of the three identification forms (Estonian National Electoral Committee, 2010; Solvak & Vassil, 2016).

Table 1-3 ID Card, Digi-ID, and Mobile-ID process comparison

ID Card or Digi-ID	**Mobile-ID**
The voter inserts the ID card into the card reader which would be attached to their computer.	
The i-Voting website (www.valimised.ee) opens.	The i-Voting website (www.valimised.ee) opens.
The voter downloads and runs the voter application.	The voter downloads and runs the voter application.
The voter identifies himself/herself by entering the PIN1 code.	The voter enters his/her mobile number into the application.
	The voter identifies himself/herself by entering into the mobile phone the mobile-ID PIN1 code (before that a control code is sent to the mobile phone by SMS).
A consolidated list of candidates for the electoral district of the residence of the voter shall be displayed to the voter on the computer screen.	A consolidated list of candidates for the electoral district of the residence of the voter shall be displayed to the voter on the screen.
The voter makes their choice.	The voter makes their choice.
The voter confirms his/her choice by digital signature (by entering the PIN2 code).	The voter confirms his/her choice by a digital signature, entering into the mobile phone the mobile-ID PIN2 code (before that a control code is sent to the mobile phone by SMS).
The voter receives a notice screen that the vote has been accepted	The voter receives a notice screen that the vote has been accepted

1.3.3.3 Outcome

As Estonia is in a unique position to offer internet e-Voting to citizens across multiple elections, there is an interesting trend of voter adoption of the i-Voting system. Table 1.4 presents the Estonian election statistics for the 2005–2014 period, including voter turnout and various i-Vote metrics. As can be seen in Table 1.4, there is an increase in i-Votes counted and an increase in i-Voting participants across the period. Analysis of this data shows that the number of i-Votes amongst the advanced votes increased as well. This increase is more evidence that the electors prefer to vote earlier via an online voting facility.

Table 1-4 Estonian election statistics 2005–2014

	Local elections 2005	Parliamentary elections 2007	European Parliament elections 2009	Local elections 2009	Parliamentary elections 2011	Local elections 2013	European Parliament elections 2014
Eligible voters	1 059 292	897 243	909 628	1 094 317	913 346	1 086 935	902 873
Participating voters (voters turned out)	502 504	555 463	399 181	662 813	580 264	630 050	329 766
Voter turnout	47.4%	61.9%	43.9%	60.6%	63.5%	58.0%	36.5%
i-Voters	9 317	30 275	58 669	104 413	140 846	133 808	103 151
i-Votes counted	**9 287**	**30 243**	**58 614**	**104 313**	**140 764**	**133 662**	**103 105**
i-Votes cancelled (replaced with paper ballot)	30	32	55	100	82	146	46
i-Votes invalid (not valid due to a nonstandard of vote)	n.a.	n.a.	n.a.	n.a.	n.a.**	1	n.a.
Multiple i-Votes (replaced with I-vote)	364	789	910	2 373	4 384	3 045	2 019

i-Voters among eligible voters	0.9%	3.4%	6.5%	9.5%	15.4%	12.3%	11.4%
i-Voters among participating voters	**1.9%**	**5.5%**	**14.7%**	**15.8%**	**24.3%**	**21.2%**	**31.3%**
i-Votes among advance votes	7.2%	17.6%	45.4%	44%	56.4%	50.5%	59.2%
i-Votes cast abroad among i-Votes (based on IP-address) *	N/A	2% 51 states	3% 66 states	2.8% 82 states	3.9% 105 states	4.2% 105 states	4.69% 98 states
i-Voting period	3 days	3 days	7 days	7 days	7 days	7 days	7 days
i-Voters using mobile-ID	N/A	N/A	N/A	N/A	2 690	11 753	11 609
i-Voters using mobile-ID among i-Voters	N/A	N/A	N/A	N/A	1.9%	8.6%	11.0%
Share of i-Votes that were verified by the voter	N/A	N/A	N/A	N/A	N/A	3.4%	4.0%

Source*:* ("Estonian National Electoral Committee, Statistics about internet voting in Estonia", 2015)
** in local elections, voters permanently residing abroad are not eligible to vote*
*** one invalid vote is depicted among cancelled votes*

1.3.4 Markham, Canada 2003–2014

1.3.4.1 Introduction

According to Goodman (2014), Canada is emerging as a local leader in binding online ballots for municipal elections more than any other country throughout the world. Most notably, Ontario has offered approximately 800,000 potential electors the facilities to cast a ballot online using internet e-Voting.

As stated by Goodman (2014), the town of Markham in 2003, population 235,000, was the first municipality in Canada to implement internet e-Voting. Since then, there have been many instances of internet e-Voting in Canadian municipal elections. As of 2010, there were over 30 municipalities in Ontario alone that utilised online internet e-Voting in elections. As well as the 2003 election, two elections (2006, 2010) have taken place in Markham where online internet e-Voting was utilised for advance poll voting, and in Leamington, Ontario, during the October 2014 election, internet voting was the only option provided (no paper ballots) (Goodman & Pyman, 2016).

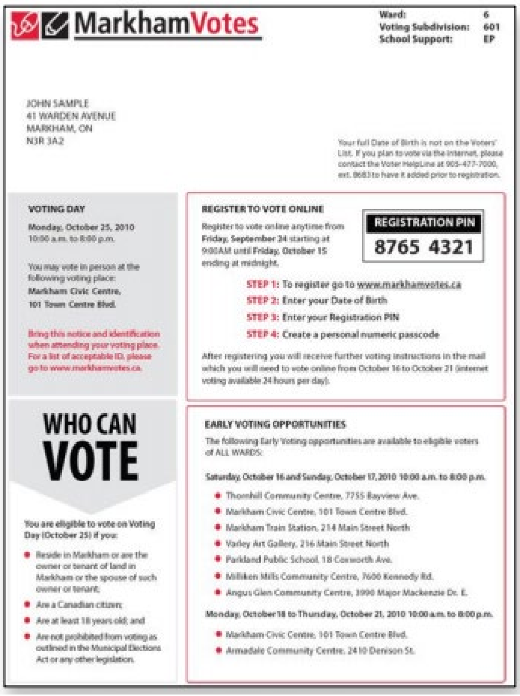
The investigations into e-Voting undertaken by the town of Markham began with a desire to enhance service excellence, more specifically, to provide a means to enhance convenience and accessibility for electors, and there was also a belief that internet and telephone voting is a natural extension of election services (Esteve et al., 2012). Therefore, Markham and the Delvinia Interactive Inc. digital agency set out to implement a voter outreach and awareness campaign to increase voter turnout (Delvinia Interactive Inc., 2003).

Research was conducted throughout the various electoral periods, and it was discovered that internet e-Voting contributed to an increase in overall voter turnout, while also validating the use of internet e-Voting as a key component of the digital experience (Delvinia Interactive, 2007). Word of mouth was also found to be a contributing factor, as electors who used the system promoted it to other electors close to them (Goodman & Pyman, 2016).

The following benefits were discovered during the research (Huycke & Tecsa, 2012; Kitteringham & Brouwer, 2010):

- Internet voting has made it more convenient for long-time voters, as those who voted online in 2003 and 2006 were engaged voters who had cast ballots in previous elections.
- Internet voting is successful in engaging typically difficult-to-reach audiences (e.g. university students, disabled voters) and could level the playing field so that all eligible members of society have an equal opportunity to engage in the electoral process.
- Two-step internet voting – the system employed in the Markham election – significantly reduces the risks associated with voter authentication and is, in fact, more reliable than other traditional methods such as mail-in ballots.
- An integrated communications campaign that includes a digital voter experience and aims to inform and educate citizens about online voting increases voter awareness and may improve voter turnout.

1.3.4.2 Implementation



MarkhamVotes

Ward: 6
Voting Subdivision: 601
School Support: EP

JOHN SAMPLE
41 WARDEN AVENUE
MARKHAM, ON
N3R 3A2

Your full Date of Birth is not on the Voters' List. If you plan to vote via the internet, please contact the Voter HelpLine at 905-477-7000, ext. 8683 to have it added prior to registration.

VOTING DAY

Monday, October 25, 2010
10:00 a.m. to 8:00 p.m.

You may vote in person at the following voting place:
Markham Civic Centre,
101 Town Centre Blvd.

Bring this notice and identification when attending your voting place. For a list of acceptable ID, please go to www.markhamvotes.ca.

REGISTER TO VOTE ONLINE

Register to vote online anytime from Friday, September 24 starting at 9:00AM until Friday, October 15 ending at midnight.

REGISTRATION PIN
8765 4321

STEP 1: To register go to www.markhamvotes.ca
STEP 2: Enter your Date of Birth
STEP 3: Enter your Registration PIN
STEP 4: Create a personal numeric passcode

After registering you will receive further voting instructions in the mail which you will need to vote online from October 16 to October 21 (internet voting available 24 hours per day).

WHO CAN VOTE

You are eligible to vote on Voting Day (October 25) if you:

- Reside in Markham or are the owner or tenant of land in Markham or the spouse of such owner or tenant;
- Are a Canadian citizen;
- Are at least 18 years old; and
- Are not prohibited from voting as outlined in the Municipal Elections Act or any other legislation.

EARLY VOTING OPPORTUNITIES

The following Early Voting opportunities are available to eligible voters of ALL WARDS:

Saturday, October 16 and Sunday, October 17, 2010 10:00 a.m. to 8:00 p.m.

- Thornhill Community Centre, 7755 Bayview Ave.
- Markham Civic Centre, 101 Town Centre Blvd.
- Markham Train Station, 214 Main Street North
- Varley Art Gallery, 216 Main Street North
- Parkland Public School, 18 Coxworth Ave.
- Milliken Mills Community Centre, 7600 Kennedy Rd.
- Angus Glen Community Centre, 3990 Major Mackenzie Dr. E.

Monday, October 18 to Thursday, October 21, 2010 10:00 a.m. to 8:00 p.m.

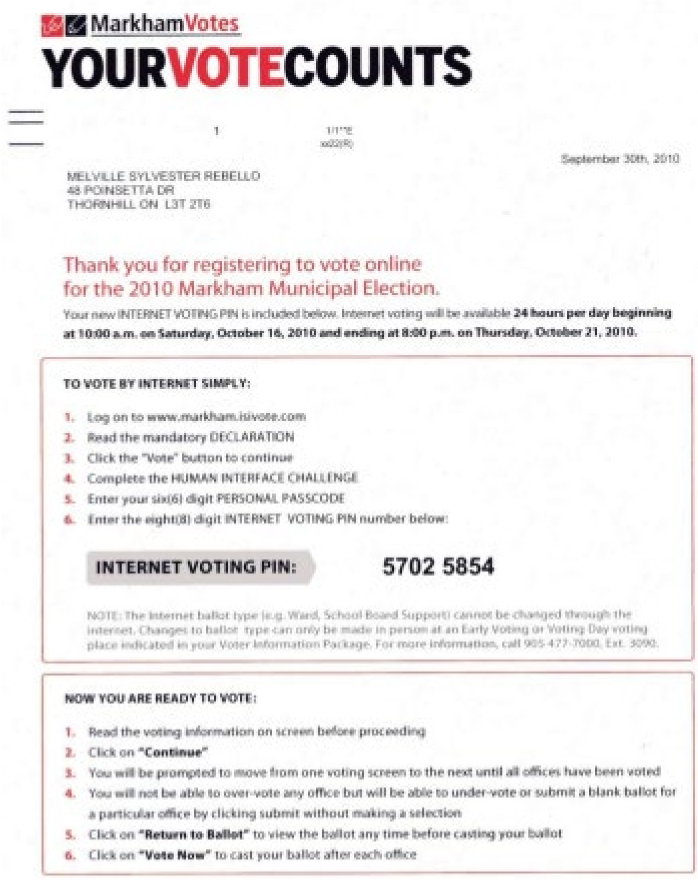
- Markham Civic Centre, 101 Town Centre Blvd.
- Armadale Community Centre, 2410 Denison St.

Figure 1-3 Markham voter notification card (Huycke & Tecsa, 2012)

Goodman (2014) states that the online internet e-Voting facility allowed potential voters the ability to cast an online ballot in advance polls. In 2003, there was a five-day period allowed, in 2006 the period was extended to six days and in 2010 and 2014, it was extended to seven days.

Goodman (2014) continues to identify that as with any online transactions, fraud was a concern during elections. Therefore, a two-step internet voting process was implemented to help authenticate voters and reduce the potential risk regarding internet e-Voting.

For an elector to be eligible to cast an online ballot, the elector must first register to vote online. Before registering, however, the eligible electors would be sent voter notification cards by mail (Step One – Figure 1-3) and then receive a second card once they had successfully registered. These cards were distributed via registered mail (Step Two – Figure 1-4).



MarkhamVotes

YOURVOTECOUNTS

September 30th, 2010

MELVILLE SYLVESTER REBELLO
48 POINSETTA DR
THORNHILL ON L3T 2T6

Thank you for registering to vote online
for the 2010 Markham Municipal Election.

Your new INTERNET VOTING PIN is included below. Internet voting will be available **24 hours per day beginning at 10:00 a.m. on Saturday, October 16, 2010 and ending at 8:00 p.m. on Thursday, October 21, 2010.**

TO VOTE BY INTERNET SIMPLY:

1. Log on to www.markham.isivote.com
2. Read the mandatory DECLARATION
3. Click the "Vote" button to continue
4. Complete the HUMAN INTERFACE CHALLENGE
5. Enter your six(6) digit PERSONAL PASSCODE
6. Enter the eight(8) digit INTERNET VOTING PIN number below:

INTERNET VOTING PIN: 5702 5854

NOTE: The Internet ballot type (e.g. Ward, School Board Support) cannot be changed through the internet. Changes to ballot type can only be made in person at an Early Voting or Voting Day voting place indicated in your Voter Information Package. For more information, call 905-477-7000, Ext. 3090.

NOW YOU ARE READY TO VOTE:

1. Read the voting information on screen before proceeding
2. Click on **"Continue"**
3. You will be prompted to move from one voting screen to the next until all offices have been voted
4. You will not be able to over-vote any office but will be able to under-vote or submit a blank ballot for a particular office by clicking submit without making a selection
5. Click on **"Return to Ballot"** to view the ballot any time before casting your ballot
6. Click on **"Vote Now"** to cast your ballot after each office

Figure 1-4 Markham successful voter registration card
(Huycke & Tecsa, 2012)

Each eligible elector was given a unique identification PIN (which was randomly generated), and they needed to provide a personal passcode and their date of birth during registration. The second card contained another unique PIN, which was used in conjunction with the personal passcode when casting a ballot (Goodman, 2014).

1.3.4.3 Outcome

As the online internet e-Voting facility was implemented in the 2003, 2006, 2010 and 2014 elections, it has been deemed by the town of Markham to be a success

("2018 Election Model Presentation", 2017). The following table analyses the registered voter pattern for the 2003, 2006, 2010 and 2014 elections.

Table 1-5 Markham voter pattern 2003, 2006, 2010 & 2014

Year	Registered Voters	% of eligible voters	Online Votes Cast	% of Registrants
2003	11,708	7.5%	7,210	61.6%
2006	16,251	9.7%	10,639	65.0%
2010	17,231	9.3%	10,597	61.5%
2014	13,615	6.7%	11,002	81.0%

Source: ("2018 Election Model Presentation", 2017)

Various surveys for the 2003, 2006, 2010 and 2014 elections were conducted. The following is a sample of the feedback that was provided during the various election surveys:

2003 Election (Delvinia Interactive Inc., 2003)

- 25% of respondents who voted online did not vote in the 2000 municipal election.
- 79% of online respondents voted online from their home computer.
- Most online voters found out about the 2003 municipal election from direct mail information or a community newspaper.
- 99% of online voters were satisfied overall with the online voting process.

2006 Election (Kitteringham & Brouwer, 2010)

- 78% “very satisfied” and 21% “satisfied” with online voting.
- 80% would recommend online voting to others.
- 88% voted online due to convenience.

2010 Election (Goodman, 2014)

- 99% were “satisfied” with online voting.
- 78% of candidates indicated the option of internet voting had a significant impact on the campaign.
- 99% would be very likely to vote online in provincial/federal elections if the option were provided.
- 34% of young people aged 18 to 24 said they either probably would not or would not have voted had internet voting not been an option.

2014 Election (Goodman & Pyman, 2016)

- 97% of voters indicated they were satisfied and would recommend internet voting to others
- 69% of candidates report being satisfied with the internet voting process.

1.3.5 Norway 2013

1.3.5.1 Introduction

As discussed by Esteve et al. (2012), in 2008, the Norwegian Government approved the trial of internet e-Voting in the 2011 local government elections. ErgoGroup and Scytl provided the internet e-Voting solution with 10 out of 429 municipalities chosen to pilot the advance polling internet e-Voting system.

Internet e-Voting would be made available for 30 days from 10 August until 9 September with the election session to be held on 11 and 12 September 2011. This, however, was not the first use of this system in Norway. Between autumn 2010 through to spring 2011, pre-trials where conducted for youth council elections and local referenda in all the pilot municipalities (Esteve et al., 2012).

An independent assessment was commissioned by the Norwegian Ministry to produce proposals that could cover several areas of assessment deemed important to the project. The Norwegian Ministry tasked the International Foundation for Electoral Systems (IFES) with this assessment and evaluation of the 2011 project. More specifically, the Norwegian Ministry requested:

> an international overview of information which draws on research from other countries with experience of e-voting in uncontrolled environments. Comparative research into Norwegian and international data about e-voting should also be included. The customer also envisages international research being drawn on to shed light on the other issues (A1-A8) [other areas of assessment] where relevant. The customer is also interested in an overview of trials with electronic voting world-wide. (as cited in Esteve et al., 2012, p. 8)

Esteve et al. (2012) stated that the report focused on:

1. availability and accessibility for the voter

2. trust and credibility – trust in the Norwegian election system and e-Voting in particular
3. opinion makers – local politicians and media
4. secrecy of the vote (e.g. family voting, undue influence)
5. participation and election turnout.

In 2013, the Norwegian Government also ran a second trial during the 2013 parliamentary elections. However, due to voter fears and negative reports, the trials ended, and the project was terminated in 2014 ("E-voting experiments end in Norway", 2014). The government stated that "voters' fears about their votes becoming public could undermine democratic processes. Political controversy and the fact that the trials did not boost turnout also led to the experiment ends" [sic] ("E-voting experiments end in Norway", 2014, para. 2).

The report conducted after the 2013 election found that ~70,000 electors cast an online ballot, which only represented ~38% of 250,000 eligible electors (The Carter Center, 2014). Multicasting (voters being able to cast a vote twice) was also a factor; it was estimated that 0.75% of electors managed to do this. Even though the internet e-Voting system allowed multicasting, electors were still able to cast a separate ballot at a polling station during the election session ("E-voting experiments end in Norway", 2014).

1.3.5.2 Implementation

A report presented by The Carter Center (2014) stated that after much research and analysis of previous international internet e-Voting solution trials and implementations, the Norwegian internet e-Voting project set out to try to ensure voter integrity and verification utilising cryptography and voter self-verification. In other words, to prove that “cryptographic voting protocols offer the promise of verifiable voting without needing to trust the integrity of any software in the system” (Karlof et al., 2005, p. 1).

The Carter Center (2014) also state that to achieve this goal, the following steps/processes were defined by the Ministry I-voting team:

1. Voters would be able to gain a sufficient receipt – some level of verification – to show that their vote was cast as intended, but not exact copies of their ballots.
2. Through encryption, the vote and its receipt were never available in the system as plain text.
3. The encryptions resulted from algorithms that were employed across a distributed architecture of servers and server ownership designed with a “separation of duty” protocol. No single server/function was supposed to have direct access to the relationship among voters, party ballots and votes cast.
4. To reduce the chances of vote-buying or coercion, the system implemented repeat voting as described above.
5. Because of repeat voting, linkages between voter and votes cast had to exist until the official election; therefore, as soon as possible, links on servers between vote and voter would be dissolved and software that would sufficiently “mix” the results would be used.

6. As soon as the internet voting phase was completed, the electronic ballot box was to be taken offline and handled on an air-gapped server (one without an internet connection and therefore not susceptible to outside attack during this phase).

Also, the Norwegian project, more specifically the 2013 trial, was broken down into four unique phases:

1. **Software development and project approval phase – 2011 pilot through to early May 2013**

This phase also included creating and building the security framework and assignment of encryption keys to eligible voters.

2. **Verifiability setup phase – July and early August 2013**

For an elector to be able to cast an online ballot, the elector would have to have received via the postal services a special card containing personalised numeric random *return codes*. The card contained a four-digit number for each party running in the election. The elector would also need to register their mobile phone online with a centralised government register.

3. **Internet voting phase – August 2013**

Once advanced polling was made available (12 August to 6 September 2013), the electors would log in to a voting website (evalg.stat.no) where they would be asked to verify their identity using either banking, smartcard, or the government MinID issued service (Figure 1-5).

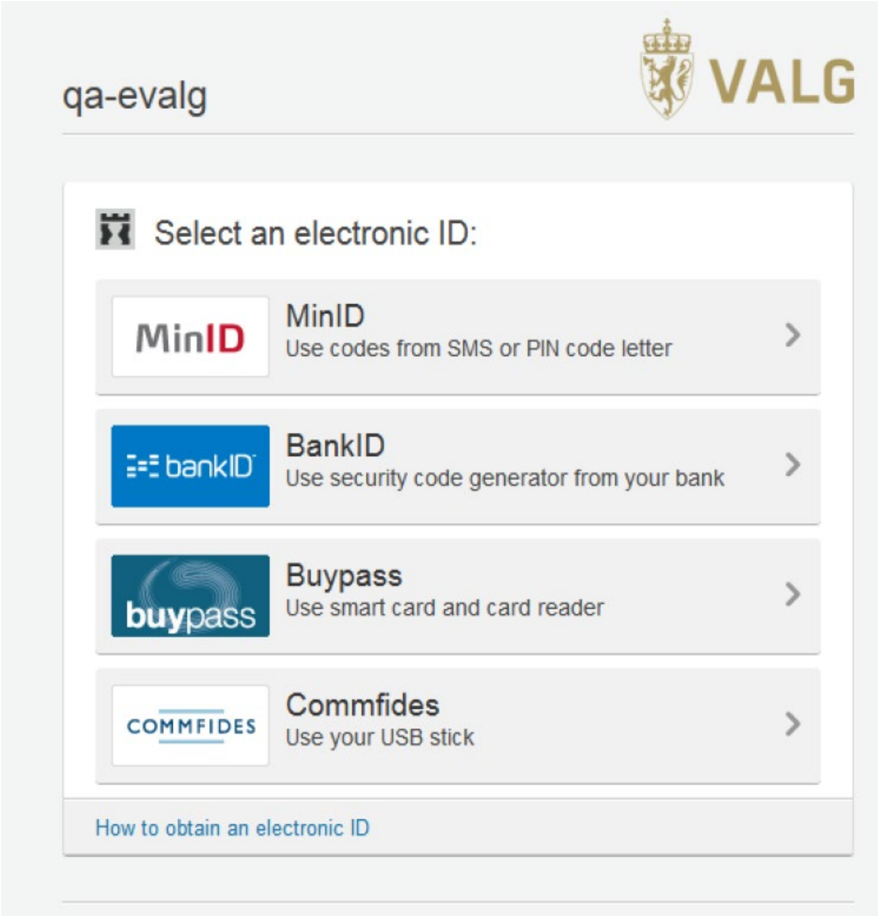


Figure 1-5 Voter authentication (Nore, n.d.)

As these forms of identity confirmation are usually linked to highly sensitive personal and financial information, an elector would be highly unlikely to share this information with another party (The Carter Center, 2014).

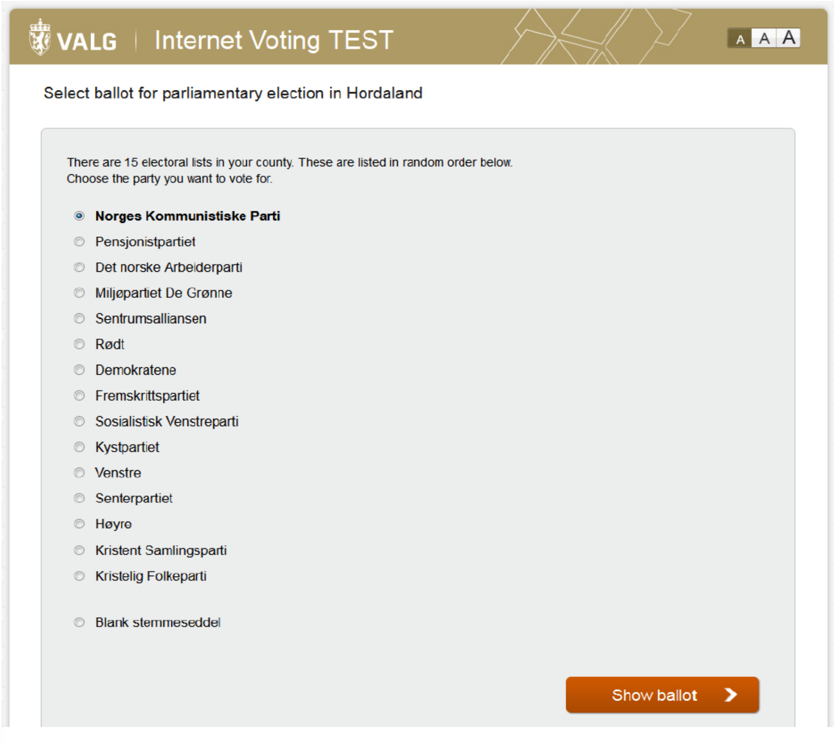


Figure 1-6 Party selection (Nore, n.d.)

Once successfully verified, the voter would then be presented with a party list that contained a ranked order of candidates (Figure 1-6). Voters were permitted to propose a reordering of the candidates as well as deletion of candidates, but unless these preferences matched 50% of other voters' preferences, the reorganising (reordering and deletions) were ignored.

Once the vote was cast, the voter would receive an SMS confirming their respective vote, which would match the personalised return codes he/she would have received in Phase 2 (Figure 1-7).

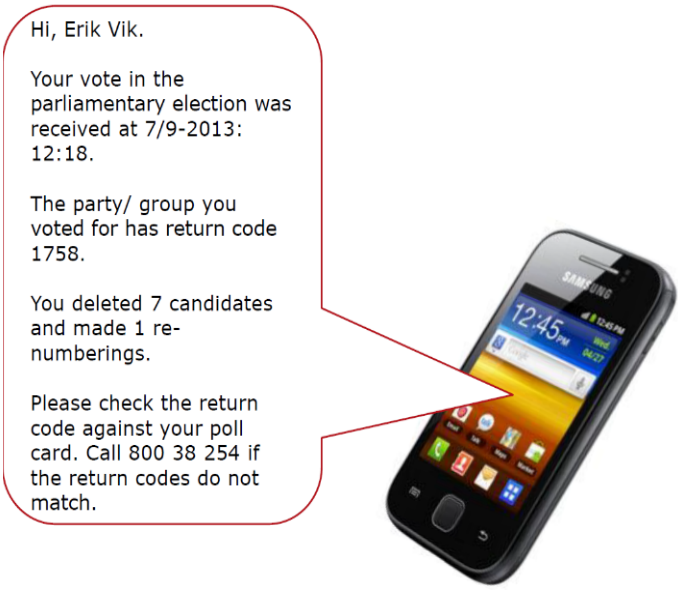


Figure 1-7 Vote confirmation SMS (Nore, n.d.)

The voter also provides an encrypted hash string of their vote, which is published to a GitHub page every hour on the hour (Figure 1-8). These steps allow the respective voter to be able to confirm the vote has been cast as intended and confirm that their vote has been counted without publicly revealing how they voted.

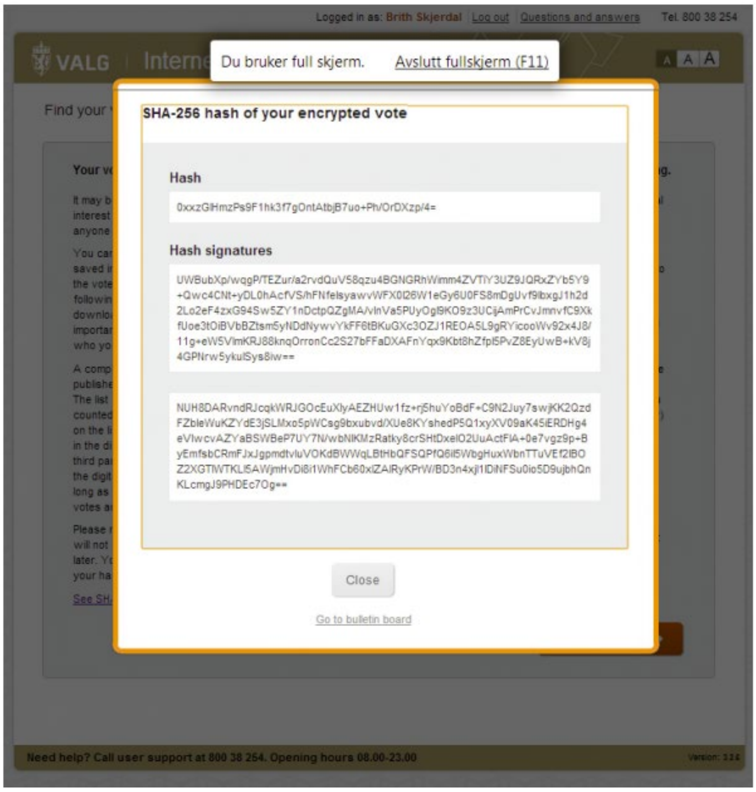


Figure 1-8 Encrypted vote (Nore, n.d.)

4. Final election phase – September 2013

Once the online voting website was closed on 6 September, the following steps took place on the air-gapped servers (Zetter, 2014):

- **Cleansing:** a process to ensure that only the last internet vote per voter would be counted during advance voting, and then only one vote per voter for the entire election would be counted. Any paper ballots cast during the advance voting period or on election day would override the internet vote.
- **Mixing:** a process to destroy the connection between voter and votes.
- **Counting:** a process to decrypt the votes and count them, and finally to submit the final count to the central election administration system.

1.3.5.3 Outcome

Approximately 35% of ballots were cast online in the municipalities, which was an increase from the 2011 trial, when 26.40% of ballots were cast online (Esteve et al., 2012). There was a similarity between the electors in the 2011 election and those in the 2013 election in the fact that if they had used online ballots in the previous election, they also did so in the 2013 election (Segaard, 2014).

As survey conducted after the election found that 94% of respondents (sample size N = 2003) were agreed that it should be possible to vote via the internet (Saglie & Segaard, 2016). As stated by Saglie and Segaard (2016), Norway is characterised by a high degree of confidence in the political institutions and mutual trust among the citizens.

Although there was empirical evidence of trust in an internet voting platform, in June 2014, the Norwegian Office of Modernisation ended the experiments following discussions within the nation's parliament. Various reports present reasons for the termination of the trials ("E-voting experiments end in Norway", 2014). These are:

- **Poor turnout:** inconclusive evidence that the internet system increased citizen participation even though there was a broad political desire.
- **Trust:** government stated that voters feared their votes becoming public, which could undermine the democratic process.
- **Security:** Norway's Institute of Social Research also expressed worries about voters casting votes in uncontrolled environments, which could lead to voter coercion and manipulation.

1.3.6 Reflection

Each trial or implementation was initiated based on various desired outcomes (triggers). Some wanted to increase voter turnout, while others wanted to assist people with disabilities or anyone who had difficulty attending the polling places.

Each trial analysed above is testament to these various triggers. However, a common factor that was faced by all the trials and implementations reviewed above, as well as others I researched, was trust. Therefore, the evidence suggests that trust (in one form or another) consistently appears to play a part in the adoption of any voting platform.

Therefore, in the scenario of internet voting, I noted that it was necessary to determine whether trust relates to the authority running the system, the implementation of the protocol or trust in the system. I needed to continue my research and find out what trust means and how it can be a factor in technology adoption.

1.4 Technology acceptance models

> *"Trust is a psychological state comprising the intention to accept vulnerability based upon the positive expectations of the intentions or behaviour of another" (Rousseau & Sitkin, 1998, p 395).*

Research has been conducted in relation to whether the suitability of an online e-Voting system can be evaluated and compared based on trust (Kremer et al., 2010). Internet e-Voting directly affects two main parties, the government and the electors (voters). Also, as with any new technology, there are cases for and against. Trust is what it comes down to, as there needs to be trust in the system and the process.

Depending on the context in which a study on online service provisioning is being conducted, trust can have various definitions. Jøsang, Ismail, and Boyd (2007, p. 3) provide three definitions of trust that can be broadly applied.

> **(a) Reliability trust.** Trust is the subjective probability by which an individual, A, expects that another individual, B, performs a given action on which its welfare depends,
>
> **(b) Decision trust.** Trust is the extent to which one party is willing to depend on something or somebody in each situation with a feeling of relative security, even though negative consequences are possible, and
>
> **(c) Reputation trust.** Reputation is what is generally said or believed about a person's or thing's character or standing.

Measuring trust has been the focus of many research studies, particularly those in the context of technological adoption. This section of the portfolio will examine a select set of models that include:

- Davis' technology acceptance model (TAM)
- Diffusion of innovation (DOI)
- Unified theory of acceptance and the use of technology (UTAUT).

1.4.1 Davis' technology acceptance model

There have been many studies on developing methodologies and models that can be used to determine attitudes towards technological adoption. One of the more popular models is Davis' technology acceptance model (TAM) (Davis, 1989, p. 198).

TAM is widely used by researchers and practitioners to predict and explain user acceptance of information technologies (Carter, 2008; Davis & Venkatesh, 1996). TAM theorises that the behavioural intention (Venkatesh & Davis, 2000) of an individual to use a system is determined by two primary constructs (as shown in Figure 1-9):

1. Perceived ease of use (PEOU)

2. Perceived usefulness (PU)

PEOU is defined by (Davis, 1989, p. 320) as "the degree to which a person believes that using a particular system would be free of effort", and PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320).

The other constructs of TAM are attitude toward using (A) and behavioural intention to use (BI). A is the user's attitude towards new technology and is directly influenced by PU AND PEOU. The higher the PU AND PEOU, the more positive the attitude towards using the technology. BI is the user's intention to use the system and is influenced directly by a user's attitude and perceived usefulness of the system (Figure 1-9).

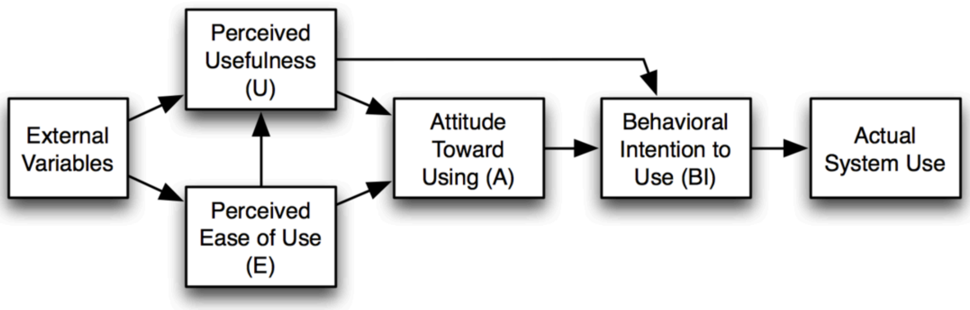


Figure 1-9 Davis' TAM (Davis, 1989)

TAM is built on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1972). According to TRA, one's behavioural intention affects actual behaviour. It is also stressed that an individual's behavioural intention towards a certain behaviour is simultaneously affected by the individual's attitude and subjective norms (Ajzen & Fishbein, 1972).

As mentioned, TAM states that an individual's actual use of a technology is influenced by the individual's behavioural intentions, attitude, perceived usefulness and perceived ease of use. TAM also states that through mediated effects, intention and actual use are affected by the impact of external factors on perceived usefulness and perceived ease of use (Davis & Venkatesh, 1996; Park, Nam, & Cha, 2012). Davis utilised TRA to explore relationships among perception, factors of affections and technology usage, and he used the derived findings to construct TAM (Wu, Chou, Weng, & Huang, 2011, p. 2).

TAM has provided a base model from which many studies have been accomplished, and has provided an evolutionary path through which other models have been derived. TAM has been used in numerous empirical studies to evaluate user adoption and "has become well-established as a robust, powerful, and parsimonious model for predicting user acceptance" (Venkatesh & Davis, 2000, p. 187). Unified theory of acceptance and use of technology (UTAUT) and the lazy user model are models that have evolved from TAM and are addressed in later sections of this review. TAM has also been through multiple iterations, having evolved to a TAM2 (Venkatesh & Davis, 2000) and a proposed TAM3 (Venkatesh & Bala, 2008).

Although Davis' TAM has been the basis for many studies on technological acceptance and the resulting models, Benbasat and Barki (2007, p. 212) state that "the intense focus on TAM has led to several dysfunctional outcomes". Therefore, they provide important recommendations for all subsequent applications of this theory. Bradley (2012) concludes that the primary goal of TAM and its extensions is the measurement of Behavioural Intention of Use and user attitude towards using the technology. However, on the use of self-reported measures in most studies, may result in unreliable findings. Bradley (2012) states that further research is needed to find a more reliable method for measuring these variables.

1.4.2 Diffusion of innovation

"Innovation is an idea, practice or object that is perceived as new by an individual or another unit of adoption" (Rogers, 1995)

Rogers' (1995) diffusion of innovation (DOI) theory is another model that is widely used to explain new technology user adoption. As with Davis' TAM, Rogers' DOI theory is based on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1972) and the innovation diffusion theory (IDT) (Moore & Benbasat, 1991). The DOI theory refers to "the process by which an innovation is communicated through certain channels over time among the members of a social society" (Rogers, 2010).

Rogers (1995) identified five constructs that may affect an adopter's decision:

Perceived relative advantage. The degree to which an innovation can bring benefits.

Ease of use. The degree which an innovation is easy to use.

Compatibility. The degree to which an innovation is consistent with existing values, beliefs and experiences of the adopters.

Observability. The degree to which an innovation is visible to others.

Trialability. The degree to which an innovation may be experimented with.

There have also been cases put forward to include a sixth construct (Carter & Bélanger, 2005):

Image. the degree to which use of an innovation is perceived to enhance one's image or status in one's social system.

Rogers includes image as an aspect of perceived relative advantage, although states that a gain in social status is the most important motivation for innovation adoption (Sahin, 2006).

Moore and Benbasat (1991) included another construct in their study that has merit within this context of internet e-Voting adoption:

Voluntariness of use. The degree to which use of the innovation is perceived as being voluntary or of free will.

This construct states that "when examining diffusion of innovations, consideration must also be given to whether individuals are free to implement personal adoption or rejection decisions" (Moore & Benbasat, 1991, p. 195)

DOI theory continues to classify members of the social system based on innovativeness (the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas that other members of the system). Rogers provided five adopter categories and LaMorte (2016) elaborates on each (Figure 1-10):

Innovators: (Venturesome) want to be the first to try the innovation.

Early adopters: (Respect) are people who represent opinion leaders.

Early majority: (Deliberate) are rarely leaders, but they do adopt new ideas before the average person.

Late majority: (Sceptical) are sceptical of change and will only adopt an innovation after it has been tried by the majority.

Laggards: (Traditional) are bound by tradition and very conservative.

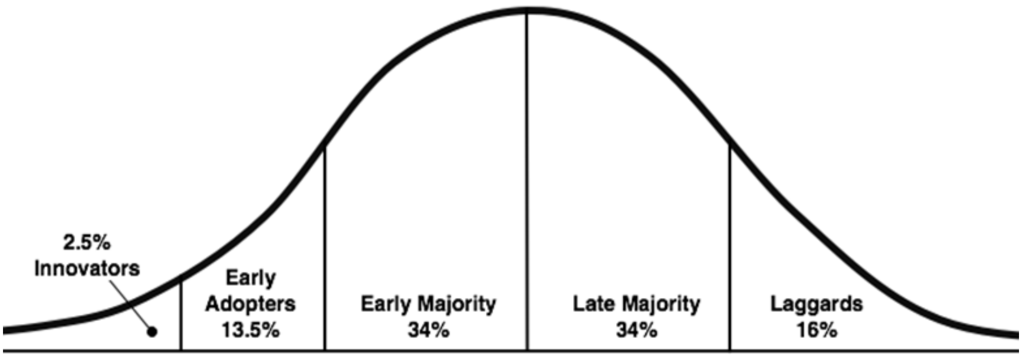


Figure 1-10 Diffusion of Innovation (Rogers, 2010)

Within the context of internet e-Voting adoption, the DOI theory can therefore provide a mechanism for understanding social systems and how various strategies must be implemented to appeal to the various member categorisations to ensure adoption.

1.4.3 Unified theory of acceptance and the use of technology

The unified theory of acceptance and the use of technology model (UTAUT) created by Venkatesh, Morris, Davis, and Davis (2003) is a unified model that combines the constructs from eight other models. These include:

- The technology acceptance model (TAM) – PEOU and PU have been renamed “effort expectancy” and “performance expectancy”, respectively
- Social cognitive theory (SCT)
- The theory of reasoned action (TRA)
- The motivation model (MM)
- The theory of planned behaviour (TPB)
- The model of PC utilisation (MPCU)
- The diffusion of innovation theory (DOI)
- A model combining TAM and TPB (C-TAM-TPB).

The model identifies four key constructs (Venkatesh, Morris, et al., 2003):

1. **Performance expectancy:** the degree to which an individual believes that using the system will help him or her attain gains in job performance.
2. **Effort expectancy:** the degree of ease associated with the use of the system.
3. **Social influence:** the degree to which an individual perceives that important others believe he or she should use the new system.
4. **Facilitating conditions:** the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system.

Performance expectancy, effort expectancy and social influence are determinants of behavioural intention and, in turn, user behaviour, whereas facilitating conditions is a determinant of user behaviour.

The model also provides four key moderating variables that impact on each construct:

1. experience
2. voluntariness
3. gender
4. age.

The interaction of the key constructs and moderating variables is demonstrated below in Figure 1-11.

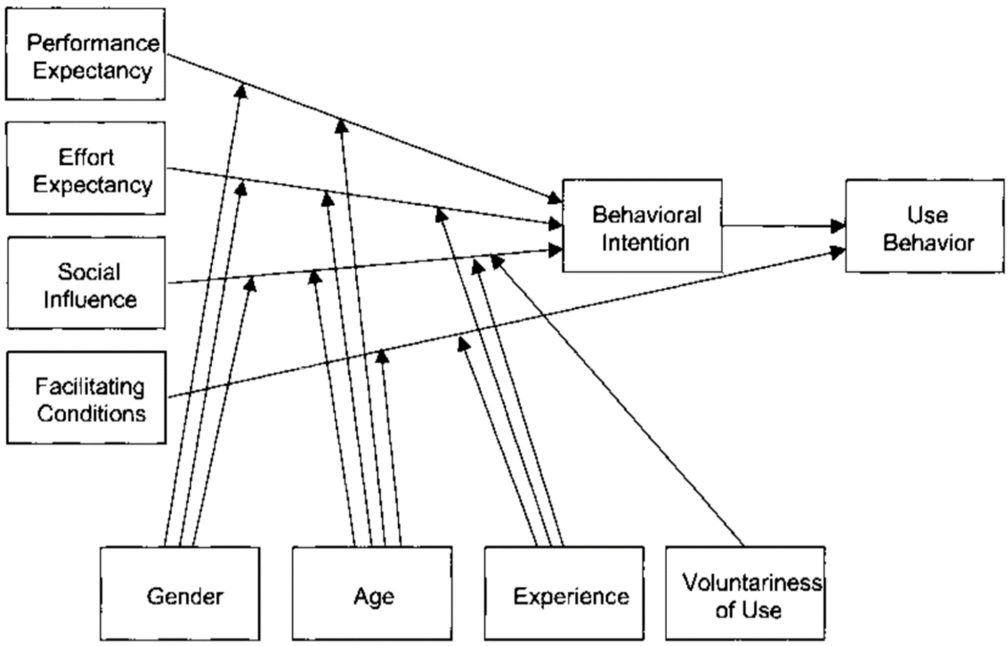


Figure 1-11 Unified theory of acceptance and the use of technology (Venkatesh et al., 2003)

This model has been applied across several studies (AbuShanab & Pearson, 2007; Martins, Oliveira, & Popovič, 2014; Venkatesh, Thong, & Xu, 2016). Studies on mobile services and technology that applied UTUAT found that familiarity with devices and user skills had an impact on user acceptance and technology use as opposed to time spent using the device.

Interestingly, Venkatesh, Morris, et al. (2003) found that during their empirical study when testing their model, the UTAUT model explained as much as 70% of variance in behavioural intention of use and 50% in actual use, although they did state that practical limitations may be reached when explaining individual acceptance and usage decisions.

1.5 Reflection

Researching trust within the realm of technological acceptance models was a real eye opener for me personally. I was not expecting there to be such a broad spectrum of works completed on the subject. Admittedly, it was, however, a challenge to try and keep the research true and not deviate. What I found most intriguing was the factors that are used to measure trust and how, when I thought about it, when deciding whether to trust a piece of technology, I was subconsciously applying these factors without being aware.

At this point, the research team and I had a solid foundation for the innovation portfolio project based on the issue of trust. It raised a few questions that we could attempt to answer with this work:

1. What role would trust play in an Australian mobile voting application?
2. What are the other factors that could influence adoption?

3. Where does the trust need to be present (system, government, process) and to what degree?

These questions would drive the direction of the next stage, the public survey and app development.

1.6 Agile methodology

I wanted to ensure that the application development was a team effort, therefore the research team was a key part of the work. I also knew from professional experience that even with a development team of one, it is necessary to keep track of the work, as it is easy to become lost throughout the project. As such, I needed to ensure I could track the work and be able to report on the efforts and changes as the application development progressed. To this end, I proposed using an agile methodology when developing the application. Being "agile" in our approach would enable us to react to changes quickly. From my experiences, when done correctly, an agile methodology can be a powerful tool. This decision inevitably led to the next bit of research I needed to undertake, which was determining the features of agile methodology and deciding which ones we were going to use.

1.6.1 Agile software development

Since its inception in 2001, agile software development has been integrated into organisations as a form of dealing with an ever-changing dynamic of client requests. The "Manifesto for Agile Software Development" (Beck et al., 2001) includes 12 development principles, and any project that adheres to these 12 principles can be classified as an agile project.

The principles as stated in the Agile Manifesto are as follows:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity – the art of maximizing the amount of work not done – is essential.

11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly. (Beck et al., 2001)

The Agile Manifesto also introduces four core values for agile development. These are as follows:

1. Individuals and interactions over processes and tools
2. Working software over comprehensive documentation
3. Customer collaboration over contract negotiation
4. Responding to change over following a plan. (Beck et al., 2001)

Agile development is a globally recognised and implemented methodology by which many organisations conduct their software development life cycle (SDLC). The SDLC, as stated by Stoica, Ghilic-Micu, Mircea, and Uscatu (2016), is the activities performed during each stage of the development process. Stemming from and yet contrary to the waterfall model, which was created in 1970 by Winston W. Royer (Royce, 1987), agile development has grown, evolved, produced various derivations and now not only encompasses development philosophy but is applied as a methodology as well. The existence of an agile model in the SDLC description and its application in software development lead to the agile methodology (Stoica et al., 2016).

As mentioned previously, the agile development methodology has grown and produced various derivations. One such derivation is the Scrum methodology. For this innovation portfolio project, I have chosen Scrum as the methodology to be used for the application development.

1.6.2 Scrum

One implementation of the agile methodology is Scrum. Dr Jeff Sutherland is the inventor and co-creator of Scrum[2], which is an agile, lightweight process for managing and controlling software and product development in rapidly changing environments (Cervone, 2011). It was originally inspired by an article in the *Harvard Business Review* by Hirotaka Takeuchi and Ikujiro Nonaka in 1986. Scrum was designed to be consistent with the four core values of the Agile Manifesto; however, it also endeavoured to define its known set of values. These values are:

1. **Focus** – Because we focus on only a few things at a time, we work well together and produce excellent work. We deliver valuable items sooner.
2. **Courage** – Because we work as a team, we feel supported and have more resources at our disposal. This gives us the courage to undertake greater challenges.
3. **Openness** – As we work together, we express how we are doing, what is in our way, and our concerns so they can be addressed.
4. **Commitment** – Because we have great control over our own destiny, we are more committed to success.

[2] https://www.scrumalliance.org/community/profile/jsutherland

5. **Respect** - As we work together, sharing successes and failures, we come to respect each other and to help each other become worthy of respect. (“Scrum Values & Agile Methodologies for Project Management”, n.d.)

The VersionOne's *10th Annual State of Agile Report* (“Version One releases 10th annual state of agile report”, 2015) found that nearly 70% of all respondents practise Scrum, with the Scrum Alliance finding that 89% of respondents currently have Scrum in place (Argue et al., 2017). The Scrum Alliance also found that most teams identified that Scrum improves the quality of work life and 95% of respondents say they plan to continue to use Scrum moving forward.

1.7 Summary

This chapter has provided a perspective of the work and research initially undertaken that shaped this innovation portfolio project.

The first section of this chapter provided the context of myself as the author and where this all began for me. The following section presented the key scholarly research and analyses that helped to identify the gaps in the research and provide a niche for this project. Throughout this research, trust was the recurring theme of discussion within the realm of internet e-Voting, so I needed to understand it better and identify how it works.

During my professional experiences, the Scrum methodology has been utilised, and has been the primary driving mechanism in achieving an iteratively developed and workable product. This methodology is also valid for this innovation portfolio project.

Without delving into too much detail about how Scrum works, from a product coordination and outcomes point of view, Scrum is based on time boxed periods (sprints) in which tasks (user stories) are undertaken by the team to achieve a version of a product by the end of the period.

Having recently achieved a Scrum Master certification (2018), one of the greatest takeaways I have been gifted was the phrase "Scrum should not be the goal; rather it should help you get towards the goal". Keeping true to that mantra, as discussed in the next chapter, the work that had been done previously (as part of the research when it was a PhD) and the work yet to be done have been retrofitted into a Scrum pattern.

Chapter 2 Research Configuration

2.1 Introduction

Chapter 1, presented the context for this research and the various driving factors. This chapter provides details about the foundations of the innovation portfolio, including the public survey design, application development, development methodology, approach to analysis and ethical considerations.

The objectives of this innovation project are:

- To establish and provide an Australian context in which future research on a mobile internet e-voting platform can be applied.
- To test hypotheses developed early in the research following a public survey.
- To apply academic principles and discoveries to the design and development of a limited prototype mobile e-Voting app.
- To conduct in-depth interviews to gauge user perspectives and gather feedback.
- To analyse the results and reflect on the findings.

I realised that it is easy for research to go off-track, therefore to achieve these objectives, I needed to approach this innovation portfolio project methodically, in the same way I would approach any other challenge. I established the following steps, which guided me through my innovation portfolio project.

1. Understand what *trust* is and how it can be achieved using proven academic models and research.
2. Develop a public survey in order to set a baseline within the Australian context on what the perspectives are in relation to an online voting platform and, as such, gauge public opinion on the current paper-based process.
3. Decide what platform/software combination will be utilised to develop a prototype in which we can simulate a real-world election within the context of the in-depth interviews.
4. Decide on the development methodology to be used to guide the software.
5. Design a questionnaire that will be completed during in-depth interviews, which are planned to be conducted before and after using the application, and correlate the findings.
6. Identity the findings from the public survey and interviews and improve the application design.
7. Reflect on the results and recommend future research directions.

2.2 Research philosophy, methodology and method

The purpose of research is to discover answers to questions through the application of scientific procedures (Bist, 2015). Doctoral research programs aim to inculcate the knowledge of the various philosophies, methodologies and methods that are associated with the school of thought (Birks & Mills, 2015;

Sutrisna, 2009). It is also important to understand the distinction between research methodology and research methods. Birks and Mills (2015) describe research methodology as a set of principles and ideas that inform the design of a research study, whereas methods are the practical procedures used to generate and analyse the data.

For this innovation portfolio project, as there were no real-world data within the Australian mobile internet e-Voting context from which hypotheses could be developed and tested against an acceptance model, there was a requirement to establish a baseline. However, once the baseline was established, the question still remained about what direction the project would take from there. The research team discussed the plan in detail as it had to be an evolutionary journey, and the results of one exercise would naturally flow on to the next.

As one of the primary research goals related to establishing public trust, we needed to ensure that the research not only captured the data but was also able to provide context behind it. The research team concluded that we needed to apply mixed research methods, incorporating both quantitative and qualitative approaches.

Newman and Benz (1998) state that the debate between qualitative and quantitative research is based on the differences in opinion on the assumptions about what reality is and if it is measurable, and whether knowledge is best understood through objective or subjective methods.

The quantitative approach seeks to gather factual data and study relationships between facts, with researchers positioned as neutral observers (Sutrisna, 2009). Quantitative research allows the collection of numerical statistical data to measure the size of an effect; that is, it produces statistical scoring on responses and establishes correlations within demographic dimensions. This approach would be best suited for the analysis of the public survey, as it would generate information that would provide an overall snapshot, with statistically identifiable key issues and their demographic correlations. This quantitative analysis will be used as the baseline against which the more targeted interview participant criteria and survey design can be defined.

In contrast, qualitative research seeks to interpret phenomena in terms of the meanings people bring to them (Hennink, Hutter, & Bailey, 2010). Qualitative research is a broad umbrella term that refers to approaches in which researchers examine people's experience using a specific set of research methods. Three of these methods are in-depth interviews, discussions and observations. For this innovation portfolio project, we will be conducting in-depth interviews. Table 2-1 shows the advantages and disadvantages of these methods.

Table 2-1 Comparison of three qualitative research methods

	In-depth interviews	Focus group discussion	Observation
Objective	To identify individual perceptions, beliefs, feelings and experiences	To identify a range of opinions on a specific issue or seek community norms	To observe how people act and interact in certain social situations
Research instrument	Interview guide	Discussion guide	Observation guide
Advantages	Gain in-depth information Identify personal experiences Useful for sensitive issues Identify context of participants' lives	Group interaction provides range of issues and opinions Discussion provides detail, justification and clarification A lot of information collected quickly Identify all issues quickly High emancipatory effect	Unobtrusive A lot of contextual information Supports data from other sources Identify people's actual behaviour Conduct in many situations
Disadvantages	No interaction or feedback from others Individual perceptions only Multiple interviews needed to identify range of issues	Less depth of information Less suitable for personal experiences Managing group dynamics	Interpretation of observations may be subjective Distinction between participation and observation is needed

Source: (Hennink et al., 2010)

To establish trust, we need to measure the user experience and specifically focus on how the user feels about the experience and how it can build trust. To measure this trust, we could look at purely quantitative measures, which, as mentioned, provide statistical numerical analysis, but quantitative measures alone can potentially miss other phenomena. For example, sampling issues such as limited sample size and self-selection bias can influence the result set. Therefore, to address the limitations of a quantitative study, features of the qualitative research method will also be included. When conducting research involving human subjects, qualitative research is understandably a valuable strategy, as it is able to access more open-ended information (Sutrisna, 2009) and, as such, we will be using in-depth interviews as the qualitative method of choice. Although there will be limitations of interviewing a small cohort, the interview technique will enable us to obtain greater detail than would be possible with quantitative analysis alone, and provide context for the quantitative data.

There is limited research that have used a balance of quantitative and qualitive research methodologies in the Australian context of public trust with regard to internet e-Voting. Carter (2008) found that although research could be conducted on technological acceptance, there was a limitation when there is no technology to test. She therefore focused some of her research on the perception of ease of use rather than actual ease of use. In this portfolio project, the application developed will make it possible to gauge both perceptions and actual ease of use.

Utilising qualitative methods, we aim to provide distinct data and evaluate theorised problems and approaches (McKie, 2002). We provided participants with the experience of online voting to capture perceptions and thoughts. The mobile voting app is key to this and as such we have applied designs and functionality that could be applied in a real-world scenario.

Staying true to the second pillar of the PhD.I, the Innovation Impact and Change Report, the application being developed will allow the team to gauge public user feedback on the technology through open qualitative responses. The application will not only need to be used to gauge user feedback but will also need to have the ability to apply dynamic change to the experience in order capture derivations in responses based on A/B testing (Gallo, 2017) protocols (i.e. feature X vs feature Y).

For this innovation portfolio project, we will accomplish our goals using a three stepped approach:

Step 1 – Quantitative. Conduct a quantitative anonymous public survey that involves a national awareness campaign spanning across social, television, radio and print media. Implementation, findings and limitations are discussed in Section 3.2.

Step 2 – Prototype. Develop a prototype device agnostic mobile voting app. The apps will be tested during in-depth interviews (Step 3), to gauge usefulness and ease of use (amongst other aspects). Application design and development are discussed in Section 3.3.

Step 3 – Qualitative. Conduct qualitative in-depth individual interviews with five individuals. Implementation, findings and limitations are discussed in Section 3.4.

2.3 Public survey design

An anonymous public survey was chosen as the data gathering mechanism to provide the required baseline upon which an initial set of hypotheses could be defined. This survey is the first of its kind conducted by an Australian academic institution, which allows this research to be approached with a sense of impartiality.

As the survey for this research was related to online technologies, I chose the online survey as the preferred method for delivery of the survey tool. To address the research team's requirement for a rationale to support this method, I needed to conduct academic research in survey design and develop an argument that supported use of an online survey.

2.3.1 Advantages of online surveys

Online surveys (or web-based surveys) have been used since the early 1990s (Kiesler & Sproull, 1986; Pitkow & Kehoe, 1996). As argued by Wright (2005), online surveys take advantage of the ability of the internet to provide access to groups and individuals who would be difficult, if not impossible, to reach through other channels. Also, one of the important differences and advantages of an online survey is that it allows automatic verification and response capture in databases (Andrews, Nonnecke, & Preece, 2003).

Timeliness is another advantage of online surveys, as once a survey has been distributed or made available, researchers do not need to allocate time to collect the data and can continue working on other tasks (Ilieva, Baron, & Healey, 2002).

The greatly reduced cost of conducting an online survey compared to a paper-based survey is also of significance. Providing a survey via an electronic medium (online) can save money when compared to the cost of generating paper-based surveys and the associated distribution costs (Fricker & Schonlau, 2002; Ilieva et al., 2002; Wright, 2005). An additional benefit is that by providing the survey online, we have the ability to freely scale without having an impact on costs.

2.3.2 Disadvantages of online surveys

Online surveys are not without their disadvantages. As we would be conducting a survey about an online e-Voting platform, we knew that sampling issues could occur. The primary concern was that we would only be gathering data from participants who were comfortable in an online environment, which would result in a sample with a biased demographic. As the survey would be an openly accessible anonymous public survey, I attempted to mitigate this risk by including appropriate questions in the demographic section of the survey to identify the correlations between the familiarity with, and access to, the online environment by identifying bias based on demographic variables; that is, determining if there was an overwhelming majority of participants within one demographic. However, this demographic data may still provide insufficient information on the characteristics of respondents and may be questionable (Dillman, 1991; Stanton, 1998; Wright, 2005).

Access (or limited access) to the online survey was also considered. The computer skills required to access the online survey or to take part were taken into consideration. To mitigate against this disadvantage, we implemented a paper-based version of the survey that could be requested and mailed out to potential participants. This strategy does not contravene the anonymity property of the survey (Ilieva et al., 2002), as postal surveys still adhere to this principle of anonymity.

The issue of malicious parties also needed to be considered. Researchers can sometimes become the targets of abusive individuals who resent the invasion of privacy when they encounter an online survey (Wright, 2005). This issue was mitigated by limiting the publicly available contact information of the research team.

2.3.3 Design

Although a survey can seem simplistic in nature, the thought process behind the design can involve a significant level of input. Bias, question design, fatigue and technological issues, to name a few, must all be considered. These design considerations are addressed in Section 3.2.1.2.

Andrews et al. (2003) collate and summarise the criteria for a quality survey design:

- supports multiple platforms and browsers/e-mail clients
- controls for browser settings
- detects multiple submissions automatically
- presents questions in a logical or adaptive manner
- allows saving of responses before completion
- collects open-ended or quantified-option responses
- provides automatic feedback with completion
- uses paper questionnaire design principles
- provides automatic transfer of responses to a database
- prevents survey alteration
- provides response control and economical displays

- provides for links to definitions, menus, button and check box options, animation, sound, graphics options, and so on
- does not require familiarity with survey presentation software
- displays appear quickly to participant
- tracks response source of response failure.

Although I was capable of developing a survey platform from scratch, the research team felt that it would be more effective and robust if we used a globally recognised third-party service to capture the results. Using the technological criteria for quality survey design as a checklist, I searched the internet for providers that meet the requirements. SurveyMonkey was chosen as the tool to conduct the survey (https://www.surveymonkey.com/) as it:

- provides an easy-to-use user interface in which to design, manage and conduct the survey
- provides support on multiple devices, including tested web browser compatibility with Chrome 18 and later, Firefox 24 and later, Safari 7 or later, Microsoft Edge, Internet Explorer 9–11
- provides analytical tools to assist in data analysis and export to standardised formats
- meets security and compliance requirements and best practice (https://www.surveymonkey.com/mp/policy/security/).

2.4 Development methodology

Being an experienced solutions architect, I have come across many methodologies through interactions with various software teams. One of the most widely used approaches to software development, and my personal preference, is the agile approach (Beck et al., 2001), specifically the Scrum framework (Cervone, 2011; Stoica et al., 2016). As mentioned throughout this journey, when deciding upon a path at each stage of the innovation portfolio project, I needed to better understand the choice and be able to justify it.

As each project and structure is unique, so is its development methodology. Prototyping projects require the benefits of faster development, such as the rapid application development (RAD) model (Powell-Morse, 2016), whereas larger enterprise applications that involve large teams would benefit from the spiral model (Boehm, 1988) or the scaled agile framework (SAFe)("Scaled Agile Framework – SAFe for Lean Enterprises", n.d.).

The first step when deciding on the methodology is to understand the deliverables (or outcomes) and constraints. To assist with this, my personal preference is to taking a page from the Snowflake method[3], which is a story design methodology used to write a novel, where the first step is to write a one-sentence summary of the novel. The same principle can be applied to a technology solution, so we begin by writing a sentence of our product.

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[3] https://www.advancedfictionwriting.com/articles/snowflake-method/

I need to deliver a mobile smartphone app that will be used as part of an in-depth interview, where the participant (interviewee) will use the mobile voting app to cast a vote during a mock election.

User stories are my preferred method for gathering requirements and translating them into deliverable pieces of work. A user story is the smallest unit of work in an agile framework. It is a software system requirement that is expressed in a few short sentences, ideally using non-technical language (Rehkopf, 2014). A user story consists of three components: a type of user, some goal and some reason. Therefore, to make all three elements of this particular task clear, the product sentence can be re-worded into a user story format:

As a researcher, I want a mobile smartphone app that can be used to conduct a mock election as part of an interview so that I am able to gauge and collect feedback on the experience and perspectives.

Now that the primary user story has been defined, the next step is to provide clear definitions to establish context around the product. Although a user story is meant to provide sufficient context for a developer to understand and act upon, from past experience I have found that providing context definitions allows the external parties and stakeholders to have a clearer understanding. Four definitions are required:

Mobile smartphone app: The mobile smartphone app is a piece of software designed and built for use on a smartphone device with access to the internet. For the purposes of the innovation project portfolio, this app will be required to be device agnostic, meaning it will be required to run on Android, iPhones/iPad and Windows devices. Even though there are other device platforms we will potentially need to cater for in a real-world scenario, for the purposes of this limited use, the platforms indicated should suffice.

Mock election: The mobile smartphone app will be used to conduct a mock election, meaning the processes of registering, casting a vote and verifying a vote will be conducted under a controlled environment. Although the app will be simulating a real election process with data being captured and presented, information about the parties will be fake.

Interview: The interview will involve participants of the mock election. The interviewees selected will be members of the public.

Feedback: Feedback will be gathered via interview prior to the participants taking part in the mock election using the mobile smartphone app. There will be three stages of data gathering: (1) before the mock election, (2) during the mock election and (3) after the mock election. These stages will be discussed in further detail in later sections.

With the definitions and the primary user story defined, we can now establish the epic (sometimes called initiative, depending on the preferred model). An epic is a large user story that can span multiple sprints[4]. Epics, in turn, are broken down into features and then further into user stories.

Most projects have multiple epics but for the purposes of this project, we will only be using a single epic with multiple features and user stories. The stage is now set to begin fleshing out the project and developing the app, which will be covered in the following sections.

2.5 Application development

When consulting and meeting with key stakeholders on a project, I usually get asked a couple of questions after I have been given the rundown on the project requirements: (1) What technology are you thinking we will do this work in? and (2) What will be the team structure behind it? My typical response is that most good software development technologies can accomplish the same task but in different ways, and in relation to the team structure, it all depends on the resourcing constraints. This section will introduce the development technology stack[5] and the team structure.

[4] A sprint is an allotted period of time during with specific user stories have to be completed and ready to review.

[5] A technology stack (tech stack) is a combination of programming languages and software products used to create a software solution

The primary requirement of the innovation project is to build a mobile smartphone application that can be used to capture votes for a mock election. In the world of mobile application development, there are three pathways for building an application:

1. native mobile apps
2. hybrid mobile apps
3. web apps

Native mobile apps are applications built for specific platforms utilising the platform's programming language. Apple iOS and Google Android are the most widely used platforms in the market ("Global mobile OS market share in sales to end users from 1st quarter 2009 to 2nd quarter 2018", 2018). Apple iOS applications have been primarily built using a language called Objective-C, which is considered to be one of the hardest programming languages to master (Appinventiv, 2018); however, Swift was introduced by Apple to simplify development and address the pitfalls of Objective-C ("Swift - Apple Developer", 2018). Google Android is built using Java, which, unlike Objective-C, is a more widely used language ("TIOBE Index - The Software Quality Company", 2018). More recently, however, it was officially announced that Kotlin will be the new language for building on the Android platform (Shafirov, 2017). It is worth noting that there are other platforms, such as Windows Phone and BlackBerry OS, but they have not had the same uptake as Apple or Android ("Global mobile OS market share in sales to end users from 1st quarter 2009 to 2nd quarter 2018", 2018).

Hybrid mobile apps are installed on devices as a native mobile app but are built and run via a web browser (Ziflaj, 2014). As the name implies, hybrid mobile apps are written specifically for any one platform and use technologies such as Apache Cordova or PhoneGap to enable native function interactions (camera, NFC, light controls, etc.). As hybrid mobile apps are primarily built using web-based languages (HTML, JavaScript and CSS), development of apps using this technology is quite appealing for web developers. Throughout my professional career, this has been the main appeal of building apps as hybrid mobile apps. The drawbacks of hybrid mobile apps, such as performance and reliability, have been highlighted when comparing hybrid apps with native apps; however, recent advancements have aimed to bridge this gap ("Capacitor: Universal Web Applications", n.d.).

Web apps are the third option for mobile application development, but not necessarily the last choice. Web apps do not require installation on a device and can be accessed by a browser app that is already installed on the device: in a nutshell, it is a website accessed via a phone's web browser. Within the category of web apps, there are four types: traditional, responsive, adaptive and progressive ("Progressive Web Apps | Web | Google Developers", n.d.; Wright, 2014).

A traditional web app is any website, whereas a responsive web app rescales and reshapes itself depending on the device on which it is accessed (Wright, 2014). Adaptive web apps display the same content, but resize depending on the different screen size (EmpireOne, n.d.). Progressive web apps are relatively new to the landscape of mobile web development. They allow websites to be cached and interact with native functionality on both mobile and computer devices (provided there is browser compatibility) ("Progressive Web Apps | Web | Google Developers", n.d.).

A few factors were considered when deciding how to the build the application:

- Limited development resources – I will be the only one developing this application.
- Limited target users – As this app is for a one time use within in-depth interviews, we will need to develop on a technology stack where we do not need to know what device the users will be using, other than it can open a web browser.
- Limited budget – Time and cost are limitations applicable to all projects; however, in this case, we only budgeted for a few months of development and limited hosting resources.

Taking these limitations into consideration, the adaptive hybrid mobile app was the pathway chosen, and the voting platform interface would be built to be device agnostic. Some of the functionality in mind would require some native functionality and because of the limited time allocated for interaction with the interview participants, we needed to ensure device compatibility is not an issue.

Regarding the remainder of the technology stack, as this application is required for a one-time interview and relates to a mock election, there will be no need for extensive development of the database, web service or security architecture.

2.6 Approach to analysis

"Trust is a psychological state comprising the intention to accept vulnerability based upon the positive expectations of the intentions or behaviour of another" (Rousseau & Sitkin, 1998, p. 395). A review of the relevant literature has highlighted that trust is a key component when evaluating the adoption of an online e-Voting system.

To achieve trust, we first need to understand it. Through vigorous research in the initial stages, we discovered that we needed to base the study on a model that provided a pathway to achieving user acceptance. To determine what factors influence user acceptance in the adoption of a mobile internet e-Voting platform, we intend to use Davis' technology acceptance model (TAM) to measure the PU and the PEOU through our survey. Davis' TAM, which was introduced in 1989, has been the model that has been the most popular and widely adopted by researchers (AbuShanab & Pearson, 2007; Carter, 2008; Carter & Campbell, 2012; Venkatesh, Morris, et al., 2003; Venkatesh & Davis, 2000).

As discussed in earlier sections, TAM is based on the theory of reasoned action, which states that "one's behavioural intention affects an individual's actual behaviour" (Fishbein & Ajzen, 1975, p. 402). TAM states that an individual's actual use of a technology is influenced by the individual's behavioural intentions, attitude, perceived usefulness and perceived ease of use, and that through mediated effects, intention and actual use are affected by the impact of external factors on perceived usefulness and perceived ease of use (Davis, 1989) (Figure 1-9).

TAM has two primary constructs: perceived usefulness (PU) and perceived ease of use (PEOU). PU is defined as the user's perception of the system to improve one's job performance, and PEOU is defined as the perception of the amount of effort required by the user to use the system (Davis, 1989). PU and PEOU influence a user's behavioural intention to use a system, which, in turn, determines actual system usage (Carter & Bélanger, 2005).

Davis' TAM has been used in many studies. In one such study, Carter and Campbell (2012) used a parsimonious model based on eight behavioural models, including TAM, to determine US citizens' perceptions of the usefulness of i-Voting. This model, as with much other research, does not consider the Australian context, where there are constraints and parameters that vary when applying the findings of these studies. These constraints and parameters have been identified previously.

As mentioned throughout this innovation portfolio project, I will be approaching the research via a mixed research method. First, information will be gathered utilising an anonymous public survey based on quantitative research methods with the goal of achieving a baseline upon which to derive hypotheses. Second, the functionality and experience pathways will be tested with selected members of the public utilising qualitative research methods and a custom-built hybrid mobile app.

2.7 Ethical considerations

The public survey was approved by the Human Research Ethics Committee of the University of New England (Appendix 1), Approval No HE15-055. The public survey was held anonymously and no personally identifiable information was captured from participants. Electronic data collected during the survey were stored in a password-protected online database, with only the research team having access to the data. All the data collected in this research will be kept for a minimum of five years after successful submission of this research, after which time it will be stored in a data curation service. Prior to taking the public survey, all participants were provided with information detailing all relevant ethical considerations, committee approval and contact information.

The public interview was approved by the Human Research Ethics Committee of the University of New England (Appendix 1), Approval No HE18-091. The public interview was conducted anonymously per participant, and no personally identifiable information was captured from participants. Electronic data collected during the survey were stored in a password-protected online database, with only the research team having access to the data. All the data collected in this research will be kept for a minimum of five years after successful submission of this research, after which time it will be stored in a data curation service. Prior to taking the public interview, participants were provided with information detailing all relevant ethical considerations, committee approval and contact information (Appendix 7). During the interview, two members of the research team were present via teleconference and/or in person.

2.8 Writing style

When my research team and I originally decided to transfer to a PhD.I, we discussed in depth the transition process and the additional work to be undertaken. One of the additional benefits of transferring was that it also provides an opportunity to present a tangible innovation. The innovation itself is a path of discovery and understanding.

This research is presented as if I am taking the reader on a journey from a researcher's point of view. This approach is an attempt to convey my mindset during the development of the project, and I implement 'narrative practices', which are based on the idea that the stories we tell about ourselves play a crucial role in our lives.

The literature review components are academic in nature and written accordingly, focusing on key areas of interest that provide an academic context for this project.

The development aspect of the portfolio is written from a developer's point of view, with the focus being primarily on process and best practice when undertaking the application development task.

The evaluation and analysis of the public survey is written in an analytical style and identifies statistical findings, while the public interview evaluation and analysis is written in an observatory style.

Finally, the reflective sections are written through a personal and subjective lens. These sections provide a description of the reflective process and relay the learnings from the journey that is the innovation portfolio project.

2.9 Summary

This chapter set the tone for how this innovation portfolio project is to be compiled. The research philosophies, methodologies and methods have been provided along with the rationale for their selection.

Quantitative research was the method chosen for the public survey, as we need to capture a statistical baseline to establish an Australian context. A qualitative methodology will then proceed by way of public interviews, in which a mobile smartphone app will be used to allow participants to undertake a mock election.

For the development of the application, I will be implementing a Scrum methodology framework to guide the development and evolution of the application. Finally, this application will be developed as a hybrid mobile smartphone app to cater for the parameters and constraints of the innovation portfolio project, primarily time, budget and limited resourcing.

Chapter 3 Innovation Portfolio Project

3.1 Introduction

After years of research and asking questions, it came time to put theory into practice. In the previous sections, the context, academic components and portfolio configuration that have guided the design of the innovation portfolio project were introduced and discussed.

This chapter presents the data from the survey and information on the process undertaken to achieve the development of the mobile smartphone e-Voting app. The innovation portfolio has three components:

1. the public survey design and implementation, which provided baseline data within the Australian context
2. the development process and the resulting app
3. public interview analysis to provide a real-world result.

3.2 Public survey

3.2.1 Implementation

When I started this research, it was ear-marked for a PhD, and the anonymous public survey was originally designed to be used as a key component. When the research shifted focus to a PhD.I, rather than scrapping all the hard work that went into the survey, the team and I decided to incorporate it as the starting block for the innovation. This way we could stay true to the academic side of this research as well as do justice to the work.

The following sections (design and measures) are taken from a publication that the team and I compiled entitled “Perceptions of the Australian public towards mobile internet e-Voting: Risks, choice and trust”, which was published in the *Electronic Journal of e-Government*, Volume 14, Issue 1, 2016 (Zada, Falzon, & Kwan, 2016).

3.2.1.1 Design

The anonymous public survey was made available online and in paper-based mail format for eligible Australian voters between 16 March and 30 April 2015. This survey was the first of its kind that specifically aimed to derive a baseline data set from which the Australian public’s perceptions and trust in mobile e-Voting could be established. In addition, the data could be used to assist in identifying key issues for future research projects that are aimed at understanding the adoption of mobile e-Voting technology.

The Mobile Voting website (http://mobilevoting.com.au) was launched in February 2015 as part of a public awareness campaign to inform about the existence of mobile e-Voting technology. The site was not meant to promote the argument for or against mobile e-Voting technology but was primarily used to promote the survey in conjunction with various social media pages on Facebook, Google Plus and Twitter. The site also allowed members of the public to subscribe for research updates. An example of an email update is available in Appendix 3.

The survey was split into seven sections, each with a different purpose. Section 1 was the information sheet, which provided participants with information about the research, the survey and ethics committee approvals, and the Section 2 asked questions to confirm eligibility to participate in the survey. Section 3 included demographic questions on gender, age, income, locality, internet accessibility, education and disabilities and Section 4 asked questions aimed specifically at identifying the internet and technological access, internet device and service preferences of the respondent. Section 5 asked respondents what they like and do not like about the current voting process and Section 6 asked respondents what properties of mobile internet e-Voting they find of appeal and concern. Section 6 also asked the key question of whether the respondent would utilise a mobile internet e-Voting platform if it was made available at the next election and their trust towards online systems. Finally, Section 7 provided the opportunity for open-ended responses that could capture any additional comments the respondent might wish to make.

These sections were designed to provide classifications and identified relationships (if any) between various responses. These relationships would allow the research team to shape hypotheses based on the findings of the survey. A statistical power analysis revealed that $N = 276$ ($\alpha = 0.05$, $\beta = 0.80$) would be sufficient numbers of respondents for the survey to detect a moderately sized effect on a normalised scale ($\Delta = 0.30$) in favour of or against mobile e-Voting.

The survey attempted to capture as much information as possible from the respondents without directing answers or generating questions of bias. It was intended that the survey be anonymous and self-completing (Brace, 2004). By adopting this design, the research team aimed to remove any potential bias in the responses while making it easier for the respondents to be honest about sensitive subjects (Brace, 2004). Survey fatigue was another area that required our attention in that too many questions could cause the respondents to rush through the survey to get it completed quickly (Brace, 2004; Porter, Whitcomb, & Weitzer, 2004). Sharp and Frankel (1983) also found that longer surveys result in lower response rates.

To address survey fatigue, multiple techniques were researched and tested. A pilot survey was planned to test the length and content of the survey prior to public release, with a target average completion time of approximately 10 minutes. Another technique utilised was to attach pre-coded responses and explanations to applicable questions (Brace, 2004). For example, respondents are given pre-coded responses like “I'd prefer not to say” or “Other” to indicate that they do not want to answer the question or their preferred response is not listed.

The survey design would also ensure that questions were ordered to prevent unintended bias of responses to later questions. Behavioural questions that are arguably easier to answer and questions that require recall were asked prior to attitudinal questions, which are meant to solicit a respondent’s position on a subject or matter. These attitudinal questions allow the team to assess the respondent’s behaviour as a consequence of their attitudes (Brace, 2004). Thus the survey design used the technique of “funnelling” (Brace, 2004), which attempts to order questions from general to more specific questions.

3.2.1.2 Measures

The survey was designed to be an anonymous survey and respondents had to satisfy a set of eligibility requirements. These requirements are the eligibility to cast a vote in an Australian election and the condition that the respondent cannot be a direct relative of a member of the research team. If a respondent met these conditions, they would be eligible to continue with the survey; otherwise, they would be redirected to a disqualification page and the survey would be terminated.

Demographic information of the survey respondents was also recorded. These data included age group, gender, average yearly income range, current living locality, highest education level and disabilities. By incorporating this information in our research, we attempt to achieve “universalism” (Hammer, 2011) in our findings. Universalism is the principle that a given value, behaviour, theory, or treatment will be the same across all groups independent of culture, race, ethnicity, gender, and other social identities (Reynolds 2008; Beins, 2009). Hammer (2011) states that thorough description of participants allows readers and researchers to determine for whom the findings can be generalised and how they can be compared. Demographic questions will also allow the sample characteristics to be compared with the national characteristics (e.g. percentage of males to females between the age of 18 and 95 nationwide).

Moreover, the survey asked questions about what devices the respondent had previously used and what tasks he or she had completed online. These data provided a baseline from which to establish the perceived ease-of-use of a potential e-Voting platform. Through capturing the types of devices used and the tasks respondents had undertaken online, we could establish the requirements that are needed to ensure compatibility across devices when the user interface and the interactivity of the e-Voting platform are designed (e.g. it should be as simple and intuitive as an online shopping store).

The survey also included questions related to the current electoral process and mobile internet e-Voting platform. Answers to these questions would allow the research team to establish the PU of a mobile internet e-Voting platform, and by understanding the likes and dislikes of the current electoral process, we could uncover what the perceived disadvantages of the current process are and how they could be addressed. At the same time, we wanted to ascertain what the perceived advantages are and how they might be reapplied (or enhanced) for the e-Voting platform to be perceived as useful.

To determine what factors influence user acceptance in the adoption of a mobile internet e-Voting platform, we used the survey to measure the PU and the PEOU of Davis' TAM (1989). The survey asked what the respondent thought was appealing and concerning for a mobile internet e-Voting platform, what devices they prefer to use to access the internet, what tasks they have previously completed using the internet, etc.

Direct questions were asked towards the end of the survey. There were three key questions:

- "From past experiences using secured online systems, both government and commercial, how would you best rate your trust of these systems?

Examples of such systems are online banking systems or welfare and human services systems".

- "If a mobile e-Voting platform were made available during the next election, would you use it to cast your vote?".
- "Rank your preference on how you would cast your vote if a mobile e-Voting platform were made available during the next election".

The aim of asking these questions in the survey was to objectively assess these demographical, PU and PEOU factors in order to develop a set of hypotheses to test the intended use (Davis, 1989) of a mobile internet e-Voting platform and the levels of trust that the respondents might have towards using the platform.

3.2.1.3 Media campaign and advertising

With the survey designed, I needed to get the word out. My supervisors recommended speaking to the university communications officer to get some advice on what to do. After a few emails, we had our first press release. The press release is provided in Appendix 4. Within hours of the press release being distributed, we had online articles published and within days, the team and I were inundated with calls and emails from various media outlets around the country wanting interviews and more information.

Table 3-1 compiles a list of media stories and interviews known to the team.

Table 3-1 Mobile Voting media coverage

Publication	Medium	Title / Presenter	Link
ABC News	Online/Print	UNE researcher says Australia should adopt mobile and electronic voting	http://www.abc.net.au/news/2015-02-06/une-researcher-says-australia-should-adopt-mobile-and-electroni/6075130
ABC News Current Affairs	Online/Print	How close is mobile voting in elections?	http://www.abc.net.au/am/content/2015/s4184471.htm
Bega District News	Online/Print	Voting via mobile phone a vision of UNE researcher	http://www.begadistrictnews.com.au/story/2827623/voting-via-mobile-phone-a-vision-of-une-researcher-poll/
Brimbank & Northwest Star Weekly	Online/Print	Derrimut: Phillip Zada campaigns for online voting	http://www.brimbank.starweekly.com.au/story/1831428/derrimut-phillip-zada-campaigns-for-online-voting/
El Telegraph	Online/Print	Mobile voting	http://mobilevoting.com.au/?attachment_id=2435
Leader Community Newspaper	Online/Print	Derrimut PhD student Phillip Zada researching mobile phone voting	http://www.heraldsun.com.au/leader/west/derrimut-phd-student-phillip-zada-researching-mobile-phone-voting/story-fngnvmj7-1227218386245
MX News	Online/Print	Voting hits snag	http://www.mxnet.com.au/story/voting-hits-snag/story-fnh38q9o-1227199616749
Technology Spectator, The Daily Telegraph, The Courier Mail, The Mercury	Online/Print	Researchers tackle mobile voting	https://www.businessspectator.com.au/news/2015/1/27/technology/researchers-tackle-mobile-voting
The Armidale Express	Online/Print	E-voting a ‘no brainer’	http://www.armidaleexpress.com.au/story/2834044/e-voting-a-no-brainer/
The Daily Advertiser	Online/Print	Electronic voting for disabled and remote people opens	http://www.dailyadvertiser.com.au/story/2889649/online-voting-now-open/
The Daily Advertiser	Online/Print	Voting could go electronic	http://www.dailyadvertiser.com.au/story/2868957/voting-could-go-electronic/
The Inverell Times	Online/Print	Vote with your phone, it's time	http://www.inverelltimes.com.au/story/2872708/vote-with-your-phone-its-time/
The Land	Online/Print	Mobile voting may be an option	http://www.theland.com.au/news/agriculture/general/politics/mobile-voting-may-be-an-option/2727546.aspx
The Mercury	Online/Print	PhD student hope to put electoral power in voters’ hands	http://www.themercury.com.au/news/tasmania/phd-student-hope-to-put-electoral-power-in-voters-hands/story-fnj4f7k1-1227193558969

The Northern Daily Leader	Online/Print	Survey asks about ballots by mobile	http://www.northerndailyleader.com.au/story/2961500/survey-asks-about-ballots-by-mobile/
NBN North West News	TV	Louise Starkey	http://www.mobilevoting.com.au/videos/nbn-north-west-news-louise-starkey/
NBN North West News	TV	Sally Rafferty Story	http://www.mobilevoting.com.au/videos/nbn-north-west-news-sally-rafferty-story/
NBN North West News	TV	Madeline Kulk	http://www.mobilevoting.com.au/videos/voters-urged-to-have-their-say-on-e-voting-nbn-north-west-news-madeline-kulk/
NBN North West News	TV	Amelia Bernasconi	http://www.mobilevoting.com.au/videos/nbn-north-west-news-amelia-bernasconi/
2GB 873AM	Radio	Steve Price	http://www.mobilevoting.com.au/videos/2gb-873am-nights-with-steve-price/
ABC 774 Melbourne	Radio	Red Symons	http://www.mobilevoting.com.au/videos/abc-774-melbourne-red-symons-interview/
ABC AM	Radio	Alice Matthews	http://www.mobilevoting.com.au/videos/abc-am-alice-matthews-story/
ABC Southern Queensland	Radio	Belinda Sanders	http://www.mobilevoting.com.au/videos/abc-southern-queensland-belinda-sanders-interview/
News Talk 4BC	Radio	Ben Davis	http://www.mobilevoting.com.au/videos/news-talk-4bc-ben-davis-interview/

In addition to the media campaign, which far exceeded our expectations, we decided to utilise social media as another platform to engage the public directly. From my personal experiences in online advertising, I found video has a powerful attention factor, so I created a "call to action" whiteboard video (Figure 3-1). Utilising the Mobile Voting Facebook page [https://www.facebook.com/mobilevotingau], YouTube channel and public website, I published this video to get more participants to take the survey.

Figure 3-1 Public survey call to action

3.2.1.4 iVote 2015 invitation

Due to the nature of the research and media exposure, I was fortunate enough to be invited to take part in an event held by the New South Wales Electoral Commission (NSWEC) alongside an international delegation to demonstrate the iVote 2015 implementation.

As mentioned in previous sections, the iVote 2015 trial, which later become an implementation following parliamentary proceedings, was the second trial of the iVote system. The iVote system was introduced by the NSWEC in NSW to:

- assist electors who would otherwise not be able to vote independently or would have difficulty voting using existing channels
- assist electors who would, by location during the election period, not otherwise be able to vote reliably
- maintain confidence in the electoral process outcomes by reducing systemic errors for difficult to obtain or handle paper votes, improve counting accuracy (i.e. reduce counting, transcription and transposition errors), and identify electoral anomalies by comparing electoral outcomes from two separate voting channels (Brightwell et al., 2015).

I was amongst delegations from around the world who were presented with the workings of the iVote, a behind-the-scenes tour and various workshops into security and implementation processes undertaken by the NSW Electoral Commission (Figure 3-2).

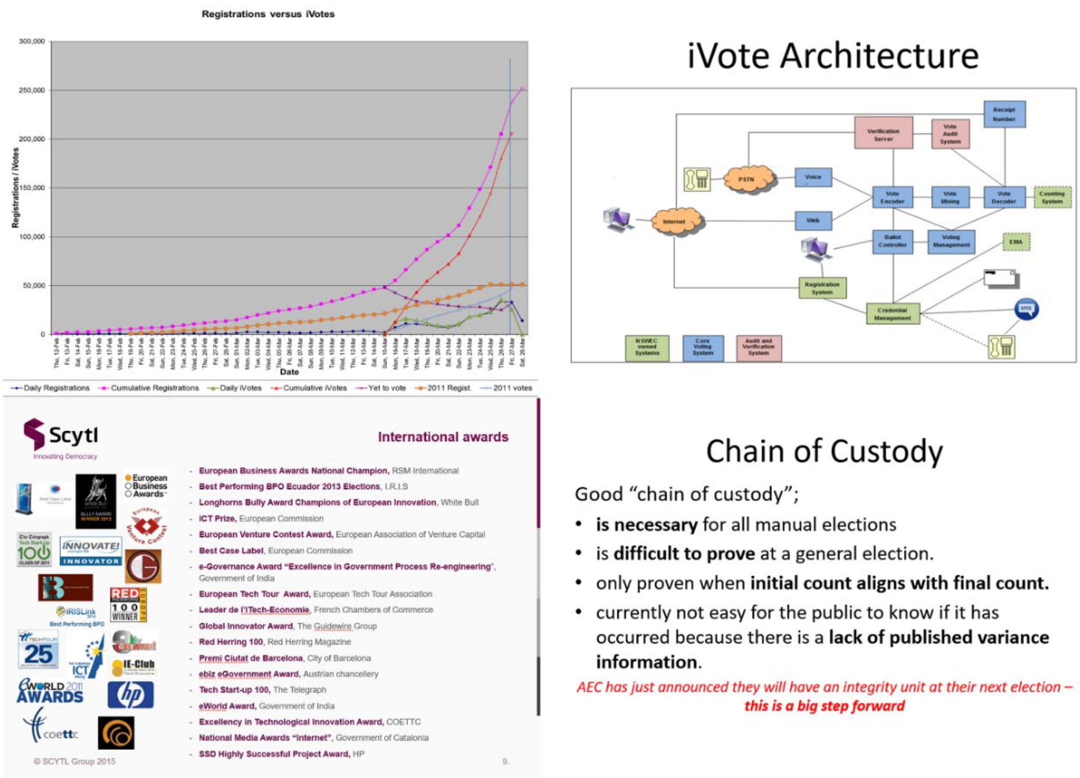

Figure 3-2 Various presentations during iVote invitation

In addition, I was very fortunate to be able to sit in with the technical team after the election had closed when they were working together to begin the process of decrypting and tallying the votes.

The overall experience was insightful and gave me an opportunity to view some of the real-world challenges faced by a real-world implementation of an internet e-Voting platform.

3.2.2 Results and analysis

3.2.2.1 Sample

In this study, there were 335 respondents; however, the results of 40 respondents were disqualified from further analysis as they had not completed the survey. As this was a voluntary survey, item non-response bias can be inferred, implying that these samples could be excluded (Sherman, 2000) and the results derived from the remaining N = 295 samples. As the original statistical power test required that N be greater than or equal to 276, the remaining sample was still within the study parameters.

Survey respondents were given the pre-coded response of “I'd prefer not to say” (PNTS) for all demographic questions. Table 3-2 contains a summary of the primary characteristics of the sample. There was sufficient representation of all age ranges from 18 to 95 and above; females accounted for 43.73% of the sample, with 2.04% PNTS. The mode average income was $0–$24,999 AUD, with 65.00% of the sample currently living in an urban location; 63.71% of respondents have undertaken or completed a tertiary university education; 8.83% had a physical or mental disability; and 3.38% were blind or vision impaired.

Table 3-2 Primary characteristics of sample (N = 295)

	%			%
Gender			**Locality**	
Female	43.73		Internationally	1.70
Male	54.23		Urban	65.42
PNTS	2.04		Rural/Remote	32.20
Age Group			PNTS	0.68
18–24 years	13.23		**Education**	
25–34 years	24.39		Didn't attend	0.00
35–44 years	15.58		Home School	0.00
45–54 years	16.28		Primary School	0.00
55–64 years	17.30		High School	15.26
65–74 years	11.53		TAFE	21.03
75–84 years	0.68		University	63.71
85–94 years	0.00		**Physical or Mental Disability**	
95 year or above	0.34		No	90.15
PNTS	0.68		Yes	8.83
Average Income			PNTS	1.02
$0–$24,999	20.35		**Blind or Vision Impaired**	
$25,000–$49,999	17.97		No	96.28
$50,000–$74,999	16.93		Yes	3.38
$75,000–$99,999	16.27		PNTS	0.34
$100,000–$124,999	9.15			
$125,000–$149,999	3.39			
$150,000–$174,999	1.36			
$175,000–$199,999	1.02			
$200,000 and up	2.71			
PNTS	10.85			

3.2.2.2 Connectivity to the Internet, devices and online services

For the respondent connectivity section (Section 4) of the survey, 98.98% of the sample had access to the internet, with 70.85% of respondents having access to mobile internet, 88.81% of the sample use a Smartphone, 10.85% have voted for an election online and 82.37% have used social media services, online shopping and online banking (see Table 3-3). Table 3-4 ranks the usage of devices by the respondents to access the internet. As can be observed, PC/laptop is the most preferred device, followed closely by Smartphones.

Table 3-3 Internet access, devices and experience with online services (N = 295)

	%			**%**
Types of Internet Access			**Devices Owned**	
Home Broadband	78.31		PC or Laptop	97.63
Mobile Internet	70.85		Smartphone	88.81
Work Broadband	41.02		Tablet	70.85
Work Not Sure	5.42		Smart TV	34.58
Other	5.08		Feature Phone	17.63
Home Not Sure	4.75		Other	4.41
Home Dial-up	1.02			
Work Dial-up	0.68			
Online Services				
Sending/Receiving Email				98.64
Social Media (e.g. Facebook, Twitter, LinkedIn)				94.56
BPay, PayPal or Other Payment Facilities				92.86
Online Banking				91.16
Online Shopping (e.g. eBay, Alibaba, Woolworths Online)				89.12
Reading/Watching News				88.44
Voting Online for an Election				10.88

Table 3-4 Ranked order of device used to access the internet (N = 295). [6]

Device \ Rank	1	2	3	4	5	6	N/A	*Score*[7]
PC or Laptop	46.78	32.20	15.25	0.68	0.68	0.68	3.73	*5.26*
Smartphone	40.34	32.20	12.20	1.69	1.36	1.69	10.51	*5.16*
Tablet	8.16	21.09	34.69	8.50	3.06	1.02	23.47	*4.26*
Smart TV	0.34	3.05	8.14	20.68	10.51	5.08	52.20	*2.89*
Other Devices	0.34	3.39	7.80	21.36	15.93	5.08	46.10	*2.81*
Feature Phone	3.73	3.73	5.42	4.75	5.76	13.22	63.39	*2.78*

3.2.2.3 Likes and don't likes about current voting process

Table 3-5 shows the reasons behind sample likes and dislikes for the current electoral process. The top three likes are "Ability to cast a vote anonymously" (67.03%), "Ability to send my vote in via mail (postal voting)" (33.33%) and "Sausage Sizzle"[8] (30.43%). On the other hand, the top three dislikes are "Lining up to vote / Time taken to cast a vote" (70.73%), "Having only one day to cast a vote physically" (57.84%) and "Travelling to the polling station" (56.10%).

[6] Values are presented as percentages.

[7] Score is the representation of the ranking average. Rankings are weighed in reverse order (Rank 1 = Weight 6, Rank 2 = Weight 5, etc…) and calculated using $\frac{x_1w_1+x_2w_2+\cdots+x_nw_n}{t}$, where w = weight of ranked position; x = response count for answer choice; t = total. N/A responses are not factored into the ranking average

[8] Sausage sizzles are charity fundraising and community events that are held at various polling stations during Election Day, where volunteers cook barbecue sausages and serve on a slice of bread or on a bread roll, accompanied by onions and sauces.

Table 3-5 Likes and don't likes of the current voting process (N = 295)[9]

Don't Like	**%**
Lining up to vote / Time taken to cast a vote	70.73
Having only one day to cast a vote physically	57.84
Travelling to the polling station	56.10
Taking time out of my day to vote	55.40
Party volunteers providing how to vote cards	52.26
Size and time to fill in a ballot paper	45.99
Security of ballot papers once cast	33.10
Compulsory voting	25.09
Name and address available to voting officials when signing in	21.60
Other	14.98
Like	
Ability to cast a vote anonymously	67.03
Ability to send my vote in via mail (postal voting)	33.33
Sausage Sizzle	30.43
How to vote information cards	18.48
Other	14.49
Being able to catch up with friends at the voting station	8.33
Being able to discuss political policy with party volunteers	6.88
Getting help to cast a vote from a friend or family member	5.80

3.2.2.4 Appeals and concerns of a mobile internet e-Voting platform

Table 3-6 shows the selections of sample appeals and concerns of using a mobile internet e-Voting platform. The top three appeals are "Able to cast a vote from anywhere online" (91.40%), "Getting a receipt confirming vote was cast" (72.90%) and "Speed to cast a ballot" (72.50%). On the other hand, the top three concerns are "Hackers,

[9] Results presented in this table are not mutually exclusive categories and therefore do not add to 100%.

malware or virus changing my vote" (75.10%), "Hackers, malware or virus being able to retrieve my vote" (65.30%) and "Hackers, malware or virus monitoring my vote" (63.20%).

Table 3-6 Appeals and concerns of a mobile internet e-Voting platform (N = 295)[10]

Concerns	%
Hackers, malware or virus changing my vote	75.10
Hackers, malware or virus being able to retrieve my vote	65.30
Hackers, malware or virus monitoring my vote	63.20
Secrecy/privacy of my vote. Being able to link my vote back to me	55.60
Lack of independent oversight of the system	44.80
System built and maintained by a contracted commercial company	44.40
Users of the system having the ability to sell their votes	41.90
The voting system not being 100% compatible with my device	27.40
Lack of government oversight of the system	26.70
Other	14.10
Complexity of casting a vote	11.90
Being influenced to vote one way by someone other than an immediate family member	6.10
The time it takes to cast a vote	4.70
Being influenced to vote one way by an immediate family member	4.00
The colour scheme of the voting system	2.50
Appeals	
Able to cast a vote from anywhere online	91.40
Getting a receipt confirming vote was cast	72.90
Speed to cast a ballot	72.50
Being able to confirm cast vote is counted as cast	69.40
Speed to obtain election result count after polls are closed	58.40

[10] Results presented in this table are not mutually exclusive categories and therefore do not add to 100%.

Voting system being thoroughly tested prior to an election by independent bodies	58.10
The voting system used to complement not replace the current system	51.90
Being able to SMS[11] my vote	44.70
Being able to see party policies information prior to casting a vote	44.70
Having an online tutorial to help understand how to cast a vote	40.50
Being able to phone in my vote to a computer system	31.60
Being able to change my vote prior to polls closing	27.10
Being able to cast a vote with multiple language support	17.50
Being able to attend a polling station to cast my vote that overrides my online vote	14.10
Other	10.00
Being able to share my preferred vote (via social media sites)	8.20

3.2.2.5 Trust in government and commercial online systems and preference towards a mobile e-Voting platform

Table 3-7 reveals that most of the respondents (72.88%) either Completely Trusted or Slightly Trusted government and commercial systems as opposed to (15.93%) who either Completely Distrusted or Slightly Distrusted government and commercial systems, 75.26% of the respondents would use a mobile internet e-Voting platform if it was made available during the next election, 15.93% were unsure and required more information and 8.81% would not use the platform. Of the respondents who Completely Distrusted or Slightly Distrusted government and commercial systems, 42.55% would still use a mobile internet e-Voting platform (Figure 3-3).

[11] Short Message Service.

Table 3-7 Trust in online systems (government and commercial) (N = 295)

Completely Distrust **1**	Slightly Distrust **2**	Neither Distrust or Trust **3**	Slightly Trust **4**	Completely Trust **5**	**Median**
4.07%	11.86%	11.19%	37.63%	35.25%	4

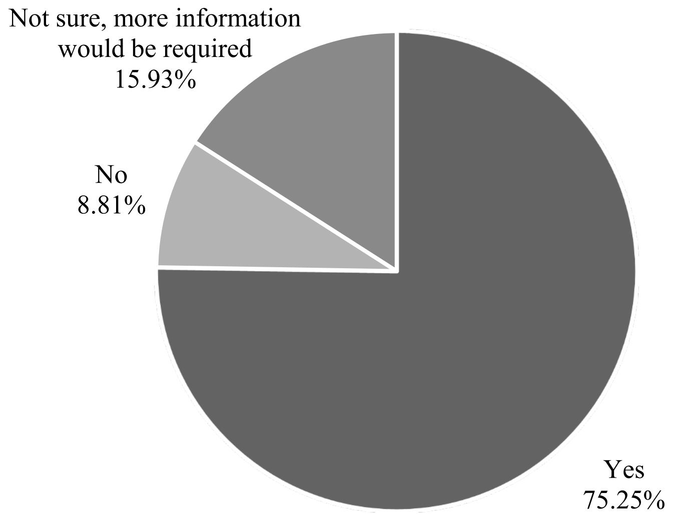

Figure 3-3 Use of a mobile internet e-voting platform if available in the next election (N = 295)

In relation to the preference of the voting mechanism, Table 3-8 shows that "Use my smartphone or tablet to vote using an app" was ranked first, followed by "Use my own connected device to cast a voting on a website – such as PC or Laptop" and "Send an SMS with my vote". The current main mechanism of casting a vote in Australia by using a paper ballot was ranked as the second last preference.

Table 3-8 Ranked order of preference of method for casting vote if a mobile internet e-Voting platform is available in the next election (N = 295).[12]

Method \ Rank	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**	***Score***[13]
A	41.02	29.83	8.81	6.44	3.05	2.37	8.47	*5.01*
B	36.95	29.15	13.56	8.14	4.07	2.03	6.10	*4.86*
C	4.57	15.25	33.22	14.92	9.49	8.14	14.24	*3.61*
D	4.07	11.86	14.58	18.98	23.39	11.53	15.59	*3.05*
E	12.54	5.42	8.81	17.63	17.63	28.81	9.15	*2.80*
F	0.34	4.41	13.90	21.69	20.68	17.63	21.36	*2.59*

A. Use my smartphone or tablet to vote using an app

B. Use my own connected device to cast a vote on a website - such as PC or laptop

C. Send an SMS with my vote

D. Use a computer setup at a polling place that is owned and maintained by the Electoral Commission to cast a vote on a website

E. Paper vote in a polling place

F. Telephone – Call into a digital touch tone service (similar to telephone banking)

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[12] Values are presented as percentages.

[13] Score is the representation of the ranking average. Rankings are weighed in reverse order (Rank 1 = Weight 6, Rank 2 = Weight 5, etc…) and calculated using $\frac{x_1w_1+x_2w_2+\cdots+x_nw_n}{t}$, where w = weight of ranked position; x = response count for answer choice; t = total. N/A responses do not factor into the ranking average

3.2.3 Limitations

This study is not without its limitations. Firstly, even though it meets the size requirement of the statistical power analysis, the sample size of 295 respondents is still relatively small. However, this study is still able to sample a diverse range of respondents in terms of age, gender, income and locality, thereby increasing the generalisability of the findings (Carter & Bélanger, 2005) by pushing the research towards “universalism” (Hammer, 2011). Future studies should seek a greater number of responses with more diversity in education and more focused research on groups identifying as having a disability that will allow more complex model testing. The survey was promoted to the public as being available via the internet or paper mail out; however, there were no requests for the paper version. This is not necessarily a limitation but can be seen as a bias. Future studies should attempt to get responses from members of the public who have limited computer skills or internet access.

3.2.4 Conclusion

The survey described in this section has provided a first step in setting a baseline from which hypotheses can be generated and tested in relation to the adoption of mobile internet e-Voting in Australian elections (Appendix 14). Survey respondents were overall more in favour of using mobile internet e-Voting (75.25%), with more respondents requiring greater information about the technology (15.93%) than being against the use of the technology (8.82%). The top appeals of the platform were mobility (91.40%), verifiability (72.90%) and speed (72.50%), with the top concerns being manipulation (75.10%), retrieval (65.30%) and monitoring (63.20%) of votes by malicious parties or software. This study also provided an insight into the current voting platform. The top three likes of the current voting platform were found to be anonymity (67.03%), postal voting (33.33%) and sausage sizzle (30.43%), with the top three dislikes being time taken to vote (70.73%), having only one day to vote (57.84%) and travelling time to vote (56.10%). Incidentally, the approval of postal voting as a mechanism used in the current platform is of interest as it is a form of remote voting that could be used to overcome the top three dislikes.

Being the first study of its kind carried out by an academic institution, this research provides insights into both the potential pathways by which e-Voting can be successfully adopted and the potential impediments that would prevent successful implementation. This study has proved to be able to sample a diverse range of respondents over an array of demographics, which allowed the findings to push towards a "universalism" that increases the generalisability of the findings.

3.2.5 Reflection

At this point, I am proud that the team and I have conducted an Australian university first study of its kind. With little to no budget or assistance, we were able to get 335 respondents to take part in the survey, of which only 40 respondents were disqualified from further analysis due to not completing the survey.

We were also honoured to be one of the only university research teams to be invited along with international delegations to take a behind-the-scenes tour of the NSW iVote implementation. This insight really put into perceptive the extent of the work we were undertaking. Having the opportunity to speak to international representatives to present our work and what we were doing was a real treat. Incidentally, there were a few remarks about how they were impressed that such a small team was trying to tackle such a large challenge.

However, when the thrill of the survey experience and media attention wound down, I began to question what we had achieved so far. I wondered whether all we had achieved was asking questions, gathering some data and defining a few hypotheses. In fact, we had achieved much more, as we were able to establish a baseline of data against which future research could be conducted. We also have evidence that a mobile voting platform is something Australians would support, and that there is an audience who would adopt the technology. Since our publication was released, we have been cited multiple times and we continue to get traction and media attention based on our research. I was even contacted to comment by the media in relation to the "Census disaster" (Sutton, 2016).

With a baseline established, I was now ready to move onto the next step of designing and building the mobile Smartphone voting app.

3.3 App development

One of the key deliverables of this innovation portfolio project is a working mobile voting app, but this product alone does not provide the full picture. As discussed throughout this innovation portfolio project, I am sharing the journey through this research. This section details the journey taken by the research team to arrive at the final product, the mobile voting app. It covers the project initialisation, planning and scope of works. Finally, it provides a review of the app and finished product.

This section is broken up into the following components:

1. **Envisioning session.** Provides direction for the software project within the context of the Scrum methodology.
2. **Backlog construction.** High level product backlog item definitions.
3. **Sprint planning, cycles, reviews and retrospective.** Chronologically ordered report of the undertaken sprints, including planning of the cycles, reviews and retrospectives.
4. **Application overview.** Detailed overview of the completed Mobile Voting App.

3.3.1 Envisioning session

The purpose of an envisioning session is to set a clear vision for a product. The vision acts as a “true north” (Pichler, 2009), which sets the direction of a product and provides essential guidance for a team. Given that I was a development team of one, I needed to ensure that I did not stray from the objectives of the application development. At the end of 2017, the research team held a lengthy session to answer the questions that Pichler (2009) states should be addressed when developing an effective product vision:

Q1. Who is going to buy the product? Who is the target customer?

We were the customer. The target customer was, simply, our team. We needed to achieve an application that we could use as part of the in-depth interviews and did not need to cater for public use.

Q2. Which customer needs will the product address?

The application needs to:

- allow the research team to conduct interviews during which participants cast a vote on a mobile device
- simulate the current voting process; in our case the Federal Election process was chosen
- allow participants to "get a feel" of what it might be like if this solution is made mainstream

Q3. Which product attributes are critical to satisfy the needs selected, and therefore for the success of the product?

The key attributes of the product are:

- to be device agnostic. The application needs to be able to be installed on any mobile smartphone device (within reason). If the participant does not have a compatible device, then we would provide one for them.
- to simulate an election. The backend infrastructure, such as servers and other services, were not required.
- no real data, such as candidates or political parties, are to be used
- collate the years of research and survey feedback to determine in our opinion the best workflow for casting a vote online.

Q4. How does the product compare against existing products, both from competitors and the same company? What is the product's unique selling points?

To the best of our knowledge there is not currently an application that meets our requirements or is accessible.

Q5. What is the target timeframe and budget to develop and launch the product?

The application needs to be developed and ready by the end of March 2018 for use with the interviews. Budget restrictions relate more to time than money. I had 20 hours per week available within my schedule for the development.

3.3.1.1 The framework

Following the envisioning session, the key aspects of the application that needed to be answered related to what and how it will be built. Given my many years in software development, the workflow, interaction and overall architecture of the application would be determined by the technology.

Whilst in real-world scenarios decisions about platforms are made following an envisioning session as requirements are discovered, for the purposes of this innovation portfolio, we selected the most appropriate platform during the envisioning session on the basis of my extensive professional knowledge and experience.

The different platforms available for the application development that were investigated were:

Xamarin

Xamarin (https://www.xamarin.com/) is a Microsoft-owned platform that provides the ability to write mobile applications using a C# shared codebase that can be deployed to Android, iOS and Windows devices. Although this technology supports some aspects of a shared user interface for the application, we felt that due to the time constraints, we would not have time to for programming should the shared packages not be adequate and require individual user interface development.

React Native

React Native (https://facebook.github.io/react-native/) is a framework developed by Facebook that uses React (which is a JavaScript based web application framework) that compiles in real native applications for Android and iOS. This technology was promising; however, we ran into the issue of deployment during investigation. We could deploy manually on each device (via manual connection to a computer) or via the various app stores, but the team decided this could run into problems as participants may be reluctant to hand over their device to be set up.

Ionic

Ionic (https://ionicframework.com/) is an open-source SDK for building and deploying hybrid mobile applications. Ionic is built on top of Google's Angular Framework (https://www.angular.io) and Apache's Cordova (https://cordova.apache.org/) platform. In essence, Ionic allows developers to write applications in Angular (JavaScript/Typescript) utilising Cordova's plugins, which will allow the application to interact with the native functionality of the device.

Although Xamarin and React Native produce native applications, Ionic apps are hybrid, which means they are browser-based applications that run in respective WebView components on the device, even though to the user it looks and feels like a regular mobile app. Therefore, Ionic was chosen as the preferred platform as it allowed not only very fast application development at no cost, but also provided a very powerful online service that would allow the team to deploy the application to interview participant devices without the need to install our application directly. The installation is achieved by their Ionic View platform.

There has been an ongoing argument that the poorer performance of running a hybrid vs a native application would be an issue. In my experience, this may be a possibility, but it depends on the application being built. In the case of our application, performance will not be a factor, as we are not building a resource intensive application (e.g. a game) that requires many animations. The performance issue with hybrid applications was put forward during the early era of Smartphones, as they were heavily dependent on browser responsiveness and web standards (Hardawar, 2012; IBM, 2011). However, Smartphone devices have come a long way in the last 10 years. Table 3-9 shows the differences in processors and RAM between older Smartphones and the more recent ones. With more hardware resources available and increased web-standards compatibility across various browsers/devices (caniuse.com), browser-based performance has increased substantially.

Table 3-9 Evolution of the iPhone

Year	Device	Processor	RAM
2007	iPhone	620 MHz	128 MB
2010	iPhone 4	1 GHz	512 MB
2015	iPhone 6	1.4 GHz dual-core	1 GB
2018	iPhone X	2.39 GHz hexa-core 64-bit	3 GB

3.3.1.2 Backend infrastructure

Upon investigation of the frameworks and having decided to develop a hybrid app using Ionic, we still needed a way to both identify the participants using the application and share some common data sets (such as candidates, election information, etc.). Therefore, although our scope did not identify the need for a fully fledged backend server infrastructure, there was a still a need for some sort of backend system. I investigated building my own microservice but that would add more time to the project that we did not have.

These constraints then lead me to Firebase (https://firebase.google.com/). Firebase is a Google platform that provides a range of "off-the-shelf" functionality and products for mobile applications. The one I was mainly interested in was the Realtime Database, which allows the application to have an active link to a NoSQL database in real time. This functionality meant we could capture, share and send data to and from the application with ease. Being a NoSQL database meant that all that we would need to do to get started was to provide a JSON package containing the initial data set.

3.3.2 Backlog construction

Even though it goes against all the guidelines of Scrum methodology, I took on the roles of product owner, Scrum master and developer. The reasoning behind this, other than being the only developer on the project, was that I wanted to apply the same principles I had been applying in my day-to-day work life. As a product owner, I needed to understand what I needed to deliver. The envisioning session gave me direction and some constraints of the application but turning that into a product backlog list was a different story. A product backlog list is "simply a list of all things that needs to be done with a project" ("The Scrum Product Backlog", 2018).

The following is a collection of the product backlog items that were created as part of the project. They are arranged in chronological order based on assignment and completion within sprints. If the product backlog item was a result of a user story it is also included at the point at which it was conceived. It is worth noting that these product backlog items were created at different points throughout the project.

3.3.2.1 Product backlog

PBI 1. Designing data model structure

Acceptance criteria:

- Design a JSON data model that can be used as a NoSQL data model for the application.
- It must provide fields for elections, users, receipts and shared settings.
- The data model must be able to be uploaded and downloaded easily into Firebase.
- The data model must also be mocked and ready for initial load.

PBI 2. Implementing a Firebase Realtime Database instance

Acceptance criteria:

- Sign up for a Firebase account.

PBI 3. Setting up Ionic project

Acceptance criteria:

- Create a new Ionic project.
- Project must build using a hello world example.
- The application must be able to connect directly to a mobile device for testing purposes.

PBI 4. Signing up and configuring Visual Studio online with GIT for source control

Acceptance criteria:

- Sign up for a Visual Studio online account for the project.
- Use GIT for source control.
- Push the initial project into the repository.

PBI 5. Configuring and deploying via Ionic View

Acceptance criteria:

- Sign up to an Ionic View account.
- Configure the project to link with the created account.
- Test that the application can be deployed remotely using Ionic View.

PBI 6. Generating mock-ups of initial flow and layout for approval by the team

Acceptance criteria:

- Sign up to a Balsamiq account.
- Develop mock-up of the user interface and interactions.
- Screens include:
  - Welcome
  - Registration
  - Sign in
  - Home
  - Cast a Vote
  - House of Representatives Ballot
  - Senate Ballot
  - Cast Submission
  - Receipt
  - Validation
  - Support
  - Profile

PBI 7. Tweaking the mock-up as per feedback from the review

Acceptance criteria:

- Add descriptions where noted and highlight some features.
- Provide a mock-up of a submitted receipt.

PBI 8. Improving on data model following mock-up outcomes

Acceptance criteria:

- Update data model to meet new requirements.
- Apply data model in Firebase.

PBI 9. Creating the home screen with screen base pages tabs. Cast, Validate, Support, Profile and Sign Out

Acceptance criteria:

- Create a tabbed UI containing links to:
    - Cast, Validate, Support, Profile and Sign-out

PBI 10. Creating the services and starting state model using NGRX

Acceptance criteria:

- Implement NGRX platform into the application.
- Implement Store Dev Tools for testing.

PBI 11. Showing the open, upcoming and closed elections on the Cast tab

Acceptance criteria:

- Must be able to see open, upcoming and closed elections from the Firebase database.
- Should display a list containing the election name, when it would close/open or when it was closed.

PBI 12. Creating a page to select a ballot for a federal election with two types – House of Representative and Senate

Acceptance criteria:

- When a Federal Election ballot is selected, provide a choice on which ballot the user would like to complete.
- Each ballot needs to include its status.
- The name and logo of the election must be shown at the top of the page.

PBI 13. Casting a House of Representatives ballot

Acceptance criteria

- Ability to complete a ballot for the House of Representatives.
- Logo for each candidate party must be displayed if available.
- Each candidate needs to be displayed in the format currently used by the AEC.
- Upon successful save, must return to ballot selection page (PBI 12).

PBI 14. Selecting the required Senate ballot option

Acceptance criteria

- When the user selects a Senate ballot, they are presented with two choices
    - Above the line
    - Below the line
- Text as per current AEC format that explains each option must be provided.
- When an option is selected, the user must be redirected to the selected ballot page.

PBI 15. Casting a Senate ballot above the line

Acceptance criteria:

- Should only display a list of party names.
- Logo for each candidate party (or parties) must be displayed if available.
- Upon successful save, must return to ballot selection page.
- Scrolling should be vertical as opposed to the horizontal ballot format.

PBI 16. Casting a Senate ballot below the line

Acceptance criteria:

- Each candidate to be displayed under their respective grouping.
- A line must be used to separate each grouping.
- If a candidate is ungrouped, they should fall under that category.
- Upon successful save, must return to ballot selection page.
- Scrolling should be vertical as opposed to the horizontal ballot format.

PBI 17. Adding validation to the House of Representatives ballot

Acceptance criteria:

- A ballot cannot be submitted without validation.
- All candidates must be given a preference otherwise the ballot cannot be submitted.

PBI 18. Adding validation to the Senate ballot

Acceptance criteria

- A ballot cannot be submitted without validation.
- A minimum number of candidates/party preferences must be selected otherwise the ballot cannot be submitted.
- This needs to be configurable in the backend.

PBI 19. Submitting a vote and receiving a receipt number

Acceptance criteria:

- When all ballots are completed, must be able to submit the vote.
- Once the vote is submitted, a receipt number must be provided and stored in the application.

PBI 20. Adding a scroll notification bar to tell the user that they must scroll down

User story:

As a user, I want the information about all candidates to be clear and easily accessible, so I want to be notified if there are more candidates or parties available that I can set a preference against.

Acceptance criteria:

- Add a scroll notification bar at the top and bottom of the page to tell the user there are more candidates if they scroll.
- Must stand out and be almost immediately noticeable to the user.

PBI 21. Adding the ability to submit an empty ballot

User story:

As a user, I want to be able to submit an empty ballot if I choose.

Acceptance criteria:

- A user may submit an empty ballot but not an incomplete ballot.

PBI 22. Adding the ability to reset a Senate and House of Representatives ballot

User story:

As a user, I want to be able to reset my ballot so that I can easily start again.

Acceptance criteria:

- Add the ability to reset each ballot type.

PBI 23. Adding the ability for the candidates to be randomised

Acceptance criteria:

- Randomise candidate positioning on the page to mitigate against donkey voting[14].

PBI 24. Adding the ability to view a candidate and party information in the ballot

User story:

As a user, I want to be able to see more information about a candidate/party so that I can find policy and other information easily.

Acceptance criteria:

[14] Donkey voting is when an elector numbers the candidates in the sequential order of appearance on the ballot.

- Alongside each candidate, show an information icon that leads to a candidate/party information page.
- Candidate may or may not provide an image.
- Ensure that each candidate has party information available if applicable.

PBI 25. Selecting a ballot preference using one click or drop down

User story:

As a user, I want to be able to use one-click selection rather than a select list of preferences so that I can easily make my choices.

Acceptance criteria:

- Provide the ability to mark preferences using one-click boxes.
- Re-clicking a selection removes the preference value.
- Make this option configurable in the event we need to switch it back to using a select list selection method.

PBI 26. Confirming the submission

User story:

As a user, I want to be notified what election I am submitting a vote for so that I can confirm I am completing the correct vote.

Acceptance criteria:

- Ensure that each ballot page refers to the selected election.
- Ensure that prior to submitting a vote, the election name is confirmed with the user.
- Reauthenticate user prior to submission.

PBI 27. Viewing previously cast votes (receipts)

Acceptance criteria:

- Previous cast votes (by an authenticated user) on the device should be displayed in the Validate tab.
- The order must be random.
- Upon user selection of the receipt, the user may review how they voted for that receipt.
- As user can only see their own cast votes.

PBI 28. Confirming receipt is loaded on the app matches the receipt at the server side (simulated)

Acceptance criteria

- When a user opens a receipt, simulate that the votes are being verified.
- Verification should display a green status message.

PBI 29. Deleting a receipt on the app

User story:

As a user, I want to be able to delete receipts from my device so that they cannot be retrieved.

Acceptance criteria:

- Add a button to the receipt review page to delete the receipt.
- Deleting the receipt will only remove it locally.

PBI 30. Providing support page containing support contact information

Acceptance criteria:

- Create a Support tab containing contact information for help.
- Links and information can be anything as this is a prototype.

PBI 31. Registering to use the application

Acceptance criteria:

- Provide a page on which a user can register.
- User must provide a valid e-Voting number, display name (optional) and password.
- SMS and fingerprint authentication must be provided for two-factor authentications.
- Upon successful registration, user may login or register another user profile.

PBI 32. Enabling SMS validation and fingerprint validation

Acceptance criteria:

- Allow the user to choose whether they want SMS and/or fingerprint validation upon registration.
- Only affects the detailed registration process.

PBI 33. Selecting user and logging in to the application

Acceptance criteria:

- Ability to select a preregistered user to log in as.
- When a user is selected, they must be authenticated using the security options enabled in their profile.
    - Password

  - SMS (if enabled)
  - Fingerprint (if enabled)
- Fingerprint and SMS authentication can be simulated.

PBI 34. Unregistering a user from the device

Acceptance criteria

- Provide the ability to unregister a user from the device in the user selection screen.

PBI 35. Signing out of the application

Acceptance criteria:

- Should able to one-click logout from the home screen using the “sign-out” tab.

PBI 36. Registering to use the application using a simpler method

Acceptance criteria:

- Provide a simpler registration page that asks just for e-Voting number, Display Name (optional), password and re-enter password.
- This feature needs to be configurable to be switched on/off in the backend.

PBI 37. Updating profile once logged in

Acceptance criteria:

- Once a user is logged in, they should be able to update their profile using the Profile tab from the home screen.
- Once updated, display a message that the profile has been successfully updated.

PBI 38. Validating SMS and fingerprint simulation

Acceptance criteria:

- Simulate SMS and fingerprint interactions with the application.

PBI 39. Controlling the interview using a command line app

Acceptance criteria:

- For the purposes of the interview, create a node base command line interface that will allow easy control over the data and provide some functionality.
- Commands:
  - User – Reset, Remove, List, Add
  - Config – Set, Get, List
  - Receipt – Receipt, Remove, List
  - Clear the console buffer
  - Exit the application.

PBI 40. Tracking the time it takes to submit a vote

Acceptance criteria:

- Add time tracking that begins when a voting session has started and finishes when the vote is submitted.
- Information should be stored with the receipt.
- For internal use only, not to be displayed to the user.

PBI 41. Conducting a survey using the application

Acceptance criteria

- Add the ability to be able to conduct a national survey using the application.
- Survey needs to be configurable in the same way as an election.

- Surveys need to be identifiable from Elections.
- User interface can be basic and contain basic questions.

PBI 42. Capturing survey response using the application

Acceptance criteria

- Once a survey is completed, it can be submitted and a receipt stored as per an election.

PBI 43. Validating survey information using the application

Acceptance criteria:

- A receipt for a survey must be validated in the same manner as an election.
- Also necessary to have the ability to delete the survey response.

PBI 44. Apply theming to the application

Acceptance criteria:

- Apply a colour scheme to the application.
- Use the colour scheme of the mobile voting website and logo.

PBI 45. Refactoring and touching up

Acceptance criteria:

- Refactor the code.
- Minimise console logs and other non-required functionality.

PBI 46. Testing the application on multiple devices

Acceptance criteria:

- Test application on multiple Smartphone devices.

PBI 47. Proof of Concept (POC) the app runs as a standalone app

Acceptance criteria:

- Compile and load the application on a device as a hybrid application.
- Must not use Ionic View for remote distribution.

PBI 48. Logging in using an override during the interview

Acceptance criteria:

- For the purposes of the interview, allow the user to bypass the security protocols.

PBI 49. Providing user icon display at the top of the screen that when clicked on will link to the user's profile

Acceptance criteria:

- Add an icon on the home screen at the top right to indicate which user is currently logged in.

3.3.3 Sprint planning, cycles, reviews and retrospective

In the previous section, the complete product backlog for mobile voting was presented. This section presents how our methodology was put into practice. Each subsection will cover a sprint cycle, what product backlog items were allocated to the cycle, the outcome of the sprint review and, finally, a retrospective.

It is also worth noting that the retrospective is an integral part of the "inspect and adapt" process, with focus on overall output and team performance ("Sprint Retrospective

Meeting", 2018). As we are a small team and I am the sole developer, the retrospectives were used as a discussion forum on the deliverables and progress of the sprint.

3.3.3.1 Sprint Cycle 1: Project initialisation

Sprint Goal: Initialise the project with the chosen technologies and develop proof of concepts with each technology to ensure compatibility.

Allocated Items:

PBI 1. Designing data model structure

PBI 2. Implementation of a Firebase Realtime Database instance

PBI 3. Setting up Ionic project

PBI 4. Signing up and configuring Visual Studio Online with GIT for source control

PBI 5. Configure and deploy via Ionic View

Sprint Review:

- Demonstrated working technology.
- Positive responses to the Ionic View pipeline.

Sprint Retrospective:

What went well in the sprint?

- Technology mix was easy to set up and configure proof of concept against.

What could be improved?

- Designing the data model structure was challenging without greater context. I was unsure what would work with Firebase, so app development had to go on hold until Firebase was completed.

What will we commit to improve in the next sprint?

- Ensure there are no dependent product backlog items in the sprint.

3.3.3.2 Sprint Cycle 2: Mock-ups and user flows

Sprint Goal: Design mock-ups of the app that demonstrate the user flow and screen layouts.

Allocated Items:

PBI 6. Generating mock-ups of initial flow and layout for approval by the team.

Sprint Review:

- Mock-up screens needed more descriptions as the team found some functionality was hard to understand.
- Missing receipt submission confirmation screen.
- Overview flow looks good, and presented concepts were well received.

Sprint Retrospective:

What went well in the sprint?

- Tooling for mock-ups was well chosen and easy to use.
- Having each screen included in the acceptance criteria made it easier to work on.

What could be improved?

- Having a single product backlog item for the entire sprint, although informative, did not provide visibility on the progress of the sprint.

What will we commit to improve in the next sprint?

- Designate bigger product backlog items as epics and break down into smaller PBI's before the sprint starts.
- Do not assume stakeholder's knowledge. Ensure everything is well defined and easy to follow [context: descriptions in mock-ups].

3.3.3.3 Sprint Cycle 3: Improve mock-ups and data model

Sprint Goal: Completed mock-ups and an updated data model

Allocated Items:

PBI 7. Tweaking the mock-up as per feedback from the review

PBI 8. Improving on data model following mock-up outcomes

Sprint Review:

- Mock-ups have been signed off.
- Data model has been signed off.

Sprint Retrospective:

What went well in the sprint?

- PBIs went smoothly, no issues.

What could be improved?

- More work could have been allocated to the sprint.

What will we commit to improve in the next sprint?

- Ensure there is an adequate amount of PBIs assigned to the sprint.

3.3.3.4 Sprint Cycle 4: App shell and state

Sprint Goal: To create an application shell and underlying architecture.

Allocated Items:

PBI 9. Creating the home screen with screen base pages tabs. Cast, Validate, Support, Profile and Sign Out

PBI 10. Creating the services and starting state model using NGRX

PBI 11. Showing the open, upcoming and closed elections on the Cast tab

Sprint Review:

- Questions were raised about the progress as most of the "visible" deliverables were light, although there was much work done on the NGRX side.

Sprint Retrospective:

What went well in the sprint?

- Using the mock-ups' screen design and flow was easy.
- Data model definition shaped the state management[15] very well.

What could be improved?

- Need to ensure more visible work is allocated per sprint for the stakeholders.
- The backend work made no reference to the Firebase integration that was required to get the services working.

What will we commit to improve in the next sprint?

- Better balance of backend and "visible" screens.

[15] State management refers to the management of state of an application's individual components and application data.

- When PBI requires various integrations, ensure that the technology mix is referenced for better estimations.

3.3.3.5 Sprint Cycle 5: House of Representatives ballot

Sprint Goal: Selection of a federal election and ability to cast a House of Representatives ballot.

Allocated Items:

PBI 12. Creating a page to select a ballot for a federal election to accept two types – House of Representative and Senate

PBI 13. Casting a House of Representatives ballot

Sprint Review:

- User flow was simple enough and the stakeholder was able to self-navigate the process of casting a House of Representatives ballot.
- There was some concern over using real political parties for the data.
- Need some form of validation upon submission to ensure that a user has met the requirements of the ballot.

Sprint Retrospective:

What went well in the sprint?

- Product backlog items where well defined and provided a clear goal for delivery.

What could be improved?

- Add reference links to third-party information i.e. AEC format/rules reference.

What will we commit to improve in the next sprint?

- Backlog items should contain links to reference materials.

3.3.3.6 Sprint Cycle 6: Senate ballot

Sprint Goal: Ability to cast a Senate ballot either above or below the line

Allocated Items:

PBI 14. Selecting the required Senate ballot option

PBI 15. Casting a Senate ballot above the line

PBI 16. Casting a Senate ballot below the line

Sprint Review:

- User flow was simple enough and the stakeholder was able to self-navigate the process of casting a Senate ballot.
- As with the House of Representatives ballot, some form of validation upon submission is needed to ensure that a user has met the requirements of the ballot.
- Having the Senate ballot viewed with vertical candidate placement compared to horizontal placement as per the paper ballot was raised and discussed. It was tabled to be reviewed later.

Sprint Retrospective:

What went well in the sprint?

- Reference to third-party information made it easier to get started with the ballot creation.

What could be improved?

- There was quite a bit of work in this sprint, which resulted in a very tight completion window with no allocation for refactoring prior to sprint completion.

What will we commit to improve in the next sprint?

- Reduce the amount of effort involved in a sprint so it is more manageable but not too light that there is not enough work.

3.3.3.7 Sprint Cycle 7: Validation and submission

Sprint Goal: Enable validation when completing a ballot.

Allocated Items:

PBI 17. Adding validation to the House of Representatives ballot

PBI 18. Adding validation to the Senate ballot

PBI 19. Submitting a vote and receiving a receipt number

Sprint Review:

- Validation mechanisms well received.
- Submission of receipt is simple and requires confirmation and acknowledgment from the user.

Sprint Retrospective:

What went well in the sprint?

- A few interesting challenges with validation but I was able to overcome the issues after some research.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- Put more insight into PBIs prior to entering the sprint. This could address the issue identified in the sprint review.

3.3.3.8 Sprint Cycle 8: Sprint paused – No development work required

Sprint Goal: This period was allocated to allow the team to review the application and play around with various functionality, at which time any sprint review changes and suggestions are to be raised.

Allocated Items:

- N/A

Sprint Review:

- Suggestions raised:
  - Need to see something on the screen to tell the user whether there are more candidates further down, i.e. scroll notification.
  - The ability for a user to submit an empty ballot but not an incomplete one.
  - The ability to reset a ballot and clear entries.
  - Randomise candidate list. This could mitigate the donkey vote.
  - It would be nice to be able to see candidate/party information and policies, similar to the how-to-vote cards that are handed out during an election.
  - Make the preference selection process quicker by replacing the select list with a one-click solution.

  - View previously cast votes.
  - Once receipt is retrieved, simulate the server validating that the vote has been cast successfully.
  - Deletion of a receipt from the application.

Sprint Retrospective:

What went well in the sprint?

- This sprint gave the team time to try out the application and come back with relevant feedback.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- We should do this again towards the end of the project (time permitting).

3.3.3.9 Sprint Cycle 9: Ballot casting improvements

Sprint Goal: Improve the ballot casting experience to allow for scroll notifications, empty ballots, resettable preferences and candidate randomisation

Allocated Items:

PBI 20. Adding a scroll notification bar to tell the user that they must scroll down

PBI 21. Adding the ability to submit an empty ballot

PBI 22. Adding the ability to reset a Senate and House of Representatives ballot

PBI 23. Adding the ability for the candidates to be randomised

PBI 24. Adding the ability to view a candidate and party information in the ballot

Sprint Review:

- Improvements work well.

- Information about candidates needs to be more detailed but can be reviewed and completed before the in-depth interviews begin.

Sprint Retrospective:

What went well in the sprint?

- Backlog items where simpler to implement as most of the inner functionality of the app was done.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- N/A

3.3.3.10 Sprint Cycle 10: Selection, submission and receipt improvements

Sprint Goal: Continue with preference selection improvements and receipt improvements

Allocated Items:

PBI 25. Selecting a ballot preference using one click or drop down

PBI 26. Confirming the submission

PBI 27. Viewing previously cast votes (receipts)

PBI 28. Confirming receipt is loaded on the app matches the receipt at the server side (simulated)

PBI 29. Deleting a receipt on the app

Sprint Review:

- App is looking better with these improvements.

- One-click functionality should be made the default setting but changeable later on if required.
- Team excited with project progress thus far.

Sprint Retrospective:

What went well in the sprint?

- Review went well, and functionality was easier to implement than expected.

What could be improved?

- One-click PBI was more difficult than expected, but other PBIs were easier than expected.

What will we commit to improve in the next sprint?

- Better PBI estimations.

3.3.3.11 Sprint Cycle 11: Support page

Sprint Goal: Complete the support tab.

Allocated Items:

PBI 30. Providing support page containing support contact information

Sprint Review:

- Investigate if there is a need to ensure that links/information of the support page can be simulated.

Sprint Retrospective:

What went well in the sprint?

- N/A

What could be improved?

- Time allocation

What will we commit to improve in the next sprint?

- Better time allocation to allow for more work to be completed within the designated timeframes.

3.3.3.12 Sprint Cycle 12: User registration

Sprint Goal: User registration

Allocated Items:

PBI 31. Registering to use the application

PBI 32. Enabling SMS validation and fingerprint validation

PBI 33. Selecting user and logging in to the application

PBI 34. Unregistering a user from the device

PBI 35. Signing out of the application

Sprint Review:

- Registration process seems a bit complicated. Need to look at a simpler option.
- We will need to simulate SMS and fingerprint as real implementations as they may not be available on demo devices. May add extra cost to the project.

Sprint Retrospective:

What went well in the sprint?

- Was able to complete all items in a tight timeframe.

What could be improved?

- Need better clarity on PBI requirements to save time.

What will we commit to improve in the next sprint?

- Clarity on PBI from stakeholders prior to commencement if unsure.

3.3.3.13 Sprint Cycle 13: User registration improvements and profile

Sprint Goal: User registration improvements and Profile tab

Allocated Items:

PBI 36. Registering to use the application using a simpler method

PBI 37. Updating profile once logged in

PBI 38. Validating SMS and fingerprint simulation

Sprint Review:

- Simpler option looks a lot easier and should be made configurable remotely for A/B testing.
- Profile update and simulation look fine.

Sprint Retrospective:

What went well in the sprint?

- Fast turnaround time made it possible to allocate some time to registration refactoring.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- Do not work outside the allocated items as there will be no tracking on work done.

3.3.3.14 Sprint Cycle 14: Sprint paused – No development work required

Sprint Goal: Allow the team time to review the application process end-to-end from registration to submission.

Allocated Items:

- N/A

Sprint Review:

- For the interviews we need to ensure we have some form of control.
- Need to track the time it takes to register and submit a vote.
- Based on what occurred during the recent national survey, it would be interesting to see if we could conduct a simulated "national" via the application.
- Need the ability to "bypass" security protocols during the interview process to avoid delays, although delays of this nature should be recorded if they occur.

Sprint Retrospective:

What went well in the sprint?

- Another good paused sprint with positive and promising outcomes.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- N/A

3.3.3.15 Sprint Cycle 15: Interview controls and tracking

Sprint Goal: Interview control logic.

Allocated Items:

PBI 39. Controlling the interview using a command line app

PBI 40. Tracking the time it takes to submit a vote

Sprint Review:

- Controls are simple and provide quick commands for use during the in-depth interviews.
- Tracking information will be insightful.

Sprint Retrospective:

What went well in the sprint?

- Ability to adapt and build out a node application to control via Firebase.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- N/A

3.3.3.16 Sprint Cycle 16: Survey

Sprint Goal: Survey implementation.

Allocated Items:

PBI 41. Conducting a survey using the application

PBI 42. Capturing survey response using the application

PBI 43. Validating survey information using the application

Sprint Review:

- Survey capture and validation works well within the application.

- Team surprised on turnaround time to develop a survey as opposed to time taken to develop election features in the app.

Sprint Retrospective:

What went well in the sprint?

- Survey was able to be easily integrated into the application framework.

What could be improved?

- Did need to go back to stakeholders for some insight and ideas around context.

What will we commit to improve in the next sprint?

- Context needs to be applied with PBIs so that during development there are no assumptions and requirements to go back to the stakeholders.

3.3.3.17 Sprint Cycle 17: Touch-up, testing and interview overrides

Sprint Goal: Touch-up, testing and interview overrides.

Allocated Items:

PBI 44. Apply theming to the application

PBI 45. Refactoring and touching up

PBI 46. Testing the application on multiple devices

PBI 47. Proof of Concept (POC) the app runs as a standalone app

PBI 48. Logging in using an override during the interview

PBI 49. Providing user icon display at the top of the screen that when clicked on will link to the user's profile

Sprint Review:

- Theming works well and is configurable.

- Application tests were successful.
- Override mechanisms were well received.

Sprint Retrospective:

What went well in the sprint?

- The application was able to be deployed as a standalone app very easily using the Ionic framework.

What could be improved?

- N/A

What will we commit to improve in the next sprint?

- Last sprint – N/A

3.3.4 The application

This section analyses the mobile voting application. The overall application architecture will be reviewed, followed by an analysis of each key available task, their screens and the flow. The tasks that will be analysed are:

- user registration
- casting a vote or survey response
- receipts
- other tasks – this will provide insight into other smaller features of the application.

We will also cover the command line interface built for the interview.

Following a review of the application, further detail is provided about the coding pattern used for the application and how it is built. Given that the app is quite extensive, I will be focusing on application state management and how it is used to control the application and its interactions with the user and backend Firebase service.

3.3.4.1 Level 0

A Level 0 diagram (Figure 3-4) is a top-most diagram of the application architecture and includes any integrated services. The real-world case for the application's Level 0 will include server architecture and any third-party integrations. However, as this app has been built with the in-depth interview in mind, it will be presented in the current state during this innovation portfolio project.

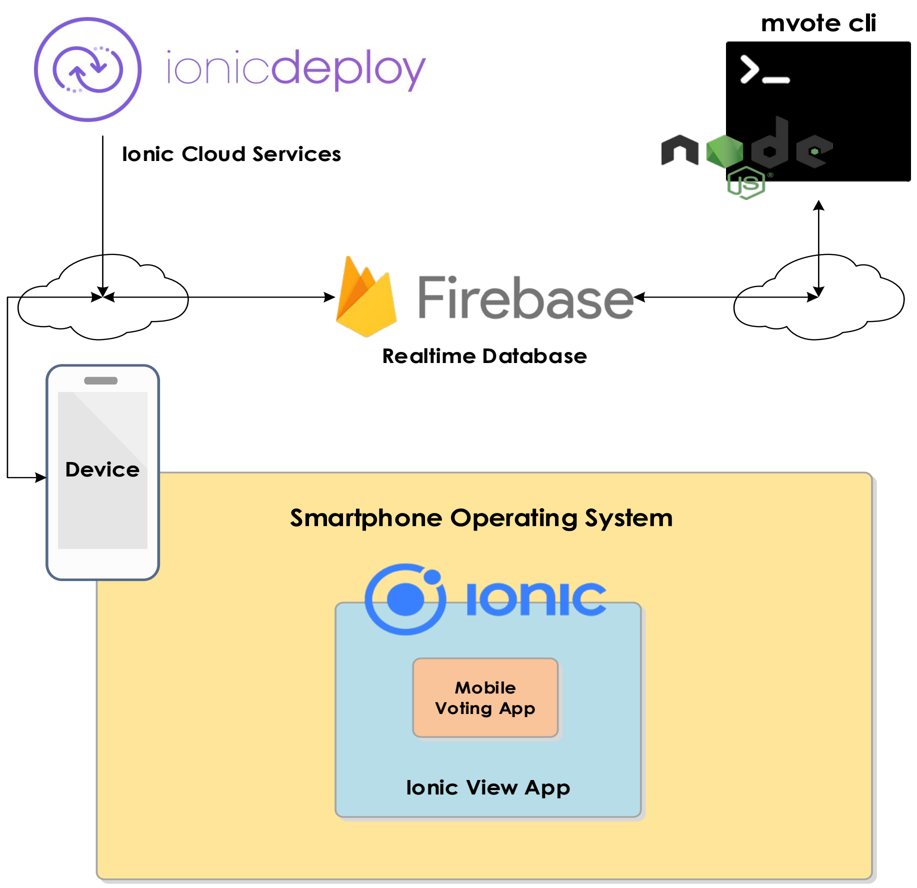

Figure 3-4 Mobile Voting app architecture

Our application is a hybrid application that will be deployed by Ionic View services. This approach allows for the application to run within a shell (or container) within the Ionic View application. There are two external integrations for the application: the live link to the Google Firebase Realtime Database and the connection to Ionic cloud services (for app access/updates). The command line app or mobile voting command line interface (mvote.cli) is a command line interface that assists with the interviews. It is built using NodeJS and has a direct connection to the Firebase Realtime Database.

3.3.4.2 User registration

The user registration task is the ability for a user to register their profile on the device. The process to register is quite simple, enter some unique user information to build a profile, and the built profile is allocated to a standalone device used for registration.

During the development of the application, there were two types of registration: simple and full modes. It was decided that these two flows would allow the team to capture how each mode would compare from a user's experience during the interviews.

This task was designed with the following features:

1. The registration page must be accessible from the home screen and is provided as the only option if there is not a user already registered on the device, i.e. no sign in option unless a user has registered on the device (Figure 3-5).
2. Prior to using the mobile voting app, the user will need to obtain an "e-Voting number" from a voter registry (a separate organisation and preferably a government-run entity). The e-Voting number is a unique identifier that is sent

with the vote and ensures anonymity when using the application (i.e. a randomly generated sequence) (Appendix 9).

3. The application allows for multiple users to register on the same device, which means multiple family members can share a device.
4. The simple mode will only ask for a display name and a password. The display name masks the e-Voting number, but it is still clear to the user of the device who the e-Voting number is allocated to, although the display name is not shared with backend services and is only on the device itself (Figure 3-6).
5. The display name is an optional field. If the display name is not provided, then the e-Voting number will be displayed at login. Point (7) addresses the risk of exposure of the e-Voting number.
6. The full mode will ask for the same information as the simple mode (display name, password) but also provide an optional configuration for 2 or 3 factor authentications. The application simulates the use of an SMS validation code and fingerprint validation. These additional factors will be required along with the password (if enabled by the user) when logging in to the application, updating their profile and casting a vote. Making the factors configurable and optional allows the user greater control of how they interact with the app (Figures 3-7, 3-8). Interestingly, reality biometric authentication, which is used in two factor authentication, is handled by the device as a replacement for using a password in order to ensure that there is no external exposure or sharing of biometric data. SMS authentication protocols would be owned and controlled by the authentication provider and would be disconnected from the vote-count body.

7. Once an e-Voting number is registered on a device, it cannot be registered on another device. As such, the e-Voting number is to be used only with the application. Telephone voting and voting at a polling station have no publicly available affiliation with the e-Voting number.
8. When a field is entered correctly, the underlining text is a bright green, otherwise invalid fields will display an error and be underlined in red.

Screenshots – User registration

Figure 3-5 Home page (Pre-registration)

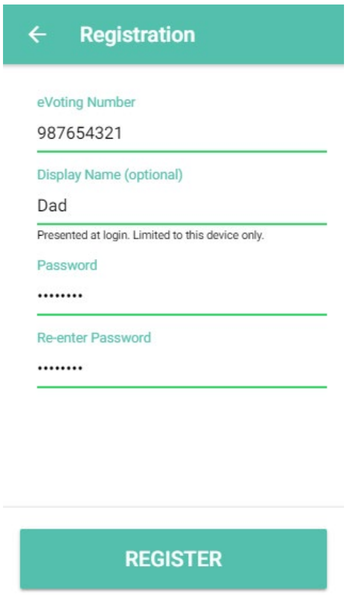

Figure 3-6 Simple registration

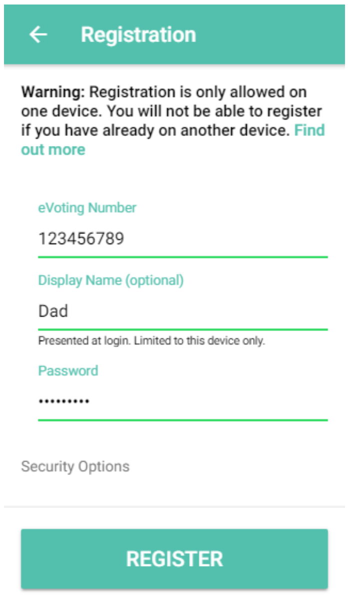

Figure 3-7 Full registration (1 of 2)

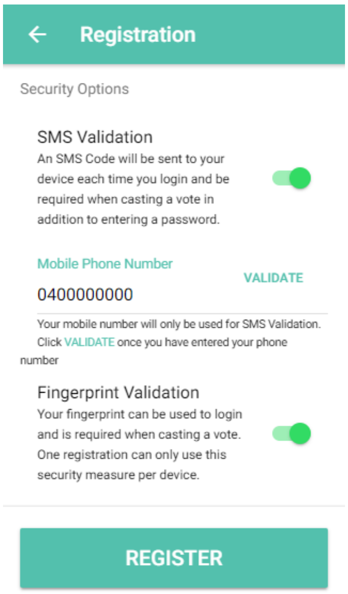

Figure 3-8 Full registration (2 of 2)

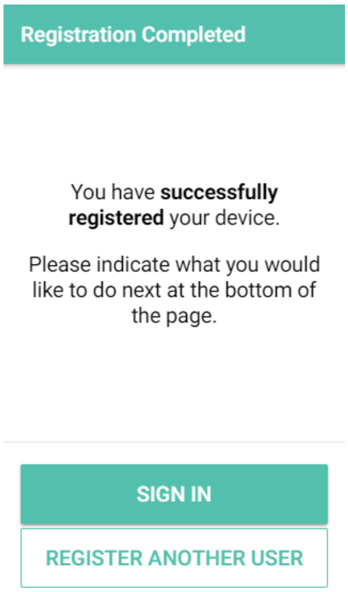

Figure 3-9 Registration confirmation

Figure 3-10 Home page (post-registration)

3.3.4.3 Casting a vote or survey response

The casting a vote or survey response task is the ability for a user to login and cast their vote or respond to a survey. Prior to this task, the user must be registered on the device to be authenticated (Figures 3-11, 3-12, 3-13).

For the purposes of this demonstration information, the election made available is the 2018 Federal Weather Elections and the Australian Sausage Sizzle Sauce Survey. The survey simulates a national public survey. All data have been randomly generated as dummy (fake) data, including names, parties, questions and affiliations.

This task was designed with the following features:

1. When an election is made available, it will appear in the “Open” section of the Cast page in the app. If an election/survey is closed or upcoming (not open yet), it will appear in the subsequence sections of the same page. Each open election/survey will also display when it will close so users will know how long

they have to cast their vote. For demo purposes, we set this to the year 3000 (Figure 3-16).

2. Once a user selects the election/survey, the subsequent flow for each type is as follows.

   Type: Election

   2a. The user is presented with each ballot they need for their vote along with its status, which is either **Incomplete** or **Completed.** The user will not be able to continue unless they complete all ballots (Figure 3-17).

   House of Representatives

   i. This ballot presents in the current format of a House of Representatives ballot provided by the AEC. Information includes the logo, ballot title, election title, electoral division and instructions (Figure 3-18).
   ii. The candidates are randomised every time this page is opened to address the issue of donkey voting.
   iii. A user can also click the information icon next to a candidate's name to bring up relevant candidate information including a profile photo, key policies and a short bio (Figure 3-19).
   iv. See 2b-2f for candidate selection process.

   Senate

   i. As per the current format of a Senate ballot by the AEC, the user is given a choice as to whether they would like to vote above or below the line. Relevant information includes the logo, ballot title, election title, electoral division and instructions. Information is also included about what each option (above or below the line) will require from the user (Figure 3-25).

ii. It is worth noting that the current process lists the candidates/parties/groups left to right on the ballot paper, whereas our application presents it top-down.

v. Candidates/parties/groups are randomised every time this page is opened, to address the issue of donkey voting.

Above the Line

a. Instructions and requirements are presented to the user so they know what is required to submit this ballot (Figure 3-26).
b. The user is presented with a list of candidate groups and can click on the information icon next to the group name to bring up information on each candidate in the group, including a profile photo, key policies and a short bio (Figure 3-27).
c. See 2b-2f for preference selection process.

Below the Line

a. Instructions and requirements are presented to the user so they know what is required to submit this ballot (Figure 3-29).

b. The user is presented with a list of individual candidates and their respective parties/groupings. The user can click on the information icon next to a candidate's name to bring up information on the candidate including a profile photo, key policies and a short bio.

c. See 2b-2f for preference selection process.

2b. There are two configurable options for candidate selection.

i. **One-Click Selection Mode** – The user clicks on the preference box next to the candidate/party and an incremental preference number is allocated in order of selection. If a user re-clicks an assigned preference, the assigned preference is cleared and they can allocate that choice to another candidate.

ii. **Select List Selection Mode** – The user can use a dropdown list to select a candidate/party. It is possible for the user to allocate the same preference twice, but this action will trigger a validation error that highlights the duplicate selections in red (Figures 3-21, 3-22).

2c. If no selections are made, the user can submit an empty ballot if they so choose (Figures 3-18, 3-26, 3-29).

2d. As there are more candidates than there is space on a single screen view, as the user scrolls through the page there is a standout notification bar that advises the user there are more candidates if they scroll further (Figure 3-30).

2e. Once the minimum number of preferences have been selected (system regulated according to ballot requirements), the user can either click continue and save their ballot or continue numbering the remainder of the ballot if they choose and the option is available, then press continue to save their ballot (Figures 3-23, 3-28, 3-30).

2f. Upon saving the ballot, the user is redirected to the previous ballot selection page and the status is changed to completed (Figure 3-24).

2g. A user also can re-enter a saved ballot and change their votes.

2h. Each ballot also can be reset via a button on the top right of the screen within each respective ballot.

Type: Survey

3a. The user is presented with the survey questions in a linear ordered format (Figure 3-36).

3b. Each question type displays the question name, the question and the ability to answer using different user input options.

Question Types

i. **Boolean** – The user has the option to enter either No or Yes to a question. The order of the Yes or No inputs are randomised to address the issue of donkey selection[16] (Figure 3-37).

[16] A derivation of the term donkey voting. Donkey voting is when an elector numbers the candidates in the sequential order of appearance on the ballot.

   ii. **Dropdown** – The user can select from a list. The order of the options is also randomised in an effort to address the issue of donkey selection[16] (Figure 3-38).

3. Once a user has met the requirements of the survey/election, the user is provided with a confirmation, which confirms that they are submitting. They can either go back or submit their response (Figures 3-32, 3-40).
4. At this point the user is revalidated using the same security mechanisms configured for their profile (Figures 3-33, 3-34, 3-41).
5. Once successfully authenticated, the response is submitted, and a receipt number and confirmation of successful submission is displayed (Figures 3-35, 3-42).
6. A user can submit an unlimited number of responses. This is to address coercion by allowing repeat casting (Section 1.3.5.2). Within the principles of online voting, only the latest vote would be counted by the electoral officials, and as a failsafe, a paper-based submission at the polling station will always override any online submission(s) (Gritzalis, 2002; Philip et al., 2011).

Screenshots – Authentication

Figure 3-11 Home screen (user registered)

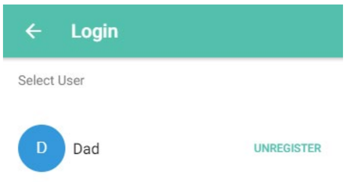

Figure 3-12 User selection

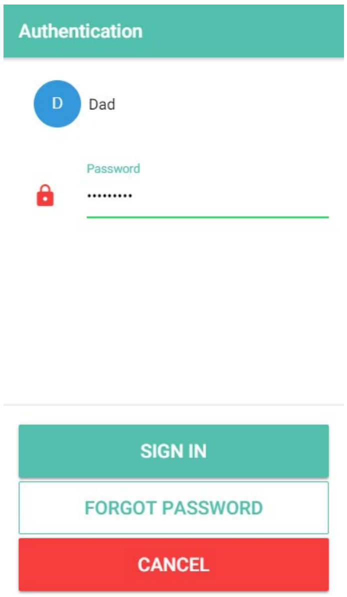

Figure 3-13 Login password authentication

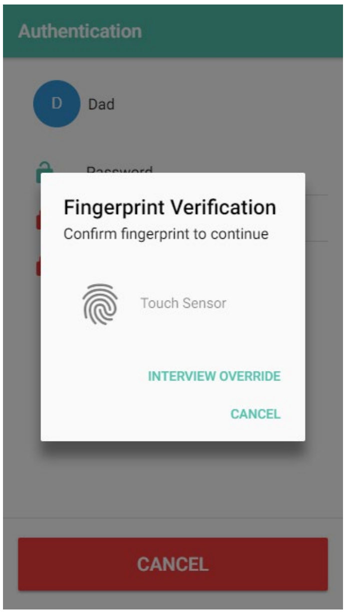

Figure 3-14 Fingerprint authentication (if set)

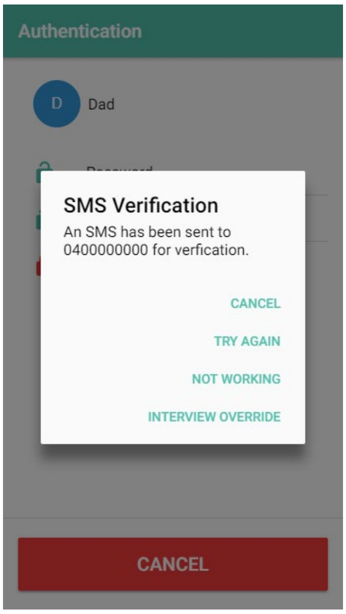

Figure 3-15 SMS validation (if set)

Screenshots – Casting a vote

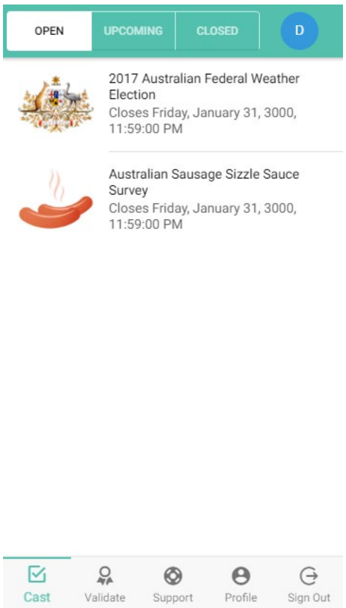

Figure 3-16 Cast page - open elections

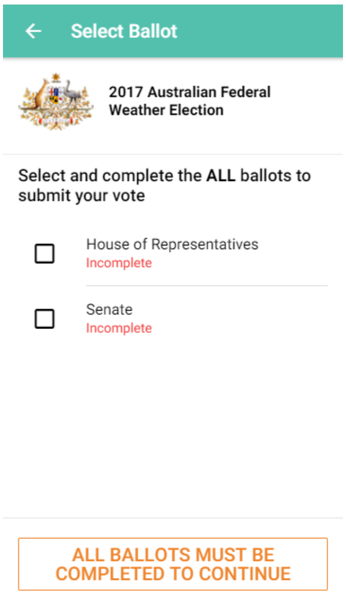

Figure 3-17 Election – Ballot selection (incomplete)

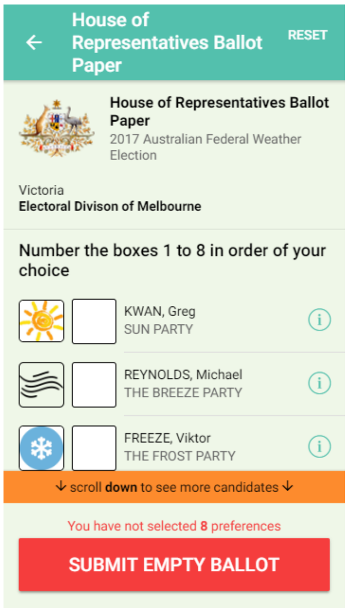

Figure 3-18 House of Representatives (empty ballot)

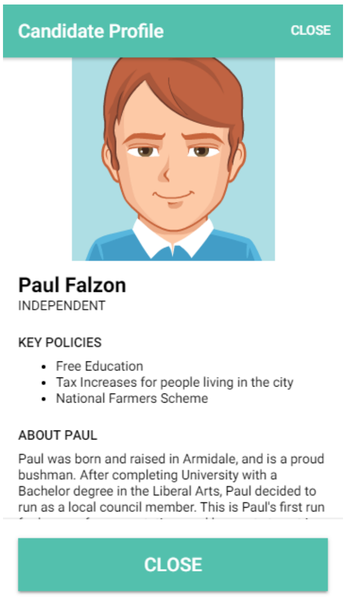

Figure 3-19 Candidate profile

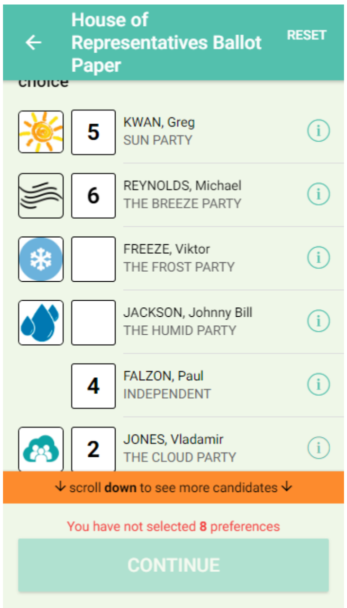

Figure 3-20 House of Representatives (incomplete ballot)

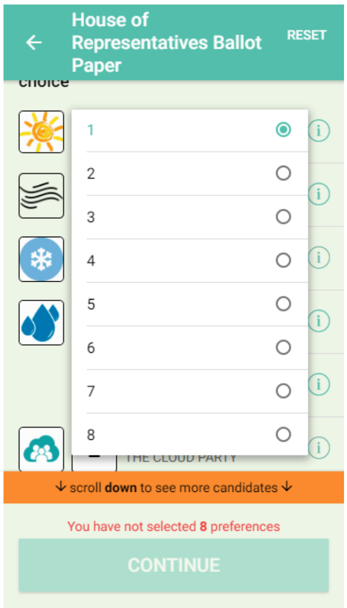

Figure 3-21 Select list preference selection mode

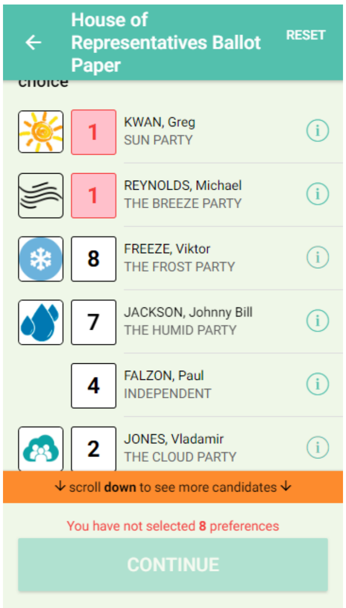

Figure 3-22 Duplicate preferences

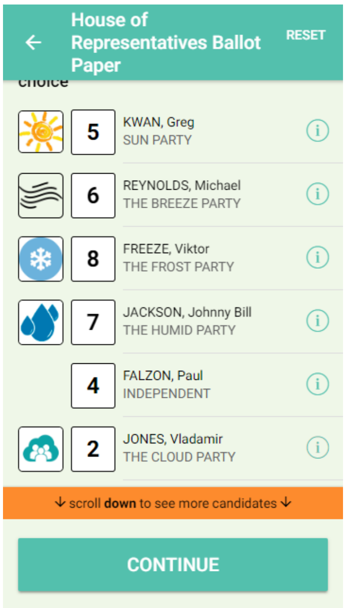

Figure 3-23 House of Representatives ballot (completed)

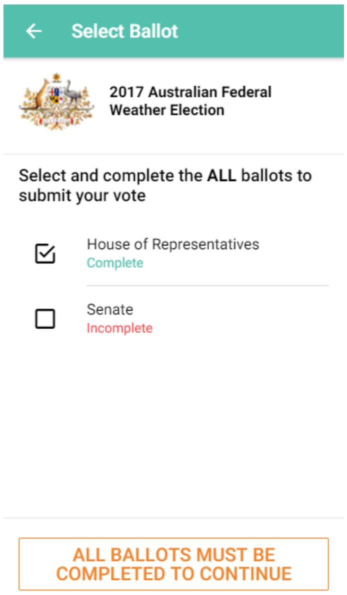

Figure 3-24 Ballot selection - completed ballot

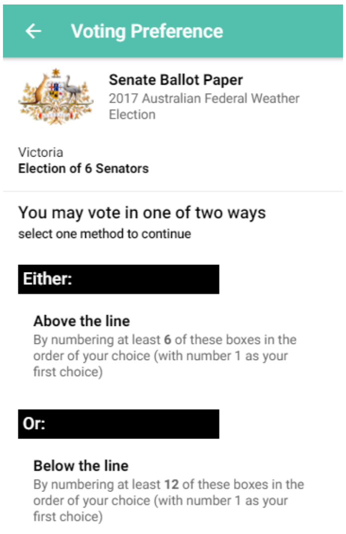

Figure 3-25 Senate ballot selection

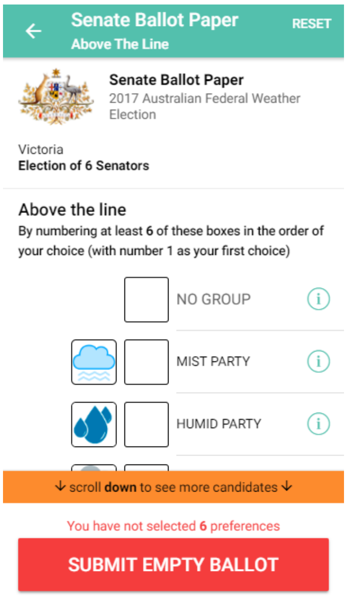

Figure 3-26 Senate - Above the line (empty ballot)

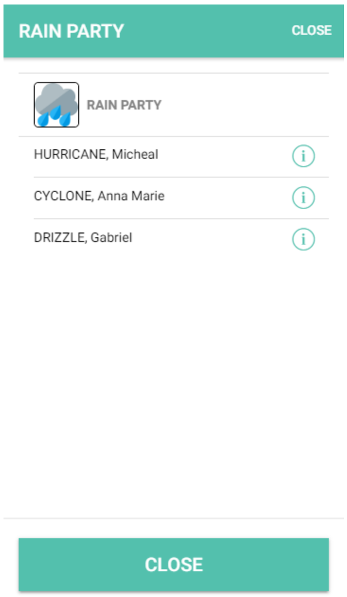

Figure 3-27 Party candidate list

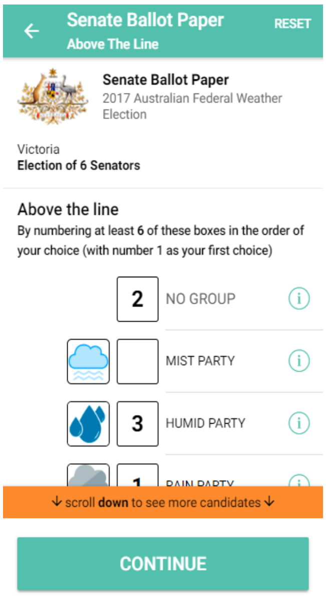

Figure 3-28 Senate - Above the line (completed)

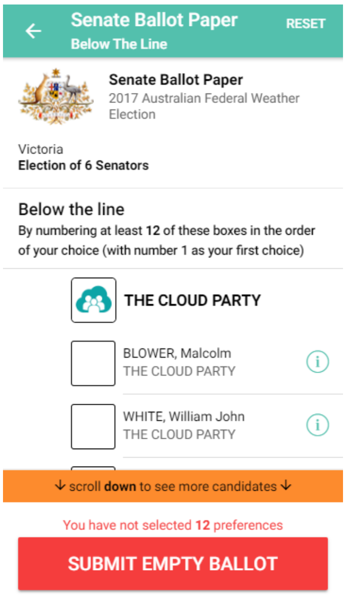

Figure 3-29 Senate - Below the line (empty ballot)

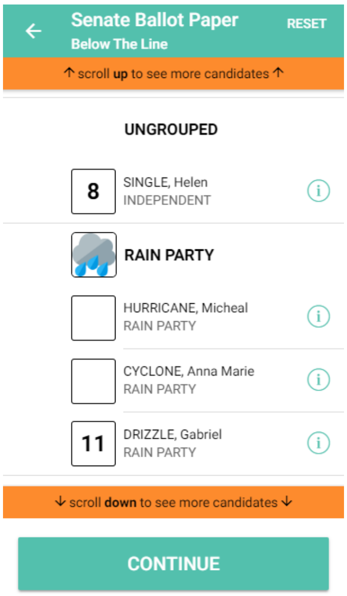

Figure 3-30 Senate - Below the line (completed)

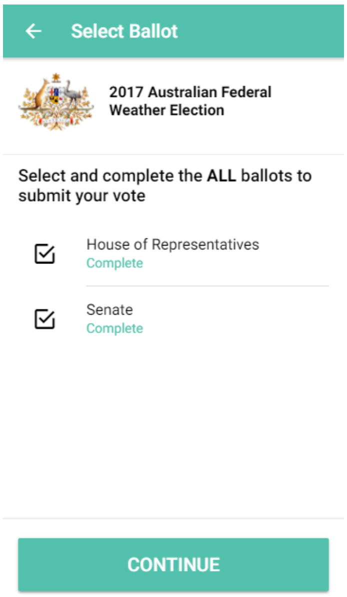

Figure 3-31 Ballot selection - All completed

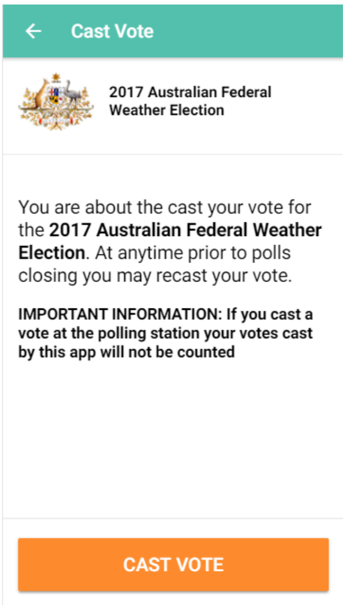

Figure 3-32 Vote submission confirmation

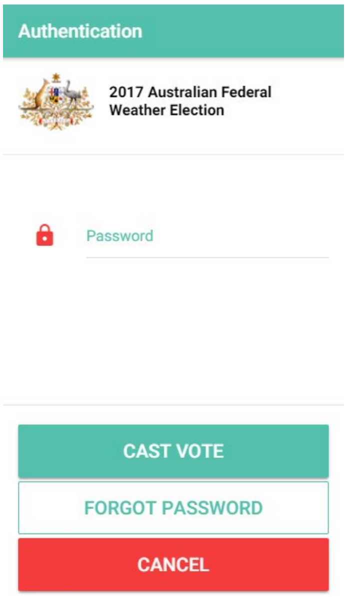

Figure 3-33 Vote submission authentication

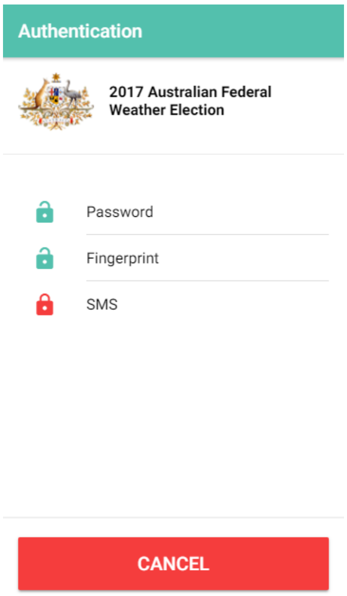

Figure 3-34 Vote submission authentication progress

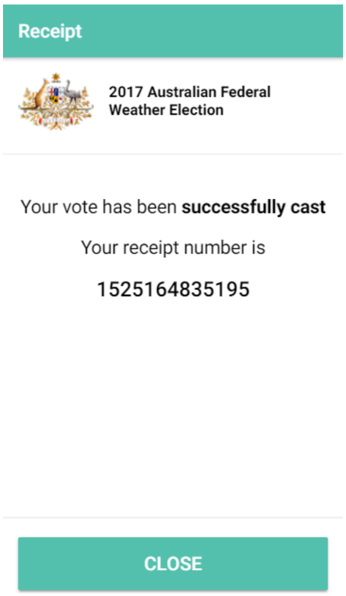

Figure 3-35 Vote submission receipt details

Figure 3-36 Survey

Screenshots – Submit a survey response

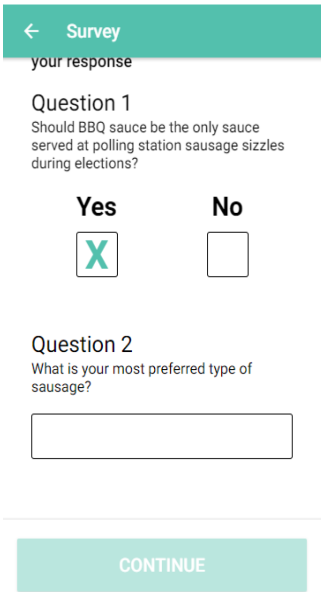

Figure 3-37 Survey boolean question answered

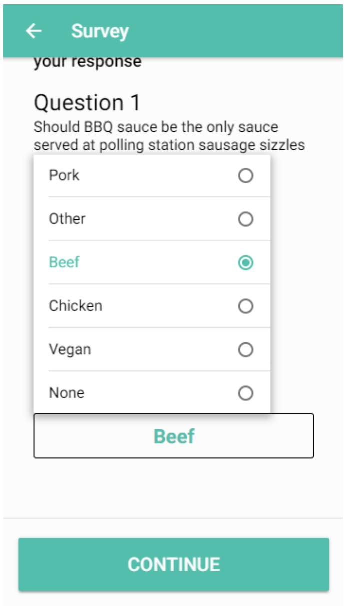

Figure 3-38 Survey - Select list options

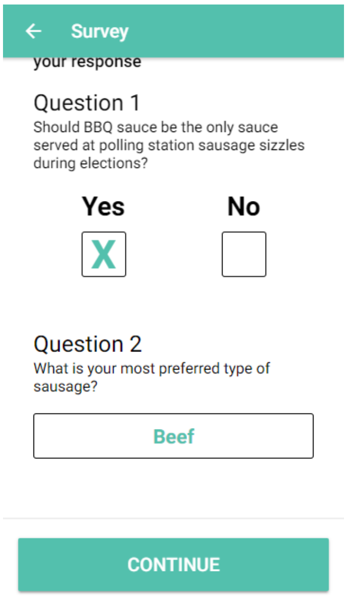

Figure 3-39 Completed survey

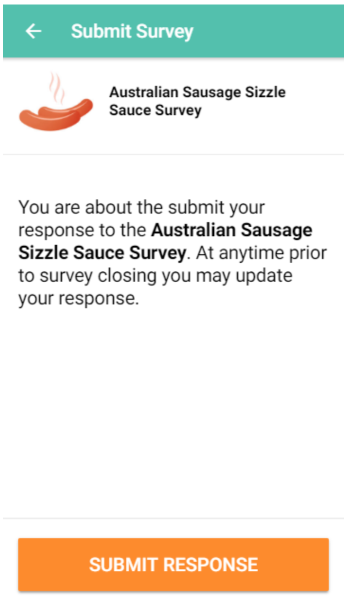

Figure 3-40 Survey submission confirmation

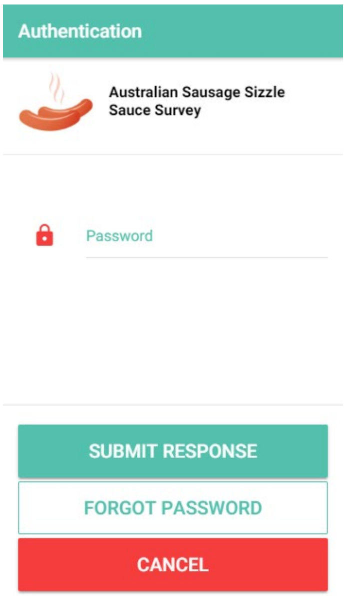

Figure 3-41 Survey submission authentication

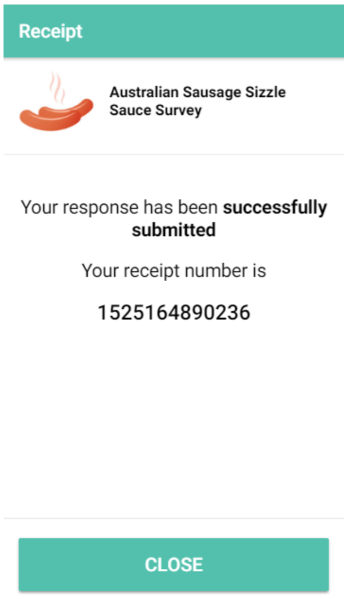

Figure 3-42 *Survey submission receipt details*

3.3.4.4 Receipts

The receipt feature is the user's ability to view a previously submitted vote/survey response. Prior to this task, the user must be registered on the device to be authenticated.

This task was designed with the following features:

1. Receipts for cast votes and survey responses are only made available on the device they were cast on. If a user profile is deleted from the device, each of the receipts are removed and cannot be retrieved (Figure 3-43).
2. Receipts appear under the headings of the corresponding election/survey in the Validate tab (Figure 3-43).
3. Receipts are displayed in a random order each time the Validate tab is active. This feature prevents votes being listed in chronological order, which could identify when a vote was cast.
4. Receipt numbers are unlinked to users and are generated randomly; however, for demonstration purposes, the receipt numbers are timestamped so that we can analyse the results post interview.
5. Once the receipt is opened, the application will validate that the receipt on the device is the same as the receipt on the server (backend). This is simulated in the current application; however, in real-world scenarios, we envisage that this step would be done using some form of irreversible hashing algorithm (Figure 3-44).
6. Once validated, a user may open the vote that was cast and view how they submitted their response (Figures 3-45, 3-46).

7. A user can also delete the receipt from their device. In principle, this would not undo/cancel their submission to the electoral office. In theory this could be used as a mechanism to avoid users being coerced to revealing how they voted (Figures 3-45, 3-46).
8. A user is presented a prompt to confirm the deletion of a receipt prior to execution of the deletion. In a real election, deletion of a receipt from a device is an irreversible action; however, during the in-depth interviews as part of this research, we want to test if a user would question a confirmation.

Screenshots – Validation and read-only receipt review

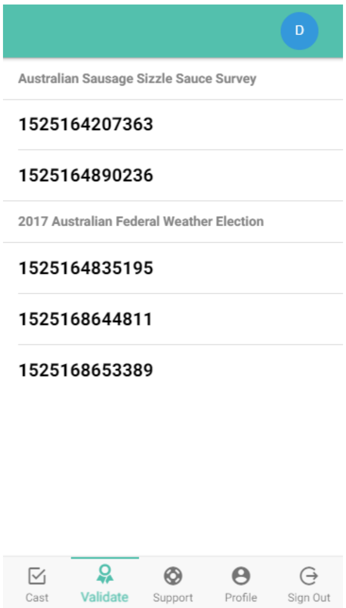

Figure 3-43 Validation tab

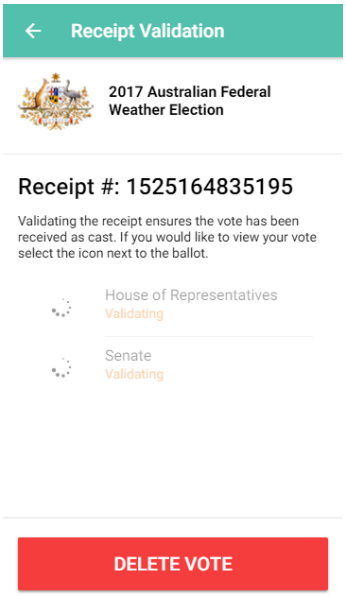

Figure 3-44 Receipt - Validating

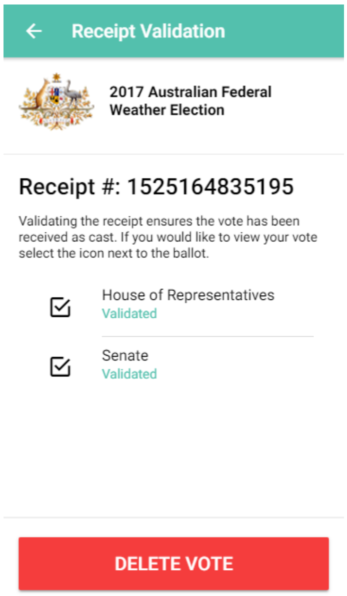

Figure 3-45 Receipt - Validated

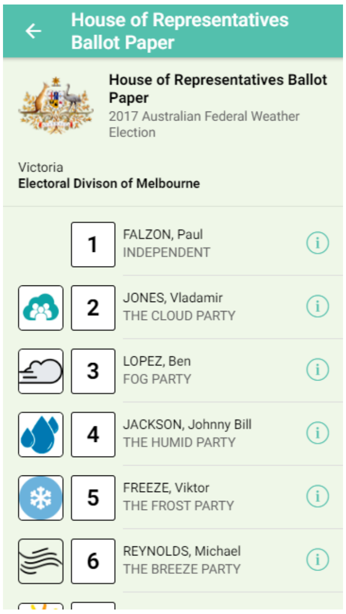

Figure 3-46 Receipt - Read-only vote view

3.3.4.5 Other tasks

The other tasks available are:

1. Support – A user can find contact information for help with the app in the Support tab. This is dummy information for demonstration purposes (Figure 3-50).
2. Profile – A user can update their profile once they are logged into the device; any changes are validated as per the registration process (Figures 3-47, 3-48, 3-49).
3. Sign-out – A user can sign out of the application.
4. User deregistration – A user can unregister from the device in the user selection screen. This action unregisters the user from the app and clears all their local information. Once unregistered, a user can re-register on the device or another device if they wish.

Screenshots – Update profile

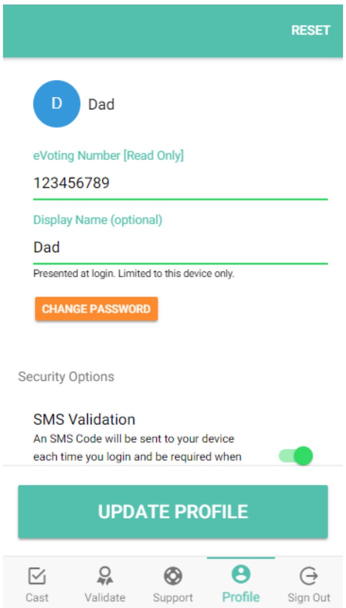

Figure 3-47 Profile

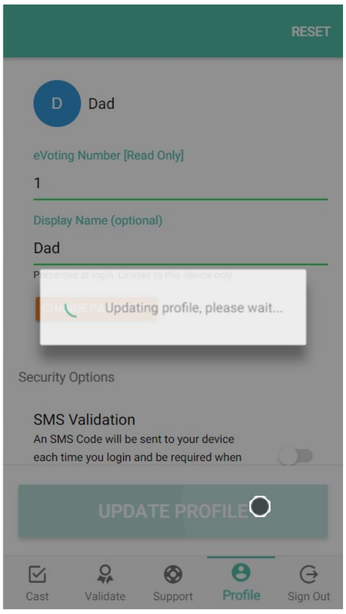

Figure 3-48 Profile loader

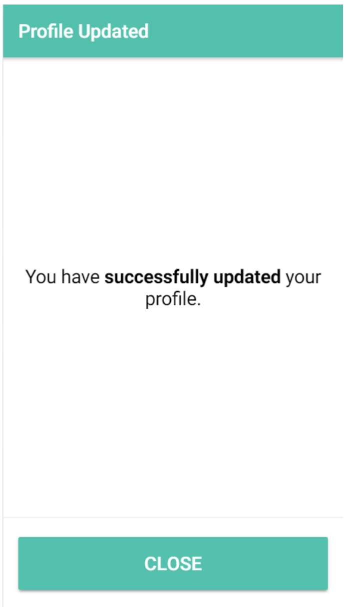

Figure 3-49 Profile successful notification

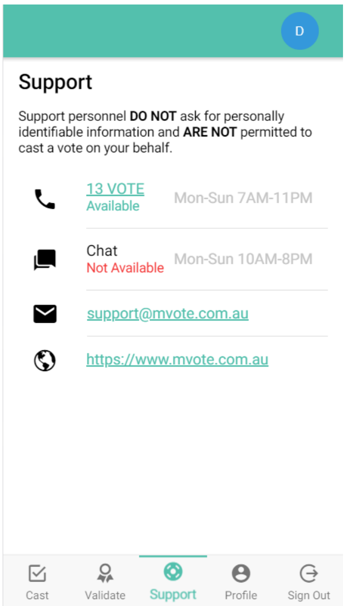

Figure 3-50 Support tab

3.3.4.6 Command line interface

The command line interface (mvote cli) is a tool that is specifically built to assist with the management and execution of the interviews (Figure 3-51). It is built using NodeJS and has a live connection to the Firebase Realtime Database.

The key purposes behind the command line interface are to:

1. allow Realtime configurations that will enable A/B testing with the participants
2. allow user profiles to be created, deleted or reset
3. allow receipts to be viewed or deleted for post analysis.

Screenshot – mVote CLI

```
Welcome to the mVote CLI

Type a command (help to list commands)
> help
Available Commands:

user [action] :id   perform actions against user objects

    action:
        reset           reset a user to an initial state
        rm, remove      remove a user
        ls, list        list all users
        add             add a new user with initial state

config [action] :key :value   perform actions against configuration

    action:
        set             set the setting value
        get             get the setting value
        ls, list        list all configuration settings

receipt [action] :id   perform actions against user receipts

    action:
        reset           reset all receipts
        rm, remove      remove a user receipts
        ls, list        list all user receipts

cls, clear          clear the console buffer
exit                exit mVote CLI
```

Figure 3-51 mVote CLI available commands

3.3.4.7 The pattern

The pattern used within the application is a combination of Ionic recommendations, NGRX best practices and Angular standards. Although the app is not for the real world, I had to ensure from the start that it would meet requirements and be able to be scaled to include other functionality.

This overview of the application structure is intended to provide a greater understanding of where the source code for various components of the application "lives". Should this project evolve further and work continues, the information contained in this section can be used by other developers.

For the development, I implemented a hierarchical and categorial order of file placement within a designated folder structure (Figure 3-52). The structure is:

- +state
    - actions
    - effects
    - middleware
    - reducers
    - selectors
    - utils
- app
- assets
- components
    - [component-name]
- directives
    - [directive-name]
- environments
- lib
- models
- pages
    - [page-name]
- pipes
- providers
    - [provider-name]

- schemas
- theme
- utils

+state

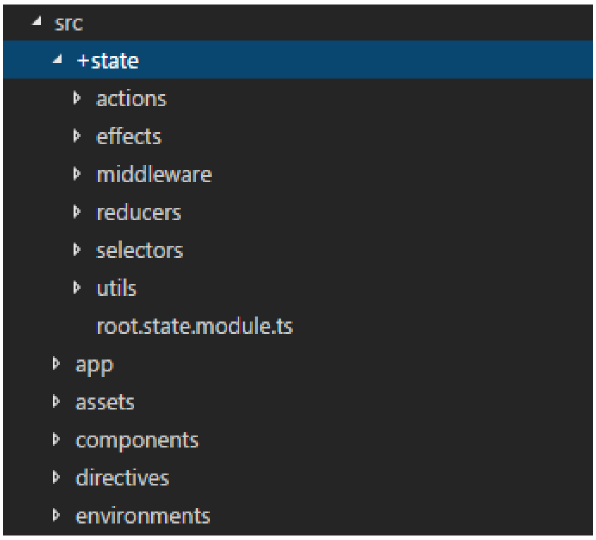

Figure 3-52 Mobile Voting code folder structure

This is the wrapping folder for the application state management files. State management is the methods and practice by which an application manages and interacts with its state. For this application, I utilised the NGRX library, which is a robust platform built for Angular that implements the Redux pattern to enable a robust state management framework.

actions

This folder contains the action classes available to the application. Actions are events that are raised throughout the application that may or may not produce a new state.

effects

Aka side effects, the effects folder contains NGRX effects, which are functions triggered when specific or predicate matching actions are dispatched. The benefit of using effects is that they allow you to perform asynchronous tasks after the action is processed. When the effect is completed, it will in return either do nothing or dispatch single or multiple actions in response to the results.

middleware

Aka meta reducers, the middleware folder contains meta reducer functions, which are functions that are executed after an action has passed through the NGRX reducer pipeline. An example would be that I created a logging meta-reducer to track actions being fired to the developer console during testing and building the application.

reducers

This folder contains the reducers for the NGRX pipeline. A reducer is a pure function that generates a new state when an action is dispatched. For efficiency and manageability, multiple reducer functions are generated and are scoped to only act on actions within their respective area of concern.

selectors

Also referred to as memoised selectors, the selectors folder contains the state selectors. A selector is a function that extracts a portion of the state. One of the key benefits of NGRX selectors is that they are “memoised”, meaning that when they are utilised, they remember the last value they generated and only regenerate themselves if the source state instance has changed. This is a kind of cache strategy and limits the number of interactions to state changes throughout your application to their respective scopes.

utils

Aka utilities, the utils folder contains helper functions and classes used throughout the +state to promote code reuse and optimisation.

app

This folder contains the root app component and module.

assets

This folder contains assets such as images and icons that are packaged and deployed with the application.

components

This folder contains reusable components (or presentation components) that are used throughout the app. These presentation components, which are sometimes also known as dumb components, generate some form of an html element on a page. The reason they are referred to as presentation components is that they do not have any direct link to a data source but rather are told by their parent components (which can either be another presentation component or a smart component) what the data are. The parent component will pass information via a defined input field and the presentation component will act on it. Presentation components are meant to be very loosely coupled, meaning they can be reused without much "integration". These components also provide a mechanism for emitting events (or outputs) that are subscribed to by the parent component. Once an event is emitted, that parent component receives a notification and can decide what to do from there.

directives

This folder contains custom directive classes. A directive is an element of an Angular application that can change the appearance or behaviour of a HTML DOM element. In Angular, there are three kinds of directives:

- Component – presentation or smart
- Structural – add or remove HTML DOM elements
- Attribute – change the appearance or behaviour of another directive, component or element.

environments

This folder contains environment-specific configurations that allow for variables to have different values, depending on the environment that the application is being run in, e.g. production vs development.

lib

This folder contains wrappers for third-party libraries that are used in the application. A wrapper allows for a custom middleware interface and ruleset when interacting with some libraries.

models

This folder contains interfaces of data models used throughout the application.

pages

This folder contains the smart components of the application. As opposed to presentation components, smart components (also known as containers) maintain a link to the data sources used throughout the application. They can either act on the data, generate HTML DOM elements, pass inputs to child presentation components or subscribe to the child presentation component events.

pipes

This folder contains the custom pipes for the application. A pipe is simple: it takes an input and transforms it into a desired output. Pipes are a powerful mechanism in data transformation and manipulation and contain very little code.

providers

This folder contains the services for the application. In Angular, a provider is referred to as a service, as it is in most cases a singleton; however, in Ionic, it is referred to as a provider. A provider provides some form of value, function or feature that is required in the application. A provider usually has a set scope, usually around some entity or data model. However, providers and services usually have a key role in communicating with backend servers or remote services (in our case, Firebase). They can also provide a single point of call for common functionality.

schemas

This folder contains the normalisation schemas for a data model. This has been used in the progress to assist with the normalisation and denormalisation of entities when sending or receiving data to or from the backend services (Firebase).

theme

This folder contains stylesheet customisations and configurations for the application.

utils

Aka utilities, this folder contains helper functions and classes used throughout the application.

3.3.5 Reflection

Looking back at the application development, I reflect on whether I would have done anything differently. If I am to be honest with myself, I would say yes. The application was developed in time and works fine, but there were some unforeseen circumstances that resulted in me spending late nights with one too many coffees.

On reflection, I would have allocated some time during periods when I had fewer time constraints to build prototypes of the functionalities I wanted to offer. There were some features that took longer and were harder to implement than I had originally thought. Encryption protocols, communication security, device integrity and other aspects were considered but were well beyond the scope and resourcing for this work. However, I could not help being joyous during the “light bulb” moments.

Also, although the Ionic framework did have some challenges and restrictions in getting the application working with some native functionality through the development mode, it did provide a large community base that I was able to reach out to for assistance.

With the application developed, the next step was the final phase of the research, the in-depth interviews.

3.4 In-depth interviews

3.4.1 Implementation

Having built and internally tested the application, it was then necessary to design the in-depth individual interview process. Earlier in the research, we conducted a public survey that was designed to capture quantitative data surrounding mobile internet e-Voting, which was published as "Perceptions of the Australian public towards mobile internet e-Voting: Risks, choice and trust" (Zada et al., 2016). This survey produced very exciting data that were measured and analysed in previous sections.

Following the survey, the research team decided that as we had already captured quantitative data, it would be beneficial to use the application to capture qualitative data as well. Because of the open nature of the methodology, qualitative data could provide the research with context, as well as information that we had not been able to anticipate.

Due to limited resources and budgeting, in an effort to capture perceptions and feedback, the team decided to conduct in-depth individual interviews with members of the public on the use of our application.

Utilising the Mobile Voting website (https://www.mobilevoting.com.au), our social media channels (Facebook, Twitter) and word of mouth, a call to action was broadcast to members of the public to register an expression of interest. The website and social media channels had been available to public access and communication since the anonymous public survey (Section 3.2).

3.4.1.1 Design

The in-depth individual interviews were conducted between July 2018 and September 2018 with one interviewer present face-to-face and the other interviewer attending via Skype. The mixed nature of the interview was required to address the University Ethics Committee's stipulation that two members of the research team be present during the interview. As the supervisory team was located in Armidale and the interviews were being carried out where I reside in Melbourne, Skype provided an appropriate tool for addressing this requirement. These interviews were limited to a 30-minute time window. During these 30 minutes, the participants would utilise our mobile app to cast a vote and we would utilise a qualitative methodology to capture their feelings, thoughts and perceptions about the technology and the experience.

Social media posts and notifications on the Mobile Voting website (http://mobilevoting.com.au) began in June 2018 as a public awareness campaign to provide information about the existence of the app and the interview.

Figure 3-53 In-depth interview "Call to Action"

The interview was designed to be a simulation of what a real-world experience would be if the mobile voting app were a reality. The interview process was purposely designed to be free flowing and unassisted, meaning a participant would be given a task, provided with some information, left to complete the task, and then asked a series of follow-up questions.

The interview was split into several segments (Appendices G-I):

1. **Information Sheet:** The potential participants were provided with information relating to the research, the interview and ethics committee approvals.
2. **Consent:** The participants were required to provide signed consent before proceeding with the interview.

3. **Pre-Questions:** The participants provide demographic information about themselves, along with information on their device and technological confidence.
4. **Unassisted Vote (Scenario 1):** The participant would be required to use the app and simulate casting a vote using either (A) or (B) configurations. The configuration would be chosen at random to ensure both a unique first experience per candidate and that there was no favouring of the configuration options.

   (A) configuration uses the detailed registration process and select list preference selection method.

   (B) configuration uses the simple registration process and one-click preference selection method.

   During the simulation, the user was asked to candidly record any thoughts and feelings.
5. **Unassisted Vote (Scenario 2):** The participant would be required to use the app and simulate casting a vote with the uncompleted configuration.
6. **Follow-up Questionnaire:** Following the completion of each simulation, the participant would be asked direct questions relating to the simulation that just took place.
7. **Survey:** Lastly, participants would be asked to take part in a simulated national online survey where they would be asked to answer a survey about using the application. As with the unassisted voting session, the participants were asked to candidly record their thoughts and feelings and they were then asked direct questions relating to the simulation.

These segments were designed to provide qualitative data in an open and comfortable environment. Like the public survey, this interview is the first of its kind conducted by an Australian academic institution. The interviews are publicly anonymous in the sense that no identifiable information will be recorded or shared publicly about the participants, which the research team believes would allow participants to be more open with their responses and opinions. Ong and Weiss (2000) found that privacy (anonymity) has a significant impact on responses.

One key technique used within the interview (and app) is A/B testing. Traditionally in software development, A/B testing is used to implement statistical hypothesis testing (Quinn & Keough, 2002; Sedgwick, 2010). Feedback from users following completion of the same task using a different mechanism (the variable) provides valuable data for evaluation. One real-world scenario example of A/B testing is conversion rates on websites. This test involves a website being randomly presented in two different ways to users, and analytical data about whether the design results in an increased (or decreased) targeted outcome (e.g. click rates or user retention) are captured.

For the mobile voting application, the two variables are used: registration and voting mechanism.

The **registration** functionality was designed to answer the first hypothesis:

H1: A more secure registration and confirmation process will result in more confidence and assurance in the application's security.

To answer this hypothesis, the registration and vote submission re-authentication process had two scenarios:

Simple: An e-Voting identifier and password is required to authenticate a user (Figure 3-54).

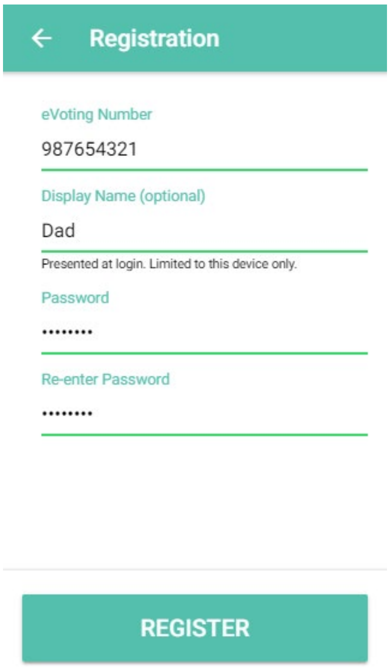

Figure 3-54 Simple registration

Detailed: An e-Voting identifier, password, SMS authentication (opt-in) and biometric (opt-in) is required to authenticate a user (Figures 3-55, 3-56).

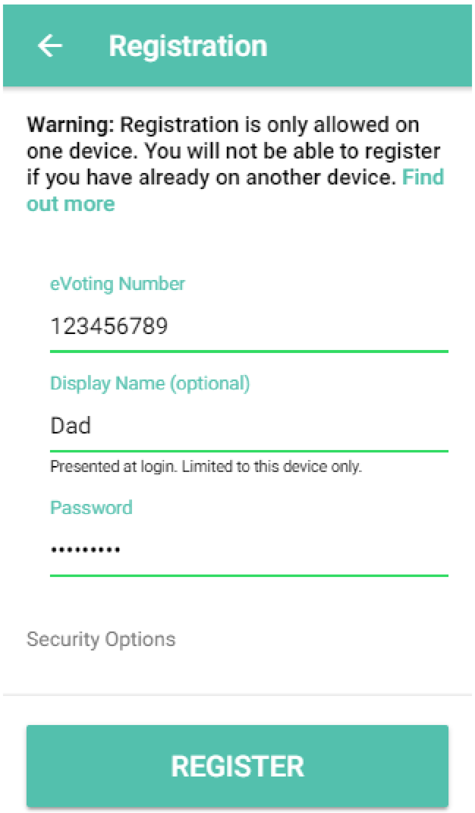

Figure 3-55 Full registration (1 of 2)

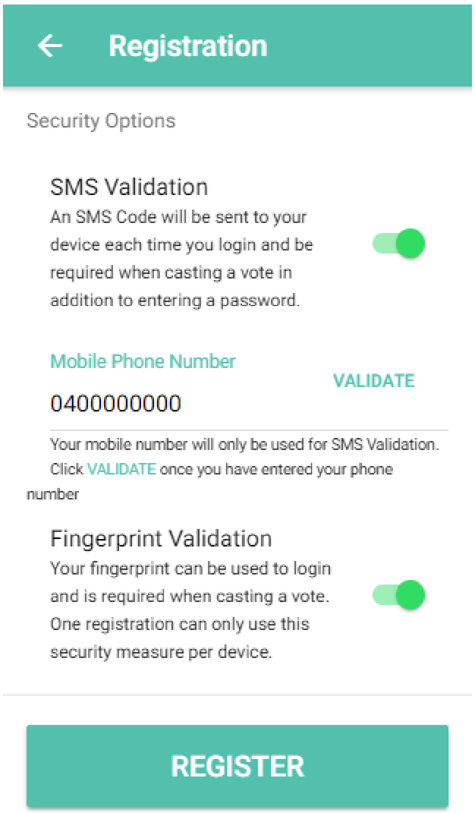

Figure 3-56 Full registration (2 of 2)

The **voting mechanism** functionality was designed to answer the second hypothesis:

H2: Simpler vote casting functionality will result in a better user experience and shorter time required to cast a vote.

To answer this hypothesis, we applied the following scenarios:

Select List Preference Selection Mode: When completing a ballot, a user must select the order in which they wish to vote for the respective candidates from a select list. This functionality may also result in the duplicate preference numbering, which would trigger error notifications to the user (Figures 3-57, 3-58).

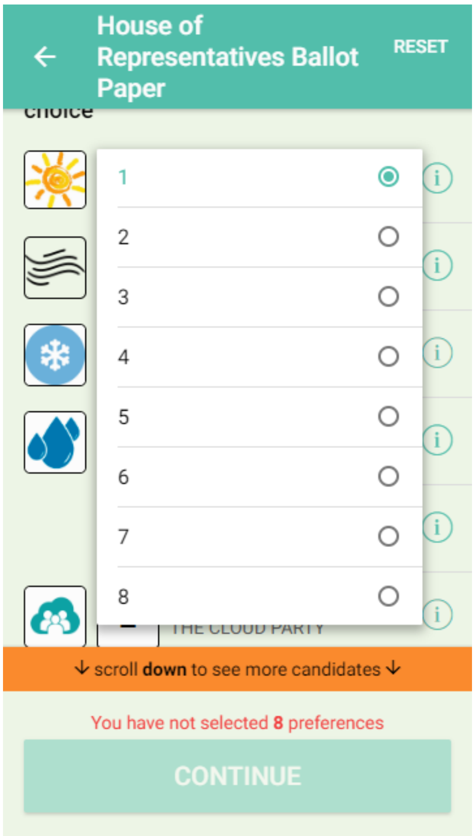

Figure 3-57 Select list preference selection mode

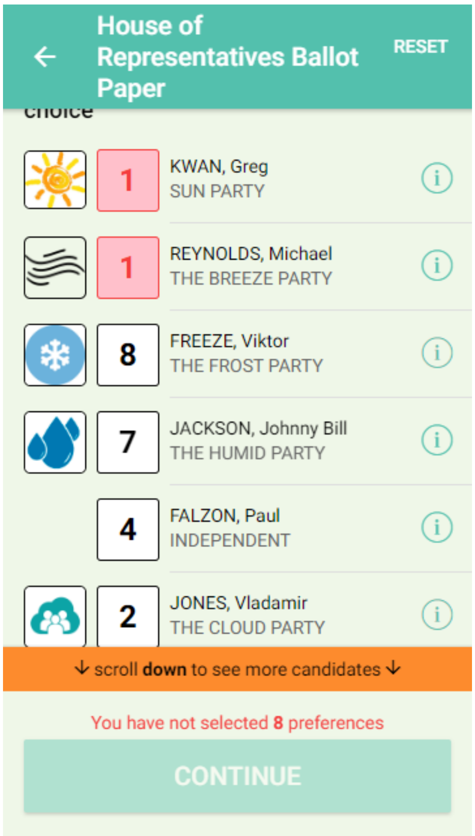

Figure 3-58 Duplicate prefrences

One-Click: When completing a ballot, a user will need to select the candidates in the order they wish to vote for them and the system will assign (or unassign if the name is re-clicked) a sequential number (Figure 3-59).

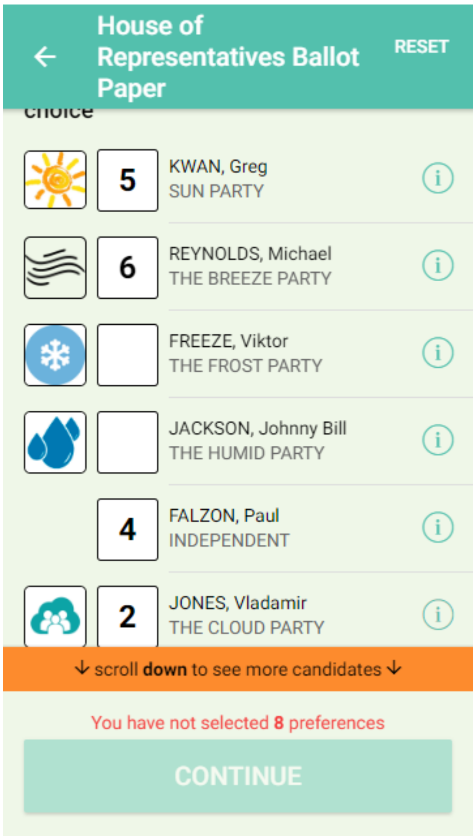

Figure 3-59 One-click selection

The app has been designed to mimic the ballots of an Australian Federal Election, and the colours, logos, party icons and candidate name formatting have all been included to achieve this. However, the electronic medium provides some additional features that are not available in the current paper-based process: random listing of candidates, provision of candidate and party information, the ability to submit an empty ballot, the ability to vote more than once and acknowledgement through a receipt.

Randomised Candidates: Candidates are displayed in random order to mitigate the risk of the donkey vote. It is also worth noting that the availability of candidate randomisation, though technically possible, might be politically challenging to accomplish within Australian Elections as candidate/preference position on a ballot paper is determined by a draw (Australian Electoral Commission, n.d.).

Candidate/Party Information: Alongside each candidate, an information icon is displayed that when clicked on provides information about a candidate or party. This functionality will still provide parties/candidates the ability to publish policy information and could potentially result in a more informed decision by the user.

Empty Ballots: Users can submit an empty ballot (informal vote) but are restricted from submitting an incomplete ballot. As presented in the *Supplementary Submission to the Joint Standing Committee on Electoral Matters – Informal Voting Report* (Australian Electoral Commission, 2011), there was an assumption that 51.4% of informal ballots were unintentionally informal. This feature addresses unintentional informal voting by preventing the submission of partially completed ballots. This functionality also conforms to the approved procedure for NSW State Elections in relation to informal voting, which states:

> 4.7.8.c. The elector may only enter an informal vote in the following manner:
>
> Legislative Assembly – not entering any preferences on the ballot paper, i.e., a blank ballot paper; and
>
> Legislative Council – a blank ballot paper both above and below the line. (“Technology Assisted Voting Approved Procedures for NSW State Elections”, 2017)

Multi-Cast: A user can submit more than one ballot; however, only the latest vote is counted. This functionality can be used to prevent coercion. For example, in the event a user is coerced to vote in a particular way, when they are in a safer environment, they can cast their vote again. It is worth noting that this is not an issue of concern in the Australian context (Brightwell et al., 2015).

Receipt: Users can obtain a receipt number that can be used to verify their vote.

3.4.1.2 Murphy's law

Using technology seems to consistently prove Murphy's Law of "whatever can go wrong, will go wrong", and our interview process that involved the testing of the mobile voting application was no exception.

An example scenario where a contingency was needed was where the application was built, the pilot tests were successful, network connectivity was perfect and the first interviewee was waiting patiently to begin the interview. We began the interview with some introductions, then asked the interviewee to download the Ionic View App from the Apple AppStore. However, because we had been working in an Android environment over the previous few months, I was unaware that Apple had updated its policies, disallowing the Ionic View application and removing it from the Apple AppStore.

Using the Android phone, I had on hand, I opened Google Play Store and found that the Ionic View app had also been removed from the Android App Store. After a quick Google search, I found that because of Apple's restrictions, the Ionic team had decided to sunset the Ionic View App on all platforms as of 1 September 2018 (Kremer, 2018).

Rather than keep the interviewee waiting, we arranged to reschedule the interview to a later time and I went into recovery mode. Within two days, I came up with three possible solutions.

1. **Install the application locally from my development machine**

   There was the possibility of loading the application from my development machine, but this would mean the interviewee would be required to be in the same room as the machine. Also, because I was developing on a Windows PC, the interviewee would need to be using an Android device. An Apple iOS device would need an iOS version of the app, which needed to be developed on a Mac.

2. **Use the Ionic DevApp**

   Ionic DevApp could be used as it does allow the application to be viewed on a smartphone from a "running serve" via a remote IP address. This would allow the interviewee to load the app remotely and use the app. However, during multiple tests, when not on the same Wi-Fi network the load time was extremely long, and I would need to be running a development version of the app live on my PC at the same time. Drop-outs also occurred. This process would have resulted in a poor experience for the interviewee and would bias the outcome.

3. **Ionic Pro + HockeyApp**

   I could utilise the Ionic Pro service to compile an Android and iOS version of the application, then upload the produced apps to an instance of HockeyApp. HockeyApp is a service offered by Microsoft to distribute apps to selective users in a private space. All an interviewee would be required to do is visit a URL, then download/install the application. Utilising this pipeline, I would also be able (if required), to make changes to the application if there is a bug discovered during one of the interviews and push it out within minutes without the user having to redownload anything.

Option 3 was the option chosen to solve the problem. With a complete continuous integration/continuous development pipeline implemented, we were able to continue with the interviews.

3.4.2 Results and analysis

3.4.2.1 Sample

Initially we were targeting 10 participants; however, there was no response to the call to action campaign (Section 3.4.1.1) within the allotted timeframe. Therefore, due to limited time, recruitment and resourcing, we decided to focus our sample and directly targeted five participants from a young and tech savvy cohort who are likely to be early adopters (Rogers, 2010). Direct communications were distributed to project subscribers from which we were able to recruit study participants who met the criteria we were seeking. There are very limited guidelines on best practice qualitative research sampling within this field. We are aware of this limitation and discuss it further in Section 3.4.3.

Therefore, these interviews were conducted with five participants. The sample included three males and two females, four of whom were in the age range 25–34 and one of whom was in the age range 35–44 years old. All interviewees were from an urban location, and had no physical or mental disability and no vision impairments. All interviewees had completed tertiary education either through university or TAFE, which is a further sampling limitation that is discussed in Section 3.4.3.

Table 3-10 Primary characteristics of sample (N = 5)

	%			%
Gender			**Locality**	
Female	40		Urban	100
Male	60		**Education**	
Age Group			University	80
25-34 years	80		TAFE	20
35-44 years	20		**Blind or Vision Impaired**	
			No	100

3.4.2.2 Interview process

The interview was recorded for potential transcription and a supervisor was also part of the interview via a live Skype Video Conferencing link. Interviewees were provided access to the mobile voting app, which was installed either on their device or a device provided by the interview team. Upon commencement of the interview, each interviewee was provided with a copy of:

- UNE Human Research Ethics Committee Approval document (Appendix 1)
- Information Sheet for Participants (Appendix 7)
- Consent Form for Participants (Appendix 8), which they were required to sign.

Following the documentation, each interviewee was required to complete an eligibility criteria question. The interviewees were all eligible.

Interviewees were then given demographic questions that included a pre-coded option of "I'd prefer not to say" (PNTS) for all demographic questions. Each demographic response is provided in the findings of the respective sections.

The interviewees were then taken through two mock election scenarios followed by a mock national survey. The interviewees were asked to use the app under two separate configuration "scenarios":

> **Scenario A** would be using the detailed registration process and the select list preference selection method.
>
> **Scenario B** would be using the simple registration process and the one-click preference selection method.

The order of the scenarios was randomised for each interviewee and their responses recorded and transcribed. The following was read out to the participants prior to commencement of the first scenario:

> *We are now going to simulate an election. To set the scene, the 2018 Australian Federal Weather Election voting session is about to open, and you are going to be using the mobile voting application to cast your vote. You have previously registered to use the application and have received this letter in the mail with your registration details.*
>
> *I would like you to open the letter and use it to register yourself on your device and cast a vote for the election. Feel free to let us know if you get stuck and need assistance.*

When done we will have a chat about your thoughts with regard to using the application. There are a couple of things you need to need to know before we begin:

1. If you see "Interview Override", just click that button to continue.

2. Unlike paper-based elections, you can have your vote displayed back to you and validate that it was received by the electoral servers as you cast it. There is an option to delete the vote but that will only delete it on your device not on the electoral servers.

3. You do have the ability to recast your vote at any time and are free to do so if you wish.

The first scenario letter (Appendix 9) was provided and the interview commenced. Once completed, questions were asked about each step of the process:

- registration
- House of Representatives ballot
- Senate ballot
- submission
- overall experience
- whether they recast or validated their vote, and would they use the app if it was made available in the next election.

Next, the interviewees where read the following:

Now we are going to try and vote using the same app, but with some different settings, here is a new letter with new details that you can use to register.

After each step, we ask you to complete the questionnaires and raise any issues or questions you may have.

The second run, as opposed to the first, required the participant to stop after each step and be asked the same set of questions as the first scenario, recognising that the individual has experienced using the app at this point within the context of the first scenario. This method provided a positive insight into comparisons between scenarios for that individual.

Following the completion of the second scenario, the interviewee was read the following:

Now for a change of pace, this app cannot only be used for elections, but for surveys as well. We have a National Sausage Sizzle survey about to begin, and we ask that you complete the survey using the app. There is no need for registration details, as you can use your previously registered credentials.

At the end, we have a small questionnaire.

The interviewees then proceeded to complete the mock survey and the responses were captured. Lastly, each interviewee was provided with an opportunity to explore the application, ask questions and provide additional feedback.

3.4.2.3 Findings

The following are the summarised common findings of the interviews. Detailed responses are found in Appendix 10. Responses to each process in the application are presented along with weighted average score of two quantitative questions. The scores are based on Likert-scaled quantitative questions that were asked of interviewees upon completion of process questions.

Registration

The registration process involved two components: the registration letter and the act of registering a unique identifier (e-Voting number) on the device. Once registered, the credentials can be used to authenticate the user. This is the first interaction with the app the user has, and as such needs to be simple and easy to understand.

The differences between the scenarios are:

Scenario A:

- The e-Voting number is 16 alphanumeric characters.
- It requires only a single-entry password.
- There is optional two factor authentication: SMS and localised fingerprint (biometric).

Scenario B:

- The e-Voting number is 16 numeric characters.
- It is necessary to re-enter the password (confirm password).
- There is no two-factor authentication provided.

This interaction would be used to test the first hypotheses:

H1: A more secure registration and confirmation process results in greater confidence and assurance in the application's security.

Feedback

The consensus amongst interviewees was that the two-factor authentication was a more preferred option; however, some respondents mentioned that confirmation of the password was also preferable and provides a greater sense of security.

Having two-factor authentication as optional was viewed negatively by some interviewees. They reflected that at least one two-factor authenticated method should be required.

A common pitfall that 4/5 interviewees experienced was confusion about whether to enter the dashes that were present (as part of the e-Voting number) in the registration letter into the respective field on the screen. The case sensitivity involved in scenario **A** was also an impediment to a smooth registration process.

The only pitfall that affected all interviewees was the display name field. When registering during each scenario, the interviewees would enter the same display name. This resulted in not knowing which name was registered to which corresponding e-Voting number. Suggestions were made that there needs to be some form of warning (or error) message to alert that the display name is already registered on the device.

The accompanying registration letter (Appendix 9) received mixed feedback. Some interviewees found it to be very straight forward and informative, while others mentioned they would like to see more detailed information on how to use the app to vote.

Scores

Table 3-11 presents the average score (from the Likert scale) of the five interviewees in relation to the perceived usefulness and ease of use of the registration process. The interviewees found both scenarios A & B useful with equal average scores of 4.80. Scenario A was found to be more difficult than scenario B with average scores of 1.60 and 1.00 respectively.

Table 3-11 Average score of the five respondents, registration process

Question	**A**	**B**
How useful did you find this process (1 – Not Useful, 5 – Very Useful)	4.80	4.80
How hard did you find this process (1 – Very Easy, 5 – Very Hard)	1.60	1.00

Reflection

The interviewees generally had no issues completing the registration process and were quite pleased with the two-factor authentication. The issue of the dashes was the only serious impediment to completion of this process. The interviewee's unique registration number is provided on the registration letter and printed with dashes (Appendix 9) to make the number more readable. Interviewees were confused about whether to enter the dashes or not and questioned the reasoning.

Two-factor authentication was the preferred method to accompany the password and was perceived as having greater security when using the application. Only one interviewee made mention of the scratch security feature (Appendix 9) over the e-Voting number. More research would be required to determine whether this feature made an impact on the perceived security of the process.

In relation to the first condition of Hypothesis H1, a more secure registration process result does provide greater confidence and assurance in the application's security.

Enhancements

- A1. Display Name is not optional, and an error message should appear if the duplicate name is used.
- A2. Confirmation of password needs to be added to Scenario A security configuration**.**
- A3. E-Voting number to be numeric only with auto insert (or acceptance) of dashes as e-Voting number is entered.

Completing a ballot

Once authenticated, the user would be able to select an open election and complete the required ballots. In the case of our mock election, there were two: House of Representatives ballot and Senate ballot.

Each scenario presented one difference:

Scenario A: Select list preference selection.

Scenario B: One-click preference selection.

The ballots look and feel similar to the Australian Federal Election House of Representatives and Senate ballots. One key difference is the Senate ballot is presented in a vertical format as opposed to the current horizontal format of a Senate ballot paper. Candidates/parties are also presented in randomised order.

This interaction would test our second hypothesis:

H2: Simpler vote casting functionality results in a better user experience and shorter time taken to cast a vote.

Feedback

Interviewees were all able to authenticate themselves and navigate to the open election. They were all able to complete the House of Representatives and Senate ballot without any assistance.

The select list mechanism was slightly challenging for some interviewees, but it was mentioned that the second time around when casting the Senate ballot, it was easier to use. The one-click mechanism was definitively more popular amongst all interviewees and resulted in a faster completion rate.

Candidate information was required by some interviewees, but they did not discover the feature button that presented the information until either the next scenario or when they were discovering the application post first run.

Some interviewees liked that the application allowed them to submit an empty ballot but prevented them from submitting an incomplete ballot.

Scores

Table 3-12 presents the average score (from the Likert scale) of the five interviewees in relation to the perceived usefulness and ease of use of completing a ballot. The interviewees found scenario B more useful than A, with average scores of 4.90 and 4.70, respectively. Scenario A was found to be more difficult than scenario B with average scores of 1.70 and 1.10, respectively.

Table 3-12 Average score of the five respondents, completing a ballot

Question	**A**	**B**
How useful did you find this process (1 – Not Useful, 5 – Very Useful)	4.70	4.90
How hard did you find this process (1 – Very Easy, 5 – Very Hard)	1.70	1.10

Reflection

Scenario B's one-click selection mechanism was universally selected as the preferred method over the select list selection. When the feature was removed or added in the subsequent scenario, it was immediately mentioned as the preferred method in a disappointed or enthusiastic tone, respectively. A quite interesting observation was that two of the interviewees had mentioned that they have never completed a paper ballot previously as they were either not registered to vote or had only recently registered. In these cases, the interviewee was still successfully able to complete a ballot with only minimal onscreen instruction. The interviewees did not notice that the candidates were randomised each time they entered the ballot; however, one interviewee did ask about how the app could address the donkey vote.

These findings support hypothesis H2, that a simpler vote casting functionality results in a better user experience and shorter time taken to cast a vote.

Enhancements

A4. Implementation of the one-click mechanism for candidate selection.

A5. Make the candidate information button more prominent.

Submission

After completing the ballot, the user must cast their vote. Prior to submission, the user sees an information display that states what they are submitting a vote for and is requested to re-authenticate themselves using the authentication mechanism used at login. A receipt number is then provided to confirm submission.

Feedback

The submission process was well received as being a simple process. The receipt number was considered a positive feature and was correlated with a successful submission by interviewees. However, a common question asked was what to do next after receiving the receipt number.

One interviewee did ask why they were required to re-authenticate prior to submission, but other interviewees found this security measure preferable and more secure.

Scores

Table 3-13 presents the average score (from the Likert scale) of the five interviewees in relation to the perceived usefulness and ease of use of submitting a vote. The interviewees found scenario B more useful than A, with average scores of 4.60 and 4.80, respectively. Scenario B was found to be easier than scenario A with average scores of 1.40 and 1.60, respectively.

Table 3-13 Average score of the five respondents, submission

Question	**A**	**B**
How useful did you find this process (1 – Not Useful, 5 – Very Useful)	4.80	4.60
How hard did you find this process (1 – Very Easy, 5 – Very Hard)	1.60	1.40

Reflection

The interviewee feedback and the average scores (Table 3-13) suggest that the re-authentication process that was required prior to submission had a negative impact on the perceived ease of use. The general consensus of the other processes (registration, completion and validation) was that scenario B was perceived as the easiest to use (average 1.025, $\sigma = 0.0577$). However, the average score of the submission process (as presented in Table 3-13) is relatively higher at 1.40 ($\sigma = 0.1893$). Most interviewees preferred the additional security measures, despite these findings.

I do not believe the submission process requires much change; however, cosmetically, there could be a button to navigate directly to the receipt or a call to action with further instructions.

Enhancements

A6. Present option buttons on what to do next after successful submission:

   a. sign out button
   b. validate receipt
   c. recast your vote
   d. back to elections

Validation and resubmission

Once a vote has been cast, the receipt is saved to the device, which allows the user to validate that the vote on the device matches the vote on the servers (i.e. registered vote). The user also can re-enter an open election and recast their vote. Internet voting protocols have dictated that the multi-vote option is a viable method for addressing coercion and also provides a mechanism to change their vote.

Feedback

Validation was simple enough; however, most interviewees did comment on not knowing if they had completed an open election. Some indication of status or a warning when recasting to inform the user that their vote had been previously cast was requested.

Some interviewees did question the process of recast, as they had the impression that recasting would mean multiple votes getting cast.

Scores

Table 3-14 presents the average score (from the Likert scale) of the five interviewees in relation to the perceived usefulness and ease of use of validation and resubmission of a ballot. The interviewees found both scenarios A & B useful with equal average scores of 4.20. Scenario B was found to be easier than scenario A with average scores of 1 and 1.40, respectively.

Table 3-14 Average score of the five respondents, validation and resubmission of a ballot

Question	**A**	**B**
How useful did you find this process (1 – Not Useful, 5 – Very Useful)	4.20	4.20
How hard did you find this process (1 – Very Easy, 5 – Very Hard)	1.4	1

Reflection

Although prior to commencement the recast and validate functions were mentioned as being available for use, most interviewees did not recast or validate their votes during the initial scenario. However, in subsequent scenarios, all interviewees did recast and validate their votes. It was observed that once interviewees were asked about validation, they were able to discover how to do it.

The process of validation and resubmission of a ballot received the lowest average score (Table 3-14) in comparison to other processes irrespective of scenario configuration. Although the average score for perceived usefulness of other processes was 4.77, the validation and resubmission process resulted in an average score of 4.20. I do not believe this reflects directly on the feature or the process, but rather a lack of information about why this feature exists and its benefit. These features are currently not offered by the current paper-based ballot process and is a fundamental change to the voting protocol.

Enhancements

A7. Add a status flag next to open election if a vote has been previously cast.

A8. Add a warning flag when casting a vote to indicate that a vote has been previously cast.

A9. Add instructional text in the Validate tab to tell users how to validate their vote.

Overall

Upon completion of the scenarios, interviewees where asked to explore the application and share any thoughts, questions or comments they may have. Interviewees were also asked a direct question about whether they would use the application in the next election and why/why not.

All interviewees where pleased with the simplicity of the app and the subsequent process. Although they re-iterated their previous comments about the selection mechanism, the general findings were that most would use the application if it were made available during the next election. Interviewees who stated that they would use the application stated that the determining factors were the simplicity of using the application and the convenience of being able to use their Smartphones rather than travel to the polling place. These findings correlate with the constructs of the technology acceptance model (Davis, 1989), which states that perceived ease of use (PEOU) and perceived usefulness (PU) directly influence a user's attitude towards new technology (A).

The interviewee who said they would not use the application stated that even though the application appeared secure and quite good, they had some reservations and needed to be more confident before they trusted the application and the process. The other interviewee who would not use the app mentioned that he wanted to go to a polling place for the first time but would use it in the next election. These findings correlate with the unified theory of acceptance and the use of technology model (UTAUT) by Venkatesh, Morris, et al. (2003), which states that facilitating conditions construct directly influences the use behaviour and the moderating variable of "experience" respectively. The facilitating conditions construct, as discussed in section 1.4.3, is the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system. Considering that UTAUT model is constructed from combining eight other models, including Davis TAM, there is an overall consensus that a greater technological adoption rate is achievable, provided that additional conditions and variables are met.

National survey

Upon completion of the mock voting scenarios, the interviewees were provided with the opportunity to submit a response to the simulated national survey. The interviewees where informed they may use either of the previous registration details to login and submit a survey response. The survey was designed to mimic the experience of the Australian Marriage Law Postal Survey (ABS, 2017). The survey context was changed to the Australia Sausage Sizzle Sauce Survey, with an additional multiple-choice question.

Feedback

The consensus was that the process was simple. A comment was raised that if the user were required to re-register, it would have been a lot more complicated. There was some conjecture about the ability to resubmit a response; however, the explanation that this was the same principle as an online vote, where the resubmission overrides the previous submission, alleviated the concern somewhat. One interviewee did comment that the survey did not look official, so they had concerns in relation to authenticity.

Scores

Table 3-15 presents the average score (from the Likert scale) of the five interviewees in relation to the perceived usefulness and ease of use of completing a survey. The interviewees found it very useful with an average score of 4.80. The overall consensus was that completing a survey was a very easy process, with an average score of 1.00.

Table 3-15 Average score of the five respondents, completing a survey

Question	Score
How useful did you find this process (1 – Not Useful, 5 – Very Useful)	4.80
How hard did you find this process (1 – Very Easy, 5 – Very Hard)	1.00

Reflection

Although the national survey was only two questions, the interviewers felt that the interviewees were able to login, navigate and complete more confidently having had the experience with the mobile voting application.

The concern raised about the authenticity of the survey was an interesting observation. The ballots used to submit the vote during the election had an official government insignia on each ballot and attempted to mimic the official look and feel of the paper votes; however, the national survey did not include the official insignia. Another interesting observation was that all interviewees responded that they would use the app if it were made available during the next national survey.

Enhancements

A10. Add Australian Government insignia to the official national survey

3.4.3 Limitations

As with the public survey, these in-depth interviews are not without their limitations. During the public survey, the research team were fortunate that the survey was able to be scheduled during the 2015 New South Wales State General Election. However, due to scheduling constraints and the current Australian election calendar, we were unable to schedule these interviews within the same environment conditionals. As a result, only five interviews were undertaken. The literature suggests, however, that we need to interview in the order of a minimum of nine people to identify the key issues of a topic (Hennink, Kaiser, & Marconi, 2017; Malterud, Siersma, & Guassora, 2015).

We were targeting 10 participants; we focused our sample and directly targeted five participants from a young and tech savvy cohort who were likely to be early adopters (Rogers, 2010). There are very limited guidelines on best practice qualitative research sampling within this field. The cohort of the population were mostly a younger, urban, technologically savvy group, who were shown in the previous public survey to be the likely early adopters of mobile voting technology. Thus, the interviews were biased towards a particular cohort and not reflective of the entire eligible Australian voter population at large. There are, however, substantial benefits to focusing the interviews on this key group. The high degree of familiarity with Smartphone technology reduces any confounding factors related to not knowing how to utilise the technology and potentially allowing greater insight into the trusted features of the A or B mobile voting app version. Furthermore, since this group is highly likely to be early adopters, they constitute a key support base for the roll-out of mobile voting technology. Studies that focus on this cohort will therefore be unlikely to have residual bias opposed to the concept of mobile voting (Malterud et al., 2015). Within the context of the technology acceptance model, minimising bias is important if we want to gain fine-grained insights into the features of an app (Hennink et al., 2017).

There are undoubtably limitations to the study due to the relatively small number of study participants who were solely from a specific population cohort. The findings of the study cannot be generalised beyond this cohort and cannot provide a complete picture of the likelihood of mobile voting uptake in Australia, nor can it be certain of the features of the mobile voting app that will be found most trustworthy across the population. For instance, there may be interesting observations to be made when considering lack of familiarity of Smartphone technology and the 'trustworthiness' of the different app versions. Extending the study to compare and contrast these different population cohorts across the country would provide invaluable further insights into how to increase potential mobile voting uptake. Such extensive studies are beyond the time and resource constraints of the current project and are identified as a priority future research area. When designing the current mobile voting app interviews, the research team decided that it was best to focus on a select cohort of participants and ensure a sufficient number of participants was obtained to draw meaningful (albeit limited) insights rather than to sample a broader range of potential users in Australia but obtain limited insights into the issues of technology use relevant to this research.

3.4.4 Conclusion

The interviews described in this section provided valuable insights into user perceptions about using a mobile voting app within a real-world simulation. The interviewees felt overall more secure with additional security mechanisms such as two-factor authentication and password confirmation during registration and subsequent login protocols. The one-click preference selection method was preferred over the select list mechanism and interviewees were positive about the candidate information being made available in the app.

Being provided with a receipt that contained preferences and provided validation following vote casting or survey response submission was perceived positively. This finding agrees with that of Storer (2007), who investigated whether the voter is able to understand why the information presented to them constitutes evidence that their vote has been counted, and also whether the provision of evidence is considered valuable by voters. However, concerns about the multiple voting submission were raised. These concerns were alleviated somewhat once the online voting protocol was explained. Most interviewees were in favour of using the app if it were made available during the next election.

3.4.5 Reflection

The in-depth individual interviews went smoothly, excluding the initial false start. I was quite intrigued by the difference between what I anticipated the interviewees would be interested in and how they would interact and what occurred during the interviews. Recruitment and resourcing were the toughest challenges. We were able to recruit five participants within a young tech savvy cohort; however, as discussed in the limitations, we would require nine respondents to identity key topic issues.

For a future study of this kind, I recommend scheduling as a key tool for achieving a more significant outcome. The public survey was conducted during the lead up to the 2015 NSW State General Election. As there was an “election buzz”, more members of the public were interested in taking part in the work. However, when we conducted the in-depth interviews, elections and voting was not a hot topic.

Looking back, however, I still believe it was a worthwhile exercise. We were able to achieve the objectives set out for the research. The application was able to be successfully used and we gathered real feedback and thoughts in relation to the process of using a mobile voting app to cast a vote. The interviews also confirmed that perceived usefulness and perceived ease of use of the application play a key role in application adoption. This was evident in the results of the A/B scenarios that showed the interviewees preferred the simpler method in most cases.

Chapter 4 Reflections and Outcomes

This chapter presents the culmination of the work conducted and outlines what this innovation portfolio project has accomplished. What has been learned during the life of the project is presented as well as a self-reflective critiqued perspective on the research, its context and its broader meaning. Furthermore, this chapter reflects on the anticipations of the innovation portfolio project, its significance, the implications for continued progression and how to manage the innovation into the future. A review of key public events that occurred over the period of the research that affected public trust and opinion in relation to an online voting platform is also discussed. Lastly, the chapter concludes with a personal reflection on the journey and the compilation of the innovation portfolio project.

4.1 Reflection

Having come to the end of this journey, admittingly I was excited, believing that the tough portion was done and the rest would be easier, but how wrong I was. Towards the end of the innovation portfolio project period, after all the research, surveys, app development and interviews were completed, my research team and I met to discuss how to conclude this work.

We met with the PhD.I program lead at the university and presented a draft of the work done, only to find that it did not quite fit the brief required for the program. My portfolio was, for lack of a better term, dry. It lacked that human element, as it did not have personal connection to the work, with the story of the journey being more of a factual recap. Transferring from a PhD to a PhD.I, I had jumped from a purely academic-based research project to one that needed to be contextual and personal. As this was a new mindset that the team and I had to put ourselves in, the lack of that was projected in the portfolio.

Following a few discussions, I was advised to “just have fun with it and see where it takes me”. I did not quite understand what that meant. However, after a few weeks, I had what could be only described in the simplest terms as a light bulb moment. I would treat this innovation portfolio project as just another project. I would discover the issues, implement a change plan, evolve the product (the innovation portfolio project) and at the end perform a retrospective, discussing what worked well, what did not work well and what I will do better next time.

The lack of the human element was the primary issue, but I needed to determine how best to incorporate it into the work. The suggestion put forward that I felt solved the problem was to use transitions and joiners. This method involved revisiting and restructuring each chapter and section to ensure there were explanatory reasonings or mindsets provided that would allow the reader to understand how one section of work lead into the next. The rationale behind this strategy was to allow the reader an opportunity to experience the research process that I undertook and to understand the deterministic factors that influenced the choices made. These transitions and joiners also allowed mini-reflections of the work thus far.

With the approach determined, I needed to look at the achievements, the pitfalls and how this research could continue to improve by undertaking a retrospective.

4.2 Retrospective

In agile methodology, a retrospective is a meeting that is held at the end of an iteration. During this time, the team reflects on what happened during the period of work, what worked well, what did not work well and what improvements could be made moving forward. The challenge with this retrospective within the context of the innovation portfolio project was that it needs to be a self-reflective retrospective.

I know from my professional experience that one of the common mistakes that occurs in projects in their infancy is that a retrospective always seems to focus heavily on the work that was done. Rather, the retrospective needs to focus on the team and how the they can be more effective. However, as this is a self-reflective retrospective, in this case both the team and the various aspects of the work will be discussed. In other words, the self-reflective retrospective could project what was learned from the work undertaken. During the application development, there were regular sprint retrospectives that reflected on some of the detail of the development, but this reflective retrospective can take a broader view of the innovation portfolio project to identify what could be done to improve the research and scope into the future.

4.2.1 What worked well

4.2.1.1 Adaptation of the research

This breadth of the work involved in the project has been able to adapt and change from its original beginnings to its final form as an innovation portfolio project. The team has been able to adjust approaches, implement new directions and adapt to change of deliverables (thesis vs innovation portfolio project). The context of the research has also been able to evolve over the years, which meant that contextual materials and works were able to be applied during various stages of the team's work.

4.2.1.2 National survey and awareness campaign

With no budget or additional resources, the team was able to design, launch and succeed with the first Australian university national public survey and public awareness campaign. This was a first for each member of the team and the results of the survey provided valuable information on what we needed to do to achieve our goal. The success of the survey is evident by the number of respondents who took part in the survey, and the number of respondents was greater than that specified in our statistical power analysis.

4.2.1.3 Recognition

Our work was recognised by the NSW Electoral Commission (NSWEC) during the 2015 iVote implementation. We were invited to join international delegations as part of a "behind-the-scenes" look at the 2015 implementation. In addition, the project attracted considerable media attention not just during the national survey but also in relation to our ongoing research and related events such as the 2016 Census.

4.2.1.4 Produce an application

We were able to produce a mobile voting application within a relatively short amount of time with few resources and with lack of team experience in building a mobile application together. The team was able meet all expected deliverables and outcomes, which shows how well we were able to collaborate and react quickly to changes.

4.2.1.5 React quickly to change

We were able to adapt quickly to any issues that arose. During the first interview, a bug was discovered in which a user was able to register without a display name and, as such, no name was displayed during the login process, thus it appeared that the user had not registered. Within 5-10 minutes of its discovery, the bug was patched, the code committed to the code repository and the new app build was completed, deployed to the distribution system and available on the interviewee's device.

4.2.2 What did not work and improvements

4.2.2.1 Understanding the innovation portfolio project requirements

The team's understanding (or lack thereof) of what is involved or even how to produce an innovation portfolio project was a primary aspect I believe did not work well. We had to go through a few format iterations and were not sure what was required or even what we needed to produce.

Looking back at the project, I now feel that rather than jumping in head first I should have "practised what I preached", spent more time on discovery and undertaken an envisioning session prior to starting the work. This more extensive planning phase would have meant team members could have discussed with stakeholders what the expectations and deliverables of the innovation portfolio project are, which would have provided a clear plan moving forward and increased efficiencies.

This experience has taught me that I need to allocate more time to the planning phase of future research projects.

4.2.2.2 No fall-back during the interviews

Just prior to the in-depth interviews, Ionic withdrew a key tool that was to be used by the interviewees to run the mobile voting app. Having the tool not available at the time of the interview was embarrassing and caused disruption not just for the team but also the interviewee, who had to return another day to conduct the interview.

This incident could have been avoided had a risk analysis been undertaken prior to the interview. This analysis would have highlighted the tool as a keystone in the interviews. Although there was a contingency of a back-up Smartphone device, it did not address the issue for remote participants and still relied on the Ionic View to be able to distribute the mobile voting app.

4.2.2.3 Publication

The publication of the national survey finding took a heavy toll during the middle of the project. It took almost nine months from initial draft to a final published version. This had a flow-on effect as team morale was affected and not enough time was spent on work following the survey. It is worth mentioning, however, that some journals that we initially submitted the publication to rejected it with no feedback as to why or the option to resubmit after a round of review. Journal turn-around time was a factor in the time it took to get to publication, and due to publication ethics, the article could only be submitted to one journal for review at a time.

I believe that in future, activities like publication should be prioritised and timeboxed, so that an allotted amount of time is allowed and if more time is required, it can be prioritised with other continued works.

4.2.2.4 Ethics approval

During both ethic submissions, there was a considerable amount of time spent waiting for ethics approval to come through. Most notably, the in-depth interview ethics approval took some months to complete. This was lack of foresight on my part, as I did not allow enough time for the university to conduct their review and approvals. In future, I should allow for a minimum of three months for ethics approval to be completed.

4.3 Anticipations

When asked to describe the effect of the work conducted in this innovation portfolio project, I can only compare it to an analogy of throwing pebbles into a calm pond. The first pebble was thrown when we held the national public survey, as it put our work into the limelight and caused a ripple effect in attention and recognition of our work. The second was thrown when this small unfunded university team developed and produced a mobile voting app that had the same effect (if not to the scale) as the national survey.

As the analogy suggests, the effect of our work will dissipate over time and we need to throw more pebbles, aka disruption. The primary outputs generated by this innovation portfolio project have resulted in the establishment of two key baselines that I believe will be instrumental in the future of mobile voting adoption:

1) We established a baseline that shows how trust and other factors can influence the adoption of a mobile voting platform.

2) We captured user experience data on the usage of various functionalities and interfaces in relation to a working mobile voting app.

These outcomes show that by combining academia and industrial expertise, it is possible to keep moving forward.

The baseline of trust in the adoption of mobile e-Voting within the Australian context provides empirical data that can be used to focus further study, potentially providing a basis for a guiding framework for another national survey that could be government supported with a much larger and diverse sample size. Not only can the survey results be used for further study, but there are also implications for the industrial and government sectors as well. This study has provided evidence that an internet e-Voting platform has the social backing for adoption, along with the relevant justifications and reasoning. It has also provided a prototype mobile e-Voting app with a tangible design that has been publicly user tested based on meticulous research, best practice design principles and the national survey findings. Thus, there is a foundation upon which a real-world implementation could be enacted.

The optimist in me believes it is not "if the technology will be adopted" but rather "when the technology will be adopted", whereas the pessimist within me knows that the eventual implementation and adoption is not an easy task to accomplish. Since I began this research, many events have occurred that have inadvertently (in my opinion) had a negative impact on the public's feelings and thoughts in relation to a mobile e-Voting platform. The following is a review of three key events that occurred during the time of this research. These include the 2016 census debacle, the 2015 NSW iVote hacking report and the Russian interference in the 2016 US presidential elections.

4.3.1 #censusfail

The 2016 Australian Census, which was later dubbed on social media as *#censusfail*, was affected by a 40-hour outage following four Distributed Denial of Service (DDoS) attacks (Belot, 2016). IBM, which was the company contracted to deliver the Census, stated that geo-blocked protocols were fully implemented to prevent the attacks.

Within days of this event, the media were quoting academics and industry experts who comment on the flow-on negative impact on attitudes towards online voting (Sutton, 2016). Although I was also interviewed about the events and flow on effects, looking back at it now I believe there was a positive outcome, as the incident strengthens the importance of preparation and risk migration for these kind of attacks (or similar). Having these securities in place would ensure that an online voting system would be more secure and provide greater assurances to the public and government.

4.3.2 iVote hacked

During the 2015 NSW iVote implementation and subsequent 2017 WA iVote implementation, academics from Australia and oversees published a series of reports prior to election day that identified various vulnerabilities that had the potential to be exploited by malicious parties (Culnane et al., 2017; Halderman & Teague, 2015; Ockenden, 2015). Security risks identified potential vulnerabilities in the transport layer of the communication channel between the browser client and the voting servers. The significance of these reports were refuted by the various state electoral commissions (Brightwell et al., 2015; Cowan, 2015; Tillett, 2017) as not being of a concern to the elections integrity. Although there was no evidence vote integrity was comprised, these claims had been made in such a way as to deal a substantial blow to trust in an internet e-Voting platform.

Incidentally, following the 2015 report, I reached out to Ian Brightwell, who was the CIO of the NSW Electoral commission and responsible for iVote at the time, to discuss in detail the effect of the report and what the flow-on effect could be, if any. We discussed that although the exploitation of the vulnerabilities was not likely substantial, the iVote system was remediated to disable the analytics code that was reported to be the vulnerability. He also advised that the iVote system design already had mitigations in place to address this type of attack i.e. voters could verify their vote was cast as intended by using DTMF phones.

These events led me to the realisation of the correlation between paper-based votes and online votes. The transportation of the vote, whether it be digital or physical, is always a challenge, which begs the question, does having a paper-based system provide greater assurance that the vote is receipted as cast than an online system?

Mr Brightwell stated that “the reality is that once you stick that piece of paper in a ballot box or an envelope, you haven’t got a clue what goes on after that” (as cited in Cowan, 2015, para. 8) and he was right. It was something that had never occurred to me when I had cast a paper-based vote, as I just “trusted” the system. During the 2013 Australian Federal Elections, nearly 1400 ballot papers were misplaced (Griffiths, 2013) and during the 2015 NSW Election, a bag of completed ballot papers were left untended after hours in a voting place (Cowan, 2015). As stated by the WA Electoral Commission, “there are risks inherent in all election systems: paper-based, electronic, internet, postal voting” (Tillett, 2017).

Both reports (Culnane et al., 2017; Halderman & Teague, 2015) stipulated that there is a security risk if the client browser or the Wi-Fi network being used by the voter is inflected by malware or the voter secure communication is broken. Having worked in the software industry, security and integrity of data are always a concern in the back of my mind. The reality of the situation is that there is a certain amount of risk when dealing with online systems. The question is how to mitigate against those risks.

Dealing with compromised client machines or networks is a risk associated with an uncontrolled internet voting system, or any online system for that matter. However, when dealing with the sensitivity of online votes, mitigation such as a system that allows votes to be read back via a separate channel (e.g. DTMF phone or SMS) could address this issue.

In my opinion, these reports of vulnerabilities, although having some merit, could have been handled in a more co-operative manner. I do not mean to presume the circumstances or get into a hearsay debate, but on face value of the events that unfolded in the media, the discovery of the risks could have been handled better. There could have been an open forum in which both parties (the researchers and the Electoral Commission) could have discussed their concerns, come to amicable consensus and resolution and released a joint press release stating that a vulnerability had been discovered, acknowledging the risks that it presented and advising how the issued had been/would be resolved or how the vulnerability was being mitigated.

4.3.3 From Russia with love

Although this innovation portfolio project has been focused on the Australian context, events occurring internationally can have a direct influence on internet e-Voting adoption in Australia. During the 2016 US Presidential Elections, Russian Government agencies allegedly directly interfered with Hilary Clinton's campaign in an effort to produce political instability in favour of other candidates ("2016 Election Hacking Fast Facts", 2018). Through various social media manipulation tactics and various other phishing schemes, these malicious parties had gained access and influenced the outcome of the presidential election. It was reported that given that the voting infrastructure of selected states was targeted, there was not a direct breach of the voting platforms (Mallonee, 2017). As these events unfolded and dominated in the Australian media, there were correlations between these events and the security of an online voting platform (Culnane et al., 2017; Riordan, 2016).

These events are still playing out some two years later. In 2018, the Australian Government established the Electoral Integrity Task Force to guard elections from cyber-attack ("New taskforce to defend against election meddling", 2018; Ziebell, 2018). As with the other events, this action should be taken as a positive outcome. By having this taskforce, Australia has bolstered protections and mitigated the risk of international influence in elections.

4.3.4 Looking to the future

The outcomes produced by this innovation portfolio project are still in their infancy. When I started some years ago, I was told that this area of research is extensive and might be overbearing; however, when faced with these conditions, I referred to a quote that I heard some years ago when I started software development: “Don’t be afraid to fail, be afraid not to try”. With that in mind, I achieved what I needed to achieve. However, I needed to identify what implications this research has for the future of e-Voting and how it can best be managed.

For an internet voting platform to be successfully developed, adopted and have an established trust, there needs to be collaboration and transparency. This can be accomplished by undertaking the following:

1. Establishment of a joint government, academic and industrial panel.
2. Open source platform and process.

4.3.4.1 Establishment of a joint government, academic and industrial panel

Successfully implementing an internet e-Voting platform is a mammoth undertaking; however, not an impossible one. Through my experience working in large-scale enterprise and government systems, the best result comes from collaboration. The panel’s primary function would be oversight and direction of the platform development, and by including members of academic and industry communities, there would be a vast pool of knowledge, experience and resources to correctly guide the project.

However, it is worth noting that a risk of having such a large collaboration with a wide range of disciplines may be having “too many cooks in the kitchen”. The risk would potentially be the flow-on effect of endless discussion with no foreseeable actions. To mitigate against this risk, I recommend:

- publication of regular proceedings that stipulate actions and deliverables for public consumption
- conduct of an open forum where parties outside the panel can raise questions or recommendations
- development of a structured governance model to ensure that progress is made.

4.3.4.2 Open source platform and process

Open source platforms have had a meteoric rise of late (McCann, 2017), stemming from the effectiveness of having an open code base in which contribution and cooperation provides various benefits, including a reduction in the burden of regressions, which improves the flow of innovation and shares the task of security review (Phipps, 2015). Having an open source code base provides the technology with the ability to grow and benefit from potentially thousands of developers and technology specialists' contributions. Open source code has become the norm in today's developer world. Most technologies and projects I work in today stem from one or more open source projects.

As mentioned, one of the key benefits of having the source code "open source" is the ability to have the platform verified and validated by potentially thousands of developers. Another benefit would be that an open source platform could also increase trust in the platform through transparency (Parent, Vandebeek, & Gemino, 2004; Welch & Hinnant, 2003). By sharing "the code", the platform would be open for public scrutiny and collaboration, which would build a more solid platform and also give members of the public an opportunity to be involved in the project.

4.4 Conclusion

I now have the difficult task of summing up the years of work and the achievements in just a few pages. Early on during this research, it became evident that there was a data gap within the Australian context. As mentioned throughout this scope of work, context plays a key role. We proceeded to conduct the first Australian university survey on the perceptions of internet e-Voting. The national public survey not only enabled the team to establish a baseline from which our work could continue, but also provided data that can be used for other research.

The survey was able to discover that there is strong support for the use of a mobile internet e-Voting, with 75.25% of respondents stating that they would use the technology if it were made available. The primary appeals of the technology for the public being the ability to cast a vote from anywhere online, getting a receipt confirming a vote was cast and the speed of casting a ballot. The survey also managed to discover public concerns about the technology. Manipulation, exposure and monitoring of votes were flagged as the primary concerns. However, it was observed later through analysis of the data that the options presented as concerns about the technology that most respondents chose all had started with “Hackers, malware or virus”, which I believe to be an interesting correlation. Could there be influencing factors that could have biased their opinions to those terms?

The survey, in conjunction with the public awareness campaign (relating to the research and survey), had also invigorated public debate and discussion in the media about using a mobile voting app during the NSW election. The team was interviewed and asked to comment on the research and its implications as well as provide commentary about other events, such as the Australian Census issues (Section 4.3.1). Our research had appeared in over 20 various media stories or interviews.

During this time in 2015, the team and our research was recognised by various electoral offices. So much so that were invited to attend, along with international delegations, a special behind-the-scenes tour and various workshops of the iVote 2015 implementation hosted by the NSW Electoral Commission. This was a very fortunate opportunity and reiterated the importance of our work.

The next major step of this work was to utilise the findings of the survey to guide the design and development of the mobile voting app. The findings from the survey, along with previous academic research, provided insight into what the research team believed were the features and functionality a mobile voting app would require to be accepted and used. The application design and overall functionality was influenced by the technology acceptance model's (Davis, 1989) correlation between perceived usefulness and perceived ease of use. In other words, we needed to ensure that the application presented as both useful to the user and easy to use.

The mobile voting app was developed and scheduled to be user tested by in-depth individual interviews, at which time the research team gauged user opinions and thoughts on the technology. Utilising an agile approach, more specifically the Scrum methodology, the application was able to be progressively built, adaptive to change and completed over a relatively short period of time.

The app was built as a hybrid mobile app, allowing the team to provide a device agnostic app. By providing a device agnostic app, we were not limiting the prospective individuals from taking part in the interviews. The app not only provided the ability to simulate an election and a national survey but also provided an array of configurations that allowed the team to A/B test features that were made available by the app. This functionality was also able to be controlled remotely and live. In my personal opinion, this is one of the more impressive features that I am very proud of. This provided the team the ability to toggle these features remotely (via a custom-built command line interface – Section 3.3.4.6) during various phases of the interview, as opposed to providing different compiled versions of the app.

The final phase of the work was to user test the application during in-depth interviews to gauge public opinion and perspectives about the technology. The interviews were originally set to target 10 individuals; however, as discussed in Section 3.4.3, due to limiting timing, scheduling and resourcing, the target audience of the in-depth interviews was refocused to a young tech savvy cohort that we believed would more likely be classified as early adopters as per Rogers' (1995) diffusion of innovation (DOI) theory.

The in-depth interviews yielded promising results for the mobile voting app. Interviewees where able to identify their preference for specific functionality through the A/B testing mechanism and were all able complete the tasks set out with ease. The one-click preference selection method was primarily preferred to the select list preference selection method. Also, most interviewees felt that additional security measures were preferable and gave a greater sense of security. The in-depth interviews also uncovered some interesting findings in relation to enhancements. Interviewees were not sure what to do next after casting a vote or what other functionality was available. Although the app was overall intuitive, additional instructions or on-screen guidance would have helped address these points.

Overall, the general findings of the in-depth interviews were that most interviewees would use the mobile voting app if it were made available during the next election. The findings obtained through the in-depth interviews also confirms that the mobile voting app's perceived ease of use and perceived usefulness result in technological acceptance (Davis, 1989) within the realm of early adopters (Rogers, 1995). An interviewee who indicated otherwise had not yet attended and voted in an Australian Election polling place and would like to have that experience first; however, they would use it in a following election if the opportunity were available. The other interview who also indicated they would not use the app stated that he had some reservations and needed to be more confident before they trusted the application and the process.

Early on in my research, I identified public perception and trust as being key issues in the adoption of a mobile internet e-Voting platform in Australia. However, this was dismissed for a more technological argument by various academics and officials when I was trying to find my niche with this research. Current world events (Sections 4.3.1-4.3.3) and this research suggests that this might in fact be a key issue. Although limited, with a need for additional studies from more scholars and industry, this innovation portfolio project does make an important contribution given the lack of information on this issue and serves as a roadmap for those wanting to progress or study the issue, as they can learn from the experiences presented within this portfolio.

If we are ever to achieve a mobile voting e-Voting platform in Australia, more needs to be done. Implementing the app, the survey and in-depth interviews within the scope of a university setting has been a major challenge, particularly within the current climate and challenges relating to trust of technology applications. As discussed in Section 4.3.4, there needs to be collaboration between government organisations, academia, industry and the public. Additional independent and government-endorsed research such as a larger nationwide survey or more qualitative analysis across multiple contrast groups could benefit this research into the future. There must also be public collaboration and transparency in the technology and process so that trust can be gained and maintained. Additionally, I believe that a nation-wide limited trial should be undertaken were a mobile internet e-Voting platform could have substantially large-scale usage within a controlled environment.

In conclusion, the primary theme of this innovation portfolio is trust. However, is trust enough to ensure that an internet e-Voting platform will be adopted? Probably not, but it is a critical ingredient. I was contemplating this question as I come to the end of this scope of work. If I were asked to provide a one-sentence outcome of this work, my response would be:

> *An Australian mobile internet e-Voting platform must provide (or surpass) the same safeties and guarantees as paper-based protocols, whilst also providing additional functionality, convenience and simplicity to ensure successful adoption.*

References

2016 election hacking fast facts. (2018, October 18). *CNN.* Retrieved from https://edition.cnn.com/2016/12/26/us/2016-presidential-campaign-hacking-fast-facts/index.html

2018 election model presentation. (2017, March). Retrieved from http://www2.markham.ca/markham/ccbs/indexfile/Agendas/2018/General/gc180305/2018%20Election%20Model%20Presentation.pdf

ABS. (2017, November 15). 1800.0 - Australian marriage law postal survey, 2017. Retrieved September 18, 2018, from http://www.abs.gov.au/ausstats/abs@.nsf/mf/1800.0

AbuShanab, E., & Pearson, J. M. (2007). Internet banking in Jordan: The unified theory of acceptance and use of technology (UTAUT) perspective. *Journal of Systems and Information Technology, 9*(1), 78–97. https://doi.org/10.1108/13287260710817700

Ajzen, I., & Fishbein, M. (1972). Attitudes and normative beliefs as factors influencing behavioral intentions. *Journal of Personality and Social Psychology, 21*(1), 1–9. https://doi.org/10.1037/h0031930

Allen Consulting Group Pty Ltd. (2011). *Evaluation of technology assisted voting provided at the New South Wales State General Election March 2011*. Allen Consulting Group Pty Ltd.

Andrews, D., Nonnecke, B., & Preece, J. (2003). Electronic survey methodology: A case study in reaching hard-to-involve internet users. *International Journal of Human–Computer Interaction, 16*(2), 185–210. https://doi.org/10.1207/S15327590IJHC1602_04

Appinventiv. (2018, January 25). Swift vs Objective-C: 15 ways swift supersedes objective-c. Retrieved from https://medium.com/@AppInventiv/swift-vs-objective-c-15-ways-swift-supersedes-objective-c-48a34289c2d2

Australia Post. (n.d.). eVoting – a new way to have our say. Retrieved from https://auspostenterprise.com.au/content/dam/corp/ent-gov/documents/eVoting-insights-paper.pdf

Australian Electoral Commission. (2008). *Remote Electronic Voting at the 2007 Federal Election for Overseas Australian Defence Force Personnel*. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=em/elect07/subs/sub169_2.pdf

Australian Electoral Commission. (2011). *Supplementary submission to the Joint Standing Committee on Electoral Matters – Informal Voting*. Retrieved from http://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=em/elect10/subs/sub087.4.pdf

Australian Electoral Commission. (2016). *Voter turnout - 2016 House of Representatives and Senate elections.* Retrieved from https://www.aec.gov.au/About_AEC/research/files/voter-turnout-2016.pdf

Australian Electoral Commission. (n.d.). *Australian voting history in action*. Retrieved September from https://www.aec.gov.au/About_AEC/25/theme1-voting-history.htm

Australian Electoral Commission. (n.d.). *Positions on the ballot paper, draw for the Senate and draw for the House of Representatives*. Retrieved March 3, 2019, from https://www.aec.gov.au/voting/ballot-draw.htm

Australian Pro Bono Centre | National Pro Bono News: Issue 41. (n.d.). Retrieved March 3, 2019, from https://www.probonocentre.org.au/australian-pro-bono-news/archive/jun-2008/

Barry, C., Brightwell, I., & Franklin, L. (2013). *Technology Assisted Voting. iVote for SGE 2015*. Retrieved from https://www.elections.nsw.gov.au/NSWEC/media/NSWEC/Reports/iVote%20reports/iVote-presentation-to-NSW-Parliament-20-November-2013-(PDF-428.7kB).pdf

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., … Thomas, D. (2001). *Manifesto for agile software development*. Retrieved September from http://agilemanifesto.org/

Belot, H. (2016, November 24). Census 2016: Government, IBM settle over website crash. *ABC News*. Retrieved from https://www.abc.net.au/news/2016-11-24/government-ibm-settle-over-census-crash/8055784

Benaloh, J. C., & Yung, M. (1986). Distributing the power of a government to enhance the privacy of voters. In *Proceedings of the Fifth Annual ACM Symposium on Principles of Distributed Computing* (pp. 52–62). New York, NY, USA: ACM. https://doi.org/10.1145/10590.10595

Benbasat, I. & Barki, H. (2007). Quo vadis, TAM? *Journal of the Association for Information Systems*, *8*(4), 211-218.

Birks, M., & Mills, J. (2015). *Grounded theory: A practical guide*. SAGE.

Bist, R. B. (2015). Research procedure: An introduction*. Journal of NELTA Surkhet, 4*, 34–40. https://doi.org/10.3126/jns.v4i0.12858

Boehm, B. W. (1988). A spiral model of software development and enhancement. *Computer, 21*(5), 61–72. https://doi.org/10.1109/2.59

Brace, I. (2004). Questionnaire design: *How to plan, structure, and write survey material for effective market research.* London Sterling, VA: Kogan Page.

Bradley, J. (2012). If we build it they will come? The technology acceptance model. In Y. K. Dwivedi, M. R. Wade, & S. L. Schneberger (Eds.), *Information systems theory* (Vol. 28, pp. 19–36). New York, NY: Springer New York. https://doi.org/10.1007/978-1-4419-6108-2_2

Brightwell, I., Cucurull, J., Galindo, D., & Guasch, S. (2015). *An overview of the iVote 2015 voting system.* Retrieved from https://www.elections.nsw.gov.au/NSWEC/media/NSWEC/Reports/iVote%20reports/An-overview-of-the-iVote-2015-voting-system-(PDF-1.6MB).pdf

Caarls, S. (2010). *E-voting handbook: Key steps in the implementation of e-enabled elections.* Retrieved from http://books.google.com.au/books?id=u_p5s7qSejwC

Capacitor: Universal web applications. (n.d.). Retrieved November 26, 2018, from https://capacitor.ionicframework.com/

Carter, L. (2008). E-government diffusion: A comparison of adoption constructs. *Transforming Government: People, Process and Policy, 2*(3), 147–161.

Carter, L., & Bélanger, F. (2005). The utilization of e-government services: Citizen trust, innovation and acceptance factors. *Information Systems Journal, 15*(1), 5–25.

Carter, L., & Campbell, R. (2012). Internet voting usefulness: An empirical analysis of trust, convenience and accessibility. *Journal of Organizational and End User Computing 24*(3), 1–17. https://doi.org/10.4018/joeuc.2012070101

Cervone, H. F. (2011). Understanding agile project management methods using Scrum. *OCLC Systems & Services: International digital library perspectives, 27*(1), 18–22. http://doi.org/10.1108/10650751111106528

Cetinkaya, O., & Cetinkaya, D. (2007). Verification and validation issues in electronic voting. *Electronic Journal of E-Government, 5*(2).

Cetinkaya, O., & Doganaksoy, A. (2008). Pseudo-voter identity (PVID) scheme for e-Voting protocols. In *Proceedings of the Second International Conference on Availability, Reliability and Security, ARES 2007, The International Dependability Conference - Bridging Theory and Practice*, April 10-13 2007, Vienna, Austria. IEEE Computer Society 2007 (pp. 1190–1196). Retrieved from http://dblp.uni-trier.de/db/conf/IEEEares/ares2007.html#CetinkayaD07a

Cowan, P. (2015, May 6). NSW Electoral Commission answers iVote critics - Security - iTnews. *Itnews.* Retrieved from https://www.itnews.com.au/news/nsw-electoral-commission-answers-ivote-critics-403635

Cranor, L. F., & Cytron, R. K. (1997). Sensus: A security-conscious electronic polling system for the Internet. In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences* (pp. 561–570). https://doi.org/10.1109/HICSS.1997.661700

Culnane, C., Eldridge, M., Essex, A., Teague, V., & Yarom, Y. (2017, March 5). iVote West Australia: Who voted for you? *Pursuit.* Retrieved from https://pursuit.unimelb.edu.au/articles/ivote-west-australia-who-voted-for-you

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13,* 319–340.

Davis, F. D., & Venkatesh, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. *International Journal of Human-Computer Studies, 45*(1), 19–45. https://doi.org/10.1006/ijhc.1996.0040

Delvinia Interactive Inc. (2003). *Internet voting and Canadian e-democracy in practice.* Retrieved from https://www.verifiedvoting.org/wp-content/uploads/2014/09/Canada-2004-Delvinia_Voting_Report_04.pdf

Delvinia Interactive. (2007). *Understanding the digital voter experience.* Retrieved from http://www.delvinia.com/egov/Delvinia_Voting_Report_07_full.pdf

Dillman, D. A. (1991). The design and administration of mail surveys. *Annual Review of Sociology, 17*(1), 225–249. https://doi.org/10.1146/annurev.so.17.080191.001301

Disabled "deserve secret ballot." (2008, April 24). *ABC News*. Retrieved from https://www.abc.net.au/news/2008-04-24/disabled-deserve-secret-ballot/2414418

Dryzek, J. (2009). The Australian citizens' parliament: A world first. *Journal of Public Deliberation, 5*(1), article 9.

Electoral Council of Australia and New Zealand. (2013). *Internet voting in Australian election systems*. Retrieved October 20, 2014, from https://www.ecanz.gov.au/research/ files/internet-voting-australian-election-systems.pdf

EmpireOne. (n.d.). Understanding apps: Mobile, native or responsive. Retrieved September 8, 2018, from http://empireone.com.au/understanding-apps-mobile-native-or-responsive/

Enguehard, C. (2008). *Transparency in electronic voting: The great challenge.* IPSA International Political Science Association RC 10 on Electronic Democracy Conference on "E-democracy – State of the art and future agenda", Jan 2008, Stellenbosch, South Africa (pp.édition électronique). Retrieved from https://halshs.archives-ouvertes.fr/halshs-00409465/document

Estonian National Electoral Committee. (2010). *E-Voting System - General Overview*. Retrieved October 20, 2014, from https://www.valimised.ee/sites/default/ files/uploads/eng/General_Description_E-Voting_2010.pdf

Estonian National Electoral Committee, Statistics about internet voting in Estonia. (2015). Retrieved November 11, 2013, from http://www.vvk.ee/voting-methods-in-estonia/engindex/statistics/statistics-about-internet-voting/

Evans, T. (2006). *Compulsory voting in Australia*. Retrieved from http://www.aec.gov.au/About_AEC/Publications/voting/files/compulsory-voting.pdf

E-voting experiments end in Norway. (2014, June 27). *BBC News.* Retrieved from https://www.bbc.com/news/technology-28055678

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, Mass: Addison-Wesley Pub. Co.

Fogel, B. (2015). *A survey of web vulnerabilities* (Unpublished doctoral thesis). Auburn University, Alabama, US. Retrieved from https://etd.auburn.edu/ bitstream/handle/10415/4569/ThesisSubmission.pdf?sequence=4

Fouard, L., Duclos, M., & Lafourcade, P. (2007). *Survey on electronic voting schemes.* Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.295.7959&rep=rep1&type=pdf

Fricker, R. D., & Schonlau, M. (2002). Advantages and disadvantages of internet research surveys: Evidence from the literature. *Field Methods, 14*(4), 347–367. https://doi.org/10.1177/152582202237725

Fujioka, A., Okamoto, T., & Ohta, K. (1993). A practical secret voting scheme for large scale elections. In *Proceedings of the Workshop on the Theory and Application of Cryptographic Techniques: Advances in Cryptology* (pp. 244–251). London, UK, UK: Springer-Verlag. Retrieved from http://dl.acm.org/citation.cfm?id=647091.713943

Gallo, A. (2017, June 28). A refresher on A/B testing. Retrieved September 8, 2018, from https://hbr.org/2017/06/a-refresher-on-ab-testing

Global mobile OS market share in sales to end users from 1st quarter 2009 to 2nd quarter 2018. (2018). Retrieved September 8, 2018, from https://www.statista.com/statistics/266136/global-market-share-held-by-smartphone-operating-systems/

Goodman, N. J. (2014). Internet voting in a local election in Canada. In B. Grofman, A. H. Trechsel, & M. Franklin (Eds.), *The internet and democracy in global perspective* (Vol. 31, pp. 7–24). Springer International Publishing. Retrieved from http://dx.doi.org/10.1007/978-3-319-04352-4_2

Goodman, N., & Pyman, H. (2016). *Internet voting project report.* Retrieved from http://www.centreforedemocracy.com/wp-content/uploads/2016/08/IVP_Report.pdf

Griffiths, E. (2013, November 4). AEC confirms WA Senate election result, apologises over 1,375 lost ballots. *ABC News.* Retrieved from https://www.abc.net.au/news/2013-11-04/wa-set-to-head-back-to-polls-in-six-senate-by-elections/5066718

Gritzalis, D. A. (2002). Principles and requirements for a secure e-voting system. *Computers & Security, 21*(6), 539–556. https://doi.org/10.1016/S0167-4048(02)01014-3

Halderman, J. A., & Teague, V. (2015). The New South Wales ivote system: Security failures and verification flaws in a live online election. In R. Haenni, R. E. Koenig & D. Wikstrom (Eds.), *E-voting and identity* (pp. 35–53). Springer. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-22270-7_3

Hammer, C. S. (2011). The importance of participant demographics. *American Journal of Speech-Language Pathology, 20*(4), 261–261.

Hardawar, D. (2012, September 11). Facebook's Zuckerberg: 'The biggest mistake we've made as a company is betting on HTML5 over native'. Retrieved November 26, 2018, from https://venturebeat.com/2012/09/11/facebooks-zuckerberg-the-biggest-mistake-weve-made-as-a-company-is-betting-on-html5-over-native/

Hennink, M., Hutter, I., & Bailey, A. (2010). *Qualitative research methods*. SAGE.

Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: How many interviews are enough? *Qualitative Health Research, 27*(4), 591–608. https://doi.org/10.1177/1049732316665344

Holmes, B. (2012, October 15). *E-voting: The promise and the practice – Parliament of Australia.* Retrieved from http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BN/2012-2013/EVoting

Huycke, S., & Tecsa, T. (2012). *Markham votes 2014 - Internet voting program.* Retrieved from http://www2.markham.ca/markham/ccbs/indexfile/Agendas/2012/General/gc121113/Internet%20Voting%20Presentation.pdf

IBM. (2011). *Native, web or hybrid mobile-app development.* Retrieved from https://www.computerworld.com.au/whitepaper/371126/native-web-or-hybrid-mobile-app-development/

iEsteve, J. B., Goldsmith, B., & Turner, J. (2012). *International experience with e-voting: Norwegian e-vote project.* Retrieved from https://www.parliament.uk/documents/speaker/digital-democracy/IFESIVreport.pdf

Ilieva, J., Baron, S., & Healey, N. M. (2002). Online surveys in marketing research: Pros and cons. *International Journal of Market Research*, *44*(3), 361–376.

Jøsang, A., Ismail, R., & Boyd, C. (2007). A survey of trust and reputation systems for online service provision. *Decision Support Systems, 43*(2), 618–644.

Juang, W., Lei, C., & Yu, P. (1998). A verifiable multi-authorities secret election allowing abstaining from voting. *International Computer Symposium, 45*, 672–682.

Karlof, C., Sastry, N., & Wagner, D. (2005). Cryptographic voting protocols: A systems perspective. In *Proceedings of the 14th Conference on USENIX*

Security Symposium (Vol. 14, pp. 3–3). Berkeley, CA, USA: USENIX Association. Retrieved from https://www.usenix.org/legacy/publications/library/proceedings/sec05/tech/full_papers/karlof/karlof.pdf

Kiesler, S., & Sproull, L. S. (1986). Response effects in the electronic survey. *Public Opinion Quarterly, 50*(3), 402–413. https://doi.org/10.1086/268992

Kitteringham, K., & Brouwer, A. (2010, January). *Markham's Online Voting Experience*. Retrieved October 20, 2014, from http://www.markhamvotes.ca/

Kremer, M. (2018, June 21). Ionic view sunsetting on 9/1/18. Retrieved October 22, 2018, from https://blog.ionicframework.com/ionic-view-sunsetting-on-9-1-18/

Kremer, S., Ryan, M., & Smyth, B. (2010). Election verifiability in electronic voting protocols. In *Proceedings of the 15th European Conference on Research in Computer Security* (pp. 389–404). Berlin, Heidelberg: Springer-Verlag. Retrieved from http://dl.acm.org/citation.cfm?id=1888881.1888912

LaMorte, W. W. (2016). *Diffusion of innovation theory*. Retrieved from Boston University School of Publish Health website: http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html

Lee, B., Boyd, C., Dawson, E., Kim, K., Yang, J., & Yoo, S. (2003). Providing receipt-freeness in mixnet-based voting protocols. In J-I Lim & D-H. Lee (Eds.), *International conference on information security and cryptology* (pp. 245–258). Springer. Retrieved from https://link.springer.com/chapter/10.1007/978-3-540-24691-6_19

Madise, Ü., & Martens, T. (2006). E-voting in Estonia 2005. The first practice of country-wide binding internet voting in the world. In R. Krimmer (Ed.), *Electronic voting* (Vol. 86, pp. 15–26). GI. Retrieved from http://dblp.uni-trier.de/db/conf/ev/ev2006.html#MadiseM06

Mallonee, M. K. (2017, September 22). DHS alerts states targeted by election hacking attempts. *CNN.* Retrieved from https://edition.cnn.com/2017/09/22/politics/dhs-election-hacking/index.html

Malterud, K., Siersma, V. D., & Guassora, A. D. (2015). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research, 26,* 1753-1760. https://doi.org/10.1177/1049732315617444

Martins, C., Oliveira, T., & Popovič, A. (2014). Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application. *International Journal of Information Management, 34*(1), 1–13. https://doi.org/10.1016/j.ijinfomgt.2013.06.002

McCann, J. (2017, September 22). The meteoric rise of open source and why investors should care. *Forbes.* Retrieved from https://www.forbes.com/sites/forbestechcouncil/2017/09/22/the-meteoric-rise-of-open-source-and-why-investors-should-care/

McKie, L. (2002). Engagement and evaluation in qualitative inquiry. In T. May (Ed.), *Qualitative research in action* (pp. 261–285). London: Sage.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192–222. https://doi.org/10.1287/isre.2.3.192

New taskforce to defend against election meddling. (2018, June 9). *Financial Review.* Retrieved from https://www.afr.com/news/politics/national/new-taskforce-to-defend-against-election-meddling-20180609-h116c6

Newman, I., & Benz, C. R. (1998). *Qualitative-quantitative research methodology: Exploring the interactive continuum.* SIU Press.

Nichter, S. (2008). Vote buying or turnout buying? Machine politics and the secret ballot. *The American Political Science Review, 102*(1), 19–31.

Nore, H. (n.d.). *Can we trust internet voting? Internet voting in Norway*. Retrieved from http://www.oas.org/es/sap/deco/seminarios/peru/pre/Henrik_Nore.pdf

NSW Electoral Commission. (2010). *Report on the Feasibility of providing "iVote" Remote Electronic Voting System*. Retrieved from https://www.elections.nsw.gov.au/__data/assets/pdf_file/0006/84498/20100723_NSWEC_iVote_Feasibility_Report_.pdf

Ockenden, W. (2015, March 24). NSW election 2015: iVote flaw "allowed vote to be changed"; electoral commission fixes vulnerability. *ABC News*. Retrieved from https://www.abc.net.au/news/2015-03-23/ivote-security-hack-allowed-change-of-vote-security-expert-says/6340168

Ong, A. D., & Weiss, D. J. (2000). The impact of anonymity on responses to sensitive questions 1. *Journal of Applied Social Psychology, 30*(8), 1691–1708.

Oppliger, R., Schwenk, J., & Helbach, J. (2008). Protecting code voting against vote selling. *Safety 2008: Safety, Protection and Reliability*, 4th annual conference of the Department of Security of the Gesellshaft fur Informatik (Vol. 128, pp. 193–

204). Retrieved from https://www.researchgate.net/publication/221307180_Protecting_Code_Voting_Against_Vote_Selling

Parent, M., Vandebeek, C. A., & Gemino, A. C. (2004). Building citizen trust through e-Government. In *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*. IEEE Computer Society Press doi: 10.1109/HICSS.2004.1265304

Peacock, T., Ryan, P. Y. A., Schneider, S., & Xia, Z. (2013). Verifiable voting systems. In J. Vacca (Ed.), *Computer and information security handbook* (2nd ed., pp. 1-51). Elsevier Inc.

Philip, A. A., Simon, S. A., & A., A. O. (2011). A receipt-free multi-authority e-voting system. *International Journal of Computer Applications, 30*(6), 15–23. https://doi.org/10.5120/3646-5092

Phipps, S. (2015, May 8). The rise and rise of open source. *InfoWorld.* Retrieved from https://www.infoworld.com/article/2914643/open-source-software/rise-and-rise-of-open-source.html

Pichler, R. (2009). The product vision. Retrieved from https://www.scrumalliance.org/community/articles/2009/january/the-product-vision

Pitkow, J. E., & Kehoe, C. M. (1996). Emerging trends in the WWW user population. *Communications of the ACM, 39*(6), 106–108. https://doi.org/10.1145/228503.228525

Porter, S. R., Whitcomb, M. E., & Weitzer, W. H. (2004). Multiple surveys of students and survey fatigue. *New Directions for Institutional Research, 2004*(121), 63–73. https://doi.org/10.1002/ir.101

Powell-Morse, A. (2016). What is rapid application development (RAD) and how do you use it? Retrieved September 8, 2018, from https://airbrake.io/blog/sdlc/rapid-application-development

Progressive Web Apps | Web | Google Developers. (n.d.). Retrieved September 8, 2018, from https://developers.google.com/web/progressive-web-apps/

PwC. (2011). *Technology Assisted Voting Audit. iVote Post Implementation Report*. Retrieved from https://www.elections.nsw.gov.au/__data/assets/pdf_file/0007/93481/iVote_Audit_report_PIR_Final.pdf

Quinn, G., & Keough, M. (2002). *Statistical hypothesis testing: Experimental design and data analysis for biologists.* Retrieved from http://users.monash.edu.au/~murray/stats/BIO3011/Eworksheets/tutorials/Hypo.pdf

Rehkopf, M. (2014). User stories. Retrieved September 8, 2018, from https://www.atlassian.com/agile/project-management/user-stories

Riigikogu Election Act (2002). Retrieved from https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/506052016002/consolide

Riordan, P. (2016, November 14). E-voting risks in Australia after Russian hacking in US election. *Financial Review.* Retrieved from https://www.afr.com/news/evoting-risks-in-australia-after-russian-hacking-in-us-election-20161114-gson92

Rjašková, Z. (2002). *Electronic voting schemes*. Retrieved from https://people.ksp.sk/~zuzka/elevote.pdf

Rogers, E. M. (1995). Diffusion of innovations: Modifications of a model for telecommunications. In M-W. Stoetzer & A. Mahler (Eds.), *Die diffusion von innovationen in der telekommunikation* (pp. 25–38). Springer. Retrieved from https://link.springer.com/chapter/10.1007/978-3-642-79868-9_2

Rogers, E. M. (2010). *Diffusion of innovations.* Simon and Schuster.

Rousseau, D. M., & Sitkin, S. B. (1998). Introduction to special topic forum. Not so different after all: A cross-discipline view of trust. *Academy of Management Review, 23*(3), 393–404.

Royce, W. W. (1987). Managing the development of large software systems: concepts and techniques. In *Proceedings of the 9th International Conference on Software Engineering* (pp. 328–338). IEEE Computer Society Press.

Ryan, P. Y., & Teague, V. (2009). Ballot permutations in Prêta Voter. EVT/WOTE, 42.

Saglie, J., & Segaard, S. B. (2016). Internet voting and the secret ballot in Norway: Principles and popular understandings. *Journal of Elections, Public Opinion and Parties, 26*(2), 155–169. https://doi.org/10.1080/17457289.2016.1145687

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology-TOJET, 5*(2), 14–23.

Sako, K., & Kilian, J. (1995). Receipt-free mix-type voting scheme: A practical solution to the implementation of a voting booth. In *Proceedings of the 14th*

Annual International Conference on Theory and Application of Cryptographic Techniques (pp. 393–403). Berlin, Heidelberg: Springer-Verlag. Retrieved from http://dl.acm.org/citation.cfm?id=1755009.1755052

Scaled agile framework – SAFe for lean enterprises. (n.d.). Retrieved September 8, 2018, from https://www.scaledagileframework.com/

Scrum Alliance (2017). *The state of Scrum report 2017 edition.* Retrieved from https://www.scrumalliance.org/scrum/media/ScrumAllianceMedia/Files%20and%20PDFs/State%20of%20Scrum/State0fScrum_2016_FINAL.pdf?aliId=253257622

Scrum values and agile methodologies for project management. (n.d.). Retrieved November 26, 2017, from https://www.scrumalliance.org/learn-about-scrum/scrum-values

Sedgwick, P. (2010). Statistical hypothesis testing. *BMJ: British Medical Journal (Online),* 340. Retrieved from https://www.bmj.com/content/340/bmj.c2059

Segaard, S. B. (2014). *Institutt for samfunnsforskning*. Retrieved from https://www.regjeringen.no/globalassets/upload/kmd/komm/rapporter/isf_internettvalg.pdf

Shafirov, M. (2017, May 17). Kotlin on Android. Retrieved November 26, 2018, from Kotlin Blog website: https://blog.jetbrains.com/kotlin/2017/05/kotlin-on-android-now-official/

Sharp, L., & Frankel, J. (1983). Respondent burden: A test of some common assumptions. *Public Opinion Quarterly, 47*(1), 36–53. https://doi.org/10.1086/268765

Sherman, R. P. (2000). Tests of certain types of ignorable nonresponse in surveys subject to item nonresponse or attrition. *American Journal of Political Science, 44*(2), 362–374.

Solvak, M., & Vassil, K. (2016). *E-voting in Estonia: Technological diffusion and other developments over ten years (2005–2015)*. Tartu, Estonia: Johan Skytte Institute of Political Studies, University of Tartu.

Sprint retrospective meeting. (2018). Retrieved November 26, 2018, from https://www.scrum-institute.org/Sprint_Retrospective_Meeting.php

Stanton, J. M. (1998). An empirical assessment of data collection using the Internet. *Personnel Psychology, 51*(3), 709–725.

Stoica, M., Ghilic-Micu, B., Mircea, M., & Uscatu, C. (2016). Analyzing agile development - from waterfall style to scrumban. *Informatica Economica, 20*(4).

Storer, T. W. (2007). *Practical pollsterless remote electronic voting* (PhD thesis). University of St Andrews, Scotland. Retrieved from https://research-repository.st-andrews.ac.uk/handle/10023/223

Sutrisna, M. (2009). *Research methodology in doctoral research: Understanding the meaning of conducting qualitative research*. Retrieved from https://www.researchgate.net/publication/275956584_Research_Methodology_in_Doctoral_Research_Understanding_the_Meaning_of_Conducting_Qualitative_Research.

Sutton, C. (2016, August 10). Census hacked: Australian online voting 'dead in the water'. *News.com.au.* Retrieved from https://www.news.com.au/technology/online/security/its-a-complete-stuffup-with-massive-ramifications-how-the-census-disaster-torpedoed-online-voting-in-australia/news-story/31b554315cda485da72faa81592ab690

Swift - Apple Developer. (2018). Retrieved November 26, 2018, from https://developer.apple.com/swift/

Technology assisted voting approved procedures for NSW state elections. (2017). Retrieved November 27, 2018, from http://www.elections.nsw.gov.au/voting/ivote/procedures/technology_assisted_voting_approved_procedures_for_nsw_state_elections

The Carter Center. (2014). *Internet voting pilot: Norway's 2013 parliamentary elections.* Retrieved from https://www.regjeringen.no/globalassets/upload/krd/kampanjer/valgportal/valgobservatorer/2013/rapport_cartersenteret2013.pdf

The Scrum Product Backlog. (2018). Retrieved November 26, 2018, from https://www.scrum-institute.org/The_Scrum_Product_Backlog.php

Tillett, A. (2017, March 6). iVote hack concerns rejected. *The West Australian.* Retrieved from https://thewest.com.au/politics/state-election-2017/ivote-hack-concerns-rejected-ng-b88406330z

TIOBE Index - The Software Quality Company. (2018, November). Retrieved November 26, 2018, from https://www.tiobe.com/tiobe-index/

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425. https://doi.org/10.2307/30036540

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems, 17*(5), article 1. Retrieved from https://aisel.aisnet.org/jais/vol17/iss5/1/

VersionOne releases10th annual state of agile report. (2015). Retrieved from https://www.versionone.com/about/press-releases/versionone-releases-10th-annual-state-of-agile-report/

Victoria Parliament Electoral Matters Committee. (2017). *Inquiry into electronic voting.* Retrieved from https://www.parliament.vic.gov.au/emc/article/2825

Weber, S. (2006). A coercion-resistant cryptographic voting protocol-evaluation and prototype implementation (Unpublished diploma thesis). Darmstadt University of Technology, Darmstadt, Germany. Retrieved from https://pdfs.semanticscholar.org/678c/88ebe19f5a4b74ad6a1bc419b667a6ad4b04.pdf

Welch, E. W., & Hinnant, C. C. (2003). Internet use, transparency, and interactivity effects on trust in government. In *Proceedings of the 36th Annual Hawaii International Conference on System Sciences*. https://doi.org/10.1109/HICSS.2003.1174323

Wright, K. B. (2005). Researching internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication, 10*(3). https://doi.org/10.1111/j.1083-6101.2005.tb00259.x

Wright, N. (2014). Choosing the best mobile app development technology. Retrieved September 10, 2017, from https://www.upwork.com/blog/2014/02/choosing-best-mobile-app-development-technology/

Wu, M.-Y., Chou, H.-P., Weng, Y.-C., & Huang, Y.-H. (2011). TAM2-based study of website user behavior-using web 2.0 websites as an example. *WSEAS Transactions on Business and Economics, 8*, 133–151.

Zada, P., Falzon, G., & Kwan, P. (2016). Perceptions of the Australian public towards mobile internet e-voting: Risks, choice and trust. *Electronic Journal of E-Government, 14*(1), 117–34.

Zetter, K. (2014, August 12). Hacker lexicon: What is an air gap? *Wired.* Retrieved from https://www.wired.com/2014/12/hacker-lexicon-air-gap/

Ziebell, W. (2018, June 9). Australia forms task force to guard elections from cyber attacks. *Reuters.* Retrieved from https://www.reuters.com/article/us-australia-security-elections/australia-forms-task-force-to-guard-elections-from-cyber-attacks-idUSKCN1J506D

Ziflaj, A. (2014). Native vs hybrid app development. Retrieved September 8, 2018, from https://www.sitepoint.com/native-vs-hybrid-app-development/

Appendix

Table of Appendix

1. Human Research Ethics Committee Approvals

University of New England

Ethics Office
Research Development & Integrity
Research Division
Armidale NSW 2351
Australia
Phone *02 6773 3449*
Fax *02 6773 3543*
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HUMAN RESEARCH ETHICS COMMITTEE

MEMORANDUM TO: Dr Gregory Falzon, A/Prof Paul Kwan & Mr Phillip Zada
School of Science & Technology

This is to advise you that the Human Research Ethics Committee has approved the following:

PROJECT TITLE:	A vulnerability analysis on the adoption of mobile internet e-voting in Australia
APPROVAL No.:	HE15-055
COMMENCEMENT DATE:	13 March, 2015
APPROVAL VALID TO:	13 March, 2016
COMMENTS:	Nil. Conditions met in full

The Human Research Ethics Committee may grant approval for up to a maximum of three years. For approval periods greater than 12 months, researchers are required to submit an application for renewal at each twelve-month period. All researchers are required to submit a Final Report at the completion of their project. The Progress/Final Report Form is available at the following web address: http://www.une.edu.au/research/research-services/rdi/ethics/hre/hrec-forms

The NHMRC National Statement on Ethical Conduct in Research Involving Humans requires that researchers must report immediately to the Human Research Ethics Committee anything that might affect ethical acceptance of the protocol. This includes adverse reactions of participants, proposed changes in the protocol, and any other unforeseen events that might affect the continued ethical acceptability of the project.

In issuing this approval number, it is required that all data and consent forms are stored in a secure location for a minimum period of five years. These documents may be required for compliance audit processes during that time. If the location at which data and documentation are retained is changed within that five year period, the Research Ethics Officer should be advised of the new location.

[redacted]

Secretary/Research Ethics Officer

13/03/2015 A15/17

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HUMAN RESEARCH ETHICS COMMITTEE

MEMORANDUM TO:	Dr Gregory Falzon, Prof Paul Kwan, Mr Ian Brightwell & Mr Phillip Zada **Administration**

This is to advise you that the Human Research Ethics Committee has approved the following:

PROJECT TITLE:	Perceptions and user experience study on the use of a mobile voting smartphone app within the Australian context
APPROVAL No.:	HE18-091
COMMENCEMENT DATE:	28 May, 2018
APPROVAL VALID TO:	28 May, 2019
COMMENTS:	Nil. Conditions met in full

The Human Research Ethics Committee may grant approval for up to a maximum of three years. For approval periods greater than 12 months, researchers are required to submit an application for renewal at each twelve-month period. All researchers are required to submit a Final Report at the completion of their project. The Progress/Final Report Form is available at the following web address: http://www.une.edu.au/research/research-services/rdi/ethics/hre/hrec-forms

The NHMRC National Statement on Ethical Conduct in Research Involving Humans requires that researchers must report immediately to the Human Research Ethics Committee anything that might affect ethical acceptance of the protocol. This includes adverse reactions of participants, proposed changes in the protocol, and any other unforeseen events that might affect the continued ethical acceptability of the project.

In issuing this approval number, it is required that all data and consent forms are stored in a secure location for a minimum period of five years. These documents may be required for compliance audit processes during that time. If the location at which data and documentation are retained is changed within that five year period, the Research Ethics Officer should be advised of the new location.

[redacted]

Jo-Ann Sozou
Secretary/Research Ethics Officer

28/05/2018 A18/51

2. Mobile Voting Website Screenshot

3. Mobile Voting Research Update Sample

Mobile Voting Update | Issue 1 | February 2015
Public campaign launched and call for support

View this email in your browser

Forward | Share | Tweet | +1 | Share

Issue 1 | February 2015

Mobile Voting Update

Welcome

Dear <<First Name>>,

Welcome to the inaugural edition of Mobile Voting News.

This monthly newsletter will be used to keep you up to date with the research currently being undertaken at the University of New England with relation to the viability of utilising an on-line mobile voting platform for Australian Elections.

With this research we intend to provide a vulnerability analysis that will identify challenges found throughout the research with implementing a mobile voting platform in Australia, as well as how to address these challenges successfully.

Public Campaign Launched

With the launch of our public awareness campaign last month, we have opened a fantastic channel in

We need your support

Using this public awareness campaign we intend to get the word out. But we need your help, we need to build our

4. Mobile Voting Survey Press Release

IT'S TIME AUSTRALIA…TIME TO HAVE YOUR SAY ON THE FUTURE OF MOBILE

March 2014

Researchers at the University of New England are giving everyday Australians an opportunity to have a say on the future of mobile e-voting.

University of New England PhD Candidate, Phillip Zada, recently launched Mobile Voting as a public awareness campaign to identify and address the possibility of implementing a successful mobile internet e-voting platform for Australian elections.

Mr Zada said the research team had tremendous success with the launch of the Mobile Voting campaign and are very excited about the next phase of the research.

"We have devised a quick 21-question survey that is available online and by post. The survey responses will enable our research team to set a baseline from which to continue our research.

"We believe this research to be an integral part of understanding what will be involved to introduce a mobile e-voting platform in Australia.

"And with the upcoming 2015 NSW General State Elections trial of the iVote system, we believe this is the best time to gauge the public's opinion of the technological concept," Mr Zada said.

Associate Professor Paul Kwan, research team member and Mr Zada's supervisor, said that while the technologies that can make mobile internet e-Voting a reality already exist, it is nonetheless critical to increase the public's awareness and gauge their perceptions for this alternate channel for voting to succeed.

The anonymous public survey is open from until 30 April 2015. To take part in the research simply visit https://mobilevoting.com.au/survey

Mr Zada is supervised in his research by UNE's Associate Professor Paul Kwan and Dr Greg Falzon. You can stay up to date on this project by visiting mobilevoting.com.au and signing up for updates.

You can also stay informed on the debate by following Mobile Voting on:

- Facebook (https://www.facebook.com/mobilevotingau),
- Twitter @MobileVotingAU

This project has been approved by the Human Research Ethics Committee of the University of New England. Approval No HE15-005, Valid to 13/03/2016.

5. Mobile Voting Public Survey

A.1 Information Sheet

The following is some information which needs to be read and understood prior to undertaking this survey.

I wish to invite you to participate in my research project, described below.
My name is Phillip Zada and I am conducting this research as part of my PhD in the School of Science and Technology at the University of New England. My supervisors are Dr Greg Falzon and A/Prof Paul Kwan.

Research Project
A vulnerability analysis on the adoption of mobile Internet e-Voting in Australia

Aim of the research
This project aims to identify the challenges that arise or are found to hinder the implementation of a mobile e-voting platform in Australia. This research utilises scholarly literature, past case studies and public surveys as sources of information and data for detailed analyses. Identified challenges will be addressed through a vulnerability analysis that will propose potential solutions.

Survey
As part of this research we will be conducting an anonymous survey to determine public perception, interests and concerns about mobile e-voting (using your mobile phone to cast a vote). The survey consists of 21 questions which you can complete either on line or via a supplied return post form. The survey will take approximately 15 minutes to complete and all responses obtained will be securely and anonymously stored on an electronic database.

Confidentiality
No personally identifiable information gathered in the course of the study and your identity will remain confidential. No individual will be identified by name in any publication of the results.

Participation is Voluntary
Please understand that your involvement in this study is voluntary and I respect your right to withdraw from the study at any time. You may discontinue the survey at any time without consequence and you do not need to provide any explanation if you decide not to participate or withdraw at any time.

Questions
The survey questions will not be of a sensitive nature: rather they are general or demographic in nature, aiming to enable you to enhance my knowledge of the issues associated with the implementation of mobile e-voting in Australia.

Use of information
I will use information from the survey as part of my doctoral thesis, which I expect to complete in August 2016. Information from the survey may also be used in journal articles and conference presentations before and after this date. At all times, I will safeguard your identity by presenting the information in way that will not allow you to be identified.

Upsetting issues
It is unlikely that this research will raise any personal or upsetting issues but if it does you may wish to contact Lifeline 13 11 14.

<u>Storage of Information</u>
Any electronic data collected during the survey will be kept on a password protected on line database. Only the research team will have access to the data.

<u>Disposal of information</u>
All the data collected in this research will be kept for a minimum of five years after successful submission of my thesis, after which it will be stored in a data curation service.

<u>Approval</u>
This project has been approved by the Human Research Ethics Committee of the University of New England, Approval No HE15-055 Valid to 13th March 2016.

<u>Contact Details</u>
Feel free to contact me with any questions about this research by email at pzada@une.edu.au. You may also contact my supervisors. My Principal supervisors name is Dr Greg Falzon and he can be contacted at gfalzon2@une.edu.au or 02 6773 2387 and my Co-supervisors name is A/Prof Paul Kwan and he can be at wkwan2@une.edu.au or 02 6773 2034.

<u>Complaints</u>
Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at:
Research Services
University of New England
Armidale, NSW 2351
Tel: (02) 6773 3449 Fax: (02) 6773 3543
Email: ethics@une.edu.au

<u>Consent</u>
- I have read the information contained in the Information Sheet for Participants and any questions I have asked have been answered to my satisfaction.
- I agree to participate in this activity, realising that I may withdraw at any time.
- I agree that research data gathered for the study may be published, and my identity will be unidentifiable due to the strict confidentiality explained in the information sheet.
- I am over 18 years of age.
- In preservation of anonymity, I understand that no name or signature is required of me to give consent. I understand that my completion of this survey implies my consent to participate in this research

A.2 Eligibility

1. To undertake this survey, you need to meet all these conditions:
   - 18 years or above
   - Of sound mind and body
   - An Australian Citizen, or a permanent resident registered to vote (as a British subject) prior to 1984
   - Do not have any relation to the research team

   0 = No
   1 = Yes

A.3 Demographics

2. What is your age group?
   1 = 18-24 years

2 = 25-34 years
3 = 35-44 years
4 = 45-54 years
5 = 55-64 years
6 = 65-74 years
7 = 75-84 years
8 = 85-94 years
9 = 95 year or above
0 = I'd prefer not to say

3. What is your gender?
1 = Female
2 = Male
0 = I'd prefer not to say

4. What is your approximate average income?
1 = $0-$24,999
2 = $25,000-$49,999
3 = $50,000-$74,999
4 = $75,000-$99,999
5 = $100,000-$124,999
6 = $125,000-$149,999
7 = $150,000-$174,999
8 = $175,000-$199,999
9 = $200,000 and up
0 = I'd prefer not to say

5. What best describes your current location?
1 = I currently live in a urban location
2 = I currently live in a rural or remote location
3 = I currently live outside Australia (International)
0 = I'd prefer not to say

6. What is your highest level of Education? *Either as an enrolled or graduated student.*
1 = Didn't attend school Home School
2 = Primary School
3 = Secondary School (High School)
4 = Tertiary education - TAFE
5 = Tertiary education - University

7. Are you considered to have a disability either physical or mental (lasting six months or more)?
1 = No
2 = Yes
0 = I'd prefer not to say

8. Are you blind or vision impaired?
1 = No
2 = Yes
0 = I'd prefer not to say

A.4 Connectivity

9. Do you have access to the internet?
0 = No
1 = Yes

10. Which type of internet connections do you have access to?
    1 = Home Dial-up
    2 = Home Broadband / NBN
    3 = Mobile Internet
    4 = Work Dial-Up
    5 = Work Broadband
    6 = Work, not sure what type of internet is being used
    7 = Home, not sure what type of internet is being used
    8 = Other (please specify)

11. Which of these devices do you currently own?
    1 = Mobile Phone – Not a smartphone
    2 = Smartphone
    3 = Tablet
    4 = PC or Laptop
    5 = Smart TV
    6 = Other (please specify)

12. Which online services have you used previously?
    1 = Online Banking
    2 = BPay, PayPal or other payment facilities
    3 = Social Media Sites (e.g. Facebook, Twitter, LinkedIn)
    4 = Online Shopping (e.g. eBay, Alibaba, Woolworths Online)
    5 = Voting Online for an Election
    6 = Sending/Receiving Email
    7 = Reading/Watching News

13. Rank in order of most used to least used device to access the internet. *If you don't use the device select N/A*
    1 = Mobile Phone (NOT a smartphone)
    2 = Smartphone
    3 = Tablet
    4 = PC or Laptop
    5 = Smart TV
    6 = Other Devices

A.5 Elections

14. Indicate what you LIKE about the current voting process. *Select one or more of the following options*
    1 = Ability to cast a vote anonymously
    2 = Ability to send my voice in via mail (postal voting)
    3 = Being able to catch up with friends at the voting station
    4 = Being able to discuss political policy with party volunteers
    5 = Getting help to cast a vote from a friend or family member
    6 = How to Vote information cards
    7 = Sausage Sizzle
    8 = Other (please specify)

15. Indicate what you DON'T LIKE about the current voting process. *Select one or more of the following options*
    1 = Travelling to the polling station
    2 = Having only one day to cast a vote physically
    3 = Size and time to fill in a ballot paper
    4 = Party volunteers providing how to vote cards

5 = Taking time out of my day to vote
6 = Compulsory Voting
7 = Lining up to vote / Time taken to cast a vote
8 = Security of ballot papers once cast
9 = Name and address available to voting officials when signing in
10 = Other (please specify)

A.6 Mobile Voting

16. Which properties of a mobile e-voting platform are of CONCERN to you? *Select one or more of the following options*

1 = Secrecy/Privacy of my vote. Being able to link my vote back to me
2 = Complexity of cast a vote
3 = The time it takes to cast a vote
4 = The colour scheme of the voting system
5 = Lack of Government Oversight of the system
6 = Lack of Independent Oversight of the system
7 = Being influenced to vote one way by someone other than an immediate family member
8 = Being influenced to vote one way by a immediate family member
9 = Hackers, Malware or Virus monitoring my vote
10 = Hackers, Malware or Virus changing my vote
11 = Hackers, Malware or Virus being able to retrieve my vote
12 = Users of the system having the ability to sell their votes
13 = System built and maintained by a contracted commercial company
14 = The voting system not being 100% compatible with my device
15 = Other (please specify)

17. Which properties of a mobile e-voting platform are APPEALING to you? *Select one or more of the following options*

1 = Able to cast a vote from anywhere online
2 = Getting a receipt confirming vote was cast
3 = Being able to confirm cast vote is counted as cast
4 = Speed to cast a ballot
5 = Speed to obtain election result count after polls are closed
6 = Being able to phone in my vote to a computer system
7 = Being able to SMS my vote
8 = Being able to cast a vote with multiple language support
9 = Being able to see party policies information prior to casting a vote
10 = Being able to share my preferred vote (via social media sites)
11 = Being able to change my vote, prior to polls closing
12 = Being able to attend a polling station to cast my vote that overrides my online vote
13 = Voting system being thoroughly tested prior to an election by independent bodies
14 = Having an online tutorial to help understand how to cast a vote
15 = The voting system used to complement not replace the current system
16 = Other (please specify)

18. From past experiences using secured online systems, both government and commercial.

How would you best rate your trust of these system? *Examples of these systems are Online Banking systems or Welfare and Human Services systems*s

1 = Completely Distrust
2 = Slightly Distrust
3 = Neither Distrust nor Trust
4 = Slightly Trust

5 = Completely Trust

19. If a mobile e-voting platform was made available during the next election, would you use it to cast your vote?
    0 = No
    1 = Not sure, more information would be required
    2 = Yes

20. Rank your preference on how you would cast your vote, if a mobile e-voting platform was made available during the next election.
    1 = Use my smartphone or tablet to vote using an app
    2 = Telephone - Call into a digital touch tone service (similar to telephone banking)
    3 = Paper vote in a polling place
    4 = Send an SMS with my vote
    5 = Use my own connected device to cast a voting on a website - such as PC or Laptop
    6 = Use a computer setup at a polling place that is owned and maintained by the Electoral Commission to cast a voting on a website

A.7 Feedback

21. If you have anything else you would like to add, or any other comments please do so below. As this is an anonymous please do not add any identifiable information otherwise the survey response will be deemed invalid.

6. Mobile Voting Public Interview Press Release

UNE MEDIA RELEASE

UNIVERSITY OF NEW ENGLAND, ARMIDALE, NSW, AUSTRALIA

Vote "1" for online ballots

5 June 2018

With five by-elections, a Federal Government and a NSW Government election looming, Australians will potentially be going to the polls multiple times in coming months. That means driving to a crowded polling station, securing a park, running the gauntlet of the paper-thrusting electioneers, and then queuing to exercise your democratic right in a cardboard cubicle.

Four years ago, after experiencing just such a scenario with an impatient toddler in tow, University of New England (UNE) researcher Phillip Zada deemed there had to be a better way. Now the PhD-I candidate and software developer thinks he's developed it - a mobile voting app that offers Australians the convenience of casting their ballot on a smartphone or tablet.

"Mobile technology is increasingly a part of our daily lives," said Phillip. "Most people have no problem doing their banking on mobile phones these days, so why not voting? I'm not advocating we replace the current paper-based system, but to supplement it to save time and resources."

Digital voting platforms are being developed and trialled all around the world. The NSW Electoral Commission gave people (with poor vision, literacy needs, a disability, 20 kilometres distant from a polling place or keen to lodge a pre-postal ballot) the chance to vote online during the last NSW Government election using iVote. Some 250,000 people took up the option.

Phillip, whose app is tailor-made for Australia, said voter support is not the impediment. A survey he conducted in 2015 found that 75% of respondents were in favour of online voting and would use it if it became available. They cited mobility, verifiability and speed as its main advantages. Opponents were concerned mainly about malicious parties tampering with votes and manipulating an election outcome.

But even in the face of the Australian census debacle, alleged Russian interference in the US elections and, more recently, the Cambridge Analytica Facebook privacy scandal, Phillip said he is confident that his prototype is secure, anonymous and efficient.

"It's inevitable that we will adopt online voting, it's just a question of when and how," he said. "If there are security fears, let's address them, rather than bury our heads in the sand. Let's mitigate against the risks. My platform has three levels of security and a means of verifying the vote cast. The biggest obstacle to its introduction is not security but the lack of political will.

"I would at least like to give Australian voters the choice between online and traditional voting. It could greatly reduce the environmental and financial costs of an election. It may also encourage people to make more informed choices because my app features an option to bring up information on the person, the party and their policies before you vote."

An added bonus, Phillip said, is that the platform could be used for national surveys or consultation. "I can see people using this app or a similar app in future to comment on legislation being debated, and to broaden the input that people have into our democratic processes," he said.

The next stage of Phillip's research is to conduct interviews to trial the app during a simulated online election and gather feedback. He said the PhD-I has allowed him to combine industry knowledge and practices with academia, enabling him to test his ideas and findings as the research unfolds.

"The PhD-I bridges the gap between academia and the business world," he said. "I'm using proven academic principles to implement some real solutions while still working in the industry."

ENDS

7. In-depth Interview Information Sheet

une
University of New England

School of Science and Technology
University of New England
Armidale NSW 2351
Australia
Phone 02 6773 4209

csisson@une.edu.au

http://www.une.edu.au/about-une/academic-schools/school-of-science-and-technology

INFORMATION SHEET

for

PARTICIPANTS

I wish to invite you to participate in my research project, described below.

My name is Phillip Zada and I am conducting this research as part of my PhD (Innovation) in the School of Science and Technology at the University of New England. My supervisors are Dr Greg Falzon, Prof Paul Kwan and Mr Ian Brightwell.

Research Project	**PERCEPTIONS AND USER EXPERIENCE STUDY ON THE USE OF A MOBILE VOTING SMARTPHONE APP WITHIN THE AUSTRALIAN CONTEXT**
Aim of the research	This project aims to identify the challenges that arise or are found to hinder the implementation of a mobile e-voting platform in Australia. This research utilises scholarly literature, past case studies and public surveys as sources of information and data for detailed analyses. Identified challenges will be addressed through a vulnerability analysis that will propose potential solutions.
Interviews	As part of this research, we will be conducting one-on-one interviews to collect data on, and determine, the usage of a mobile voting app. The process will require you to use your own personal smartphone (or we can provide a loan unit). You will be asked various questions throughout the interview, which should take approximately 30 minutes to an hour. No personally identifiable data is collected during the interview. The interview will be recorded for later transcription and use by the team. Recordings will be kept confidential and not made public.
Confidentiality	No personally identifiable information will be gathered during the study and your identity will remain confidential. No

	individual will be identified by name in any publication of the results.
Participation is Voluntary	Please understand that your involvement in this study is voluntary and I respect your right to withdraw from the study at any time. You may discontinue the interview at any time without consequence and you do not need to provide any explanation if you decide not to participate or withdraw at any time.
Questions	The interview questions will not be of a sensitive nature: rather they are general or demographic in nature, aiming to enable you to enhance my knowledge on your perceptions of using the Mobile Voting App.
Use of information	I will use information from the interview as part of my portfolio, which I expect to complete in June 2018. Information from the interview may also be used in journal articles and conference presentations before and after this date. At all times, I will safeguard your identity by presenting the information in way that will not allow you to be identified.
Upsetting issues	It is unlikely that this research will raise any personal or upsetting issues but if it does you may wish to contact your local Community Health Centre or Lifeline on 13 11 14.
Storage of information	Any electronic data collected during the interview will be kept on a password protected on line database. Any hardcopy data collected will be kept in secured filing cabinets. Only the research team will have access to the data.
Disposal of information	All the data collected in this research will be kept for a minimum of five years after successful submission of my thesis, after which it will be disposed of.
Approval	This project has been approved by the Human Research Ethics Committee of the University of New England (Approval No HE18-091, Valid 28/05/2018 to 28/05/2019).
Contact details	Feel free to contact me with any questions about this research by email at pzada@une.edu.au by phone on 03 8376 6238. You may also contact my supervisors. My Principal supervisors name is Dr Greg Falzon and he can be contacted at gfalzon2@une.edu.au or 02 6773 2387 and my Co-supervisors names are Prof Paul Kwan and he can be at wkwan2@une.edu.au or 02 6773 2034 and Ian Brightwell and he can be at i.brightwell@unsw.edu.au.

Complaints	Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at: Research Services University of New England Armidale, NSW 2351 Tel: (02) 6773 3449 Fax: (02) 6773 3543 Email: ethics@une.edu.au Thank you for considering this request and I look forward to further contact with you. Regards Phillip Zada

8. In-depth Interview Consent Form

CONSENT FORM
for
PARTICIPANTS

Research Project: PERCEPTIONS AND USER EXPERIENCE STUDY ON THE USE OF A MOBILE VOTING SMARTPHONE APP WITHIN THE AUSTRALIAN CONTEXT.

I have read the information contained in the Information Sheet for Participants and any questions I have asked, have been answered to my satisfaction.

Yes/No

I agree to participate in this activity, realising that I may withdraw at any time.

Yes/No

I agree that research data gathered for the study may be quoted and published using a pseudonym.

Yes/No

I agree to having my interview audio recorded and transcribed.

Yes/No

I am older than 18 years of age.

Yes/No

………………………………..	……………………………
Researcher	Date
………………………………..	……………………………
Participant	Date

9. In-depth Interview Mock Registration Letter

THIS IS NOT AN OFFICIAL LETTER AND IS ONLY TO BE USED AS PART OF THE MOBILE VOTING RESEARCH INTERVIEW

HE18-091

Welcome to the Mobile Voting Experience

Thank you for registering to the use the Mobile Voting Mobile App. Once you have downloaded the app from the Apple App Store or Google Play, please use the following eVoting Number to register.

IMPORTANT INFORMATION

- **The number can only be used on a SINGLE DEVICE ONLY.**
- **KEEP PRIVATE AND DO NOT share this number with anyone. Electoral Officials are not permitted to ask for this number.**

Your eVoting Number is: **XXXX-XXXX-XXXX-XXXX**

SOME TIPS

- You may cast a vote as many times as you wish using the app, only the latest entry will be counted.
- During an Election, if you cast a vote using the App and then cast a vote at a polling station, the votes cast on the App are discarded.
- Your vote can be deleted from your device after it is cast, but it will remain with the voting office.
- For more information please visit https://mobilevoting.com.au/tips

mobile voting

une University of New England

THIS IS NOT AN OFFICIAL LETTER AND IS ONLY TO BE USED AS PART OF THE MOBILE VOTING RESEARCH INTERVIEW

HE18-091

Welcome to the Mobile Voting Experience

Thank you for registering to the use the Mobile Voting Mobile App. Once you have downloaded the app from the Apple App Store or Google Play, please use the following eVoting Number to register.

IMPORTANT INFORMATION

- The number can only be used on a **SINGLE DEVICE ONLY.**
- **KEEP PRIVATE AND DO NOT** share this number with anyone. Electoral Officials are not permitted to ask for this number.

Your eVoting Number is:

SOME TIPS

- You may cast a vote as many times as you wish using the app, only the latest entry will be counted.
- During an Election, if you cast a vote using the App and then cast a vote at a polling station, the votes cast on the App are discarded.
- Your vote can be deleted from your device after it is cast, but it will remain with the voting office.
- For more information please visit https://mobilevoting.com.au/tips

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THIS IS NOT AN OFFICIAL LETTER AND IS ONLY TO BE USED AS PART OF THE MOBILE VOTING RESEARCH INTERVIEW

HE18-091

Welcome to the Mobile Voting Experience

Thank you for registering to the use the Mobile Voting Mobile App. Once you have downloaded the app from the Apple App Store or Google Play, please use the following eVoting Number to register.

IMPORTANT INFORMATION

- The number can only be used on a **SINGLE DEVICE ONLY.**
- **KEEP PRIVATE AND DO NOT** share this number with anyone. Electoral Officials are not permitted to ask for this number.

Your eVoting Number is: **3197-0485-5577-9661**

SOME TIPS

- You may cast a vote as many times as you wish using the app, only the latest entry will be counted.
- During an Election, if you cast a vote using the App and then cast a vote at a polling station, the votes cast on the App are discarded.
- Your vote can be deleted from your device after it is cast, but it will remain with the voting office.
- For more information please visit https://mobilevoting.com.au/tips

10. Interviewee Feedback

Participant 1

Demographics

Age Group	25-34 years		**Education**	Tertiary Education – University
Gender Identity	Female		**Physical or Mental Disability**	No
Location	Urban Location		**Blind or Vision Impaired**	No
Device Used	Samsung S8			
Device Confidence	I’m an Expert		**Device Ownership**	Interviewee
			Use Online Voting before	No
Scenario Order	A, B			

Scenario Feedback

Registration Process		Usefulness	Difficulty
A	Surprised that the two-factor authentication was optional and not a requirement. Compared with myGov, which always has two-factor authentication enabled. Could potentially use myGov being a federal government service. Like that two-factor wasn't a requirement, didn't like the display name was an option. It was a simple registration process. **Questions / Comments:** • Do I need to enter the dashes as presented in the registration letter for my e-Voting number? • Can't you only register 1 user per device?	Very Useful	Very Easy
B	Felt more secure than first scenario, even though two-factor authentication wasn't offered. I liked that I had to re-enter my password and didn't like that two-factory authentication wasn't offered. Overall it was a very simple process. **Questions / Comments:** • The device should warn if the same display name is used at registration	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee was pleased with the two-factor authentication being optional in **A** but didn't like the fact that there was no option for two-factor authentication in **B.** During the registration the interviewee entered the same display name for both times, this presented an issue when logging in as the interviewee was unsure which registration belonged to which e-Voting number.			

House of Representatives Ballot		Usefulness	Difficulty
A	Dropdown list was confusing, remembering the numbers that have been previously chosen in the drop down was challenging. Liked that I was able to submit an empty, didn't like the dropdown list, preferred typing. **Questions / Comments:** • N/A	Very Useful	Easy
B	Love it, much easier process. The preference selection was much better. Using the same selection mode to remove and change the preferences was better. Liked it was really easy, nothing I didn't like. **Questions / Comments:** • N/A	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee appeared frustrated with the dropdown selection method in **A** however was excited when one-click selection was made available via **B**.			

Senate Ballot		**Usefulness**	**Difficulty**
A	The mode selection didn't look like buttons or choice, needed some indication to show I need to make a selection. The instructions were good, and the instructions made it simple on how to vote. **Questions / Comments:** • Would be interesting to see what it would look like with 112 options as per the current senate ballot paper	Very Useful	Easy
B	I used below the line as this scenario provided a much easier mechanism to select preferences. I like the candidate selection process and didn't not like anything. **Questions / Comments:** • As before, would be interesting to see what it would look like with 112 options as per the current senate ballot paper	Very Useful	Very Easy
Interviewer Comments and Observations: Second time submitting a ballot the interviewee appeared more comfortable with the selection mode in **A.** Though the interviewee did comment on the mode selection (above the line/below the line) not being clear it was "selectable" (which contained instructions on the page), the interviewee was able to explore and figure it out. As with **B** the interviewee knew after figuring it out during **A** how to select a senate mode.			

<table>
<tr><th colspan="2">Submission</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>Confused why I need to reauthenticate when I’m already logged in. The two-button submission was quick and simple. I didn’t like that I had to reauthenticate. The submission process is still faster than walking into a polling place and cast a paper vote.

Questions / Comments:
• What would happen if I vote using the app and still enter the polling place and submit a paper ballot?</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td>B</td><td>Same as scenario A, nothing additional, it was very easy. Though I did feel the need to screenshot the receipt number and felt strange re-entering my password as with scenario A

Questions / Comments:
• N/A</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
N/A</td></tr>
</table>

<table>
<tr><th colspan="2">Overall</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>Doesn’t feel like a government app, which can influence whether I trust the app or not. I liked that it was really quick and simple and did exactly what I needed it to do without too much hassle. I didn’t like the drop-down selection for candidate preference. The information button was good which allows me to see candidate information.

Questions / Comments:
• Validating is useful, so you know that you’ve done it
• Too easy to recast and validate, need indication that you have already cast a vote</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td>B</td><td>It replicated the paper vote, though I’d prefer this scenario more so than scenario A due to candidate selection. It was a very easy process

Questions / Comments:
• N/A</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
Upon recasting the vote (in A) the interviewee discovered the candidate information icon button which provided information about the candidate, their party and they key policies. The interviewee was pleased with this feature.</td></tr>
</table>

Post Scenario		Usefulness	Difficulty
A	**Recast Vote:** Yes	Useful	Very Easy
	Validate Vote: Yes		
	Would you use the app if it were made available during the next election? Yes, normally I postal vote as it is an inconvenience for me to be available to vote at a polling station		
B	**Recast Vote:** Yes	Useful	Very Easy
	Validate Vote: Yes		
	Would you use the app if it were made available during the next election? Yes, easy than applying for postal vote		
Preferred Scenario: B, much simpler to use			
Final Comments: This would work well with people using smart devices, however there are people who would not be comfortable using it online			

Survey	**Usefulness**	**Difficulty**
It was good survey. It was easy to cast a response; however, I didn't like that I had the ability to recast repeatedly. It also didn't feel very official.	Very Useful	Very Easy
Would you use this app for the next national survey? Yes		

Interviewee Final Comments

- When you update the user profile, it sends you to a useless page that you need to close. I suggest you replace it with a message that appears and disappears.
- The application lacks an official feel, this will affect the trust factor of the application. You might need to involve an official body like the Australian Electoral Commission.

General Observations

- The interviewee shared that they usually vote via postal voting due to the inconvenience of voting on election day at the polling place.
- When the interviewee overcame a challenge, such as the select list selection or the one-click preference mode selection, after experiencing it once and figuring it out, the interviewee was able to continue usage of the application and successfully submit a ballot without assistance. The time taken to complete the ballot was also significantly quicker as more time was spent on the application.
- During the interview, questions were raised about the voting process, such as casting a paper-based vote and online vote, once the voting protocol was explained the interviewee felt more comfortable about the process.

Participant 2

Demographics

Age Group	25-34 years		**Education**	Tertiary Education – University
Gender Identity	Male		**Physical or Mental Disability**	No
Location	Urban Location		**Blind or Vision Impaired**	No
Device Used	Samsung S8			
Device Confidence	Somewhat confident		**Device Ownership**	Interviewee
			Use Online Voting before	No
Scenario Order	A, B			

Scenario Feedback

Registration Process		**Usefulness**	**Difficulty**
A	Conveyed the letter was simple and easy to follow. Registration process wasn't annoying compared to other experiences. Confirmed Fingerprint two-factor authentication made them feel the app was more secure. **Questions / Comments:** N/A	Very Useful	Easy
B	This was straight forward and easier to follow, less things to read on screen so it was more efficient. **Questions / Comments:** • Do I need to enter the dashes in the registration letter?	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee mentioned that the two-factor authentication alleviated security concern. The registration letter got high praise due to its simplistic and easy to follow registration instructions. During the registration the interviewee entered the same display name for both times, this presented an issue when logging in as the interviewee was unsure which registration belonged to which e-Voting number. Question about the dashes was asked during the second scenario as opposed to the first as with other interviewees.			

House of Representatives Ballot		Usefulness	Difficulty
A	The ballot had the same look and feel as the polling place, with the added benefit of not having to waste time travelling. It wasn't a complicated process, however would prefer a different candidate selection method. **Questions / Comments:** N/A	Very Useful	Very Easy
B	A better experience than the first scenario. The one-click selection mechanism was preferred and there was nothing that was disliked. **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee was impartial to the **A** select list selection method, when presented the **B** one-click scenario found the process much simpler and smoother. Comparisons were made amongst the look and feel of the electronic version vs the paper ballot which could have resulted in recognition of what needed to be done.			

Senate Ballot		Usefulness	Difficulty
A	Same experience as with the House of Representatives Ballot experience **Questions / Comments:** N/A	Very Useful	Very Easy
B	Same experience as with the House of Representatives Ballot experience **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: Though there wasn't any notable there is a correlation with time experienced with the app and the difficulty. In the House of Representatives ballot it was rated as easy whereas the senate ballot (second time completing a ballot) was rated very easy.			

Submission		Usefulness	Difficulty
A	The ability to confirm and cater for change of mind prior to submission as opposed to paper ballot was mentioned. This method of casting can prevent tampering, scribbling or incomplete ballot submission. Re-authentication prior to submission was liked as a security mechanism **Questions / Comments:** N/A	Very Useful	Very Easy
B	Same as scenario A, nothing additional, it was very easy. **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: N/A			

<table>
<tr><th colspan="2">Overall</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>The two-factor security features were good. The app guides you through what needs to be done. It was a lot easier than first thought, as the preconception was it would have been a lot harder to complete a vote.

Questions / Comments: N/A</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td>B</td><td>It felt less secure, but it did offer a password and unique e-Voting number which was ok. The registration letter is secured (with the scratch panel), can’t be hacked and was very informative.

Questions / Comments: N/A</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
Interviewees perceptions that either scenario provided enough security safeguards, though scenario B was mentioned as less secured it was still self-justified as being adequate.</td></tr>
</table>

<table>
<tr><th colspan="2">Post Scenario</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td rowspan="3">A</td><td>Recast Vote: No</td><td rowspan="3">Very Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
Looks like it’s safe to use, easier then travelling into the polling booth and taking a lot of time. As opposed to using the app with would take less than 3 minutes to complete.</td></tr>
<tr><td rowspan="3">B</td><td>Recast Vote: Yes</td><td rowspan="3">Very Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
Yes, very easy to use, think it is safe enough and has securities in place. Makes life easier</td></tr>
<tr><td colspan="4">Preferred Scenario: B, easier to use selection mechanism</td></tr>
<tr><td colspan="4">Final Comments: N/A</td></tr>
</table>

Survey	**Usefulness**	**Difficulty**
Not having to waiting for the letter is a bonus. Having the ability to open the app and response earlier is preferred	Very Useful	Very Easy
Would you use this app for the next national survey? Yes		

Interviewee Final Comments

- Support page is good, I can email or chat with someone if I need help
- Like the fact that I can change my password and security options without having to re-register

General Observations

- The interviewee shared time taking to travel and cast their vote was a deterministic factor
- Security mechanisms were adequate to the interviewee, but as long as they were present there wasn't concern about app security
- As the interviewee experienced more of the app, they appeared more confident on what needed to be done and how to navigate the app.

Participant 3

Demographics

Age Group	35-44 years		**Education**	Tertiary Education – University
Gender Identity	Male		**Physical or Mental Disability**	No
Location	Urban Location		**Blind or Vision Impaired**	No
Device Used	OnePlus 3			
Device Confidence	I’m an Expert		**Device Ownership**	Interviewee
			Use Online Voting before	No
Scenario Order	B, A			

Scenario Feedback

<table>
<tr><th colspan="2">Registration Process</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>It was quite hard to read the e-Voting numbers and letters and distinguishing between a zero and the letter O. It shouldn’t be case sensitive and enter the dashes for me. It was more assuring that there was extra two-factor authentication. Surprised it wasn’t available in the first scenario, I don’t think it should be optional but rather a requirement

Questions / Comments:
• Felt a little complicated</td><td>Useful</td><td>Neither Very Easy or Very Hard</td></tr>
<tr><td>B</td><td>Felt insecure and the e-Voting number feels disconnected from me. Anyone who has this number can use it to vote as me. The process felt simple and intuitive.

Questions / Comments:
• How is my e-Voting number connected with the polling place vote</td><td>Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
Interviewee was questioning how and e-Voting number links to their profile and seemed more curious about the technical aspect rather than the process. Interviewee preferred a more forced secured mechanism (two-factor) from scenario A.</td></tr>
</table>

House of Representatives Ballot		Usefulness	Difficulty
A	The candidate selection process was quite cumbersome. Though it allowed me to assign a preference to a candidate at the position I want, I would have assigned in order anyway as per the last scenario. I had to review my preferences multiple times to make sure it was correct. **Questions / Comments:** N/A	Useful	Neither Very Easy or Very Hard
B	An easy and simple process. Didn't really research about candidates, if this were a real scenario I would want to know more about the candidates. **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: Given this was the interviewee's first interaction with an Australian Ballot, he was able to complete a ballot with little instruction.			

Senate Ballot		Usefulness	Difficulty
A	Was the same as the previous ballot, it followed the same pattern and there was nothing new. **Questions / Comments:** N/A	Very Useful	Easy
B	Was the same as the previous ballot, it followed the same pattern and there was nothing new. **Questions / Comments:** N/A	Useful	Very Easy
Interviewer Comments and Observations: As the interviewee was experience at filling in a ballot was able to do so with ease.			

Submission		Usefulness	Difficulty
A	The submission process is ok. Would have liked to copy the receipt number and/or the ability to send it to myself via email. **Questions / Comments:** N/A	Very Useful	Easy
B	Might have taken me longer in the real world as I would have wanted to research the candidates, potentially a few days. Like the ability to recast but would prefer to save partially complete ballot and have the ability resume. Submission was simple and like how it re-authenticated prior to submission. **Questions / Comments:** N/A	Useful	Easy
Interviewer Comments and Observations: Interviewee notability preferred the more secure mechanism of **B.** By this point the user seemed more confident in using the app.			

<table>
<tr><th colspan="2">Overall</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>Process was short and quick, not much to think about. I did not like the select list preference selection feature.

Questions / Comments: N/A</td><td>Useful</td><td>Easy</td></tr>
<tr><td>B</td><td>Liked that is on my Smartphone device and I can vote from anywhere. This is a very useful application, but I do have concerns about security. Would like to research about the app and how it is protected.

Questions / Comments: N/A</td><td>Very Useful</td><td>Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
The interviewee was comments suggest they are more technologically savvy and would like to know the technical aspects about the application.</td></tr>
</table>

<table>
<tr><th colspan="2">Post Scenario</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td rowspan="3">A</td><td>Recast Vote: No</td><td rowspan="3">Very Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
As before - No, want to try the polling place first. Maybe during the one after that</td></tr>
<tr><td rowspan="3">B</td><td>Recast Vote: No</td><td rowspan="3">Neither Useful or Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: No</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
No, want to try the polling place first. Maybe during the one after that</td></tr>
<tr><td colspan="4">Preferred Scenario: B, more intuitive and the one-click preference selection mechanism was what I’d prefer</td></tr>
<tr><td colspan="4">Final Comments: Upon resubmission, would like it to be more transparent and show that you have previously submitted a vote, with the ability to edit the preferences.</td></tr>
</table>

Survey	**Usefulness**	**Difficulty**
It was simple, and I wasn't required to reregister. If I had to reregister it would have made it more complicated.	Useful	Very Easy
Would you use this app for the next national survey? Yes		

Interviewee Final Comments

- N/A

General Observations

- The interviewee shared that he had not voted in and Australian election before. Although he was new to process, he was able to figure it out with little assistance. This was assisted by his ability to identify with the various visual cues (prompts, messages) and what to do to continue.
- This interviewee seemed focused on how the technology works and the technical aspect.

Participant 4

Demographics

Age Group:	25-34 years		**Education:**	Tertiary Education – University
Gender Identity:	Male		**Physical or Mental Disability:**	No
Location:	Urban Location		**Blind or Vision Impaired:**	No
Device Used:	Samsung S7 Edge			
Device Confidence:	Somewhat unsure		**Device Ownership:**	***Interviewer***
			Use Online Voting before:	No
Scenario Order	A, B			

Scenario Feedback

<table>
<tr><th colspan="2">Registration Process</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>Got a bit confused about the dashes. Was able to figure it after three attempts.

Questions / Comments:
• Do I need to use SMS or Fingerprint?</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td>B</td><td>A lot easier than the first one (A) as it the e-Voting number was numeric.

Questions / Comments:
• When the page is initially presented it should show the error messages (e.g. the missing fields) before you click the button.</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
Interviewee got stuck with e-Voting number dashes and whether to use it or not. When using the app the second time around to register in mode (B), this wasn’t an issue and the user seemed more comfortable.</td></tr>
</table>

House of Representatives Ballot		Usefulness	Difficulty
A	Quite good, it was easy to use, and I could easily see which party I was voting for. I thought the validation was really good as it prevented me from setting the same preference twice. I also liked how I got a notification that the ballot was completed. **Questions / Comments:** • N/A	Very Useful	Very Easy
B	Easier to use compared to the first one (**A**). Wasn't sure that the number would display, but once I got into the rhythm of it, I found it easy. **Questions / Comments:** • If I need to change the preference, I didn't know how to do it.	Very Useful	Easy
Interviewer Comments and Observations: Interviewee showed more confidence in selecting the preference during the second run (**B**). Even though he got stuck trying to unset a preference, he was able to figure it out after a few seconds.			

Senate Ballot		Usefulness	Difficulty
A	Wasn't clear what I needed to press to make a selection. I didn't like the select list preference selection as there was a big list of numbers to choose. The validation and informed completion were a positive experience. **Questions / Comments:** N/A	Very Useful	Very Easy
B	Same as the first, however I knew how to select groups. I was also used to how to reverse a selection. **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: By this stage the interviewee was used to using the app and showed confidence. They were able to complete a Senate ballot (which is bigger than a House of Reps ballot) in a relatively shorter time in both circumstances. The interviewee reiterated their preference to the one-click selection mode (**B**).			

<table>
<tr><th colspan="2">Submission</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>Clear that the submission was completed, and the prompt showed this. I had to figure out where to check the receipt. It didn’t have a timestamp, so I wasn’t sure when it was submitted.

Questions / Comments:
Needs some improvements to show when the last vote was cast (timestamp)</td><td>Useful</td><td>Neither Easy or Difficult</td></tr>
<tr><td>B</td><td>Same as scenario A, gave me a receipt number which is good. Able to go back and see the history of the receipts and the ability to delete the receipt if I’d made a mistake. If would have also been good to get a confirmation that the vote had been deleted.

Questions / Comments: N/A</td><td>Useful</td><td>Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
When using the app in scenario B, the user knew where to see the receipt and experimented with vote deletion. I explained after scenario B, the concepts of deleting a vote and how to fix an incorrect ballot you would need to submit another vote.</td></tr>
</table>

Overall		**Usefulness**	**Difficulty**
A	Didn’t know what else to do with the app so just signed out, it was simple to do. **Questions / Comments:** • Didn’t know what to do next, some information would have been helpful • Happy with it, maybe it was my first experience, not sure if it would get easier for more use	Useful	Easy
B	I don’t understand why I have to re authenticate if already logged in during submission. It was too easy to delete votes and would have liked to see a timestamp when I voted and keep deleted votes on the phone. **Questions / Comments:** • Happy with this scenario, prefer over scenario **B**	Useful	Easy
Interviewer Comments and Observations: Though the concept of deletion was explained, it was still questioned. It was interesting that the user liked the additional security mechanisms by questioned reauthentication during submission.			

<table>
<tr><th colspan="2">Post Scenario</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td rowspan="3">A</td><td>Recast Vote: Yes</td><td rowspan="3">Useful</td><td rowspan="3">Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
No, I have reservations about using it, particularly about the voting and voting multiple times, need further education. I need to know if it is a supported by governance bodies to confirm legitimacy.</td></tr>
<tr><td rowspan="3">B</td><td>Recast Vote: Yes</td><td rowspan="3">Very Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
No, same as previous. It would be good to see some sort of extra guidance or step by step training,</td></tr>
<tr><td colspan="4">Preferred Scenario: B, registration was easy, e-Voting number is numbers only, one-click preference selection was quite good</td></tr>
<tr><td colspan="4">Final Comments: If this was a formal app declaration stating truth about submission would be preferred. Also help or tutorial would be good.</td></tr>
</table>

Survey	**Usefulness**	**Difficulty**
Easy to use and the questionnaire was straight forward. I was confused about being allowed to enter responses multiple times and why I would need to do that.	Very Useful	Very Easy
Would you use this app for the next national survey? Yes		

Interviewee Final Comments

- The app would need government support and backing before I would use it in a real election
- Additional training material or walk-through guide would also be good

General Observations

- The interviewee, however, was able to use the application without much assistance; they were more concerned about government body support and control of the app.

- There were also multiple occasions where I needed to explain some concepts of mobile voting and why certain functionality exists (delete votes, multicasting). These concerns could be addressed in a FAQ or companion introduction video.
- Although the interviewee found the app easy and useful, he said he would use the app based on experience and lack of government control, that threw me. Though the TAM model doesn’t consider these influences directly, the UTAUT does cater for these constructs and variables.

Participant 5

Demographics

Age Group	25-34 years		**Education**	Tertiary education - TAFE
Gender Identity	Female		**Physical or Mental Disability**	No
Location	Urban Location		**Blind or Vision Impaired**	No
Device Used	Samsung S9 Plus		**Device Ownership**	Interviewee
Device Confidence	Somewhat confident		**Use Online Voting before**	No
Scenario Order	B, A			

Scenario Feedback

Registration Process		Usefulness	Difficulty
A	I liked how this scenario added extra security questions. I'd chosen fingerprint has that is what I use for everything else. Being able to enable fingerprint authentication felt more secure and it gave it as an option, so I wasn't forced to use it. **Questions / Comments:** N/A	Very Useful	Very Easy
B	It was easy, I was able to enter the e-Voting number to register, link it to my phone and that's it. There were no extra reading instructions. **Questions / Comments:** • The device should warn if the same display name is used at registration	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee was preferential towards the additional security mechanism of **A.** It was observed that the interviewee was able to enter the e-Voting number more easily when it was just numbers in **B**, and repeatedly confirmed their e-Voting number before submitting when in **A**.			

House of Representatives Ballot		**Usefulness**	**Difficulty**
A	Was good, but I lost track where I was up to in the preferences. The positive thing is you can go through the preferences sequentially and choose your preference directly. **Questions / Comments:** • I had to check a couple of times to see what number I was up to. • If it could hide/disable the available preference numbers in the select list that would be good so not to confuse what has been selected.	Useful	Easy
B	One-click process was simpler than writing the number yourself. **Questions / Comments:** • The numbering process was really good, easy and simple.	Very Useful	Very Easy
Interviewer Comments and Observations: Interviewee took a greater amount of time completing scenario **A.** Though the user had already submitted a ballot at this point, it appears the dropdown list was a slight impediment.			

Senate Ballot		**Usefulness**	**Difficulty**
A	Same as the first time. However, this time I found the candidate information tab which was good. **Questions / Comments:** • The candidate information table was great to retrieve information about who I was voting for.	Very Useful	Very Easy
B	It was good, I personally don't understand the concept of above the line or below the line. **Questions / Comments:** • App was good, I just don't understand the voting process	Very Useful	Very Easy
Interviewer Comments and Observations: It was at this point that the interviewee revealed that she had not voted at an Australian election. I explained the above the line and below the line concept after the second run through (**A**).			

<table>
<tr><th colspan="2">Submission</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td>A</td><td>As other scenario, easy and allowed for reauthentication

Questions / Comments: N/A</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td>B</td><td>Real easy, it talks you through what you need to do and was easy to submit

Questions / Comments:
I really liked the fact that I was asked to re-input my password. This would stop someone for submitting a vote if I’d put the phone down.</td><td>Very Useful</td><td>Very Easy</td></tr>
<tr><td colspan="4">Interviewer Comments and Observations:
N/A</td></tr>
</table>

Overall		Usefulness	Difficulty
A	Same as before, however it took some time to get over the select list selection mode. **Questions / Comments:** N/A	Very Useful	Very Easy
B	Real simple, quick and easy. It doesn't take more than a couple of minutes to complete a vote **Questions / Comments:** N/A	Very Useful	Very Easy
Interviewer Comments and Observations: N/A			

<table>
<tr><th colspan="2">Post Scenario</th><th>Usefulness</th><th>Difficulty</th></tr>
<tr><td rowspan="3">A</td><td>Recast Vote: Yes</td><td rowspan="3">Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: Yes</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
Yes, same as the other time.</td></tr>
<tr><td rowspan="3">B</td><td>Recast Vote: No</td><td rowspan="3">Useful</td><td rowspan="3">Very Easy</td></tr>
<tr><td>Validate Vote: No</td></tr>
<tr><td>Would you use the app if it were made available during the next election?
Yes, simple, on the phone and don't have to line up in the long queues and password protected. The app allows me to do it from home so why would I go into the polling place.</td></tr>
<tr><td colspan="4">Preferred Scenario: B, I like both, like some features from the first one (B) and the some of the second one (A). However, if I had to choose then B would use as it is, but would add the security from A in B.</td></tr>
<tr><td colspan="4">Final Comments: No</td></tr>
</table>

Survey	Usefulness	Difficulty
So easy, easy to work with. Surprised how easy it was to complete. No complicated questions.	Very Useful	Very Easy
Would you use this app for the next national survey? Yes		

Interviewee Final Comments

- N/A

General Observations

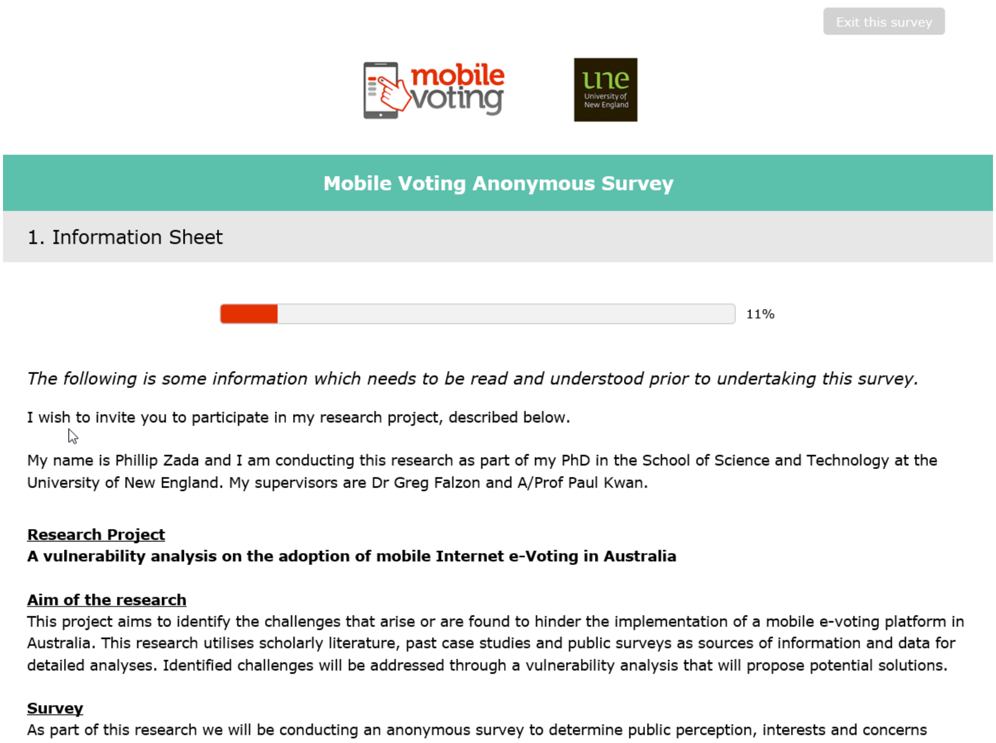
- The interviewee didn't discover some key functionalities of the app still the send scenario. These included the candidate information feature, the vote deletion and validation feature, and the ability to recast a vote or survey response.
- The interview was very pleased with the security mechanisms of scenario A, but showed more preference for the selection mechanism of scenario B (one-click).

11. Instructions: Accessing the Online National Survey

The following are instructions on how to undertake the Mobile Voting anonymous national public survey. The survey will be made available until 1 December 2019.

Instructions:

1. Open your web browser.
2. Enter the following URL: https://www.surveymonkey.com/r/mvote-survey-interactive
3. Complete the survey.



12. Instructions: Accessing the Mobile Voting App

The following are instructions on how to download and access the mobile voting app. For distribution (and as per the distribution used in the actual in-depth interviews), a public HockeyApp links will be made available. This link will be disabled by the 30th March 2019. The HockeyApp will provided the android apk or apple ipa file containing the app. Additional permissions maybe required to install the application. We have also provided 30 available e-voting numbers for use. Authentication mechanism has been defaulted to the more secure mechanism (optional fingerprint and SMS).

Hint: When logging into the application, you use the interview override functionality for authentication. This option can be accessed using the "**forgot password**" button, which is presented when being authenticated, then clicking "**interview override**".

Android Instructions: (Android 4.4 or greater):

1. Open the link in your browser on your mobile Smartphone device: http://bit.ly/mvote-android
2. Proceed to download and install the app. Additional permissions may be required to allow your browser to install the app from your browser.
3. Once installed open the app using the icon (app name: mvote).
4. Proceed to register, login and use the app.

Apple iPhone Instructions:

1. Open the link in your browser on your mobile Smartphone device: http://bit.ly/mvote-iphone

2. Proceed to download and install the app. Additional permissions may be required to allow your browser to install the app from your browser.
3. Once installed open the app using the icon (app name: mvote).
4. Proceed to register, login and use the app.

Available e-Voting numbers:

Note: If you are presented with an error stating the number is already in use, please proceed to use another number from the list below:

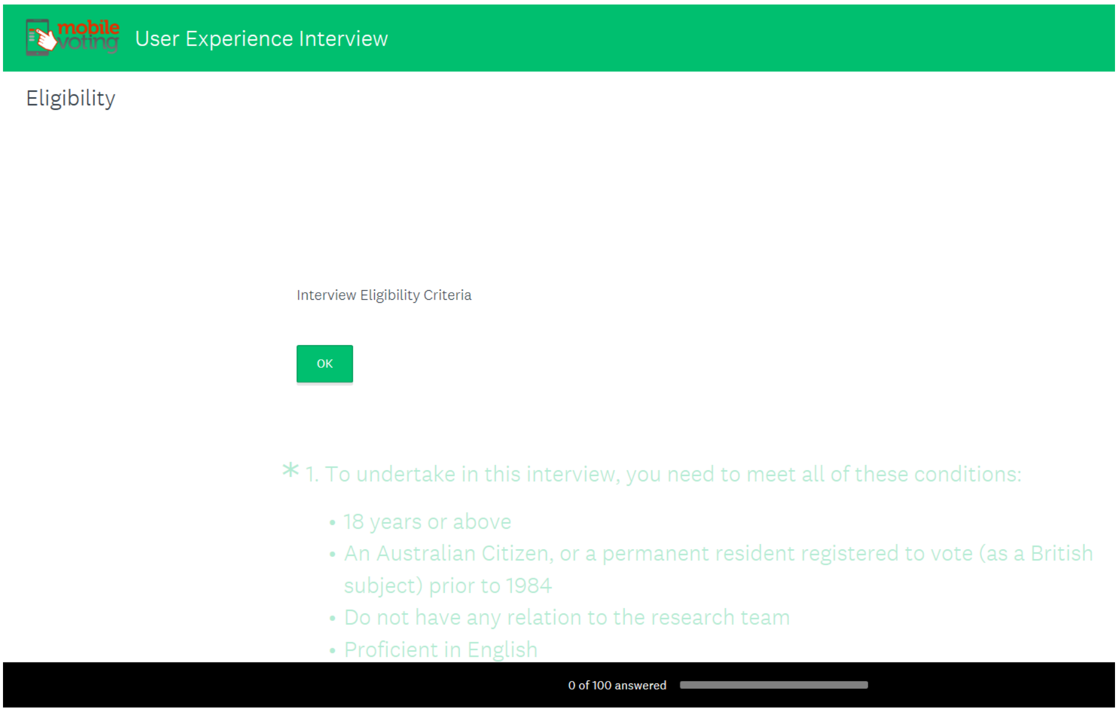
Mode A **Select list preference selection**	**Mode B** **One-click preference selection**
0391681063583054	1763241991750118
9595093555074630	4361900024395614
1716725169439095	6570045766482451
7671408829726420	5780889779175515
3255093786410337	2249724814715310
8793898454588870	6102610171716587
1148017938801883	7983644507477769
6954993974822025	5774922101187278
2805824801874561	6142247190200384
4316434839158157	1013814594727429

13. Instructions: Accessing the In-depth Interview Questionnaire

The following are instructions on how to undertake the Mobile Voting user experience interview. The interview questions will be made available until 1 December 2019.

Instructions:

1. Open your web browser.
2. Enter the following URL: https://www.surveymonkey.com/r/mvote-user-interactive
3. Complete the survey.



14. Hypotheses relating to the adoption of mobile e-voting in Australia.

H1. Trust is critical to mobile internet e-voting adoption.
H2. Greater perceived ease of use will contribute to a greater likelihood of mobile internet e-voting adoption.
H3. Greater perceived usefulness will contribute to a greater likelihood of mobile internet e-voting adoption.
H4. Significant levels of trust in the government and commercial agencies contribute to the likelihood of mobile internet e-voting adoption.
H5. Verifiability and anonymity must be proven for the likelihood of mobile internet e-voting adoption.