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Crafting the Government Mobile Application: A Mixed Methods Analysis of Public Value Creation as it Relates to Citizen Engagement and Participation in the Development of Government Smart City Mobile Application

Sean M. Mossey
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CRAFTING THE GOVERNMENT MOBILE APPLICATION:

A MIXED METHODS ANALYSIS OF PUBLIC VALUE CREATION

AS IT RELATES TO CITIZEN ENGAGEMENT AND PARTICIPATION IN

THE DEVELOPMENT OF GOVERNMENT SMART CITY MOBILE APPLICATION

A Dissertation Presented
by
SEAN M. MOSSEY

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CRAFTING THE GOVERNMENT MOBILE APPLICATION: A MIXED METHODS ANALYSIS OF PUBLIC VALUE CREATION AS IT RELATES TO CITIZEN ENGAGEMENT AND PARTICIPATION IN THE DEVELOPMENT OF GOVERNMENT SMART CITY MOBILE APPLICATIONS

A Dissertation Presented

By

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ABSTRACT

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With smart city and e-government (electronic government) initiatives striving for increased levels of citizen participation, public managers continue to search for a way to increase the utilization of Information Technology (IT) services. However, most efforts focus on linking operations and IT services, rather than facilitating greater means of citizen engagement in government service development (Granier & Kudo, 2016). Furthermore, few studies examine the effect of citizen engagement, particularly in relation to the New

Information Communication Technology (NICT), or the smartphone mobile application. These smartphones and their associated mobile applications are quickly becoming one of the primary tools for smart cities worldwide in delivering their government services.

According to Moore's theory of public value generation by managers, both a value chain and an authorizing chain are needed to create value associated with the authorizing environment (legitimacy and support) and resources needed (operational capabilities) to create value (performance). Therefore, this study asks, "Does the development of smartphone mobile application technology that proceeds according to Moore's public value management theory lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with future applications?"

Specifically, it utilizes a case study of the City of Boston and a mixed-method approach that consists of a survey to 425 City of Boston-specific application users and 16 application developers in the city to examine its central research question. The qualitative interview findings show that government authorizers and application developers are primarily motivated to ensure that applications are continuously utilized when they are being developed. Further, components of awareness campaigns surrounding the application are tied to the notion of garnering usage and building a sustained user base. By ensuring this, the degree to which two-way communication proceeds between developer and user is extensively mentioned as also being of importance. The results of the logistic regression show that value generation and a user's likelihood to engage with future applications is motivated primarily by the ease of use of the application, their prior experience with other

City applications, and whether they had been a contributor to prior City of Boston applications.

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I would like to express my deepest appreciation to my advisor and committee chair, Dr. Aroon Manoharan, who has guided me through my doctoral studies at the University of Massachusetts Boston. You have provided me with numerous opportunities to enhance my skills during our time together, and without your guidance, this journey would not have been possible. Looking back at the last four years, the opportunities we had to collaborate have truly been one-of-a-kind. I am thankful every day that we were matched together, and I look forward to many more collaborations in the future.

To Dr. Daniel Bromberg, my friend and colleague, thank you for consistently pushing me in my research and for the advice and numerous opportunities with which you provided me. You acted as my mentor when I needed it most and guided me toward a path that challenged me at every turn and allowed me to grow in many ways. To Dr. Michael Ahn, thank you for always being there to answer my questions, even before I began my program at the university, which ultimately led me to pursue this degree. Thank you as well for challenging me throughout my e-government studies to realize my potential as a scholar. Also, completion of this project would not have been possible without the support and dedication of my classmates and doctoral cohort: Drew, Caitlin, George, Jeff, Marcia, Bridget, and Katelyn. We were always there for each other through all the ups and downs, and I could not have asked for a better 2015 cohort to be a part of. Thank you as well to the Department of Public Policy, which guided me through this journey and provided me with the opportunity to grow as a scholar.

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To my "Turt" siblings Alex, Jessica, and Robert, thank you so much for the years of support, laughter, and movie quotes. I think we have an exceptional gift of quoting movies that exceeds the limits of most. All I have to say to you all is "It's over now…" To my cousin and best friend, James, thank you for a wonderful childhood and late nights spent designing our own pen and paper games while watching *Predator* and *Billy Madison*. We saw those movies at least 100 times each, and here's looking to 100 more watches in the future. To my Uncle Dave, you have been like a father to me, and in many ways I have tried to model my life after yours. Thank you for taking me on so many adventures with James, and for instilling in me that wanderlust that I keep in my heart. I look forward to many more conversations as we continue to talk about travelling the world and visiting far-off places.

To my father, thank you for imparting your wisdom to me and always teaching me to think critically about everything around me. Also, thank you for teaching me how to make the perfect steak. Eighteen years later, I never forgot.

To the love of my life, the knight of the laughing tree, and my princess in the tower, Nicole: I am so thankful that fate brought you into my life. During the hardest of times you were there for me, and I cherish every moment I spend with you. Without you by my side, this journey would not have been possible. You are my Nissa Nissa, my Jonquil, my blue flower growing in a wall of ice.

To my mother, there is so much to say: From the beginning of my journey till the end, you have been the reason I am where I am. Your hard work, the commitment you had to your children, and the support you gave me my entire life made this journey possible. You always worked so hard for us and allowed us to have magnificent opportunities. For you, I have nothing but gratitude for imparting in me the strength and ability to achieve everything that I have achieved.

To all the others who have guided me along the way during all my years of study, I am extremely grateful for your guidance, support, and the wisdom you have imparted to me. All the way through my school years, during my undergraduate studies at the University of New Hampshire, to my studies in Public Administration at that same university, and throughout my doctoral coursework, I am and will continue to be eternally grateful for your support every step of the way.

DEDICATION

"You must gather your party before venturing forth"

Nicole "Lyanna" Casinelli

Class: Bard
Background: Guild Artisan
Magic Item: Marvelous Pigments

STR	DEX	CON
10	14	10
INT	**WIS**	**CHA**
14	13	14

Feat: Resilient
Skills: Sleight of Hand, Persuasion, Perception

Karen "Soothsayer" Mossey

Class: Cleric
Background: Inquisitor
Magic Item: Crystal Ball

STR	DEX	CON
12	12	13
INT	**WIS**	**CHA**
14	15	10

Feat: Healer
Skills: Perception, Insight, History

James "Kharmic" Wrocklage

Class: Ranger
Background: Simic Scientist
Magic Item: Exercise Tome

STR	DEX	CON
10	13	15
INT	**WIS**	**CHA**
15	11	11

Feat: Lucky
Skills: Athletics, Survival, Insight

Robert "Angler" Browning

Class: Monk
Background: Fisher
Magic Item: Bracers of Defence

STR	DEX	CON
14	16	13
INT	**WIS**	**CHA**
10	10	12

Feat: Grappler
Skills: Acrobatics, Athletics, & Survival

Jessica "Lioness" Browning

Class: Paladin
Background: Soldier
Magic Item: Mind Control Potion

STR	DEX	CON
14	10	12
INT	**WIS**	**CHA**
12	14	14

Feat: Everybody's Friend
Skills: Animal Handling, Athletics, Performance

Alexander "Pooky" Mossey

Class: Barbarian
Background: Adventurer
Magic Item: Thrower of Flame

STR	DEX	CON
15	8	15
INT	**WIS**	**CHA**
10	10	15

Feat: Tough
Skills: Performance, Intimidation, Persuasion

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CHAPTER 1: INTRODUCTION

1.1 Overview of the Issues

Information and Communication Technology (ICT) provides new channels for citizen participation in the policymaking process. Over the past three decades, the continued proliferation of the Internet and the progression of ICTs have been characterized by initiatives that tout greater levels of e-democracy, social change, and public involvement. This has caused a rapid shift in the development of electronic-democracy (e-democracy) and electronic-participatory (e-participation) opportunities within cities worldwide that proceed in line with tenets of electronic governance (e-governance), where citizen participation takes on a central role (Lee, 2010).

The use of ICTs has been a way to enhance and foster citizen engagement in addition to traditional methods (phone, in person, ballet, etc.) by providing and encouraging the use of these technologies. Specifically, ICTs do this by increasing channels for communication and, in doing so, providing more equity in access by quickly and efficiently bringing citizen concerns to the attention of policymakers (Ferro, Loukis, Charalabidis, & Osella, 2013b). Ideally then, smart cities, or those cities that strive to possess smart capabilities, are theoretically built to bring about their e-governance goals with citizen participation assuming a central role. The interconnection of processes and networks via the smart city approach is characteristically galvanized by this citizen-driven participation and engagement

(Zubizarreta, Seravalli, & Arrizabalaga, 2015; Hansson, Belkacem, & Ekenberg, 2014; Coe, Paquet, & Roy, 2001).

A congruent step, however, concerns the development of the ICT service itself and the degree of engagement revolving around that service. Development theories regarding ICTs proceed according to many different public administration theories (traditional public administration, new public management, etc.), but a predominant argument is made for developing ICT services that reflect public value outcomes, where deliberation and citizen engagement take on a central role in the applications development (Stoker, 2006). For example, Moore (1995) notes the outcomes of pubic value as tied to the Resources and Capabilities (operational capability) and Authorizing Environment (legitimacy and support) that lead to the Value (performance) of the service in question. Therefore, the linkage between public value and citizen participation and ownership associated with an ICT service is important. Chapter 3 expands on this notion in its discussion of public value theory; however, quantifying this sense of ownership, while also examining how ownership is sought by citizen stakeholders in ICTs, and how governments are attempting to create ownership of these services in order to facilitate greater levels of engagement is an important query, and one that has largely not been examined.

I argue in this proposal that ICTs developed according to public value outcomes that are perceived as valuable by users generate greater levels of ownership associated with that service. From this sense of ownership, there will be a greater desire to participate in the ICT service for citizens in the future, in regards to both its function (e.g. contributing to and utilizing the application) and its development (contributing to the application before, during,

and after its development). Furthermore, the relationship should proceed in a multidimensional fashion, with organizations striving to generate this public value and create ownership in the application that leads to greater levels of citizen participation, which enhances: public service delivery capability, public engagement capability, co-production capability, resource-building capability, and public sector innovation capability (Pang, Lee, & DeLone, 2014). The mixed-methods approach of this dissertation utilizes a convenience sample of City of Boston mobile application users, supplemented by interviews with city mobile application developers and project leads to examine this question.

From a policy standpoint, I argue that New ICTs (NICTs), such as that of the smartphone, are the new tools of smart cities going forward, and if created with public value theory in mind, will lead to a greater sense of ownership with these services. Further, they bring immense opportunity regarding citizen engagement capabilities, as they are mobile, ubiquitous, cost effective, and limit digital divides. Further, mobile applications are a central tool of the smart city that can bring about services in an equitable and efficient manner. My central argument is that applications designed with public value outcomes in mind will be associated with higher value of the applications service as represented by ownership in these applications, and that such ownership could lead to greater trust on the part of the user that government is listening to their needs and developing services based upon them and higher levels of engagement. The central question I ask in this proposal is: "Does the development of smartphone mobile application technology that proceeds according to Moore's public value management chain lead to greater levels of ownership associated with these smart city

services and a willingness to co-productively engage and participate with such services?" The policy component of the analysis carried out in this study are outlined in Chapter 6.

Framed within a smart city, that of Boston, I utilize a survey to city mobile application users, interviews with mobile application developers, and project leads to gather evidence for this central research question. Chapter 3 outlines this methodological approach in greater detail.

As Chapter 2 examines in the literature review component of this study, few studies have examined how public value in the e-government process itself can lead to effectiveness of various IT services. I argue then it becomes important for public managers to connect their management activities to the will of citizens in this regard and according to standards of e-governance (Lee, 2010). With smartphone use in the united states and worldwide on the rise (Smith, 2015), and with mobile application preference among consumers increasing at immense rates (Holst, 2019), only a few studies have examined public value generation in smartphone application development and its effectiveness (Yu, 2013a). In addition, due to the strength of mobile technology in bridging digital divides, limiting digital inequality, its speedy delivery of services, and cost effectiveness, there will likely be a sustained proliferation of mobile application technologies going forward.

1.2 Integration of the Smart City Model, e-Governance, and Citizen Engagement

Scholars now show there is a new age of information, and the global proliferation of ICTs and NICTs has created tremendous potential regarding the ability to integrate government services in an efficient and effective manner for governments, citizens, and businesses (Linders, 2012). The smart city model, or smart community, is built on the notion

that the city and networked intelligence operations are embedded with the geographic area in question (city, neighborhood, multi-neighborhood, etc.). This allows the citizens, organizations, and governing institutions to utilize NICTs to better transform their region in a collaborative fashion (Eger, 1997). The benefits of smart cities include an increase in economic prosperity in the region, an improvement of the quality of life for those within the community, greater citizen participation, and more equity in the use of such technology (Hansson et al., 2014).

This technological proliferation has been occurring at rapid rates around the globe as governments have come to realize the potential of e-government in restructuring bureaucratic procedures to increase service delivery capability, foster the dissemination of information to the public, and increase opportunities for citizen participation via the tenets of direct democracy (Moon, 2002). Successful e-governance then is described as occurring from three angles: identification of stakeholders, recognition of different interests among stakeholders, and the ways in which an organization caters to and furthers these interests (Tan, Pan, & Lim, 2005). Such tenets closely align with many public value theoretical outcomes and the operationalizing of these outcomes (Moore, 1995; Bozeman, 2007).

The smart city is set to change the landscape of urban development as it links ICTs with goals for efficiency, sustainability, and co-productive citizen engagement. Within the smart city, e-governance relies on public management efforts that link the viewpoints of the citizen to the policymaking process. Though smart city developments inherently rely on collaboration between many internal and external stakeholders throughout the process, the citizens' viewpoints are one of the key components of e-governance and public

administration that lend themselves to overall good governance. In IT services, however, there has been little development that has expanded participatory channels that sought to align policymaking goals in the form of IT service development that meets and reflects the public's needs via citizen co-production (Linders, 2012). Furthermore, public value paradigms rely heavily on such citizen engagement and a sense of ownership associated with the service to effectively develop services that reflect citizens' needs (Moore, 1995; Bozeman, 2007).

1.3 Background of the Problem

Despite accounts regarding the benefits of greater levels of citizen participation in e-government, most global municipal governments often neglect initiatives that foster citizen involvement (Kim & Holzer, 2014). Some government are still stuck in a Web 1.0-based system of e-governance known as Government 1.0, wherein governmental processes proceed from the government to the citizen in a uni-directional fashion, failing to transition to smart city initiatives (Cardullo & Kitchin, 2017). While input can still be garnered on these functions, the two-way communication that occurs in later levels of e-governance is more difficult to achieve (Lee, 2010). Web 2.0-levels of governance are needed in the smart city model, which is reliant on this two-way interaction between stakeholders and the government (Coe et al., 2001).

Further, cities around the world have been slow in their development of citizen participatory channels, and citizen participation itself has also been low. A recent Rutgers Survey, *The Eighth Annual Global E-governance Survey,* is a longitudinal assessment of government's e-governance efforts in the key categories of e-governance: Privacy and

security, usability, content, services, citizen participation, and social engagement (Holzer & Kim, 2018). The survey has been conducted since 2003, and while other categories have seen significant increases in their scores rises, citizen participation and social engagement has only risen an average of 1.67 points (from 3.26 to 4.93 out of a possible 20 points) over 13 years. Table 1a shows these trends in all e-governance categories.

Table 1a: Average Score by E-Governance Categories 2003 – 2017-18

	Privacy/ Security	Usability	Content	Service	CS Engagement
2017-18 Averages	7.39	14.58	9.47	7.94	4.93
2015-16 Averages	5.55	12.38	8.22	6.82	3.87
2013-14 Averages	4.88	12.04	7.62	5.49	3.34
2011-12Averages	4.99	12.09	7.38	5.78	3.53
2009 Averages	5.57	11.96	8.21	6.68	3.5
2007 Averages	4.49	11.95	7.58	5.8	3.55
2005 Averages	4.17	12.42	7.63	5.32	3.57
2003 Averages	2.53	11.45	6.43	4.82	3.26

Source: Holzer and Kim, 2018

To move toward more Web 2.0-oriented e-government, the last stages of e-governance need be fully realized. These stages encourage two-way communication between citizens and government (Chun, Shulman, Sandoval, & Hovy 2010). According to this model then, citizen voices should be encouraged and heard by the government in order to actively engage citizens in the policymaking process. In addition, systems of co-production also allow citizens to help facilitate governmental activities, transcending those of typical citizen

participation toward actively engaging citizens in the betterment of their community through ICTs (Linders, 2012). Regarding what services and opportunities exist, deliberation on services that reflect the need of the community becomes necessary.

1.4 The Rise of Smartphone and Mobile Application Technology

Due to their widespread proliferation, mobile phones and smartphones provide a means by which citizen engagement and this deliberation can be greatly enhanced. The most common ICT device carried by people is the mobile phone, and global penetration has risen beyond 96% (Yfantis, Vassilopoulou, Pateli, & Usoro 2013), with three-fourths of the world's population having access to mobile phones (Worldbank, 2015). Spending on mobile phones has also grown more than anything else in the world (Oghuma, Park, & Rho, 2012). Worldwide governments that offer mobile services doubled from 2012 to 2014 as governments were striving to increase their mobile efforts (Henning, Janowski, & Estevez, 2014). Furthermore, mobile phones are noticeably cheaper and easier to use than traditional ICT devices (Yu & Kushchu, 2004).

In addition, more advanced opportunities continue to surface in mobile government (m-government), especially in the form of smartphone technology and mobile applications. The technological landscape has been changing rapidly, and specifically, smartphone mobile applications are becoming a highly in-demand technological medium. Ghose and Han (2014) use estimated demand function to show that mobile applications have led to consumer surplus increases of $33.6 billion annually in the United States, with marketing and design strategies coming to dominate market trends. 4G services can transfer data at a rate of 100 Mbps in some instances, making them a fast and efficient substitution for wired or wireless

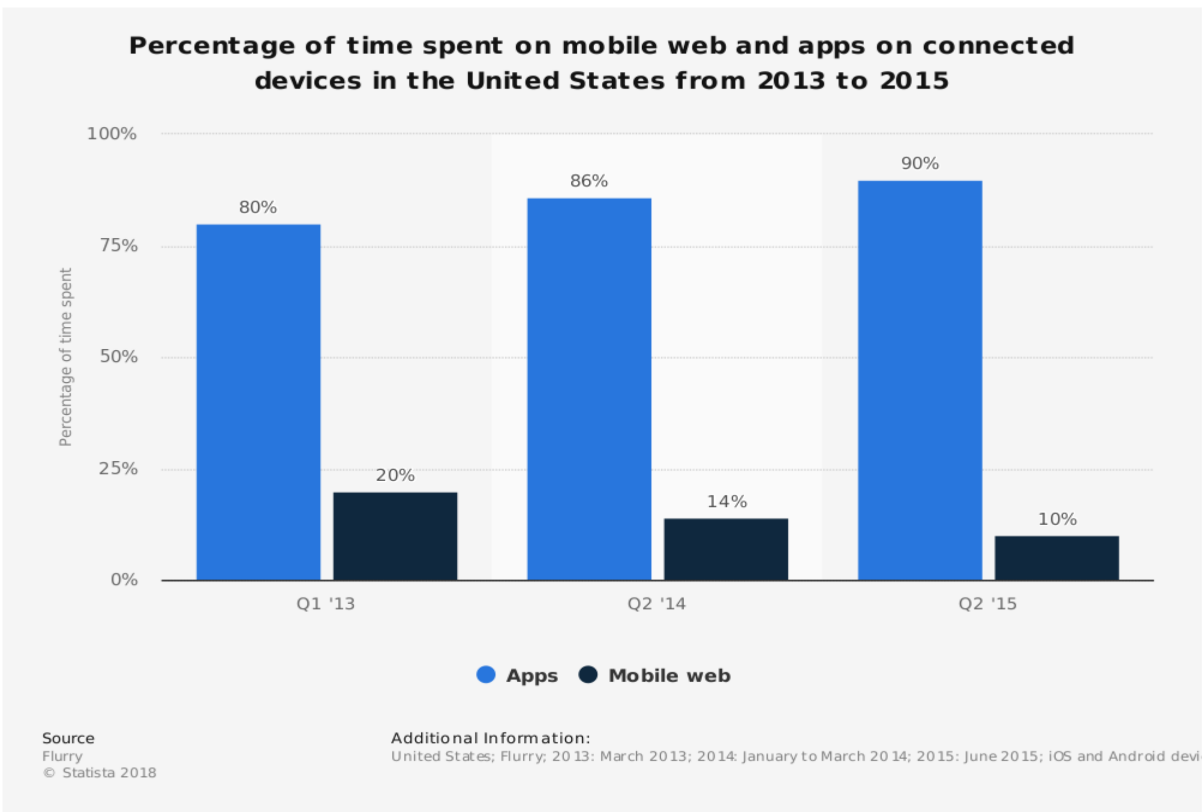
Internet services, which can be costly (Rumney, 2013). The smartphone then puts personal computing at one's fingertips at a fraction of the cost.

Further, an aspect of the smartphone, the mobile application, has seen immense growth and associated demand. A recent poll conducted by Statista (Holst, 2019) showed that there has been an ongoing trend regarding mobile application growth. The poll showed that in 2009, mobile application downloads amounted to approximately 2.52 billion, but in 2017 they reached 178.1 billion downloads (Holst, 2019). By 2022, they are expected to reach 258.2 billion downloads. These mobile applications have been a source of income for private sector companies, and in 2015, global mobile app revenues amounted to $69.7 billion U.S. dollars. In 2020 these revenues are projected to reach 188.9 billion USD (Holst, 2019). The survey also showed that most users use their applications more than once a week, and that the preferred mobile applications are free. Furthermore, mobile application features follow cost regarding what affects whether or not users download these applications. After being entertained, the user's primary reason for downloading mobile applications is to carry out a specific task (Holst, 2019). In addition, 51% of application users download zero new mobile applications per month, making the application market a competitive one (Holst, 2019).

Below, figure 1a shows that mobile applications are highly preferred to websites regarding connected devices between 2013 and 2015. Accessing mobile websites is underutilized compared to applications, with regard to overall time spent on smart devices. Figure 1b shows that for mobile data web traffic, there is an expected rise to over 77.49 exabytes (7.749 e^10 gigabytes) in 2021, compared to only 11.51 exabytes in 2017 (1.151 e^9 gigabytes). In the United States, figure 1c shows that there were only .49 mobile

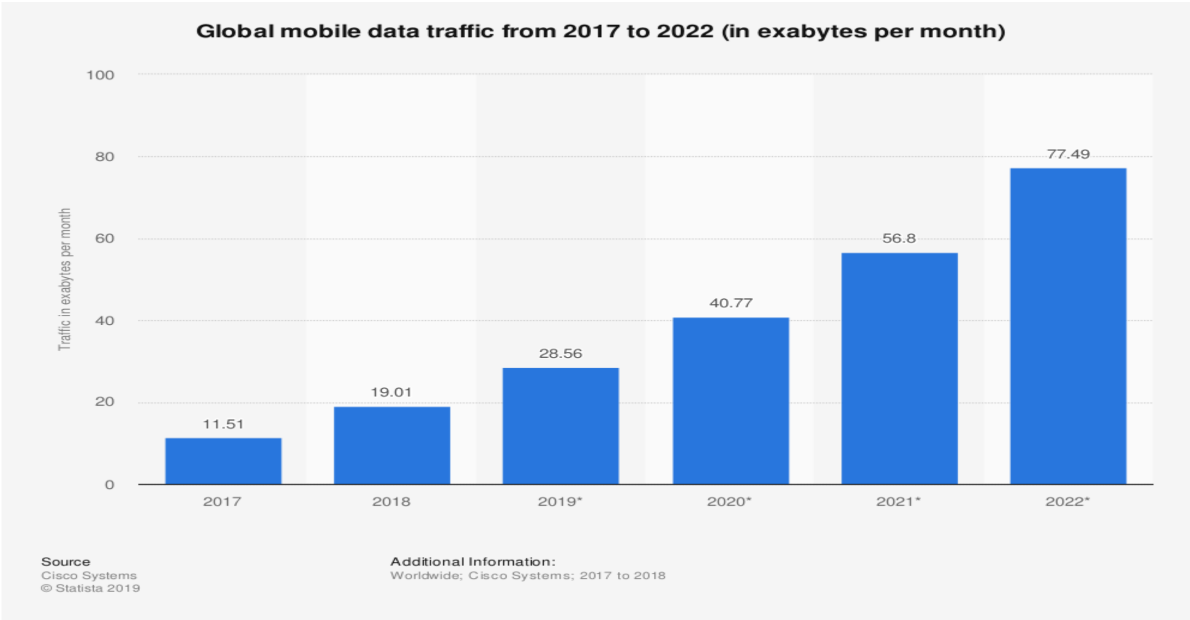
subscriptions per 100 U.S. residents in 2004, but that this number grew to 132.9 subscribers in 2017. Finally, as Figure 1d shows, those age 18 to 64 spent 50% of their time or more using smartphone applications compared to desktops, tablets, smartphone web use, and target web use. Only those aged 65 years and older spent significantly less time using applications at 27%, compared to desktop use of 53%. However, those aged 18 to 24 spend 66% of their time using applications, compared to 23% desktop use.

Figure 1a: Time Spent on Mobile Devices Compared to Websites in United States



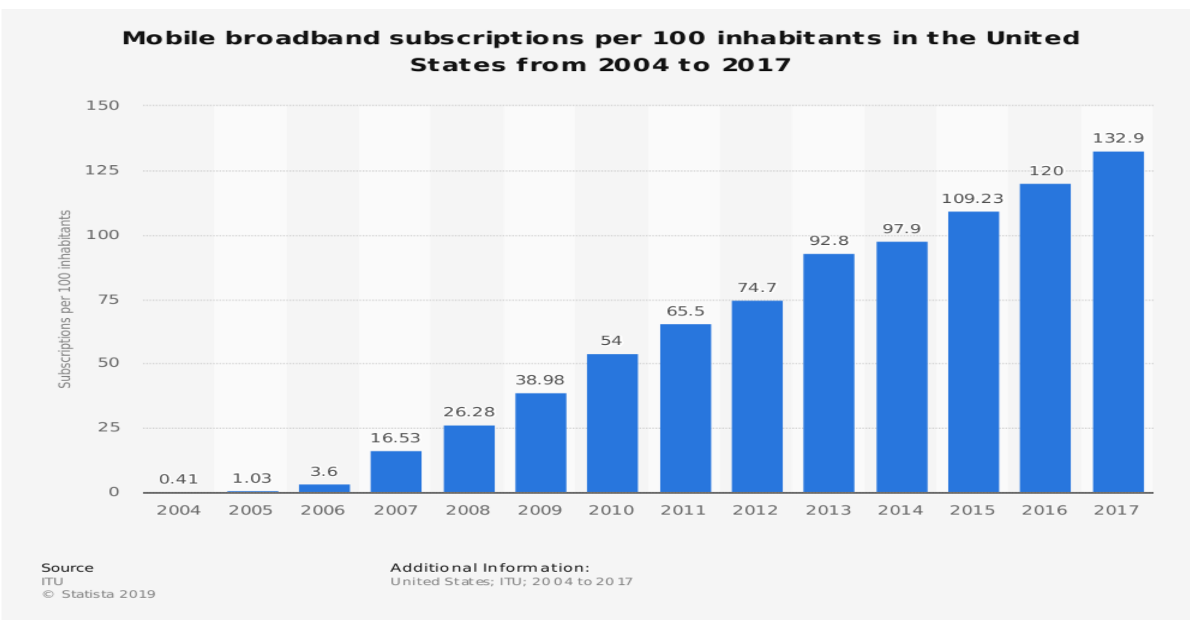
Source: Holst, 2019

Figure 1b: Global Mobile Traffic



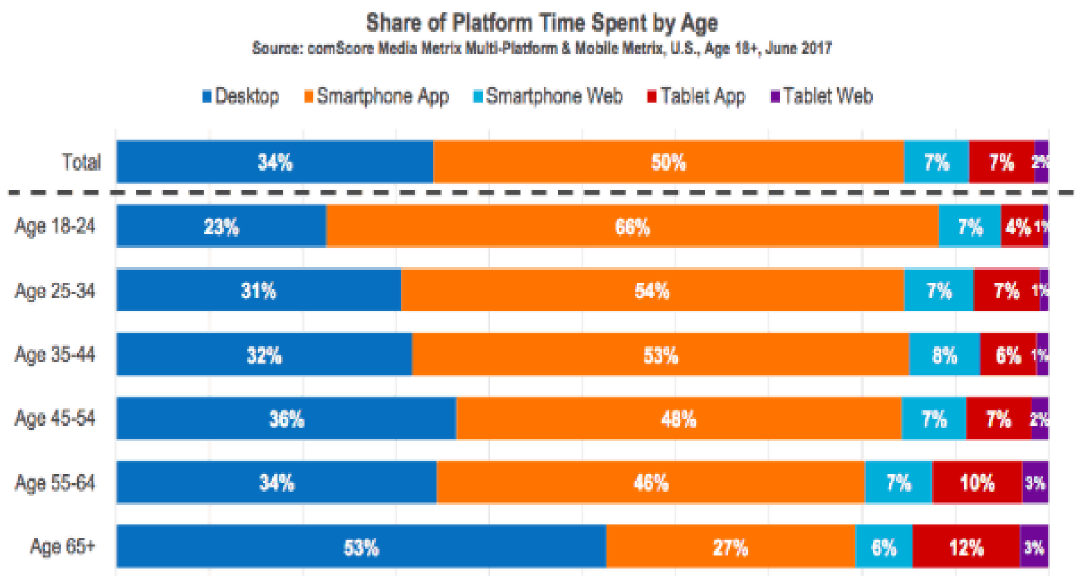
Source: Holst, 2019

Figure 1c: Mobile Broadband Subscriptions



Source: Holst, 2019

Figure 1d: Share of Platform Time Spent by Age



Source: Holst, 2019

Data displayed in table 1b (Smith, 2015), below, shows that among U.S. adults, 68% of the population owns a smartphone. Cell phone ownership by itself has reached near saturation among Americans at 92%. Furthermore, nearly half of those surveyed consider such service a necessity in their everyday lives. From the standpoint of access to online services, 10% of Americans rely on smartphone technology exclusively for their Internet access.

Further, some have observed that disenfranchised groups can garner greater access through mobile technology, which helps to limit digital divides among certain populations and root out digital inequality. African Americans use smartphones at slightly higher rates than their white counterparts and Hispanics at slightly lower rates. While usage is lower among older populations, those with less education, and those with lower wealth, the use of

smartphone technology is still high in these populations. In addition, as compared to ownership of personal computers as shown in table 1b, smartphone ownership rates are relatively high. The digital divide still leaves some citizens behind, and a potential solution arises in the use of smartphones and mobile technology, particularly in areas of lower wealth where connectivity to typical Internet services is limited (Emmanouilidou & Kreps, 2010).

Table 1b: Smartphone Ownership in the United States

Smartphone Owners More Likely to be Younger, More Affluent and Highly Educated

% of U.S. adults who own a smartphone, e.g. iPhone, Android, Blackberry or Windows phone

U.S. adults	68
Sex	
Men	70
Women	66
Race/ethnicity	
White	66
Black	68
Hispanic	64
Age group	
18-29	86
30-49	83
50-64	58
65+	30
Household income	
<$30K	52
$30K-$49,999	69
$50K-$74,999	76
$75K+	87
Educational attainment	
Less than high school	41
High school	56
Some college	75
College+	81
Community type	
Urban	72
Suburban	70
Rural	52

Source: Pew Research Center survey conducted June 10-July 12, 2015. Whites and blacks include only non-Hispanics. N=2,001.

PEW RESEARCH CENTER

Source: Pew Research Center Survey (Smith, 2015)

Table 1c also shows that ownership of laptops and computers remain at around 73% among adults. This number remains at levels similar to those displayed 10 years ago. Clearly then, there is a rise in demand and usage of smartphone technology. The increasing numbers of smartphones in America was staggeringly high from 2010 to 2015.

Table 1c: Computer Ownership in the United States

Computer Ownership Varies Greatly by Race and Ethnicity, Household Income and Educational Attainment

% of U.S. adults who own a desktop or laptop computer

U.S. adults	73
Sex	
Men	74
Women	71
Race/ethnicity	
White	79
Black	45
Hispanic	63
Age group	
18-29	78
30-49	81
50-64	70
65+	55
Household income	
<$30K	50
$30K-$49,999	80
$50K-$74,999	90
$75K+	91
Educational attainment	
Less than high school	29
High school	63
Some college	81
College+	90
Community type	
Urban	67
Suburban	78
Rural	67

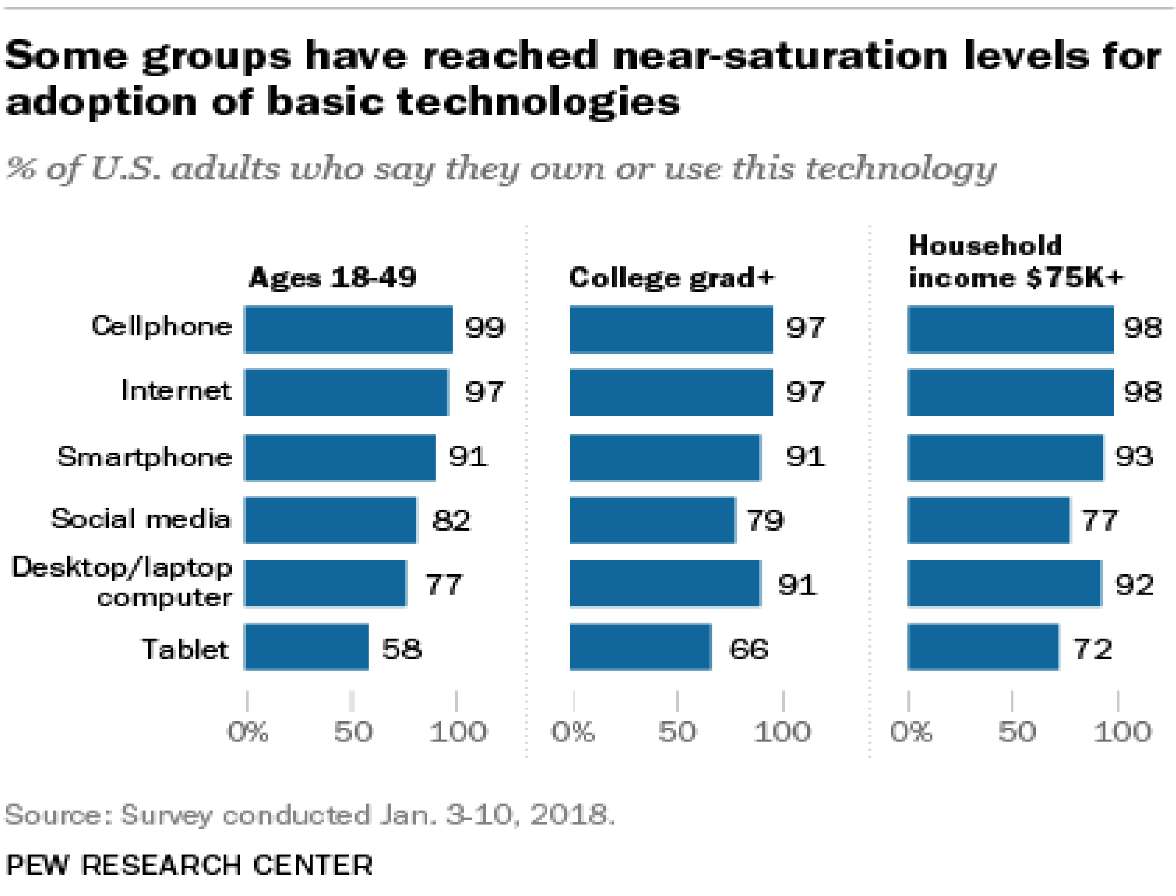
Source: Pew Research Center survey conducted March 17-April 12, 2015. Whites and blacks include only non-Hispanics. N=959

PEW RESEARCH CENTER

Source: Pew Research Center survey (Smith, 2015)

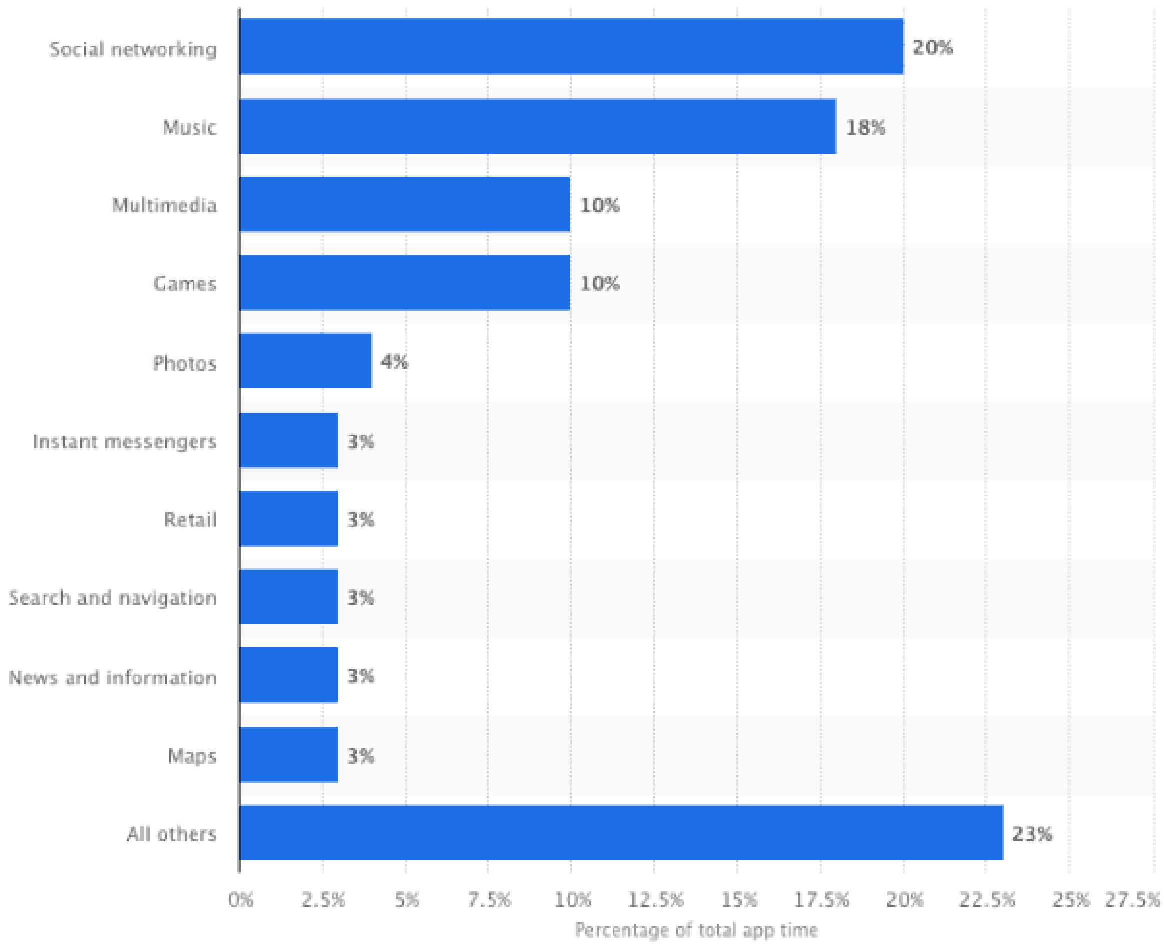
As Figure 1e examines, smartphone usage is strikingly higher than tablet ownership in 2018 among those ages 18 to 49 and outpaces computer usage by 14%. Figure 1f also shows that smartphone users mostly use them to access social networking sites. Figure 1g shows that among certain demographic groups, there were significant shifts away from broadband technology in favor of smartphone technology between 2013 and 2015. Furthermore, there was a 5% shift among all adults from 2013 to 2015.

Figure 1e: Percentage of U.S. Adults Who Own a Cellphone, Smartphone, Tablet, or e-Book



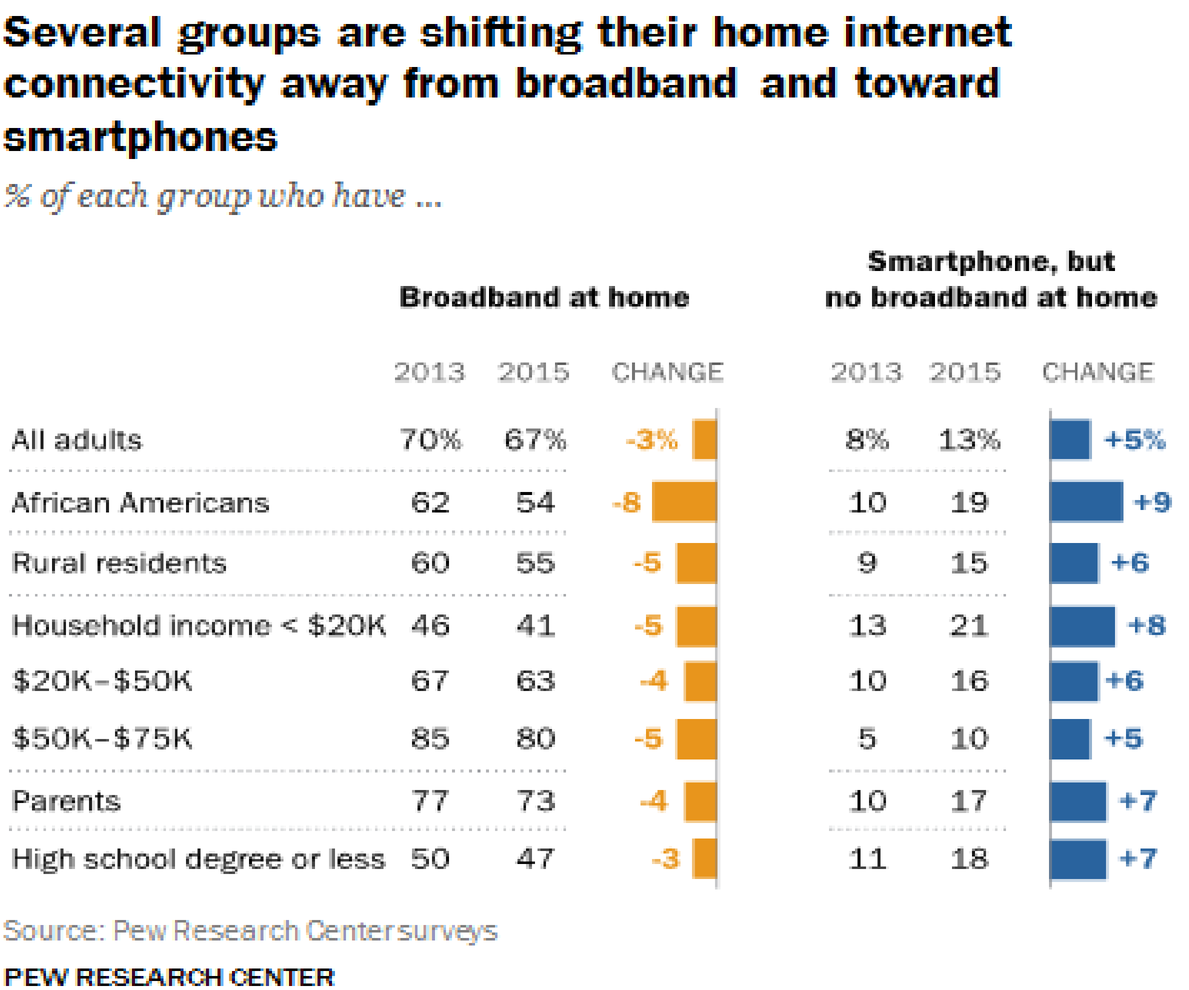
Source: Pew Research Survey (Hitlin, 2018)
*Cell phone, including smartphones

Figure 1f: Smartphone Use by Type of Service



Source: Holst, 2019

Figure 1g: Trends Toward Smartphone from Broadband



Several groups are shifting their home internet connectivity away from broadband and toward smartphones

% of each group who have ...

	Broadband at home			Smartphone, but no broadband at home		
	2013	2015	CHANGE	2013	2015	CHANGE
All adults	70%	67%	-3%	8%	13%	+5%
African Americans	62	54	-8	10	19	+9
Rural residents	60	55	-5	9	15	+6
Household income < $20K	46	41	-5	13	21	+8
$20K–$50K	67	63	-4	10	16	+6
$50K–$75K	85	80	-5	5	10	+5
Parents	77	73	-4	10	17	+7
High school degree or less	50	47	-3	11	18	+7

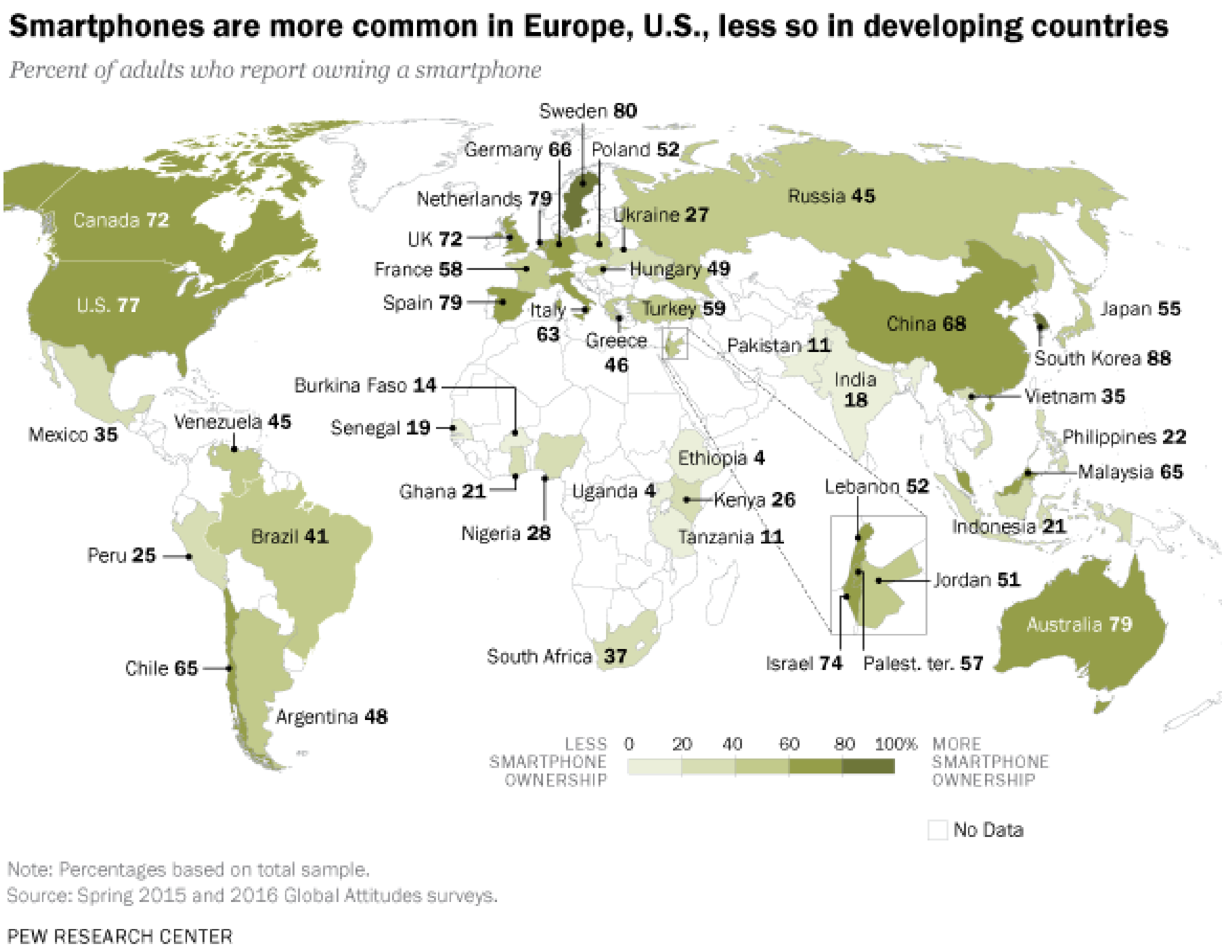
Source: Pew Research Center surveys

PEW RESEARCH CENTER

Source: Pew Research Survey (Smith, 2015)

Worldwide, the trend toward smartphone technology has also shown staggering growth. As Figure 1h shows, there are still digital divides present between developing and developed countries regarding smartphone technology. However, among developing countries, smartphone proliferation has occurred at high rates, rising from a median ownership worldwide of 21% in 2013 to 37% in 2015 (Smith, 2015), a 16% growth in only two years.

Figure 1h: Smartphone Ownership by Country



Source: Pew Spring 2015 Global Attitudes Survey (Poushter, 2016)

1.5 The Use of Mobile Applications in the Smart City

The smart city concept itself is built upon the notion of a community that is intricately connected by ICTs and similarly reliant on collaboration in the development of smart services (Hansson et al., 2014). A tool of the smart city, the mobile application, provides a simple and effective way to facilitate IT service delivery for citizens. The mobile application expands on the concept of e-government by providing a new means of interaction in the form of m-government. It proceeds through the utilization of a smartphone or other similar mobile computing device that possesses nearly the same capabilities of a personal computer. Furthermore, new data shines light on how smartphone ownership is on the rise (Smith, 2015), and how mobile applications, rather than typical websites, are quickly becoming the preferred medium of communication for service delivery on ICT devices (Holst, 2019).

Zubizarreta et al. (2015) classify the smart city further according to six goals that manifest in six types of mobile application: Economy (competitiveness), People (social and human capital), Living (quality of life of citizens), Governance (participation of citizens), Environment (natural resources, sustainable growing), and Mobility (transport and ICT). Figure 1i, below, from the authors shows that among the service applications, people- and engagement-centric applications presented among the lowest percentages.

Figure 1i: Service Focus among Smart Cities

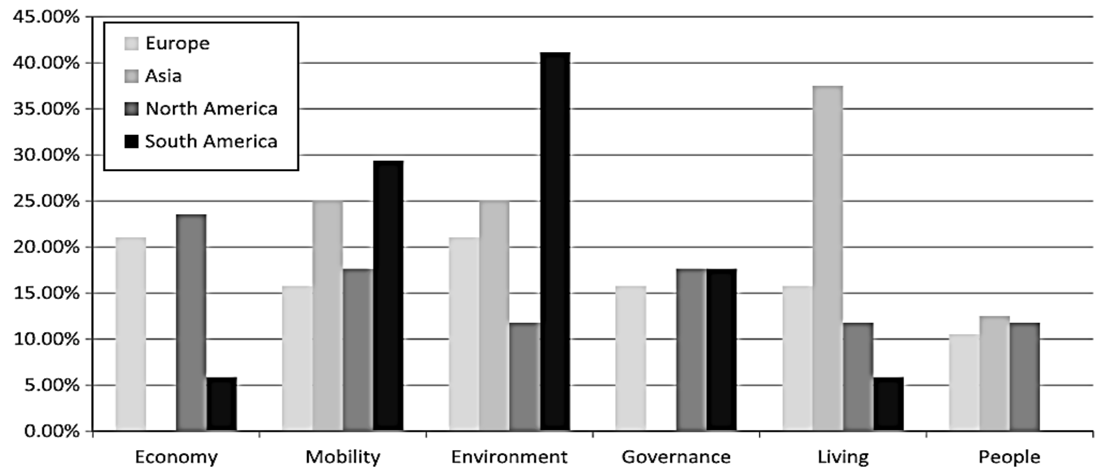


Fig. 2. Percentage of applications from the different classification standards

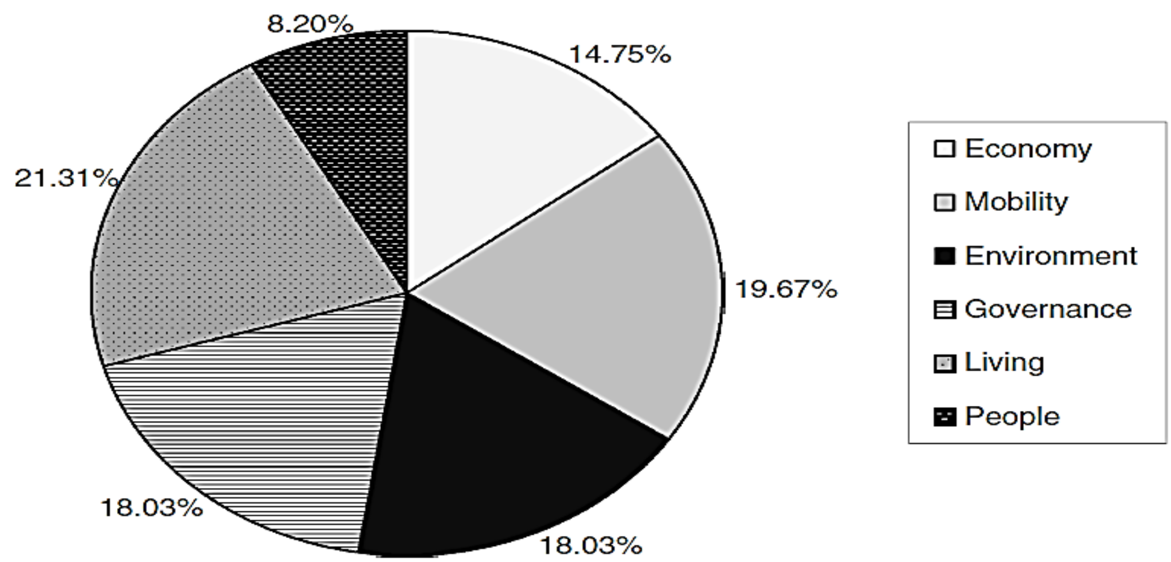


Fig. 3. Percentage of applications from the different classification standards in total

Source: Zubizarreta et al., 2015

Regarding citizens, this identification of interests and catering to these interests becomes immensely important when considering good e-governance within the smart city. Citizen participation and engagement then is critical. Overall, citizens, with strong beliefs in what they can contribute to their government and what their capabilities are, feel they can exercise control over it via this capabilities approach. This participation can lead to positive outcomes for society, its people, and both government and non-government institutions (Cialdini & Goldstein, 2004). Developing this **sense of ownership** by catering to public value paradigms in application development may enhance the smart cities' capabilities in fostering citizen engagement and participation at needed levels.

The new model of the smart city therefore seeks to achieve the goals of e-governance by gathering the collective view of what the citizenry deems valuable. This proceeds through the utilization of the ICT services to manage cities assets across many organizations. A central component of such cities is the improvement of the quality of life of citizens and the means of communication that allow citizens to directly interact with their government in many ways. These channels allow public managers to more efficiently meet the needs of the city, while also gathering citizen perspectives that lead to economic, social, and political transformations (Coe et al., 2001). While the technological aspect of governmental websites is of importance, the entire concept of open government and the smart city model revolves around the openness and participatory dimension that all integrated technologies contribute to and the change that such contribution can have on how governments function (Hansson et al., 2014). Designing smart mobile applications according to public value inputs that reflect a

desire to engage and build ownership is a central component of integrating this new and emerging ICT with the smart city model.

1.6 Statement of the Problem

Smartphone applications are widely used throughout the private sector to cater to consumer needs and generate revenue (Holst, 2019). As private sector data from Ghose and Han (2014) shows there is a widespread demand for smartphone technology and mobile applications. However, the public sector aspect should not be ignored, as the advantages of applications as a smart city service carry significant potential for service delivery.

This study examined public value and its effects on citizens' **sense of ownership** and the willingness to participate associated with these smartphone mobile applications. From a policy standpoint, examining this could allow governments to more accurately design services that reflect citizens' needs, as well as garner higher usage of mobile application services. To carry out good overall governance, the models of e-governance that cite citizen participation as a central component (Tan et al., 2005; Lee, 2010) should measure whether the identification of stakeholder outcomes and catering to these interests leads to greater overall effectiveness of the mobile application. This characterizes the end stages of e-governance, whereby citizens become co-producers and co-contributors to government policy-making and develop services in line with their wants and needs (Linders, 2012).

As the literature review in Chapter 2 outlines, scholars extensively examined the need for citizen participation in e-government and its role in the progression of e-government, throughout m-government and within the smart city model. Largely unexamined is how to facilitate ownership regarding the ICT device, and whether development according to public value paradigms can contribute to such ownership and subsequently lead to a greater willingness of citizens to participate. In addition, operationalization of these value inputs has been theoretically proposed in Karunasena and Deng's (2012) model but has not been formally measured.

The benefits of such engagement via the tenets of the smart city model have been examined, but analyzing ownership development of ICT services via public value input variables and its benefits within the model would be beneficial to policymakers from both a quantitative and a qualitative standpoint. Questions arise with the dawn of these preferred NICTs that have not been previously explored in the e-government literature. Are city mobile applications that reflect public value being developed? Do public value inputs lead to ownership associated with the mobile applications? How do citizens develop ownership? What is the benefit to the smart city?

1.7 Overview of the Study

Using a model of e-governance developed through the literature review conducted in Chapter 2 and a mixed method that explores in greater detail the public value input variables that affect ownership, I argue the research is unique in its questions and in its methods. I do so by developing a mixed-methods case study analysis of the City of Boston, as it represents a smart city that has a strong application development initiative as outlined in Chapter 3.

Surveys are widely used and easy components by which governments can gather necessary feedback regarding demographic information and preferences for certain IT services over others. In this study, I use surveys to examine public value inputs developed through a review of the literature in Chapter 2 and a theoretical model developed in Chapter 3. In this design, qualitative interviews sheds light on a much-needed perspective regarding government mobile application development by analyzing Moore's (1995) authorizing environment considering these inputs.

> **Central Research Question:** Does the development of smartphone mobile application technology that proceeds according to Moore's public value management chain lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services?

The study has two primary purposes that could lend themselves to future policymaking regarding government mobile application development, which measure the effect of engaging citizens on the development of government smartphone applications. It uses interviews and surveys as its primary methods, with their results outlined in Chapters 4 and 5 respectively.

Chapter 4 proceeds through interviews with 16 application developers or project leads within the City of Boston. It uses process coding based on themes associated with the input variables from Moore (1995) and Karunasena and Deng (2012) to examine the research question below in more depth. The qualitative interview findings show that government authorizers and application developers are primarily motivated in ensuring that applications are continuously utilized when they are being developed. Furthermore, components of

awareness campaigns surrounding the application are tied to the notion of garnering usage and building a sustained user base. In ensuring this, the degree to which two-way communication proceeds between developer and user is extensively mentioned as also being of importance.

> **Primary Research Question #1:** How are smart city managers, in the form of mobile application architects and developers, working to create an authorizing environment that generates public value, builds ownership in applications, and facilitates co-production and citizen engagement?

Chapter 5 uses descriptive analysis and logistic regression to determine which public value input variables, as developed by Moore's (1995) and Karunasena and Deng's (2012) models, lead to a greater likelihood of engagement with future applications developed by the City of Boston. The results of the logistic regression show that value generation and a user's likelihood to engage with future applications is primarily motivated by the ease of use of the application, their prior experience with other City of Boston applications, and whether they been a contributor to prior City of Boston applications.

> **Primary Research Question #2:** How does the development of smart city mobile applications that reflect public value outcomes affect user's sense of ownership, their engagement with the application, and the value associated with the applications measured by their willingness to engage with future city applications?

1.8 Significance of the Study

The question as to how ownership is developed via the value chain and fostered via the authorizing chain within the context of a smart city has been largely unexplored (Moore, 1995). Governments can use similar methods to gauge their own citizens' viewpoints and create value associated with the mobile applications among users.

As will be outlined in the subsequent literature review chapter, later stages of e-governance continue to evolve toward greater levels of citizen participation. Information and communication technology can be utilized to facilitate this participation in efficient and cost-effective ways and can serve the specific needs of the community and its citizen-users. This will arguably lead to higher levels of usage and ownership of the technology, along with citizen-centric development according to the smart city model. Mobile application technology is also a preferred medium, and moving forward, studies regarding how these applications can be designed from citizen input and the effects of this input are beneficial. I argue that this study's research question is unique and useful to scholars of e-governance and has value in its academic contributions, and also in its flexibility as a policy tool that cities can use to develop their technologies.

1.9 Limitations

The limitations of each methodology are explored in their respective chapters.

1.10 Assumptions

This study carries with it several assumptions, which I have expanded on in the first section of this dissertation proposal. First, I assume that mobile applications are presenting a new trend in technology, and that such applications will remain the relevant and preferred

method by which smartphone users access their services for some time. This speaks greatly to the need for the study. Furthermore, I assume that governments want to engage citizen-stakeholders in the application process, and that they wish to do so to make the application more useful to citizens. In relation to this, I assume that the goal of these governments is to have users utilize these mobile applications and develop ownership in them according to the central research question. Lastly, I assume public value (Moore, 1995) is a beneficial and accurate theory by which governments can conduct their governance, and that smart city initiatives are appropriately coupled with this theory in their governance and policymaking.

1.11 Definition of Terms

Citizen Engagement: The engagement of citizens in the deliberative policymaking process.

Citizen Participation: The process by which citizens are given the opportunity to influence public decisions and contribute to democratic decision-making.

Digital Divide: The divide that arises between those who have access to technologies and those without such access, which is often influenced by several variables.

Electronic Governance (e-Governance): The use of ICTs to increase transparency, exchange information, carry out transactions, and integration of various stand-alone systems to Governments (Government-to-Citizens, or G2C), Businesses (Government-to-Business, or G2B), and other Governments (Government-to-Government, or G2G).

Electronic Government (e-Government): The utilization of Information Technology (IT) and Information Communication Technologies (ICTs) to improve or enhance the efficiency and/or the effectiveness of service delivery in the public sector.

Information Communication Technologies (ICTs): Refers to the infrastructure and technological components that relate to modern computing. This includes other mediums of communication, including, but not limited to, computers, software, storage, and telecommunications.

Mobile Government (m-Government) and Mobile Governance (m-Governance): The extension of e-government and e-governance to mobile devices, including cell phones, smart phones, and PDAs (personal digital assistants).

New Information and Communication Technologies (NICTs): An extension of ICTs that encompasses the newest trends in technological development. Examples are smart phones, cloud computing, and mobile applications, among others.

Public Value: Coined by Moore (1995) this term concerns the value that an organization contributes to society.

Smart City: An urban development that securely integrates ICTs and the Internet of Things (IoT) to manage city assets and carry out day to day functions for citizens and administrators.

Smartphones and Mobile: A mobile phone that has capabilities in line with that of a computer, and having a touchscreen interface, Internet access, and an operating system capable of running downloaded applications. The "app" often has a specific function which makes accessing services easier on the mobile device.

CHAPTER 2: REVIEW OF THE LITERATURE

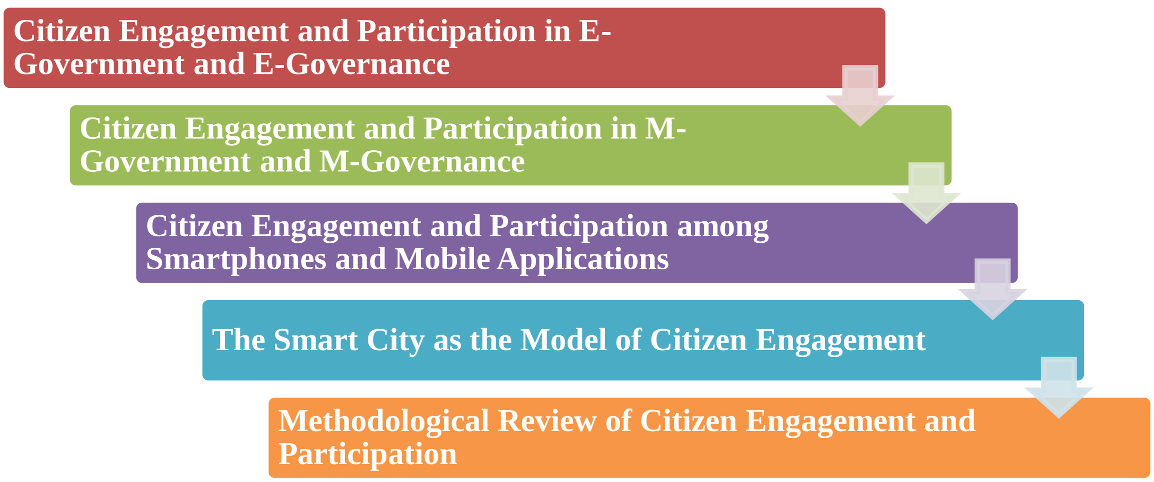
2.1 Introduction to the Literature Review

This chapter explores literature surrounding how e-government, e-governance, m-government, m-governance, the smart city model, and mobile applications can be used to foster greater levels of citizen participation, and the benefits and drawbacks of such ICT integration as it has been discussed in the e-government, m-government, and smart city literature. It attempts an in-depth analysis of the literature thus far to discern what studies have already found regarding this theme. It attempts to uncover missing areas where research is needed and does so to formulate the argument that there is a gap between examining value generation as it relates to citizen engagement in the smart city via the mobile application. Methodologies used to examine citizen engagement and participation thus far will also be outlined in the last section of this chapter to provide justification for the methodologies chosen.

Regarding the literature review, e-government discussion has been vast and multifaceted. M-government has largely been the same with developments and findings continuing to surface in many areas. Though there are many discussions involving e-government, m-government, and on mobile applications, including discussions of cost, efficiency, services, organization, etc., the study will primarily review literature that revolves around the effectiveness of citizen participation and citizen involvement in the e-government process along with the progression of e-government toward greater levels of citizen

engagement. In keeping close to the central research question of the study, many of the other aspects of e-governance will not be discussed. The reason and purpose for this is to hone the study specifically toward the effect of involving citizens in the mobile application development process to determine if such participation is in line with the literature reviewed and creates potential policy solutions in this e-government strategy.

Figure 2a: Hierarchy of Literature Review Components



2.2 Citizen Engagement and Participation in e-Government and e-Governance

The term "e-government" was coined by Stratford and Stratford in 2000. However, e-government has its roots earlier, having emerged in the late 1990s with the Internet boom of that decade. During this time, governments began to publish information online. Especially in the Federal Government, there was a recognition of the increased need for IT in government functions to improve processes (Snellen & Thaens, 2008). This trend continued and expanded in the 2000s, and e-government evolved over this period. The definition of e-government refers to the transformation of the business of government through its IT-driven operations and processes (Backus, 2001; IADB, 2001). Specifically, e-government has come

to encompass, “the use of Information and Communication Technologies (ICTs) in public administrations combined with organizational change and new skills in order to improve public services and democratic processes” (Grönlund, 2010, 20).

First and foremost, e-government promises increased efficiency and cost savings through the integration of government services with IT (Chadwick & May, 2003; Fountain, 2001). These aspects are also characterized by increased speed in the delivery of government services and with transactions and citizen interactions (Thomas & Streib, 2003). In addition, transparency on the part of government constituents is greatly enhanced through the availability and online display of information that can be easily searched and acquired more readily (Andersen & Henriksen, 2006; Layne & Lee, 2001; Moon, 2002; West, 2004; Kim, Lee, & Kim, 2010; Tolbert & Mossberger, 2006), and through internal transparency where administrator activities can be easily monitored through technology (Shim & Eom, 2008; Ho, 2002). Lastly, citizen participation is improved by supplementing old ICT systems (telephone, fax, etc.) and in-person interactions with Internet-related (sometimes 24/7) services to citizens (Reddick, 2005).

E-government not only refers to the provision of public service (e-administration), but also to the provision of supporting e-democracy (i.e., the tenets of e-government associated with involving citizens in the decision-making process in government). E-democracy is enhanced by fostering channels for citizen participation and engagement in political decision-making (Navarrete, Gil-García, Mellouli, Pardo, & Scholl, 2010; Schuppan, 2009). A part of e-democracy concerns electronic engagement (e-engagement), whereby citizens become participants in the policymaking process through ICT mediums. These processes are not

constrained to physical spaces, but instead proceed through IT-driven components and are facilitated through the Internet.

Such processes are described as leading to greater overall efficiency and effectiveness in public administration practices (Backus, 2001; IADB, 2001). E-government is a multidisciplinary field that sits at the crossroads of computer science, information systems, public administration, and political science. One argument is that simplification of services is needed to automate efficient transactions between public organizations and various stakeholders (Sprecher, 2000). Furthermore, e-government has been shown to decrease the workload of administrators, thus making it beneficial to implement from an internal perspective (Kirillov & Shmorgun, 2011).

Still, early studies by Tapscott (1996) capitalized on another aspect of e-government: E-government exists to facilitate greater collaborative capacity in government as well, and to increase effectiveness through such collaboration. In this sense, e-government acts as a tool to facilitate collaboration, whereby public agents can interact with societal stakeholders to generate value and form strategic directions. From this, others have taken the stance that e-government should embrace the citizens' perspectives (Lawson, 1998), with power to affect governmental workings being transferred to the people through such IT-driven channels. Wimmer and Traunmüller (2000) also saw e-government as a new era of public administration guided by ethical principles associated with empowerment and opportunity for citizens, which would allow citizens to more substantially contribute to policy formulation and legislation.

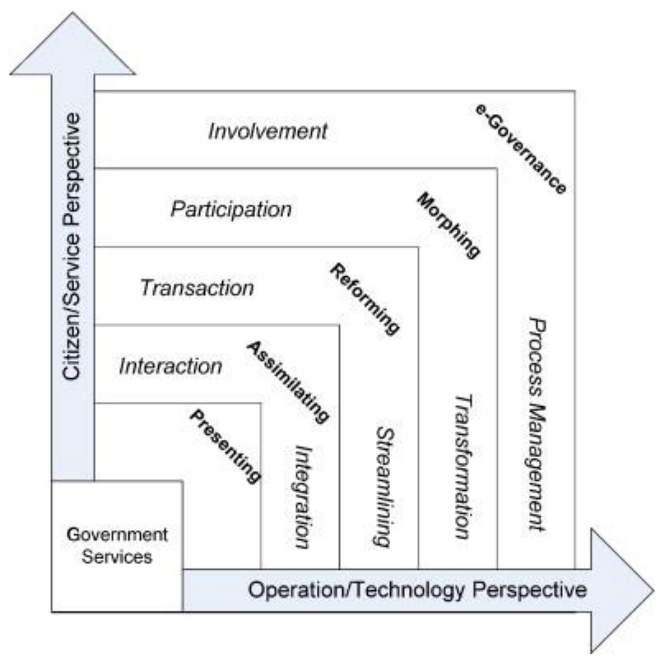
A common theoretical foundation for e-government is to analyze it as it proceeds through stages. Analyzing these stages becomes important in addressing the progression of e-government toward later levels characterized by citizen-centric collaboration. The classic stages model was developed by Layne and Lee (2001) early in the e-government literature. Layne and Lee developed the first model of e-government as progressing through four stages: the Cataloguing Stage, whereby information is displayed for users; the Transaction Stage, whereby users interact with government by licenses, forms, tax payments, and accessing other services; the Vertical Stage, whereby local systems link to higher levels of government; and the Horizontal Stage, which refers to sharing information across the different levels of the local government. However, this model did not consider the interactions between governments and external users and the evolutionary move in the stages of e-government needed to encompass such interactions (Andersen & Henriksen, 2006).

Hiller and Bélanger's (2001) model enhances the notion of e-government stages and contains five distinct stages: one-way communication, two-way communication, service and financial transaction capabilities, integration among departments (horizontal and vertical), and political participation. In the fifth stage of this model, the tenets of citizen participation take hold, characterizing the most advanced stage of e-government that is possible. Similar models are proposed by Moon (2002) and West (2004), with Moon suggesting the final stage encompass online voting, online public forums, online opinion surveys and other mediums by which citizens can contribute to the political process. By and large, the stages proceed from the simplest forms that disseminate information to the public to two-way interactions

between government, citizens, businesses, and employees. Each stage is also characterized by the degrees of greater technological capacity that is necessary to bring them about.

A 10-year retrospective by Lee (2010), however, saw the stages as being more complicated, with increased technological and IT capability defining the stages in different ways. Lee expanded on the stages and characterized them as being defined by greater levels of collaboration between government and stakeholder (Lee, 2010). Figure 2b shows how these themes and dimensions give way to stages with themes centralized around the citizen and service perspective and operation/technology perspectives that gives way to 5 stages: the Presenting Stage, the Assimilation Stage, the Reforming Stage, the Morphing Stage, and the e-Governance Stage. The latter two stages are characterized by participation and involvement on the part of citizens in the governance process.

Figure 2b: Advanced Stages of e-Governance Model



Source: Lee, 2010

What becomes important is that, as the stages progress, a common dilemma is that throughout this process challenges arise to government and stakeholders in the form of: information and data processing and collection, information technology concerns, organizational and managerial capability, legal and regulatory concerns, and institutional and environmental concerns revolving around the e-government implementation (Gil-García & Pardo, 2005). Systems become reliant on the technical merits of the system, but also on the changed management and user views of the system. Throughout the implementation process, various internal and external stakeholders emerge in the form of politicians who enact laws, public administrators who translate laws, programmers who design e-government systems, and citizens who are the end users of such systems (Evangelopoulos & Visinescu, 2012). One major external end user of the system are those internal and external stakeholders that manifest in the form of Government-to-Citizen or Government-to-Customer (G2C), Government-to-Business (G2B), Government-to-Government (G2G), and Government-to-Its-Employees (G2E) processes (Backus, 2001; Palvia & Sharma, 2007).

E-governance refers to these government, business, citizen, government employee, and non-profit interactions. The governance aspect from a managerial point of view focuses on the creation of efficient practices that reflect the needs of these groups by gathering feedback from internal and external stakeholders (Palvia & Sharma, 2007).

E-governance, then, seeks to bring about e-government but differs from it in characteristic ways. Governance becomes importantly characterized by the outcome of the interactions of the government, the public service, and the citizens throughout the political process, policy development, program design, and service delivery (Kumar & Sinha, 2007).

Pablo and Pan (2002) note that e-governance differs from e-government in that it is a broader terms that includes the transformation of e-government services through the transformation of the business of government (e-government); a shifting toward increased participation, openness, transparency, and communication (Schiavo-Campo & Sundaram, 2000); a transformation in the interactions between government and its (internal and external) clients (G2C, G2B, G2E, G2G); and a transformation of society itself through the creation of "e-societies."

The performance of e-governance by a government has two dimensions: the integration and transformation of services, and the degree of online citizen participation (Chen & Hsieh, 2009). The degree of how successful e-governance is can then be measured according to its I-Administration capabilities, or its improvement on internal functioning of its ICTs (back-office capabilities); its e-Government capabilities, or how it properly provisions its ICT-related services to citizens, and the efficiency, efficacy, and quality of these public services; and its e-Democracy capability, or the degree to which it engages the people and public in decisions comprised of e-voting and e-participation (Ferro & Molinari, 2010).

What is derived from the discussion above is that the later stages models of e-governance noticeably agree that greater capacity in e-governance is characterized by high levels of citizen participation in the policymaking process (Lee, 2010; Hiller & Bélanger, 2001; Andersen & Henriksen, 2006). With greater levels of civic participation, decisions can be made and are likely to be more accepted by the populace, as they represent citizens' inherent will (Heberlein, 1976). These efforts seek to engage citizens in the policymaking

process. Citizen participation itself has been shown to lead to positive outcomes for the people and institutions within society (Cialdini & Goldstein, 2004). Citizen participation is also argued to lead to greater levels of social wellbeing, as they believe their participation leads to greater acceptance of policies that will strengthen and benefit themselves and their society (Mannarini, Fedi, & Trippetti, 2009).

In this public participation, it is assumed that the information exchanged between government and its stakeholder arises through deliberation and dialogue, and that such opinions are addressed regarding both parties. It differs markedly from public communication where information flows one way from government to constituents or public consultancy where information flows from the public to the government (Winstanley, Sorabji, & Dawson 1995).

As Ertiö (2013) notes, there are traditional means of facilitating such public participation that manifest in referenda, public hearings, public surveys, consensus conferences, public advisory committees, and focus groups. However, such traditional means of bringing people together are presented with challenges, such as citizen selection, citizen briefing, expertise, the time needed to organize participation, and the capacity to absorb the information given by citizens in these arenas.

However, opening such traditional channels through digital mediums to capture citizen preferences and facilitate conversations presents many problems (Shareef, Archer, Kumar, & Kumar, 2010). As an example, digital divides occur in e-government between those with access to computers and those who do not have access, and between those with computer skills and those without such skills (Norris, 2001). Such divides further exacerbate

the ability of disenfranchised groups to connect with their governments and influence policy-making.

Despite this, however, the latest technologies present opportunities for improving on existing channels and creating better dialogue between government and citizen while tackling information technology and digital divides. E-participation concerns the use of ICT technologies to enable citizens to connect with their government (Sæbø, Rose, & Flak, 2008). This can include electronic voting, consultations, and petitioning, among other means by which this two-way communication occurs. Dialogue between elected officials and constituents can then occur to help facilitate better governance. In e-government, such e-participation can help to enhance democracy, be implemented easily and cost-efficiently, comes with greater access, and increases citizen trust and confidence in government services (Seifert & Peterson, 2002; OECD, 2003).

The responsibility of government becomes the delivery of services that meet the needs of the citizens (Hassan, Shehab, & Peppard, 2011). By proxy, e-governance is highly dependent on such citizen interactions, and the concept of e-governance encompasses the delivery of improved services to citizens, and more knowledge of to better facilitate access to the governing process and encourage greater levels of citizen participation (Castro & Mlikota, 2002).

As Calabrese and Borchert (1996) notes, democracy via ICT technology must rest on the vision of the government and the need to realize the power of such technology in facilitating democracy and citizen participation. Furthermore, as Axelsson, Melin, and Lindgren (2013) argue, the primary goal of e-governance is to make access portals to such

services accessible and available. There has been enough of a shift in differentiating citizen over-user participation as to designate the difference between external users (citizens, businesses, non-profits, etc.) and internal users (administrators) of the e-government system (Fischer, 2011; gen Schieck et al., 2006; Kraut et al., 2010).

This characteristically citizen-centric aspect of e-governance is showcased in the tenets surrounding citizen co-production, whereby citizens work with government to develop services that meet their needs. Web 2.0 technology, whereby interactions are facilitated in a two-way fashion, can largely facilitate these collaborative discussions between governments and citizens (de Zúñiga, Jung & Valenzuela, 2012; Linders, 2012). Specifically, Linders offers testament to this need for citizen-centric e-government efforts related to citizen co-production. Such co-production proceeds through citizen-sourcing, government as a platform, and do-it-yourself government facilitated by interactions with the citizen and carried out by government entities. In this G2C model, citizens are encouraged to share their experiences with government to facilitate citizen-centric policymaking.

When citizens are equipped with the necessary tools to facilitate such contributions, they can contribute to governmental on-goings and create more value associated with the e-government applications that are developed. Linders sees this transition as one from e-government to “we-government” whereby a “a new kind of social contract” is formed (Linders, 2012,453), with the public taking on increased roles and responsibilities in governmental on-goings. The system then becomes divided as citizens become consumers of public goods and services (Fernandes, Gorr, & Krishnan, 2001; Newcombe, 2000), while

also being members of the democratic system and contributors to policymaking (Cumming, 2001; Elgarah & Courtney, 2002; Webler & Tuler, 2000).

In the past, e-government strategy has been to distribute content that reflects the needs of the community to make citizens more interested and to promote citizen engagement (Gonçalves & Ballon, 2011). However, new ICTs and Web 2.0 technologies have changed the relationship between governments and citizens over the past decade, and with these have come new opportunities for citizen engagement (Dutil, Howard, Langford, & Roy, 2008). A problem, however, is that more often than not, the citizen aspects of the e-government portal are given low priority next to internal agency efficiency aspects, even though successful e-service efforts depend on citizen engagement (Axelsson et al., 2013).

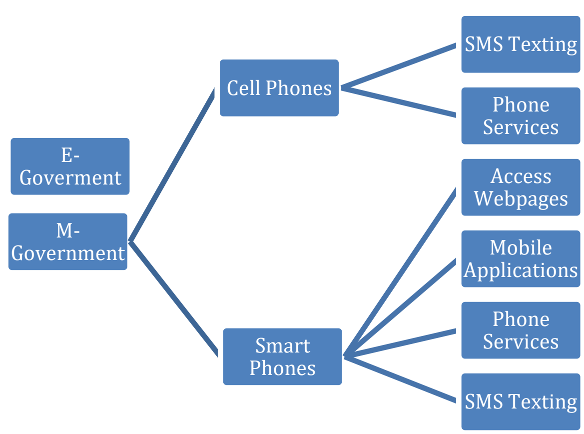
Furthermore, despite the increase in e-participation service offerings, many projects have not delivered their promise of truly engaging the public (Sæbø et al., 2008). This lack of opportunity for e-participation largely takes policymaking out of the hands of citizens and leads to a decrease in value generated. Further, the problem becomes that citizens do not use these services as they are intended (Esteves & Joseph, 2008). Because citizens question the utility of the program, they view these services as failures of e-government (Sæbø et al., 2008). As Pardo, Nam, and Burke (2012) note, the success and integration of such systems should proceed according to the three pillar goals of transparency, participation, and collaboration to determine the effects of such venues on society.

One other persistent problem becomes motivating citizens to participate in e-government efforts, and various strategies have been used to enhance participation by government (Harper, Li, Chen, & Konstan, 2007; Beenen et al., 2004; Rogstadius, Kostakos,

Kittur, Smus, Laredo, & Vukovic, 2011). However, Sweeney (2008) finds that e-government services are preferred mediums for citizens in terms of accessing services. Overall, citizen concerns are still largely tied to local-level concerns and issues that specifically affect them, but greater levels of civic engagement and greater involvement of citizens in the policymaking realm could lead to greater levels of engagement in other planning and decision-making processes through ICT mediums (Ellison & Hardey, 2013).

In e-government, young people are especially touted as being the means of increasing such engagement, as they make up the majority of Internet users, but by-and-large show less interest in civic affairs (Galston, 2001; Mossberger, Wu, & Crawford, 2013). Regarding usage, mobile and smartphone technologies are embraced by younger users (Smith, 2015), and such technologies may present ways in which citizens who feel empowered in decision-making can utilize ICTs to increase their civic engagement. As figure 2b shows, the progression from e-government to m-government systems becomes necessary based on technological developments and ownership by users. The use of smartphones and cell phones to carry out m-government tasks derives from this evolution.

Figure 2c: E-Government to m-Government and Its Subsets



2.3 Citizen Engagement and Participation in m-Government and m-Governance

This literature review now turns to a discussion of m-government and its transformative potential in facilitating greater and more equitable citizen participation via ICT technology. Based on the definition of e-government, Tseng, Yen, Hung, and Wang (2008) note that e-government extends to all IT platforms, regardless of ICT device. M-government then is the subset of e-government that utilizes ICT mobile technologies (e.g., smartphones, cell phones, and tablets) in e-government and allows businesses, agencies, other governments, and citizens to interact with and participate in the government with mobile devices (Trimi & Sheng, 2008; Wu, Ozok, Gurses, & Wei, 2008; Traunmüller, 2011; DIT, 2012; Karunakaran, 2011; OECD/ITU, 2011; Kushchu & Kuscu, 2003). It can also be referred to as "ubiquitous government" or u-government (Bélanger, Carter, & Schaupp, 2005; Cho & Chun, 2010), a name characterized by the global spread of mobile government.

Contrary to e-government, which refers to the use of the Internet and any digital medium to deliver information and government services, m-government only uses mobile technologies to accomplish these tasks (West, 2004; Ntaliani, Costopoulou, & Karetsos, 2008). M-governance expands on and facilitates the C2C, C2G, and G2C interactions that enhance digital democracy and strengthen e-governance. Furthermore, mobile government manifests in the form of m-communication, m-transactions, m-services, m-administration, m-democracy, and m-communities (Wu et al., 2008; Criado, Sandoval-Almazan & Gil-García, 2013). The latter two concern the voting and participation, and user-generated content and social networking in m-government, like the later stages of e-governance characterized by the Lee (2010) model.

Yu (2013a) notes that among the advantages of m-government are its mobility, ubiquity, portability, accessibility, and localization, with such systems providing value to all end users of m-government systems. Such value manifests in the convenience, efficiency, effectiveness, personalization, cost reduction, profitability, productivity, accountability, and transparency associated with this form of government (Yu, 2013a). With the evolution of this ICT technology, e-government itself has evolved, and scholars have begun to look at the advantages of this subset of e-government. While m-government offers one-way and two-way services in line with e-government, the benefit comes in the ability of mobile devices to receive information anywhere and anytime, regardless of location (because mobile devices are easily carried) or access to wired Internet (Shareef et al., 2010). Another advantage of mobile services is the ability to deliver real-time information to citizens based on their location (Kupper, 2005). Ultimately, such devices offer two primary advantages over traditional ICTs: mobility and wireless capability (Trimi & Sheng, 2008).

M-government then is not a separate field from e-government, but instead encapsulates a new technological tool, that of the mobile phone. Early studies on m-government by Kushchu and Kuscu (2003) suggested that m-government was only in its earliest stages of development, but that it would expand on other e-government services, effectively improving service delivery for users. The communication that exists through mobile phones allows for greater interactions between users, thus allowing them to more easily organize when they are seeking to carry out political action or civic engagement (Pierskalla & Hollenbach, 2013; Peng & Choi, 2013; Rotberg & Aker, 2013). Specifically,

mobile participation expands on e-participation by utilizing mobile technology to engage with citizens (Ertiö, 2013).

Early struggles with m-government were noted to proceed according to infrastructure development, privacy and security, legal issues, mobile penetration rate, accessibility, and compatibility concerns. Still, if these struggles can be overcome through m-government, citizens are able to save time, energy, and money by accessing networks through these mobile portals (Kumar & Sinha, 2007). To Kumar and Sinha, mobile applications rely on back-office capability, but m-government and related applications have the potential to bring about greater e-government functionality, equity, and capability. However, there have been rapid advances in m-government and a continued proliferation of mobile technologies worldwide, which has caused m-government service delivery to increase worldwide. Some even suggest that the inherent nature of the cultural, social, and political dialogue that occurs between mobile device users may change from traditional channels because of the widespread proliferation and use of this technology (Wasserman, 2011a; Wasserman, 2011b).

Still, Zamzami, Mahmud, and Abubakar (2014) note that these services are mostly developed without user-involvement. This is to say that these services do not account for citizen preferences during their development. Furthermore, e-government is inevitably moving toward encompassing more m-government technologies that offer users better accessibility and can empower citizens through technology better than typical e-government. Also, many governments are still stuck in the early stages of e-government, and the potential of m-government has not been fully realized (Zamzami et al., 2014).

Counter to this observation, however, trends as shown by Kushchu and Kuscu (2003), who note that m-Government is inevitable. Gutiérrez et al. (2013) argue that the aim of the smart city must include a dynamic view of city services that are embedded with each other, but must do so according to the citizens and the idea of engaging them in the policy realm. According to the authors, such cities not only incorporate ICTs, but also encompass the ICTs' role in organization, design, and planning. Mobile government and mobile device integration become central in allowing citizens to interact with their government anywhere and at any time.

M-governance success has been noted to proceed in a fashion very similar to that of e-governance. However, the transformative potential of m-government to enhance citizen participation and empower those disenfranchised through typical e-government systems is realized through m-government. Success factors of m-government as recorded by Al Khamayseh, Lawrence, & Zmijewska (2006) are: privacy and security, infrastructure, user needs and preferences, quality and user-friendly applications, e-government acceptance, cost, standards and data exchange protocols, a coherent m-government framework, high mobile penetration, infrastructure management, m-government awareness, access, strategy, IT literacy, m-government portal and exclusive gateway, partnership with private sector, legal issues, and liberalization of the telecommunication sector. Achieving success, therefore, is a difficult and multifaceted process.

The use of mobile phones has also been showing to increase civic engagement on the part of citizens, especially related to their use of social networks (Xie, 2014). Further, as cities move toward being classified as “smart cities” (Shapiro, 2006; Hollands, 2008), the city becomes a platform for creativity in application development that empowers citizens (Mainka, Hartmann, Meschede, & Stock, 2015). The empowerment potential of m-government becomes evident as it seeks to facilitate co-production (Linders, 2012) of services, whereby citizens become more than customers in government, but instead contribute to its overall wellbeing. Four primary delivery models then can be transformed from e-governance to m-governance:

Government-to-Citizens (G2C) → M Government-to-Citizens (MG2C)

Government-to-Government (G2G) → M Government-to-Government (MG2G)

Government-to-Business (G2B) → M Government-to-Business (MG2B)

Government-to-employees (G2E) → M Government-to-employees (MG2E)

Equity concerns are also addressed through m-government. Narrowing the digital divide becomes a key benefit (Trimi & Sheng, 2008; Salge et al., 2012). Many studies in e-government have identified a digital divide between those who have access to ICT technologies and those who do not. Cordella (2007) notes how reforms inspired by market logic can leave out those members of the population that are disenfranchised through technology by treating citizens as customers. In this regard, impartiality and equity is lost. Furthermore, Hoffman, Novak, and Schlosser (2001) note how socioeconomic factors such as education level and income can lead to a loss in equity on the part of those who do not own personal computers due to their skill level and lack of access. Early in the literature,

Hoffman and Novak (1998) showed these disparities, especially between white and black populations in their computer usage. Specifically, increased levels of income led to increased home computer ownership and use.

A solution arises in m-governance, as it is a way to bridge the digital divide and give citizens more access to government capabilities through their mobile devices. Being more affordable and often less reliant on a wireless network, citizens can access government services, participate in decision-making, and access transparent government information more easily (Manoharan, Bennett, & Carrizales, 2012). Despite this, m-government has been ignored in many areas, and along with it, the opportunity to bridge the digital divide (Manoharan et al., 2012). The mobile phone presents a way for economically and politically disenfranchised groups to better interact with government over other traditional ICT mediums. These networks effectively circumvent obstacles presented by other public infrastructures and create channels to strengthen the voices of these groups (Chen, 2015; Song & Liu, 2013; Ndlovu & Mbenga, 2013; Yuan, Raubal, & Liu, 2012).

With the goal of increasing democracy being prominent over the past 30 years, the Internet has provided a means by which public participation can be facilitated at far greater rates (Lee, Tan, & Trimi, 2005). For citizens, the ubiquity and convenience of mobile devices provides them with the opportunity to use wireless services more frequently. Savvy mobile users will increasingly look to m-government channels to interact with their governments (Lee et al., 2005). Many authors have noted that this vision of citizen-centric governance has been largely ignored related to e-government and m-government (Mossberger et al., 2013; Thiel, Reisinger, Röderer, & Fröhlich, 2016).

Among the problems associated with m-government, user acceptance becomes a critical concern in m-government, as technological acceptance drives utilization of mobile and other ICT devices (Bélanger et al., 2005; Hung, Chang, & Kuo, 2013; Hung, Chang, & Yu, 2006). The user acceptance model, a commonly utilized model in e-government and m-government, notes that the driving factors behind uptake of technology relate to trust, usefulness, ease of use, and risk associated with the technology (Hung et al., 2013; Horst, Kuttschreuter & Gutteling, 2007; Gilbert, Balestrini, & Littleboy, 2004).

Hellström (2010) also notes that many things can be communicated via mobile phones, and that these mobile devices have immense power in the realms of news and information updates, law enforcement and safety concerns, elections, disaster and crises management, education and awareness, data collection, and monitoring. Still, in the realm of increasing participation, the flow of information is consistently being improved upon by technological advances, such as the mobile device that quickly communicates information via SMS or MMS systems. Relating to the tenets of co-production, social media and citizen journalism allow everyone to participate.

However, Hellström (2010) notes that many challenges occur when implementing mobile and mobile application development, from both a user and developer perspective. From the user perspective, electricity-related issues, affordability, IT support systems, ICT literacy, language barriers, consumer rights, privacy issues, gender issues, network issues, lack of trust of the technology, and concerns about security can all present problems that inhibit mobile uptake. Developers also face problems; product development, sustainability, revenue availability, scaling up projects, infrastructure, fragmentation, handset limitations,

content, lack of developer training, the policy environment, lack of documentation, and lack of coordination and collaboration among stakeholders are noted as noticeable impediments to development. Risks do arise in m-government, as devices can be lost or stolen more easily (El-Kiki & Lawrence, 2007).

Much like in e-government, risks can also occur in a shortage of ICT skills among citizens and users (Ghyasi & Kushchu, 2004). M-government devices are still costly, but less so than traditional e-government devices (Mengistu, Zo, & Rho, 2009). Privacy and security also present huge obstacles for m-government and real-time services. Citizens often ask why data is being collected and what such data is being used for, which limits efforts (Lam, 2005), with users being susceptible to online tracking of their information by government (Layne & Lee, 2001).

Though there are numerous reasons why people may not participate, the largest impediment is availability in channels, which has been demonstrated to significantly limit those who participate. Furthermore, implementing user-centric designs carries large implications for increasing citizen participation in e-government, and e-government effectiveness hinges on these user-centric services (Bertot, Jaeger, & Grimes, 2010).

The context of mobile technology visual enhancements to interface are also noted to increase participation (Kukka et al., 2013). Further, it has been shown that the mobile phone has increased levels of political participation by opening a new avenue whereby citizens can interact with their government (Bratton, 2013; de Zúñiga, Copeland, & Bimber, 2013; Lee, Kwak, Campbell, & Ling, 2014a). Self-efficacy also increases with such a device, along with confidence in the ability to perform civic engagement functions associated with the ICT

technology (Cegarra-Navarro, Garcia-Perez, & Moreno-Cegarra, 2014; Kim & Chen, 2015; Kim, Kavanaugh, & Hult, 2011). Further, the use of social media and mobile applications not only exist in the social realm, but also impact community activism, civic engagement, and user-led and -generated innovations (Foth, Forlano, Satchell, & Gibbs 2011).

2.4 Citizen Engagement and Participation Among Smartphones and Mobile Applications

This literature review now turns to a discussion of the power of mobile applications and their strength in increasing citizen engagement and participation as a new and preferred technology, and the argument that they characterize e-government and m-government efforts moving forward. Mobile applications are specifically analyzed as a subset of m-government, but as a powerful tool that is largely underutilized by government around the world. Furthermore, they act as a tool within the smart city to carry out functions associated with it, presenting smart capabilities that allow mobile users to act as co-producers in gathering data and voicing their concerns in the smart city.

It has been shown that in m-government, the use of different applications and mechanisms can lead to greater levels of engagement (Gonçalves et al., 2013; Rogstadius, Vukovic, Teixeira, Kostakos, Karapanos, & Laredo, 2013). Smartphone and mobile application use as a subset of m-government has only recently been studied by e-government scholars. Many authors have noted the benefits of smartphones for civic participation, as they provide an advantage over basic mobile phones due to their functionality, which is much like that of a personal computer (Rice & Katz, 2003; Shah, Cho, Eveland, & Kwak, 2005). Further, smartphones and mobile applications provide a means by which communities with

fewer resources can access services without the need for in-home connectivity or the possession of a computer and Internet package (Hellström, 2010). Smartphones come with that mobile capability while still possessing many of the functional features of a computer, which allows the user to interact with government anywhere (assuming data or wireless Internet is available), and they are not dependent on staying in a fixed location (Lee-Gosselin & Miranda-Moreno, 2009).

Hellström (2010) shows that mobile application use in the private sector has transcended typical social networking, whereby users stay in touch with friends and family, and is moving toward information- and demand-oriented services. Furthermore, the authors analyze stakeholders present in the mobile development space as not only those in the private sector, but also as policymakers, mobile network operators and service providers, mobile phone manufacturers, application developers, government sector players, small- and medium-sized enterprises, researchers, innovators, consultants, and civil society users. Therefore, the applicability of mobile applications and their usefulness is far-reaching.

For civic engagement, mobile smartphone technology can lead to increased levels of civic engagement and political participation. To the user, the sense of self-efficacy through the smartphone technology, the feeling of influencing policymaking easily, and accessibility become important determining factors for potential users of such technology (de Zúñiga et al., 2013; Lee et al., 2014). The social networks that have been expanded upon by having a mobile smartphone has changed cultural, social, and political norms, especially for young people who have embraced such technology and have grown up with it as part of their everyday lives (Chuma, 2014; Licoppe & Smoreda, 2005). But as Hellström (2010) shows,

this benefit can also be extended to older users, especially if smartphones and applications have usable interfaces designed for new users.

Users of smartphone technology, who are usually pre-teens, teenagers, and young adults (but not exclusively these demographics), have shown an increase in their civic engagement through such use, especially related to the use of social networks, whereby they are able to more readily organize discussion around important political topics (Xie, 2014). In a practical sense, Christin, Roßkopf, and Hollick (2013) show that participants are ready and willing to contribute to mobile application use, and to do so in a co-productive sense by providing information that better enhances the application's overall capabilities. The application analyzed by Christin et al., uSafe, has led to increased levels of participation in urban sensing, whereby the community generates data for various urban needs. In this application, safety of urban neighborhoods is reported when, users report problems, reported information is made available to users in map form, and the anonymity of participants is protected.

Regarding co-production of mobile applications, citizen-centric applications ("citizen apps") are referred to by Desouza and Bhagwatwar (2012) as those applications that are developed by citizens to tackle specific government needs, as opposed to those developed by the government. In public management, co-production of mobile applications is not a common principle, despite the success of co-production related to public management from the standpoint of efficiency and effectiveness, and the widespread study of the tenets of co-production regarding ICT in the literature. Despite this, there is immense potential for mobile applications to empower individuals and allow them to contribute to the overall wellbeing of

their communities through ICT mediums. A central argument for applications that are designed according to co-production standards is that these applications will lead to increased innovation, responsiveness, and utilization of such ICTs (Zouridis & Thaens, 2002). For example, Christin et al. (2013) show that in uSafe, a privacy awareness and participatory application, citizens were likely to contribute to the applications' functions and become ready participants if the app met their safety needs.

Paletti (2016) specifically shows that those ICTs that facilitate co-production, whereby citizens contribute to the on-goings of their government, have potential in building public value, or a community sense of value associated with the service in question. Among the applications, the authors analyze that empowerment of the individual and the realized benefits to them are of extreme importance in facilitating co-production. By-and-large, the applications tend to connect people, share data with the community, and contribute to the "Internet of Things" concept, whereby the Internet links various objects such as smartphones, sensors, tags, computers, and mobile phones to non-human and human actors (Atzori, Iera, & Morabito, 2010). It is like the smart city model, whereby the city and its many ICT-related features become integrated (Tambouris et al., 2006).

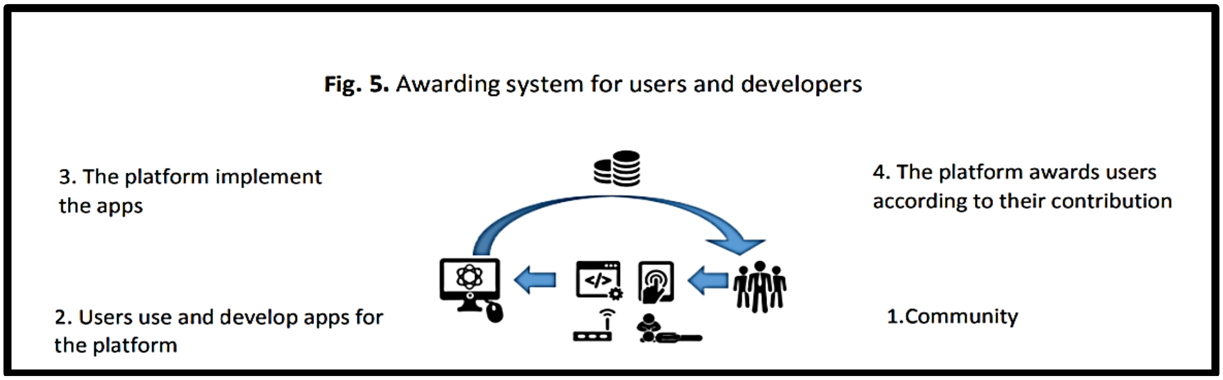
As was outlined previously, ICTs have the power to change public administration and public policy initiatives immensely as they create a new realm by which public opinion can be gauged and services delivered (Bovens & Zouridis, 2001). Paletti (2016) outlines how it becomes necessary according to Actor Network Theory, where citizens influence the network they are involved in, to allow citizens to produce new models of services that satisfy specifically their needs and values. As such, the state acts as coordinator of such services and

generates associated value through their services. It becomes imperative for the final users of such services, the citizens, to be actively involved in their development. She builds on the research of Fishenden and Thompson (2013), which states that such citizen-centric bottom-up initiatives can improve innovation and reduce costs while satisfying citizen needs and garnering higher levels of usage.

Emaldi, Aguilera, and López-de-Ipiña (2017) also show a quadruple-helix model of stakeholder-oriented co-created mobile applications in the WeLive project, whereby citizens, private companies, research institutes and administrators create applications. The fourth helix is specifically that of the citizen who becomes a central collaborator in the development of the application. During the 24-month development process, the authors through questionnaires and focus groups show how the collaboration efforts provided the means for the various stakeholders involved to collaborate in the development process successfully.

Such a system relies on high levels of in-house ICT expertise to manage the open architecture platform. In Paletti's (2016) most advanced model of co-created platforms, the members of the community can modify and contribute to the contents of the application, with technical aspects relegated to in-house ICT providers. Citizens and companies can freely compete to contribute to the co-production of public services, as seen in figure 2d.

Figure 2d: User-Developed Mobile Applications



Source: Paletti, 2016

2.5 The Smart City as the Model of Citizen Engagement

From e-government, the idea of the smart city as an all-encompassing, sustainable, citizen-centric, and efficient city enabled by ICT technology has arisen. The smart city notion has been ambiguously defined, but a more coherent version begins to emerge regarding the new model of the urban city. According to Meijer and Bolívar (2013), the smart city concept becomes appealing for economic, sustainability, information-centric, and fashionable reasons. Public value creation, societal transformations, energy, and sustainability concerns dominate the discussion, but a key driving force is the need for greater levels of participation and collaboration. Lee and Lee (2014) also note that any service with a goal of increased efficiency and effectiveness that proceeds through ICTs can be classified as a smart city service.

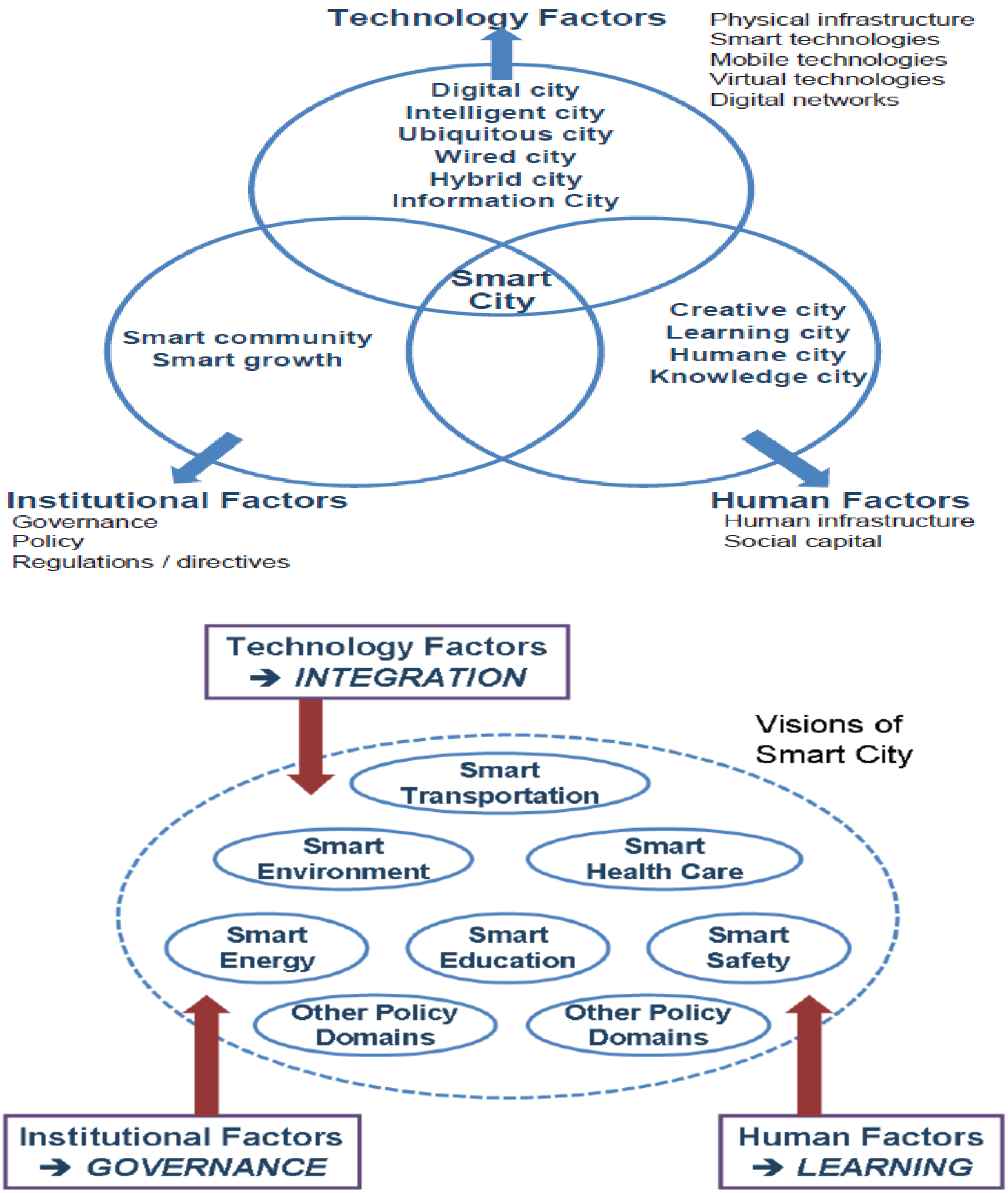
The smart city is built on the principle that the city uses technology to pursue its goals both through creating an overall better quality of life, improving environmental conditions, and improving services (Dameri & Cocchia, 2013; Gutiérrez et al., 2013; Mellouli, Luna-

Reyes, & Zhang, 2013). It is derived from e-government and m-government, with a central component of the smart city being tied to both citizen participation and the use of smart technologies, primarily the smart phone and the associated mobile applications. Thus, these devices and services act as a tool for the city. The concept itself is summed up by Dameri and Cocchia (2013) accordingly through their analysis of 705 articles containing the term "smart city." They conclude that it (the smart city):

> [R]egards both sustainable technologies, able to reduce pollution and energy consumption, and communication technologies, based on the large use of smart phones or other smart devices. Moreover, also ICT could be at the basis of sustainable urban strategies, such as smart software used to support a better local public transport planning. The use of the smart label to address sustainable cities is driven by EU programs, but the smart city idea overcomes this definition to collect under this urban strategy heterogeneous technologies and policies. Moreover, the smart city concept is not entirely based on technology: also, energy savings through more aware behavior, or larger urban green areas, are sometimes considered smart actions. (5)

Early in the literature on smart cities, Nam and Pardo (2011) saw the smart city as a connection between the technology, institutional, and human factors associated with the city. To the authors, the social factors became central in developing smart city services that proceeded according to a "socio-technical" path. Smart governance proceeds in-line with e-governance, and smart technologies provide the means to carry out and build social capital and human-centric learning and co-productive efforts, according to figure 2e (below).

Figure 2e: Smart City Development and Critical Factors



Source: Nam and Pardo, 2011

Much like with Linders (2012), the smart city concept is built upon the notion that citizen participation in the development and betterment of services is essential to the overall success of the smart city. Gutiérrez et al. (2013) argue that the inherent need for the smart city is to create a more urban-friendly experience for users.; these users are ultimately the citizens of the city. Therefore, they argue that citizens must be involved with the very first stages of smart city movement. Therefore, smart government relies on the forward-thinking notion of enhancing citizens' experiences with information technology (Mellouli et al., 2013; Gil-García, Helbig, & Ojo, 2014; Lee & Lee, 2014).

Meijer and Bolívar (2013) analyze the marriage of the smart city with the tenets of e-government and note that the concept of the smart city rests on a vision of e-government and its attributes. They find that four aspects of the smart city are rooted in their analysis of literature on the topic: government of a smart city, smart decision-making, smart administration, and smart collaboration. Furthermore, the level of transformation of the city presented by the various interventions increases accordingly with smart collaboration, thus creating enormous transformative potential, much like it does in e-government, according to the stages model (Lee, 2010).

Figure 2f: Perspectives on Smart City Governance

Perspective on smart governance	Level of transformation	Focus
Government of a smart city	Low	Good administration, good policy
Smart decision-making	Medium-low	Innovate decision-making
Smart administration	Medium-high	Innovate administration
Smart collaboration	High	Innovate governance

Table 1. Perspectives on smart city governance

Source: Meijer and Bolívar, 2013

Meijer and Bolívar (2016) also later address the ambiguity in the smart city model, and through their analysis of 51 articles on the smart city, the authors conclude that smart city forward-thinking capabilities rely on providing new avenues for human collaboration enhanced by various ICTs. Such outcomes should lead to more open governance, and technology is not the driving force but rather the tool used to achieve institutional change. Therefore, much like with e-governance, smart city governance as its end goals relies on providing channels for collaboration that lead to greater levels of citizen participation and collaboration. The authors devised four major suggestions regarding the smart city: Conceptualize smart city governance as an emergent socio-techno practice, focus on both the transformation and conservation of urban governance institutions, assess the contribution of smart city governance to both economic growth and other public values, and analyze the politics of smart city governance. Van der Graaf and Veeckman (2014) show through a case study analysis of the city of Ghent that urban space can effectively be co-designed to utilize

the skillsets of citizens, when capacities and skills of the citizens are considered regarding the design of the application.

De Lange and de Waal (2013) examine “ownership” as it relates to smart city services and the concept of co-creation of public services that creates the social fabric of the smart city. They ask how to engage and empower citizens in this model according to participatory platforms and conclude that organization and new medias present enormous potential for organizing citizens and allowing ownership of city initiatives. Therefore, to optimize the co-productive efforts of the smart city and its services, the concept of designing services according to the input of citizens becomes important in the city’s initial and continued development with ICTs. The co-design of ICT-centric spaces that play to the strengths of all citizens to enable greater efficiency in service delivery and data gathering becomes centrally important.

Berntzen and Johannessen (2015) note that such citizen participation enhances the smart city in three primary ways: by utilizing the experiences of citizens and listening to their voices, more efficient practices may be garnered, by collecting environmental data using citizen smartphones and applications to gather data for various means, and by enhancing democracy and creating an environment and community with citizens invested through technology. They note that it becomes the responsibility of the government to set the agenda regarding a specific service and to call for input from citizens and other stakeholders in the project. Chourabi et al. (2012) state, “Projects of smart cities have an impact on the quality of life of citizens and aim to foster more informed, educated, and participatory citizens.

Additionally, smart cities initiatives allow members of the city to participate in the governance and management of the city and become active users" (2293). Inherently, Mellouli et al. (2013) show that the smart city that considers citizen perspectives represents a sort of collective action and relies on the input of the citizens and their trust in the view that their perspectives are valued and taken into consideration. However, van der Graaf and Veeckman (2014) also show that participation can exclude some users in development. Therefore, processes need be developed that proceed through multiple channels and are not technologically limiting.

Gil-García, Pardo, and Nam (2015) later expand on the notion of the smart city and seek to conceptualize the practical aspects of the smart city with what it theoretically hopes to purport by analyzing academic literature and practical tools. Below, in figure 2f, the authors first identify the core components of the smart city, then they identify the new model of the smart city as it seeks to improve itself as it becomes more effective and incorporates more practical aspects. As the more progressive figure shows, in accordance with the tenets of e-governance in the smart city, citizen engagement takes on a fundamental role.

Figure 2g: A View of Smart City Components and Elements

J.R. Gil-Garcia et al. / What makes a city smart?

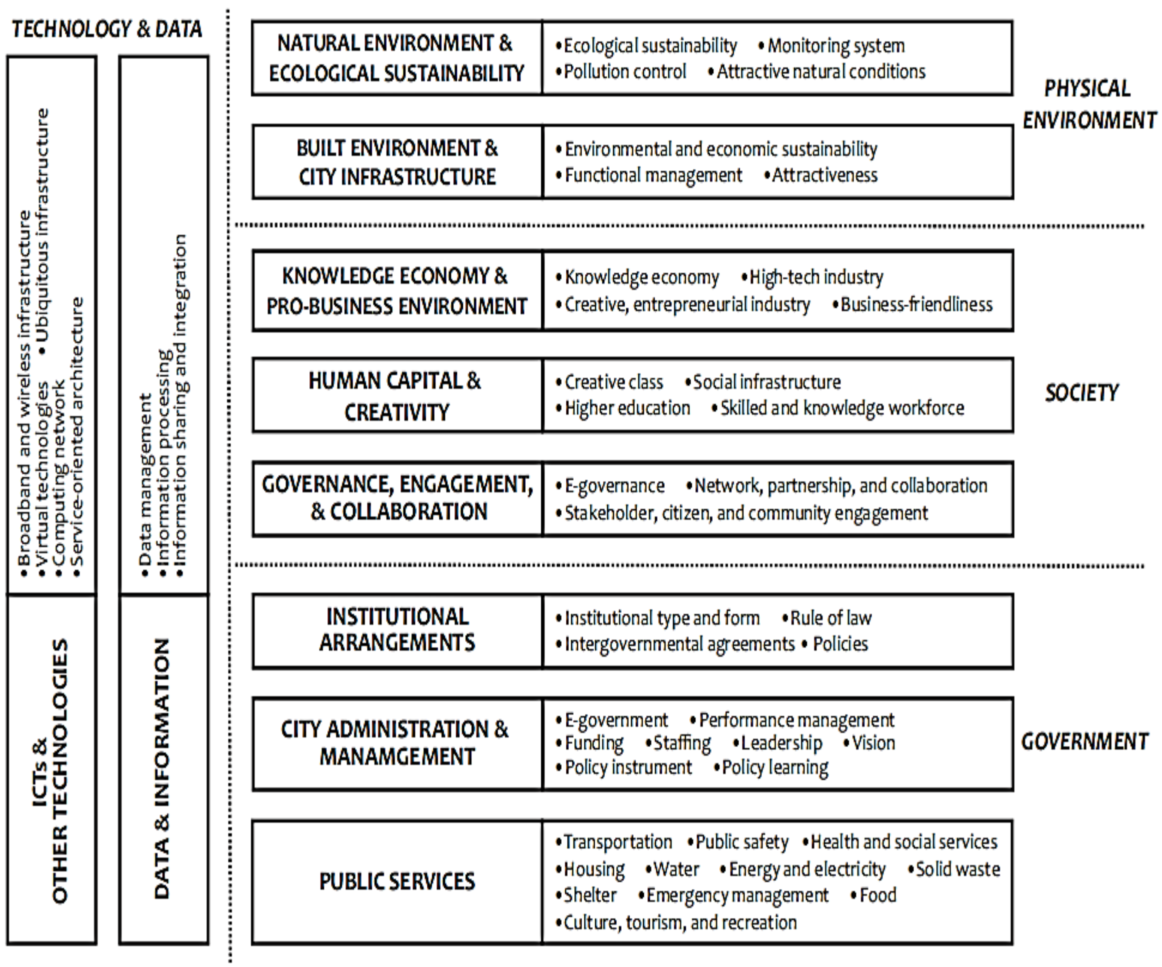
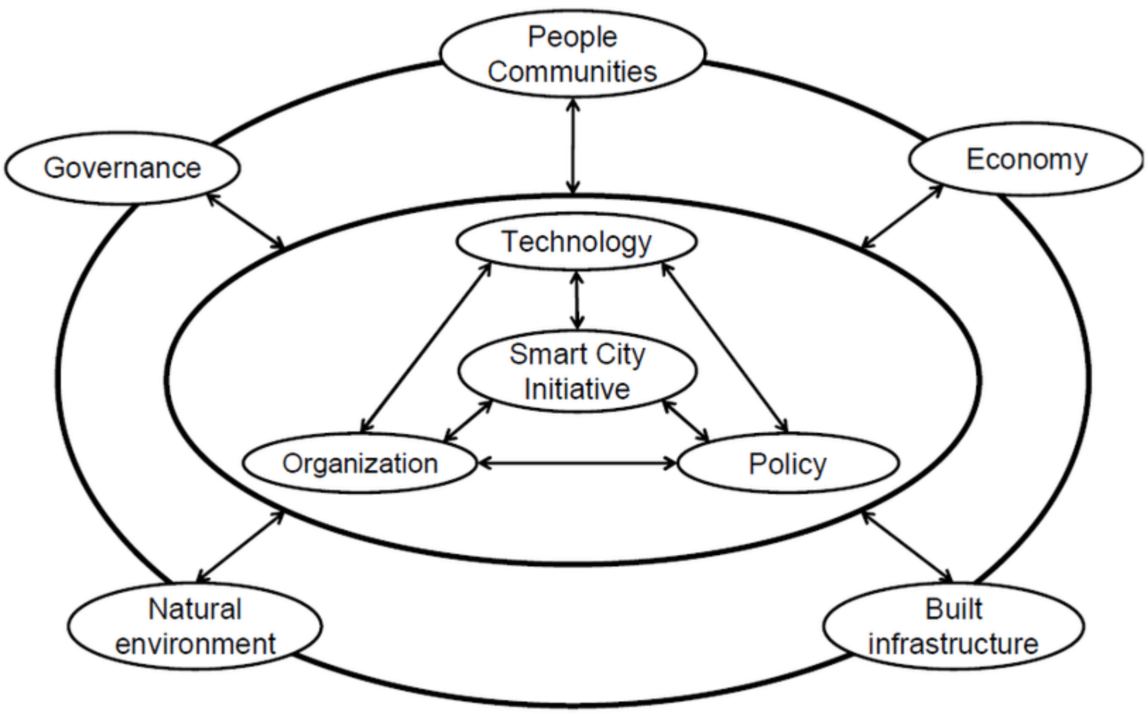


Fig. 2. A comprehensive view of smart city components and elements.

Source: Gil-García et al., 2015

Chourabi et al. (2012) show in figure 2h that the smart city becomes centrally located around the initiative it presents, with eight critical factors presenting themselves in the smart city initiative: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment.

Figure 2h: Smart City Initiatives

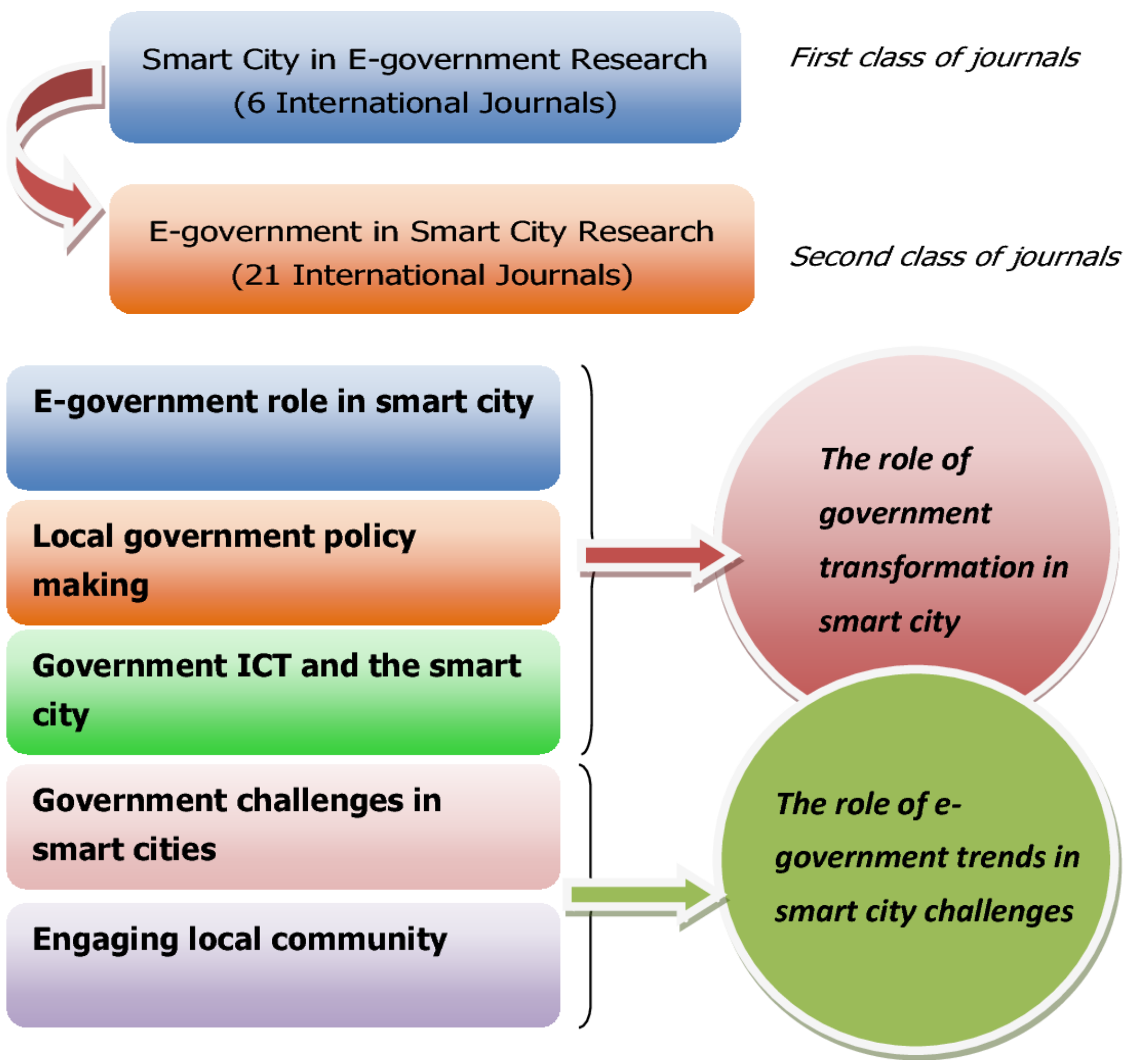


Source: Chourabi et al., 2012

In addition to all of this, Anthopoulos and Reddick (2016) examine the interrelation between e-government and smart cities to determine if e-government effectively consists of theoretical concepts and frameworks that address smart city concepts through an analysis of 27 e-government journals. They conclude that e-government has a role in the smart city concerning the transformation of local government services; that smart city tools are largely

reminiscent of e-government tools; that the role of government in incorporating ICTs is in line with both e-government and smart city models; that smart cities address challenges associated with local governments; and that cities represent the forefront of e-government adoption, and the smart city incorporates concepts associated with engaging the local community.

Figure 2i: Smart Cities in e-Government Literature



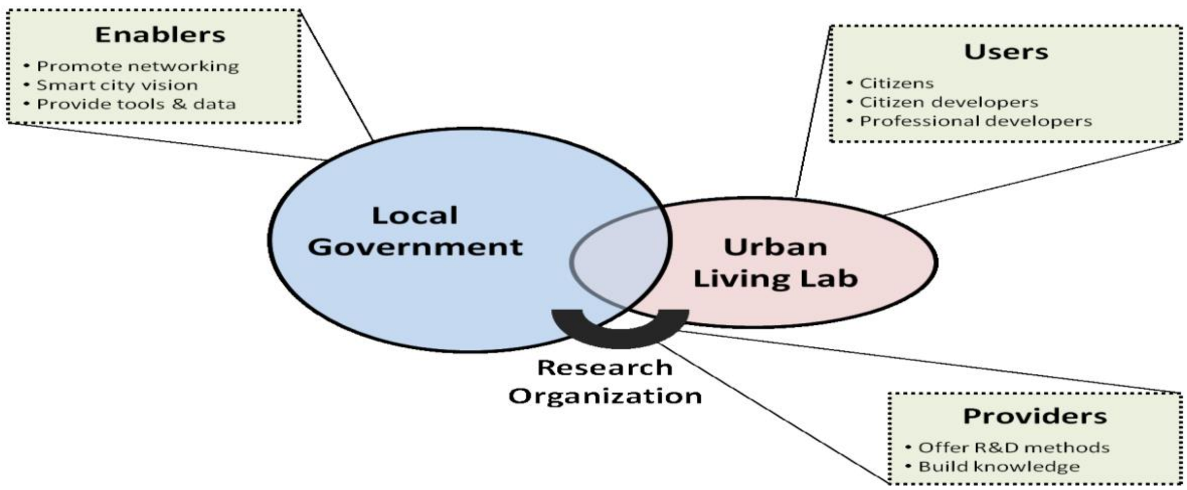
Source: Anthopoulos and Reddick, 2016

The tenets of e-governance are therefore deeply rooted within the smart city model. As a consequence, citizen engagement becomes centrally needed. Veeckman and van der Graaf (2015) also examine the new approaches to bottom-up citizen engagement in smart cities by examining four smart city collaborative initiatives in Europe. They show that the smartphone mobile application presents a means by which e-governance and citizen participation can be transformed according to the power of such services. These services enable the ability to gather data, while also creating and developing services for both tech-savvy and less-tech-savvy users. “Smart city applications thus form a new digital layer of the city, in which citizens are not only invited to participate in the data collection (e.g., crowdsourced information about air quality), but also in the actual ideation and development process of the services” (4).

Therefore, the smart city creates an ecosystem whereby development occurs with citizens and other stakeholders playing select roles depending on their capabilities. Of note in this process are the users, as these users are invited to participate and provide feedback through the co-creation process. In the study by Veeckman and van der Graaf (2015), for the development of a tourism-centric mobile application, such users were characterized according to their technical ability and skill level and grouped into those with no, limited, or high technical knowledge. They conclude that their living lab approach, whereby the lab develops according to user-centric input and develops along the way, led to: the facilitation of participation with testing and feedback being given along the way by various stakeholders; the understanding that co-creation processes could include and exclude due to technological differences in users, and the fact that technical errors could discourage users from continued

participation in the process and solutions and success relied on tools and interventions that matched skill levels; and the knowledge that the approach empowered citizens and that participation led to skill development and empowerment in the goings-on of the community.

Figure 2j: Contributors to the Smart City



Source: Veeckman and van der Graaf, 2015

Granier and Kudo (2016) show that citizen participation has largely not been examined as to its effect on the smart city. They interviewed smart city administrators in Japan and found that citizen participation became a central goal of these cities, with efforts proceeding toward more co-productive services, rather than direct citizen input in developing smart city services. As Gil-García et al. (2015) note, bridging the gap between theoretical concepts, such as e-governance and citizen engagement, and practical tools to and implementation of smart city concepts becomes of extreme importance.

Zubizarreta et al. (2015) analyze the role applications play in the smart city model and the relationship between the citizen-user and the tool of the smart city, namely the

application. The application then acts as a tool of "awareness, representation, expression, communication, as well as management, governance, and planning" (2). Further, they manifest as associated with six types of mobile application: Economy (competitiveness), People (social and human capital), Living (quality of life of citizens), Governance (participation of citizens), Environment (natural resources, sustainable growth), and Mobility (transport and ICT).

Furthermore, Kleinhans, van Ham, and Evans-Cowley (2015) show the benefits of mobile technologies engagement, which has potential in transforming citizen engagement in the context of the smart city. However, a clear note they make is that certain divides still present pressing concerns and that engagements and efforts should be made to include both technologically savvy and slow adopters of technology. Further, benefits will only materialize if a concrete action and connection is made between the engagement and the service. Such benefits should also accrue in the real world and be indicative of better services, improvements in the urban area, or events.

Ultimately, Cardullo and Kitchin (2017) conclude that significant work is needed to re-imagine the smart city according to citizen-centric principles. The authors rework Arnstein's (1969) seminal work on citizen participation into a "scaffold of smart citizen participation," and examine such a scaffold according to services provided in Dublin, Ireland. They conclude that while citizen initiatives are diverse and multifaceted, "citizens are encouraged to help provide solutions to practical issues – such as producing an app, or feeding back on a development plan, or to perform certain roles/responsibilities – but not to challenge or replace the fundamental political rationalities shaping an issue or plan" (18).

Involvement in the consultation and development processes is noted to be limited by the authors, along with the role citizens play in conception, development, and governance itself.

Figure 2k: Scaffold of Smart City Participation

<table>
<tr><th colspan="2">Form and Level of Participation</th><th>Role</th><th>Citizen Involvement</th><th>Political discourse/ framing</th><th>Modality</th><th>Dublin Examples</th></tr>
<tr><td rowspan="3">Citizen Power</td><td>Citizen Control</td><td>Leader/ Member</td><td rowspan="2">Ideas, Vision, Leadership, Ownership, Create</td><td rowspan="2">Rights, Social/Political Citizenship, Deliberative Democracy, Commons</td><td rowspan="3">Inclusive, Bottom-up, Collective, Autonomy, Experimental</td><td>Code for Ireland, Tog</td></tr>
<tr><td>Delegated Power</td><td>Decision-maker, Maker</td><td rowspan="2">Civic Hacking, Hackathons, Living Labs, Dublin Beta</td></tr>
<tr><td>Partnership</td><td>Co-creator</td><td>Negotiate, Produce</td><td rowspan="2">Participation, Co-creation</td></tr>
<tr><td rowspan="3">Tokenism</td><td>Placation</td><td>Proposer</td><td>Suggest</td><td rowspan="8">Top-down, Civic Paternalism, Stewardship, Bound-to-succeed</td><td>Fix-Your-Street, Smart Dublin Advisory Network</td></tr>
<tr><td>Consultation</td><td>Participant, Tester</td><td>Feedback</td><td rowspan="2">Civic Engagement</td><td>CIVIQ, Smart Stadium</td></tr>
<tr><td>Information</td><td>Recipient</td><td rowspan="4">Browse, Consume, Act</td><td>Dublinked, Dublin Dashboard, RTPI</td></tr>
<tr><td rowspan="3">Consumerism</td><td rowspan="3">Choice</td><td>Resident</td><td rowspan="3">Capitalism, Market, Neoliberalism</td><td>Smart building/ Smart district</td></tr>
<tr><td>Consumer</td><td>Smart meters</td></tr>
<tr><td>Product</td><td>Personal data generated by tech</td></tr>
<tr><td rowspan="2">Non-Participation</td><td>Therapy</td><td rowspan="2">Patient, Learner, User, Data-point</td><td rowspan="2">Steered, Nudged, Controlled</td><td rowspan="2">Stewardship, Technocracy, Paternalism</td><td>Smart Dublin, Dublin Bikes</td></tr>
<tr><td>Manipulation</td><td>Traffic control</td></tr>
</table>

Source: Cardullo and Kitchin, 2017

2.6 Methodological Review of Citizen Engagement and Participation

This section has the goal of outlining previous methods that have focused on the benefits of citizen participation and co-production in e-government and m-government related to mobile applications. This section of the literature review argues that this study's design shows a necessary causal parameter by which e-government policymakers can design applications based on citizen input. Interviews take an interpretivist view on building knowledge bases toward a greater understanding of the "why" and "how" citizens utilize mobile applications.

Specifically, it seeks to show the unique aspect of this proposal's methodologies by shining new light on its central research questions. Heeks and Bailur (2007) find the use of qualitative methods has been sparse throughout the literature. Overall, among the e-government literature, there has been immense attention paid to the benefit associated with e-government, but less regarding how to gauge the creation of perceived value in ICT systems when citizens are engaged in the policymaking and ICT development processes. Even less attention has been shown toward measuring the effect of systems designed according to citizen inputs that reflect the desires of the citizen.

Heeks and Bailur (2007) undertook a content analysis of 84 e-government papers to find that most are based on theoretical constructs, but which by-and-large do not provide practical guidance to those seeking to undertake better e-governance. Overall, e-government academic works are found to be dominated by frameworks derived from various theories that lend themselves to testable hypotheses, but with methodologies that do not lend themselves to strategies for better e-governance and citizen engagement for policymakers. Lindgren and

Jansson (2013) also focus on the lack of theory-building in e-government, with studies failing to build on and utilize theory to garner applicable results. Despite the stages model of e-governance (Layne & Lee, 2001), there is little tested regarding how stages progress and if these theories hold true. Bannister and Connolly (2015) also conclude that among e-government literature, such literature is highly dependent on the descriptive case study or case history methodologies, and that there is a need to test existing theories using different methods.

Similarly, Hansson et al. (2014) also conduct a content analysis of prominent e-government journals to discern what focus has been given to open government and the notions of transparency, deliberation, and representation and how they are addressed. They find that journals that analyze the democratic and deliberative process about e-government are lacking, and that such information seems to be largely congregated in specific journals and is not widely studied in a multidisciplinary sense. Further, Algeo (2012) conducted a literature review of existing e-government articles to determine whether such global e-government strategies were leading toward greater levels of deliberative processes and were in fact successful in their e-governance efforts. They found that they were not meeting such equitable and deliberative standards. Specifically, while e-government has made great strides in its transactional offerings, there has been little success in fostering e-government efforts that lead to the change of policy by citizens.

Using case study analysis, Tan et al. (2005) determine that citizen stakeholders are motivated by a desire to self-actualize themselves through e-government interactions. Their results determine that these viewpoints are important and should be captured in the governing

process. Mueller-Lankenau and Wehmeyer (2005) expand on these findings a survey to consumers in the private sector to see what factors influence citizens' use of mobile couponing and find that such empowerment in viewpoints is also beneficial in the private sector. They note how consumers utilize such functions if they see such avenues as useful the consumer perspective, with such couponing also generating revenue for the firm.

Scott (2006) examined the capacity of the 100 largest U.S. municipal city's websites early on to see if they were fostering tenets of e-democracy and public involvement and found that websites provided very little evidence of public involvement. While the websites had potential to integrate such services, they had largely not done so yet. Further, likely explanations for such little development related to capacity, but also to the political and legal aspects of risks associated with opening such channels. Regarding this argument over capacity, Tseng et al. (2008) use participatory observation of IT consumers and interviews of IT managers to show there is a need to evolve toward e-government that encompasses more innovative IT applications that build capabilities in=-line with the goals of e-governance and with the support of the community. Such apps should be designed to build a community culture that facilitates knowledge management and promoted participation to generate public interest in the IT-development capabilities.

Alonso (2009) finds that e-participation efforts may take longer on the part of local government as they become familiar with the process and must have mechanisms in place that address consumer demands. Schwester (2009) attempts to show through multiple regression of largely populated city's data how some cities have progressed in their e-government while how other cities have not, especially from the standpoint of progress

toward later levels of e-government, such as e-participation. The results show that holding all other factors constant, financial, technical, and human resources components lead to overall e-government success. Those with higher budgets, more full time IT staff, and better technical hardware will have greater e-government scores. Political components and support from elected officials were also a significant determinant, while privacy and security were not.

Bertot et al. (2010) note, however, that economically there are major challenges to measuring and capitalizing on e-participation and quantifying such benefits. Administrative costs need to be weighed against the usage of such applications and their benefit to society. If quantified, however, such benefits can be a means of measuring if the mobile application is useful and whether a high degree of citizen engagement will be beneficial in the development of such applications.

Further, debates occur over participation and inclusion in e-government. Quick and Feldman (2011) define participation and inclusion separately, with participation entailing efforts to increase public input regarding policy and program content, and inclusion entailing the creation of a community that is involved in the co-production process and contributing to the benefit of the project in question. Their findings regarding public inclusion and public participation and engagement show that both dimensions of engagement for stakeholders in the process and showing the benefits of such co-production has immense power in facilitating use. Linders (2012) expands on this to show that citizen participation relies on citizen-sourcing, government as a platform, and do-it-yourself government. Axellson (2013) asks who should be involved in the e-government process among stakeholders, and their

findings show that in the case analyzed, there was no citizen participation at all in the project that developed a public e-service for application medical licensing and documentation. Among their conclusions they find that internal stakeholder concerns are weighed higher than those of external stakeholders separate from the tenets of proper e-governance.

Gonçalves et al. (2013) conducted a groundbreaking study behind the psychological empowerment that drove m-government channels and motivated citizen participation in the context of public transportation. They studied self-efficacy, sense of community, service quality, and causal importance, and hypothesized that increased levels of development according to these three constructs would lead to increased participation. Their experimental design attempted to discern what motivated citizens to participate in co-designing public transit services through reporting problems associated with these services. Each SMS texts that were sent reflected key constructs associated with psychological empowerment that were hypothesized to lead to increased participation, increased perceptions of quality of services, and a more positive attitudes toward participation. Compiled with interviews of selected participants after, the results of their experimental design show that perceived self-efficacy and causal importance lead to increased participation in co-production of transit services. Zamzami et al. (2014) also show through interviews with users that user interface elements such as context, content, and customization of mobile interfaces are of importance regarding usage of mobile websites. Specifically, they find that content of the mobile site has the most significant impact on satisfaction, followed by context of the mobile, and then customization. Designers and government developers then should pay attention to content firstly to develop user-centric initiatives that keep users using government sites, followed by context/format

(page layout, section breakdown, and page seamlessness) that encourages usage of these sites.

Mossberger et al. (2013) conduct a content analysis of city websites to show that by and large city websites are taking means to integrate open government and interactive platforms, but most of this has been in the context of social media. Further, while citizen surveys have grown, they have done so primarily via the website presence, and mobile application venues are still lacking. Sandoval-Almazan and Gil-García (2012) conduct a similar study of 108 Mexican municipal websites whereby they collect data from these websites to determine the extent to which they are fostering interaction, participation, collaboration, and information sharing. They find that while most cities are sharing information and providing services to their constituents, they are largely not providing tools and applications for interaction, and as far as participatory opportunities, there were very few opportunities for citizens.

In the realm of civil protest and collaboration, Panagiotopoulos, Bigdeli, and Sams (2014) analyzed tweets in the City of London that related to riots and found that 699 tweets by London Boroughs and 1047 by other councils in England addressed the riots in order to disseminate information and address the most affected areas. Sandoval-Almazan and Gil-García (2012) also analyze cyber activism through historical document analysis according to several movements: the Zapatista uprising of 1994, the Twitter movement of #InternetNecesario (“Necessary Internet”) of 2009, and the #YoSoy132 (“I'm 132”) movement of the Mexican presidential election in 2012. They identify how different levels of interaction, organization, and opportunity are afforded to activists through various

technological mediums. Further, activists change their strategies according to such platforms and the issue in question. Social media itself is found to have immense power in spreading cyber activism.

Bonsón, Royo, and Ratkai (2015) show that municipalities should align Facebook and other social media strategies to meet citizen needs, provide useful information to them, and collect their opinions on sensitive topics. In addition, the use of photos is seen to elicit higher levels of citizen participation. Engagement in governments that allowed posts on the government Facebook wall was also higher. The most important finding presented was that engagement is largely dependent upon the administration style of the municipality, and that lagging municipalities can utilize new technologies to enhance citizen participation by opening easily accessible two-way channels of communication. Hofmann, Beverungen, Rackers, and Becker (2013) tout the benefits of such social networks in fostering citizen participation and engagement. However, they show that among the top 25 German cities only 14 posts encouraged citizens to co-design a government service.

Lee and Lee (2014) show that developing a citizen-centric typology for smart services is of critical importance, and models of the smart city thus far have been developed largely from a provider-centric point of view. Such a typology is built on notions of modes of technology (automation, information, and transformation), service purpose (utility of the services), service authority (voluntary or mandatory aspects of the technology), and modes of delivery (the multiple means to integrate the technology). Khan, Yoon, Kim, and Park (2014) show that the Korean government has effectively used social media interactions to build the relationship between government and citizen. Their findings show that direct networking

strategies that target citizens does not motivate participation but does reinforce G2G relationships. The conclusions they draw lend themselves to the notion that government should continue to connect with citizens and build followers, but more importantly, focus on communication with citizens and the responses to their needs. Hubbard and Van Belle (2013) note that the primary determinant driving an organization's ability to transition from a web only to a mobile web presence is significant correlated to their organizational capability.

Ohme (2014) analyzes the intent to use mobile applications in Germany by citizens and utilizes multiple linear regression models to conclude that perceived usefulness is the strongest predictor of intention to use the mobile application even amidst possible risk factors, which echoes findings from Hung et al. (2006); Lean, Zailani, Ramayah, & Fernando (2009); and Hung et al. (2013). Another strong predictor was that overall attitude toward m-government impacted use of services, with government being able to act as strong vessels in shaping an attitude toward mobile acceptance and value generation.

Ganapati and Reddick (2014) analyze the extent to which U.S. municipal governments have adopted open e-government initiatives by utilizing a comprehensive survey of municipalities with populations over 100,000 and interviews with select CAOs to address transparency, participation, and collaboration. While CAOs rated open government as a high priority and had high hopes and positive views of collaborations, they had negatively correlated views on satisfaction and achievement of such efforts. Transparency efforts were also found to focus on fiscal transparency, while participatory tools centered on social media and GIS extensively, and collaboration results favored more government-to-government interactions being predominant. Cegerra-Navarro, Garcia-Perez, and Moreno-

Cegerra (2014) draw a sample from Cartagena City Hall users and argue that most technical obstacles are overcome gradually by users, but that disposition to use technology according to the Technology Acceptance Model (TAM) is more influenced by addressing citizens' needs, and that governments should build initiatives around these needs. Their results are in line with the findings of Bélanger et al. (2005) as they find that perceived usefulness, ease of use, and attitude toward technologies affect knowledge and use of technology.

Wirtz and Kurtz (2016) utilize a survey among 117 municipalities with a total of 717 citizens in German local e-government portal and a logistic regression to predict the intention to use e-government city portals by citizens and find that overall, citizens want e-services that offer material that is beneficial to them (data, statistics, forms, etc.), and that have a user-centric strategy with an emphasis on gathering user inputs that reflect their needs. Among their suggestion is to develop mobile applications that provide key services to citizens, which are designed according to their needs and wants. They found that 44.2% of participants found that implementing mobile devices and m-government interactions was important, and over one-third of respondents also noted that their government portal did not offer enough mobile services. 33.1% of recipients use mobile devices to access government services. With specific reference to mobile applications, 38.4% of users said they have a strong preference for the integration of such services to proceed via mobile applications. The authors find that the demand for mobile services in general is set to increase five-fold in the next 3 years.

Fortunati and Taipale (2014) show based on surveys to four European countries: France, Germany, Spain, and the UK that there are many country differences regarding mobile phone features with not all countries at the same level of integration. They also find

that users only use approximately one-third of services, and that there is an oversupply of mobile services and applications compared to what users utilize. Such findings suggest that there is not overwhelming desire to use many of the services provided by the government, and that such services may not be deemed useful by the population. Mainka et al. (2015) conducted an interesting study in Hong Kong to determine what the most downloaded applications were among users. Those which covered many different types of features were in fact not among the most downloaded, but rather those apps that cover one thing entirely. They also show that those applications that relate to problem identification and problem resolution are rarely downloaded, and that citizens have not yet seen this figure as useful for their everyday lives. The applications that were deemed as "useful" were the ones most downloaded by the citizenry, and above all, this was the primary consideration.

Also, according to Alotaibi, Houghton, and Sandhu (2016) in their study of Saudi Arabian Mobile application development their qualitative findings participants in m-government projects saw it as a necessity. They ask of experts in e-government what factors influence m-government adoption in Saudi Arabia. Further, mobile application proliferation became an important aspect of the m-government design. Ingrams (2015) examines South Africa, where the mobile phone is an important aspect of the technology landscape, and finds that it is an effective enabler of citizen engagement and reinforces other ICT technologies in fostering engagement in that it enables information and communication, and enables social connectivity. Chen, Vogel, and Wang (2016) elaborate on the debate regarding what drives users to adopt and utilize mobile government services by surveying users in China and find that procedural fairness increased user satisfaction, time critical functions improved

procedural fairness by increasing transparency, location sensitive functions improved procedural fairness through information accuracy, and personal control functions (usability) improved procedural fairness. Such adherence lends itself to greater levels of user satisfaction and subsequent usage of m-government services.

Regarding mobile applications, Christin et al. (2013) evaluated uSafe, a privacy awareness and participatory application, from both the perspective of how users felt about contributing to the application and their likelihood in contributing to the applications functions. They found that 44% of users surveyed would be willing to contribute to uSafe in a co-productive fashion, and that the privacy and security aspects of the application limited others' involvement. Further, 43% of users noted that incentivizing use of the application would lead to greater usage on their parts. Ertiö (2013), similarly, evaluated 100 worldwide urban governance applications and found that in the realm of urban planning, there were few participatory planning applications that afforded citizens strategic leverage, which the author showed was exhibited in higher levels of participatory capability, and which drew on citizens' tacit knowledge in a co-productive fashion. Specifically, these focused participatory applications whereby they provide strategic leverage were noticeably rare. Those that occupied broader governance contexts i.e. Service provision (reporting apps), transportation planning, or neighborhood surveying were more common but still rare.

Regarding the model of the smart city, Gutiérrez et al. (2013) show through case study analysis of Participatory Sensing Systems that processes largely proceed through smartphone applications and have been successful in providing real time sensor data to governments for many purposes rely on citizen interaction, with such systems hampered

continuously by privacy concerns for citizens, but enhanced through transparency in the use of data provided by users. Van der Graaf and Veeckman (2014) also show through an analysis of the City of Ghent's efforts that co-design in smart city spaces can optimize co-productive efforts associated with mobile applications that show that collaboration in smart city service development has significant impact, but that sometimes participation can exclude some users in development. Therefore, processes need be developed that proceed through multiple channels and are not technologically limiting.

Van der Graaf and Veeckman (2014) show through a case study analysis of the city of Ghent that urban space can effectively be co-designed to utilize the skill sets of citizens when capacities and skills of the citizens are considered regarding the design of the application. Therefore, to optimize the co-productive efforts of the smart city and its services, the concept of designing services according to the input of citizens becomes important in the cities initial and continued development with ICTs.

Further, Meijer and Bolívar (2016) analyzed 51 papers to aggregate the term "smart city" and discern the tenets of the smart city that emerged in the analysis. From their analysis four major themes emerged: government of a smart city, smart decision-making, smart administration, and smart urban collaboration. Similarly, Zubizarreta et al. (2015) analyzed 61 applications from 33 smart cities in North America, Europe, South America, and Asia to determine the tool specification from these cities according to their "smart" classification. They found that applications associated with people represented the lowest number among smart city applications. Further, they conclude that "Democracy, participation, urban design, ICT, and telecommunication are all components of the new strategic vision for cities" (8).

CHAPTER 3: THEORY AND METHODOLOGY

3.1 Introduction to Public Value Management Theory

Public value management theory is grounded in the thought that public managers should connect their policymaking goals to the goals and viewpoints of citizens and other stakeholders in their government (Bozeman, 2007; Moore, 1995; Meynhardt; 2009). By proxy, public value management is perpetuated on the thought that people are motivated by their involvement with the networks in their respective governments (Stoker, 2006). The involvement in such networks proceeds in both ways with networks and stakeholders interacting to create value associated with the authorizing environment (legitimacy and support) and resources (operational capabilities) being utilized to create value (performance) (Moore, 1995). Subsequently, performance measures should be derived from such goals with performance characterized by the desires of the public.

According to Bozeman (2007), citizens effectively become co-contributors to government policymaking which leads to the generation of public value associated with the benefits that are carried out via a democratic or representative form of government. He writes that the societies public values are in essence, “the rights, benefits, and prerogatives to which citizens should (and should not) be entitled; the obligations of citizens to society, the state, and one another; and the principles on which governments and policies should be based” (17). To Bozeman the failure of the public manager comes when they fail to provide services to citizens associated with eight key criteria and public value generation occurs when certain

criteria are met among the stakeholders. Thus, measuring public value to Bozeman becomes possible and necessary according to his model. In their inventory of public value Jørgensen and Bozeman (2007) provide eight criteria among which public value is evaluated seen in the figure below.

Figure 3a: Nodal Values, Neighbor Values, and Co-Values

Nodal Value	Neighbor Values	Covalues
Human dignity	Citizens' self-development, citizen involvement, protection of the rights of the individual	Justice, benevolence, voice of the future, equity
Sustainability	Voice of the future	Stability, continuity, the common good, the public interest, moral standards, ethical consciousness, solidarity
Citizen involvement	The will of the people, listening to public opinion, responsiveness	Dialogue, balancing interests, self-development
Openness	Responsiveness, listening to public opinion	Accountability, rule of law, dialogue, democracy, the will of the people, collective choice
Secrecy		Stability, continuity, the rule of law, protection of the rights of the individual, productivity, effectiveness
Compromise	Balancing interests	Reasonableness, fairness, dialogue, adaptability, robustness
Integrity	Honesty, dignity, fairness, ethical consciousness, moral standards, professionalism, openness, impartiality, loyalty to the regime	
Robustness	Stability, adaptability, reliability	Legality, social cohesion, flexibility, responsiveness, rule of law, timeliness, effectiveness

Source: Jørgensen and Bozeman, 2007

The list is further expanded on, as Jørgensen and Bozeman (2007) note key measurable values associated with the inventory of public value management and public value creation:

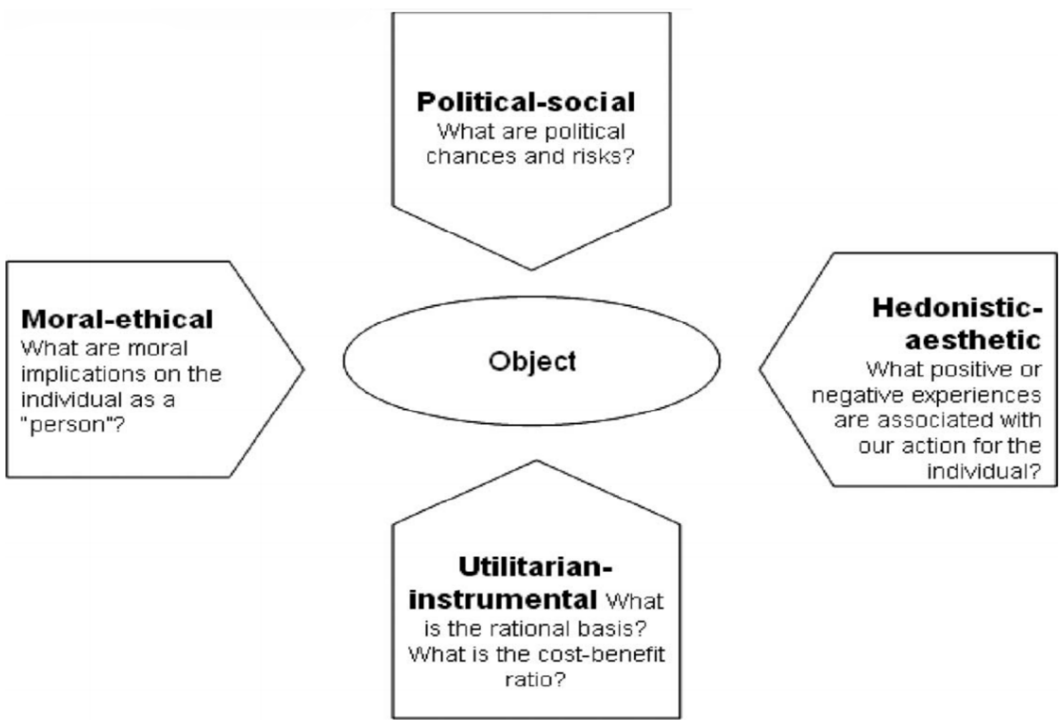
> "Accountability, adaptability, advocacy, altruism; Balancing interests, benevolence, businesslike approach; Citizen involvement, citizens' self-development, collective choice, common good, competitiveness, compromise, continuity, cooperativeness; Democracy, dialogue; Effectiveness, efficiency, employees' self-development, enthusiasm, equal treatment, equity, ethical consciousness; Fairness, friendliness; Good working environment; Honesty, human dignity; Impartiality, innovation, integrity; Justice; Legality, listening to public opinion, local governance; Majority rule, moral standards; Neutrality; Openness; Parsimony, political loyalty, professionalism, protection of individual rights, protection of minorities, productivity, public interest; Reasonableness, regime dignity, regime loyalty, regime stability, reliability, responsiveness, risk readiness, robustness, rule of law; Secrecy, shareholder value, social cohesion, stability, sustainability; Timeliness; User democracy, user orientation; Voice of the future; Will of the people" (377-378).

From this analysis and according to these criteria, an obligation is placed on the citizen to contribute to policymaking to generate public value. An inherent argument of the theory is that government policymaking should follow the will of the citizens (Bozeman, 2007). In that sense, the role of the public manager becomes shaping the current or existing service to match the desires of the citizens to achieve the greatest level of public value. Agenda setting then should encapsulate these citizen concerns and developments that

encompass public value variables should generate more value as purported by the various models. Alford (2002) describes public value generation as tied to this social exchange between manager and shareholder. The social exchange and societal aspect then become necessary in providing services to recipients based on cooperation and compliance.

Meynhardt (2009) echoes many of the sentiments of Bozeman in the sense that such value is generated for the public when "evaluations about how basic needs of the individuals, groups, and the society as a whole are influenced in relationships involving the public." However, he sees public value as being less tied to the institutions and governmental apparatus in question, but rather as formed around the psychological subjective feelings of citizens according to four evaluation perspectives.

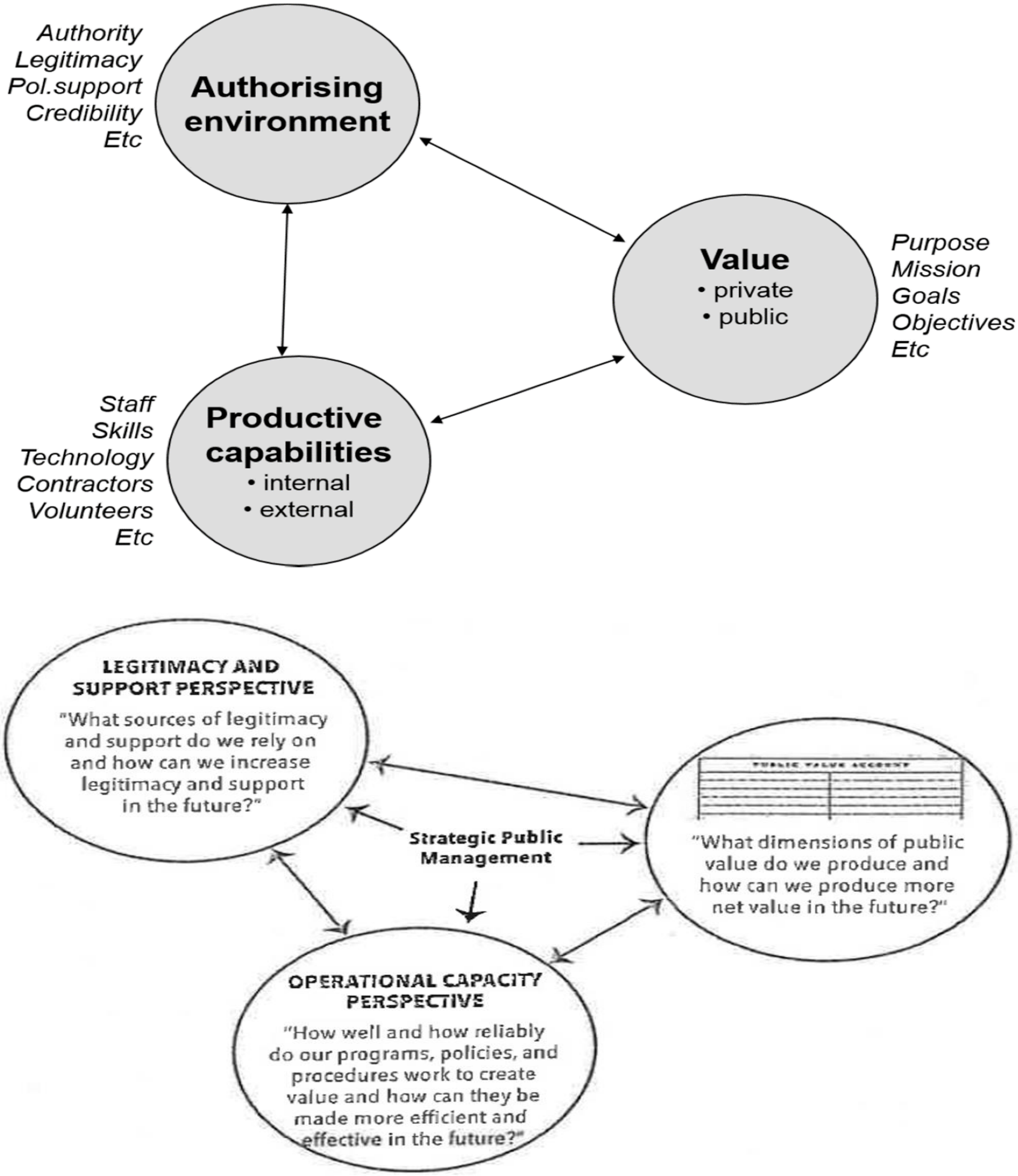
Figure 3b: Four Inductive Evaluation Perspectives



Source: Meynhardt, 2009

Whereas Bozeman (2007) looks at public value from the societal level, Moore (1995) casts the public manager according to the economic individualism of those shareholders within the society comingling the idea shareholder value with the public managers task in creating value for citizen-shareholders. For Bozeman, the process can consist of clearly measurable outcomes associated with collectively valued outcomes among shareholders such as efficiency, effectiveness, socially and politically desired outcomes, and justice associated with the service. From this, Moore derives the strategic triangle whereby the desired value is produced by the manager while balancing what is valuable, can be authorized, and is achievable. To Moore, the Resources and Capabilities (operational capability) and Authorizing Environment (legitimacy and support) lead to the Value (performance) of the service in question. Subsequently, to Moore these are broken down into an Authorizing Chain (legitimacy, support, and operational capability) and a Value Chain (public value).

Figure 3c: Strategic Factors in the Public Sector



Source: Moore, 1995

Kavanagh expands upon Moore's model by describing each of the three areas further:

"Though the public value account will help mobilize and build legitimacy and support, and animate and guide operational capacity, its primary purpose is to force a definition of public value. Public value is only one corner of the strategic triangle, so *Recognizing Public Value* combines the public value account with two other documents (one for each remaining corner of the triangle) to create a complete "public value scorecard." [The image above] summarizes the key elements Moore presents. The darkened sections have direct linkages to the public value account or another corner of the strategic triangle.

The operational capacity perspective will probably be familiar to most public managers. Moore does advocate for a few concepts, however, that are not part of the approach to performance management for most public sector organizations. These include continuous improvement methodologies (e.g., Lean / Six Sigma), structured management of innovation, and active development of volunteer efforts from the community and other forms of co-production (rather than necessarily relying on direct production by public employees).

The legitimacy and support perspective ask managers to consider the extent to which the organization's mission is aligned with the community's values, including those of segments of the community that might not normally be engaged with the government. It also asks managers to think about the organization's standing with formal authorizers (e.g., the governing board), the media, and general citizenry, as well as

> influential individuals outside of the formal organization and the standing of the organization in larger policy discussions (e.g., political campaigns, the campaign promises of current elected leaders). The last two rows consider legislative actions that could affect the organization and how citizens are engaged in helping to produce public services (e.g., volunteers)”. (Kavanagh, 2014, 59)

From this the public manager along with the institution itself understands the operational capacity and legitimacy that leads to the public value creation associated with the service. The services in question then must be revitalized and reshaped to create the greatest generation of value for the user. From this, Moore is speaking to the public manager and elected officials within society, which inherently relies on a functioning democracy, whereby citizen input is taken into consideration.

The goal and purpose of the government organization then is to forward the creation of this value via initiatives that can effectively quantify the desires of the citizenry. In such a way, the governmental system is supported and legitimized to foster citizen participation, with the government organized to achieve the goals of the people (Moore, 1995). The obligation, then, lies with the government to provide the channels of communication whereby citizen concerns can be addressed and through which citizen desires can be formulated into active policy solutions. Ideally, such public value is also equitable in that it is characteristic of all members of society regardless of class or social order. Specifically, the public value that is generated comes from the public and their experiences. In this sense the relationship between the individual and society is fostered and enhanced through the creation of this public value (Meynhardt, 2009).

As an operational measure then, public value is built upon pillars of operational capacity, legitimacy, and public value (Moore, 1995). Stakeholders within the system are represented not only by citizens and constituents, but also all stakeholders with a vested interest in the public service in question effectively mimicking the shareholder value within the community. In summary, then, both the activity of citizens is necessary along with channels of communication provided by the government to understand the legitimacy and operational capabilities to set agendas that foster public value creation according to measurable criteria. Subsequently, as described in the table below by Kelly, Mulgan, and Muers (2002) the key goal of public value becomes the tackling of problems most perceived as important by the public, with public managers existing to carry out deliberative opportunities associated with such practice. Below, Kelly et al. summarize how operationalization of public value proceeds to capture the value associated with a service:

1. Public value refers to the value created by government through services, laws regulation and other actions
2. In a democracy this value is ultimately defined by the public themselves. Value is determined by citizens' preferences, expressed through a variety of means and refracted through the decisions of elected politicians. Later sections of this paper summarize a wide range of evidence on public perceptions and preferences.
3. The value added by government is the difference between these benefits and the resources and powers which citizens decide to give to their government. An implicit – and sometimes explicit – contract underlies public value. The legitimacy of government generally depends on how well it creates value.

4. The concept of public value provides a rough yardstick against which to gauge the performance of policies and public institutions, make decisions about allocating resources and select appropriate systems of delivery.
5. For something to be of value it is not enough for citizens to say that it is desirable. It is only of value if citizens – either individually or collectively – are willing to give something up in return for it. Sacrifices are not only made in monetary terms (i.e., paying taxes/charges). They can also involve granting coercive powers to the state (e.g., in return for security), disclosing private information (e.g., in return for more personalized information/services), giving time (e.g., as a school governor or a member of the territorial army) or other personal resources (e.g., blood). The idea of opportunity cost is therefore central to public value: if it is claimed that citizens would like government to produce something, but they are not willing to give anything up in return, then it is doubtful that the activity in question will genuinely create value.
6. As a rule, the key things which citizens value tend to fall into three categories: outcomes, services and trust. These overlap to some extent. However, they provide a useful way of thinking about the dimensions of public value and are explored in more depth later.

3.2 Public Value and Citizen-Centric Mobile Application Development in e-governance

Karunasena and Deng (2012) note how e-government strategy can proceed according to three major pathways: Technology-driven, cost, and user. Like their names, a technology driven pathway focuses on the uses of ICTs and their capabilities in increasing efficiency and effectiveness. A cost-driven pathway focuses on the operational efficiency of public service

delivery. The user driven pathway, of which my research focuses on, pays attention to the requirements and expectations of the user.

As the literature in Chapter 2 has examined, e-government has been slowly progressing toward greater levels of citizen participation, but this progress has been lacking in citizen-centric opportunities that lead to collaborative channels through which citizens can influence ICT development. Still, the tenets of proper e-governance are closely in line with questions concerning how managers generate public value. Public value be the collective goals of society that proceeds according to the vision of citizens contained within it (Bozeman, 2007; Meynhardt, 2009). E-government agencies act according to Moore's (1995) model whereby the legitimacy, resources, and public value outcomes are linked in the creation of the specific e-government service.

Public value generation then coupled with needs to meet user outcomes is becoming an increasingly important aspect of e-government (Bonina & Cordella, 2008). As UNDESA (2003) note, "People express preferences, the government uses ICT to enhance its own capacity to deliver what people want, and eventually a public value is created." This approach characterized by citizen-centric ICT channels of communication can foster citizen engagement and participation and arguably lead to public value creation in ICTs. The eGep (2006) measurement framework for e-government indicates as well that public value of e-government revolves around organizational, political, and user value. The organizational value much like Karunasena and Deng (2012) note regards operational efficiency and effectiveness of the ICT. The political value is of concern for the citizen component as it concerns the systems openness and transparency, but also the participation of citizens. User

value as well relates to those quantifiable measures that improve user satisfaction according to established public value measurement outcomes.

3.3 Value Generating Mechanisms to Create Ownership in e-Government Services

Thus, a sense of ownership surrounding the ICT in question is needed whereby the citizen acts as co-producer in the services according to the outputs generated via typical public value paradigms (Linders, 2012). Therefore, I argue that a public value oriented managerial viewpoint on ICT development in government should not be associated with monetary value according to New Public Management (NPM) models, but rather according to the shared public value these technologies can bring to citizens which leads to greater levels of ownership in the ICT service in question and therefore a citizen’s willingness to collaborate in the ICT’s development (Cordella & Bonina, 2012).

Public sector ICT-development should then proceed according to standard public value outcomes, and should does so to capture citizen viewpoints regarding these outputs for the service, to ensure public value is created. Such governance can be highly effective and advantageous in lowering costs in an efficient manner, while also focusing on citizen-centric ways to communicate policy initiatives to citizens and identify problems that they perceive as important (Ferro et al., 2013a).

Various theories in e-government have purported how to measure the public value outcomes associated with an ICT service. Hughes (2008) notes how public value allows the values of these citizens, such as equality, justice, protection of the environment, and transparency to be quantified in economic terms and counters the new public management

paradigm which sees citizens as clients who only want more efficiency services at lower prices (O'Flynn, 2007).

Millard (2013) notes that for public value creation to occur in an effective manner it must encompass broad collaborative platforms supported by ICTs. Such reforms must incorporate the frameworks, guidelines, resources, and supports advocated by Kelly et al. (2002) that does not limit the actors in the system, but instead gathers all viewpoints from public sector stakeholders. As Millard (2013) puts it ICT platforms "…should encourage collaborative use through hackathons, discussion fora, blogs, consultation, support and advice, brokerage, good practices, arbitration, workshops, events, etc. Further, the public spaces are defined in public value creation as those characterized by innovation, whereby stakeholders feel safe and secure in their contribution (Heifetz & Linky, 2002). Such groups have common purpose and join to create dialogue by which the government can discern and bring about this purpose (Benington, 2015). Regarding ICTs then such spaces should possess the same characteristics.

Subsequently, standards for measuring the effectiveness of e-governance should encapsulate public value development. Bannister and Connolly (2015) argue that a citizen-centric approach is needed to accurately assess the public value of the system, with the performance of e-governance services measured according to their effectiveness in this regard. This relates to Bozeman's (2007) advocacy for an alignment of public value with agenda setting on the part of governments. Later, Bannister and Connolly (2015) expand on this notion and argues against other forms of e-governance performance measurement. Models that proceed via managerial design and do not account for local and national

concerns are deemed ineffective as they do not generate such value. Bannister and Connolly specifically advocates for more qualitative case study analysis that shows best practices and methods in gathering local and national citizen opinions regarding what they want in their governments.

Kearns (2004) argues that e-governance can be evaluated by its ability to increase public value through public administration policies that foster such input. The model from Kearns examines how e-government leads to the delivery of public services based on achievable outcomes among stakeholders and leads to the development of the public's trust in government.

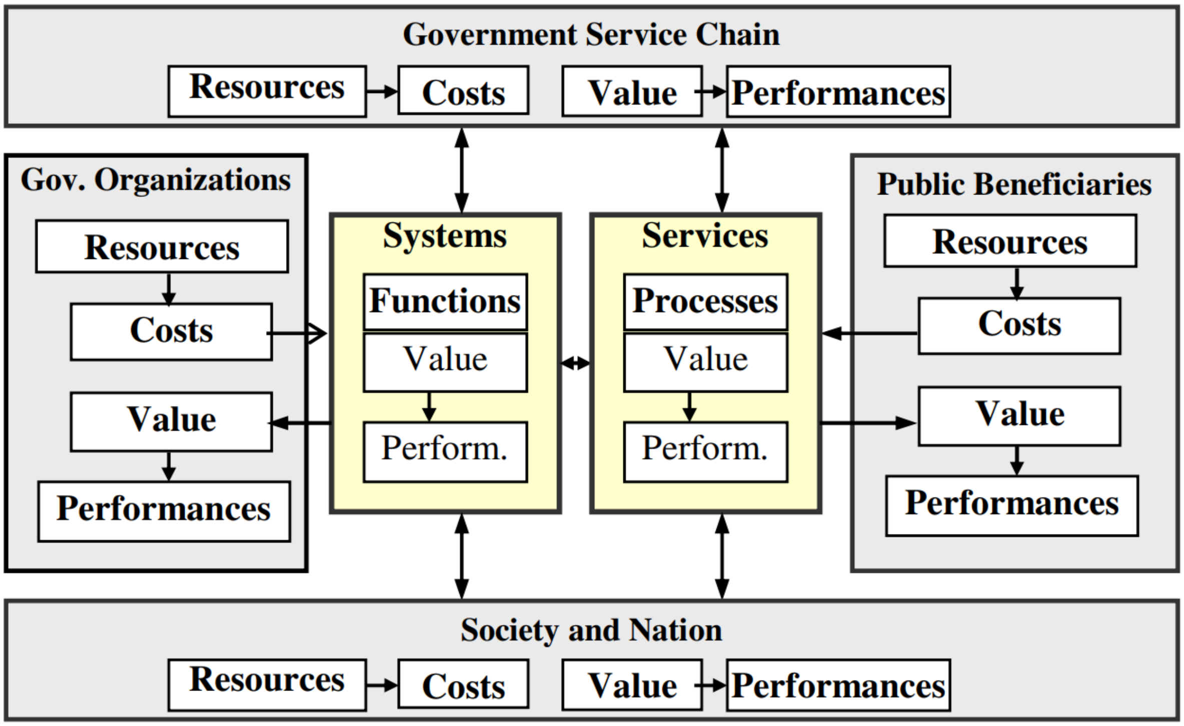
Further, networks of deliberation in such models become a key component of public value driven management that differs from traditional public administration and new public management (Stoker, 2006). Still, Savoldelli, Misuraca, and Codagnone (2013) conclude that many e-government systems do not have specific mechanisms in place that can measure consensus or disapproval of certain policies. They do not garner citizen-centric participation in the policymaking process, nor in the application development process.

Regarding successful public value generation, having the means to communicate, address, and achieve citizens' policy goals is a necessity. Similarly, when utilizing ICT services to create public value, the level of quality of these services must be enough for citizens to utilize them to their utmost potential (Kelly et al., 2002). Kearns (2004) therefore advocates for ICT systems that focus on service delivery, achievement of outcomes, and trust in institutions. This is supported by the claims of Savoldelli, Misuraca, and Codagnone (2013) who advocate for the use of ICTs in government that closely monitor the progress and

evolution of e-government application and platforms. Shareef et al. (2010) also shows that value is generated by the G2C and C2G two-way channels, and this lends itself to adoption of the service in question by the user when the channel is perceived as useful, has an advantage for the consumer, and has perceived security. Thus, arguably, the citizen develops a sense of ownership associated with the service leading to increased engagement with it.

Regarding m-government, Yu (2014) notes that the creation of value involves six steps: developing an objective for all stakeholders, establishing the value proposition, creating a value measurement framework, developing briefs and specifications, designing and reviewing options, and assessing outputs and outcomes. Yu also notes that the arguments of Hossain, Moon, Kim, & Choe (2011) measure such value of e-government systems according to their organizational efficiency, operational transparency, and public satisfaction. Trimi and Sheng (2008) expand on this in m-government by noting these systems bring increased value in their improved delivery of services, having no need for Internet connectivity, their tackling of digital divides, and their cost effectiveness. Still as Yu (2013b) explored there has been little done on measuring the value associated with mobile applications specifically. Figure 3d by Yu encapsulates the studies value creation model.

Figure 3d: A Value-Centric Business Model Framework for Mobile Government



Source: Yu, 2013b

The theoretical review above lends itself to the primary argument that mobile applications should be developed so that they encompass the outcomes of citizens to create a sense of ownership for the ICT service in question with public value inputs leading to value achievement in the sense of ownership**.** For mobile applications, which act as the tool by which smart cities facilitate e-governance, citizens will perceive such applications are more effective and utilize them if such value development occurs and is measurable. Further, management efforts that focus on such public value development could lead to greater ownership associated with these services. Such tenets stem sequentially from e-governance to m-governance and are centrally located within the smart city model. The governance process

can then benefit from a measure of such outputs as they currently exist within the context of a smart city as it seeks to develop applications that will first and foremost be utilized by citizens, and second will address their needs. Arguably, government mobile applications will address citizen needs according to the smart city model. Also, implementing high levels of trust in the applications development and high levels of usability, along with measuring other outcomes associated with public value in development of the mobile application, could lead to a greater sense of ownership associated with the application in question.

3.4 Policy and Public Value Within the Smart City

Smart cities then are inherently tied to the need to involve citizens in services via co-productive mechanisms. As managers and policymakers continually seek to utilize the smart city to better the lives of citizens through ICT technology, examining how the smart city tool the mobile application can be enhanced through public value generation is arguably important.

Nam and Pardo’s (2011) seminal work on the smart city saw it as the integration of technology, institutional, and human factors associated with the city. The “socio-technical” path they outline is characterized by the human factors that build capital for the user to generate value and utility about the smart city service. This combined with the technological and institutional factors characterized the smart city vision.

Further, the smart city application acts as a central tool within the city to facilitate the smart city’s vision. Zubizarreta et al. (2015) note six goals that manifest in six types of mobile application: Economy (competitiveness), People (social and human capital), Living (quality of life of citizens), Governance (participation of citizens), Environment (natural

resources, sustainable growing), and Mobility (transport and ICT). Still, governance applications are among the lowest utilized applications among smart cities according to their study despite their importance. Therefore, building the desire to facilitate governance and co-production is arguably a critical component of the smart city and e-governance.

De Lange and de Waal (2013) expand on the idea of ownership**,** specifically as it regards smart city services, tying such ownership to the co-creation of public services to the success of the service itself. Engagement and empowerment are interconnecting concepts that allow the citizen to be a partial owner of the service in question in their community, which the authors describe as "networked publics" according to the interpretation put forth by De Lange and de Waal (2013). Thus, ownership to the authors is defined as follows:

> "We use ownership to refer to the degree to which city dwellers feel a sense of responsibility for shared issues and are taking action on these matters. As such it is a "hack" of ownership in everyday parlance as being the proprietor of something, which gives the possessor the right to exclude someone else. When understanding ownership in more inclusive terms it means that one has the right to act upon an issue. It is this sense of ownership that we are after: not a contractual, proprietary ownership, but a sense of belonging to a collective place, commitment to a collective issue, and willingness to share a private resource with the collective to allow other citizens to act, without infringing on other people's right of ownership.

The authors ask how to engage and empower citizens and conclude:

> The advent of digital media technologies in the urban sphere offers opportunities to organize citizen engagement neither in local bottom–up nor institutionalized top–down fashion, but in networked peer–to–peer ways. Instead of seeking consensus these tools allow room for managing differences. We have seen how urban new media are often perceived to alleviate and eliminate moments of uncertainty and tension inherent to urban life" (5).

Peer-to-peer networked co-production, and facilitation of mechanisms that generate public value for citizens can optimize capabilities and build a sense of ownership regarding the ICT. As the literature review in Chapter 2 examines, the smart city mobile application acts as a mechanism that can be used for service delivery and can provide equitable access to a variety of stakeholders seeking greater ownership in the ICT service. The development of ownership becomes important in the cities initial and continued development with ICTs.

According to Berntzen and Johannessen (2015), participation and ownership enhance the smart city service in three ways: by utilizing the experiences of citizens and listening to their voices, more efficient practices may be garnered; by collecting environmental data using citizen smartphones and applications to gather data for various means; and by enhancing democracy and creating an environment and community with citizens invested through technology. Such a linkage represents the directional linkage between operational capacity and public value, as greater attention to such protocols will arguably lead to public value generation.

The role of the manager then is to set the agenda, while the input from citizens and other stakeholders is used to mold the project. Chourabi et al. (2012) state, “Projects of smart cities have an impact on the quality of life of citizens and aim to foster more informed, educated, and participatory citizens. Additionally, smart cities initiatives allow members of the city to participate in the governance and management of the city and become active users.” Inherently, Mellouli et al. (2013) show that the smart city that considers citizen perspectives represents a sort of collective action and relies on the inputs of the citizens and their trust in the view that their perspectives are valued and being considered. However, van der Graaf and Veeckman (2014) also show that participation can exclude some users in development, and therefore accounting for such controls within smart cities becomes of importance. Access to technology becomes a limiting factor, as does certain demographic characteristics that may impede both participation and access and thus lead to less-developed ownership**.**

Gil-García et al. (2015) also show citizen participation, governance, and engagement taking on a fundamental role within the societal aspect of the smart city, along with human capital and creativity, and a knowledgeable and pro-business environment. All of these are arguably tied to the tenets of co-production forwarded by Linders (2012), whereby the capital of citizen-developers is aggregated in a co-productive sense with citizens acting as both contributors and developers, with their input being taken into consideration for the development of the service in question. However, the societal component is most intrinsically tied to the co-productive and citizen engagement efforts touted by e-governance and public value. From a policy point of view then the thematic analysis of what components of the

societal aspect (Nam & Pardo, 2011) of the smart city is of importance in analyzing how ownership contributes to the overall enhancement of the smart city vision.

3.5 Operationalizing Public Value Measurements

How then does the operationalization of public value management as it pertains to the smart city proceed if the goal of the smart city is to develop a sense of ownership around its citizens regarding mobile applications.

Moore casts the public manager as the creator of public value and the authority in capturing such value and determining how it manifests. Further, Moore does not see them as constrained by the rules of traditional public administration, a potentially unrealistic characterization, and instead sees them as "explorers commissioned by society to search for public value" (Moore, 1995). Thus, the public manager takes on a central role in creating such value and represent the policy suggestion lens that derives from this study. If each component of Moore's triangle can be examined in the sense of the smart city and with attention to the smart city of Boston, then a better understanding of how organizations are developing ownership in smart city services can be understood.

Regarding ICTs, value is generated as the community collaborates to make known these forms of public exchange that can be greatly enhanced through ICTs (Cordella & Bonina, 2012). Further, such viewpoints inherently change over time, and therefore ICTs allow the viewpoints of citizens to be known instantly rather than through typical elections and political events. Paletti (2016) observes that there are few examples globally of co-production that make co-production efforts easy and applicable on large scales, but that ICTs present a means to circumvent many of the complex organizational components of co-

production. Arguably, mobile applications can further these efforts if developed according to public value input measures. In this sense, Bovaird and Loeffler (2012) note that applications value represents the value of the application as perceived by the citizen both in the form of public goods, public policies, and public services.

Mobile applications that seek to foster co-production and engagement should fit with the goals of the organization and of the citizenry and should be analyzed according to their technical difficulties, governance perspectives, and their ability to facilitate discussions and engage large audiences to generate user-centric data. Further, such tenets are tied to those of proper e-governance which occurs from three angles: identification of stakeholders, recognition of different interests among stakeholders, and how an organization caters to and furthers these interests (Tan et al., 2005). Analytics that showcase the strengths of public value management among in addressing and catering to interests of various stakeholders then become necessary in carrying out effective public-value-centric governance. A **sense of** ownership then can then be a concept from which managers can determine if their mobile applications are working to create public value.

> Public managers create public value. The problem is that they cannot know for sure what that is. . . . It is not enough to say that public managers create results that are valued; they must be able to show that the results obtained are worth the cost of private consumption and unrestrained liberty forgone in producing the desirable results. Only then can we be sure that some public value has been created. (Moore, 1995, 29)

3.6 Operationalizing Ownership According to Public Value Inputs

The goal of this study is to determine whether applications developed according to public value paradigms are associated with greater levels of citizen uptake and engagement as demonstrated by a sense of ownership associated with the application. It is specifically important to examine this ownership as it relates to smart cities, and the city of Boston is representative of such a smart city with application initiatives that are arguably developed with citizen concerns as their primary driving force.

To reiterate, I ask then as my central research question:

> **Central Research Question:** Does the development of smartphone mobile application technology that proceeds according to Moore's public value management chain lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services?

Operationalization proceeded first according to Moore's (1995) triangle as I sought to discern centrally both whether public value itself was generated via quantitative and qualitative means, and whether the legitimacy, support, and operational capacity of institutions within the city are proceeding according to public value paradigms, and what the results of such initiatives have been. I examine this according to two chains in Moore's model: the Authorization Chain (legitimacy, support, and operational capacity) and the Value Chain (public value).

Stakeholders associated with the authorization chain are represented by government, private sector, non-profit and citizen-application-developers. These individuals are associated with the authorizing environment (Moore, 1995), and according to de Lange and de Waal

(2013), the development of ownership can lead to greater capacity associated with the service in question Kavanagh (2014). Regarding the Authorization Chain, I therefore ask:

Research Question #1: How are smart city managers, in the form of mobile application architects and developers, working to create an authorizing environment that generates public value, builds ownership in applications, and facilitates co-production and citizen engagement?

Moore Connection (Authorizing Environment): Operational Capability and Legitimacy and Support

Methods: 16 Interviews with Application Architects (Government, Private Sector, Citizen, and Non-Profit)

Stakeholders associated with the public value chain in this study are citizen-application-users. For the survey component all citizens who receive the survey and who are City of Boston application users are eligible for the study. I ask then regarding the value chain:

Research Question #2: What is the effect of including public value outcomes in developing a sense of ownership associated with mobile applications on the user's willingness to engage with the applications in a co-productive sense?

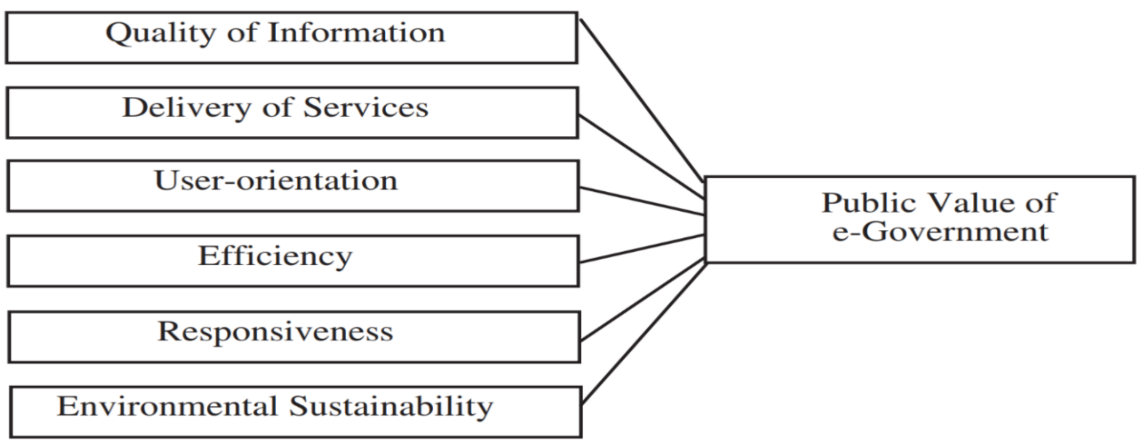
Moore Connection (Value Chain): Public Value and Operational Capability

Methods: Survey to users who have used City of Boston-specific mobile applications

Examining ownership in applications is once again the primary focus of this second portion of the study, with a survey being distributed to capture public value variables are developed according to Karunasena and Deng's (2012) comprehensive analysis of models

previously developed that sought to operationalize public value generation among citizens according to certain input variables (X) that lead to a discernable outcome of public value (Y). They undertake a comprehensive analysis of the e-government literature as it surrounds public value to develop their conceptual model of public value as it related to e-government service delivery. They expand upon the model developed by Heeks (2006) that is composed of four dimensions: the delivery of public service, achievement of outcomes, development of trust, and the effectiveness of public organizations. Karunasena and Deng (2012) attach to this key deliverables for public value generation as seen in figure 3e.

Figure 3e: A Revised Model of Public Value in e-Government



Source: Karunasena and Deng (2012)

Figure 3f: A Conceptual Framework of Public Value Variables

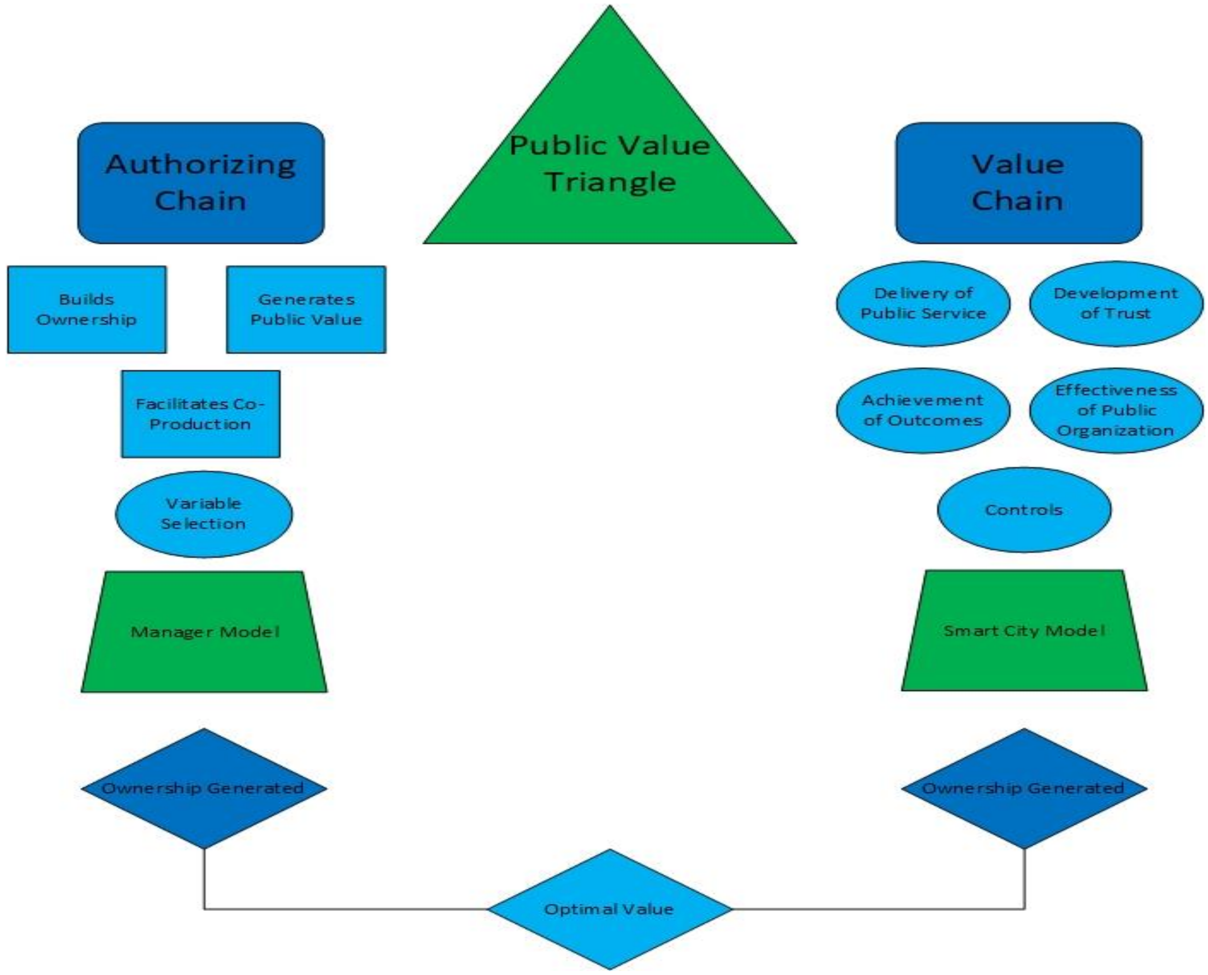
Table 1. A description of the proposed conceptual framework

Dimension	Attributes	Description
Delivery of Public Services	Information	Availability of information for citizens through e-government
	Importance	Importance of the information to the citizens
	Choice	Availability of e-government channels to access public services
	Fairness	Fairness of e-government service delivery
	Cost Savings	Cost savings for citizens using e-government services
	Take-up	Use of e-government services
	Citizens' Satisfaction	Citizens' satisfaction with e-government services
Achievement of Outcomes	Direct Outcomes	Achievement of socially desirable outcomes for specific constituencies through e-government
	Intermediate Outcomes	Achievement of socially desirable outcomes for a entire sector through e-government
	End Outcomes	Achievement of socially desirable outcomes for entire society or economy through e-government
Development of Trust	Security and Privacy	To what extent government secure public information and privacy of citizens through e-government
	Transparency	To what extent public organizations disclose their work, decision making processes and procedures through e-government
	Trust	Public's trust for e-government services
	Participation	The number of people using e-government services for contributing to better governance
Effectiveness of public organizations	Efficiency	The improved return on investment in public organizations
	Accountability	The number of public agencies publishing online information
	Citizens' Perceptions	Citizens' opinions about a public organization where e-government initiatives are implemented

Source: Karunasena and Deng (2012)

I am interested then in what components from this model lead to greater levels of ownership in the city of Boston's mobile applications both among the authorizing chain and value chain of Moore's model, hence the mixed-methods approach. The mixed-methods study outlined in the subsequent section is unique in the context of the literature and methods analyzed. Surveys are a commonly used tool in e-governance for gauging citizen input, but surveys have not explored what public value inputs influence ownership, and in this sense, generate public value. The qualitative interviews section examines the important authorizing chain associated with public value generation to determine how those developing applications are doing so with public value in mind. The qualitative portion then serves to shine greater light on the findings from the survey. The theoretical model developed below outlines the chain of logic associated with the prior examination of theory and e-government literature and frames this studies goals.

Figure 3g: A Conceptual Framework of Public Value Variables as They Relate to the Generation of Ownership in Smartphone Mobile Applications



3.7 Mixed-Methods Design

This proposal specifically seeks to determine if developing smart city services according to public value paradigms leads to a greater sense of ownership associated with those services, and from this, a willingness to participate and engage with them. As an outcome measure then ownership becomes the variable by which public value is measured and determining whether certain tenets of public value and the smart city correlate to greater

levels of such ownership**.** As the City of Boston has had a citizen-centric ICT boom over the last two decades as described in the subsequent section, it will serve as the case for this study as it is representative of a smart city that has incorporated aspects of public value centered on the citizen in its initiative. Further, it is an application heavy city that has had many applications developed that serve a variety of citizens' needs. Thus, it provided the impetus necessary to examine how public value inputs influence ownership.

As de Lange and de Waal (2013) show a sense of ownership has been shown to increased citizen participation and led to increases in belief of the service associated with citizen input. Further, ownership can quantify if public value has been generated based on certain operational components. I measure this causal mechanism through the sense of ownership citizens feel regarding the city of Boston's applications. As Creswell and Plano Clark (2007) discuss, the need for mixed-methods research arises when there is a need via the theoretical or research objective to utilize such methods. The need to examine the authorizing chain and value chain according to Moore's theory lends itself to such a mixed method analysis that: utilizes surveys to examine the value chain among City of Boston mobile application users, and the authorizing chain through interviews with City of Boston mobile application developers and project managers.

The value chain is examined to determine how value is generated among citizens about City of Boston mobile applications. Surveys allowed me to quantify the operational inputs to determine what inputs were leading to greater levels of ownership among the applications of the city of Boston. Effectively they allowed me to examine my research question of if the development of smartphone mobile application technology that reflects

public value leads to greater uptake of services and citizen engagement as measured by a sense of ownership in the application?

In addition, the authorization chain is examined as to discern what managerial and structural supports are facilitating public value generation in mobile applications, and if such initiatives are moving toward developing ownership in applications. As Moore (1995) notes, the public-value-centric initiatives stem from managerial initiatives and the smart city as well is characterized by the development of such initiatives by political and administrative bodies there is a need for a qualitative look at what efforts have been taken so far to examine Boston’s managers and ask how smart city managers, in the form of mobile application architects and developers, are working to create an authorizing environment that generates public value, builds ownership in applications, and facilitates co-production and citizen engagement?

I argue that there is a need also for such qualitative techniques. While the surveys expose if public value via ownership is generated, examining managerial viewpoints is of concern if examining the smart city in its entirety to capture the viewpoints of all bodies of Moore’s (1995) triangle and the interconnections of the Value and Authorization Chain and value generation. The synthesis of the above theories and literature review then lends itself to a mixed method design for this reason. Further, as mentioned in Chapter 2, there is a lack of these two methodological approaches in explaining public value generation among ICTs.

3.8 Data

Concurrently with the survey, 16 interviews were conducted with representatives from government, private sector, citizen, and non-profit developers and project managers who had developed applications for the City of Boston or with a City-of-Boston focus. This paper is both quantitative and qualitative in nature. Interview participants were contacted individually for approximately one-hour long interviews surrounding their experience in developing their City of Boston application. The qualitative interview methodology is outlined in Chapter 4 of this study. Quantitative data was gathered from **survey** distribution to a sample of mobile application users in the city of Boston. The quantitative survey methodology is outlined in Chapter 5 of this study. Each component was done so in according to the case of the City of Boston. The reason for the choice of this case is outlined in the subsequent section of this chapter.

3.9 Case Study: City of Boston

Boston is characteristic of a smart city that has re-developed its institutional apparatus to incorporate the viewpoints of citizens via a public value approach. How the city's applications develop a sense of ownership among citizens is an important question then.

The city of Boston has been largely successful in implementing this citizen-centered e-government over the past two decades due to the institutional apparatus in place. Regarding local level governments, the mayor-council form of government, whereby a mayor is elected by constituents and enacts legislation jointly with the council who are also elected officials, makes it distinctly different from the council-manager form of local government as it gives much power to the mayor to shape the ICT mission as they see fit. This differs from the

council-manager governments that have elected council members governing in tandem with the experience of a strong managerial figure in the form of a town manager (Saffell & Basehart, 2000).

This form of city government manifested in strong leadership that has increased e-governance and citizen participation avenues that foster e-democracy under former Mayor Thomas Menino and current Mayor Martin Walsh. While Hayes & Chang (1990) conclude that there is no relative change in the efficiency of either form of government, Coe et al. (2001) show that a critical aspect in the development of a smart community regards the leadership of individuals within the community. Further, by nature the institution of having a strong mayor over a weak mayor gives more power to the elected official in bringing about innovative change.

The role of the institution and its self-reinforcing nature becomes apparent about the implementation of e-governance in Boston. Further, evidence surrounding such implementation lends itself to a hybridized view of the city's institutions. For example, the mission of the City of Boston emphasizes a client-based approach to carrying out public services, which is reinforced by the city's traditions (Mission Statement City of Boston). The progressive mission of the institutions in place in engaging citizens in all levels of the process is a central goal of the city and its leadership (Clavel, 2011). Such tenets are in line with the co-production standards of e-governance that actively encourage institutional acceptance of the potential that e-governance can bring in bridging services between citizen, business, and government (Linders, 2012). Thus, measuring ownership as it relates to ICT service delivery and the generation of public value is an important goal of the city as it seeks

citizen-centric e-governance. In addition, the mission of the Menino camp, which spearheaded e-governance initiatives in Boston, was to bring about all active entities involved in the process regarding innovation development (Mossberger et al., 2013; Kirsner, 2014).

In the case of the city of Boston, building coalitions and citizen-communities was inherently supported by advancing technology that perpetuates greater levels of citizen participation. As Coe et al. (2001) note this is in line with the smart city model as well, which seeks to bring all parties involved in the process into harmony via the use of ICT technology. The cyber district in Boston and the integration of various stakeholders was characteristically tied directly to a new institutionalist approach that garnered supported in a multifaceted fashion from businesses, citizens, and the government (Mossberger et al., 2013). Collaboration and stakeholder interest then came to inherently affect development.

Further, the platforms of the mayor and his council often relied on engaging multiple interest groups in the process of developing innovative solutions to Boston's problems (Quinn, 2014; Mossberger et al., 2013). The strategy then of this institution became the alignment of interests of the city itself, as represented by its citizens, and the mayor. Therefore, the competition for such resources was streamlined to the benefits of all parties involved with IT technology. Development of such initiatives became primarily about the city and the mayor, bridging institutional interests with those of the city's multiple stakeholders. For Osgood and Jacob, the developers of Citizen Connect, Boston's mobile application for citizen communication with the government, Mossberger et al. (2013) report that the question became "How do you pull people together - agencies together-that we have

no direct control over but figure out a way to align themselves around a particular mission and orientation?"

Further, the need to bring about successful e-governance is heavily reliant on the leadership in place and the need to foster such participatory opportunities through IT, in particular (Heeks, 2006). Mossberger et al. (2013) notes how the appointment of heads of New Urban Mechanics (the Mayor's technology department), Chris Osgood, Nigel Jacob, Bill Oates, Mitchell Weiss, was directly tied to the constituent-focused leadership goals of the Mayor, and the vision of e-governance for Boston was tied to his uniquely personal dynamic for change. This sentiment is echoed by Heeks as he notes the need for such alignment and strong leadership in bringing about services, and in determining the substance of such services (constituent-based/participatory vs. service-based vs. management-based vs. information-based, etc.: "A critical precondition in successful e-governance for development is an e-champion or small group of e-champions: leaders with vision who put e-governance onto the agenda and make it happen" (Heeks, 2006).

The institutions were and have continuously been built to foster technological innovation and citizen-centric IT services. Regarding Mayor Menino's initiative, this was exemplified in his 20-year term as mayor of Boston. In the case of New Urban Mechanics and the implementation of technology in Boston: "They were empowered to act, within limits: They had to make sure that what they were doing was within the mayor's strategic framework" (Mossberger et al., 2013). Mayor Menino used his leadership then to fundamentally change the institutional apparatus by exercising the formal and informal processes of power described by the Skowronek (2000) to accomplish the central goal of IT

integration. Further, the goal revolves specifically around implementation of IT services for the citizen and is beneficial to the citizen according to a co-production logic (Linders, 2012). "Now that the Mayor's Office of New Urban Mechanics in the city budget and occupies slots in City Hall-and is not under the CIO function-the next mayor would have to affirmatively city the office to eliminate it" (Mossberger et al., 2013).

Subsequently, performance management and big data gathering come second to the "engagement" of the citizens according to the Mayor Menino's vision (Mossberger et al., 2013). The central app "Citizens Connect" developed by the mayor was characterized by a need to allow the citizen to report problems that the city could respond to in a personalized fashion. This is characteristic of the plebiscitary co-productive approach that allowed the citizen to determine the direction of their city. In addition, while it is still not fully e-democracy it is characteristic of the co-production government (Linders, 2012), where citizen and government act in a two-way fashion to address concerns. Similarly, it is characteristic of a move toward government 2.0, where such interaction occurs in a two-way fashion (Chun et al., 2010). Citizen perspectives and political landscape can influence the power and authority of the Mayor, which can influence institutions for later Presidents. In the case of the City of Boston, the technology proceeds primarily regarding a citizen-focus characteristically defined by the leadership of Mayor Menino that focused on human interactions. Leadership, then, is perhaps the greatest driving force behind citizen-centered ICT integration in the City of Boston:

> I think of buzzwords we throw around like "rapid prototyping" and "human-centered design." [Those words] deeply describe our mayor. . . . What does that immensely

> strong concern about people mean? That just means ...that's where you start. That's what you're really trying to get at, right? Don't design your operations around what's good for government. Design what's good for people. . . It's totally where the mayor is. (Mossberger et al., 2013, 12).

In the case of the City of Boston, the "Localocracy" approach taken by the city is seen as one that fosters participation and increases transparency to engage citizens via constructive contributions to improve service delivery (Cole, 2011). The Political Landscape of Boston needed to characteristically change, adapt to, and accept such e-participation agendas for ICT advancement to occur. In the case of Boston, the efforts were spearheaded by Mayor Menino, but encompassed all members of city hall united behind a mission to incorporate citizen-centric e-governance. Further, the mission of City Hall became the engagement of all various stakeholders in the benefits associated with the process. Businesses, citizens, and various city organizations were brought into the fold regarding the benefit that citizen and service-centric innovation could have for their collective interest (Mossberger et al., 2013).

First, in this situation, the driver of such change was undoubtedly the advent of the Internet and the technological boom of the 1990s. The number of Internet and computer users grew exponentially from 1990-1998 from less than a million to nearly 30 million (Comer, 1999).

Ho (2002) showed in a content analysis of city municipalities that that many of these were moving toward integrating e-government services that transcend those of traditional

service delivery in the early 21st century. These e-government movements emphasized the coordinated technology efforts, external collaboration, and customer service over the typical bureaucratic approach. There was a characteristic paradigm shift in the delivery of government services with the advent of technology, and many cities were forced to adapt with the changing times or be left behind about their capabilities (Ho, 2002). The initiatives of Boston, then, were no different as the mayor's campaign came to be defined by this need to innovation. Further, having lost innovation to Silicon Valley in the 1990s, Boston itself had considered lagging behind its former technological leadership in the 1970s and 1980s (Miller, 2014). The initiatives of Boston, then, needed to be both cutting edge and highly unique. "Citizens Connect, according to Mitchell, was a cutting (edge application at the time: 'Nobody was doing this.' The largest portion of the work was getting the application to work smoothly with Lagan; integration took about six months" (Mossberger et al., 2013).

While many cities were moving toward greater levels of service delivery, Boston went the route of Citizen Participation according to the Mayor's unique vision and the climate of the city that was citizen-focused (Mossberger et al., 2013). Further, the office of the Mayor and New Urban Mechanics engaged all key stakeholders in the benefits of technology and innovation. Along with the characteristic paradigm shift created by technology, the innovative attitude was characteristic of the coordination efforts of the Mayor's office in bringing about technological change.

On the other hand, the Mayor's Office of New Urban Mechanics, the innovative ethos of Boston's 2013 City Hall, and Citizens Connect are all very well known in

> government innovation circles—thought leaders, the press, foundations, and other 26 mayoral offices—even if Bostonians don't know the players or the office. The Office accomplished a good deal in a relatively short period of time. The open question is whether its accomplishments will be enough to allow it to survive a change in administrations. (Mossberger et al., 2013, 25-26)

Second, majority control in this case did not need to be present, simply because the strong mayor form of government can circumvent such control to enact change. However, pressures did arise from interests outside the organization who demanded progress about the integration of IT. Governmental stakeholders found themselves at a crossroads between innovating according to previous models and doing so regarding a uniquely citizen-centric atmosphere that characterized the city of Boston. Further, the press was constantly involved in the process from start to finish, and with the difficult task of creating unique innovation characterizing the city's efforts pressures grew to create such citizen-centric e-governance and to do it successfully (Mossberger et al., 2013). The impetus for change needed to encompass all interests of the key stakeholders involved, while still proceeding toward a citizen-centric technological development according to the mayor’s mission. The applications and technologies then were characteristically incorporated with this functionality in mind (Mossberger et al., 2013). While “Citizen Connect” was developed to directly engage the citizens in the decision-making process and facilitate co-production according to Linders’s (2012) suggestions, other technologies such as “City Worker” were developed in tandem to facilitate easier processes for government employees to help with the delivery of government

services. The applications and technologies themselves then encompass these various interests of the stakeholders involved, and initially and continuously they have evolved to meet various needs according to an IT focus:

> “The system has evolved over time to include, among other things, a mobile app for field workers in the Department of Public Works (City Worker), a smartphone app for citizens (Citizen Connect), reports that are useful for performance management, and several different channels through which citizens can interact with City Hall, while retaining its high-touch, personalized character”. (Mossberger et al., 2013, 3)

Lastly, New Urban Mechanics did not need to rely on majority control, but still bureaucracy presented a large barrier to change within the organization. Despite support from the mayor, Mossberger et al. (2013) note how despite creating impetus for change among constituents, the bureaucracy and changing political landscape proved problematic in carrying the efforts forward:

> Despite the enthusiasm with which core City Hall staff talk about the New Urban Mechanics ethos and the evolution of Boston's CRM system, the significant cultural changes that the team has brought about over the last several years may have had limited effects within city government. “There's still a lot of bureaucracy in the building. We haven't ended that,” says Mitchell Weiss. As a result, these changes may not have been adequately institutionalized; they may not survive the city's transition to a new, inexperienced mayor. Boston may be the best in the country in late 2013 at engaging people and building relationships that further the aims of city government,

> but it is not clear what will happen to this culture when the key people leave the building in January 2014. (Mossberger et al., 2013, 25)

Meier and Wrinkle (1999) discuss how in a representative bureaucracy individual within organizations must make discretions as to how they are going to make decisions and allocate resources due to the inherent constraints placed on the organization (in effect, every organization cannot cover every contingency). Resource allocation then became a key concern of the administration as they struggled to implement ICT technology amidst diverging interests. The solution to navigating this bureaucratic dilemma was to bring stakeholders from outside the organization in to fund initial IT development. Amidst budgetary constraints, New Urban Mechanics and Mayor Menino showcased innovation according to the opportunity it could present about performance management efforts (Mossberger et al., 2013). Further, the idea of reinventing the innovation district in Boston characterized the Mayor's mission (Kirsner, 2014). In effect this constituted a change in the political environment itself for Boston, which characteristically a move toward innovation.

Carmines and Stimson (1989) argue that individuals within government organizations are assumed to maximize their utility according to economic principles by making decisions that benefit their own common interests. Therefore, in the case of Mayor Menino, the budget approval for later IT advancements was sold to constituents claiming it would solve many of the city's existing problems surrounding service delivery, citizen participation, and trust (Mossberger et al., 2013). Bureaucratic hurdles were surmounted based on the tenets forwarded by Mayor Menino and New Urban Mechanics that fostering citizen input via would increase and encourage new forms of engagement and present cost savings for

administrators (Mossberger et al., 2013). In effect the use of ICT technologies in this regard would increase overall public value for the government by increasing these channels and building digital equity in communication (Pang et al., 2014). Coleman, Brudney, and Kellough (1998) argument that race, education, age, party identification, years employed by the federal government, and perceived work obligations all can create an imbalance in the distribution of resources according to bureaucratic processes is limited regarding ICT implementation (Linders, 2012; Pang et al., 2014). Further, issues revolving around trust of government, trust of institutions that are typically solved on the citizen-level were addressed through ICT development (Kuriyan, Kitner, & Watkins, 2010), while to City of Boston it was advanced on principals akin to Linders' (2012) views on co-production and the collaborative cost savings it can present for the government as a whole:

> The near zero marginal cost of digital data dissemination and computer-based services enables government to make its knowledge and IT infrastructure available to the public that paid for their development. In so doing, the state can help citizens improve their day-to-day productivity, decision-making, and well-being. Government is not responsible for the resulting activity, but can leverage its platform and influence to foster greater public value. (Linders, 2012, 448)

The goal of New Urban Mechanics and Mayor Menino became the linkage of citizen-groups via ICT technology that sought to empower citizen-groups through the newly available mediums. Therefore, enhancing the power of certain social groups became a central component of the Mayor's mission. Further, such tenets proceed according to the smart city model that encourages citizen empowerment via the use of ICT mediums (Aladalah, Cheung,

& Lee, 2015). The populist notion, then, was fully embraced by the Menino campaign. As Walker (1983) notes the power of various interests' groups rests in their ability to be organized according to budgetary, leadership, and other detriments that allow them to successfully organize.

> Citizen groups must begin with a fairly large staff, or they will have little chance of reaching enough of their far-flung potential membership to create a stable organizational base. Because of the organizational problems facing citizen groups, they must almost always gain financial assistance to launch their operations. (Walker, 1983, 398)

The goal of Mayor Menino became the elimination of these barriers to allow for greater citizen participation independent of the typical powers that limit organization on their part. The focus on the use of social media, mobile applications, and citizen-centered application and service development allowed participatory functions to occur regardless of place or time (Mossberger et al., 2013; Cole, 2011).

Though faced with initial challenged regarding implementation of such services, the mission kept a citizen-centered core focus that evolved with technology to bring about greater levels of participation and co-production (Linders, 2012). Often the power to stimulate such groups must arise from the initiative of individual political entrepreneurs, who operate largely on their own devices in bringing about social changes that are targeted at citizen-groups (Walker, 1983). Previous sections of this case study analysis have examined how in the case of New Urban Mechanics and Mayor Menino, the catalyst for change was such political determinants that proceeded via a central e-government and ICT driven

mission that focused on citizen enhancement (Mossberger et al., 2013). The focus of the Mayor's office also encompassed the critical constructs “sense of impact, competence, meaningfulness and sense of control and citizen participation” that lead toward empowerment according to the suggestions from Aladalah et al. (2015).

Such citizen-centric empowerment proceeded with discussion of equity in mind, which became a critical component of the Mayor’s technology initiatives. The Mayor wished to utilize ICT channels to increase communication with citizens. With a slogan of “Connecting residents to city services: 24 hours a day, 7 days a week,” the ICT medium was meant to increase public participation. In this regard, the task force of New Urban Mechanics took a critically constituent-centric focus according to the wishes of the mayor allowing empowerment to proceed in a two-way fashion. Not just from government to citizen, but also from citizen to government with policy recommendations stemming from the constituent base.

> Colleagues credit the core team of Weiss, Osgood, Jacob, and Oates with being particularly successful in translating the mayor's obsessive focus on constituent services and personal touch into an integrated CRM platform that makes possible varied forms of two-way communications with real people while also facilitating the hard-nosed tracking of city performance. (Mossberger et al., 2013, 12)

The driving force behind democratization of the public then became ICT technology. The ICT medium then could accelerate activities typically associated with citizen participation at accelerated rated. Utilization of social media, mobile applications, email, and

other tools of technology the government could rapidly respond to citizen concerns in an efficient manner using new technology resources.

> So, what we do now, not only do we close The loop with people by email—you report a pothole to us, you get an email when the case is closed by the public works employee and that affords you the opportunity to reply to us and have any further discussion that might be necessary by that report. We also pick up the phone and give you a call back every once a while just to check and make sure you're satisfied. (Mossberger et al., 2013, 6-7)

The objectives and strategies of participants can be directly understood via the utilization of such ICT mediums, which is deemed as critically important in expanding policy discussions according to Gais et al. (1984). Gais et al. note one of the key determinants in determining whether citizen perspectives are being listened to involves whether they are being integrated into the institutional apparatus. This allows them to circumvent the complex Iron Triangles that usually limit the direct participation of citizen-groups, who must proceed through other institutional apparatus to achieve policy goals and enhance policy discussions. In the case of technology, this manifests in the form of routine access to the decision-making process. As Linders (2012) notes the inherent goal of the co-production system becomes the embrace of such an ideology. In the case of the city of Boston, the ever-expanding use of technology expanded with the times as the city continued to incorporate mechanisms that facilitate citizen participation and tenets of public value at greater rates (Twitter, Facebook, more sophisticated apps, etc.).

From this case, Boston then presents a case that is representative of a smart city, but one that encompasses citizen concerns in development and arguably has proceeded with co-production efforts in mind.

CHAPTER 4: QUALITATIVE ANALYSIS OF CITY OF BOSTON APPLICATION DEVELOPER INTERVIEWS

4.1 Introduction

This chapter of the dissertation, specifically, uses qualitative analysis to examine Moore's Authorizing Chain to determine how legitimacy, support, and operational capabilities are impacting mobile application development in the city of Boston. Interviews were conducted with 16 total government, private sector, citizen, and non-profit mobile application developers to examine the subordinate research question. The purpose of this section is to expand on the mixed-methods design outlined in Chapter 3 of this study to analyze how the two primary research questions, tied to the Authorizing Chain (Chapter 4) and the Value Chain (Chapter 5) of Moore's theory (1995), have developed within the City of Boston.

Interviews allow the researcher to capture insights regarding the phenomena that is being examined (Krueger & Casey, 2015). Gathering the authorizing environments perspective according to Moore's (1995) Authorizing chain is of importance in evaluating how public value components have been incorporated into the service in question.

The terms reliability and validity are sometimes argued to be quantitative in nature. These terms are rooted in positivist deductive techniques and are not applicable to qualitative research, by and large (Golafshani, 2003). However, techniques can be used to make qualitative studies reliable and valid. Trustworthiness on the part of the researcher enhances

reliability, while validity is enhanced by quality and rigor in the process. These protocols can be compiled with the elimination of bias on the part of the researcher to lead to more valid and reliable findings.

The interview questions in Appendix VIII were designed around the theory and literature developed to see how managers are developing applications according to public value outcomes, how they are encouraging participation, and how they are building ownership? These Interview questions were designed according to Krueger and Casey's (2015) suggested interview approach characterized by an "opening," "introductory," "transition," "key," and "ending" questions. Most importantly, I hope the qualitative section will bring about a detailed description of the practices that build ownership according to the characteristics I am examining according to Weiss's (1994) model.

The purpose of the interviews is to derive how and whether ownership is being incorporated by the authorizing environment (application developers within Boston). Further, the public value components associated with the societal component of the smart city will be discerned along with aspects of the prior intervention according to Karunasena and Deng (2012).

4.2 Research Question

Below are the research questions associated with the interview component of the study. From the interviews, I examine the research question through deductive coding considering the theoretical model developed.

Central Research Question: Does the development of smartphone mobile application technology that proceeds according to Moore's (1995) public value management chain lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services?

Primary Research Question #1: How have government application developers, citizen application developers, private-sector application developers, and politicians sought to shape smart city mobile application initiatives to generate public value, generate ownership in the application, and encourage future citizen participation?

4.3 Interview Process

Semi-structured interviews were conducted with 16 mobile application developers and project managers in high-level positions within the City of Boston. The interviews were conducted with application developers that fit into the defined criteria of **governmental application developers, citizens application developers, non-profit, and private sector application developers**, and whose applications have a city of Boston focus of some sort that provides a service to citizens.

The subjects of the interview were either developers or high-level managers, who have knowledge relevant in answering the questions posed. Managers were chosen due to their knowledge of the subject, and their ability to answer all the questions posed according to Weiss (1994) suggestions. Participants were chosen via a "convenience sample" by interviewing those subjects who are easy to reach but also due to their expertise with the application in question. I recognize this sampling methods problematic nature as "non-

probability" according to Weiss (1994), but with a low number of developers within the city, I argue it is necessary to uncover deeper meaning behind the research question. The incentive attached to the study was distribution of the final report free of cost.

The table below shows the distribution of these interviews based on the sector the individual worked in, the mobile applications focus, and the length of the interview. To protect anonymity of respondents no further aspects of the mobile application or the interviewer can be outlined.

Table 4a: Interview Distribution by Focus and Sector

Mobile Application Category	Mobile Application Focus	Interview Length	Count of Interviews
Government	Citizen Engagement/Participation	54:33	8
	Public Service	46:59	
	Public Safety	38:42	
	Public Service Delivery/ Public Safety	48:36	
	Public Service Delivery	51:41	
	Public Service Delivery	59:02	
	Citizen Engagement/Participation	59:13	
	Public Service Delivery	1:06:31	
Private/Non-Profit	Public Service Delivery	32:52	4
	Public Service Delivery	112:52	
	Citizen Engagement/Participation	38:55	
	Public Service Delivery	51:12	
Citizen	Transportation	42:30	4
	Transportation	38:57	
	Public Service Delivery	43:18	
	Public Service Delivery	52:09	
Total Interviews Conducted			16
Total Time of Interviews			772:37
Average Time of Interviews			48:17

Regarding facilitation, all interviews were conducted by the primary facilitator and author of this study, Sean Mossey. The facilitator's primary duty was to ask questions of the respondents and not give his own opinion on the subjects. No note-taker was necessary as scripts can be derived from the audio recording of the interview. Following the interviews, they were transcribed using Rev.com. Transcriptions were then saved and renamed in the format of "SECTOR_APP NAME ." To clean up interviews the questions were inserted in the transcript to proceed the question to each answer. Any of the interviewer's voice was deleted for the coding process but maintained in the master records.

During this interview, the facilitator introduced themselves and the study they are conducting, along with its purpose. Further, the interviewer derived consent from the participants and assured them that all responses would be kept confidential. Questions were asked that gauge the characteristics of the research questions. Appendix VIII lays out these questions, which are open-ended and elicit open-ended responses from participants.

4.4 Coding Process

In the subsequent results and discussion sections, thematic analysis was conducted using NVivo to discern major themes and sub-themes that emerged from the discussions with application developers. The first step involved was the determination of the coding method to be utilized. Analysis of the data proceeded from the session's audio recorded transcript. The first initial step was to transcribe this data from the audio recording. The research question involved understanding the nature of a phenomenon and is therefore epistemological in nature. Asking how City of Boston application developers have sought to shape smart city

applications to generate ownership is of importance in examining the study's central research question.

Subsequently, the overall goal was to discern the biggest ideas or themes that emerged in relation to the research question asked. From each interview, I coded responses and grouped similar ideas into specific codes (or nodes in Nvivo) that related to similar concepts. The overall themes were designed based on these codes taken throughout the process via an inductive approach, but with the answers deriving from interview questions based on the theoretical components outlined in Chapter 3. Ownership was coded as a separate code to discern overlap in other codes and themes generated and this main component of interest. As the nature of the question involved the process of developing a mobile application, and as the questions reflected such processes, **process or action coding** was utilized in assigning initial codes to the data collected. Initially, these codes were formed into the subcategories of the analysis.

In line with the mixed-methods design of this study, I used **reference** coding to then sort codes by whether they were referring to the specific theoretical concept associated with the literature, public value theory, data findings, or another new concept. These references represented "themes" that emerged. Subcategories that had overlap or related to some greater concept were grouped together and deemed as "Categories" which were assigned to parent nodes that related to these categories. Specific references to ownership were also assigned to a parent node, and were thus a major theme based on de Lange and de Waal's (2013) conceptualization.

Lastly, in synthesizing the data I used **pattern coding** to examine the initial codes when sorted and divided these codes into labeled major "themes" as determined by the nature of these "categories" and "subcategories." These themes were then integrated into the narrative below, with the categories representing subsections presented throughout.

Throughout, references to findings and Moore's (1995) theory are also referenced considering these findings to discern contradictions and/or support from established literature and Moore's theory regarding the authorizing environment. Further, the relationship of these themes to findings from the prior quantitative survey study are also addressed via the intention of the mixed-methods design of the study.

In section 4.5 below, I generate tables and a word cloud that showcase the themes and categories that emerge from the coding process. Among each question, I analyzed the weight of the themes that emerge based on the aggregate amount among all interviews by the prevalence of the code. For example, for a specific question and among interviews, if participants talked about a theme extensively, I will aggregate the discussion of that theme by noting the number of instances of occurrence. I also note these instances as they relate to overlap with discussions of the Ownership theme and one another. Further, according to Hill et al. (2005) specific reference should also be made to the frequency of the category's occurrence. This study contained 16 participants, so categories that occurred among 1-3 participants would be considered "rare," those that occurred among 4-8 participants "variant," among 9 to 15 participants "Typical," and among 16 participants "General." However, although the frequency and instances are of importance, the substance of the analysis lies in the narrative produced.

Following the tables and graphics produced, the results section below is written according to the question topics and the themes that emerged and is in a narrative format. Specifically, sections will be analyzed according to the themes that emerged that spoke to the research question and the major categories derived from that theme. Quotes are used throughout to emphasize particularly powerful points that are made by participants or that showcase a theme or category more clearly. I will also report how the discussion has led to a deeper understanding of ownership development in smart city service delivery, and in Chapter 6, I synthesize the findings from this chapter and Chapter 5.

4.5 Results Tables and Figures

Figure 4a: Word Cloud of Content

Table 4b: Themes and Categories Developed

Predominant Theme		Category	N total*	N Unique*	Frequency*	n (own)*
Developing Ownership	A	Developing Ownership	48	48	General	---
Establishing Governmental Stewardship	A	Working within Government	197	36	Typical	6
	B	Having Leadership Support the Idea	33	28	Typical	1
	C	Generating Trust of the Application	77	35	Typical	6
	D	Upholding Security and Privacy Standards	55	50	Variant	1
Allocating Resources	A	Utilizing Available Resources	86	36	Typical	5
	B	Facilitating Application Improvement	124	68	General	4
	C	Building Awareness of the Application	62	35	Typical	1
	D	Being Attentive to Feedback	199	74	General	19
Providing Evidence for Authorizers	A	Making the Application Valuable to the User	76	30	Typical	8
	B	Identifying Application Failures	45	27	Variant	0
	C	Garnering Usage	130	46	General	9
	D	Determining the Success of the Application	210	76	General	15
Aspirations for the Community	A	Responding to the Digital Divide and Ensuring Equity	59	47	Typical	1
	B	Bettering Society and One's City	64	21	Typical	14
	C	Increasing Usability of the Application	134	69	General	8
	D	Facilitating Co-Production and Civic Design	191	71	General	19
	E	Garnering Citizen Participation	126	71	Typical	19
Total	18					

*The number of total occurrences, unique occurrences, frequency, and overlap with ownership is noted in the last 4 columns.

Table 4c: Categories and Subcategories Developed

Category	Sub Categories
Developing Ownership	None (0)
Working within Government	Facilitating a Culture Change in Government, Ensuring Government Cost Savings, Developing Ownership of the Application by the City, Dealing with Different Stakeholder Goals, Collaborating and Competing with Others (5)
Having Leadership Support the Idea	Having a Dedicated Application Development Team (1)
Generating Trust of the Application	None (0)
Upholding Security and Privacy Standards	Allaying Irrational Fears, Ensuring the Anonymity of Users (2)
Utilizing Available Resources	Ensuring Application Sustainability, Ensuring Application Isn't Overextended, Dealing with a Lack of Innovation, Having a Single Application Developer (4)
Facilitating Application Improvement	Benchmarking vs. Other Similar Applications, Continuously Improving, Using Experiments in Development, Conducting User Testing (3)
Building Awareness of the Application	Demonstrating (Demo) The Application, Holding Community Meetings, Distributing Paper Ads (3)
Being Attentive to Feedback	Providing, Feedback Mechanisms, Creating Feedback Loops, Creating Feedback Metrics/Measuring Feedback (3)
Making the Application Valuable to the User	None (0)
Identifying Application Failures	None (0)
Garnering Usage	Making Sure Application Appears in Searches, building a User Base, Building Momentum Around the Initiative, Attempting to Get Application Downloads, Sending Push Notifications, Giving Rewards for Using the Application, Identifying the Application's Customer (7)
Determining the Success of the Application	Focusing on Accountability, Addressing Problems, Being Timely and Responsive to Needs, Making the Application Cost Effective, Improving the Lives of Citizens, Disseminating Information, Improving a Process, Increasing Safety, Solving and Identifying Problems, Generating Time Savings for Users, Increasing Transparency (11)
Responding to the Digital Divide and Ensuring Equity	Being Aware of Those with Disabilities, Ensuring Feedback is Gathered Equitably, Engaging and Listening to Non-Tech Users, Ensuring Usability Across Devices, Making the Application Useful for All Users and Doing So Equitably (5)
Bettering Society and One's City	Integrating Technologies, Making the Application Boston-Specific or -Centric, Building toward a Smart City (3)

Increasing Usability of the Application	Attention to Application Design, Making Sure Application is Not Over Complicated, Ensuring Application is Easy and Convenient to Use, Limiting Data Usage, Having Responsive Applications, Building Unique and Simple Applications, Paying Attention to User Experience, Ensuring Web Application Functionality, Ensuring Uniformity in Applications, Giving the Application Realistic Expectations, Having Quick Use Times, Making Application Flexible to Use (12)
Facilitating Co-Production and Civic Design	Utilizing Citizen-Sourcing/Open Sourcing, Hosting Civic Design Competitions, Facilitating Co-Production and Engaging Users in Design, Collaboration with Others (Citizens and Other Developers), Citizen-Developer Altruism (5)
Garnering Citizen Participation	Building Stewardship within the Application, Dealing with Negative Participation/Engagement, Ensuring Two-Way Communication (3)
Total Subcategories	66

4.6 Findings

The findings are presented below for the 16 interviews according to the themes and categories discerned from the coding process. The findings are in a narrative format and flow according to processes conducted. Quotations are also used throughout to draw attention to compelling findings.

The section first proceeds by outlining the main theme, and then analyzing each theme, first by noting the overlap between the theme and the development of ownership. Each section then discusses the major findings within the categories associated with that theme, separate from the overlap with ownership. The only exception to this general format is the initial "Developing Ownership" theme, which is discussed in its own lens. In this opening section on ownership and in the discussion section relevant ties to the literature are also included to refute or support the findings. Any relation to the quantitative findings in Chapter 5 is presented in Chapters 5 and 6 among the mixed-methods findings.

4.6a Developing Ownership General Comments

How initially do cities work toward developing ownership in their applications, and how does this ownership manifest among mobile application developers within Boston? A primary notion that arose from the interviews revolved around how applications acts as a strong nudge in building stewardship around the services that are provided through the application, and how the application works toward making citizens stewards of their community. By participating, they act in accordance with Moore's (1995) model to more greatly facilitate the public service delivery and increase the effectiveness at which the organization operates. As one interviewee noted, "The city really owns the service, but these people are stewards of their neighborhood, they're stewards of their property...I think a lot of people want to feel, you could use ownership, but they want to feel like they're contributing to their neighborhood."

Primarily, the main goal in developing ownership or the gateway step that emerged among respondents was to get people to download the application and throughout to build a network to make people feel they had some ownership in its development. Ultimately, the developers want to get people to use it and to do so, in most cases, frequently and consistently. When users are made to feel they don't have influence over it, it was reported by respondents that they felt users won't use it. What was essential was building a core user base initially which will expand over time. This meant bringing people to the table to have discussions not on the technical workings of the application, but rather who the users are and what they wanted from the application. External input was described as essential and needed to include viewpoints of users of the end application in order especially to not limit the scope

of it to only what the developers could envision. The findings are supported by those of Tan et al. (2005) as they note the need to self-actualize is important in building these government to citizen e-government interactions.

However, for some applications that did not encourage citizen reporting, ownership they found could manifest in other ways such as through ownership of the information or through accessibility and usefulness of the application. The nature of the application then to interviewees purports the level and method of ownership needed. For some service-centric applications, the need is to fix the problem and move on to the next one rather than garnering engagement and input that doesn't pertain to the service itself or is outside its scope. One predominant theme that emerged was building toward stewardship of the individual and fostering the city-user relationship. In distributing the ownership of the application among the user base, the ownership of the application needs to be distributed among the communities using it and needs to be done so equitably and with input from the communities it touches. This supports the findings of van der Graaf and Veeckman (2014) who suggest the smart city relies on such collaboration and the distribution of value among citizens.

The subsequent goal then became reliant on strengthening the relationship between the city and the application user. The application's intent shouldn't be to simply facilitate the service but to strengthen the bond between the city and the user according to respondents. To interviewees, however, ownership development relied mainly on design and usability, and if the application simply doesn't work, it will not garner ownership in the long term. Additionally, feedback and changes made to cater to only a small subset of users may adversely affect the experience of many users and impact ownership. Both of these notions

were echoed by Chen et al. (2016) as they noted what drives users to adopt an application as tied to what users saw as procedural fairness, which was intrinsically linked to usability and user satisfaction. In designing the application, a process error that was noted among respondents was to simply present an application to a community and not engage them in other ways as this garnered little ownership. Instead it was noted that involving people in the design the application developer distributes ownership to the users and builds their investment in the application's outcomes. As one user noted this is essential in building ownership in design:

> "But if you involve people in the design of that thing, then you're distributing ownership to the users, and they're invested in its outcomes and its persistence. And so, that's core. I would say, that that's not just an outcome, that that's essential for the DNA of effective design processing."

The goal becomes bringing the message of the application to more people and challenging them to engage others in activities surrounding the application. It involved getting people to say they own the application not just participated. Building this ownership can be done by surprising people in a positive way and doing so consistently to build trust in government and build ownership around the service through responsiveness and attention to the constituents' or users' voices. This is in line with tenets of the smart city (Chourabi et al., 2012), co-production (Linders, 2012) and public value (Bannister & Connolly, 2015; Bozeman, 2007; Moore, 1995).

In this sense, engaging the community around the application leads to value creation that in turn leads to happiness or satisfaction associated with the application that can take

many forms. This sentiment is echoed by Millard (2013) who saw such ICT platforms as needed to create public value by gathering all viewpoints in the community. For example, as interviewees noted it could be from increased efficiency from general happiness surrounding the application and solving what the user deems as real problems, it could be from the quality of the response given to a problem, pride in initiatives, feedback loops, or transparency in results. In an ideal situation if users weren't happy with an application feature, the government would disable it. Government needs to be critical of its shortcoming and pivot quickly to remedy them to sustain ownership. Benington (2015) saw this engagement as pivotal for the government manager in creating public value in diagnosing the problems as they arose. As one interviewee put it isolation of what the value is for each application becomes critical:

> "Now, your goal must be if you're going to be successful at all long-term, you have to deliver value. You need to isolate what that value you're delivering is early on. And you may not find it. You may find that you did something and what people cared about was something completely unexpected. You might have written an app for one purpose, and it turns out they're using it for something else entirely. And that's fine. You can pivot and go after that, too. That all pulls in everything about empowerment and ownership and trust and everything else. So, if you're a citizen in the world, pure intentions for a single united purpose go a long way."

By and large, interviewees reported that people want to be part of the application and are eager to participate if given the right opportunities, and while information dissemination is a part of the equation, there are other engagement and two-way communication initiatives

to consider. Having a basic level of support and attentiveness to feedback is of importance initially and gives users the capability to learn about the technology and its capability. One mechanism that was mentioned on multiple occasions was having a direct channel to the person or group that developed the application, which builds a positive relationship in knowing that those are the parties with the power to create changes. As the process gets longer and more arduous, usage drops off. However, it was noted that by engaging with users and being responsive usage did increase for many of the applications discussed. Opening such channels was a common theme in the literature to strengthen the voice of users as they experienced the application and developed their investment with it (Chen, 2015; Song & Liu, 2013; Ndlovu & Mbenga, 2013; Yuan et al., 2012).

In addition, attention to feedback through multiple mechanisms is of the utmost importance because it gives insight into applications especially when other resources to track satisfaction are not available. People are using the application and those results are visible all day and tracked through usage statistics, dashboards etc. This also means that the ways in which governments engage people and garner feedback can be multifaceted, and it should be. Not everyone wants to provide feedback, attend community meetings, or send emails so figuring out how users can contribute their data and facilitating such data collection is important. Yu (2014a) noted the advantages to having these multiple channels available in leading to greater convenience, efficiency, effectiveness, personalization, cost reduction, profitability, productivity, accountability, and transparency. Ownership through the application itself is described as a gradual process whereby a feedback loop is created with actions taken by the government to solve problems, but with an attention toward creating

civic behavior that becomes behaviorally ingrained in the citizen's day-to-day tasks. The focus is largely on neighborhood level results, and then over time, the focus improves toward more city level initiatives.

Behaviorally, then, the application acts as a facilitator toward garnering greater levels of civic engagement as stated below: "You get people to do these simple things, and pretty soon, after . . . assuming that it's a good user experience and things are actually getting closed, that they will see this as part of what you do when you live here."

To interviewees, feedback loops and attention to constructive feedback created reinforcing behaviors around the application and the users that asked for changes. Implementing those changes, when possible and feasible, to respondents went far in developing an attachment to the application by the users and influencing future behavior surrounding it. This related to the notion of how feedback mechanisms were essential in both e-government and in the development of the smart city, and how sustained feedback throughout could lead to influence in behaviors (Palvia & Sharma, 2007; Veeckman & van der Graaf, 2015).

One government interviewee described a reporting application features as facilitating behavior that would be exhibited by the user. The ownership came as stated below through a sense of connection to the City itself, by promoting certain behaviors. "[I]f we can get you to report things that are broken, the hope was that you feel more connected to the city, to the city that you live, and that you develop a sense that this is not our city that you are using, but this is really your city, and you can change the way that it works."

By and large, the first step to gaining ownership to respondents revolved around whether the application worked or not. Bad user interface was described as a severe detriment to developing ownership and facilitating civic behavior. Many interviewees described the notion that if an application wasn't usable or useful it would garner little use and thus have little ownership. This was in line with the findings of Chen et al. (2016).

Further, the notion of information and information exchange was also mentioned. Information as well becomes an important method of garnering activity from these citizens as they were previously given so little that they now want information made available surrounding the service. It was also important to interviewees to be cognizant of information overload as to not discourage uptake or use of the service. This echoed the findings of Christin et al. (2013) as they note users are eager to uptake information and providing information from and to the government. Data donation becomes a metric as well when needed in the application, but it is imperative that such information remain anonymized. Such data donation presents problems as it is harder to overcome trust barriers in generating ownership, so anonymity and protection of information was noted as being essential. This as well was echoed in the findings of Christin et al. (2013).

Further, decision- making and engagement throughout the process becomes important in developing ownership. Specifically, what interviewees noted was it was important that the end users feel they are the end owners of the application. Therefore, the need is for them to see how it affects their day to day on goings to facilitate use and garner positive rewards based on the application's development. This is tied to the notion of usefulness as noted in the literature and uptake of technology which proceeds through trust, usefulness, ease of use,

and risk associated with the technology (Hung et al., 2013; Horst et al., 2007; Gilbert et al., 2004; Mainka et al., 2015).

One concluding remark regarded the leadership needed among internal stakeholders in understanding what the application is meant to accomplish, the resources it requires, processes involved, technology available, and protocols that need to be followed. Especially, interviewees noted that core leadership was needed to often carry out the project successfully and create a successful application. Ownership then must proceed both for end users but also for those invested in the application from a managerial viewpoint. It was noted that despite their efforts to develop an application, if an organization involved with the application that plays a critical role along the way does not buy into the initiative, the efforts usually culminated in an unsuccessful application. Ownership diminishes rapidly as end users are not paid attention to, and the momentum surrounding the applications uptake dissolves through this lack of attention to feedback and concerns. This echoed what Heeks (2006) notes in bringing about successful e-governance, which is heavily reliant on the leadership in place and the need to foster such participatory opportunities

For respondent to build ownership governments must work toward magnifying their voice and the success and visibility of their application's functions and successes. Feedback loops that magnify the voice of the government become important in bringing people back to use the application and keep them coming back time after time. These users become part of a community and can be leveraged time and time again in a co-productive sense to test features of the application or updated whether in functionality or design. Ultimately, ownership development relied on that trust of government and trust between citizen and government.

Such sentiments were echoed in support of e-government as it acted as a method to generate trust and confidence throughout such digital services (Seifert & Peterson, 2002; OECD, 2003).

One interviewee described it well in his culmination of what they felt ownership was. To paraphrase they said when users were using the application people feel they are helping, whereas when they called in, they felt they were complaining. Influence becomes important, as giving people the ability to say what they want and manipulate their environment was a key tenet of developing that ownership. Ownership became tied to influence, and if users don't have influence in some way the interviewees noted we were lying to them. Ultimately, many interviewees said not to feature products that cannot be delivered on, and do not have feedback mechanisms that are listened to. The crux of the Boston strategy focused on engaging users to increase usability both initially and throughout the process and focusing on that feedback:

> "Certainly, engaging with those users, we were totally dependent on their willingness to be part of this. We saw our relationship with them as critical. We went to great lengths to be supportive and be open to suggestions, and so on. Both I think philosophically and practically, we knew that it was the right thing to do. I think it really did, it built a collaborative spirit."

4.6b Establishing Governmental Stewardship

According to the interviewees, establishing government stewardship becomes intricately tied to ownership development in several ways. The major concepts that emerged surrounding this theme related to leaderships role in creating spaces for dialogue and

engagement, but also being attentive to such dialogue and generating trust of the government based on such attention. Further, designating project leads to own the project and facilitate interactions with the public was essential.

Specifically, interviewees mentioned the importance of having a focused team and designating ownership of projects to teams and stakeholders. This relied on good leadership and designating someone as the leader of a project to allocate resources and understand the project related goals. As a note about failure, for past projects respondents noted that and regarding application development, some entities involved in the process didn’t pay attention to the feedback they were getting from users, which hindered the application. In this sense, then, support in engaging the public and listening to concerns is needed from all parties with power over the application’s wellbeing. It’s important then to create spaces not just for engagement via typical mediums in a one-way fashion. Engagement relied on facilitating two-way information sharing and had the goal to facilitate public learning to experiment with ideas surrounding applications in a collaborative fashion. As one developer said, it becomes about stage setting:

> “And too often, we forget that there must be information sharing, not just information collection. And so, what we're trying to do is create that capacity for public learning. That ability to, again, to share, to experiment. And that means that you've got to make space for that. You've got to create some slack in a system. You've got to create the ability for meeting . . . making an interaction.”

Again, respondents noted that, in the past, people were asking to have their opinions heard but no one was listening. Users “felt like they were knocking, and no one was home.”

This translated to bad perception of delivery of the service and application features being stale, as project leads were not encouraging engagement and were unable to modify features due to this. From this need for two-way communication in building stewardship of the government, magnification of the voice of the government is imperative, as they are the entity that responds to create feedback and keeps users coming back to the application. For this reason, the responsibility lies on the governmental organization behind the application. For respondents, it is imperative that the relationship be branded around the city with the city taking central focus on the success of the application to strengthen the relationship between citizens and the government. To paraphrase one interviewee, the relationship relies on the user not feeling more connected to the application itself but instead to the city.

Subsequently, being responsive as governments and acting on specifically what constituents are looking for can lead to trust generation for not only applications, but potentially future projects. It was noted that it become surprising to constituents when governments are attentive. Therefore, initiating and enforcing that surprise is of importance. In creating the data capture and developing the application the privacy policy becomes imperative in informing capital investments and decision making. The government's role in answering what they are capturing and why relates to the dynamic method to engage users and the process that will be followed. As one private developer noted, if there is to be trust in their business as a company there needs to be both trust in our service and trust of government to implement and act on the change.

Effectively, without giving people influence, the breakdown of trust occurs and thus ownership is impacted as the service in a way “lies” to the constituents. It becomes important

to not offer features that the developer can't deliver on, but to also follow up on those suggestions they can. As trust erosion occurs as people begin to lose hope in their opinions being considered, attention to update applications based on this. As one government developer put it, placebo effects regarding changes to the application lead to erosions in trust that breakdown empowerment and ownership surrounding the application universally and lead to a lack of creative cohesion around the applications purpose:

> "I think that's a bad idea. It may be psychologically good or something, but I think there's better ways to do that, and lying to people is a very good way to lose trust right away, because people figure it out. People figure out that if they vote on stuff and after a while it's pretty clear that everybody's ignoring their votes, there's nothing worse than opening up the suggestion box and seeing a bunch of pieces of paper in there that are 20 days old."

Working Within Government

How then are application developers and managers working within government in their application development to create governmental stewardship? Specifically, the subcategories coded related to facilitating a culture change in government, ensuring government cost savings, developing ownership of the application by the City, dealing with different stakeholder goals, and collaborating and competing with others. Below these components are outlined narratively.

Collaboration and knowing in the request for proposal (RFP) phase of bidding for government application was of extreme importance to respondents. Private sector companies, who had developed Boston applications, acknowledged that they were inherently building a

government-based business that was reliant on relationship building between internal and external stakeholders. In addition, numerous times interviewees mentioned how applications were often contracted out to external vendors capable of building the application, while discussions about the functionality were based on dialogue between internal stakeholders and the needs of the organization(s) the application effected. For most applications, the outreach was done to local groups familiar with the City and through partnerships they had with research institutions.

The citizen-developers interviewed described how they often created applications based on how they, as the user, would like the data to be utilized and displayed. They took user feedback and expanded on their application based on this feedback. However, they described how they become reliant on government information in many cases for the services they provide. In the case of one citizen-developer who utilized public government data to create their application, they noted how often feedback would come back in criticism of the public service their application expanded upon. Governments utilized these citizen-developers as well, and held competitions and brought in individual or small teams of talent to develop their applications. Rather than working in house, they leveraged private companies through RFPs, but also tested applications by partnering with individual citizen-developers. These developers were often associated with non-profit or educational institutions, and they were used to effectively test their idea and technological capacity of their applications. As one government project manager put it:

> "When it comes to doing the development, we work very closely with a partner. In all three of these cases, the city of Boston, identifying some of the executive sponsors

somebody who's writing the checks and felt it's worth doing, and keep them happy and understand what their goals are. But, then, there's the day-to-day people that you work with. Everybody's going to have their own opinions and their own little ideas, but most important thing is to develop this shared vision, identify what those critical pieces are and then just iterate. We like getting things in hand to play with early and then iterate over and over. That's kind of our general philosophy and how we've gotten."

In addition, some private sector and government developers noted that often, due to deeply rooted relationships with previous application vendors, there could be a sense to undermine the application development, if some sort of other similar vendor was in the market for that service. Internally as well, there were reported problems with communication between parties involved with the application, who later took over projects with little knowledge of the many application's prior successes or failures. Due to the experimental nature of the applications in their development, such experience and having a focused and experienced team behind application efforts was of importance. Further, the explicit intent of many of the applications was not necessarily to save money but instead to improve processes and facilitate co-production and stewardship among citizens, which sometimes caused friction between parties.

However, the applications have also worked toward building collaboration on the delivery side. One application that garnered much success had as its goal, in addition to improving co-productive capacity and reporting, allowing for operational improvements and collaborations between departments.

The focus to fix problems then distinctly fell on the government, which was a notion that was echoed in many interviews with both private and public sector project managers. The responsibility to fix problems lie with the government, and the success of failure on the application depended on that accountability. Further, this was echoed by private sector developers who "weigh labeled" applications to have it reflect the government providing the service more directly and not have the focus be on the company who developed the application. However, while Boston clearly had the capabilities to handle the attention needed for reporting, many smaller municipalities around the city who were interested in adopting the application lacked the operational capabilities. One government manager noted how the reliance fell on the city to maintain the application:

> "I would say it definitely created to change the way that people think about their jobs. I remember very distinctly having several conversations in the weeks following the initial release of the application where I had colleagues come up, and they basically said who built this? Who did this for us? And we said well we did this, I mean, there was a technology company, but I mean, they were relying on us to get it done."

Having Leadership Support the Idea

Leadership supporting the movement was one of the less spoken about categories, but one that was still essential in managing the application The primary key for success noted among nearly all interviewees for an application's success in the City, not only in the case of Boston but universally, was the presence of a dedicated application development team. One of the major shortcomings noted was when the roles and responsibilities "became muddled" regarding who would be the champion around the application or ultimately own its

development. When those roles shifted, or were unclear, problems could arise. The success of the project as one interviewee noted was reliant on their experience and expertise in confronting all the various hurdles of developing the application.

> "And that there was dedicated team that had been here for a while and was going to stay here for a while. And they had all those internal relationships, and they were able to get projects funded and basically really think about the long-term of these projects, and then think about the handoff. I'm not saying that I think it works perfectly, because there were challenges."

As shown above, these initiatives relied on significant operational capabilities, and many interviewees noted that smaller cities were reluctant to take up similar initiatives due to this, but also due to changing administrations with less regard for the power of technology to facilitate co-productive capacity or improve processes. They did not have the "interface" to the city through the dedicated application team.

In building this application team, and concurrently creating a vision for a city that facilitates co-production and citizen engagement through its applications, many noted that the ultimate vision rested on executive level leaders to fund and support these projects. Without such leadership, in the experience of many interviewees, the initiatives would die, or the focus would be a different method other than mobile applications. In the case of Boston, one interviewee noted how the need was to expand on existing initiatives and foster greater operational improvement for them through a new and unique medium:

> "One of the advantages we had in Boston was that this is, a well-maintained city. Operationally we're not a city that doesn't know how to fix potholes, or that can't do

> it, we're actually pretty good. The mayor we know spent 20 years making things rock solid, that we've ever had, and so when people look to this technology, it was the same kind of protective service, they said it just must work, don't make it too fancy. Don't do all kinds of bells and whistles, just make it work. And make it fast.”

Often, the ideas for these initiatives stemmed from these small teams and through the ideas of top-level executives within the Mayor’s office with collaboration occurring between this office and other parties with the capacity to develop the application or experimentally test the idea. These technology initiatives and ways of thinking were described as deeply ingrained within the culture of Boston, and without this, many thought that now successful mobile application initiatives would have failed or never been thought of to begin with. Further, possessing such knowledge was critical in determining what vendors would best develop the application for the vision the city had (depending on the application). The vendors as well noted one of their critical tasks was to guide the hand of the city, through their expertise in determining what they wanted with their application and how they could effectively make that project happen.

Reliance was put on leaders to gather resources to fund such initiatives, which could not be built in house due to operational capabilities. No single interviewee suggested that such development should be done in house. Rather, they suggested the government should have the vision and facilitate the application’s development, but the actual development of the application needed to come from outside parties due to resource constraints. Champions surrounding each project were noted as making the sure the goals of the initiatives were communicated clearly. Leadership on the team was noted for the success of some

applications and failures of others. As one interviewee put it, the application's success transcended simple resource allocation and fell on the team to both guide the project and make sure it was communicated to the public: "And so, the challenge here is, not only do you have to invest in building an app, but then you have to invest in ... get ... empowering someone within the organization, to be the ongoing intricate between the public and that app, and that doesn't happen that much."

Generating Trust of the Application

As is noted throughout the results of this study, ownership relied heavily on generating trust among users. In generating such trust, many noted it relied on building "responsiveness," "transparency," and "communication." Communication via feedback submitted was primarily noted as the means of building trust, and in tying to the later section on digital divides, understanding how to respond to processes for those less familiar with technology was critical. In addition, having varied levels of responses was a key component in generating that trust and having such responses be timely.

As one citizen-developer put it, he lacked the resources to contact people over the application, and due to their protection of information, could not reach out via the application, so he was reliant on feedback to make changes to the application. Using social media that aligned with the service, he was providing and interacting with people in these mediums and on other forums. This feedback provided directly through the application allowed him to make needed changes to garner trust and usage.

While rewards did not become associated with trust among interviewees directly, mechanisms that pushed out notifications or sent follow up quickly throughout the process

were noted as being effective in both being communicative and responsive. For City services, confirmation of receipts for services that come from the City of Boston, both for service-centric applications and those that have a citizen reporting component, were effective in generating usage and more positive feedback. Intrinsically tied to trust building was the idea of making the user experience good, but also communicating the changes made:

> “So, our theory of change was that if we build a good user experience that potentially is our version of test. So, people trust that we're delivering these good user experience, and a good user experience is the interaction with the app, as well as insuring that the thing is fixed, or if you crawl into the center that you're getting, that's the user experience as well. People are confident and right in everything, and so a lot of it was just kind of focused on those issues.”

Making sure the application works and that the service provided or metrics gathered were delivered in a timely manner were mentioned extensively as an important component among the interviewees in generating trust. Tied to the stewardship of the government, was the notion of delivering services that improved public perception of the government. The application, then, could provide a means for doing that in accordance with its associated service. Some interviewees noted how expectations the application wouldn’t work were usually initially high among users, so by making it work initially and throughout, they automatically garnered more trust in the service. The application itself then acted to generate trust via technology. Success would improve such perception and failure would diminish it. As one interviewee said, this should be the goal of every project:

> "You know, the main goal was to improve constituent's confidence in their local government. That we come across as a place that is welcoming, that is friendly, that is also the authority on a given topic, but that we believe that we can be responsive and friendly and authoritative. So, I think that was a big project for us. Every project, improving the public's perception of what we were doing and how we were delivering services for them."

Echoed throughout the interviews were two questions: When does that trust building initially occur, and how important is this two-way communication in generating trust? In answering the first question, nearly universally the answer was throughout the process but most importantly initially. Upon first download, interviewees noted that, if the application created a poor user experience, trust diminished, and it was unlikely the user would continue to utilize it. After that initial contact, it became important that users were being answered in a two-way fashion, and that the outcomes delivered via the application were deemed as effective. As one respondent reported, outcomes should lead to a "growing process that actually lead to a greater capacity, stronger networks, and then ultimately, includes trust." In answering the second question, interviewees noted how it was pivotal to make sure we were moving toward civic technology through which users felt empowered, and that implementing two-way communication in this fashion was pivotal. Time savings were also mentioned regarding all efforts as generating trust. Intricately tied to the notion of empowerment was the notion of accountability and genuine calls to action about getting feedback and being responsive to needs through an effective service delivery mechanism. Further, in generating trust, the design of the application should reflect the components, deemed by the community,

that generate such trust. Ultimately, accountability in service delivery and feedback were mentioned as the primary drivers of trust:

> "We're constantly holding ourselves accountable for the work that we're committing to and putting that out there publicly. As far as trust is concerned, we're just trying to be as responsive as possible putting our work proactively, if somebody writes into us through our feedback form, we get an answer to them within minutes, honestly, certainly by the end of the day. The same on social media. If someone sends a question through direct message, any of those channels, then our digital team people will respond."

Upholding Security and Privacy Standards

Tied intricately to trust generation was the notion of security and privacy among users. In building trust, these protocols needed to be followed. One component that emerged was the idea of friction in increasing usage of the application. Security, from the technical standpoint, was spoken about extensively. To start, getting servers up and running and building in mechanisms such as firewalls and back-end protections to protect users' security and limit the application's vulnerability were needed. Further, increasing security standards was a critical concern among interviewees, who often mentioned these were still not enough to combat looming cyber threats. However, most echoed that having communication between parties involved and utilizing the security teams involved, both in the City and within the vendor, was highly beneficial.

For users abusing terms of service of the application, managers noted how they sometimes but infrequently did have to revoke access. Often this was by removing certain

content, putting in profanity filters for reporting applications, or in extreme cases blocking the user. However, there were instances reported where users would write scripts or spam the system. In these situations, managers had to balance privacy and anonymity of the entire community with police action taken against the abuser. In protecting the entire groups trust and anonymity, one interviewee noted:

> "So that's kind of where we go back and forth. It's harder to be the advocate for the city who pays the bills and calls the shots, and for the citizens that you're trying to respect and do right by. That makes kind of an uneasy feeling sometimes in making those choices. That's where it gets hard, and you try to walk that line...So that's the balance where we've been going back and forth with the cities, where if you want anonymity, then you have to maintain the anonymity, and if somebody works hard to be anonymous, then we're going to let them be anonymous, and we have to deal with that."

A major theme concerned if the application requires a sign in or some disclosure. This required a level of trust among the user, and it was noted that the user is unlikely to use or interact with the application in this case. Anonymity for users therefore became a key component in ensuring that users utilized the application and that it built and gathered their trust. Many echoed the sentiment that if a login was required or some identifying information such as email needed, users likely wouldn't use the application. As one developer put it, not having the contact information of users was worth the shortcoming of not being able to contact people via this medium to garner greater trust: "I don't collect email addresses, so I don't force them to sign in or anything like that. Now, if I did, I'd be able to collect email

addresses, and I'd have the contact details of people who'd be using it. I think with something like that, that would put people off using it in the first place."

Initially, answering questions to solve problems and communicating where data was going was critical in ensuring the application adhered to security and privacy standards. Designing according to "minimalist" standards was a common theme that spoke to the idea of storing only information deemed necessary for the functionality of the application. Especially about payment-centric applications, this was important, but it was also important for all applications that had even general minimalist functions. Though perhaps beneficial down the line to have information, most interviewees mentioned how gathering only the needed components to perform the service were required. One interviewee put this notion well: "[A]t its core when you're doing this you have to balance delivering a good system and doing the functionality, but also be the advocate of individual rights, and privacy is a big one."

For data donation applications, this sentiment emerged in that data donation itself should be voluntary and of the user's volition, and never used without their consent. In addition, this minimalistic approach to data capture went a long way in allaying user concerns over tracking and usage of their information. Lastly, ensuring anonymity and transparency in data use was critical. Also, stewardship on the user's part and clear communication of the intent of the application built into this notion as one interviewee mentioned:

> "So, we made a bunch of decisions that you had to agree to turn the app on. You had to agree, it would run in the foreground, so that you knew what it was doing. Then at

> the very end of the run, when you clicked stop on the app, that you had to choose to upload it to this public domain server. We thought a lot about the public interaction with the data, and how we were putting it into the public domain, and so on."

In allaying fears, developers needed to ensure users that the process itself presented little harm to them and to build trust associated with the specific intent of the use of their data. They should only be capturing data that was not sensitive and was needed for the application's success. Not doing this likely would frighten a user, and they would not download the application or use it. Many interviewees spoke about how, behaviorally, building investment initially was needed, and only asking for sensitive information (name, phone number, credit card, location) when it was needed for basic functionality of the application was a best practice. This built a sort of investment that brought users in and didn't frighten them away initially. As one interviewee said, "[G]ive them something before you take something." In creating this "low friction" environment it ensured initial use and future use for users.

To an extent as well, users had somewhat "irrational" fears that needed to be allayed by the government respondents that were mentioned extensively. As one interviewee put it, there were the "legitimate concerns" and the "quasi-legitimate concerns," both of which needed to be addressed in turn. One reason for the latter of these concerns was noted as tied to the notion that many users did not understand the back-end technological component, which explanation and transparency campaigns tried to address. In gathering initial buy in, however, the various applications had to make sure the fears brought forward were less severe than people perceived. Allaying these fears came down in large part to campaigns that

answered questions but did not give in on their perception of what did and did not constitute security risks. One interviewee talked about this in the context of already easily findable infrastructure and a reporting application and noted how the application wouldn't make such targets more vulnerable: "So, it's this idea that making already obvious infrastructure slightly more findable somehow will increase your rates of terrorist attacks was just a ridiculous idea, and so it was kind of the same idea here."

In some instances, the idea of communicating anonymity became the hardest part. As one respondent put it, despite complete anonymity in the process, sometimes initiatives needed to be abandoned simply because perceptions of anonymity were not there:

> "There was a technical solution that said, 'You authenticate with Google, you get to that token, you go through a proxy that strips the information so that nothing going into our system ever has any of your contact information, and it's just some quiz, you know, we don't know. But through a challenge response, we'll know it's you and you're the same person.' But we abandoned it, because there was no way we could possibly explain to the public that you were anonymous, even though you were signing in with something."

4.6c Allocating Resources

As was mentioned in prior sections, the internal stakeholders surrounding the application must act as the champions for that application to build ownership and ensure functionality as it relates to usability and attention to user feedback, which was a sentiment echoed throughout interviews. Both these as stated in the section above on ownership development are critical toward building stewardship among users. Understanding resource

constraints and which budgetary and technological limitations applied to the application, and communicating that goal to them, was of importance. When there are competing interests and goals, it was noted that the application was reliant on managers and leaders to reel in efforts to have a clear road map and direction toward implementation. Further, one more important note was to understand how feedback could be incorporated and having realistic expectations of how to deliver and answer that feedback without compromising the integrity and goal of the application. In this regard, bandwidth, both actual technology and of the team answering feedback, was often brought up as a necessary impediment to integrating and incorporating feedback directly. Practicality of the feedback often drove the integration of user feedback regarding changes made to the applications.

Such attention to feedback often manifested in simple mechanisms such as emails or chats with fast responses to questions asked that allowed for continuous improvement of the application. This enabled developers to learn with agility and to most effectively target areas that needed attention quickly. Though other forms of interaction were performed during initial development and getting various stakeholders and beta testers present to develop the application, the predominant trend of developing ownership throughout revolved around simple mechanisms through which users could communicate and have a feedback mechanism in place to answer their questions. Equity and timeliness were both regarded as direct means to build ownership around the application and enable people to feel invested in “shaping” the application. In shaping and improving the application through attention to feedback, one developer commented:

> "I basically made sure our team responded to everybody, like an individual response within 24 hours of them emailing us. And we gave them a place to track the issue. So, we put it all on GitHub and made it all open. Opened our dead issues, so people could see what the actual development issue is, what the tickets are to improve the website and see their own issues."

Awareness surrounding the application and attention to feedback then become ingrained with the application improvement campaign and use of resources to represent one aspect of the resource component of the Authorizing Chain (Moore, 1995). One citizen-developer, who developed an application on his own accord for a public service, commented on his distance from the application (meaning he did not reside in the City of Boston) and the vital nature of how attention to feedback formed a key resource for his development plan. This developer noted how simply having the portal there (in this case, Facebook and email) was a first step, but answering users and giving them the sense, they were being heard was the consequent step in building usage through engagement:

> "Because I'm not a user of the app itself, I am very dependent on people's feedback. It would be crazy to ignore it, because they are the people who will ultimately drive what I do. But, the only sources of really feedback I've had so far been that class and then some comments that I've had from Facebook as well. And, I've asked questions on Facebook, like about maybe time form and some of that. I've asked a lot of questions and when I've come back with answers, I've adopted them...what I've sort of found is that, by interacting with people, they do start using it. It definitely seems

> like I see a little rise in numbers after going through a process like that where I'm engaging the people."

In building this awareness and ownership, developers noted how the primary factor driving this development was usage of the application, followed by the usability of the application, and then followed by integration and attention to feedback. In many of the cases, the feedback received was overwhelmingly positive with more positive than negative criticism and interviewees noted how they utilized this data (both positive and negative) to both measure the success of their application and make needed changes. For many developers this engagement was welcome and showcased the success of the application. However, many of the concerns they struggled with implementing due to resource or technological limitations surrounding the application. Awareness campaigns then focused on actual deliverables rather than promising changes that could not be made. As one person noted regarding attention to feedback:

> "Well I think the one danger of ownership is people think, 'Oh you should just do what I say.' As I said before, I'm like, 'Well sometimes what you want actually will make things worse for 100 other people.' So, if people believe that ownership means that, then I think we have a problem. That's my concern. Don't offer features that you can't actually deliver on what you're implying you can."

Utilizing Available Resources

Resources, naturally, were mentioned as a severe limitation or benefit to the development of certain applications. Mentioned by many developers was the bureaucratic red tape that limits government innovation and often the technology available and working

among other municipalities limits governments integration among software’s. This lack of innovation, compiled with the need to ensure the application is not overextended and is sustainable, to many interviewees, relied on having a dedicated application development team to utilize resources effectively.

In terms of funding for government developers, typically grants were utilized to help fund projects and grants drove many research initiatives for the experimentally developed applications utilized by the City. These grants allowed the City to partner not only with the private sector developers they were utilizing, but to partner with research institutions that could explore certain problems the application’s hoped to solve and see if the application was a feasible solution.

Despite efforts to move applications to other cities, however, what many interviewees noted was that smaller cities simply did not have the resources and money to continue the application after grant funding had been used up. However, also mentioned was the fact that there were problems with some partnerships who provided subpar service despite the investment of resources by the City, and therefore learning from those experiences and utilizing other RFPs to develop applications could be beneficial. As one interviewee notes, one of the major reasons for application failure was funding and lack of resources:

> “Yeah. Funding was a big issue. I feel like, I don't know, if we had another chance at it and a lot more money, I think we would give it a chance. I think it would do well in general. There'll be lots of issues as far as who it is monetizing it and who is managing it, all kinds of issues, but certainly funding was a big issue. Funding and

> staffing. It was really beyond our ability. We were getting calls from all over the world about how to use it."

For citizen-developers, they were largely reliant on other resources that have been open sourced, and which can be manipulated to provide the service through their application. These developers can only handle a limited amount of installations on their servers, but both citizen-developers interviewed mentioned how they avoid any sort of pay or monetizing of their application. In promotion the application as well to gather awareness, one developer mentioned a lack of resources for promotions and lack of capability to keep updating the application based on user feedback and technological shortcomings. One interviewee put it well: "I think for a lot of the individual citizen-developers, developing an app's easy. Maintaining it's hard."

In ensuring application sustainability and use, the lack of funding often translated to a lack of resources to effectively explore "user experience." Not having a dedicated user experience staff member for the applications developed by the City was noted as a significant drawback in the organization, and having to rely on other entities, while welcome, was not the most effective way of developing a coherent application development strategy that ensured long term longevity of the government's applications. As mentioned by one developer, it's this lack of resources and overextension that lead to application failure, and, while ensuring citizens were involved was important, dialing in the business side was the first necessary step:

> "On the application side, I mean not really. There's always more we'd like to be doing. One of the key things is you just must be careful to not overextend yourself

and do what you have the resources to both build and maintain and support. Are there more things I'd love to be doing? Yes. But I don't have the resources to do all of that and sell it and support it. There's basically a whole bunch of this stuff that's more on the business side, than really on the public benefit side, and if you don't get that part right, you're hooped. All those app developers who are complaining to you, it's because they haven't thought the business side through."

Facilitating Application Improvement

How then did managers best go about facilitating application improvement? Already mentioned significantly was the theme of experimentation that occurred in initial application development. However, the idea of having continuous improvement and benchmarking themselves vs other similar applications, while conducting extensive user testing was mentioned extensively to ensure application success.

Experimentation often arose out of identification of a specific problem that faced some group of constituents or was envisioned by leadership as a problem that needed solving. In some instances where government lacked resources, citizen-developers noted how the availability of government information was used by them to develop the application. In these cases, they noted how they did this with the government's data to create the application. In other instances, managers in Boston regarded how partnering specifically with Boston developers allowed them to experiment separate from typical vendors regarding some of the application ideas they had. The partnerships chosen, between private and public managers, were heavily reliant on flexibility in experimenting with the application.

Regarding development, the perceptions of users were unequivocally regarded as an important aspect of ensuring that the application improved among all developers: private, public, and citizen. As one interviewee mentioned, they want engagement throughout, with pre and post user research and “real, live, random people off the street to influence you at the design process.” Echoed throughout statements was the idea that, if an application had problems, users were eager to report that issue to fix it. For one application that did not perform well, interviewees mentioned how they did not gather feedback before development to the detriment of the application. This was a major setback when the application was launched as it did not account for many issues outside the scope of their original design that users encountered. Treating the input valuably and paying attention to feedback was highly regarded by one respondent:

> “I think often; these kinds of people don't get a lot of input into the operation or the management side of things. So, they really, I think we’re proud of the fact that we were treating them as experts. That we were looking to them to give us the high-quality feedback. It was a great experience.”

Regarding user testing and garnering feedback in the development of an application, interviewees noted how getting input initially and maintaining that throughout was near essential for success. The mechanism of user testing was especially noted as important. Further, beta testing initially with local users interested in the application was a widely recognized practice among managers. This meant, to respondents, paying attention to the data associated with usage of the application. For example, how users were navigating through the application, how long they spent on each section, drop off rates, general usage

statistics, and technological problem areas during usage. An interviewee regarded below how this beta testing initially was important, but engaging throughout was equally as important:

> "Basically, any time that you can get people involved in the development of product through getting their feedback, and then hopefully implementing changes to the apps based on their feedback, that's a big one. . . . It's just happening throughout from the beginning to if the project ever ends, because everything is in flux."

Often, interviewees noted that they were able to benchmark their application regarding other market applications, and even sometimes existing applications they had previously developed for the city. In benchmarking the application, one citizen-developer noted how they were able to compare their application to other similar applications within the market:

> "In terms of benchmarking accuracy, I've compared what other apps out there, and I'm quite happy that it delivers accurate information. Accurate in the sense that it's delivering the raw information that it's given. I mean, obviously predictions can be sorted out quite a lot."

Ultimately, success of the project relies on managers with long range visions to ensure that projects don't fall to the wayside and that long-range sustainability of a project is accounted for. Value in the application was mentioned and that value tied to the vision associated with the application, which was enhanced throughout the lifecycle of the application via continuous improvement. For those applications that failed, ultimately, they did so because they lacked a long-range plan based on that value, maintenance of the technology, and ample resources to continue the project throughout its lifecycle:

> "It means if you're designing technologies with an organization, to assure that the organization has the capacity to not only continue to run it, but to maintain it and build on it, which is often not the case. . . . All too often, things are built and plopped into specifically government's hands, and then the government has no idea what to do with it. So, what we try to do, is to do that work of building capacity as we go. Sometimes, it's successful, and sometimes it's not."

Building Awareness of the Application

Awareness manifested in several ways and there was no unilateral strategy noted by interviewees. However, specifically mentioned were demonstrations of the application, paper advertisements, and community meanings were mentioned the most numerously among interviewees. Regarding outreach, it was noted as a major effort needed for the application's success for obvious reasons, but primarily to communicate the purpose of the application, garner usage, and address problems. Overall, numerous interviewees noted how constant advertisement of the application was needed to garner downloads and that those advertisements should be associated with spikes in downloads measured and separate from normal trends: "But a bunch of these things, you find that, like anything else, you might have a great product, but if you don't let people know, and continuously let people know, then it'll taper off and back out of that baseline. So that's the hardest one."

One citizen-developer advertised their application via social media and noted the primary reason for this was to gather that initial usage as stated below. This became important in getting people to use his application, which he felt was the best on the market and separate them from other similar applications they were previously using.

> “They started using it and they didn’t go back to the previous app they had. Because this is good for me, that event let them see my app, because maybe they weren't aware of my app, because they had a different app which they were happy using this, and they didn't even check if there is this new app, and there you go.”

However, other citizen-developers noted problems associated with garnering usage of their application related to a lack of resources and the need to get press articles published to convey the purpose of their application. Also mentioned was deeply ingrained collaborations between an existing application and governmental agencies that made it difficult for their application to compete. As one interviewee mentioned “getting the application linked to the website” associated with the service would be the most effective way to likely garner usage.

This collaborations between departments was also mentioned as effective by governmental interviewees in nudging people toward use of the application over other mediums as developers noted they would work with associated service departments to send communications that relayed what the application’s purpose was.

Lastly, extensively mentioned by interviewees was the “Boston Brand” and having such a brand on applications that garnered usage among other associated applications. The brand identified the application as uniquely Boston, and prior successes made it, so users identified that brand, and associated the success of the application with the City. Further, the brand, as noted by private sector collaborators with the City, gave the City immense flexibility and allowed them to save their user base with later iterations of the application. If the application partnership was abandoned or a new application created, the user base could

be migrated over easily, and the application brand would follow with the new application, preventing the government from having to start over.

One interviewee mentioned the dangers of awareness campaigns since in some instances this brand presented an equity concern as awareness campaigns could be used to mischaracterize the brand regarding equity in servicing only the most affluent neighborhoods. In the instance described by several interviewees, an application was mischaracterized by a third party (not associated with the application) to present it as inequitable. Despite the notion by interviewees that the claim was not true, they noted how the negative press adversely affected the application:

> "A bunch of big organizations picked up on that. Didn't do the research, and then they republished that. We started seeing all these crazy stories about Boston using apps in equitably. . . . So for about a year afterwards, people were using that as an example of technology gone awry. We would have to go through and track down who said it. That was never correct. It was a mistake made by some guy."

In solving this problem several interviewees suggested transparency and open sourcing of the application, so users could see its code and discern that it was safe, effective, equitable, etc.:

> "I think we would have spent a lot of time in the public eye talking about how it works and how it didn't work, and how we're protecting people's privacy and so on. I think we would have tried to. . . . I think one of the ideas, our takes from the earliest stages, was that we wanted to open source it. So that people, not everybody, but

certainly people would be able to look at the code to get a sense of are we telling the truth? Are we lying about what we're actually doing?"

Being Attentive to Feedback

The category most spoken about in this section was attention to feedback. Talked about extensively was the need to provide feedback mechanisms, create feedback loops for users, and measure feedback and analyze metrics associated with this feedback. In addition, feedback manifested in many forms from general praise to something the user wanted fix or to other sorts of random inquiries. It relied on the resources associated with the application to determine what feedback was useful and what metrics to associate with that.

Mentioned, specifically, was having feedback mechanisms that proceeded through multiple channels including being active on social media, the application itself, email, forms, surveys, chat, texting, newsletters, neighborhood liaisons that conducted community meetings, and forums. Most universally mentioned, however, and what seemed most successful were emails to the development team and mechanisms within the application that can be used to directly to send feedback. Community meetings were also widely mentioned and deemed effective by interviewees. Social media, though widely mentioned, had mixed results among respondents in gathering feedback and working as an effective mechanism. In addition, things like forums were noted as being successful in many regards. The theme that arose was that users wanted to directly voice their concerns, happiness, or grievances to the application developer and receive an answer or acknowledgement. In addition, what arose most predominantly was the concern that garnering this feedback had to be easy:

> "Yeah, we tried to make it as easy as possible in-app to send feedback. You know, we'd make it very clear that we wanted to hear from you, and so we put those buttons and links to surveys and different things very prominent in the web app, on the webpage. Yeah, and we tried to give . . . there's all kinds of different ways, of maybe you don't want to use this app, or go through the website, but you can email us or phone us. We'll take whatever and use it."

Interviewees also noted the use of specific surveys, focus groups, and analytic analysis that was used to gather and analyze feedback. One theme mentioned about these more research-oriented methods was that, qualitatively, useful details emerged out of conducting focus groups and surveys among users. One interviewee said it well that these methods were extractive, they differentiated from the above methods designed to encourage co-productive feedback and build ownership:

> "Focus groups and surveys can be extractive, right. They extract information and data from people. So, they're not necessarily participatory, they don't do that work. They provide information to the designer, that often, the designer doesn't feed back to the people who provide that information. So, I don't think focus groups and surveys are necessarily effective. Again, they can be effective in knowledge creation for the designer, but not for trust building or ownership."

Further, quantitative techniques and data capture were effective and the metrics on usage and other aspects of the application telling. However, many interviewees weren't always knowledgeable of the direct usefulness of these metrics or how these could be utilized

for the betterment of the application. Collaboration with others in research roles then was mentioned to leverage these metrics more clearly to garner further expertise.

There was a need to continuously develop the application based on feedback that was mentioned near universally among interviewees. However, also mentioned was the evolutionary nature of attention to this feedback and how feedback associated with applications changes over time. To paraphrase many interviewees, during the first few years people want to be engaged they are vocal, and they are invested in that application as new users. Over time as they become long time users, they just want the application to work and their feedback becomes less frequent unless there is a technical problem. One interviewee mentioned then how the metric that was often most telling aside from feedback was the App store or iTunes rating. Incorporating feedback throughout was universally noted as important, but with the nature of that feedback changing over time and the strategies employed by the application developers in being attentive to that feedback was put well by one interviewee: "As we get larger scale, building the muscle of how you listen to users becomes more and more important. You can't just react to complaints, because doing something might actually make things worse for others."

Resources were mentioned as a primary hindrance in being able to be attentive to all inquiries. These were mentioned as having a lack of personnel, lack of research capability, lack of finances, and technological shortcomings specifically. Further, negative aspects of feedback were mentioned according to some interviewees as tied to two primary ideas: that the user thought the application was associated with another service or department, and that the application did something that it was not designed for. Mentioned was the idea that such

inquiries were out of the scope of the application, but attentiveness to them was equally important about salvaging users. Forwarding of these inquiries was mentioned, when it was possible, to enhance the user-application relationship despite the user being incorrect about the application's functionality. Further, having a neighborhood liaison to serve as a voice for government was mentioned as a means to enhance the application's image. Despite of the shortcomings, one application developer noted how feedback was laborious, but necessary and needed to be the focus of the application project as it evolved:

> "It's basically just a lot of hard work and making sure that we're able to implement iterative feedback. Just constantly getting feedback and making sure that we can quickly implement it, I think that's a key thing for most of our projects . . . So if things are set up where things are lean enough and we're in a position where we can quickly change something based on some caller feedback, that's the important thing. We never imagined that we would just build it once or twice maybe, and then it would be kind of static, but we imagined the platform as evolving over time, dependent on the kind of feedback that we were getting from people. And that stayed true, people had lots of specific ideas."

4.6d Providing Evidence for Authorizers

Providing evidence for authorizers manifested in several ways for interviewees when developing their applications, but primarily usage showed the evidence most necessary for an application's success. Initially, however, the actual value of the application for the user was the goal of the development and, ultimately, it was this value generation that lead to ownership development and subsequent usage. Value manifested primarily through

determining what was needed for the community and developing an application based on that need to address certain problems. However, one problem developers found was that the smaller the scope of the application, the harder it was to build user bases. Even when value was generated, having a broader user base and subsequently more grandiose vision for the applications focus (meaning citywide rather than neighborhood-wide or for specific users) often garnered more success. Further, the applications couldn't limit certain users and needed to be equitable in nature based on their scope. As one manager noted, this became challenging in ensuring there was not just a user base with a large scope, but also an equitable one: "[O]ne of the challenges that we face in the public sector frequently is the function that we must deal with everyone the same, right? We build one app that the idea is that everyone will use that, right?"

One important aspect of this value, which was directly tied to ownership among several interviewees was the idea of accessibility in the service. Having the mobile application available was key, but also having access through other mediums allowed participants to, "have ownership over the information, because they're able to use [it] in a way that is most accessible for them, or useful for them."

Garnering usage then became critically important in determining how to continue development toward more ownership as defined by usage and uptake. Statistics that showed when, how many times, and how long the application has been used by users allowed key development surrounding updating the application and seeing where changes can be made and tracking its long-term success. Echoed throughout the interviews was a need for constant usage of the application not only for metrics on usage, but also to ensure that the community

was sustained and actively engaged. Universally, application developers commented on how people want to be engaged in development but with a drop off the user base, the momentum and support of the application dies out. This is regarding both internal and external stakeholders as one interviewee put it: “Otherwise, again, they could do tremendous research, but if the stakeholders haven't bought into it or aren't understanding why or seeing the value along the way, then it's absolutely meaningless. They're not going to do anything with it.”

Pivoting from failures and determining successes related to ownership development among interviewees and there was special regard to attention paid to the request by those behind the application. Success from the user standpoint was near universally regarded among interviews by the response of the government, and whether such a response was deemed valuable by the user and if they felt the response was adequate. As one interviewee said:

> “Obviously the thing people are most concerned about is, if they submitted a request, is the response good enough? I think that's the main thing . . . people are going to transition the way that they behave to adopt that new type of technology because it brings them incrementally, or a step function more of value in their day-to-day whether that's from happiness or efficiency or whatever it might be. So yeah, again I think it's super important to focus on value creation, and like, solving a real problem that people have.”

It was noted especially how lack of response, and in some interviews a lack of past responsiveness through older mediums would or had already tarnished the reputation of the government on delivering those services. Effectively, many regarded how this inhibited the

success of the application from the start. Two things were tied to this usage or ownership drop off. One was continued lack of response, whereby the user was ignored regarding their request. The other was stale information dissemination within the applications. Despite the unique nature of each application, interviewees noted how unanswered question despite the service and outdated, hard to find, or incorrect information regarding the service would drive ownership down and subsequently lead to a lack of success in the application. Information overload was always a critical concern, but lack of information was mentioned among many interviewees as detrimental to uptake.

Making the Application Valuable to the User

How did developers then go about making the application valuable to the user, specifically as it related to providing evidence on its success? Primarily, the concern that was spoken about the most was making the application "useful" to the user. The notion of what connotations "usefulness" varied, but it universally entailed constant feedback from the user's regarding development. To interviewees, the notion of "usefulness" revolved primarily around creating a user experience that was related to the wants and desires of citizens in the community and, which was designed with those opinions in mind. By making users overall "happier" with the application, step one of making it valuable would occur.

Firstly, bettering user experience manifested in other ways by creating a culture shift within the community and a sense that the citizens would help better their city through participation. However, the application itself was meant to be how the citizen-built accountability with the City as their thoughts and concerns were taken into consideration

consistently when the city modified the application. Engagement, then, was thoroughly mentioned to build investment in the application and to make it valuable.

However, applications with simple designs or functions were the most mentioned as building value, simply by working. Ease of use was widely mentioned to sustain downloads of the application after enticing users with engagement efforts. As one interviewee put it this created change and trust in government, that government was working efficiently and effectively, through the application: “So, in a lot of ways although the intention was to provide an interesting and useful service to the public, in a lot of ways, it helped to demonstrate change through a big institutional bureaucracy.”

If the developer could surprise the user with their experience, which was mentioned as a reaction by some interviewees, then they could change the perception of what government was doing it and the way they were doing it. Further, for some applications while being able to engage with the application was valuable, for others simply saving time was the concern for most and having the application represent a true time saving device.

> “And I think in those situations, they have a channel for them to either provide feedback or be more involved, or sort of track progress or something like that in a way that's useful, but also to affect the fact that people have different kinds of priorities, and there are stipulations where you're talking about the app for them to be engaged in them or almost to sort of volunteer their time, but to simply make it so that it's as simple and easy as possible, they can spend more of their time doing the things that they care about.”

The challenge came among interviewees in both managing the needs of the client (which was the City whether the interview was done by a private or public developer,) and the user. Often these goals clashed, and the user experience would suffer based on what the client may have wanted or some functionality that had not been tested on the user. Further, a challenge was determining what the value was for each user and their value associated with the application, not just what the client determined the value for society was. One interviewee put it well:

> "Now, your goal has to be . . . If you're going to be successful at all long-term, you must deliver value. You need to isolate what that value you're delivering is early on. And you may not find it. You may find that you did something and what people cared about was something completely unexpected. You might have written an app for one purpose, and it turns out they're using it for something else entirely. And that's fine. You can pivot and go after that, too. And as we think about why people are going to give hours of their time to a thing, we still must really think about the value proposition for every individual that's participating, as opposed to just sort of general eco of good will and public engagement."

Identifying Application Failures

What things then were noted as leading to failure among applications for those interviewed? Mentioned was the notion of competition with others and a recognition that another application already did the service better, and thus the application became obsolete. Citizen-developers, especially, were cognizant of the competitive market regarding the service they developed and noted how getting downloads greatly relied on "being the best."

Elaborating on this notion was a similar notion that a lack of stakeholder investment could lead to application shortcomings. Reorganizations among public interviewees that caused project ownership of the application to be shifted to parties unfamiliar with it or with competing priorities could lead to application failures. Many applications that ultimately failed had short term success but long-term failure with the primary reason for this failure associated with a lack of upkeep by the primary stakeholders. Interviewees noted how when even one of the parties involved fails to keep up aspects of the application, which were primarily noted as enhancing and fixing the technology or engaging users, the application fails. Further, when parties failed to take on operational components of the application that were necessary for it to fully function, the application's quality diminished.

Technology was noted by some as a time when the application could fail as technology was not relevant to users or was not working properly for them. However, business models as well were mentioned as a primary reason for why some applications succeeded or failed. Less important was the technology as one interviewee noted: "There's always a question of the business model behind it. In a lot of ways, the business model is more important than the technology because almost all technology can be made to work so really a lot of our question is ultimately about business model."

However, the experimental nature of the City has largely not cast application failures in a bad light and interviewees, both government and public, noted how the experience lead to learning experiences and changes in thought processes. Learning and moving on from these failures became a predominant theme, as did the notion that applications should not be designed with success being the only goal of the project. In a sense, some interviewees noted

that sometimes the failure was necessary to explore whether ideas were meant to be implemented, which could not be known without first testing them as one respondent said:

> "I'm talking, not about any particular app, but I'm talking about the approach of trying a bunch of things and experimenting and looking for successes. Inevitably, that means that some of them are going to fail. So certainly, when we talk about these things, we don't promote it, but we will talk about it as one of the dead ends that we had. . . . And my hope is always that it will result in a discussion. And so, my hope is that, as we talk about how you do these experiments and how you deal with failure, and how you pivot, and how you talk about these things . . . and I think some people get the decision, but I think most people don't."

Garnering Usage

Getting people to use the mobile application became critical, not only for the success of the application, but also in building ownership and providing evidence for authorizers of its success. Subcategories around garnering usage entailed making sure the application appeared in searches, building momentum around the initiative, getting application downloads, sending push notifications, giving rewards for using the application, and identifying specific application customers. As one interviewee put it, "It's pretty simple. The overall goal is to try and get people using this."

Primarily, download statistics were the number one method used to determine whether the application was successful or not and whether people found the application useful. From gathering downloads, the popularity of the application in the Google Play Store or iTunes Store rises and garners people to download it more, due to its popularity, and in

this way shows the success of the application. One citizen interviewee described the success of his application, which revolved, as he thought, around being the most usable and useful application regarding that service:

> "I can see how many people install my app, how many people uninstalls my app, and I can see it on daily basis. I can see how many people are using my app daily, because I have statistics like usage . . . So I can see it's constantly growing. I can give a number, like, for example, at the beginning, my daily users were like, three, four people per day. And now I am up to 6000 use people per day . . . now I think this month I have over 80,000 thousand users installed my app. I think I basically gained more users than other apps at the same time."

However, downloads alone and appearing in searches were not the primary method mentioned that determined whether the application was truly being used and was successful. Many described how it was necessary to dive deeper into the metrics to determine what the number of unique asks a day were and how many users were actively using the application, not just downloading it. This success was separated from the initial metric of "downloads" and provided more relevant metrics regarding many of the different applications that let people build outreach to users uniquely rather than through other awareness campaigns. One interviewee described this phenomenon of downloads types well:

> "I believe it's something like if you have 500,000 population, you should expect to see about 100, 150 downloads of your app with a search of the city every week. If you do nothing. Just because 500,000 people, there's at least 100 people, 150 people that are going to say, 'Oh, I got this, my new phone and I'm bored, I'm in Boston, I'm

> going to search the word and see what Boston stuff there is.' Which is pretty good given that Boston is about 600,000 or so. So, we have over 150,000 downloads, and at any given day there's somewhere around maybe 3,000 to 5,000 people who go into the app, and it results in about maybe 300 or so unique submissions."

In addition, government used platforms like social media to analyze the broader campaigns surrounding the success and communication of the application separate from usage statistics. To garner usage and engagement, some applications used rewards within the application to reward the user, while others showed how their input had led to some positive outcome. Others simply reported that the service had been completed or provided information. Largely, the function of the application determined if some reward system or feedback mechanism could be put in place. Further, many interviewees noted that the usage depending on the outcomes of the application, with those outcomes determining whether usage had occurred at appropriate levels. One private sector respondent described this well, and the notion that the determination of an application's success for a city is unique to that city and varies with their goals:

> "What we always want to do is say, 'Well, what is success for you? Is it, and then use metrics or something tangible is important so maybe like say, How many issues, what would be success? If we had a 100 people report in a month, would that be successful? Would 50? 1000?' And, when pushed, a lot of people will generally have a pretty good idea that they'll often think about."

Also, mentioned was the idea of leveraging the core base of users referred to from interviewee as "power users." Analyzing this base provided evidence for how usage was

proceeding early in the application's development and many interviewees noted this strategy in further grabbing the attention of other users. Further, creating trust and dialogue across users through connecting with users was the predominant category talked about and connecting with users on a different level to gather usage. This proceeded, to interviewees, according to dialogue with the users and to ask questions about their experience in addition to conducting outreach that build awareness of the application through two-way dialogue. One interviewee described this pushing out information and pulling in feedback mechanism well:

> "There's also a really big difference on pull versus push communication for engagement. So being a place where people can come if they want to be engaged and want to contribute . . . there are situations where we want to be pushing information at people. And I think being really aware of how people respond and the different stipulations for those different methods is really important, too . . . we randomly pulled people on the website as well but without that sort of push, without that sort of notification that pops up at you and is kind of aggressive, you also wouldn't be collecting a lot of information that was going to be making that more useful."

Determining the Success of the Application

Ultimately then what did respondents note lead to the success of the application in providing evidence for authorizers? There were a number of issues that were mentioned but the category was dominated by a need to primarily address problems, be timely in response to needs, provide a cost effective application, in some way improve the lives of citizens, disseminate information, somehow improve an existing process, sole and identify a specific

problem, generate time savings, increase transparency, focus on accountability, and create safety. This wide array of needs was highly representative among the many people interviewed and shows the need for applications to be effective in many ways. Ultimately, then, interviewees echoed the need to identify the end user of the application and build success metrics based on that:

> "Whenever we develop something new, we try to identify a customer, an end-user right away. We don't believe in doing things completely on spec. In other words, a developer can sit in a room and come up with all kinds of great ideas, but it really needs to be grounded in somebody it's intended for. We start with who is the person that would use this, understand them, understand the requirements, prioritize things, figure out what, this is the key part, what is the MVP, what is the minimum viable thing that will make it worth doing."

The initial focus for government was to identify if the application both identified and solved a problem, and whether the application was the appropriate tool for solving that problem, or if another technology would likely be more effective. This could relate to process improvement or enhancement of an existing service, or in some cases simply a better way to handle the service separate from traditional mediums. Identification of what was the right problem was critical and in relation to previous sections discussed it relied on collaboration with users. From this, the application's success depended on how well, "you can do something that deep. I mean in that particular instance, that vastly improved the effectiveness of the city." Many developers uniquely noted that inception of the project came from a leadership vision to either transform or improve a process in some way due to concerns over

its existing manifestation. Improving this was pivotal in the success of the application and this was based on the perceptions and experiences of users. Ultimately, what was deemed successful was the degree to which the application solved a problem among many constituents:

> "Yeah. We first and foremost are looking at if it's going to help people out and it's going to help a sizable amount of folks out . . . We're prioritizing based on a strong need in the community, and if anything, if anyone is prevented from doing a transactional experience with the city that would affect their day to day or could make it more efficient if we get involved, so that's how we prioritize things."

Further, the effectiveness of the application, as one citizen-developer put it, was based on the notion that he could create an application that most successfully rolled up the service in a way that would be most useful to the user. It was the identification of this problem and attention to user feedback based on their desires that largely made his application successful and appear as #1 in the Google Play and iTunes Store:

> "So ultimately, I created the app for myself, but maybe my needs are different than the needs of other people, so I started requesting feedback and from my users, and if I saw that a request from different users, then I started adding features to my app, even if they don't have the ability of good for myself, or useful for myself. I think they are beneficial for other people. So, I started adding features to my app, and I think that is also what makes my app better"

From this came the primary concern of improving the lives of citizens in some way that many mentioned did not stem from the user's directly, but which later usage of the

application would dictate was an improvement for them. In culmination with this was the idea of eliminating friction within the application that made it easy to use, saved time through the application, and in this sense provided a cost savings for using the application over traditional mediums for the user. Much of this was tied to the application's functionality and user experience. The goal was, "to make things easier for people, to give them a mobile means to do this as opposed to having to go online."

Responsiveness lead to increases in accountability and application developers tried to be responsive in all cases, but for applications that provide some service that relied on internal teams to make sure they were acting on requests submitted by users. Transparency was also a widely recognized concern for nearly all application developers, in the sense they both wanted information to be provided about the service and be readily available in real time or as updates occurred with service requests. From this stemmed a need for communication and visibility on the part of the developer to bring attention the users' needs to facilitate greater participation. Once again, the goal was to make the lives of citizens easier through this method. Further, the metric of usage and these feedback mechanisms were mentioned as ways to track this success:

> "And so, the way that we can improve things for constituent's feedback works with their interactions, the way they behave with it, or the kinds of things that they search for, because then we can more clearly direct our outreach based off it like that. At the end of the day, may not realize that they're actively contributing to improving it. But by using it they are."

On the other side, several applications noted how the goal was to provide safety to the users through their service. Interestingly, the goal was still to do so with little friction put on the user. The application largely facilitated gathering the data needed to improve safety and the part of the user was simply to use the application. Ultimately, efficiency and process improvement were tied to the notion of providing the best and easiest service for the customer and determination of what was successful was based on those perceptions. Ultimately, features became less important next to the services delivered and metrics that Reporting then should be tied to this metric and the idea that successes are built on accountability as determined by the task of the application. These metrics then should be self-reflective of the applications success as put by one interviewee:

> “We just built features into the application that are focused on delivering accountability right to the inbox and through the device based on push notifications and push emails that are sent when issues are resolved. We have aggregate reports that are rolled up and can be delivered to managers internally as well as individual employees on the account that say, "Hey look. This number of potholes was reported this week. It's up X% from last week. We responded in this number of days and it's up X% from . . . Down X% from the previous week."

Success of the application was largely based on the notion as said by one interviewee, “[I]t's about over time, does the existence of that app actually impact one's trust for this government, and also trust in general . . . trust generally that things will get done.” Specifically, this relates to the improvement of a process and attention to their needs. In

measuring success, the predominant notion from this section was put well by one interviewee below:

> "We should assess the accuracy of information given. We should assess the satisfaction of users. And then, the way in which that path is impacting how people organize their daily routines. That's super important, so you're not waiting out in the cold for 20 minutes for your bus to come. If you can rely on that app, then it has to . . . that's a game changer."

4.6e Aspirations for the Community

The primary aspiration for the community regarding ownership development regarded increasing usability, facilitating co-production, and garnering citizen participation, two categories tied closely to other previously mentioned points regarding attention to feedback and garnering usage. Bettering one's society, however, provided some interesting insight into ownership generation regarding this category. Developing a sense of pride within the community was important among interviewers as they discussed expanding upon and making people excited about the on goings in their city: "I think it's just, people want to be excited about where they live and the things that city, they're doing to make it easier to be there, and like, be proud of all the initiatives that were going on."

Bettering the city was always mentioned as actively contributing to the effort through direct participation with the application and this idea of betterment and its link to ownership of the application could manifest through reporting, utilizing the application, or in some cases submitting data. As one interviewee put it, the idea of bettering one's city should be ingrained in the user's behaviors and facilitate co-productive efforts:

> "Yeah, certainly. So, we always imagined the app as encouraging specific behavior, right? And so, the hope would be that, some companies said this is the on ramp to citizen engagement. So you may have not have ever gone to a community, but if we can get you to report things that are broken, the hope was that you feel more connected to the city, to the city that you live, and that you develop a sense that this is not our city that you are using, but this is really your city, and you can change the way that it works."

From this a sort of snowball effect is discussed by many interviewees whereby they can get people to report initially and then are able to see sustained reporting through attention to that feedback with the individuals. In addition, they hope to be able to build user bases for other applications developed that encourage participants to engage across the various applications. By having them see the tangible benefits of contributing to the betterment of society, the theory for many developers was that would translate to use of other applications. What developers often saw was that, especially about reporting applications, the area with which the user was interested expanded from the city level outward as their use of the applications and length of time using it increased. As mentioned earlier in prior sections, distribution of ownership and that sense of "helping out" translated to the user base. It was elaborated upon with other comments around facilitating engagement around the community level and thoughts of better the user's society through active stewardship. Advocacy builds, and the developers describe how these users can be utilized for the overall betterment of the application through developing their community level ownership:

> "There are a group of users that feels like they are part of the larger community and we're leveraging them. It might be we're leveraging them for feature ideas and design testing, which we do, or it could just be that they were the first person to start using the application in our community and they either advocated for the city to bring it on or the city had already brought it on and they advocated for their group."

Thoughts behind garnering usability become important as well in developing ownership among constituents. On the most basic level interviewees noted that increasing usability relied inherently on basic functionalities, which meant in many instances having a feedback mechanism in place, whether it be form email or other mediums such as chats. Ease of use these along with feedback mechanisms became the most important factors mentioned throughout interviews about having people actively co-contribute with the application. Echoed throughout many interviews was the desire that people primarily want something just easy to use. Only slightly mentioned was attention to the digital divide with regard specifically to ownership, and this concerned increasing accessibility as to not limit certain users to only using the application for access to information. Specifically, referenced was one application developer's findings through collaboration with a research institute on how to facilitate two-way communication and ownership: "It was where we look at, do these apps encourage pro vocal behavior? A one of the things that we learned early on was that the app tends to make it easy to report things, you are more likely to report more things than otherwise."

How then was co-production talked about among those who interviewed from the City? In addition to the prior points that have been made, there was also the sense of building

an urbanized landscape around not just interacting with the service and submitting feedback but also submitting data and building toward a collaborative space city wide. Data submission though, separate from data gathered simply from use of the application, was a touchy subject with many interviewers talking about how such initiatives were desirable but ultimately a bit unsuccessful due to a mistrust of the use of the data.

A noticeable trend throughout the interviews was the discussion of dialogue creation and the sense of getting people to talk about the application and encourage others around them to interact. Marketing the application continuously then became important as did keeping awareness of the application at the forefront, while also encouraging dialogue among users. Highlighting the happiness and focusing on that community of users that had taken up the application and were satisfied with it was focused on to translate and communicate their experience to others. In some senses this meant simply making sure the application worked and building a positive awareness campaign, while in others it meant actively encouraging people to act as co-contributors:

> "But there's a lot of stuff where you don't want to get out of their way. There's a lot of stuff where you want to be in their face. Like if you're going to dig somebody on zoning regulations changing in our neighborhood, they want to be engaged. They want to be consulted. And a lot of situations, people want to have an opportunity to be heard."

Participation then was tied to the idea of co-contribution and the separation of ownership and participation was an important theme. It was near unanimously agreed among by interviewees that while participation was a component of ownership development, it was

not the end all in determining whether a person could say they have ownership of an application or could characterize the application as having public value. The goal was to one interviewee: “[H]aving them say that they own the application as opposed to just saying that they participated in some sort of tool, or competition.”

One component mentioned was to form citizen task forces that follow the application through its lifecycle to determine what components of the application are giving people the sense that they want to have sustained contribution with it and build a positive perception of the city and its other applications. One reporting application developed to improve its ease in which reporting could be done, and in doing so the application team saw ownership build in the sense that people were not just reporting things sporadically but daily and often multiple times a day during their down time. Contribution became a critical component of ownership, but co-production through enabling owners to participate in the design or components of the application was noted by managers as developing more ownership around the service and within the community. It facilitated the dialogue for people to encourage others to use the application, but also built attachment from the very beginning to the application and built a sense of personal attachment to the application:

> “So, creating spaces for play, creating spaces for interaction, is what's necessary, not just, ‘Tell me what you think.’ And this is, I think, a general problem when we ask the public to say, ‘Hey, tell me what you think.’ When we don't do anything to set the stage, or to provide the appropriate context. Right? Because public engagement has a kind of pop up learning, or pedagogical aspect to it.”

Responding to the Digital Divide and Ensuring Equity

In responding to the digital divide and ensuring equity in services, there were several concerns noted but none so explicitly stated the “digital divide” itself. Specifically mentioned was being aware of those with disabilities in development, ensuring equitable feedback is gathered, engaging with non-tech savvy users, ensuring usability across devices, and making the application useful for all its users and doing so equitably. The most echoed notion regarding equity was ensuring both that the application was available on multiple platforms for access and that it did not cater to a subset of users, but rather the population of users. Despite certain demographics being the most vocal regarding their desires, the perceptions of other grouping and those who couldn’t comment (due to time availability or other factors) needed to be heard and one interviewee summed up the notion of ensuring equity well:

> “That's not really an option for us, right? We must ensure that everyone is served in some way, and so that means that if we can get 80% of a group on one channel, we can do that, but we must think about how do we get service to the remaining 20%? And that may mean three additional platforms. It’s kind of depends, but so we have to be thinking about everybody, rather than just those that want to use our primary platform.”

One other major challenge mentioned was making sure the application catered to both new and more experience technology or smartphone users. What was done to remedy this was to make sure the application’s user interface was as friendly as possible and ensure that there were mechanisms in place to address questions. However, a major challenge associated with paying attention to feedback was differentiating technology concerns from those that

were meant to facilitate engagement. Despite needing to garner usage, building momentum around the applications required that, often, all users within the city were the intended audience. For those instances, where the application targeted only a specific group of people it wanted to target all those people equitably. One interviewee mentioned:

> "It also helps build momentum around the apps, which means that there's going to be more wherewithal within the city to make sure that more and more people are using it. That we are making sure that it's just not one cohort in the city using the app, but it's being used equivocally throughout the city."

In addition, several interviewees commented on how, during the early inception of applications in the City, the lack of compatibility across smartphone devices presented concerns regarding equity. Criticism came as many felt that smartphones, at the time, allowed for only the most elite to access the service and isolated other areas of the population. Further, as applications evolved along with smartphone proliferation, the concern was also how to deal with devices that had low usage, such as blackberry, while also ensuring that the service was available. Limited resources and lack of technological compatibility made having early applications available on all devices difficult. One interviewee theorized usage of certain devices may be tied to socioeconomic status, so ensuring this equity amidst limited resources was even more pressing of a concern. One interviewee however noted the solution of the city in one regard:

> "And the thought was, well this is getting very low usage amongst those phones, so why don't we do a text-based interface as a half measure, right, so the idea that we would see, if they want to use it, they can always use the text-based interface, right,

and it would work on everything. And the hope was also that would be a way that we could fit onto all potential platforms. And would also be an easy way for people to kind of come up with third party apps too."

Bettering Society and One's City

Tied to the notion of building aspirations toward the community was the notion of bettering society and one's city. Despite being talked about only briefly among interviewees, it was mentioned that integrating city technologies, making Boston-specific or -centric applications, and building toward a smart city were needed to better the society through the application.

In some instances, interviewees noted that, quite obviously, the application had no need outside Boston, while in others the functionality could easily be transformed to focus on any city with the same or similar service. Applications could be "re-skinned" by private developers to serve the basic needs of the cities they served regarding the service they provided. Being "future-focused" and building that accountability was noted extensively among interviewees as a necessity as each application worked toward building the greater vision of the integrated smart city vision of Boston. The focus as one interviewee put it was to help the most members of the community and by doing that, we helped society as whole:

"Yeah. Well, I think there's sort of a two-part answer to that. One, is to start seeing good widely by starting with the individuals. If you're helping individuals, that scales out, because the more individuals you help then the better off society is...We kind of get it at both ends, because we're able to directly make things better for individuals,

> but also we're enabling the city to be able to be more efficient and do things that benefit a lot of people more efficiently."

However, one major hurdle and point that was made was the need to work across departments within the city to create the vision for the application and to have it work to best serve the needs of the City. Working across these boundaries and having others think about both Boston and Greater Boston in this sense was noted as being important: "Our take, and my take, is that, to solve the big problems that we didn't solve, we need to be working across boundaries. And so, the question is how do you encourage your colleagues to think in those terms."

From this accountability stemmed the thoughts on trust and confidence building mentioned in prior sections that lead to the overall success of the application. In addition, the thought that the city and individual were working together to build a society beneficial to all those within it through efficient practices and accountability on the part of the City and the person reporting stemmed from this through process. Two separate interviewees put this societal issue well when discussing the two-way relationship among participants:

> "Yeah. I think it's straight forward for us. The trust in government has eroded at an alarming rate over a couple decades, a few decades. Lack of transparency and accountability is a huge contributor there, plus misinformation via the social web. We're a social application that actually provides accurate information and rebuilds trust and with every service request that gets responded to, there is usually a few people that actually see that, and it creates a moment that reminds people that government is working for them."

> "[Y]ou have the person reporting and their role is simply, they want the city to know about problems. That's the main goal, and they want to do that easily. The city of course wants to receive that information in a way it can process it without confusion."

Increasing Usability of the Application

Increasing usability was one of the most extensively discussed categories. Usability, as was mentioned in previous sections, was a huge component in garnering usage of the application and subsequently building ownership. How then were managers working to increase usability? Among the many tactics mentioned were paying attention to application design, making sure the application is not overcomplicated, ensuring ease and convenience in use, limiting data storage, having a responsive application, building unique and simple applications, paying attention to the user experience, ensuring web functionality, ensuring uniformity among other applications, having realistic expectations for the applications, garnering quick use times, and making the application flexible to use.

To summarize the above points, the desires of participants was echoed again in this section that, above all for the application, users want it to work. Specifically, it was mentioned that people want it to be quick and simple to use, and people want it to not be over complicated. Regarding quickness in use, multiple interviewee echoed the "60-90 second" use of an application as a standard. Further, they noted how the need for an application for a service itself should depend on the need. As one interviewee put it, "There's a threshold where, if you're doing something one time, you're probably not going to download the app for it."

To ensure usability, what was primarily noted was there needed to be movement away from smartphone-specific (meaning unique to one operating system) applications toward responsive applications among devices. Also, when applications become overly complicated with information, interviewees noted the received complaints regarding them. The same was said to be true if they had complex or slow user interfaces. Further, the difficulty in design lay in making the application usable right away and relying on the interface to speak for itself as one interviewee put it, “We don't have user manuals, obviously, apps generally don't. If you must explain to somebody how to use it, you've already failed. So, wording, there's not much, and it's got to be very small and limited.”

Usability was not typically tied to the underlying technology of the application of the service provided but rather it’s design. This relied on the technology, but interviewees regarded the user interface design as the more complicated component. In designing these, interviewees noted they often relied on collaborations with others or partnerships, as they often suffered from limited resources for design. Two interviewees described how this design was inherently needed to make the application successful and alleviate many of the problems discussed above:

> “So, from the construction of the actual underlying technology to the actual use, I would say the harder part was doing the design and usability of the product in order to make it simple, fast, and seamless for somebody.”
>
> “Yes. Exactly. I was thinking about all these emails for additional information for my app, but I don't want to make my app too broad, too much complicated, and to have too much information, because it's also sometimes not good.”

In enhancing usability, the feedback needed as mentioned in previous sections was a critical component to implement design changes that were appealing to the user. However, also noted was the failure of applications whose partnerships and specific partners did not see the need for consumer-centric design and simply relied on back-end capability that facilitated the process associated with the service. Further, the attention to consumer requests was noted as making applications successful while other applications failed due to a lack of attention. The notion then of having responsive and accountability was needed to build a user base, as mentioned in prior sections, that could consistently provide feedback about the product as one user put it: “They should get internal follow-up, they should have a notification when the case is closed, and communication as to how it was closed.”

The primary purpose then in ensuring usability as noted was to have a unified vision among the team that spoke to all tenets of usability as one interviewee put it so well:

> “You need to be grounded by goals that are actually tied to actual delivery of the functionality and the results. Not the features that get their results. People will often get lost in, it must be, it must have this kind of feature or this kind of button or must have this kind of display, we've got a dashboard. The hardest part, the most critical is to kind of reshape all the things as a team so that you're talking from kind of the same playbook that says we want something that is going to make it easy for people to report issues, and allow people to effortlessly check the status on the issues or I want someone to be able to turn on, put the phone down and have it start recording with as little interaction as possible”

Facilitating Co-Production and Civic Design

How then are governments working to facilitate co-production and civic design? This was a commonly mentioned theme and one whose process was well ingrained in the City of Boston. Utilizing citizen sourcing, open sourcing, hosting civic design competitions, facilitating co-production and engaging users, collaborating with others (both citizens and developers), and fostering citizen-developer altruism were all mentioned as methods. However, some of these methods largely were met with mixed concerns among interviewees with some casting them positively and some noting their drawbacks.

The predominant notion that emerged was the idea of engaging the community around development of the application. This occurred in two-ways primarily, from the technology side and through citizen-sourcing. From the technology side, the City could host competitions for developers or make their applications open sources to garner feedback and updates. The first of these, civic design competitions (hackathons and application development contests) were hosted by the government but also with citizens judging participants to provide resources to developers hoping to help the City. The competitions were noted as a method to help develop ideas for the public space as one interviewee put it below:

> “And then the other thing is in another realm of our work, such as on what we just talked about, which is helping people implement their ideas in public space through our design competitions. Part of that involves working with them to . . . Well, the first thing is funding their ideas, because it's hard to find funding for this kind of stuff. Working with them to develop their idea, because lots of things change and there are

> all sorts of constraints with these installations if you haven't done it before. And even if you're experienced, just all sorts of things come out, so we provide development support there."

However, the utility of these competitions was not unanimously held, and some interviewees noted that the inherent goal of them was flawed, because, while it encouraged innovation, it did not build long term sustainability for the application. After winning the competition and developing the application, the winner may abandon the project for future goals or the application or technology would sit with no continued support. Some regarded this strategy then as flawed from the standpoint of creating sustainable technologies. It was not noted by many how citizen-developer altruism and partnerships were effective, and some interviewees noted the opposite notion that partnerships in this sense were highly effective. However, others noted that the competitions themselves didn't do enough to encourage the overall application's sustainability and true developer altruism was noted as a more effective means to develop sustainable partnerships. One interviewee described this well, and he noted that "hackathons" specifically were more beneficial than "application development contests" for this reason:

> "Hackathons are generally great, because they inspire. They show what's possible and motivate and get innovative ideas. App contests, in my opinion, generally suck, because what you do is, you'll get a lot of students who will, or part-time hacker types, who will put together an app, and they'll win a contest. And what happens though is then it's not sustainable. And the cities think, 'Hey, instead of spending a bunch of money and hiring somebody to build us an app, we'll put on a contest. So,

> for a fraction of the price, we'll get all these good things.' And you're going to get what you pay for. What happens though is the city will then try to put that out as a solution, and it was developed to win a contest, not . . . its purpose was not necessarily to benefit the citizens, but to win the contest."

Regarding the open source component, both citizen-developers noted how they were reliant on this government data to ensure functionality in their application and its success. Further, several applications relied on user submitted data to function at all and building that trust component with the users to have them move toward active engagement, which was regarded as extremely important. This user submitted data however differed largely from what interviewees noted was the dichotomous breakup between the developer community and user community. As one interviewee put it, the citizen-developer community largely just wanted the application to work and having an open source component in some instances could be detrimental to the application's overall functionality due to a lack of resources and support for such initiative and the allowing of the technology to be manipulated:

> "This was an interesting concern, so in some cities they took the road of trying to engage with the citizen developer committees, and in our case, the kind of feedback that we were getting from people, people didn't really want to get involved in writing code. People just wanted it to work, and wanted it to be rock sold, and so we went that route rather than . . . We got a lot of criticism from the civic world for not making it open source, but a core concern of ours in developing the app was that more than anything it must work. It must be stable. We liked open source where appropriate . . . And some cities, I think cities jump on this open source band wagon a little too

> quickly sometimes, and they often will open source things just because they heard that it's a good idea, but if you're not able to support your open source project, what good is it, right? If you can't make changes in a timely way, you don't have developers that know how to write movie or something, why, what is the point of that? And so, you're just sort of under delivering to people, or philosophical end, which sometimes could be a good road to take."

The second side concerned having user testing groups and mechanisms to gather feedback during the design of the application by the actual or potential users. Near unanimously agreed upon was the need to engage the users of the application pre and post development in its sustained upkeep. Doing this both explicitly via user testing groups and focus groups was effective as was garnering their feedback throughout by using easy to use in application mechanisms. The process was described well by one interviewee:

> "Probably one little thing I'll point out is you want some people, for a sense of continuity, to re-engage some of the people that you talked to before. But most things should be new strangers. You only get one chance to have a first impression. There's a whole art to doing things. The hardest part is just showing up and watching people. You know, put it in front of them and don't say anything. Then, if they look at you and ask you how to do something, you make note of it and say, 'Well, what do you think? What are you trying to do? How would you do it? Talk to me. What's your thought process?'"

However, one citizen-developer did note that while he was attentive to people's ideas, he sometimes had to use his judgement as a developer to determine what was the necessary

course of action. Still, when he did incorporate that feedback he mentioned, as did many others, that they strived to be transparent in the changes they had made, which would lead to more future engagement:

> “And sometimes if I have a request from user, and I am working on the new feature, I contact the user a couple times to give him feedback or talk to him and I sends him screenshot from the app or even give him the app with this, in development process, or like beta testing, to get their feedback. And I think people are happy about that, that they can be involved in development process.”

Further, again mentioned was the functionality and purpose of the application. Information-centric applications interviewees felt needed little explicit engagement channels, while social and citizen sourcing applications heavily relied on such engagement. The trust component of engagement then and civic design relied on listening to these concerns and bringing people in early with the focus of the application being the need to be attentive and listen to users and build a society level strategy based around co-productive efforts:

> “We need to question who benefits every time we design things now. And that doesn't mean that just because not everyone benefits, doesn't mean that it's not worthwhile. So, that's one thing. We also need that if we want to make sure that some people benefit, that we actually involve them in the process . . . you assure that you maximize the benefit of any design process by bringing people in early, so that you can identify the outcomes that you want, not as government or an outside designer, but as a whole group.”

Garnering Citizen Participation

The last point mentioned is how do developers garner citizen participation and what specific methods are effective? Primarily noted was the need to build stewardship within the application, having a process for dealing with positive and negative feedback, and ensuring two-way communication. Echoed was the notion that building this stewardship lead to process improvement through participation, but often the goals had to represent a paradigm shift of trust development in government and developing ownership from users regarding the city's applications. Facilitating community level democracy as one interviewee point it was the goal:

> "And so, it's important that you kind of go into these things with an open, honest mind, and approach, and it's not about your ego, it's about listening to what people's issues are, and that's community level democracy. And that slows things down. Democracy is not high performance."

In building stewardship, the "genesis" of the project should start inherently with the user according to interviewees. The project should work toward building "goals tied to outcomes, such as efficacy, and voice." Facilitation of dialogue between the public and the government was the main component of many applications, which interviewees regarded to address problems and deliver better services. In this sense, the collaborative aspect of the service was important as many said it should be designed as a two-way mechanism no matter the service in question. Further, building community space whereby people were encouraged to participate from the beginning of the project and throughout was noted as essential. The participatory component should not act as a "check box" at the beginning of the process and

fall off as the project moved on. Near unanimously, interviewees agreed that development with participation had and would likely lead failure:

> "Developing technology without people is fruitless, particularly if the purpose of that technology is for them to use it as a tool for better engagement. Having apps feel responsive to changes they might have helps to demonstrate feedback and accountability."

Two-way communication of the service became essential in building the stewardship that was mentioned as needed for sustained participation on the part of the user. Confirmation of the request or of attention to questions was the way to facilitate such communication and proceeded via multiple mechanisms that proceeded from the citizen to the government and back to the citizen. Lack of response was noted by many as leading to application failure and lack of ownership of the application by the city via the accountability aspect of the service, but also regarding listening to communications. Push/pull mechanisms were mentioned and other ways to measure and track correspondence between both parties, government and user. Thank you buttons and mechanisms for those fulfilling requests that build sustained desire to service those requests due to direct feedback from citizens were also mentioned as of extreme importance.

Also, of importance was the notion of having real live updates and/or pictures of the people performing the services in some cases that could be reported back to the citizen in a two-way fashion to build accountability and garner later participation as one interviewee put it regarding one service-centric application: "It's a reminder that there are people out in the

field working hard and the constituent can see the people actually fixing the thing, which I think facilitates a . . . It creates a better bond between residents and city workers.”

Further, engagement and garnering participation should not be done solely on the application and interviewees mentioned the power of social media and press conferences in facilitating participation with the application and building awareness. By and large, interviewees did not note many negatives to engaging the public although and noted how politics can play a large role. However, they cautioned about being wary to engage all members of the population not just the demographic of core users. One note made was that engagement, however, should not be pushed among the users and there should be a way to toggle such responses. Fatigue was mentioned as a very real concern, as was the notion of pushing too many engagement efforts on the users to create such fatigue:

> “If you're going to have channels where you're engaging a group of people in a way where they can provide feedback and want to be engaged. Just making sure they can really toggle up or down how engaged they are. It's very important. I think if you're too heavy handed with a lot of these things, you end up alienating people who might not have that level of desire to engage or motivation or the time or a lot of different reasons. So, the important part is that you don't get like engagement exhaustion.”

Overall, the notion was to have a system that encouraged participation to improve the application and garner usage of the application throughout. Even for applications with less citizen reporting services, this was considered essential. With fatigue in mind, the last major component was building transparency in the process so that users could both see the changes being made in the process and actively contribute to its success. The notion of why such

participatory mechanisms were needed for project success was put well by one interviewee: “When you have a system that is opaque, and you can't see what is going on and you're not invited in any way to help, you're not going to help. In fact, you're probably just going to complain and complain that it's their problem.”

4.7 Discussion

In analyzing the primary research question in lieu of, the findings above, many distinct observations arose concerning the processes through which mobile application managers and developers within the City of Boston were working toward generating public value, generating ownership, and encouraging future citizen participation. The process followed, first, seemed to be in line with many tenets of e-governance, as developers were moving toward more citizen-centric government. In this sense they noted how citizens were actively contributing in government and such contribution were being actively encouraged among their teams. According to the theories on public value set forth (Bozeman, 2007; Moore, 1995; Meynhardt; 2009), these application managers were highly attentive to the citizen-centric and co-productive aspects of public value. However, this theme manifested more as it regarded citizen involvement, security, and openness especially. Among interviewees, it was noted less predominantly how they were paying attention to other aspects of public value such as human dignity, sustainability, compromise, integrity, and robustness. These themes were present as discussed above but were not predominantly featured in discussions.

However, the managers were highly attentive to the needs of citizens, with citizens acting as shareholders in creation of the value according to the core components of public

value theory (Meynhardt, 2009; Alford, 2002). The other aspects of public value mentioned were discussed above but, by and large, the citizen participation component and usability components dominated the discussion on how citizens wanted their applications shaped. As is described below, the City does adhere highly to Moore's (1995) notion as they create a system that is supported and legitimized to foster citizen participation, with the government organized to achieve the goals of the people. The channels they utilize and their attention to fostering this participation is highly indicative of the tenets of Moore's authorizing chain and is discussed at length among their responses.

Overall, the case of Boston was most summed up as a later stage of e-governance, which is defined by greater levels of collaboration between government and stakeholder, and whereby the citizens become directly involved in the governance process (Lee, 2010). Even more so, the tenets of co-production (Linders, 2012; Christin et al., 2013; Desouza & Bhagwatwar, 2012) are present in the narrative as developers have been working to facilitate mobile application development both according to the user's concerns, and with user's involved in the process that is designed, specifically, to address user-centric needs and concerns. The attention to these specific needs and concerns, and the notion of what was deemed a "problem" by constituents was discussed extensively in the narrative above. Further, the attention paid to this is highly indicative of Moore's (1995) approach in providing the channels of communication whereby citizen concerns can be addressed, through the authorizing chain.

Even when it was not the case, for example, when the application did not require citizen participation or reporting capability, the predominant theme was that paying attention

to user concerns and engaging the user base in the development of the application was always a necessary step regarding building ownership in the service. Overall, the theme echoed the notion in the literature that governments should work toward making citizen both consumers of public goods and services (Fernandes et al. 2001; Newcombe, 2000) and contributors to policymaking, service delivery, and decision making (Cumming, 2001; Elgarah & Courtney, 2002; Webler & Tuler, 2000). In this sense, then, success of the application, whether it required reporting or data acquisition or not, was reliant on citizen input in some capacity.

Further, not all applications had resource savings in mind, and it was a common theme throughout interviews that these services were to be citizen-centric. The goal, as stated by many interviewees, was to create useful applications for citizens, while also serving the needs of the city. This was in line with the citizen-centric notions of both public value (Bozeman, 2007; Moore, 1995; Meynhardt; 2009; Kearns, 2004), e-governance (Tapscott, 1996; Lawson, 1998; Layne & Lee, 2001; Andersen & Henriksen, 2006; Hiller & Bélanger, 2001; Moon, 2002; West, 2004; Lee, 2010), and the smart city (Pardo et al., 2012; Chourabi et al., 2012; Gutiérrez et al., 2013).

However, interviewees often mentioned how focusing on citizen concerns over cost savings could present a difficult sell to the city, who saw applications in terms of cost savings only. Though cost savings and efficiency are critical components of e-government (Chadwick & May, 2003; Fountain, 2001; Backus, 2001; IADB, 2001), the thoughts were more in line with later stages of e-governance that called for a movement from initial stages toward more integrated citizen-centric ones (Lee, 2010). From this stemmed the idea of

noting how the application was successful through providing evidence of its success for its authorizers.

Developing ownership and generating value was deemed as a success factor in line with Kelly et al. (2002) notion of what the public deemed as the most important problems for their society. However, regarding this service there could also be needed modification within the application that led to utilization and thus value generation. In defining ownership, itself, separate from how ownership was generated, the key theme of making the application "useful" arose from interviews. This usefulness echoed the pillars set forth especially by Kelly et al. (2002) as they note that the public value of the service itself is defined by those using it, and this, largely, was unique for each application.

However, it was noted by interviewees that as the government proceeded to measure success, "useful" applications were ones that were valuable and that citizens felt they owned or were invested with. It followed that subsequent notions of how to measure application success by these managers expanded upon this notion. Echoed in this notion was the advantage applications themselves and their value generation as facilitating greater levels of convenience, efficiency, effectiveness, personalization, cost reduction, profitability, productivity, accountability, and transparency associated with the service in line with the suggestions of Yu (2013a). Savings of time energy and money as put by Kumar and Sinha (2007) also emerged as a predominant theme throughout the narrative. This was noted as being in line with the nature of the mobile application, which should allow users to interact anywhere and at any time. To interviewees, the application team should be cognizant of these aspects of "usefulness" and implement them to garner high use.

This is not to suggest that other components of ownership and value generation proposed by others (Bozeman, 2007; Moore, 1995; Meynhardt; 2009) are not valid, but rather that making the application useful was the primary means that managers in the city took to generate ownership. The management style of interviewees, described in the narrative above, supported the notions of Pardo et al. (2012) when they noted the success and integration a e-service should have three pillar goals in mind, which should be consistently monitored by the government regarding the success of the service: transparency, participation, and collaboration. Further, the discussion of the interviewees echoed the notion by Nam and Pardo (2011) that the smart city was integrated based on the technological, institutional, and human factors within the city.

From this, stemmed the notion of value generation. This value generation relied on making the application useful for the community of users that would utilize the service associated with it. In addition, a major theme of value generation centered on the idea of trust in the application. This trust manifested in the idea that users would trust the City with their information and security, which was deemed as highly important in garnering initial usage. With citizens concerned over use of data and the notion of tracking use, users are often hesitant to trust the organization in handling their data which could heavily impact usage (Hellström, 2010; Lam, 2005; Layne & Lee, 2001). The narrative addresses these concerns as they relate to trust associated with privacy and security especially and note it as a needed gateway component that needs to be addressed before trust can be generated.

Trust, however, also manifested in the idea that the City would be attentive to the users' needs about the service. This built on the internal transparency of the organizations

and the ability to monitor the administrator activities performed by the city through the technology, which in turn can lead to trust generation and user participation (Shim & Eom, 2008; Ho, 2002). Further, such notions expanded on the smart city concept surrounding the societal and participatory aspect of the smart city structure, with citizens perceiving attention to their needs as an overall improvement on their quality of life (Chourabi et al., 2012). Further, attention to this builds their overall trust that their perspectives are being considered (Mellouli et al., 2013). Both the notion of trust through security and trust through attention were indicative of models proposed for public value, with the "development of trust" being a key theme in generating the outcome of ownership (Kearns, 2004; Karunasena & Deng, 2012).

The notion that if the user downloaded the application and utilized it that the city would be responsive and accountable was a major determinant in if the application garnered future use. User acceptance, then, as it related to mobile technology, matches the notion in the literature that attention to certain factors drives uptake of the service in question (Bélanger et al., 2005; Hung et al., 2013; Hung et al., 2006). Overall, manager attempted to build stewardship in the mobile device by incorporating success factors like those mentioned by Al Khamayseh et al. (2006) but with attention paid to success factors such as privacy and security, user needs and preferences, creation of user-friendly applications, high mobile penetration, take up of the application, awareness, access, and partnerships with the private sector. These mirror the trust, usefulness, ease of use, and risk associated with the technology that so often are references as leading to failure and lack of uptake of mobile services (Hung et al., 2013; Horst et al., 2007; Gilbert et al., 2004).

However, in building this usefulness, the primary way that managers noted they worked toward increasing ownership and generating value was to garner citizen participation both in use of the application and in reporting. This tied to the notion of stewardship mentioned and the idea that managers are building the users investment with the application early in the development process. Effectively, they built toward a more urban friendly experience for the user as was associated with notions of the smart city forwarded by Gutiérrez et al. (2013). This was also tied to the notion forwarded by Paletti (2016) in that ICTs that facilitate co-production build public value and a community sense of value associated with the service in question. To the city, this meant engaging users co-productively throughout the process to build investment and a relationship with the application, but also to engage users as to get their input, both positive and negative, to modify the application. Supported in their attention to these initiatives, is the notion that self-efficacy also increases the use of mobile devices and confidence in the ability to perform civic engagement functions associated with the ICT technology or service (Cegarra-Navarro et al., 2014; Kim & Chen, 2015; Kim et al., 2011; de Zúñiga et al., 2013; Lee et al., 2014).

Such modification of the application, according to user feedback and what was possible without compromising the applications overall usability, was noted to, both, reinforce the voice of the audience of contributors and to also make the application preferable to its user base. From this idea of creation of feedback loops and user testing, the managers were able to discern the major factors that lead to adoption of the application or it's "use ." These feedback loops were indicative of the co-productive efforts Linders (2012) noted as relying on citizen-sourcing, government as a platform, and do-it-yourself government.

Further, the narrative of the city's developers supported the notions of Christin et al. (2013) that smartphone users were willing to contribute in a co-productive fashion to provide information to the city that helps improve processes for applications with such features, or at the very least they were willing to interact with the application which improved the service. Further noted among interviewees, was the notion of forward-thinking regarding citizen-development and involving the users of the application in the first stages of development. This mirrored notions on the major components of the smart city, which is reliant on enhancing citizen's experiences through feedback from the citizens regarding the use of information technology (Mellouli et al., 2013; Gil-García et al., 2014; Lee & Lee, 2014).

It was this usage that, by and large, was noted as the primary means with which developers could gauge how useful the application was. This allowed them to determine the value it had to users. It mirrored the agenda setting strategy set forth by Bozeman (2007) as managers sought to align their agenda with the concerns of citizens. Higher or lower usage was tied to higher usefulness, with the goal of managers being to garner higher levels of this through attention to citizen concerns. Usage, but more so consistent usage, for all applications was more regarded in value determination over downloads of the application, though the latter could help build the awareness of the application via the Apple and Google Play stores. Such usage, as well, was noted as leading to likelihood to engage with other applications in the future. This was tied to overall trust of the city to deliver on the services it provided through the application. Garnering use of the application was an important first step. Effectively, managers noted how they were seeking to measure, through usage, whether their application created more efficient practices that reflected the needs of the user groups

according to their feedback. This was a methodology in line with the notion of success of the smart city initiative touted by Palvia and Sharma (2007). Chen & Hsieh (2009) also note the success of the system relies on both the success of the service delivered, but also the ability with which the service encourages and has active citizen participation.

If the use of the application to managers then meant it had generated value and users felt ownership associated with it, the failure of the application was tied to a lack of utilization of the application and its abandonment by its user base. Consistent utilization or use, then, throughout the life of the application-built investment within it and was noted as being critical for application success. Once this trust and use of the application was lost, it was hard to recover. Further, it was through lacking citizen participation of co-production efforts that applications were noted as failing, and these findings echoed notions of other systems in e-governance failing from a similar lack of attention to engaging users (Sæbø et al., 2008; Pardo et al., 2012). This reinforces the notion in the literature set forth that e-participation channels can work toward increasing citizen trust and confidence in government services (Seifert & Peterson, 2002; OECD, 2003).

It was this user base that managers were trying to build in their applications no matter what the service was and independent of the applications complexity. Such use was enhanced when, as managers noted, the application was providing time savings to the user, was flexible in its use across devices, was easy to use, had a good user interface, and had built in mechanisms to provide feedback. More simplicity in functionality was tied to each of these components. Managers noted that the key takeaway was to have the application provide the service in the simplest way possible and not be overwhelming to the user. However, while it

should be easy to use, there should also be built in easy to use mechanisms that allow users' voices to be heard regarding the application's later development. This echoes the argument made by Axelsson et al. (2013) that the primary goal of e-governance is to make access portals to such services accessible and available.

From this notion stemmed societal goals of bettering the community in which the users lived. However, it was noted that, without garnering their interest and investment with the application, these higher goals could not be realized. Much like the actor network theory forwarded by Paletti (2016), individuals work toward betterment of society through their own influence over the network they are involved in. Contrary to this, however, it was often the managers, themselves, who had these societal level goals in mind as they developed applications to better the community. Using channels that encouraged citizen participation, they were generating societal well-being according to the users as Mannarini et al. (2009) mention. This led to greater acceptance of service that they believed strengthened and benefited themselves and their society. Managers facilitated this by leveraging and focusing on the needs of the community. Further, the city created co-collaborative spaces according to the smart city model (Meijer & Bolívar, 2016; van der Graaf & Veeckman, 2014; de Lange & de Waal, 2013) to gather data for the various service offered by the application and facilitate the co-design of the ICT service that lead to ownership associated with the service according to de Lange and de Waal's theory (2013).

Many times, constraints were placed on the application and, in ensuring the success of the application and that it generated value, interviewees often relied on collaboration with others to ensure resources were used most effectively and that those with the appropriate skill

sets were brought on board to enhance the application. This was confirmed in the literature as developers often face problems in maintaining and supporting the technology about lacking technological capacity, collaborative components and relationships, and specific mobile and design skill sets of those leading the mobile initiative (El-Kiki & Lawrence, 2007). However, the narrative notes how collaboration primarily built the design and research component around the application. Technical developers helped to design the application and its user interface, and research institutions conducted tests and research surrounding the user base through the relationship with the city. These collaborations were also noted by Al Khamayseh et al. (2006) in addition to resource allocation to greater facilitate delivery of the service and circumvent technological shortcomings.

The government had as its primary role leadership surrounding the application. The first goal was to build awareness of the application and garner utilization, initially. Following that, a dedicated application team or champion behind the application needed to ensure the application was managed properly to include constantly updating it, ensuring feedback was incorporated, and that the awareness of the application continued. Much of this leadership initiatives were echoed in the notions of Paletti (2016) in managing smart city services that attempted to facilitate co-production and create public value. Much like his findings, the interviewees were required to have high levels of in-house ICT expertise to manage this open architecture platform, which they garnered through collaboration and partnerships with others.

4.8 Limitations

The study came with some limitations that are outlined in this section. One limitation of this study concerned the spread of the type of developer and, specifically, the predominance of government interviewees. Though an evenly distributed sample was sought between government, private, non-profit, and citizen-developers/managers, the overwhelming willingness of the government to speak to me was overshadowed by the willingness of citizen- and private-sector developers. To accommodate these requests, I increased the original number of interviews from 12 to 16 and retained the original amount of 4 participants per grouping. Still, having 3 to 4 members in each of these groups, I feel gave enough attention to the different perspectives needed to reach saturation of the themes.

In addition, though the 16 interviews may seem like a small amount, for the City of Boston I do believe I reached saturation with the themes in question. Further, the difficulty to acquire additional interviews and the lack of responses after acquiring 12 interviews showed there would be few other developers who offered their time. Reaching the 16 amounts for these interviews then, I feel, is enough for the needs of this study. In enhancing this study, interviews could be performed outside of the scope of the City of Boston to include other cities with similar initiatives. Through this a multiple case study could be conducted like what was suggested in the quantitative portion of the study.

Though a limitation of qualitative research is a lack of causality, this portion of the study’s findings will be discussed in Chapter 6 via the studies mixed-methods approach to give more meaning to the causal mechanisms explored in Chapter 5. I have tried to eliminate personal bias in my analysis of these findings as well, and only reported on the themes

gathered. Further, I have tried to maintain rigor as was outlined in my methodological analysis. Lastly, I have in my write up ensured the anonymity of all responses with no personal information being linked to their responses.

4.9 Recommendations and Future Research

This study is conducted in conjunction with the findings presented in the following chapter in the hope that the authorizing chain of Moore's (1995) model can be examined next to the perceived value of certain application components as presented in Chapter 5. Chapter 6 of this study will discuss the findings of each chapter to examine the overall research question of the study in more depth, but the discussion section above has examined the process of how and why managers within Boston are incorporating smart city components. Like in the next chapter, this study represented only a single case study the study should be expanded to include other smart cities to examine Moore's (1995) model among a greater number of mobile application developers with different perspectives in tandem with surveys of these cities designed uniformly with the survey component.

CHAPTER 5: LOGISTIC REGRESSION OF USER SURVEY ON OWNERSHIP DEVELOPMENT ACCORDING TO PUBLIC VALUE INPUTS

5.1 Introduction

The first component of this research utilized survey distribution that focused on the input and output variables synthesized from the literature review and theory. Specifically, the public-value-centric inputs developed by Karunasena and Deng (2012) relate to the output measured by ownership as representing value generation purported by de Lange and de Waal (2013). In addition, other control and demographic variables are inserted into the model based on components of the literature that may influence ownership associated with smart city applications.

Fowler (2009) suggests survey design should proceed so that it encapsulates the variables to be measured, ensures the usefulness of such estimates, and should have a representative sample distribution. The sampling method is that of a convenience sample as participation is voluntary and only encapsulates those with a knowledge of mobile phone applications pertaining to the City of Boston. However, based on Pew data (Smith, 2015), I expected that many the city’s inhabitants have smartphone technology and are aware of some of the city’s mobile application initiatives. Further, Boston takes means to advertise these applications around the city to garner participation and use. Therefore, the sample was somewhat representative of the city's population and high response rate occurred. Specifically, the sample was very close to the racial and gender make-up of the greater

Boston area, but there was variation in income, education, and age diversity in the sample as compared to the population (U.S. Census Bureau, 2018).

The survey instrument was developed using Qualtrics and distributed via email or as users visit the link through the advertisement. Advertisements for the survey proceeded through online mediums such as Twitter, Facebook, Instagram, Reddit, Quora, survey websites, and via various list servs gathered. The highest response rates were gathered from list servs.

Utilizing such a method of sampling I believe avoids the synecdoche that Becker (1998) mentions in accurately relating the sample to the phenomenon I sought to study. By surveying the users directly, I increased the overall validity and reliability of the study and was able to generalize the study to a large population of mobile application users, within similar smart cities worldwide, giving it moderate external validity. External validity however does suffer due to the nature of the convenience sample.

A high number within the sample allowed me to recognize any noticeable disparities in the survey design, increasing reliability and the consistency in measurement and allow relation to the population to be better undertaken. Content validity was developed through relating the explanatory variables to theoretical explanations. In designing the survey, I avoided attempting to explain all phenomena in question, and instead focused the survey on the variables (partly to garner a high number of cases) according to Becker's (1998) suggestions to increase construct validity. Therefore, the time for the survey was approximately 5-10 minutes for the typical user to complete, and the average survey length was ~7 minutes.

Due to the nature of quantitative research and my attempt to identify a micro level pattern among mobile application users to test preexisting theories, a high number of cases is beneficial to the study and increases its statistical power (Ragin & Amoroso, 2011). In the method of distribution, the number of cases was high because the survey was being distributed so widely. To achieve a 3% margin of error a sample of 1066 participants would be needed. To achieve the minimum 5% margin of error 384 responses will be needed. The final sample size was **426 participants** giving the study a 5% margin of error at the 95% confidence interval.

I hope this method of sampling accounted for the micro level explanation I hoped to attempt. Further, it is through this pattern of identification among many cases that I attempt to infer clues about causation that can lead to explanatory conclusions which I analyze in this chapter. Primarily, I will: identify a pattern of covariation and the strength of the correlation between the variables, use such correlation to explain causation, and explain the phenomenon built on this causal relationship (Ragin & Amoroso, 2011). This analysis will also contribute a greater knowledge of the phenomena surrounding the research questions posed.

The analysis attempts to infer correlation via the variables mentioned to determine the probability that an outcome (the extent to which citizens feel ownership concerning the City of Boston's applications) will occur. From this, I will also correlate public value derived theoretical explanatory variables, demographic characteristics of respondents, and control variables that may influence user's sense of ownership

I ask what variables lead to more ownership**,** and thus **public value generation**? The design of the survey will proceed via Ragin and Amorosa's (2011) suggestions to avoid

confusion for the survey taker and so that the survey is easily understood. I do not anticipate any IRB conflicts with this distribution as the question will limit any risk to mobile application users and will amount to no risk. According to Marshall and Rossman's (2011) considerations of vulnerability and harm to subjects had no risk or ethical shortcomings in its method of analysis.

The survey methodology proceeded via survey distribution first and only via an email and distribution through Qualtrics. As mentioned above, the survey was advertised online to garner a high response rate. Specifically, I gathered independent variables that relate to public value characteristics (Karunasena & Deng, 2012), demographic characteristics, prior use of mobile applications and the satisfaction with them, and control variables to answer the research question according to the established literature and theory. The design of the survey questions proceeded primarily via Fowler's (2009) suggestions to increase the quality and representativeness of the questions asked by relating them to established literature and theoretical components.

5.2 Research Question

Below are the research questions associated with the survey component of the study. From the survey, I test the subsequent hypotheses derived from the literature review and based on the research question.

> **Central Research Question:** Does the development of smartphone mobile application technology that proceeds according to Moore's public value management chain lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services?

Primary Research Question #2: What is the effect of including public value outcomes in developing a sense of ownership associated with mobile applications and the user's willingness to engage with the applications in a co-productive sense?

5.3 Data Collection

To evaluate the above research question, I use ordered logistic regression to examine specifically what variables contributed to greater levels of a citizen's likelihood to engage given incremental increases in these input variables.

The sample was gathered from the population of City of Boston mobile application users via a convenience sample to explain what variables lead to more likelihood to develop ownership**.** The unit of analysis was; therefore, City of Boston-specific mobile application users and the survey was conducted among such users.

The level of analysis was therefore the individual level with a final sample size of n=426. The variables and hypotheses listed below are, in all cases but mobile phone type, are seeking to reject the null hypothesis in addressing the research question regarding user's likelihood to engage with application in the future according to the variables listed.

The dependent variable, the extent to which citizens feel ownership**,** was gathered from the survey along with independent variables according to the dimensions of Karunasena and Deng's (2012) model. Other, demographic questions relate to participant income, level of education, race, and gender, and whether they live in suburban, rural, or urban settings. Tech comfortability is also examined as it proves a key determinant in willingness to use the application. Lastly, the number of mobile applications and City of Boston-specific mobile applications installed on their phone will, their frequency of use, and their satisfaction with

each of these groups was examined. Below the variables and their initial capture via the survey and transformations are examined further.

5.4 Variable Specifications

5.4a Dependent Variable

De Lange and de Waal (2013) note that "ownership" as it regards smart city services is tied to the willingness to co-create public services for the success of the service itself. As noted earlier, they say "we use ownership to refer to the degree to which city dwellers feel a sense of responsibility for shared issues and are taking action on these matters (1) ." The construct serves as the dependent variable of the study and is important in gauging the willingness of citizens to take action on matters via mobile applications in order to co-contribute to and engage with the smart city. In this sense, engagement and empowerment are interconnecting concepts that allow the citizen to be a partial owner of the service in question in their community, which the authors describe as 'networked publics' according to the interpretation offered by Varnelis (2008). Thus, the dependent variable of ownership is conceptualized as follows:

Ownership is defined as "the extent to which mobile application users show a greater willingness to engage with the city's future e-government service (mobile applications) compared to more traditional channels." The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "My experience with City of Boston-specific mobile applications has made it more likely that I will participate and engage with current or future applications developed for the city."

The variable then is measuring the likelihood that users will be co-contributors to future applications. As is later described, the users are characterized according to the scale into “unlikely to engage” and “likely to engage” depending on their score. The construct is important as is described in Chapter 3 according to the idea that ownership is tied to value creation, which is a central output component for examining the value chain of Moore’s (1995) model. As the Smart City components showcase, the self-efficacy and influence the user feels over the technology is of importance in determining factor in whether users utilize such technology in the future (de Zúñiga et al., 2013; Lee et al., 2014). Thus, measuring this dynamic of engaging with future developed applications showcases the ownership in question.

In the case of this variable and in the case of the input variables in the next section, the specific channel of the smartphone application is compared to other channels through which services proceed. This is because of the need to differentiate the ownership the participant feels toward the mobile applications public-value-centric characteristics, and not the specific service in question. Tied to the research question is this need to specifically address if greater levels of ownership are derived by the user through their interactions with this technology. Further, Karunasena and Deng (2012) note how in measuring the success of e-government services they must be held against other traditional channels in deriving their value. Therefore, in the cases below the m-government service of specifically the mobile application is compared to all other services both traditional and indicative of the earlier stages of e-government.

5.4b Public Value Input Variables

Karunasena and Deng's (2012) model provides a description for each of the four dimensions of public value and ties them to specific attributes associated with these dimensions. Below the model specifications are transformed according to the use of mobile applications. The survey that gathered metrics on these variables is in Appendix I. Each variable is defined below. The hypothesis for each of the variables is also below. All variables are anticipated to have positive correlation to ownership**.**

Ha: The greater the perceived level of attention to public value attributes among mobile application users within the City of Boston's will lead to greater levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city

5.4c Independent Variables: Delivery of Public Services

When measuring the delivery of the public service, Karunasena and Deng (2012) note how these input constructs are important to the timeliness and quality of the e-government service (Kearns 2004; Heeks 2006), which they operationalize through the availability of information, the importance of information to citizens, choice, cost savings, fairness of services, satisfaction of citizens, and take-up of e-government services.

Information is defined as "the extent to which **mobile application users** feel the mobile application provides them with **greater levels of information** compared to more **traditional channels** ." This construct concerns, specifically, the amount and type of information that the channel provides through the service in question (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to

complete agreement with the following statement: "City of Boston-specific mobile applications have provided me with a greater amount of information compared to other service channels”.”

Importance is defined as “the extent to which **mobile application users** feel the mobile application provides them **information that they feel is more useful to them** compared to more **traditional channels** .” Importance as a construct reflects the perception of the usefulness of the service as it regards their specific needs and in relation to the information provided (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: “City of Boston-specific mobile applications have provided me with more useful information compared to other service channels.”

Choice is defined as “the extent to which **mobile application users** feel the mobile application provides them **with more available channels to access public services** compared to more **traditional channels**.” Choice as a construct specifically refers to availability and the ease in which citizens gather access to the public e-government service (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement. “City of Boston-specific mobile applications have made it easier to access their public services compared to other service channels.”

Fairness is defined as “the extent to which **mobile application users** feel the mobile application provides them **equal capability compared to others in accessing public**

services compared to more **traditional channels**." Fairness as a construct refers to the perception by the user that they feel the service is available to all members of the population, even those who may be socially disadvantaged. Specifically, this concerns how available these resources are to the groups perceived (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have made it so that I have equal access to public services within the city compared to other people."

Cost Savings is defined as "the extent to which **mobile application users** feel the mobile application provides them **greater cost savings** compared to more **traditional channels**." Cost savings as a construct refers to the amount of money citizens can save through the e-government service (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have provided me with greater cost savings compared to other service channels."

Take Up is defined as "the extent to which **mobile application users** are **more willing to utilize** the service compared to more **traditional channels**." Take up as a construct measured the use of the e-government service and the continued use of these e-government services. In the case of mobile applications, the use of one service is changed from Karunasena and Deng's (2012) model to suggest take up of the application over other channels. The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile

applications have made me more willing to utilize their services compared to other service channels."

Citizen Satisfaction is defined as "the extent to which **mobile application users** are **more satisfied with** the service compared to more **traditional channels**." Satisfaction as a construct refers to the experience of the citizen using the e-government service (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have made me more satisfied with their services compared to other service channels."

5.4d Independent Variables: Achievement of Outcomes

Socially desirable outcomes to Karunasena and Deng (2012) are an important component of public value creation and represent the impacts, deliverables, and consequences of the public service (Kearns, 2004; Heeks, 2006). Specifically, these include direct outcomes, intermediate outcomes, and end outcome (Codagnone & Undheim, 2008). Specifically, in the case of the model below they relate to neighborhood, city, and entire society reflection of the impact of mobile applications among users.

Direct Outcomes are defined as "the extent to which **mobile application users** feel the service **achieves greater levels of socially desirable outcomes for their specific constituency** as compared to more **traditional channels**." As a construct, direct outcomes refer to specific constituencies and the outcome of the service on them (Karunasena & Deng, 2012). In the case of this study, I attribute this to the neighborhood level impact of the

applications. The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes within my SMALL COMMUNITY OR NEIGHBORHOOD compared to other service channels."

Intermediate Outcomes are defined as "the extent to which **mobile application users** feel the service **achieves greater levels of socially desirable outcomes for the entire city** as compared to more **traditional channels**." Intermediate outcomes as a construct refer producing results for an entire sector or larger area (Karunasena & Deng, 2012). In the case of this study, I attribute this to the city level impact of the applications. The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes within my GREATER COMMUNITY OR CITY compared to other service channels."

End Outcomes are defined as "the extent to which **mobile application users** feel the service **achieves greater levels of socially desirable outcomes for the entire society** as compared to more **traditional channels**." End outcomes as a construct refers to achieving specific targets or goals for the entire society or entire economy based on the service (Karunasena & Deng, 2012). In the case of this study, I attribute this to the societal level impact of the applications. The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes for my ENTIRE SOCIETY AS A WHOLE compared to other service channels."

5.4e Independent Variables: Development of Trust

Third, according to Karunasena and Deng (2012) the development of trust between the service or government and citizens is a component of public value generation in e-government (Kearns, 2004; Heeks, 2006). The components are tied to the perspectives of the citizen concerning their security and privacy (Kearns, 2004; Bélanger et al., 2005), the transparency of the e-government service (Golubeva, 2007; Undheim & Blakemore, 2007), the trust of citizens in e-government services (Kearns, 2004; Heeks, 2006), and the participation of citizens in public discussions.

Security and Privacy are defined as "the extent to which **mobile application users** feel the service **achieves acceptable levels of privacy for services and information** as compared to more **traditional channels**." As a construct, security and privacy refers to the extent the service managers the citizen's personal information and ensures its confidentiality, which is characterized by perceptions of actions or laws and regulations that make specific note to these concerns (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications contain a sufficient degree of security associated with them that protects my private information compared to other service channels."

Transparency is defined as "the extent to which **mobile application users** feel the service **provides them with greater levels of disclosure of information, decision making processes, and procedures** as compared to more **traditional channels**." As a construct,

transparency refers to the extent the service discloses its work, process, and procedures associated with the service and does so in a timely manner (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: “City of Boston-specific mobile applications lead to greater levels of government disclosure of information, decision making processes, and procedures compared to other service channels.”

Trust is defined as “the extent to which **mobile application users** feel the service **is more trustworthy and reliable** as compared to more **traditional channels**.” Trust as a construct refers to the perception of the quality and perceptions about the e-government service (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: “City of Boston-specific mobile applications have led to greater levels of trust of government as compared to other service channels.”

Participation is defined as “the extent to which a **mobile application user** is **more willing to participate for better governance** as compared to more **traditional channels**.” Participation as a construct refers to the willingness of the citizens to be involved in decision making processes using the e-government tool and various web tools that allow them to vocalize their opinion (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: “City of Boston-specific mobile applications makes me want to participate more for better governance in my city as compared to other service channels.”

5.4f Independent Variables: Effectiveness of the Public Organization

Lastly, the effectiveness of the organization is indicative of the public value generated by the service according to Karunasena and Deng (2012). According to Moore (1995) this is measured according to the efficiency, accountability, and citizens' perceptions about public organizations. E-government as a service is described by Heeks (2006) as improving processes to cut down on costs and better manage performance among agencies, which in turn leads to greater effectiveness (Heeks, 2006), which leads to greater financial return compared to the e-government investment (eGEP, 2006).

Efficiency is defined as "the extent to which a **mobile application user** perceive that the service provides them with **more return on investment** as compared to more **traditional channels."** Efficiency as a construct refers to the financial return on investment that the user feels regarding the e-government channel compared to other channels they utilize based on their investment in the channel (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications provide me with more return on my investment as compared to other service channels."

Accountability is defined as "the extent to which a **mobile application user** perceive that the service provides them **greater access to public organizations** as compared to more **traditional channels**." As a construct, accountability refers to the government's ability to answer questions about the service, and also the ability of the government to answer for its performance (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale

from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications provide me with greater access to public organizations as compared to other service channels."

Citizen Perceptions is defined as “the extent to which a **mobile application user** perceive that the service takes into account **their opinions to a greater extent** as compared to more **traditional channels**.” Perceptions from citizens as a construct concern the ability of the citizens for their concerns to be considered and the positive or negative perceptions of the opinions (Karunasena & Deng, 2012). The variable was measured using a 0-100 scale from complete disagreement to complete agreement with the following statement: "City of Boston-specific mobile applications provide me with greater opportunity for my opinions to be taken into account as compared to other service channels.”

5.4g Independent Variables: Demographic Control Variables

The following variables act as control variables for demographic characteristics in the models. According to Pew data (Smith, 2015) data there are deviations in smartphone ownership among certain demographic groups that may impact their sense of ownership both through sustained and initial development. Digital divides also exist that may manifest according to these variables (Emmanouilidou & Kreps, 2010). Though the digital divide among genders is arguably shrinking, there may still present statistically significant differences between the sense of ownership of participants in development (Hoffman et al., 2001). Therefore, gender was captured as a categorical variable with gender captured as male, female, or non-binary.

Further, ownership by age is shown to have a drastic impact on willingness to use technology by participants and may impact sense of ownership (Cordella, 2007). Ownership by minority groups is higher for mobile smart phones, and therefore such ownership and reliance on a singular technology divide may increase the sense of ownership associated with contribution on those devices, and therefore minority groups may show higher levels of sense of ownership. Due to connectivity issues, geographic area may limit some users about the sense of ownership of mobile applications in development (Cordella, 2007). In government, as well such areas may not have more government-centric applications, which may be confined to city areas mostly. Income has been shown to have perhaps the greatest effect on users from the standpoint of the digital divide and income can also lead to reluctance to participate based on many extraneous factors. Therefore, income likely will heavily impacted ownership. Educations as well has been shown to increase levels of civic engagement and be limited by digital divides (Hoffman et al., 2001). Therefore, it likely will also affect sense of ownership**.**

Gender

Ha: Being female will have a negative effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Age

Ha: Increases in age will have a negative effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Race

Ha: Being a minority race will have a negative effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Geographic Area

Ha: Being in more rural geographic areas will have a negative effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Income

Ha: Higher levels of income will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Education

Ha: Higher levels of education will have a negative effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

5.4h Independent Variables: Control Variables

The following variables act as control variables in the model concerning experience with Boston applications, all applications, tech comfort, phone type, their belief in two-way communication, and whether the participant had been a prior application user. The degree of tech comfort is mentioned by several sources as a factor influencing the capability of users to participate and their willingness to do so (Kleinhans et al., 2015). From this as well, the number of mobile applications installed on a user's phone may lead to overall greater familiarity with the technology, but also may increase the utility the user associates with mobile applications in general. Therefore, having government mobile applications installed may be akin to a preference for the technology that shows greater willingness to be involved in development and thus greater sense of ownership. Further, a greater belief in two-way communication and the degree to which citizens feel government should proceed in such a direction may affect the willingness of users to participate (Linders, 2012; Cumming, 2001; Elgarah & Courtney, 2002; Webler & Tuler, 2000). Further, the more users feel that communication should proceed from government to citizen and back to government via the tenets of e-governance likely will affect the degree of their sense of ownership. Lastly, mobile phone type here acts as a control for the study. As applications vary in capability among certain mobile operating systems and phones (i.e., an Android version of an application may be sophisticated than an Apple version, or vice versa) there is a need to see if experiences and perceived usefulness is affected by a user's mobile operating system.

Number of Boston Applications

Ha: Increases in the number of City of Boston-specific mobile applications installed will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Frequency of Use Boston Applications

Ha: Increases in the frequency of use of City of Boston-specific mobile applications will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Prior Experience with of Boston Applications

Ha: Increases prior experience in the use of City of Boston-specific mobile applications will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Technology Comfort

Ha: Having higher levels of technology comfortability will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Number of All Applications

Ha: Increases in the number of all mobile applications installed will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Frequency of Use All Applications

Ha: Increases in the frequency of use of all mobile applications will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Prior Experience with All Boston Applications

Ha: Increases prior experience in the use of all mobile applications will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Belief in Two-Way Communication

Ha: A greater belief in two-way communication will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Extent of Prior Contribution

Ha: Being a "contributor" as opposed to a "non-contributor" will have a positive effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

Mobile Phone Type

Ha: The mobile phone type will have no effect on the levels of ownership associated with the application as demonstrated by more likelihood to engage with future applications developed by the city as determined by likelihood to engage with future applications

5.5 Data Preparation and Descriptive Statistics

According to a phone interview with a Boston city official, who oversees application development within the city of Boston, the maximum downloads of a City of Boston application was 100,000 users representing the population of City of Boston-specific mobile application users. However, it is likely the actual number that represents the population of users is much higher than this figure. However, due to the already large population there is little change in the confidence level and interval of the population were it higher than 100,000. The final sample size of the survey was n=426. This represents a confidence interval of 5% with a confidence level of 95% allowing for robust approximation of the findings.

5.5a Descriptions of Cases Removed and Data Transformations

For variables Income, Gender, and Race where participants indicated they did not want to disclose information the cases were dropped bringing the final sample size to n=426 from an initial sample size of n=462. There was no missing data for those who did not complete the survey as these responses were not recorded. The table below outlines the cases removed and number of cases, which brought the final sample size to n=426.

Table 5a: Cases Removed Due to Missing Data

Variable	N	Justification
Income	22	Respondents did not disclose income
Gender	9	Respondents did not disclose gender or indicated they chose not to disclose gender
Race	5	Respondents did not disclose race or indicated they chose not to disclose gender

Data transformation occurred first for the dependent variable "Ownership" which was re-coded from its initial data capture of 0-100 indicating the strongest disagreement to the strongest agreement on whether the person's experience with City of Boston applications would cause them to engage with future applications. Specifically, the variable was made dichotomous with "0" indicating scores 50 and below and being "unlikely to engage" and scores above 50 being "likely to engage." This re-coding groups the respondents as we examine the likelihood that changes in the independent variables may lead to greater willingness to engage with future applications and addresses the development of ownership as outlined in the research question for this chapter. None of the public value independent variables required transformation as the variables represented interval level data with a scale of 0-100.

Regarding demographic variables gathered, Gender needed no re-code, though categorical dummy variables were created for this variable. Age was re-coded to break respondents into ordinal level categories that represented age dynamics in line with the demographic characteristics of the population of the Greater Boston area (U.S. Census Bureau, 2018). Similarly, Race was categorized into 5 categories “White,” “Asian,” “Black,” “Hispanic or Latino,” and “Other Race,” according to allow comparison to Pew data (Smith, 2015) gathered and the demographic data of the population (U.S. Census Bureau, 2018). Like Gender, Race was coded into categorical dummy variables from this first re-code. Geographic Area needed no re-code and was subsequently transformed into categorical dummy variables. Income and Education as well were broken down from its initial ordinal scale to match the data of the population (U.S. Census Bureau, 2018).

For control variables gathered, Boston Application number and all applications number needed re-coding to put variables into proper ordinal order, but no major re-code was needed. Frequency of use was re-coded for both Boston applications and all applications to break the variable into 6 categories “No Use,” “Very Low Use,” “Low Use,” “Moderate Use,” “High Use,” and “Very High Use.” For Boston applications and all applications regarding the experience around the application the variables only needed re-coding to put variables into proper ordinal order. The variables of Technology Comfort and Two-Way Communication needed no re-coding. Contribution level needed re-coding to combine those who indicated they were a “developer” into a “contributor” and subsequent categorical dummy variables were created. Lastly, as there were many phone types indicated, Phone

Type was re-coded into “Apple,” “Samsung,” and “Other” categories, and categorical dummy variables were created based on this.

For compete re-coding procedure, the more detailed codebook for the study is in Appendix II. The table and model below show the final list of the variables selected for the logistic regression model along with the scale and variable type. Section 4.5c discusses the correlation matrix and highly correlated variables that were dropped from the model. They are indicated in the model below.

Table 5b: Model Descriptions of Final Variables

Category	Variable Name	Scale
Dependent Variable	Ownership	Dichotomous variable indicating unlikely to engage (0) and "likely to engage" (1)
Delivery of Public Service	Information**	0-100 scale from disagreement to agreement
	Importance	0-100 scale from disagreement to agreement
	Choice	0-100 scale from disagreement to agreement
	Fairness	0-100 scale from disagreement to agreement
	Cost Savings	0-100 scale from disagreement to agreement
	Take Up	0-100 scale from disagreement to agreement
	Satisfaction**	0-100 scale from disagreement to agreement
Achievement of Outcomes	Direct**	0-100 scale from disagreement to agreement
	Intermediate	0-100 scale from disagreement to agreement
	End	0-100 scale from disagreement to agreement
Development of Trust	Security	0-100 scale from disagreement to agreement
	Transparency	0-100 scale from disagreement to agreement
	Trust**	0-100 scale from disagreement to agreement
	Participation	0-100 scale from disagreement to agreement
Effectiveness of the Public Organization	Efficiency	0-100 scale from disagreement to agreement
	Accountability	0-100 scale from disagreement to agreement
	Perceptions	0-100 scale from disagreement to agreement

Demographic Characteristics	Gender*	Categorical variable indicating "male" (1) or "female" (2)
	Age	Ordinal variable indicating age categories from 18 to 29 (1) to Over 80 (7)
	Race*	Categorical variable indicating "White" (1), "Asian" (2), "Black" (3), "Hispanic or Latino" (4) and "Other Race" (5)
	Geographic Area*	Categorical variable indicating "Urban" (1), "Suburban" (2), "Rural" (3)
	Income	
	Education	Ordinal variable indicating education categories from "No Degree" (1) to "High School" (2) to "Bachelors" (3), and "Graduate" (4)
Control Variables	Boston Apps Number	Interval Data from 0-11, with highest number being 11
	Boston Apps Frequency	Ordinal variable indicating categories from "No Use" (0) to "Very High Use" (5)
	Boston Apps Experience	Ordinal variable indicating categories from "Poor" (1) to "Excellent" (5)
	All Apps Number	Ordinal variable indicating categories from "1-25" (1) to "201 or more" (9)
	All Apps Frequency	Ordinal variable indicating categories from "No Use" (0) to "Very High Use" (5)
	All Apps Experience	Ordinal variable indicating categories from "Poor" (1) to "Excellent" (5)
	Technology Comfort	Ordinal variable indicating categories from "Very Low" (1) to "Very High" (5)
	Two-Way Communication	0-100 scale from disagreement to agreement
	Contribution Level*	Categorical variable indicating "Non-Contributor" (1), "Contributor" (2)
	Phone Type*	Categorical variable indicating "Apple" (1), "Samsung" (2), or "Other Phone" (3)

*All categorical variables were re-coded into dummy variables based on the number of responses

**Variable was dropped due to high collinearity

5.5b Multicollinearity

Multicollinearity in logistic regressions can be identified using correlation values. To detect high levels of correlations in models, Hosmer and Lemeshow (2000) suggest conducting a correlation matrix of interval level variables to detect the strength of association between these variables. Pallant (2007) suggests variables with associations greater than .7 be dropped from the model as they are examining characteristics like one another. In our correlation matrix, the variable “Information” was highly correlated with the variable “Importance.” The variable “Direct” was highly correlated to the variable “Intermediate.” The variable “Take up” was highly correlated with “Satisfaction.” Lastly, the variable “Trust” was highly correlated with “Participation.”

In the case of variables showing greater than .7 correlation, Pallant (2007) suggests combining these variables into one or dropping them from the model. Midi, Sarkar, and Rana (2013) second this notion. I chose to drop variables according to the theoretical and literature review conducted in prior chapters. Information quality is often valued higher than amount of information (Ferro & Molinari, 2010; Gonçalves et al., 2013), so the variable Importance was kept in the model, with Information being dropped. As the smart city is indicative of city level initiatives and most applications are city-centric (Gil-García et al., 2015), and therefore Intermediate was kept in the model, and Direct was dropped. Utilization is highly correlated with satisfaction and utilization is seen in the literature review as indicative of such satisfaction (Chen et al., 2016; Mainka et al., 2015). For this reason, Take Up was kept in the model, and Satisfaction dropped. Lastly, Trust is highly correlated with Participation though these two variables only slightly met the .7 correlation threshold, trust of government can be

influenced by other factors separate from public value and can lead to a lack of participation via technological acceptance (Hung et al., 2013; Horst et al., 2007; Gilbert et al., 2004) and thus may adversely impact views of government. For this reason, Participation was left in the model. The correlation matrix for these variables can be seen in Appendix III.

Further, Midi et al. (2013) suggest conducting a VIF for these variables and due to the nature of the dependent variable first being captured as interval level this becomes possible. The results of the VIF with the remaining variables shows a mean VIF of 1.96 with the highest VIF being 4.06. The suggested mean VIF should be less than 10 (Midi et al., 2013) and ideally less than 5 according to some sources for individual level variables. Therefore, the model meets these additional specifications as shown as the max VIF is 4.06 as shown in Appendix IV.

For correlations between categorical variables chi square tests Pearson chi2, likelihood-ratio chi2, gamma, Cramer's V were all performed to assess if any correlations existed among the variables in question. Among the 5 categorical variables in the model the tests above showed significant correlations among gender and phone type, race and contribution level, race and phone type, and geographic area and contribution level. The results of each test are shown in Appendix V.

Specifically, females were more likely to own Apple products then males with 63% of females owning Apple phones vs 49% of men. Race as well was highly correlated with contribution level as 82% of white survey takers indicated they were contributors compared to 75% of all other races, and 50% among Hispanic or Latino survey takers. Race and Phone Type were slightly correlated but the major discrepancy comes with 0% of those of Another

Race owning an Apple product. The proportions save for that were rather evenly distributed. Geographic Area was also correlated with Contribution level as 72% of those who identified as contributors lived in an Urban setting compared to 87% who lived in a Suburban setting and 83% a Rural setting. These findings correspond to common associations between digital divide variables as outlined in the literature review portion of this study (Smith, 2015).

For ordinal variables Kenda's Taub B and C were performed to detect associations among these variables. According to Berry, Johnston, Zahran, and Mielke (2009) it is more suitable for tests based on ordinal variables with asymmetric categories to use Tau C. As some categories were asymmetric and some symmetric, both tests were used. Strong relationships, those over .40, should be evaluated and potentially dropped from the model. In the case of the correlation table no correlations met that threshold, so none were dropped. The results of these associations can be seen in Appendix VI.

5.5c Logistic Regression

Multivariate logistic regression was chosen based on the research question asked and the variables in question that were interval, ordinal, and categorical in nature. The dichotomous transformation of the dependent variable allowed me to capture what participants were deemed "likely to engage" and "unlikely" to engage with future applications, which lends itself to the research question asked concerning what variables lead to ownership development and the willingness to engage co-productively in future application services (de Lange & de Waal, 2013; Linders, 2012; Varnelis, 2008). From this analysis, the predictor variables can be held against the ownership score to determine the strength and the direction of the relationship (Creswell & Creswell, 2017).

In logistic regression the dichotomous nature of the dependent variable has the variable take on a value of “1” or “0.” In this study, those “likely to engage” are coded as “1” and those “unlikely to engage” are coded as “0.” The logistic regression calculation is given by Hosmer and Lemeshow (2000) below, along with the logistic transformation.

$$\boldsymbol{\pi}\mathbf{(x)}=\frac{\mathbf{e^{B}\ o+b1x}}{\mathbf{1+e^{B}o+b1x}}$$

$$\boldsymbol{\pi}\mathbf{(x)=ln}\left\lfloor\frac{\boldsymbol{n}(\boldsymbol{x})}{\mathbf{1}\boldsymbol{n}(\boldsymbol{x})}\right\rfloor$$

=Bo+B1x

In this case, the logit may range from -∞ to +∞, with the distribution of the outcome variable being dichotomous in the case of this study (Hosmer & Lemeshow, 2000). In this sense the likelihood function of the logistic regression allows me to predict the likelihood that an event will occur based on the predictor parameters within the model. In this case the various predictors allow me to predict the likelihood that a person will move from being “unlikely to engage” to “likely to engage” given increases among the predictor variables. For the analysis of the logit regression, maximum likelihood estimators are used to examine these probabilities (Hosmer & Lemeshow, 2000). The relationship between the predictor variable and the dependent variable of ownership is modeled according to this equation with the relationship between ownership or y being “1” based on the probability (p) of y being one. P, then, represents this probability with B0 representing the y intercept and B1 the coefficient of the model and with ‘xk’ representing the values taken by the predictors.

Logit (pp) = log(p/1-p) = B0+ B1*xk.

The probability or odds of the event occurring is given by the equation as follows:

P=exp (B0 + B1*x1 … +B,*xk) (1+exp(B0+B1*x1 + …+ Bk*xk))

From this analysis, the odds ratio is examined in each model to determine the odds of the event (likelihood to engage) occurring and the likelihood to develop ownership based on changes among predictor variables.

5.5d Model Fit Measures Based on the Likelihood Function

Each model was tested for goodness of fit using various methods described in (Hosmer & Lemeshow, 2000; Menard, 2002). Specifically, each model is analyzed for model fit measures based on the likelihood function Omnibus test of model coefficients by using the likelihood ratio chi squared test, Cox and Snell pseudo R2, Crag-Uhler/Nagelkerke R2, McFadden R2, and the Wald Test. Specifically, the likelihood function Omnibus test of model coefficients tests the null hypothesis that all coefficients estimates in the model are zero versus the alternative hypothesis that at least one coefficient differs from zero. Various R2 tests report that adding the covariate factors in the model increased the log-likelihood function when adding these components to the model from the model's base value with only a constant. The Wald test tests the null hypothesis that two coefficients of interest are equal to zero. When the tests fail it suggests that removing these variables does not substantially harm the fit of the model, indicating good fit. Lastly, each model is analyzed finally using the Hosmer-Lemeshow goodness of fit test. It uses a Chi-square goodness of fit measure to test how well predictions from the model compare to observed values throughout the range of predicted probabilities ranging from 0-1. This tests the null hypothesis that the distribution of expected outcomes matched the observed outcomes in the sample. A small chi square value

indicates a good model fit, while a large chi square will reject the null hypothesis and suggest a poor fitting model.

5.5e Model Fit Measures Based on Predicted Probabilities and Observed Outcomes

In addition, each model is analyzed for model fit based on predicted probabilities by examining the model's sensitivity and specificity using the STATA commands Estat Class, LSENS, and LROC. Sensitivity in these tests indicates how well the model correctly predicts the observed events for the dependent variable at Y=1? Specificity says that when events do not occur how accurate is the model at predicting them at Y=0? Models with good fit should have high specificity and sensitivity. When examining them visually, they should have a large area under the LROC curve (not near the 45-degree line) and have a gradual slope as the cutoff points changes in the LSENS curve, with specificity decreasing when lowering the cutoff point and increasing when raising it. Such visuals indicate a good model fit. The opposite is true for sensitivity. At the end of the analysis the models are examined uniformly by the Bayesian information criterion (BIC) and Akaike information criterion (AIC) to determine the fit of each of the models.

5.6 Results

The purpose of this chapter is to examine the research question "what is the effect of including public value outcomes in developing a sense of ownership associated with mobile applications and the user's willingness to engage with the applications in a co-productive sense"? To examine this research question, logistic regression was conducted to analyze the

relationship between variables of concern and the dependent variable of ownership as examined by the respondent being “likely to engage.”

The results of the quantitative analysis are presented below. 6 models are analyzed below. These models were chosen primarily based on the breaking up into groupings based on specific **public value outcomes, demographic outcomes, Boston-centric outcomes, and outcomes related to comfort with technology**. The last model, represents the best model that is not over fitted based on the inclusion of too many variables, called **The Smart City Model.**

The primary model includes all public value, demographic, and control variables being analyzed. This is to be considered the first model of the study, with subsequent models testing if significance is retained among different model specifications. Specifically, the models are broken down according to one that contains only the public value variables in question, one that contains only demographic variables, one that outlines prior experience with City of Boston applications, and one that contains technology comfort variables. A final model The Smart City Model represents the final model of concern and the best fit model based on the variables in question.

One last logistic regression model was added in the form of the **Authorizing Chain Model.** This model builds on the major themes developed from the qualitative findings for a comparison with the Smart City model derived. Through an analysis of this model, the two can be compared in order to determine the differences among both models.

Overall, descriptive statistics for the variables in question are presented initially. Next, each model was analyzed by how well it met the goodness of fit measures, as

mentioned in the above section. Finally, logistic regression is used to analyze the findings of each model and discuss the odds ratio of statistically significant predictors on the dependent variable.

5.6a Descriptive Statistics

Below, descriptive statistics are presented for all variables of interest, save for those which were dropped due to issues of multicollinearity as mentioned in the prior sections. The standard deviation, standard of error, and the range are presented for the interval and ordinal variables. For interval variables, the mean is presented and for ordinal variables the median. For categorical variables the number and percentage of cases in that category are presented.

Table 5c: Descriptive Statistics of the Full Model

Interval Variables	**Mean**	**Std. Dev**	**Std. Error**	**Min**	**Max**
Public Value Variables (15)					
Importance	65.49	20.42	.012	0	100
Choice	70.55	19.30	.011	1	100
Fairness	66.79	21.04	.011	0	100
Cost Savings	55.15	24.74	.009	0	100
Take Up	67.57	20.21	.013	0	100
Intermediate	63.68	19.89126	.012	0	100
End	59.78	21.8726	-.019	0	100
Security	63.20	20.50434	.000	0	100
Transparency	60.99	20.63262	-.003	0	100
Participation	60.26	21.87281	.022	0	100
Efficiency	57.92	22.08	.011	0	100
Accountability	64.92	20.35	-.007	0	100

Perceptions	60.36	22.38	-.004	0	100
Two-Way Communication	83.21	17.92	-.006	18	100
Boston Apps Number	1.94	1.93	.334	0	11
Ordinal Variables (9)	**Median**	**Std. Dev**	**Std. Error**	**Min**	**Max**
Income	3	1.79	-.032	1	8
Education	3	.73	-.291	1	4
Age	2	1.10	.164	1	7
Boston Apps Frequency	1	.78	-.220	0	5
Boston Apps Experience	4	.91	.510	2	5
All Apps Frequency	4	1.30	.161	1	5
All Apps Experience	4	.76	.008	2	5
All Apps Number	2	1.55	-.100	1	9
Technology Comfort	4	4.15	-.171	2	5
Categorical Variables (10)	**n**	**Percent**			
Female	250	60.00			
Asian	37	8.71			
Black	24	5.65			
Hispanic	26	6.12			
Other Race	11	2.59			
Urban	212	49.88			
Suburban	178	41.88			
Contributor	336	79.06			
Apple	245	57.65			
Samsung	97	22.82			

N=426

5.6b Tests of Model Fit and Logistic Regression Results for Full Model

The predictor variables included in the model below are:

1. Importance
2. Choice
3. Fairness
4. Cost Savings
5. Take Up
6. Intermediate
7. End
8. Security
9. Transparency
10. Participation
11. Efficiency
12. Accountability
13. Perceptions
14. Female
15. Age
16. Asian
17. Black
18. Hispanic
19. Other Race
20. Urban
21. Suburban
22. Income
23. Education
24. Boston Apps Number
25. Boston Apps Frequency
26. Boston Apps Experience
27. All Apps Number
28. All Apps Frequency
29. All Apps Experience
30. Technology Comfort
31. Two-Way Communication
32. Contributor
33. Apple
34. Samsung

Table 5d: Logistic Regression Results for Full Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
Importance	.014	.012	6.67	1	.235	1.01	-.009	.037
Choice	.021	.011	3.35	1	.067**	1.02	-.001	.043
Fairness	.001	.011	.02	1	.902	1.00	-.020	.023
Cost Savings	.006	.009	.42	1	.518	1.00	-.012	.024
Take Up	.041	.012	40.44***	1	.001***	1.04	.016	.067
Intermediate	-.001	.011	.01	1	.913	1.00	-.025	.023
End	-.019	.011	2.97*	1	.085*	.980	-.04	.003
Security	.000	.010	.00	1	.965	1.00	-.020	.020
Transparency	-.003	.013	.05	1	.815	.997	-.028	.022
Participation	.022	.011	4.15**	1	.042**	1.02	.001	.043
Efficiency	.011	.010	1.19	1	.275	1.01	-.009	.032
Accountability	-.007	.013	.30	1	.587	.993	-.031	.018
Perceptions	-.004	.011	.11	1	.745	.996	-.026	.019
Two-Way Communication	-.006	.008	.56	1	.045	.994	-.023	.010
Boston Apps Number	.3335714	.1718249	3.77**	1	0.05**	1.40	-.003	.670
Income	-.031	.092	.11	1	.735	.969	-212	.149
Education	-.291	.229	1.61	1	.204	.748	-.739	.158
Age	.028	.164	.03	1	.863	1.03	-.294	.351
Boston Apps Frequency	-.220	.318	.48	1	.490	.802	-.844	.404
Boston Apps Experience	.510	.218	5.44**	1	.020**	1.66	.081	.938

All Apps Frequency	.161	.149	1.16	1	.281	1.17	-.131	.453
All Apps Experience	.008	.240	.00	1	.973	1.01	-.462	.478
All Apps Number	-.100	.132	.45	1	.450	.904	-.360	.160
Technology Comfort	-.171	.298	.33	1	.566	.843	-.754	.413
Female	-.193	.342	.32	1	.573	.825	-.863	.478
Asian	-.350	.521	.45	1	.501	.704	-1.37	.67
Black	-.140	.591	.06	1	.813	.870	-1.29	1.02
Hispanic	.660	.843	.61	1	.434	1.93	-.993	2.31
Other Race	-.181	.949	.04	1	.850	.834	-2.04	1.68
Urban	-.243	.567	.18	1	.669	.785	-1.35	.870
Suburban	.064	.559	.01	1	.909	1.07	-1.03	1.16
Contributor	2.14	.685	9.72**	1	.002***	8.46	-.023	.010
Apple	-.073	.434	.03	1	.867	.930	-.924	.779
Samsung	-.141	.486	.08	1	.772	.869	-1.09	.812

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 148.91 and 34 degrees of freedom, which was statistically significant at the .000 level, using a threshold of p>.05. This allows me to reject the null hypothesis that the

model is not a good fit implying that all the coefficients of the predictors in the model have found to be non-zero.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were also performed by removing all categorical variables, which returned a chi-square of 12.19 and probability of .27 allowing me to reject the null hypothesis that that the coefficients of interest are equal to zero. Removing them from the model does not substantially harm it.

The model also met the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 15.29 and probability of .0538. This allowed me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 18% (McFadden), 30% (Cox & Snell), or 46% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 94.93% and a specificity of 45.56%, meaning that those who were classified as “likely to engage” were done so with 95% accuracy and those “unlikely to engage” were classified with 46% accuracy. Overall, the model suggests that 84.47% of values are correctly classified. However, if I predict that all respondents are not likely to engage, we would classify 70.69% correctly. Then our Adj % correct = (84.47%-

70.69%) / (100- 70.69%) = 47.01%. This suggests the model performs at 47% of the 100% level of predictive accuracy, which is very good.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is the case with largely incremental change occurring, which indicates good fit.

Examination of the LROC curve as shown in Appendix VII also shows very good model fit by a large “bowed” representation and large area under the curve, with the curve lying far from the 45-degree line. Specifically, the area under the curve is .8752, a very large value showing a very good fit for the model in predicting outcomes.

The above tests lead to the conclusion that the model has a very good fit and is accurate in predicting the outcomes in the below logistic regression. However, the model contains a high number of variables and may be subject to overfitting, so it will be broken down in the final model.

The logistic regression model shows several things in relationship to the hypotheses forwarded earlier in this chapter. Examining, first, public value-centric variables there are four variables that show statistically significant results at the 95% confidence interval: Choice, Take Up, End, and Participation. The null hypothesis that choice, as represented by the ease in which respondents could access a City of Boston application, did not predict the likelihood of participants being “likely to engage” was rejected. The variable was significant

at the .10 level. Specifically, for each one-unit increase (from a 0-100 scale) in Choice, respondents were 1.02 times more likely to engage with future applications holding all other variables constant.

Further, the null hypothesis that Take Up, as represented by the willingness to take up and utilize the City of Boston application, did not predict the likelihood of participants being "likely to engage" was rejected. The variable was highly significant at the .01 level. Specifically, for each one-unit increase (from a 0-100 scale) in Take Up, respondents were 1.04 times more likely to engage with future applications holding all other variables constant.

Interestingly, End, or the degree to which respondents believe that the application contributed to the betterment of society and contributed to societal level socially desirable outcomes was negatively correlated with ownership. For example, participants who had a higher degree to which they felt the City's applications contributed to the betterment of society were less likely to engage with future applications. Therefore, out initial hypothesis was incorrect, and there may be a perception that city-centric applications should not have an overall societal focus, somewhat rejecting the notions set forward by Moore (1995). The variable was significant at the .10 level. Specifically, for each one-unit increase (from a 0-100 scale) in End, respondents were .980 times more likely to engage with future applications holding all other variables constant.

Lastly Participation was a statistically significant variable in the model. The null hypothesis that Participation, as represented by a perception that prior applications have taken the respondents opinions into account, did not predict the likelihood of participants being "likely to engage" was rejected. The variable was moderately significant at the .05

level. Specifically, for each one-unit increase (from a 0-100 scale) in Participation, respondents were 1.02 times more likely to engage with future applications holding all other variables constant.

Among demographic variables, two were significant: The number of City of Boston applications the participant had, and their experience with those city applications. In both cases we were able to reject the null hypotheses that the number of applications and experience with city applications did not predict the likelihood of participants being “likely to engage .” Each variable was moderately significant at the .05 level. Specifically, for each one-unit increase (on an interval scale) in the number of City of Boston applications they had installed on their phone, respondents were 1.40 times more likely to engage with future applications holding all other variables constant. In addition, for each one-unit increase (on a 0-5 scale) in their experience with City of Boston applications, respondents were 1.66 times more likely to engage with future applications holding all other variables constant.

Lastly, one control variable was significant that of whether the respondent indicated they were a past contributor to City of Boston applications. In this was case I was able to reject the null hypothesis that being a past contributor to an application did not predict the likelihood of a participant being “likely to engage” with future applications. The variable was highly significant at the .01 level. As participants move from non-contributor to contributor in the variable category, they are 8.46 times more likely to engage with future applications holding all other variables constant.

5.6c Tests of Model Fit and Logistic Regression Results for Public Value Model

The predictor variables included in the model below are: Importance, Choice, Fairness, Cost Savings, Take Up, Intermediate, End, Security, Transparency, Participation, Efficiency, Accountability, and Perceptions.

Table 5e: Logistic Regression Results for Public Value Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
Importance	.018	.010	3.07*	1	.080*	1.01	-.002	.039
Choice	.022	.010	4.74**	1	.029**	1.02	.002	.042
Fairness	.000	.010	.00	1	.980	1.00	-.019	.019
Cost Savings	.008	.008	.79	1	.373	1.01	-.010	.023
Take Up	.040	.011	13.92***	1	.000***	1.04	.020	.063
Intermediate	-.004	.010	.15	1	.700	.996	-.025	.016
End	-.011	.010	1.26	1	.262	.989	-.031	.008
Security	.002	.009	.07	1	.787	1.00	-.015	.020
Transparency	-.007	.011	.32	1	.572	.993	-.029	.016
Participation	.022	.010	5.40**	1	.020**	1.02	.004	.041
Efficiency	.011	.010	1.23	1	.267	1.01	-.008	.030
Accountability	-.006	.011	.30	1	.585	.994	-.027	.016
Perceptions	-.002	.010	.03	1	.861	.998	-.020	.185

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 112.64 and 13 degrees of freedom, which was statistically significant at the .000 level, using a threshold of $p>.05$. This allows me to reject the null hypothesis that the model is not a good fit implying that all the coefficients of the predictors in the model have found to be non-zero.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. As there are not categorical variables in this model Wald tests were not performed in removing these variables.

The model did not meet the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 17.87 and probability of .0222, it was significant at the $P>.05$ level. This did not allow me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating that this was a poor model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 19% (McFadden), 23% (Cox & Snell), or 36% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 94.03% and a specificity of 27.78%, meaning that those who were classified as “likely to engage” were done so with 94% accuracy and those

“unlikely to engage” were classified with 28% accuracy. Overall, the model suggests that 80.00% of values are correctly classified. However, if I predict that all respondents are not likely to engage, we would classify 55.56% correctly. Then our Adj % correct = (80.00% - 55.56%) / (100 - 55.56%) =55.00%. This suggests the model performs at 55% of the 100% level of predictive accuracy, which is very good.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is the case with largely incremental change occurring, which indicates good fit.

Examination of the LROC curve as shown in Appendix VII also shows very good model fit by a large “bowed” representation and large area under the curve, with the curve lying far from the 45-degree line. Specifically, the area under the curve is .8442, a very large value showing a very good fit for the model in predicting outcomes. In comparison to the curve of the full model it is very close to the original area under the curve of .8752.

The above tests lead to the conclusion that the model has a very good fit and is accurate in predicting the outcomes in the below logistic regression. The failure of the Hosmer-Lemeshow does not solely indicated poor fit as the test is sensitive to group specification.

The logistic regression model shows nearly the same relationships as the full model, but with significance increased among the significant variables in question. In these public

value-centric variables there are three variables that show statistically significant results at the 95% confidence interval: Choice, Take Up, and Participation. The variable End, which was significant in the full model was no longer significant. Changes occurred as Choice became significant at the .05 level (up from the .10 level). Take up remained highly significant at the .01 level, and participation significant at the .05 level.

5.6d Tests of Model Fit and Model of Demographics

The predictor variables included in the model below are: Female, Age, Asian, Black, Hispanic, Other Race, Urban, Suburban, Income, and Education.

Table 5f: Logistic Regression Results for Demographic Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
Female	-.302	.253	1.42	1	.233	.739	-.798	.194
Asian	-.251	.412	.37	1	.542	.777	-1.06	.556
Black	-.498	.475	1.10	1	.294	.607	-1.43	.432
Hispanic	.366	.565	.516	1	.516	1.44	-.740	1.47
Other Race	-.406	.7001	.34	1	.562	.666	-1.78	.967
Urban	.357	.431	.69	1	.406	1.43	-.486	1.20
Suburban	.358	.438	.67	1	.413	1.44	-.500	1.21
Income	-.009	.072	.01	1	.905	.991	-.150	.133
Education	-.098	.641	.31	1	.579	.907	-.443	.248

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 4.55 and 9 degrees of freedom, which was not statistically significant at the .05 level, using a threshold of $p>.05$. This did not allow me to reject the null hypothesis that the model was not a good fit and imply that all the coefficients of the predictors in the model have found to be non-zero. Therefore, the model represented a poor fit.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were also performed by removing all categorical variables, which returned a chi-square of 4.04 and probability of .77 allowing me to reject the null hypothesis that that the coefficients of interest are equal to zero. Therefore, removing categorical variables from the model does not substantially harm it.

The model met the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 9.42 and probability of .3082, it was not significant at the $P>.05$ level. This did allow me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating that this was a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 1% (McFadden), 1% (Cox & Snell), or 2% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 100% and a specificity of 0%, meaning that those who were classified as “likely to engage” were done so with 100% accuracy and those “unlikely to engage” were classified with 0% accuracy. Overall, the model suggests that 78.82% of values are correctly classified. The specificity of 0% indicates a poor model fit.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would significantly increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is not the case with a steep drop in these levels occurring with slight changes in the threshold, which indicates poor fit.

Examination of the LROC curve as shown in Appendix VII also shows very poor model fit by showing a trend close to the 45-degree line with a small area under the curve and little bow to that curve. Specifically, the area under the curve is .5642, a small value showing a very poor fit for the model in predicting outcomes. In comparison to the curve of the full model it is very far from the original area under the curve of .8752.

The above tests lead to the conclusion that the model has a very poor fit and is not accurate in predicting the outcomes in the below logistic regression. The success of the Hosmer-Lemeshow does not solely indicate a good fit as the test is sensitive to group specification. The logistic regression model shows no new significance among the demographic variables, and no variables were significant in the original model.

5.6g Tests of Model Fit and Model of City of Boston Precursor Variables

The predictor variables included in the model below are: Boston Apps Number, Boston Apps Frequency, Boston Apps Experience, Contributor, and Two-Way Communication.

Table 5g: Logistic Regression Results for Boston Experience Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio		Lower (95% CI)	Upper (95% CI)
Boston Apps Number	.259	.140	3.45*	1	.063*	1.30		-.014	.533
Boston Apps Frequency	.214	.259	.68	1	.408	1.24		-.293	.722
Boston Apps Experience	.943	.168	31.70***	1	.000***	2.57		.615	1.27
Contributor	2.12	.617	11.75***	1	.001***	8.29		.906	3.33
Two-Way Communication	.003	.007	.16	1	.691	1.00		-.011	.016

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 88.65 and 5 degrees of freedom, which was statistically significant at the .000 level, using a threshold of $p>.05$. This allows me to reject the null hypothesis that the

model is not a good fit implying that all the coefficients of the predictors in the model have found to be non-zero.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were also performed by removing all categorical variables, which returned a chi-square of 11.75 and probability of .000 which did not allow me to reject the null hypothesis that that the coefficients of interest are equal to zero. Removing specifically Contributor from the model does substantially harm it.

The model did meet the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 3.84 and probability of .8714, it was not significant at the $P>.05$ level. This allowed me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating that this was a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 18% (McFadden), 19% (Cox & Snell), or 29% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 95.82% and a specificity of 22.22%, meaning that those who were classified as “likely to engage” were done so with 96% accuracy and those “unlikely to engage” were classified with 22% accuracy. Overall, the model suggests that 80.24% of values are correctly classified. However, if I predict that all respondents are not

likely to engage, we would classify 58.82% correctly. Then our Adj % correct = (80.24% - 58.82%) / (100 - 58.82%) = 52.02%. This suggests the model performs at 52% of the 100% level of predictive accuracy, which is very good.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is the case with largely incremental change occurring, which indicates good fit.

Examination of the LROC curve as shown in Appendix VII also shows very good model fit by a large "bowed" representation and large area under the curve, with the curve lying far from the 45-degree line. Specifically, the area under the curve is .7957, a very large value showing a very good fit for the model in predicting outcomes. In comparison to the curve of the full model it is very close to the original area under the curve of .8752.

The above tests lead to the conclusion that the model has a very good fit and is accurate in predicting the outcomes in the below logistic regression. The failure of the Wald test alone for Contributor does not solely suggest poor fit, just that the variable is highly influential.

The logistic regression model shows nearly the same relationships as the full model, but with significance increased among the significant variables in question. In these Boston-centric variables there are three variables that show statistically significant results at the 95% confidence interval: Boston Apps Number, Boston Apps Experience, and Contributor. The

variable Boston Apps Number, which was significant in the full model at the .05 level dropped in significance to the .10 level. Specifically, for each one-unit increase (0-11 scale) in Boston Apps Number respondents were 1.30 times more likely to engage with future applications holding all other variables constant. Boston Apps Experience went from being significant at the .05 level to being highly significant at the.01 level. Specifically, for each one-unit increase (0-5 scale) in Boston Apps Experience, respondents were 2.57 times more likely to engage with future applications holding all other variables constant. Contributor remained highly significant at the.01 level. Specifically, as people moved from being Non-Contributors to Contributors, respondents were 8.29 times more likely to engage with future applications holding all other variables constant.

5.6f Tests of Model Fit and Model of Technology Comfort Variables

The predictor variables included in the model below are: All Apps Number, All Apps Frequency, All Apps Experience, Technology Comfort, Apple, and Samsung.

Table 5h: Logistic Regression Results for Technology Comfort Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
All Apps Number	.121	.094	1.65	1	.200	1.13	-.064	.306
All Apps Frequency	-.012	.108	.01	1	.908	.988	-.223	.198
All Apps Experience	.326	.172	3.61*	1	.058*	1.39	-.010	.663
Technology Comfort	-.127	.205	.39	1	.534	.880	-.529	.273
Apple	-.367	.337	1.19	1	.276	.692	-1.03	.294
Samsung	-.353	.384	.84	1	.358	.703	-1.09	.400

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 7.47 and 6 degrees of freedom, which was not statistically significant at the .05 level, using a threshold of p>.05. This did not allow me to reject the null hypothesis that the model was not a good fit and imply that all the coefficients of the predictors in the model have found to be non-zero. Therefore, the model represented a poor fit.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were

also performed by removing all categorical variables, which returned a chi-square of 1.25 and probability of .54 allowing me to reject the null hypothesis that that the coefficients of interest are equal to zero. Therefore, removing categorical variables from the model does not substantially harm it.

The model met the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 13.20 and probability of .1051, it was not significant at the P>.05 level. This allowed me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of p>.05, indicating that this was a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 2% (McFadden), 2% (Cox & Snell), or 3% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 100% and a specificity of 0%, meaning that those who were classified as "likely to engage" were done so with 100% accuracy and those "unlikely to engage" were classified with 0% accuracy. Overall, the model suggests that 78.82% of values are correctly classified. The specificity of 0% indicates a poor model fit.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would significantly increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this

model that is not the case with a steep drop in these levels occurring with slight changes in the threshold, which indicates poor fit.

Examination of the LROC curve as shown in Appendix VII, also shows very poor model fit by showing a trend close to the 45-degree line with a small area under the curve and little bow to that curve. Specifically, the area under the curve is .5709, a small value showing a very poor fit for the model in predicting outcomes. In comparison to the curve of the full model it is very far from the original area under the curve of .8752.

The above tests lead to the conclusion that the model has a very poor fit and is not accurate in predicting the outcomes in the below logistic regression. The success of the Hosmer-Lemeshow does not solely indicate a good fit as the test is sensitive to group specification.

The logistic regression model shows new significance among only one variable All Apps Experience, which was insignificant in the primary model but is now significant at the .10 level. Specifically, for each one-unit increase (0-5 scale) in All Apps Experience, respondents were 1.39 times more likely to engage with future applications holding all other variables constant.

5.6g Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) Indicators of Model Fit

Bayesian information criterion (BIC) and Akaike information criterion (AIC) indicators test the goodness of fit of alternative models. Following the examination of each of these models, it is relevant to examine their fit in relation to the primary model using these tests. Given information on two models fitted on the same data and with equal number of

cases, the smallest value of the two scores is considered the best fit. In the case of the previous models specified, the public value model has the lowest score among the four models indicating its indicators fit the model best. This claim is supported in the prior section as suggested by the tests of model fit based on the likelihood function and based on predicted probabilities and observed outcomes. Further, following that the Boston Experience Model represents the next best fit among the AIC and BIC criterion.

Table 5i: Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) Indicators Results Table

Model Name	AIC	BIC
Public Value Model	**354.20**	410.93
Demographic Model	454.30	494.82
Boston Experience Model	**362.19**	**386.50**
Technology Comfort Model	445.36	473.73

*Note here smaller values of AIC and BIC indicate a better model fit

5.6h Final Model of the Smart City Model

The predictor variables included in the model below are: Importance, Choice, Fairness, Cost Savings, Take Up, Intermediate, End, Security, Transparency, Participation, Efficiency, Accountability, Perceptions, Boston Apps Number, Boston Apps Frequency, Boston Apps Experience, Contributor, and Two-Way Communication.

Table 5j: Logistic Regression Results for Smart City Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
Importance	.015	.011	1.89	1	.169	1.02	-.006	.037
Choice	.020	.011	3.45*	1	.063*	1.02	-.001	.041
Fairness	.003	.010	.06	1	.802	1.00	-.018	.023
Cost Savings	.007	.009	.56	1	.453	1.01	-.011	.024
Take Up	.036	.012	9.19***	1	.002***	1.04	-013	.059
Intermediate	-.004	.011	.12	1	.724	.996	-.023	.018
End	-.016	.010	2.19	1	.139	.984	-.034	.005
Security	.001	.010	.01	1	.917	1.00	-.018	.020
Transparency	-.005	.012	.19	1	.659	.995	-.023	.019
Participation	.019	.010	3.46*	1	.063*	1.02	-.001	.039
Efficiency	.011	.010	1.11	1	.292	1.01	-.009	.030
Accountability	-.005	.012	.21	1	.649	.995	-.028	.018
Perceptions	-.001	.011	.02	1	.892	.999	-.022	.019
Boston Apps Number	.290	.155	3.51*	1	.061*	1.34	-.013	.594
Boston Apps Frequency	-.152	.292	.27	1	.603	.859	-.725	.421
Boston Apps Experience	.518	.195	7.05***	1	.008***	1.68	.136	.901
Contributor	2.10	.689	9.24***	1	.002***	8.13	.744	3.45
Two-Way Communication	-.007	.008	.66	1	.418	.993	-.023	.009

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 142.43 and 18 degrees of freedom, which was statistically significant at the .000 level, using a threshold of $p>.05$. This allows me to reject the null hypothesis that the model is not a good fit implying that all the coefficients of the predictors in the model have found to be non-zero. The fit of the model is therefore good according to this test.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were also performed by removing categorical variable of Contributor, which returned a chi-square of 9.24 and probability of .002 allowing me to not reject the null hypothesis that that the coefficients of interest are equal to zero. Removing Contributor from the model did substantially harm it, but this is likely due to it being a highly significant variable.

The model also met the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 13.54 and probability of .0945. This allowed me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 33% (McFadden), 29% (Cox & Snell), or 44% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 95.22% and a specificity of 45.56%, meaning that those who were classified as “likely to engage” were done so with 95% accuracy and those “unlikely to engage” were classified with 46% accuracy. Overall, the model suggests that 84.71% of values are correctly classified. However, if I predict that all respondents are not likely to engage, we would classify 71.93% correctly. Then our Adj % correct = (84.71% - 71.93%) / (100 - 71.93%) =45.53%. This suggests the model performs at 46% of the 100% level of predictive accuracy, which is very good.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is the case with largely incremental change occurring, which indicates good fit.

Examination of the LROC curve as shown in Appendix VII also shows very good model fit by a large “bowed” representation and large area under the curve, with the curve lying far from the 45-degree line. Specifically, the area under the curve is .8715, a very large value showing a very good fit for the model in predicting outcomes. In comparison to the curve of the full model it is very far from the original area under the curve of .8752, which is a very close approximation indicating variable specification is close to ideal.

The above tests lead to the conclusion that the model has a very good fit and is accurate in predicting the outcomes in the below logistic regression.

The logistic regression model shows several things in relationship to the hypotheses forwarded earlier in this chapter and matches the first full model in its significant variables with the exclusion of the End variable. Examining, public value-centric variables, there are three variables that show statistically significant results at the 95% confidence interval: Choice, Take Up, and Participation. The null hypothesis that Choice, as represented by the ease in which respondents could access a City of Boston application, did not predict the likelihood of participants being “likely to engage” was rejected. The variable was significant at the .10 level. Specifically, for each one-unit increase (from a 0-100 scale) in Choice, respondents were 1.02 times more likely to engage with future applications holding all other variables constant.

Further, the null hypothesis that Take Up, as represented by the willingness to take up and utilize the City of Boston application, did not predict the likelihood of participants being “likely to engage” was rejected. The variable was highly significant at the .01 level. Specifically, for each one-unit increase (from a 0-100 scale) in Take Up, respondents were 1.04 times more likely to engage with future applications holding all other variables constant.

Lastly Participation was a statistically significant variable in the model. The null hypothesis that Participation, as represented by a perception that prior applications have taken the respondents opinions into account, did not predict the likelihood of participants being “likely to engage” was rejected. The variable was slightly significant at the .10 level. Specifically, for each one-unit increase (from a 0-100 scale) in Participation, respondents were 1.02 times more likely to engage with future applications holding all other variables constant.

Among demographic variables, two were significant: The number of City of Boston applications the participant had, and their experience with those city applications. In both cases we were able to reject the null hypotheses that the number of applications and experience with city applications did not predict the likelihood of participants being "likely to engage ." The variable Boston Apps Number was significant at the .10 level, while the variable Boston Apps Experience was highly significant at the .01 level. Specifically, for each one-unit increase (on an interval scale) in the number of City of Boston applications they had installed on their phone, respondents were 1.34 times more likely to engage with future applications holding all other variables constant. In addition, for each one-unit increase (on a 0-5 scale) in their experience with City of Boston applications, respondents were 1.68 times more likely to engage with future applications holding all other variables constant.

Lastly, one control variable was significant that of whether the respondent indicated they were a past contributor to City of Boston applications. In this was case I was able to reject the null hypothesis that being a past contributor to an application did not predict the likelihood of a participant being "likely to engage" with future applications. The variable was highly significant at the .01 level. As participants move from non-contributor to contributor in the variable category, they are 8.13 times more likely to engage with future applications holding all other variables constant.

5.6i Authorizing Chain Model

One final model was developed based on the variables derived from the qualitative interview findings. This model considers the predominant notions that arose from the

analysis in Chapter 4 to derive an Authorizing Chain model to juxtapose next to the Smart City model developed in this chapter.

The predictor variables included in the model below are: Take Up, Participation, Efficiency, Accountability, Boston Apps Number, Boston Apps Frequency, Boston Apps Experience, Contributor, and Two-Way Communication.

Table 5k: Logistic Regression Results for Authorizing Chain Model

Variable	B	SE	Wald X2	df	Sig.	Odds Ratio	Lower (95% CI)	Upper (95% CI)
Take Up	.044	.010	18.39***	1	.000***	1.04	.023	.064
Participation	.016	.009	3.50*	1	.061*	1.01	-.000	.033
Efficiency	.010	.008	1.55	1	.213	1.01	-.006	.026
Accountability	-.004	.009	.26	1	.608	.995	-.023	.013
Boston Apps Number	.256	.148	3.01*	1	.083*	1.29	-.033	.545
Boston Apps Frequency	-.025	.279	.01	1	.926	.874	-.573	.521
Boston Apps Experience	.616	.186	10.95***	1	.001***	1.85	.251	.981
Contributor	1.93	.674	8.17***	1	.004***	6.85	.605	3.25
Two-Way Communication	.010	.008	.59	1	.442	.994	-.021	.009

N=426

*Indicated significance at the .10 level

**Indicated significance at the .05 level

***Indicated significance at the .01 level

The following tests based on the likelihood function were performed according to the suggestions of Hosmer and Lemeshow (2000). The Omnibus Test of Model Coefficients had a Chi-square of 131.29 and 9 degrees of freedom, which was statistically significant at the .05 level, using a threshold of $p>.05$. This allows me to reject the null hypothesis that the model is not a good fit implying that all the coefficients of the predictors in the model have found to be non-zero. The fit of the model is therefore good according to this test.

The various Wald tests of variables shows results in line with the logistic findings and insignificant variables when removed from the model do not substantially harm it, allowing us to reject the null hypothesis that coefficients of interest are equal to zero. Wald tests were also performed by removing the categorical variable Contributor, which returned a chi-square of 8.17 and probability of .004 allowing me to not reject the null hypothesis that that the coefficients of interest are equal to zero. Removing Contributor from the model did substantially harm it, but this is likely due to it being a highly significant variable.

The model also met the Hosmer-Lemeshow test of goodness of fit with eight degree of freedom broken down into deciles with a chi-square value of 11.17 and probability of .1924. This allowed me to reject the null hypothesis that the observed and expected proportions are the same across groupings using a threshold of $p>.05$, indicating a good model fit.

According to the numerous R2 tests utilized adding the covariate factors in the model increased the log-likelihood function by 30% (McFadden), 27% (Cox & Snell), or 41% (Cragg-Uhler/Nagelkerke) from its base value with only a single constant.

Similar tests of fit were also performed based on predicted probabilities and observed outcomes. The model had a sensitivity of 95.82% and a specificity of 41.11%, meaning that those who were classified as "likely to engage" were done so with 956% accuracy and those "unlikely to engage" were classified with 41% accuracy. Overall, the model suggests that 84.24% of values are correctly classified. However, if I predict that all respondents are not likely to engage, we would classify 72.55% correctly. Then our Adj % correct = (84.24% - 72.55%) / (100 - 72.55%) =42.59%. This suggests the model performs at 43% of the 100% level of predictive accuracy, which is very good.

A visual examination of the cutoff point using the LSENS as shown in Appendix VII shows this visual representation according to the .5 cutoff level. Lowering the cutoff point would increase sensitivity but lower specificity, with the reverse being true for raising the cutoff point. A model has good fit is small changes in these thresholds do not produce large changes in either specificity or sensitivity depending on the direction. In this model that is the case with largely incremental change occurring, which indicates good fit.

Examination of the LROC curve as shown in Appendix VII also shows very good model fit by a large "bowed" representation and large area under the curve, with the curve lying far from the 45-degree line. Specifically, the area under the curve is .8529, a very large value showing a very good fit for the model in predicting outcomes. In comparison to the curve of the full model it is not very far from the original area under the curve of .8752, which is a very close approximation indicating variable specification is close to ideal.

The above tests lead to the conclusion that the model has a very good fit and is accurate in predicting the outcomes in the below logistic regression.

The logistic regression model shows several things in relationship to the hypotheses forwarded earlier in this chapter and matches the Smart City Model entirely in its significant variables, though it excludes Choice, which that model contained. Examining, first, public value-centric variables there are two variables that show statistically significant results at the 95% confidence interval: Take Up and Participation.

The null hypothesis that Take Up, as represented by the willingness to take up and utilize the City of Boston application, did not predict the likelihood of participants being "likely to engage" was rejected. The variable was highly significant at the .01 level. Specifically, for each one-unit increase (from a 0-100 scale) in Take Up, respondents were 1.04 times more likely to engage with future applications holding all other variables constant.

Lastly Participation was a statistically significant variable in the model. The null hypothesis that Participation, as represented by a perception that prior applications have taken the respondents opinions into account, did not predict the likelihood of participants being "likely to engage" was rejected. The variable was slightly significant at the .10 level. Specifically, for each one-unit increase (from a 0-100 scale) in Participation, respondents were 1.01 times more likely to engage with future applications holding all other variables constant.

Among demographic variables, two were significant: The number of City of Boston applications the participant had, and their experience with those city applications. In both cases we were able to reject the null hypotheses that the number of applications and experience with city applications did not predict the likelihood of participants being "likely to engage." The variable Boston Apps Number was significant at the .10 level, while the

variable Boston Apps Experience was highly significant at the .01 level. Specifically, for each one-unit increase (on an interval scale) in the number of City of Boston applications they had installed on their phone, respondents were 1.29 times more likely to engage with future applications holding all other variables constant. In addition, for each one-unit increase (on a 0-5 scale) in their experience with City of Boston applications, respondents were 1.85 times more likely to engage with future applications holding all other variables constant.

Lastly, one control variable was significant that of whether the respondent indicated they were a past contributor to City of Boston applications. In this was case I was able to reject the null hypothesis that being a past contributor to an application did not predict the likelihood of a participant being "likely to engage" with future applications. The variable was highly significant at the .01 level. As participants move from non-contributor to contributor in the variable category, they are 6.85 times more likely to engage with future applications holding all other variables constant.

5.7 Discussion

The discussion in this chapter is of the quantitative portion of this study primarily. As this is a mixed-methods study, it also discusses its conclusions considering the qualitative findings discussed further in Chapter 4. Chapter 6 as well will have a discussion of the findings considering the two research questions of the study along with the primary research question.

Among the 34 variables specified in the full model, 7 were significant, while in the Smart City model of 18 variables, 6 were significant. Further, in the Authorizing Chain model 9 variables were specified with 5 being significant. Each of these models was robust

according to its fit. Further, variables did not lose significance between models indicating proper specification.

5.7a Summary of Results

Take Up is the only variable in the model of public value-centric variables that is highly significant, and it represents the willingness of the participant to use the channel based on their experience with the application considering other available channels. Thus, Take Up largely represents the user experience associated with the application and that applications performance next to more traditional channels. Mainka et al. (2015) echo this sentiment as usefulness and usability become critical concerns in ensuring the application remain downloaded on the user's phone. Chen et al. (2016) also echo that usability against other similar services and timeliness of the service become critical components of user adoption of the technology (Bélanger et al., 2005; Hung et al., 2013; Hung et al., 2006). In this sense the user's experience with these applications may be shaped initially by good or bad initial usage experiences. These findings suggest that users may turn away from or embrace applications based on this initial exposure.

Much like Take Up, Boston Apps experience reflects the prior experience of the user with all City of Boston applications. The variable is highly significant in suggesting future behavior and likelihood to engage with future applications and therefore it becomes a key contributor in ownership associated with the city's applications. The idea that a user's experience with the City's applications affects their use of future applications is well founded, but interestingly their experience with all applications is not found to be significant. This echoes the sentiment of Gutiérrez et al. (2013) when they describe the smart city

experience as creating a city-centric experience for the end user. Other's echo capturing such experience early on and enhancing that experience using information technology (Mellouli et al., 2013; Gil-García et al., 2014; Lee & Lee, 2014). This suggests it is not necessarily mistrust of the technology or an unwillingness to utilize the medium (Bélanger et al., 2005), but instead building ownership is associated with the City's capabilities in delivering applications that are associated with positive overall experiences for the users. Negative experiences then could significantly hamper future efforts to build engagement and ownership among applications and lead to less uptake of the technology (Bélanger et al., 2005; Hung et al., 2013; Hung et al., 2006).

Contributor as well is highly significant and as respondents move from a category of non-contributor to contributor, the likelihood that they will engage with future applications significantly increases. This suggests that if cities can initially move respondents toward being contributors, they build their initial investment with the city's applications. As Boston apps experience and Take up measure experience with prior applications, this variable examines something different which is that initial movement of the respondent to a category where they are actively contributing with the City's applications or have done so in the past. Tan et al. (2005) show that this sense of self-actualization as a contributor may encourage participation with the mobile application in question. A survey by Mueller-Lankenau and Wehmeyer (2005) expanded on this notion as well. Further, Alonso (2009) shows that familiarity and experience with the process continues with the user through their lifecycle, and Linders (2012) shows how this sense of co-contribution through: citizen-sourcing, government as a platform, and do-it-yourself government creates feedback loops for co-

production. In building ownership, this variable is highly important as it seems to suggest that making this initial movement results in a near 8-fold increase in their likeliness to contribute. This suggests that though incremental changes and initial development is important in building ownership over time, the primary goal may be to move citizens toward a contributor status to ensure ownership in the City's applications over time.

Among the less significant variables, Choice was another public value-centric variable that lead to respondents having greater ownership as incremental changes in the variable occurred. This variable related directly to the ease in accessing the service through the mobile medium versus other channels. Hellström (2010) notes how this variable can be highly influential in increasing usage of smartphone services. Such a variable being significant is little surprise as one of the main reasons why users download applications is so that they have a simple and easy to use mechanism to access some service, and one that proceeds on a convenient device for them. A lack of ease in access may suggest that users become disgruntled with the applications and their likelihood to contribute with future applications is diminished considering this experience. Chen et al. (2016) suggest as much in a similar study of users in China, where usability became a key proponent in the take up of smartphone technology. This suggests that City's should work primarily to improve the ease of use in an application by avoiding complexity and slowdowns associated with using the service.

Participation was the last public value variable that was slightly significant. The variable related to the construct that the application allowed users to participate for better governance through the service. Ownership development then through the participation

mechanism on the application may be of importance as user's feel their voice is being heard regarding the government service in question. This finding directly showcases the findings of de Zúñiga et al. (2013) and Lee et al. (2014) who show how self-efficacy regarding participation and influencing policymaking easily and accessible is of importance to smartphone users. Christin et al. (2013) also show in their study user's willingness to participate and provide information in a co-productive sense. The city then may wish to work toward increasing participatory measures throughout the application in developing ownership among these applications.

Lastly, the raw number of City of Boston mobile applications may be of some importance in developing ownership for application users within the City. Interestingly, this may suggest that as the initial ownership is built in the applications it becomes important for users to accept the application to the extent it remains on their phone and that feedback and use of these installed applications may be of importance in developing future ownership. Mainka et al. (2015) show that downloads based on the usefulness of the application to citizens was the primary driving force for the application to remain downloaded. Further, simplicity and many different types of features were in fact not among the most downloaded, but rather those apps that cover one thing entirely. Fortunati and Taipale (2014) also show that oversupply of applications can be detrimental to overall city-wide application success. Likely, then the goal should be to increase key variables to the point where the applications stay installed on the user's phone and are deemed useful and effective when developed.

What is interesting is that, in the Authorizing Chain model, all these variables still had significance except for Choice, which was not included in the model. There is significant

overlap, then, in what the interviewees note and the best specific model, the smart city model. Interviewees did not seem to indicate choice in platform used as a key tenet by which they designed their mobile applications. Choice related directly to the ease in accessing the service through the mobile medium versus other channels. Therefore, as managers seek to implement public value-centric initiatives and garner future use and thus ownership, there attention to the convenience the application brings to users in a comparative lens to other mediums may be of more concern. Though this notion was mentioned slightly, it was not a primary driver of City of Boston developers in their efforts.

5.7b Conclusions

Speculating on these results, it is interesting how conclusions derived from Moore's (1995) model and based on Karunasena and Deng's (2012) input variables are not highly significant in predicting ownership as defined by (de Lange & de Waal, 2013). Interestingly, it is the experience with the applications that seems to be driving the primary notions of ownership as defined by the likelihood to engage with future initiatives. Of note is also the fact that opportunities to participate in governance processes and ease of use and access also become key driving factors with sustained application installations and downloads being somewhat likely as well to lead to future likelihood for engagement.

In building co-productive capabilities (Linders, 2012) ensuring that citizens initially become active contributors, in the scope of this study, will lend to future likelihood to contribute with later developed applications. The strategy overall then in building public value may be to focus initially on developing applications that are user friendly and garner a good user experience with simplicity and time saving in mind, while also ensuring that

citizens keep such applications installed on their phone and are continuously probed to engage with the application and remain in the “contributor” state. Other public value inputs, then, may be less important in developing early stages of ownership, and that subsequent efforts at ensuring these inputs are in place should follow a strategy as set forth above. Further, it may be the case that these variables are simply not known to users. The benefit among certain demographics may not be so significantly felt as user’s utilize mobile applications for the city, and the perception may be that the mobile application is beneficial or not beneficial regardless of gender, race, and region. While these variables were controlled for along with others, the primary take away both from the qualitative and quantitative findings is that users value ease of use of the application and are heavily impacted by their prior experience with other City applications, with those who had been prior contributors indicating they were more likely to continue to utilize and derive value from applications.

The results of the Smart City model, then, are mirrored in the efforts of City of Boston application developers as they shape their strategies to build successful mobile applications that generate public value. One difference between the Authorizing Chain and Value Chain (Smart City Model) was the notion of Choice affecting the user’s future uptake. User’s seemingly value the power the mobile application brings compared to other mediums of interaction, and the campaign of developers may wish to be shaped according to this input variable more as they seek to build effective applications. Therefore, incorporating and focusing on the variables specified and significant in the Smart City model primarily may be an effective strategy, while ensuring that control variables are integrated and accounted for but not the primary drivers behind the campaign.

5.7c Limitations

The study came with several limitations regarding examining its central research question through logistic regression. The first major limitation of the study is that it utilized a convenience sample and its nonrandom nature made its results less generalizable the population of the Greater City of Boston area then if a random sample had been conducted. This impacted the studies external validity or generalizability.

In addition, the study had large variation among demographic control groups, specifically education, income, and age. Most of those who took the survey were lower- and middle-class individuals, who were middle aged, and had at least a bachelor's level education. Thus, generalizability to other groups outside of this population was lacking. Weighting this data, however, was not conducted as the sample was non-random and as inflation factors of such weight can skew data significantly. However, the sample did have very close representation according to the Greater Boston areas racial and gender breakups. In this sense, the findings of the study and their relatable to the general population should be examined with caution as there may be underrepresentation of certain proportions of the population. The use of a well-established set of controls, however, as examined in the literature review and theoretical portion of this study did increase generalizability somewhat, and construct validity.

However, this specification of a convenience sample is needed when resources are lacking such as having a more formal lists of the population in question. In this case the number and users of mobile applications was not known due to the strict privacy and trust components associated with the city's application efforts. Therefore, a random sample was

largely not possible. Further, the population of downloads 100,000 out 4.73 million in the greater Boston area likely would have required significant resources to undertake the study and would not have been possible.

The nature of self-reported data could also have impacted the results of the study and thus the internal validity of this study may have been impacted using surveys over methods with high internal validity such as experiments (Gerber & Green, 2012). Some data as well needed to be deleted due to incomplete responses, however, the sample size was adequate for the final model and represented a confidence interval of 95% with a confidence level of 5%. As logistic correlation does not seek causation, the use of surveys was adequate in addressing the research question asked.

One other note about this method is that it is coupled in the next chapter with qualitative techniques that expand upon its findings and managerial decisions were also based on similar techniques and experimental techniques that credit the studies external and internal validity.

5.7d Recommendations for Future Research

This study can be considered an overview of the research question and an initial look at how public value component development can lead to ownership in the smart city tool of mobile applications. It is unique in this sense but suffers from a lack of resources and a need to increase generalizability and internal validity. Further, as this represented only a single case study, the study should be expanded to include other smart cities to examine Moore's (1995) model according to Karunasena and Deng's (2012) input variables according to the output of Ownership (de Lange & de Waal, 2013).

Future research should focus on these variables in the context of other smart cities with similar application development initiatives and approaches. A multiple case study analysis, with a randomized sample, would greatly increase the generalizability of the results and lend more predictive capability to the initial analysis conducted. Further, researchers may wish to increase internal validity by examining, through experimental design, how variation of certain components of public value inputs may increase or decrease ownership or likelihood to contribute within these cities via an experimental and a control group.

CHAPTER 6: MIXED-METHODS FINDINGS,
POLICY RECOMMENDATIONS, AND CONCLUSIONS

6.1 Chapter Overview

This chapter concludes the mixed-methods study and recalls the connections between the literature review conducted, the theoretical components of the study, and the studies mixed-methods findings. Further, it discusses the limitations of the study, the studies contributions, and proposes policy recommendations for City mobile application developers as they seek to explore mobile application development that proceeds in order to generate public value. The chapter is divided into six sections. The first section reiterates the research questions. The next section discusses the mixed-methods conclusions of chapters 4 and 5 and how they have attempted to address the primary research questions posed in addition to the central research question. Following that the contributions of the study to the overall breadth of the literature and theory are discussed. Subsequently, policy recommendations and suggestions for mobile application developers, given the findings, as they seek to develop their own mobile application efforts are discussed. Next, suggestions for future recommendations and future research for the study are discussed. The last section briefly concludes the study by examining the elements and findings of the study as they relate to the greater scope of the literature on e-government, m-government, and smart city citizen-centric initiatives.

6.2 Research Questions

To reiterate, the central research question of this study was derived from public value theory (Moore, 1995) and reads as follows.

Central Research Question: Does the development of smartphone mobile application technology that proceeds according to Moore's public value management chain lead to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services?

Chapter 4's discussion section attempted to address the first of the subordinate research questions of the study through interviews with City of Boston mobile application developers. The findings and discussion have examined this in accordance with the research question below:

Primary Research Question #1: How are smart city managers, in the form of mobile application architects and developers, working to create an authorizing environment that generates public value, builds ownership in applications, and facilitates co-production and citizen engagement?

Chapter 5's discussion section attempted to address the second of the subordinate research questions of the study through a survey to a sample of City of Boston mobile application users. The findings and discussion have examined this in accordance with the research question below:

Primary Research Question #2: How does the development of smart city mobile applications that reflect public value outcomes affect user's sense of ownership, their

engagement with the application, and the value associated with the applications measured by their willingness to engage with future city applications?

6.3 Discussion of the Mixed-Methods Findings Considering the Research Questions

This section will now turn to a discussion of the main conclusions of the study given the mixed-methods approach in addressing the central research question of the study. Regarding the ownership development and from it the willingness of the user to engage with the application and future applications, the findings were telling. In examining both the interview and survey findings there were clear themes that emerge for developers that lead to unique conclusions considering the two methodologies. Specifically, the themes derived from the interviews are examined considering the findings of the survey analysis. Specifically, 4 areas of discussion are examined in the sections below: a) Overall Boston Application Experience, b) Prior Contribution of the User and Building a User Base, c) Usable and Useful Applications, and d) Citizen Participation and Co-Production Capabilities.

6.3a Overall Boston Application Experience

First, the experience with applications in both the interviews and surveys became a predominant determinant of a user's willingness to contribute to future applications and in ownership development. Specifically, the interviews noted how the in-house expertise around developing the application needed to be significant to ensure the applications success. Further, the awareness campaigns that advertised the application, and most importantly the need to constantly update the application to ensure usability, were of immense importance. Building user acceptance and usability in the application, through these methods, provided a means to garner utilization. Overall, building a positive user experience to the developers

relied on enhancing channels for user feedback in order to not compromise the applications functionality, but also to ensure the voice of those participating was heard. This voice was noted as being indicative of the needs of the user base. Feedback loops became indicative of the co-production efforts that were designed to enhance the user experience and encourage use of the application like notions forwarded by Linders (2012) and Christin et al. (2013).

Forward-thinking efforts, then, had user experience in mind during all stages of applications development. Successes were noted as those which kept focusing on user input and ensuring functionality, while failure was tied to lack of updates and inattention to user concerns. Further, success was mentioned according to downloads of the application as a first metric and usage as a second. Like Bozeman (2007) forwards, developers sought to align their agenda with the concerns of citizens and usage by and large among interviewees was the means to gauge success of an application. In addition, this usage needed to be sustained with users continuously utilizing the application over other channels for the service in question. Awareness campaigns, to interviewees, needed to garner initial buy in through downloads. Also, there also there needed to be sustained efforts to maintain buy in throughout the application's lifecycle.

This usage presented the metric most often used to measure success of the application, but the results of this echo the findings of the logistic regression as well. Experience and number of City Boston application downloads correlated to higher levels of ownership and likelihood to contribute with future applications developed by the city. The interviews shed light on how this experience manifested and echoed the notion that the smart

city should ensure that it paid attention to citizen experience through feedback mechanisms (Mellouli et al., 2013; Gil-García et al., 2014; Lee & Lee, 2014).

6.3b Prior Contribution of the User and Building a User Base

Next, tied to the notion of garnering experience was the notion of building user bases that moved the user into a category of “contributor”, whereby they actively participated with mobile applications in some way in the past. As mentioned above, co-productive measures were encouraged among successful applications and moving users from simply a user of the application to a “contributor” made them much more likely to engage and use future applications. This was mentioned in the interviews, but also in the logistic regression as being a past contributor had an immense and significant effect on ownership development and likelihood to contribute with future applications. Echoed in the interviews was this notion of building a user base that not only interacted with one application developed, but that were more likely to interact with other city applications based on prior experience. This was especially true for applications developed by governmental entities, who likely had more upcoming application ideas in mind.

Consistent utilization, then, throughout the lifecycle of the applications was noted as being important. However, tied to this notion was the idea that by fostering consistent utilization the user would be more likely to become a community member for other applications developed by the city, through trust development upon exposure to prior applications. In this sense, it was the e-participation channels that increased citizen trust and confidence in government services (Seifert & Peterson, 2002; OECD, 2003) as mentioned in the prior section, along with ensuring the application was useful and usable which is

mentioned in the subsequent section. The overall user experience then was of importance, and specifically noted was the idea of making the application useful and usable right away, as the next section mentions. Doing so, to interviewees, increased the user's first perception of the application gathering their interest. Next, attention to their feedback and consistent updates strengthened successful application, whereas lack of these things led to failure in other applications.

Building the user base was the goal of all developers as they sought success in their applications. While developers did work toward bettering the community, they relied on the user involving themselves with the application in question in order to influence the network they were involved in, like Paletti's (2016) notions of networked governance. The managers themselves however had the overarching societal goals in mind, with the user base acting as the facilitators of bringing about that goal. The strategy overall then echoed the findings of the survey's logistic regression in that moving the status of the user toward a "contributor" state had immense impact on value generation and likelihood to engage with future applications.

6.3c Usable and Useful Applications

Subsequently, highly significant and widely discussed was the notion of usability and usefulness in the mobile applications use and garnering usage based on this. Much like in the past two sections, usability provided the gateway means by which users could access the application. Therefore, when this component didn't function as intended, the use of the application broke down no matter it's goals or other features. Manifesting concurrently with ownership was the idea of making the application "useful", which was a predominant theme

in the interviews, which echoed the sentiment of Kelly et al. (2002) as they define ICTs purpose as designed by those utilizing it. Usefulness, then, for successful applications was noted as being developed with the developers desires in mind, but also with the viewpoints and opinions of users in mind regarding what they felt was useful.

Useful applications were noted as those that were most convenient, efficient, effect, personalized, cost-reducing, profitable, accountable, and transparent. Further, those instances where users felt a sense of investment with the application, where they felt their voices were being most heard were also deemed as useful. Managers noted that applications should ultimately provide time savings to the user, be flexible in use across devices, easy to use, have a good user interface, and have built in mechanisms to provide feedback. These components were critical, while also ensuring the application should be easy to use and provide the application in the simplest way possible and avoid complexity. This was tied to the notions of accessibility and availability forwarded by Axelsson et al. (2013). A predominant theme was the notion that the application would save them time, energy, and money which echoed the observations Kumar and Sinha (2007) has made. Value propositions then followed usefulness in the sense that those that garnered ownership were the applications deemed most useful. Public value and the idea of usefulness then became intrinsically linked on this idea for the sake of getting users to utilize and contribute with applications.

The quantitative survey findings supported this notion, as the variables of Choice and Take Up were correlated with ownership and the likelihood of a user to contribute with future applications. Specifically, users wanted opportunities to participate in governance

processes and, especially, ease of use and access to the applications. Take up was highly significant in the Smart City model and showcased the usefulness of the application over other channels. From this variable stems the notion that the use of the application had led the user toward being more likely to contribute with future applications, simply because the application had superseded the prior method of delivering the service. This is directly tied to the notion of usefulness of the application, which the interviews noted was tied to utilization and ownership development. Also, significant, Choice showed the ease of use in using the application. This was highly tied to the notion of having usable and easy to use applications that allowed users to access the service in the easiest way.

Citizen Participation and Co-Production Capabilities

Lastly, application developers within the City of Boston were highly attentive to citizen concerns in line with the theories on public value (Bozeman, 2007; Moore, 1995; Meynhardt, 2009). Openness and participatory opportunities were notes as an important component in building ownership associated with the service and garnering use of applications. Along with this the notion of co-production (Linders, 2012; Christin et al., 2013; Desouza & Bhagwatwar, 2012) became a predominant theme in the interviews, whereby developers noted the need to have channels for two-way communication and a means for citizens to act as a means to test and provide feedback for the applications that would lead to changes within it. In this sense, as was mentioned citizens became consumers of public goods and services (Fernandes et al., 2001; Newcombe, 2000) and contributors to policymaking, service delivery, and decision making (Cumming, 2001; Elgarah & Courtney, 2002; Webler & Tuler, 2000).

In this manner, citizen participation became a predominant concern of developers as sought to create an application, or system of applications in the case of city developers, that supported and fostered citizen participation. This tied to the notion of building the user's investment in the application, not just through usefulness or usability, but through co-productive channels that were in line with notions of the smart city that build toward community value and a more friendly smart city experience (Gutiérrez et al., 2013; Paletti, 2016). Applications, then, became designed in a co-productive sense to gather users input, both positive and negative, to modify the application in a variety of ways. This tied to the notion of self-efficacy in the ICT and a feeling that they had ownership over its design through voicing their concerns (Cegarra-Navarro et al., 2014; Kim & Chen, 2015; Kim et al., 2011; de Zúñiga et al., 2013; Lee et al., 2014).

Interestingly, this echoed the findings of the survey portion of the study as the input variable of "participation" according to Karunasena and Deng's input variables (2012) carried with its significance and it indicated the degree to which the user felt the city applications made them more willing to participate compared to other service channels. The developer's attention then to fostering channels for input has led to positive ownership generation and was a component that lead to sustained use and value generation, which effectively linked the authorizing chain and value chain in building ownership.

As the prior sections discussed, the notion of developers revolved predominantly among ensuring useful applications were produced that were also highly usable and ensuring a positive experience with these applications, while also building sustained user bases. Citizen-centricity as it relates to public value (Bozeman, 2007; Moore, 1995; Meynhardt,

2009; Kearns, 2004), e-governance (Tapscott, 1996; Lawson, 1998; Layne & Lee, 2001; Andersen & Henriksen, 2006; Hiller & Bélanger, 2001; Moon, 2002; West, 2004; Lee, 2010), and the smart city (Pardo et al., 2012; Chourabi et al., 2012; Gutiérrez et al., 2013) were echoed in the interview findings. Citizen channels for participation served to ensure participation with the application, and also served as a way to improve it to improve the overall user experience.

6.4 Contribution of this Study

This study has attempted to contribute to the overall breadth of the literature and theory by contributing to studies in e-government, m-government, public value management, and smart city components. Specifically, it has examined mobile applications as the tool of the smart city, and how the development of these applications with public value components in mind can lead to greater ownership associated with the applications.

In the scope of the literature and theory examined, there have been extensive studies on e-government, m-government, smart cities, and mobile applications and their various components. Less studies have concerned citizen participation in these areas, though a fair number have examined this topic. Further, e-government and public value studies have been conducted but there has been little attention paid to the effect of public value derived smartphone application components and their effects on citizens sense of ownership and their willingness to participate associated with these smartphone mobile applications. The question of how to facilitate ownership regarding the ICT device and whether development according to public value paradigms can contribute to such ownership and subsequently lead to a greater willingness to participate by citizens may be beneficial to current and future city

application developers (arguably across sectors) as they seek to incorporate public value components into their applications that reflect citizens needs and garner high usage. The study therefore has contributed to the fields mentioned, and has done so considering this NICT, which has not been extensively examined by e-government scholars.

6.5 Policy Implications

The policy findings of this study are arguably of importance for cities wishing to expand upon or begin their mobile application development, and who wish to do so according to the public value theoretical component advocated by Moore (1995). The reasons for this need and the problems associated with a competitive application market, lagging citizen participation, and the need to ensure public value components are integrated in application development echo back to the main problems outlined in Chapters 1 and 2 of this study. These concerns regard both the benefits of smartphone mobile applications and the often-lacking degree of citizen participation in e-governance efforts.

Therefore, if government application developers wish to develop smartphone applications that garner greater ownership associated with them due to this output variable, they may want to consider the various input variables that were significant from the survey findings chapter. In addition, they may also want to head the interview findings chapter and prior experiences of City of Boston application developers in their development. The mixed-methods conclusions above most succinctly address these findings as they address the primary research question. As the market for mobile applications continues to grow, the need to develop robust mobile applications that garner value and future use is of importance. Further, developing these applications with public value-centric input variables in mind and

according to encapsulate the Smart City model value chain, and the viewpoints of City of Boston Application developers via the authorizing chain is of importance.

Specifically, it is the user experience both initially and throughout that affects the willingness of users to engage and participate with the mobile application. Success and failure stories from the qualitative findings note that success of an application relies extensively on user testing and gathering perceptions of the user base to create the most useful and usable application for them. Further, adhering to these concerns builds the user base while also moving some users toward a status of "contributor" whereby they are far more likely to contribute with future application developed by the city.

In this sense, the quantitative findings note how it is user's experience using Boston applications, along with whether they were past contributors, the ease of use of the application, and opportunities for participation that motivate users to continue to engage with the application. The primary takeaway then from this portion of the study is that applications should have active engagement mechanisms, while also being highly usable with the first experience of the user being pivotal in garnering not only the success of that application but with future applications developed by the City.

Overall, from the implementation and planning point of view the trust and reliance of the application should be developed early for the user. The study's findings show that trust breakdown leads to a lack of value generated surrounding the application. This breakdown of trust in the applications capabilities leads to a drop off in likelihood the user will be interested in using future applications. Noted extensively throughout the interviews was the idea of involving users in all stages of the development process in order to ensure the

usability and usefulness of the application is enough for the larger user base. Managers then can specifically examine what quantitative variables in this study regarding public value influence ownership of the application, while also reading the process involved in the qualitative findings in their future application development efforts.

6.6 Future Recommendations and Future Research

This study has presented only a single case study analysis of one smart city and its generation of public value, namely the City of Boston. Several things can be done to improve upon this research and make it more robust in the future. First, the expansion of this study to include other smart cities to examine Moore's (1995) would benefit the study greatly, so that the results could be measured among smart cities to see how they are generating value. These cities would need to have similar mobile smartphone initiatives in place but analyzing these cities to see common trends and differences would be highly beneficial. This should be done from the standpoint of the interview questions analyzing the Authorizing chain and the survey questions analyzing the Value chain according to Karunasena and Deng's (2012) input variables and according to the output of ownership (de Lange & de Waal, 2013).

Subsequently, the study could benefit from having a similar number of interviews within each city and having the representation of the sectors (private, public, non-profit, and citizen) from which the interviews were drawn be more representative of the sample of all application developers within the city. Overrepresentation of government mobile application developers in this study may have somewhat skewed perspectives. However, given the willingness of those contacted to be interviewed, the study does have good representation of the various sectors, just over representation of some. In this sense, increasing the interview

response rate to account for this both in this study and in the multiple case study may be beneficial. This would take more time and resources to find and contact interviewees.

Lastly, the survey component could benefit from a trimming of those unnecessary variables and, given more time and resources, a factor analysis may determine what constructs are measuring similar components to a greater effect than the tests utilized in this study. For this reason, before conducting a multiple case study, the results of this study should be published, and peer reviewed further before undertaking this task. This will allow the overall model and questions to become more robust. Further, researchers may wish to increase internal validity by examining, through experimental design, how variation of certain components of public value inputs may increase or decrease ownership or likelihood to contribute within these cities via an experimental and a control group.

6.7 Conclusions

This study attempted to discern via a case study analysis of the city of Boston how the development of the smart city service of, specifically, the mobile application that proceeded according to Moore's Public Value Management Chain lead to greater levels of ownership associated with these smart city services. It, first, examined the Authorizing chain of the model by interviewing City of Boston mobile application developers to determine how smart city managers were working to generate public value, build ownership, and foster co-production and citizen engagement. Following that, it examined the Value chain of the model via a logistic regression of input (Karunasena & Deng, 2012) and control variables to examine what variables significantly impacted user's sense of ownership as determined by their willingness to engage with future applications (de Lange & de Waal, 2013). The mixed-

methods study attempted to examine what components of public value according to the Authorizing and Value Chain led to greater levels of ownership associated with these smart city services and a willingness to co-productively engage and participate with such services.

The mixed -methods findings indicate overall that usability and usefulness in an application are the key gateway drivers to overall improve the user's initial uptake of that application, with the overall experience with prior applications being significant in determining their future use of city applications. Fostering this positive user experience, while ensuring that channels for communication, participation, and continuous improvement via co-productive capabilities is important to both users and developers in building value associated with the service. Building a user base and having people become active contributors to the application, both via the interviews and the logistic regression was also shown to have a significant impact on future uptake of services. Overall, building this satisfied user base became important in developing ownership surrounding the city's efforts in its various sectors.

In conclusion, it may be beneficial to undertake a more robust study and examine smart cities to see if the results of the logistic regression align across smart cities, and what the experience of other smart city application developers was. Considering this study solely in the scope of the literature and theories examined, policymakers and public administrators may wish to align the goals of their smart city according to these findings or change direction toward more citizen-centric components that build a sustained user base, with functional and useful applications for users. While keeping public value input components in mind, ensuring

these strategies are incorporated may lead to greater levels of ownership associated with the service and a future willingness of users to utilize the city's applications.

APPENDIX I: SURVEY QUESTIONS

1) Have you used a smartphone and mobile applications?
   a. Yes
   b. No

2) Are you familiar with at least one smartphone mobile application that involves some service (governmental or non-governmental) associated with the City of Boston? Note: A **City of Boston-specific** mobile application would be one that is used in an informative or service capacity in some way for the city. It could be a government application or an individually developed one by a non-governmental organization that has something to do with a service specific to the City of Boston. There are many applications that can fit these criteria, but some examples are listed below. The Boston 311 application provides citizens the opportunity to report non-emergency instances of need to the city or seek information via the application. Park Boston, the application, provides an easy and convenient way to pay for on-street parking using your device. Boston.com from the Boston Globe allows users to read news about the City of Boston via the mobile application
   a. Yes
   b. No

3) Have you used at least one of these **City of Boston-specific** smartphone mobile applications in the past?
   a. Yes
   b. No

4) How would you best describe your comfort level using smart phone technology and mobile applications?
   a. Very Low (e.g., I have had or used a smartphone and mobile applications, but can rarely use most of their functions)
   b. Low (e.g., I can use a smartphone and mobile applications, but frequently have difficulty using the majority of their functions)
   c. Medium (e.g., I can use a smartphone and mobile applications fairly easily, but sometimes have trouble using some of their functions)
   d. High (e.g., I can use a smartphone and mobile applications fairly easily and rarely have trouble using their functions)
   e. Very High (e.g., I can use a smartphone and mobile applications with ease and also have the ability to code or program iOS and/or Android applications)

5) Who is the maker of the mobile smart phone you most commonly use?
   a. Apple
   b. Samsung
   c. Google Pixel
   d. OnePlus
   e. LG
   f. Xiaomi
   g. HTC
   h. Sony
   i. Oppo
   j. Vivo
   k. Huawei
   l. Lenovo
   m. Motorola
   n. Other

6) Approximately, how many total mobile applications do you currently have installed on your phone?
   a. None
   b. 1-25
   c. 26-50
   d. 51-75
   e. 76-100
   f. 101-125
   g. 126-150
   h. 151-175
   i. 176-200
   j. 201 or more

7) How many times per day would you estimate you use mobile applications on your phone to carry out a task or seek information?
   a. Never
   b. About less than once a month, but not never
   c. About once a month
   d. About once a week
   e. About every other day
   f. About 1 time a day
   g. About 2 times a day
   h. About 3-4 times a day
   i. About 5-6 times a day
   j. About 7-8 times a day
   k. About 9-10 times a day
   l. About 11-20 times a day

m. About 21-30 times a day
n. About 31-40 times a day
o. About 41-50 times a day
p. More than 50 times a day

8) In general, how would you rate your experience with all mobile applications?
a. Excellent
b. Very Good
c. Good
d. Fair
e. Poor

9) How many total City of Boston-**specific** mobile applications do you currently have installed on your phone? Note: A **City of Boston-specific** mobile application would be one that is used in an informative or service capacity in some way for the city. It could be a government application or an individually developed one by a non-governmental organization that has something to do with a service specific to the City of Boston. There are many applications that can fit this criteria, but some examples are listed below. The Boston 311 application provides citizens the opportunity to report non-emergency instances of need to the city or seek information via the application. ParkBoston, the application, provides an easy and convenient way to pay for on-street parking using your device. Boston.com from the Boston Globe allows users to read news about the City of Boston via the mobile application
a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. 6
h. 7
i. 8
j. 9
k. 10
l. More than 10 (please insert number)

10) How many times per day would you estimate you use these **City of Boston-specific** mobile applications to carry out a task or seek information?
a. Never
b. About less than once a month, but not never
c. About once a month
d. About once a week
e. About every other day

f. About 1 time a day
g. About 2 times a day
h. About 3-4 times a day
i. About 5-6 times a day
j. About 7-8 times a day
k. About 9-10 times a day
l. About 11-20 times a day
m. About 21-30 times a day
n. About 31-40 times a day
o. About 41-50 times a day
p. More than 50 times a day

11) In general, how would you rate your prior experience with these **City of Boston-specific** mobile applications?
a. Excellent
b. Very Good
c. Good
d. Fair
e. Poor

12) Regarding your participation with **City of Boston-specific** mobile applications, would you classify yourself as a **non-contributor**, **contributor**, or **developer**? **A non-contributor** would be someone who uses only the service or information aspect of a mobile application and does not participate or contribute data in some fashion **A contributor** would be someone who provides information to the city in a two-way fashion participating with and engaging with the application or providing data to the city through the application **A developer** would be someone who has contributed to developing an application either through some sort of input or technical skills either before its implementation or throughout the development process to enhance its functionality
a. Non-Contributor
b. Contributor
c. Developer

For 13-32 The scale below is a 0 to 100 scale, where 0 represents being in complete disagreement with the statement, 50 represents being neither in agreement or disagreement with the statement, and 100 represents being in complete agreement with the statement

Regarding City of Boston-specific mobile applications, what is your level of agreement or disagreement with the following statement?

13) "My experience with City of Boston-specific mobile applications has made it more likely that I will participate and engage with current or future applications developed for the city"

14) "City of Boston-specific mobile applications have provided me with a greater amount of information compared to other service channels”

15) "City of Boston-specific mobile applications have provided me with more useful information compared to other service channels"

16) "City of Boston-specific mobile applications have made it easier to access their public services compared to other service channels"

17) "City of Boston-specific mobile applications have made it so that I have equal access to public services within the city compared to other people"

18) "City of Boston-specific mobile applications have provided me with greater cost savings compared to other service channels"

19) "City of Boston-specific mobile applications have made me more willing to utilize their services compared to other service channels"

20) "City of Boston-specific mobile applications have made me more willing to utilize their services compared to other service channels"

21) "City of Boston-specific mobile applications have made me more satisfied with their services compared to other service channels"

22) "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes within my SMALL COMMUNITY OR NEIGHBORHOOD compared to other service channels"

23) "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes within my GREATER COMMUNITY OR CITY compared to other service channels"

24) "City of Boston-specific mobile applications have improved what I feel are socially desirable outcomes for my ENTIRE SOCIETY AS A WHOLE compared to other service channels"

25) "City of Boston-specific mobile applications contain a sufficient degree of security associated with them that protects my private information compared to other service channels"

26) "City of Boston-specific mobile applications lead to greater levels of government disclosure of information, decision making processes, and procedures compared to other service channels"

27) "City of Boston-specific mobile applications have led to greater levels of trust of government as compared to other service channels"

28) "City of Boston-specific mobile applications makes me want to participate more for better governance in my city as compared to other service channels"

29) "City of Boston-specific mobile applications provide me with more return on my investment as compared to other service channels"

30) "City of Boston-specific mobile applications provide me with greater access to public organizations as compared to other service channels"

31) "City of Boston-specific mobile applications provide me with greater opportunity for my opinions to be taken into account as compared to other service channels"

32) "Government communication should proceed in two ways (i.e., from citizen to government and then back to citizen)"

33) I identify my gender as

a. Male
b. Female
c. Non-Binary
d. I prefer not to answer
e. Other

34) Please indicate your age in years

a. Under 18
b. 18 to 29
c. 30 to 39
d. 40 to 49
e. 50 to 59
f. 60 to 69
g. 70 to 79
h. 80 or over

35) I identify my ethnicity as
a. American Indian or Alaska Native
b. Asian
c. Black or African American
d. Hispanic or Latino
e. Native Hawaiian or Other Pacific Islander
f. White
g. I prefer not to answer
h. Other

36) What is your highest level of education?
a. Less than High School Graduate or GED
b. GED
c. High School Graduate
d. Bachelor's Degree
e. Master's Degree
f. Doctoral Degree (MD, DO, PhD, JD)

37) How would you best describe the density of your primary residence?
a. Urban
b. Suburban
c. Rural

38) What is your current before tax household income per year?
a. $0-24,999
b. $26,000-$49,999
c. $50,000-$74,999
d. $75,000-$99,999
e. $100,000-$124,999
f. $125,000-$149,999
g. $150,000-$174,999
h. $175,000-$199,999
i. $200,000 and up
j. I prefer not to answer

APPENDIX II: CODEBOOK AND INITIAL DESCRIPTIVE STATISTICS (N=426)

Variable Name	Initial Data	Recode	Sign
Dependent Variable	0-100 Scale Completely Disagree to Completely Agree		
Ownership		1=High Ownership (Score 51-100) 0= Low Ownership (Score 0-50)	---
Delivery of Public Service	0-100 Scale Completely Disagree to Completely Agree		
Information		No Recode	Positive
Importance		No Recode	Positive
Choice		No Recode	Positive
Fairness		No Recode	Positive
Cost Savings		No Recode	Positive
Take Up		No Recode	Positive
Satisfaction		No Recode	Positive
Achievement of Outcomes	0-100 Scale Completely Disagree to Completely Agree		
Direct		No Recode	Positive
Intermediate		No Recode	Positive
End		No Recode	Positive
Development of Trust	0-100 Scale Completely Disagree to Completely Agree		
Security		No Recode	Positive
Transparency		No Recode	Positive
Trust		No Recode	Positive
Participation		No Recode	Positive

Effectiveness of the Public Organization	0-100 Scale Completely Disagree to Completely Agree		
Efficiency		No Recode	Positive
Accountability		No Recode	Positive
Perceptions		No Recode	Positive
Demographic Characteristics			
Gender	1=Male 2=Female 4=Non-binary 5=I prefer not to answer 6=Other	1=Male 2=Female *Dropped Non-Binary, I prefer not to answer, and Other*	
Male		1=Yes, 0=No	Positive
Female		1=Yes, 0=No	Negative
Age	11=Under 18 12=18 to 29 13=30 to 39 14=40 to 49 15=50 to 59 16= 60 to 69 17=70 to 69 18=Over 80	1=18 to 29 2=30 to 39 3=40 to 49 4=50 to 59 5= 60 to 69 6=70 to 69 7=Over 80 *No respondents under 18*	Negative
Race	1=American Indian or Alaskan Native 2=Asian 3=Black or African American 4=Hispanic or Latino 5=Native Hawaiian or Other Pacific Islander 6=White 9=I prefer not to answer 11=Other	1=White 2=Asian 3=Black 4=Hispanic or Latino 5=Other Race *Dropped I prefer not to answer*	
White		1=Yes, 0=No	Positive
Asian		1=Yes, 0=No	Positive
Black		1=Yes, 0=No	Positive
Hispanic		1=Yes, 0=No	Positive
Other Race		1=Yes, 0=No	Positive
Geographic Area	1=Urban		

	2=Suburban 3=Rural		
Urban	1=Yes, 0=No		Negative
Suburban	1=Yes, 0=No		Positive
Rural	1=Yes, 0=No		Positive
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 10=I prefer not to answer	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-$199,999 8=$200,000 and up *Dropped I prefer not to answer*	Positive
Education	1=Less than High School or GED 2=GED 3=High School Graduate 4=Bachelor's Degree 5=Master's Degree 6=Doctoral Degree (MD, PhD, DO, JD)	1=No Degree 2=High School 3=Bachelors 4=Post Grad	Positive
Control Variables			
Boston Apps Number	1=0 15=1 5=2 6=3 7=4 8=5 9=6 10=7 11=8 12=9 13=10 14=More than 10	0=0 1=1 2=2 3=3 4=4 5=5 6=6 7=7 8=8 9=9 10=10 11=11	Positive

Boston Apps Frequency	1=Never 10=About less than once a month, but not never 11=About once a month 12=About once a week 13=About every other day 14=About 1 time a day 4=About 2 times a day 5=About 3-4 times a day 6=About 5-6 times a day 7=About 7-8 times a day 8=About 9-10 times a day 20=About 11-20 times a day 16=About 21-30 times a day 17=About 31-40 times a day 18=About 41-50 times a day 9=More than 50 times a day	0=No Use 1=Very Low Use (Up to about every other day) 2=Low Use (up to 3 to 4 times a day) 3=Moderate Use (up to 7 to 8 times a day) 4= High Use (up to 11 to 20 times a day) 5=Very High Use (up to more than 50 times a day)	Positive
Boston Apps Experience	1=Excellent 2=Very Good 3=Good 4=Fair 5=Poor	1=Poor 2=Fair 3=Good 4=Very Good 5=Excellent	Positive
All Apps Number	1=None 2=1-25 13=26-50 3=51-75 4=76-100 5=101-125 14=126-150 6=151-175 7=176-200 15=201 or more	0=None 1=1-25 2=26-50 3=51-75 4=76-100 5=101-125 6=126-150 7=151-175 8=176-200 9=201 or more	Positive
All Apps Frequency	1=Never 13= About less than once a month, but not never 2=About once a month 11=About once a week 10=About every other day 3=About 1 time a day 18=About 2 times a day 4=About 3-4 times a day 5=About 5-6 times a day 6=About 7-8 times a day 12=About 9-10 times a day 7=About 11-20 times a day 15=About 21-30 times a day 8=About 31-40 times a day 16=About 41-50 times a day 17=More than 50 times a day	0=No Use 1=Very Low Use (up to about every other day) 2=Low Use (up to 3 to 4 times a day) 3=Moderate Use (up to 7 to 8 times a day) 4= High Use (up to 11-20 times a day) 5=Very High Use (up to more than 50 times a day)	Positive

All Apps Experience	1=Excellent 2=Very Good 3=Good 4=Fair 5=Poor	1=Poor 2=Fair 3=Good 4=Very Good 5=Excellent	Positive
Technology Comfort	1=Very Low 2=Low 3=Medium 4=High 5=Very High	N/A	Positive
Two-Way Communication	0-100 Scale Completely Disagree to Completely Agree	----	Positive
Contribution Level	1=Non-Contributor 2=Contributor 3=Developer	1=Non-Contributor 2=Contributor (Combine with Developer)	
Contributor		1=Yes, 0=No	Positive
Non-contributor		1=Yes, 0=No	Negative
Phone Type	1=Apple 2=Samsung 3=Google Pixel 4=OnePlus 5=LG 6=Xiaomi 7=HTC 8=Sony 9=Oppo 10=Vivo 11=Huawei 12=Lenovo 13=Motorola 14=Other	1=Apple 2=Samsung 3=Other	
Samsung		1=Yes, 0=No	---
Apple		1=Yes, 0=No	---
Other Phone		1=Yes, 0=No	---

APPENDIX III: CORRELATION MATRIX

	Information	Importance	Choice	Fairness	Cost-Saving	Take-up	Satisfaction	Direct	Intermediate	End
Inf	1.00	**.81**	.59	.57	.47	.60	.66	.49	.61	.53
Imp	---	1.00	.67	.61	.45	.66	**.72**	.49	.61	.56
Cho	---	---	1.00	.52	.40	.68	.67	.41	.52	.48
Fai	---	---	---	1.00	.51	.56	.58	.45	.52	.52
Cos	---	---	---	---	1.00	.52	.51	.48	.48	.50
Tak	---	---	---	---	---	1.00	**.77**	.51	.56	.56
Sat	---	---	---	---	---	---	1.00	.57	.62	.56
Dir	---	---	---	---	---	---	---	1.00	**.74**	.56
Int	---	---	---	---	---	---	---	---	1.00	.68
End	---	---	---	---	---	---	---	---	---	1.00
Sec	---	---	---	---	---	---	---	---	---	---
Tra	---	---	---	---	---	---	---	---	---	---
Tru	---	---	---	---	---	---	---	---	---	---
Par	---	---	---	---	---	---	---	---	---	---
Eff	---	---	---	---	---	---	---	---	---	---
Acc	---	---	---	---	---	---	---	---	---	---
Perc	---	---	---	---	---	---	---	---	---	---
Two	---	---	---	---	---	---	---	---	---	---

Two-Way Communication	Perceptions	Accountability	Efficiency	Participation	Trust	Transparency	Security
.14	.46	.44	.44	.44	.45	.42	.48
.20	.49	.55	.46	.48	.48	.45	.48
.22	.37	.49	.37	.40	.39	.37	.37
.18	.42	.57	.42	.45	.47	.51	.54
.07	.47	.42	.57	.42	.47	.44	.40
.31	.49	.58	.48	.46	.48	.46	.44
.21	.49	.60	.46	.47	.51	.49	.49
.16	.56	.54	.48	.59	.56	.51	.40
.15	.54	.55	.45	.56	.58	.54	.45
.10	.52	.49	.54	.50	.52	.51	.46
.15	.36	.48	.43	.46	.52	.57	1.00
.15	.57	.67	.49	.65	.69	1.00	---
.15	.56	.57	.54	**.70**	1.00	---	---
.15	.62	.56	.45	1.00	---	---	---
.09	.55	.50	1.00	---	---	---	---
.23	.59	1.00	---	---	---	---	---
.20	1.00	---	---	---	---	---	---
1.00	---	---	---	---	---	---	---

APPENDIX IV: VARIANCE INFLATION FACTORS

Variable	VIF	1/VIF	Variable	VIF	1/VIF
Urban	4.06	.246	Boston App Experience	1.80	.555
Suburban	3.91	.255	Boston App Frequency	1.74	.575
Take-Up	3.13	.319	Boston App Number	1.71	.585
Importance	2.88	.348	All Apps Frequency	1.53	.652
Transparency	2.72	.368	All Apps Experience	1.51	.661
Intermediate	2.59	.387	Technology Comfort	1.38	.722
Accountability	2.57	.389	All Apps Number	1.30	.768
Perceptions	2.52	.397	Contributor	1.30	.772
End	2.47	.405	Education	1.26	.793
Choice	2.46	.406	Income	1.26	.796
Participation	2.37	.423	Age	1.24	.810
Fairness	2.27	.441	Two-Way Communication	1.22	.820
Efficiency	2.03	.486	Female	1.16	.863
Cost-Savings	2.00	.499	Other Race	1.16	.865
Apple	1.92	.522	Hispanic	1.16	.872
Security	1.89	.523	Asian	1.13	.884
Samsung	1.82	.550	Black	1.08	.927
			Mean VIF	**1.96**	

APPENDIX V: CATEGORICAL VARIABLES CORRELATION TESTS

Pearson Chi Squared

	Gender	Race	Geographic Area	Contribution Level	Phone Type
Gender	---	3.41	.44	.15	9.11**
Race	---	---	12.24	16.05**	19.6007*
Geographic Area	---	---	---	14.16***	7.72
Contribution Level	---	---	---	---	.22
Phone Type	---	---	---	---	---

*Significance at the .05 level
** Significance at the .01 level
***Significance at the .001 level

Likelihood Ratio Chi Squared

	Gender	Race	Geographic Area	Contribution Level	Phone Type
Gender	---	3.36	.44	.15	9.09**
Race	---	---	17.37*	13.55**	23.74**
Geographic Area	---	---	---	14.50***	7.92
Contribution Level	---	---	---	---	.22
Phone Type	---	---	---	---	---

*Significance at the .05 level
**Significance at the .01 level
***Significance at the .001 level

Cramer's V

	Gender	Race	Geographic Area	Contribution Level	Phone Type
Gender	---	.08	.03	.02	.15*
Race	---	---	.12*	.19*	.15*
Geographic Area	---	---	---	.18*	.09
Contribution Level	---	---	---	---	.02
Phone Type	---	---	---	---	---

*Weak Association .10 to .20
**Moderate Association .20 to .40
***Strong association .40 and above

Goodman and Kruskal's Gamma

	Gender	Race	Geographic Area	Contribution Level	Phone Type
Gender	---	.02	.05	.05	-.25
Race	---	---	-.20	.35	.18
Geographic Area	---	---	---	-.37	.09
Contribution Level	---	---	---	---	-.05
Phone Type	---	---	---	---	---

*Significance at the .05 level
**Significance at the .01 level
***Significance at the .001 level

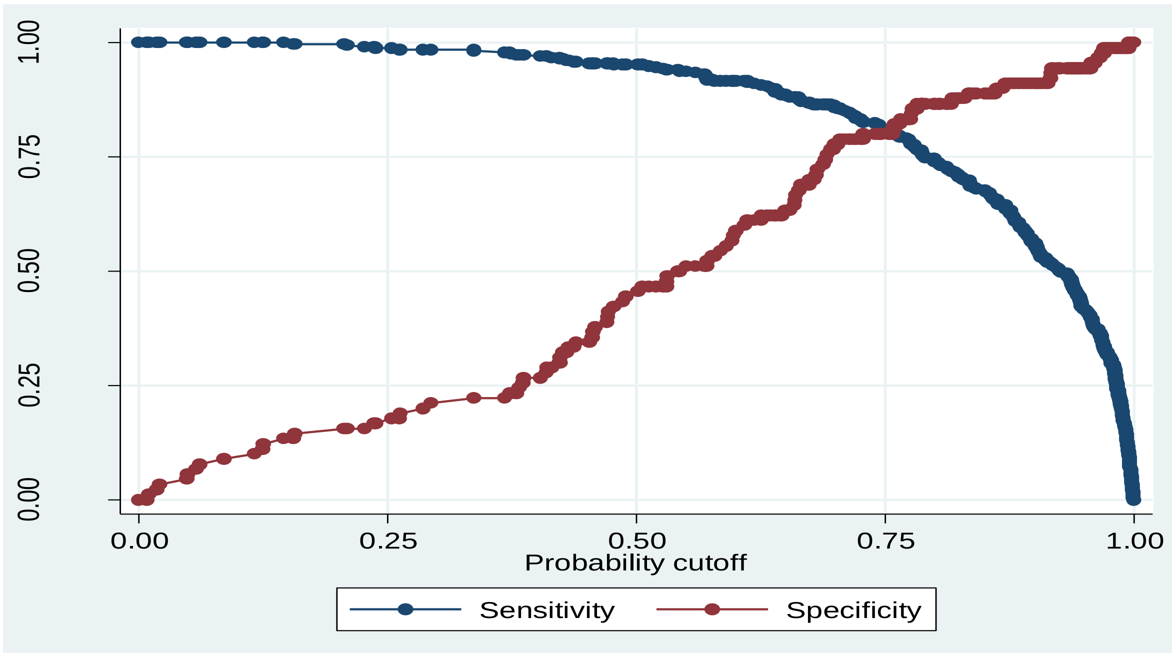
APPENDIX VI: KENDALL'S TAU B AND C RESULTS
FOR ORDINAL VARIABLES

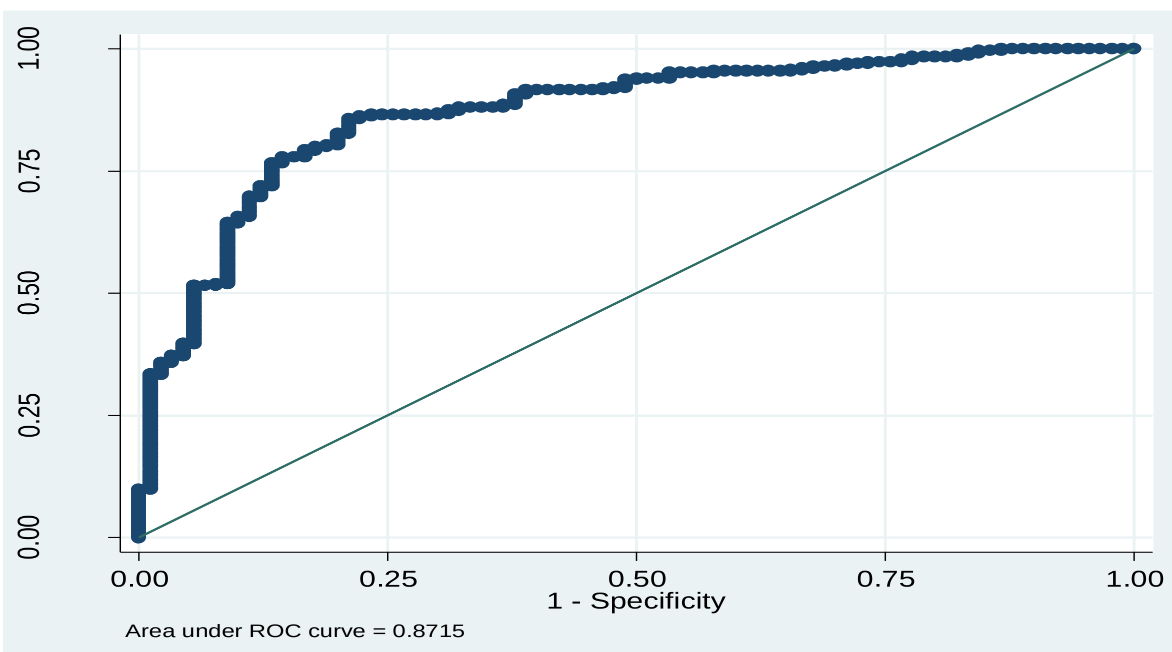
	Income	Education	Boston Apps Frequency	Boston Apps Experience	All Apps Frequency	All Apps Number	All Apps Experience	Technology Comfort
Income	---	.27**	-.03	.04	.02	.09	.01	.02
Education	---	---	-.00	-.03	.04	.07	-.05	-.03
Boston Apps Frequency	---	---	---	.18*	.08	.03	.07	.03
Boston Apps Experience	---	---	---	---	.10*	.06	.34**	.18*
All Apps Frequency	---	---	---	---	---	.31**	.21**	.25**
All Apps Number	---	---	---	---	---	---	.14*	.23**
All Apps Experience	---	---	---	---	---	---	---	.32**
Technology Comfort	---	---	---	---	---	---	---	---

*Weak Association .10 to .20
**Moderate Association .20 to .40
***Strong association .40 and above

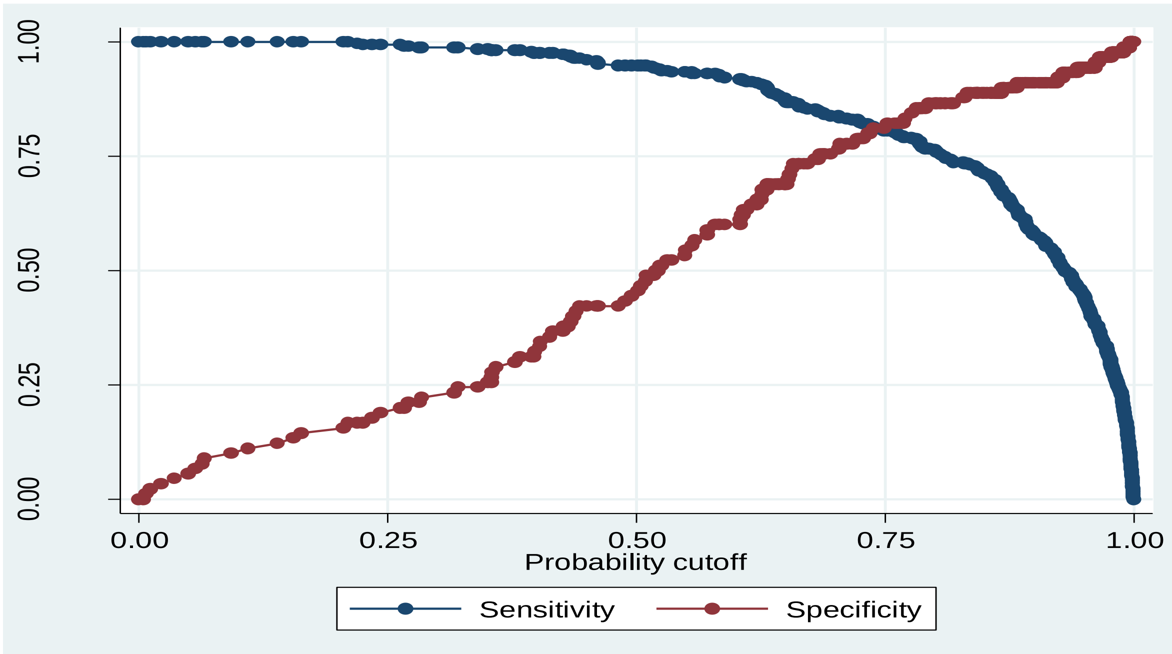
APPENDIX VII: LSENS AND LROC CURVES FOR VARIOUS MODELS

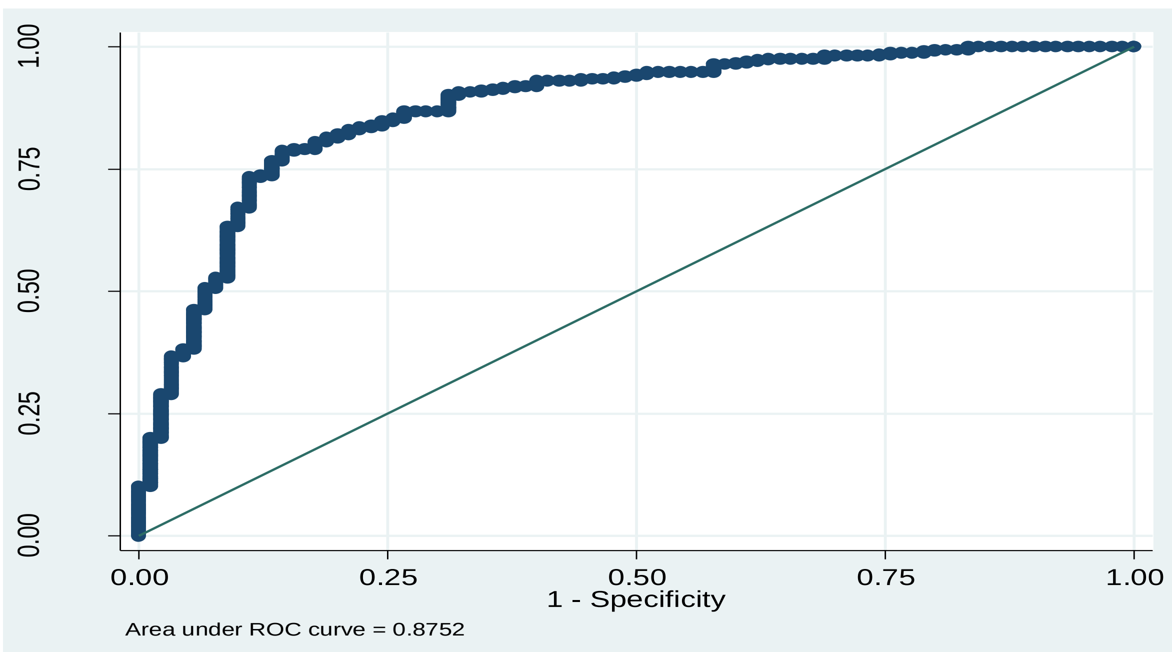
Smart City Model



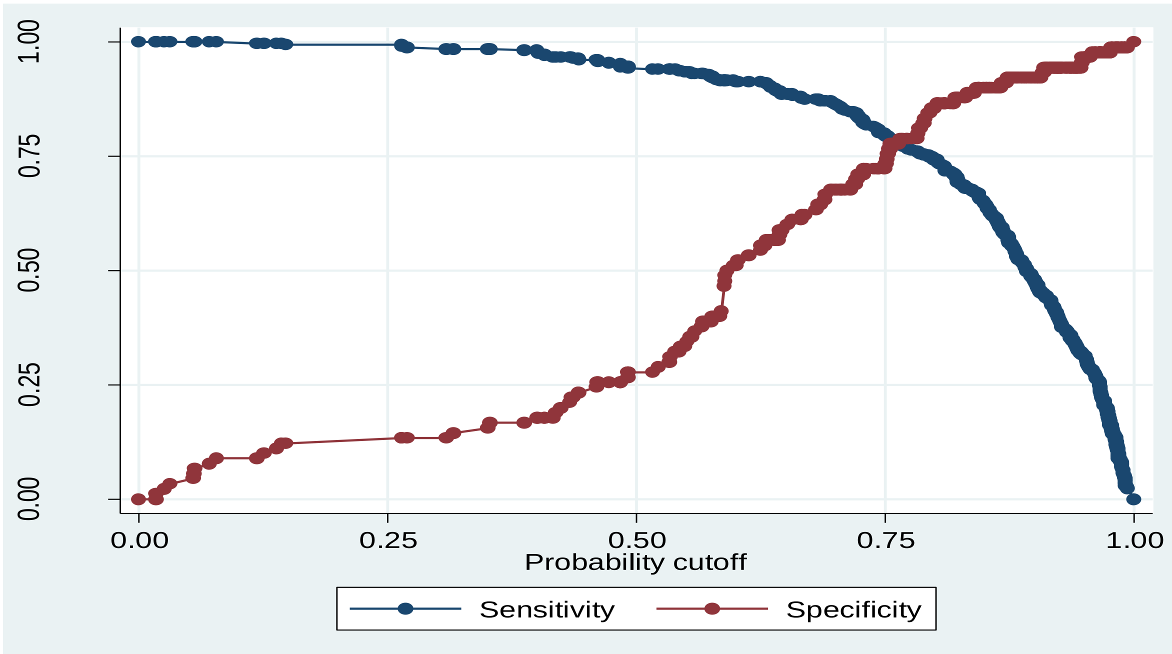


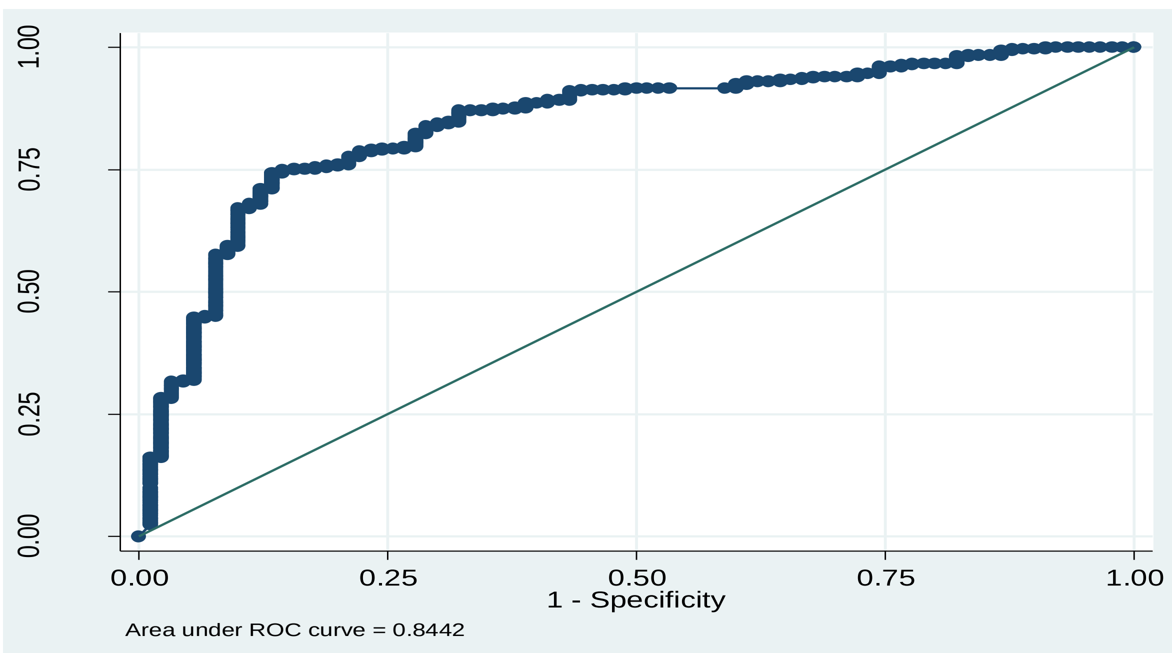
Original Model



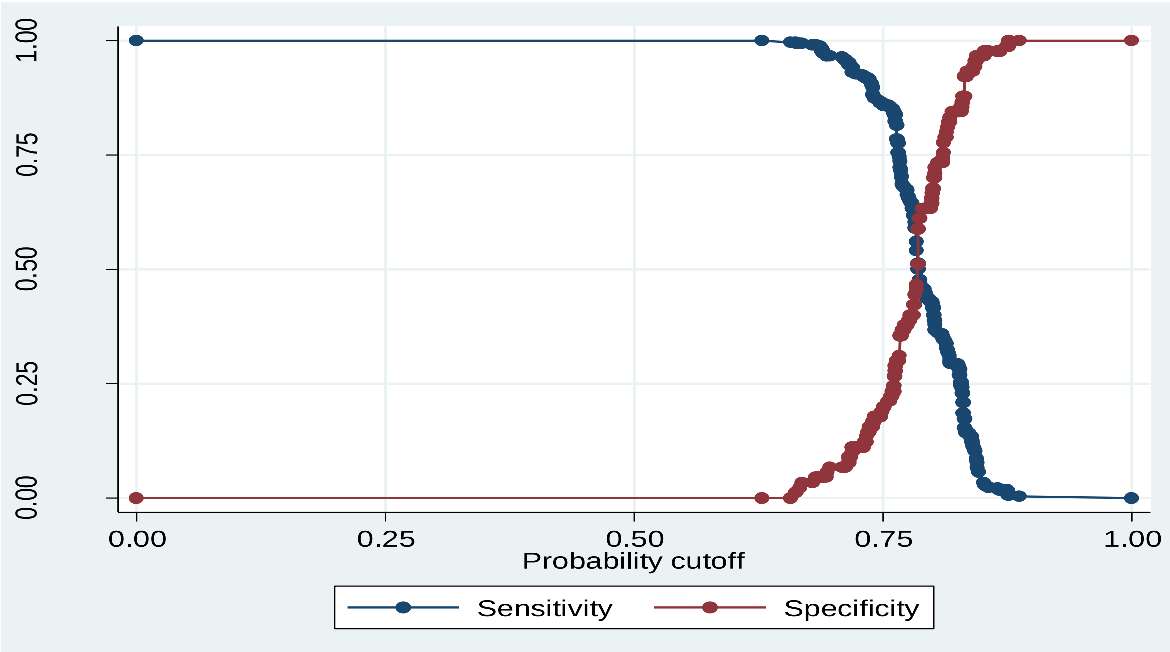


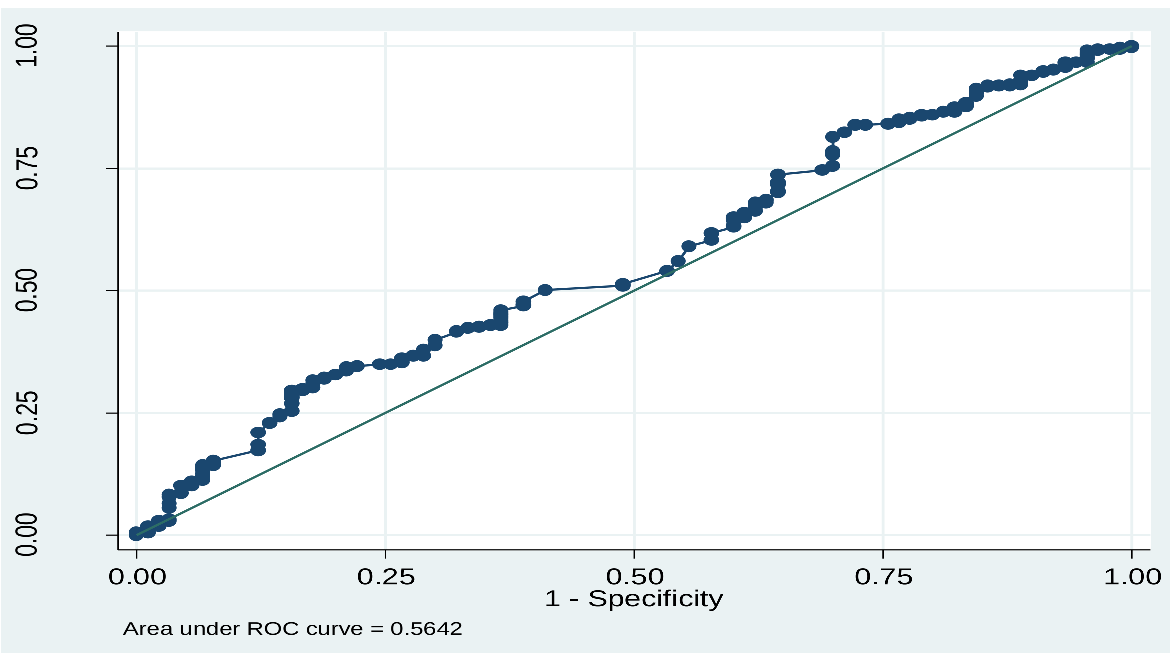
Public Value Model



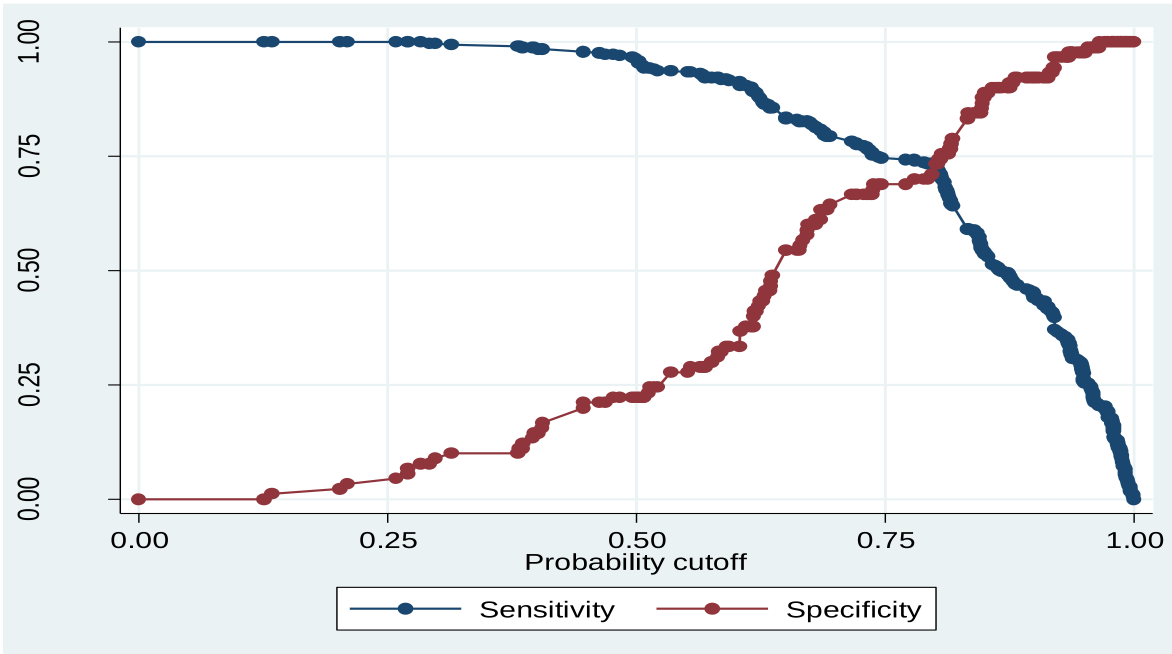


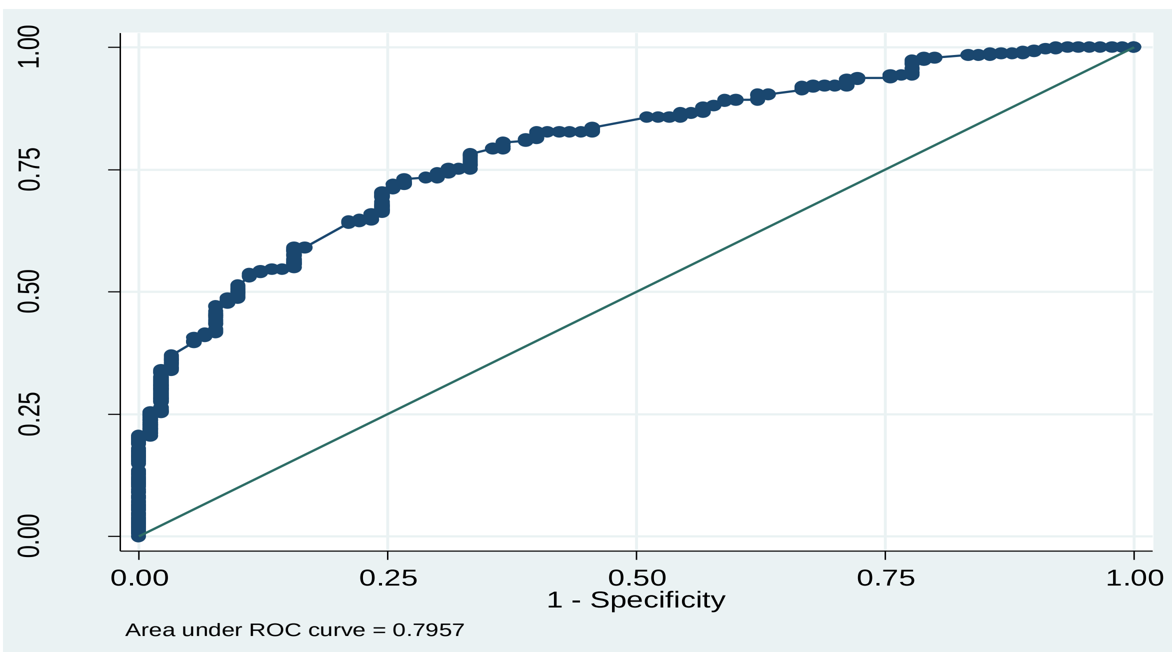
Demographic Model



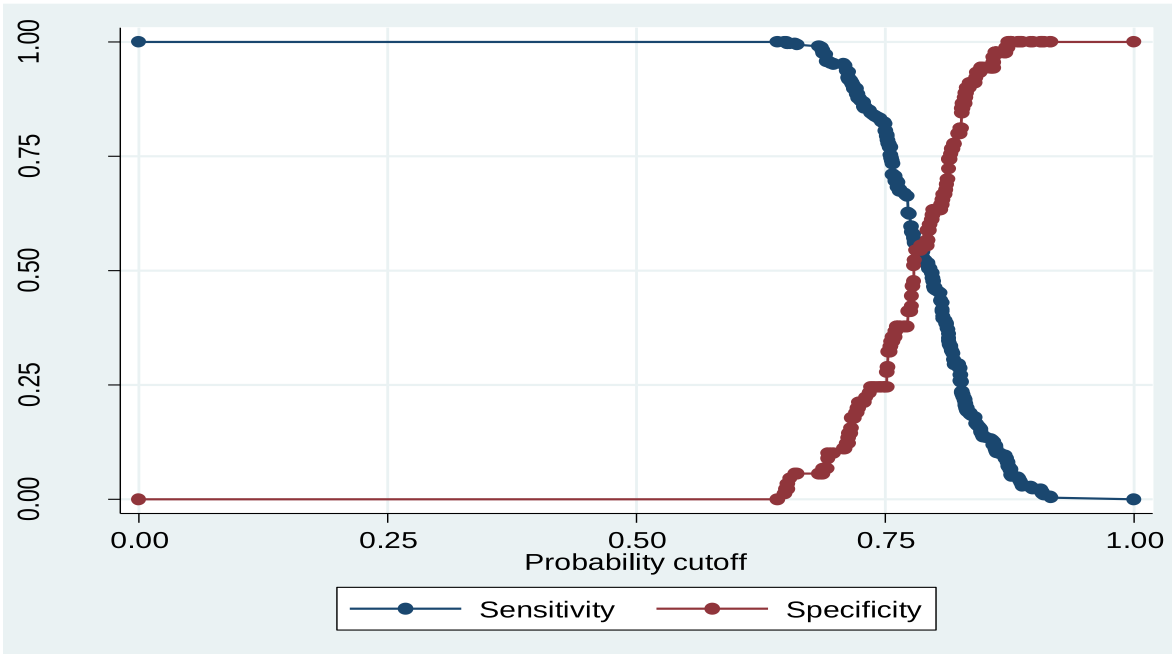


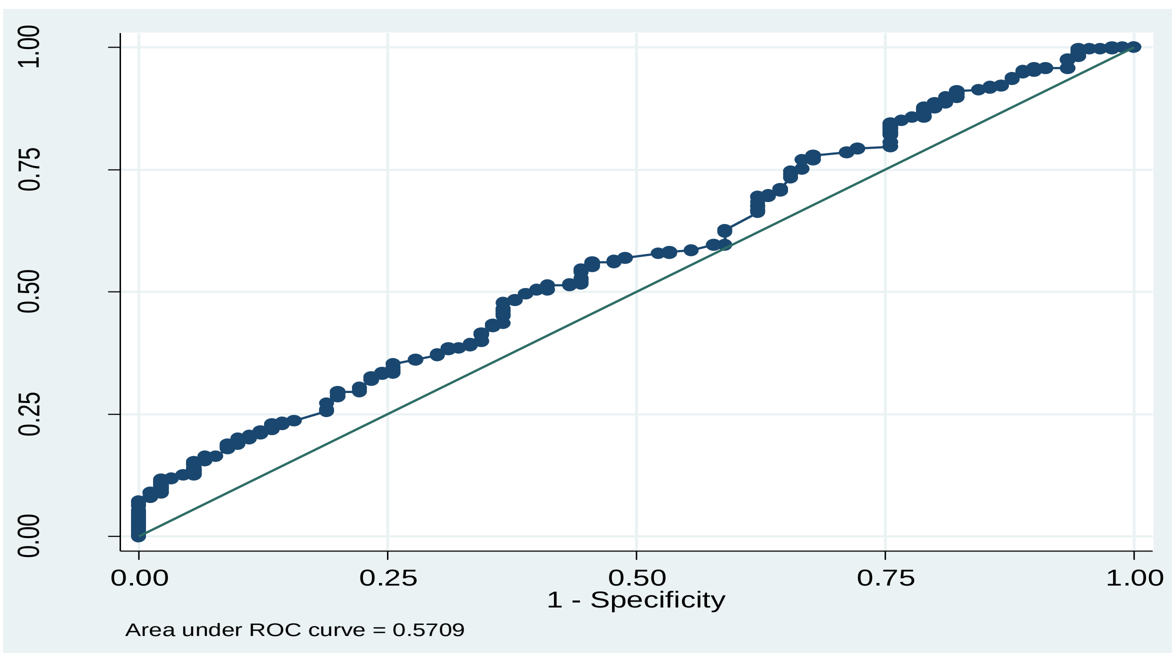
Boston Experience Model



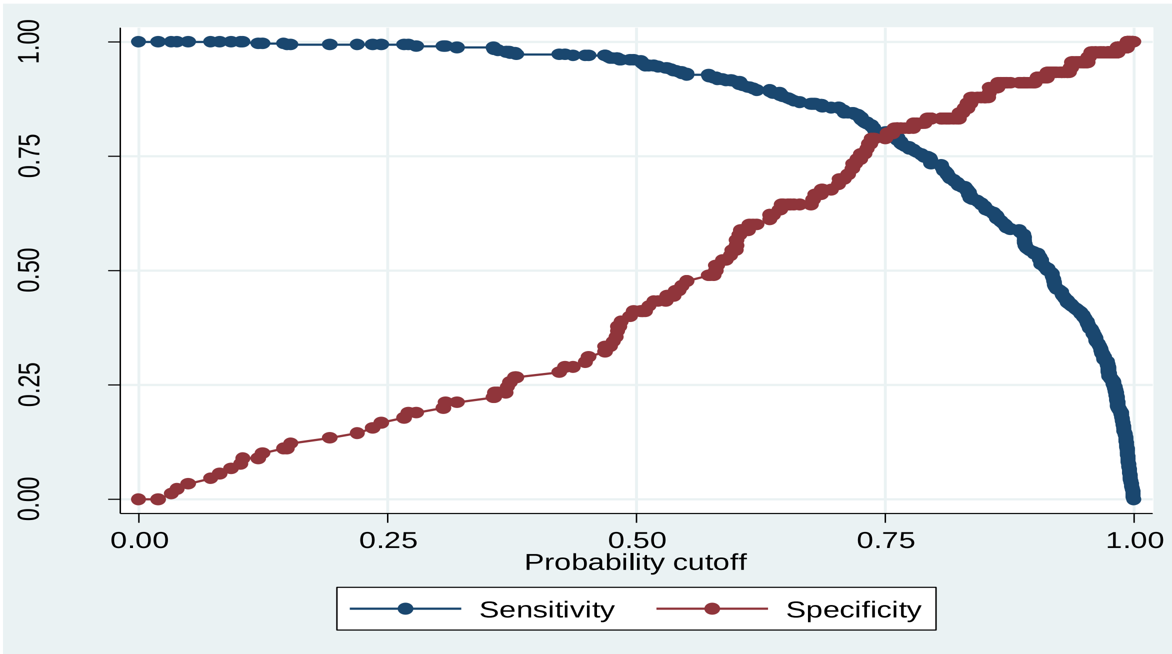


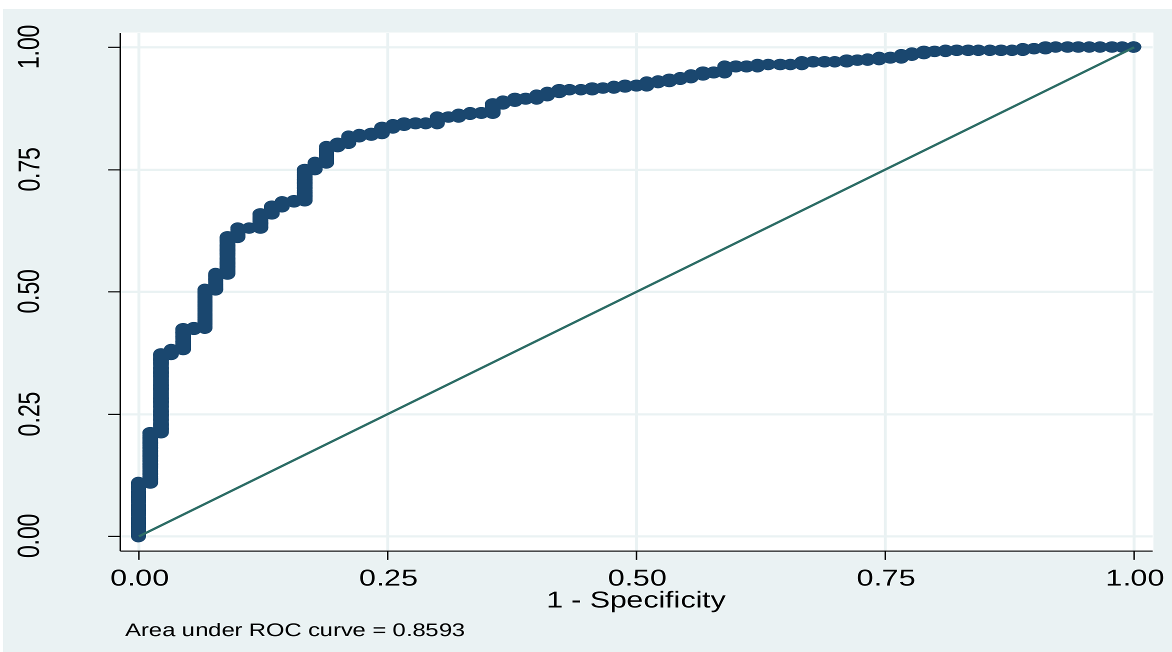
Technology Comfort Model





Authorizing Chain Model





APPENDIX VIII: INTERVIEW QUESTIONS

“We are speaking today about the mobile application **[Insert App Name Here]**. I anticipate the conversation should take about an hour though it may take slightly less or more time depending on the answers provided. Just so you are aware this conversation will be recorded with your consent, so please do not use your name or anything that could identify yourself or others. Your personal information will be protected during all times and once this recording is transcribed it will be deleted. Further, if you do provide specific information it will not appear in any reports for this research. I am only looking for major themes that emerge when interviewing participants and not specific aspects about your application, where you work, or your personal information. Anonymity in all its forms will be protected during all steps of the process.

I am also looking for a look at how the particular City of Boston applications you developed were managed. **Can I ask first, do you give your consent to be recorded during this conversation”?** “Great, starting with the first question…

1. Can you comment on your City of Boston-specific mobile application, it’s functionality, and intended goals?

2. When developing your application, what was your initial thought process regarding the application’s development?

3. Can you describe your application development strategy and the typical goals of your project in more depth?

4. Can you comment on how you benchmark the success of the delivery of the public service your application provides for citizens or users (Karunasena & Deng, 2012)?

5. Can you comment on how you achieve the outcomes you desire for the application for both constituents, but also society in its entirety (Karunasena & Deng, 2012)?

6. How do you work toward building trust both within the application and in its features for citizens (Karunasena & Deng, 2012)?

7. How do your application work toward building the overall effectiveness of the public organization (or organizations) it relates to (Karunasena & Deng, 2012)?

8. Does your application have citizens actively participating with the application in some way and does it encourage such participation (Linders, 2012)?

9. Do you feel like when developing an application, you provide citizens with a sense of ownership in the application? That is, you empower them to be co-contributors in some

way by encouraging their investment with the application. Why or why not (de Lange & de Waal, 2013)?

10. [IF YES TO QUESTION #9] What methods do you use and why to empower citizens in developing ownership in applications?

11. [IF NO TO QUESTION #9] Why do you feel you do not pursue a strategy that develops ownership in the applications?

12. In relation to the above question, do you engage citizens directly in the development of the application? This can be as a contributor in any sense? Why or why not?

13. [IF YES TO QUESTION #12] What methods do you use and why to engage citizens?

14. [IF YES TO QUESTION #12] Does engagement only occur prior to development, or do you engage them throughout the process, and/or post development, and/or as the application continues to develop? Also, can you elaborate further on this process?

15. [IF NO TO QUESTION #12] Why do you feel you do not engage citizens in the development of your application?

16. Regarding the questions previously asked, can you comment further on if feel a strategy that empowers citizens in development is successful and if developing ownership is of importance? Why or why not?

17. What specifically do you feel are the benefits or drawbacks to engagement and developing ownership in your application? Have you seen this in practice?

18. Can you comment on the success or shortcoming of your application and what takeaways you have gathered from those experiences?

19. Do you have any other comments about questions we have previously asked or other insights you'd like to share?

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