2011

Predicting the Diffusion of Next Generation 9-1-1 in the Commonwealth of Virginia: An Application Using the Deployment of Wireless E9-1-1 Technologies

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Predicting the Diffusion of Next Generation 9-1-1 in the Commonwealth of Virginia:
An Application Using the Deployment of
Wireless E9-1-1 Technology

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

by

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April 18, 2011

ACKNOWLEDGEMENT

The author wishes to thank several people: my husband, Randy, for his love, support and patience; my grandmother, Anna Elko, for her unending love and devotion; my friend and companion Talulah, for keeping her promise; and Dr. Blue Wooldridge, my dissertation chair, for his help and direction with this project. I also want to recognize my dissertation committee members for their support and advice throughout the writing of this dissertation: Drs. Ashok Agrawala, Ivan Suen, and Roland Weistroffer, and Mr. John Ulmschneider.

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ABSTRACT

PREDICTING THE DIFFUSION OF NEXT GENERATION 9-1-1 IN THE COMMONWEALTH OF VIRGINIA: AN APPLICATION USING THE DEPLOYMENT OF WIRELESS E9-1-1 TECHNOLOGY

By Dorothy Ann Spears-Dean, Ph.D.

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This study examines the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two as a diffusion of innovation. The research method used in this study is a cross-sectional study employing secondary data in a discriminant function analysis. The study population is Virginia units of local governments (95 counties and 39 cities) that had not deployed Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two as of January 1, 2001. The period of time included in this study is from 2001 to 2006. The purpose of the study is to assess the overall accuracy of the three principle theories of policy innovation adoption: diffusion, internal determinants, and unified theory, which are variations of the fundamental diffusion theory, in predicting the deployment of wireless E9-1-1 by Virginia units of local government. This assessment was conducted by identifying Virginia specific variables from models associated with these policy innovation theories to determine the best performing model for the deployment

of Wireless E9-1-1 throughout the Commonwealth of Virginia. The Virginia specific variables utilized in this study are: Wealth, Population, Fiscal Health, Dedicated Funding, Financial Dependency, Urbanization, Regionalism, and Proximity to Interstate. Dedicated Funding and Regionalism had the largest absolute size of correlation among the predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two, thus generating the best performing model. This information will provide the basis from which to develop a statewide comprehensive policy and plan for Next Generation 9-1-1 and will help provide an answer to the question of when and how governments get involved in designing and implementing a 9-1-1 emergency service network.

CHAPTER 1: INTRODUCTION TO THE STUDY

Problem Statement

The importance of 9-1-1 as the Nation's universal emergency assistance number has long been recognized. When in need of emergency services, Americans are accustomed to relying on 9-1-1, a system that has proved its dependability through its long and successful history. This success was substantiated in a report compiled by the National Emergency Number Association (NENA) and based upon the results of a public opinion survey conducted by Harris Poll. This report validated what public safety professionals already knew, that the American public was satisfied with the current level of services it has received when dialing 9-1-1 (NENA, 2001). On the whole, the development of the United States' 9-1-1 system remains a public policy success (Hatfield, Bernthal, & Weiser, 2008).

Federal legislation has also recognized 9-1-1. The importance of 9-1-1 was first officially acknowledged with the passage of the Wireless Communications and Public Safety Act of 1999 (Hatfield, 2002). In addition to recognizing 9-1-1 as the universal assistance number, the law was enacted "to enhance public safety by encouraging and facilitating the prompt deployment of a nationwide, seamless communications infrastructure for emergency services that includes wireless communications" (http://www.fcc.gov/Bureaus/Wireless/News_Releases/2000/nrwl0029.html). Since then, the number of wireless 9-1-1 calls has dramatically increased as the type and availability of wireless communication devices have proliferated. The Cellular

Telecommunications and Internet Association (CTIA) estimates that nearly 70,000 Americans become wireless subscribers everyday (http://www.ctia.org/media/press/ body.cfm/prid/1600).

And since the passage of the historic Wireless Communications and Public Safety Act of 9-1-1, the federal government continues to acknowledge the importance of 9-1-1, as well as the need to support the development of a more technologically advanced E9-1-1 system. In 2004, Congress enacted the "Ensuring Needed Help Arrives Near Callers Employing 9-1-1" (ENHANCE) Act, which established an "E-911 Implementation Coordination Office" and authorized $250 million per year (for five years) in matching grants to enhance emergency communications services. The 9-1-1 Modernization and Public Safety Act of 2007 was introduced in an attempt to provide additional federal leadership on the transition to a next generation network for emergency communications. This bill became the New and Emerging Technologies 911 Improvement Act of 2008 (NET 911), which required Internet Protocol (IP) enabled voice service providers to provide 9-1-1 and enhanced 9-1-1 (E9-1-1) to their customers.

To deploy the wireless 9-1-1 technology, which has been described in the preceding discussion on federal legislation, has required the cooperation of some 6,000 Public Safety Answer Points (PSAPs), a myriad of commercial wireless providers, and regulatory oversight, of which the Federal Communications Commission (FCC) is the lead agency (Hatfield, 2002; Hatfield, Bernthal, & Weiser, 2008). PSAPs are the 9-1-1 call centers that are responsible for answering and processing wireless and traditional wireline calls for emergency services. Prior to the mandated deployment of wireless 9-1-1, a caller in need of emergency services accessed the 9-1-1 emergency system by dialing 9-1-1 from their wireline phones. Switching and signaling equipment provided by telecommunications carriers recognized the 9-1-1 abbreviated dialing code and relayed emergency calls to the PSAPs. A wireline 9-1-1 call that was placed in a region with Enhanced 9-1-1 (E9-1-1) capability would transmit both the caller's telephone number and address to the PSAP (Ten Eyck, 2001).

Unfortunately, these enhanced features were not originally associated with a wireless 9-1-1 call. This required the emergency operator receiving the wireless 9-1-1 call at the PSAP to gather information, such as the caller's phone number and location of the emergency, wasting valuable time. To alleviate truncated service levels between wireless and wireline 9-1-1 calls, the FCC in 1996 adopted rules in a *Report and Order and Further Notice of Proposed Rulemaking* that required wireless carriers to deliver their customers' 9-1-1 calls to PSAPs and obligated them to implement and deploy enhanced 9-1-1 features. The Commission scheduled its E9-1-1 requirements to occur in two phases. Phase One obligated carriers to transmit the phone number of the wireless handset making the call. Phase Two required more precise location technology and for carriers to provide the latitude and longitude of the wireless phone making the call.

The objective of the FCC's regulatory mandate to provide wireless E9-1-1 services was to offer mobile telephone users security and emergency services equivalent to those provided to wireline callers. However, the necessary requirements for enabling PSAPs to receive wireless E9-1-1 calls has resulted in substantial upgrades to their 9-1-1 call processing equipment, a financial and technical responsibility that has fallen largely on state and local governments. And unfortunately, the industry that supports wireless communications, and the regulatory bodies that oversee them, have historically underestimated the technical complexity and financial cost burdens associated with deploying wireless E9-1-1 (MacLeod, 2004). The underestimation of technical and financial resources, which began in the early 1990s, has been and continues to be an obstacle in the efficient, timely and cost-effective deployment of wireless E9-1-1 in the medium to long-term time frame (Hatfield, 2003; Hatfield, Bernthal, & Weiser, 2008). The result has been that it “has taken 10 years for there to be any significant rollout of wireless E9-1-1 services in the United States” (MacLeod, 2004, p. 79). In response to technological innovation, our current 9-1-1 infrastructure is a clever but “jury-rigged” system that uses yesterday’s technology to provide service in a world very different for which it was designed. “Indeed, the limits of the legacy technology used in emergency communications can best be understood by viewing today’s 9-1-1 system as an analog island in a digital sea” (Hatfield, Bernthal, & Weiser, 2008, p. 5).

To overcome the challenges to completing the implementation of wireless E9-1-1 and to determine the nationwide status of the wireless E9-1-1 effort, the FCC conducted an independent audit. The audit was performed by Dale N. Hatfield (2002) and was entitled *Report on Technical and Operational Issues Impacting the Provision of Wireless Enhanced 911 Services*. Hatfield’s findings underscored the difficulty associated with wireless E9-1-1 deployments. First, he acknowledged the difficulty of integrating digital wireless E9-1-1 into the existing 9-1-1 system, a result of the functional and capacity limitations associated with the analog infrastructure of the wireline E9-1-1 network. Secondly, he identified the lack of appropriate funding mechanisms as a deterrent to the ability of PSAPs to upgrade and allow wireless E9-1-1 services to effectively integrate to the wireline E9-1-1 network. However, as more Americans carry wireless phones and wireless use continues to grow dramatically, and as wireless handset capabilities and networks continue to expand, the government’s focus on wireless service must become a certainty (Guttmann-McCabe, Mushahwar, & Murck, 2005).

In 2008, another study, *Health of the US 9-1-1 System*, was conducted by the 9-1-1 Industry Alliance to determine the current state of technology, funding and governance of the United States 9-1-1 system. One basic conclusion of this report is that “states with effective oversight bodies are able to provide 9-1-1 services far more effectively than those without oversight…A state must offer incentives and effective guidance to spur PSAP technology upgrade ” (Hatfield, Bernthal, & Weiser, 2008, p. 5). In Virginia, there is a coordinated effort between state and local government to provide funding for wireless E9-1-1. With wireless E9-1-1 (Virginia § 56-484.17), the state of Virginia has mandated a seventy-five cents surcharge for all wireless handsets of which Virginia units of local government receive a share. Overall, state government has played a significant role in enabling and encouraging the deployment of wireless E-9-1-1 in Virginia. But, how can Virginia leverage its successes with the deployment of wireless E9-1-1 to plan for other emerging technologies, also requiring interconnection with the 9-1-1 network?

Purpose of the Study

The purpose of this empirical study is to assess the overall accuracy of the three principle theories (Berry & Berry, 1990, 1992, 1994, 1999) of policy innovation adoption – diffusion, internal determinants, and unified theory, which are variations of the fundamental diffusion theory - in predicting the deployment of wireless E9-1-1 by Virginia units of local government. This assessment will be conducted by identifying Virginia specific variables from models associated with these policy innovation theories to determine the best performing model for the deployment of wireless E9-1-1 throughout the state of Virginia. This best performing model would then provide the basis from which to develop a statewide comprehensive policy and plan for the interconnection of emerging technologies, such as VoIP, with the 9-1-1 network

In addition to the statewide deployment of wireless E9-1-1, another major technological development is already impacting 9-1-1 emergency services in Virginia. This development is the growing interest in voice delivered using Internet Protocol (VoIP) http://www.telegeography.com/ee/free_resources/reports/voip/index.php). Providing 9-1-1 emergency services for VoIP will require an enormous coordinated effort on the part of state and local governments. However, provisioning for VoIP emergency services will require a level of funding far in excess of that which can be reasonably generated through wireless surcharges (NENA, 2010; NRIC VII 1A, 2005). Virginia local governments will require a larger capital investment and a more comprehensive implementation strategy for VoIP E9-1-1 than was required for wireless E9-1-1. The technologies associated with wireless and VoIP telephony are different. The interconnection of VoIP telephony with 9-1-1 emergency services will be a more technologically complex issue than it was for wireless telephony. Nonetheless, similarities between the two technologies do exist and some of the interface solution mechanism will be repeated (NRIC VII 1B, 2004; NRIC VII 2B, 2004; NRIC VII 1D, 2005; NRIC VII 2A, 2005; USDOT, 2005, 2007; NENA, 2010). Furthermore, many of the lessons learned from wireless E9-1-1 deployments will be applicable to the planning process associated with VoIP E9-1-1. The knowledge needed to move governments closer to building optimum network solutions for emergency services, and facilitate a more rapid rollout of VoIP E9-1-1 emergency services, may be embedded in the data related to the deployments of wireless E9-1-1 (Hatfield, 2002, 2003; Hatfield, Bernthal, & Weiser, 2008).

The ability to develop a better planning process for the interconnection of emerging technologies, such as VoIP, and 9-1-1 emergency services is vital. Moreover, this new technology is already transforming many aspects of traditional telephony service (Schulzrinne, 2004). The agencies and individuals assigned the task of choosing network components related to 9-1-1 emergency services must be cognizant of the market complexity related to VoIP technology (NENA 2006, 2008; Sicker & Lookabaugh, 2004). It was the failure to understand the market complexity associated with wireless telephony that contributed to the delay in deploying 9-1-1 emergency services (Hatfield, 2002; Hatfield, Bernthal, & Weiser, 2008). Going forward, however, achieving consensus on the finer details of the architecture will be challenging and complex (Dodge, 2007). The ideal deployment process for VoIP E9-1-1 emergency services, then, would be one in which market complexity is better addressed to expedite deployments. In an attempt to gain insight into achieving this goal for VoIP E9-1-1 deployments, this study will assess the overall effectiveness of the three principle theories and associated models of policy innovation adoption in predicting previous wireless E9-1-1 deployments by Virginia units of local government. The value and significance of this study will be in providing results that can be used to enhance the deployment process by developing the best performing model to interconnect VoIP, and other emerging technologies, with 9-1-1 emergency services.

Significance of the Study

At the present time, VoIP is becoming a substitute for traditional phone service, but in the not too distant future, wireline, wireless, and VOIP will all become interchangeable solutions for telephone service (Legler, 2003). The reason behind this phenomenon is technological and industrial convergence, a topic that has received much attention among researchers (Athreye & Keeble, 2000; Fai & von Tunzelmann, 2001; Gaines, 1998; Lind, 2004; Stieglitz, 2004). Technological convergence is creating a junction among the business processes of previously separate telecommunication and technology industries through the increased use of IP-based service delivery networks. (http://europa.eu.int/ISPO/ convergencegp/97623.html; retrieved 02/13/06). The result of IP convergence will be the interchangeability among wireline, wireless, and VoIP telephony. Thus, VoIP cannot be treated as a technological island. Any analysis of VoIP must recognize its interrelated relationship with the wireline and wireless consumer telephone services (Legler, 2003). However, wireless, VoIP, and other broadband-based technologies are still unable to communicate with the 9-1-1 network in an advanced (i.e., digital and IP-based) format (Hatfield, Bernthal, & Weiser, 2008).

There is common agreement that the future network infrastructures will merely consist of a combination of dedicated access technologies connected to a common IP core in a next generation network (NGN) type of infrastructure design (Saugstrup & Tadayoni, 2004, NENA, 2010). The paramount reason for the revolutionary change has been the sweeping digitization of telecommunications and related industries. Telecommunications technology has become digital. In addition, the consumer and business telecommunications interfaces have become more versatile and closer to multifunction computers than to traditional telephones (Economides, 1998). VoIP holds the promise of integrating voice communications with other technologies to create a set of customized and personalized applications. The wireless carriers see both the promise of new services as well as the potential cost savings that VoIP can enable. This combination is becoming increasingly irresistible to pass up. The many advantages of VoIP are encouraging telecommunications carriers to experiment with the technology (Freilich, 2003).

This trend can already be seen in cellular handsets with integrated camera, video camcorder and television capabilities (http://europa.eu.int/ISPO/convergencegp/ 97623.html; retrieved 02/13/06). At the same time, cellular handset makers have their eyes on the booming “wireless fidelity” 802.11 market, too. Wi-Fi is becoming the focal point of another major convergence of technologies, from voice to data (Fourty, Val, Fraisse, & Mercier, 2005). Cell phones have begun to incorporate both cellular and VoIP technologies, using a Wi-Fi high-speed Internet connection (Rosen, 2004). However, even as these services roll-out, there are still many challenges facing the adoption of VoIP in a wireless environment (Freilich, 2003). But, regardless of the challenges inherent in VoIP technology, the transition is clear; it will be from voice oriented wireless services to data oriented wireless services. Mobile communications originated with voice telephony; the next means of promoting growth is by broadening the scope to wireless services (Jain, 2004). And along with this broadening of service functionality, must come the provisioning of 9-1-1 emergency services.

If our nation relied on a 9-1-1 network based on cutting-edge broadband Internet Protocol-based technology, it could take advantage of, rather than cripple, the capabilities of modern-end-user devices (Hatfield, Bernthal, & Weiser, 2008). Consider for example, that most modern cell phones could easily send along pictures to a PSAP of a car leaving the scene of an armed robbery, but that PSAPs are not equipped with the necessary technology to be able to receive and process such information. Similarly, the adoption of enhanced IP-based technology would enable a deaf person, who relies upon the text messaging features of a modern wireless phone, to communicate electronically with a PSAP by sending a text message to the 9-1-1 call-taker. This message could request help and convey relevant information about the emergency situation (McKay, 2007). To ensure that sufficient resources are made available to implement and operate the future of 9-1-1, state and federal governments and grant programs should reflect the growing convergence and integration of emergency response technology and agency interaction (NENA, 2010).

In Virginia, the General Assembly has required that the Virginia Wireless E9-1-1 Services Board plan for future deployments of VoIP E9-1-1, as well as the interconnection of 9-1-1 with other emerging technologies. This requirement is in addition to providing local governments with funding and technological assistance to help in the deployment of wireless E9-1-1. Unfortunately, as next generation technologies are offered to consumers, reproducing emergency services for these new technologies, and maintaining the same high levels of consumer satisfaction with 9-1-1 will become a significant challenge (Sickler, 2004). The current network that maintains E9-1-1 wireline and wireless emergency services is severely constrained, and dependent on outdated technology systems and protocols:

> In a period of unparalleled technological advances, our public safety network, on which American lives and property so greatly depend, finds itself trapped by an architecture that can no longer adapt to change. The existing 9-1-1 infrastructure is in no condition to accommodate the pervasive use of wireless technologies, the Internet, or the many other product offerings that invite or demand access to 9-1-1 services (SCC Communications Corp, 2001, p.2).

It is crucial that coordination, funding, and educational programs for both consumers and those directly involved with E9-1-1 be ramped up significantly to fully meet the nation's needs (Handler, 2005). Within this complex environment, critical network architecture choices are being made by government through policy decisions that will have a profound and lasting effect (Hatfield, 2003; Hatfield, Bernthal, & Weiser, 2008). Undoubtedly, the choice of a particular architecture, the set of specifications or framework within which the detailed design is carried out, can have far-reaching implications for a public network. Network architectures truly are becoming increasingly important components of public policy (Lessig, 1999). In the case of E9-1-1, Hatfield (2003) suggests that there may be a need for a "master architect", an entity charged with the responsibility for the overall system engineering function.

At the very least, better processes are needed to respond to this increased complexity. Furthermore, governments have a role to play in moving their citizenry and their wireless devices closer to optimum technological solutions that will facilitate a more rapid interconnection with 9-1-1 emergency services. The interconnection of 9-1-1 and wireless telephony, and eventually the entire spectrum of emerging technologies, is important not only to the economic wellbeing of all citizens, but also to preserving life, property, and homeland security. The ability to extend E9-1-1 access successfully to a rapidly growing number of non-traditional devices, systems, and networks will be hampered unless it is a current consideration in governmental policy decisions (Hatfield, 2003). The Monitor Group (2003), conducting a detailed analysis of PSAP readiness, citizens' concerns, and other related matters to wireless E9-1-1, reinforced this need when it reported that one of the implementation concerns upon which all of the stakeholders agreed was the need to "future proof" the E9-1-1 system.

Future proofing the E9-1-1 system means planning for the next generation of technologies that will follow wireless telephony. These technologies will be based on Internet Protocol (IP). A potential strategy to discover the better process, as suggested by Hatfield, and locate the knowledge needed to move governments closer to building optimum network solutions for 9-1-1 emergency services, may be embedded in wireless E9-1-1 data (Lam, 2004). The ability to develop a better planning process for 9-1-1 emergency services is vital. The fundamental questions, then, becomes when and how do governments get involved in designing and implementing a 9-1-1 emergency services network. A model derived from wireless E9-1-1 emergency services data may be an instrumental tool for governments to use when answering these questions and developing new policies.

Existing Approaches for Studying Innovation

Government innovation scholars have developed a number of explanations for the adoption of new policies. From these varied explanations, two major approaches have emerged. Following Walker (1969) and Gray (1973a), one approach has focused on the diffusion of innovation across states to explain policy innovation. The other approach, following Dye (1966), has focused on internal state determinants. However, even though these traditional innovation theories involve single-explanation models, scholars continue to recognize that a state may adopt a new policy in response to the combined effects of both internal and external conditions. Nonetheless, these same scholars have generally ignored the nonexclusive nature of these explanations, and instead have analyzed these conditions in isolation (Berry & Berry, 1999).

Since the late 1960's, the use of single-explanation models was the preferred approach (Downs & Mohr, 1976; Menzel & Feller, 1977; Sigelman & Smith, 1980; Regens, 1980; Canon & Baum, 1981; Glick, 1981; Sigelman, Roeder, & Sigelman, 1981). But in isolation, these models are a drastic oversimplification of policy innovation. The more fully a research design can control for alternative explanations of innovation, the more trustworthy is the conclusion. Recognizing that these models are not mutually exclusive, Berry and Berry (1990, 1992) proposed a third research methodology, a unified theory approach, as an inclusive model to analyze state policy innovation. The unified theory developed by Berry and Berry incorporated both internal and external influences to overcome the inadequacy of the conventional single-explanation methodologies. Since the vast majority of empirical research has tested these models individually, the conclusions about these models may provide an incomplete explanation of states' adoption of policy innovation.

In a simulation analysis, F. S. Berry (1994) called into question the bulk of the existing evidence based on single-explanation models. From this analysis, Berry found no evidence of false negatives; however, a pattern of false positives was discovered. Even though the traditional diffusion tests did not fail to detect innovation and diffusion processes when they were present, these same tests also found innovation and diffusion processes when no such influence existed. Berry and Berry (1999, 187) "believe that the key to progress in research on state innovation is the development of models sensitive to the diversity of potential influences on a state's propensity to adopt a new policy – including forces both internal and external to the state". In order to develop such a model, this study will test Virginia specific internal and external variables from various models associated with the three principle theories of policy innovation adoption – diffusion, internal determinants, and unified theory –to determine the best performing model for the deployment of wireless E9-1-1 throughout the state of Virginia. This best performing model would then provide the basis from which to develop a statewide comprehensive policy for the deployment of 9-1-1 emergency services for VoIP and other emerging technologies. State government leaders need to understand the relationship between innovations and the policy process in order to develop a successful implementation plan for the interconnection of 9-1-1 emergency services with emerging technologies.

The dominant practice in the public policy literature is to define an innovation as a program that is new to the government adopting it (Walker, 1969). As a result, one cannot claim to understand policymaking unless one can explain the process through which governments adopt new programs, and the variables that affect this process. Recognizing this fact, public policy scholars have conducted extensive research into the adoption of policy innovation. Some studies of policy innovation have been cross-national, investigating how nations develop new programs and how such programs have diffused across countries (Collier & Messick, 1975; Heclo, 1974; Brown et al. 1979; Kraemer, Gurbaxani, & King, 1992; Weyland, 2007; Simmons, 2008). Other studies have focused on innovation by local governments within the United States (Aiken and Alford, 1970; Crain, 1966; Bingham, 1977; Midlarsky, 1978). However, most public policy scholars, when conducting inquiries into the adoption of policy innovation, have focused primarily on models that use the individual states from within the United States as its unit of analysis (Walker, 1969; Gray, 1973a; Walker, 1973, Gray, 1973b; Grupp & Richards, 1975; Nelson, 1984; Clark, 1985; Freeman, 1985; Jacob, 1988; Berry & Berry, 1990; Click, 1993; Berry, 1994; Hays & Glick, 1997; Mintrom, 1997b; Mintrom & Vergari, 1998; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006; Bowman & Woods, 2007; Karch, 2007; Mintrom & Norman, 2009). Despite the dominance of the American-state model, research has not been limited since this model can easily be modified and adapted to other governmental units (Berry & Berry, 1999). In this study, in order to explain the adoption of wireless E9-1-1 by Virginia units of local governments, the three principle theories of policy innovation adoption will be used as the theoretical frame.

In the broadest sense, studies of diffusion have provided an empirical and quantitative basis that have been used to develop more rigorous approaches to theories of social change (DeFleur, 1966). As a result, diffusion has become a widely investigated research area in sociology, economics, political science, and communication (Wejnert, 2002). Rogers (1983) defines diffusion as the process by which a new idea or product is communicated through certain channels over time among members of a social system. Diffusion models are inherently intergovernmental; they view state adoptions of policies as emulations of previous adoptions by other states (Walker, 1969; Gray, 1973a; Walker, 1973; Grupp & Richards, 1975; Nelson, 1984;

Clark, 1985; Freeman, 1985; Jacobs, 1988; Berry & Berry, 1990; Berry, 1994; Hays & Click, 1997; Mintrom, 1997; Mintrom & Vergari, 1998). In contrast to the diffusion models of policy innovation adoption, internal determinants models (Berry, 1994; Berry & Berry, 1999) posit that internal state characteristics determine whether or not a state adopts a policy innovation (Regens, 1980; Glick, 1981; Canon and Baum, 1981; Filer, Moak, and Uze, 1988). Much of the popularity of the internal determinants model is due to the works of Mansfield (1961) and Griliches (1957).

Using the single-explanation theories of diffusion and internal determinants as an evaluative framework, numerous studies of state innovation have been conducted since Walker (1969) published his ground breaking research. These studies have yielded insights into the determinants of innovativeness for a variety of policy areas, thus expanding the scope of innovation analysis. However, research from the mid 1970s has not lead to major advances in the conceptualization of state policy innovation adoption or the empirical approach to investigation (Berry & Berry, 1990). Yet while the same basic diffusion and internal determinants approaches have been applied to new policy contexts for modeling government innovation, a big puzzle remains. How do ideas gain prominence on government agendas and what causes policy innovation adoption?

Even though nearly all explanations of government innovation have taken the form of either diffusion or internal determinants models, these two models are not mutually exclusive (Berry & Berry, 1999). Furthermore, the segregation of these two types of explanations has become a critical conceptual weakness in the policy innovation adoption literature (Berry & Berry, 1990). Internal determinants models typically specify no role for diffusion, or external influence (Downs & Mohr, 1976; Regens, 1980), while diffusion models generally assume that internal state characteristics have no effect (Grupp & Richards, 1975; Light, 1978). The separate treatment of these two models in the literature indicates a failure to recognize that diffusion is not a separate topic from innovation, but instead, one possible explanation for innovation (Berry & Berry, 1990).

> It is unrealistic to assume that a state blindly emulates its neighbors' policies without its public officials being influenced by the political and economic environment of their own state. It is also implausible to presume that states are totally insulated from the influences by neighboring states, given the context of federalism, active national associations of state officials, and media attention on state innovation (Berry & Berry, 1990, p. 396).

However, diffusion and internal determinants models can be unified theoretically without compromising either explanation, as exemplified in Berry and Berry's (1992) unified theory of policy innovation. Berry and Berry (1990) demonstrate that both internal and external behavioral variables that influence a state's likelihood of innovation can be predicted. This demonstration is based on Mohr's (1969, 111) theory that the propensity to innovate is a function of "the motivation to innovate, the strength of the obstacles against innovation, and the availability of resources for overcoming such obstacles." Therefore, the major task of innovation scholars is to follow the course of several recent studies and develop and test more realistic models that specify the simultaneous impacts of internal determinants and influences by other jurisdictions (Berry & Berry, 1990, 1992; Mooney & Lee, 1995; Hays & Glick, 1997; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006).

Given this theoretical frame, this study explores the following research question:

1. Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a

unified approach - generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government?

Methodology

In this study, a market research approach will be used to address the proposed research question. A market research approach is a systemic, formal, and conscious procedure for evolving and testing hypotheses about real markets (Kotler, 1988). The market research approach used in this study will bring together in a logical, unbiased, and systemic way all the information and judgments related to the three principle theories of policy innovation adoption. It will also test them against a specific event that has unfolded in Virginia, the deployment of wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. An overall model for market research, as suggested by Fildes & Hastings (1994, 5) should "concern itself with socio/technical links to its market, the reconciliation of incompatibilities in the information received, the breadth and quality of information considered in the forecasting process and the clarity of the responsibility for the flow of information that is finally transformed into the forecast." In this study, a quantitative market research forecasting technique has been chosen to explore the research question: Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model for the deployment of wireless E9-1-1 by Virginia units of local government?

The research method used in this study is a cross-sectional study. In this type of approach, a snapshot of a population at a certain time is taken, allowing conclusions about phenomena across a wide population to be drawn. The considerable collection of data needed for this approach will be satisfied with data that is currently available from the U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Commerce, U.S. Census Bureau; Commonwealth of Virginia , the Auditor of Public Accounts; and, the Commonwealth of Virginia, Virginia Information Technologies Agency's Public Safety Communication Division. The variables related to the policy innovation adoption used in the cross-sectional study were identified through a review of policy innovation adoption literature specific to the diffusion of innovation. Furthermore, these variables were used in a way that is consistent with the methodology of previous research studies based on the three principle theories of policy innovation adoption.

The specific analytical technique is discriminant function analysis. The goal of discriminant function analysis is to predict group membership from a set of predictors. In this study the goal was to discriminate between three naturally occurring groups – No Wireless E9-1-1 Deployments, Wireless E9-1-1 Phase One Deployments, and Wireless E9-1-1 Phase Two Deployments. Discriminant function analysis is broken into a 2-step process: (1) testing significance of a set of discriminant functions, and; (2) classification. The first step is computationally identical to MANOVA. There is a matrix of total variances and covariances; likewise, there is a matrix of pooled within-group variances and covariances. The two matrices are compared via multivariate F tests in order to determine whether or not there are any significant differences (with regard to all variables) between groups. One first performs the multivariate test, and, if statistically significant, proceeds to see which of the variables have significantly different means across the groups.

Once group means are found to be statistically significant, classification of variables is undertaken. DA automatically determines some optimal combination of variables so that the first function provides the most overall discrimination between groups, the second provides second most, and so on. Moreover, the functions will be independent or orthogonal, that is, their contributions to the discrimination between groups will not overlap. The first function picks up the most variation; the second function picks up the greatest part of the unexplained variation, and so on. Computationally, a canonical correlation analysis is performed that will determine the successive functions and canonical roots. Classification is then possible from the canonical functions. Cases are classified in the groups in which they had the highest classification scores. The maximum number of discriminant functions will be equal to the degrees of freedom, or the number of variables in the analysis, whichever is smaller.

Limitations

Because wireless telephony is a relatively new technology, there has not been sufficient time since the passage of the Wireless Communications and Public Safety Act of 1999 for the analysis of wireless E9-1-1 deployments to have occurred in research studies. As a result, the analytical technique chosen for this study, discriminant function analysis, has not been previously applied to wireless telephony studies. However, this analytical technique has been utilized in several past studies involving the three principle theories of policy innovation adoption examined in this study.

In this study, instrumentation must be considered. Instrumentation includes changes in the calibration of a measuring instrument or changes in the observers or scorers used that may produce changes in the obtained measurements. In this study, changes in the unit-level record file database were not expected. The simultaneous construction of the unit-level record file database from secondary data electronically obtained from websites and archived databases will help control for the effects of instrumentation.

Definitions

The following definitions are used throughout this dissertation to describe Diffusion of Innovation Theories and Wireless telephony as it relates to 911 emergency services.

9-1-1 Emergency Services: A three digit telephone number to facilitate the reporting of an emergency requiring response by a public safety agency (NENA, 2005, p. 8)

9-1-1 System: The set of network, database, and customer premise equipment components required to provide 9-1-1 service (NENA, 2005, p. 8)

Diffusion: The process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995, p. 5).

Diffusion Models: The underlying assumption of these models is that state policy innovations occur because of external influences. Examples of these external influences include a national communications network among state officials, replicating policies of neighboring states, and the emulation of state and national leaders (Berry & Berry, 1999, pp. 171-177).

Enhanced 9-1-1 (E9-1-1): An emergency telephone system which includes network switching, database and CPE elements capable of providing Selective Routing, Selective Transfer, Fixed Transfer, call routing, and location information. This definition is applicable for wireline, wireless, and VoIP 9-1-1 (NENA, 2005, p.31)

Innovation: An idea, practice or object that is perceived as new by an individual or other unit of adoption (Rogers, 1885, p. 6).

Internal State Determinants Models: These models presume that the factors causing a state to adopt a new program or policy are political, economic, and social characteristics of the state. Thus, in their pure form, these models preclude diffusion effects in which a state is influenced by the actions of other states or the national government (Berry & Berry 1999, pp. 171-178).

Internet Protocol (IP): The method by which data is sent from one computer to another on the Internet or other networks (NENA, 2005, p. 24)

Next Generation 9-1-1 Network: The next-generation network seamlessly blends the public switched telephone network (PSTN) and the public switched data network (PSDN), creating a single multiservice network. Rather than large, centralized, proprietary switch infrastructures, this next-generation architecture pushes central-office (CO) functionality to the edge of the network. The result is a distributed network infrastructure that leverages new, open technologies to reduce the cost of market entry dramatically, increase flexibility, and accommodate both circuit-switched voice and packet-switched data (http://www.iec.org/online/tutorials/next_gen/; retrieved 03/27/06).

Public safety answering point (PSAP): A facility equipped and staffed to receive 9-1-1 calls (NENA, 2005, p. 33).

Telecommunications: One, the art and science of "communicating" over a distance by telephone, telegraph and radio. And two, a fancy word for "telephony," which it has replaced (Newton, 2002, p. 733).

Telephony: The science of transmitting voice, data, video, or image signals over a distance greater than what you can transmit by shouting (Newton, 2002, p. 738).

Unified Theory Model: This model integrates the internal determinants and diffusion models of state innovation. This model is based on Mohr's analysis of organizational innovation (Berry & Berry, 1990, p. 399).

Voice over Internet Protocol (VoIP): Provides distinct packetized voice information in digital format using the Internet Protocol. The IP address assigned to the user's telephone number may be static or dynamic (NENA, 2005, p. 43).

Wireless: Means any Commercial Mobile Radio Service (CMRS) that falls under the FCC's Docket 94-102 requirement for wireless enhanced 9-1-1 service (NENA, 2005, p. 43).

Wireless Phase One: The delivery of a wireless 9-1-1 call with callback number and identification of the cell-tower from which the call originated (NENA, 2005, p.75)

Wireless Phase Two: The delivery of a wireless 9-1-1 call with Phase One requirements plus location of the caller within 125 meters 67% of the time and Selective Routing based upon these coordinates (NENA, 2005, p. 75).

Overview of the Remaining Chapters

In chapter two, a review of the Diffusion of Innovation literature is presented for internal state determinants, diffusion, and unified theory models and the research hypotheses are developed.

In chapter three, the methodology of the study is provided. The methodological elements will include the type of study and research settings, the sample, operationalization of the variables, statistical techniques to test hypotheses, and plans for assessing reliability and validity.

In chapter four, the results of the study are presented and discussed. This includes an interpretation of the results, an outline of the strengths and weaknesses of the research strategy in relation to previous research, and a discussion of the contributions made to the field of diffusion of innovation.

In chapter five, the evaluation and interpretation of the results, conclusions, and suggestions for future research and public policy are presented.

Chapter 2: LITERATURE REVIEW

Introduction

In chapter one, the following research question was posed: Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model for the deployment of wireless E9-1-1 by Virginia units of local government? In order to provide an answer to this question, the Diffusion of Innovations (DOI) theory will be utilized in this study.

> "Diffusion" refers to the process of communicating an innovation to and among the population of potential users who might choose to adopt or reject it (Zaltman et al. 1973). An understanding of the diffusion process can aid in allowing those who could benefit from an innovation, such as a new technology, to begin accruing those benefits earlier. By identifying critical social factors and processes in the adoption, implementation, and utilization of a technology, the literature indicates that decision making responses of individuals, groups, and organizations may be predicted and therefore may also be accommodated or redirected through prescriptive strategies (Convenor, 2001).

But what does the DOI theory encompass? The DOI theory is a broad psychological and sociological theory that describes the patterns related to how innovations are adopted, explains the mechanism that underpins these patterns, and assists in predicting whether and how a new invention will be successful (Rogers, 1962, 1971, 1983, 1995, 2003; Clarke, 1999; Fitzgerald, 2002). Rogers (2003) states that "no other field of behavior science research represents more effort by more scholars in more disciplines in more nations" (see also Musmann & Kennedy, 1989, Restar, Lachman, Lempbert, & Pinto, 1999; Clarke, 2001; Klopfenstein, 2002). Over the years, the DOI theory has established a rich tradition of multi-discipline research. In the same year that Rogers made the preceding statement, the number of diffusion publications was over 4,000 and represented diffusion research conducted in the following disciplines: anthropology, agricultural economics, communication, education, early sociology, geography, general economics, general sociology, industrial engineering, marketing and management, public health and medical sociology, psychology, public administration and political science, rural sociology, and statistics (Rogers, 2003, pp. 44-45). However, the specific focus of this study's literature review will be on policy innovation adoption research.

Berry & Berry (1999) posit that policy innovation may be traced back to a policy innovation and that the reasons for why government units innovate can be reduced to three: to learn from one another (Simon, 1947; Lindblom, 1965; Walker, 1969), to compete with one another (Walker, 1969; Peterson & Rom, 1990; Gray, 1994), or to respond to internal public pressure to adopt policies that have been initiated by another governmental unit (Berry & Berry, 1990). The principle models used to research government innovation in the public policy literature may be traced to versions of the basic diffusion model discussed later in this chapter.

Furthermore, the DOI theory has been applied to information technology ideas, artifacts, and techniques, and has been used as the theoretical basis for a number of information systems and information technology research projects (see Fichman, 1992). In these applications, the DOI theory was used to explain the manner in which a new technological idea, artifact, or technique, or the new use of an old technological idea, artifact, or technique, migrated from creation to eventual use (Cleland, 2001). The utilization of DOI theory in these types of previous research projects reinforces the suitability of using theories and models derived from DOI theory as the theoretical framework for a study involving wireless E9-1-1 telecommunications. In this chapter, the DOI theory literature that pertains to the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - will be reviewed and the various models associated with these theories will be discussed. This literature review will provide the foundation for the hypotheses presented in this chapter.

Basic Concepts

The diffusion of an innovation has been defined as the process by which innovation "is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p.5). Embedded in this definition are the four main elements related to the diffusion of innovations: the innovation, communication channels, time and the social system (Rogers, 2003, p. 10; Mahajan & Peterson, 1985, p. 7). Over a span of thirty years reviewing DOI research, Rogers (1962, 1971, 1983, 1995, and 2003) observed "these elements are identifiable in every diffusion research study" (Rogers, 2003, p.10). In addition to the four key elements, another basic concept of the diffusion process is the S-shaped curve. The diffusion pattern of most innovations may be described in terms of this S-shaped curve. In this section the four key elements in the diffusion process are introduced along with the S-shaped curve.

"An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p.12). Thus, if something is new in a particular setting, it can be seen as an innovation. Furthermore, "the newness of an innovation is irrespective of time and may be expressed in terms of knowledge, persuasion or a decision to adopt" (Mahajan & Peterson, 1985, p. 7). However, with regards to knowledge as a descriptive element of "newness", further clarification is needed. An innovation can only be considered new so long as the individual, or other unit of adoption, has "not yet developed a favorable, or unfavorable attitude toward it, nor have adopted or rejected it" (Rogers, 2003 p. 12).

The second element in the diffusion process is the communication channel. Diffusion is a particular type of communication in which the "message content that is exchanged is concerned with a new idea" (Rogers, 2003, p.18). The exchange process, whereby an individual communicates a new idea to another individual or to a group of individuals, is the vital element of the diffusion process. Communication channels are the means by which messages are transferred from one individual to another and may be either mass media channels or interpersonal channels. For example, Berry & Berry, (1999, p. 172) when reviewing the various external-influence policy research models in the literature, observed that each focused on a different communication channel. These specific external-influence policy research models will be discussed later in the literature review, and are as follows: the national interaction model, the regional diffusion model, the leader-laggard model, and the vertical influence model.

Time is the third element in the diffusion process. Rogers (2003) identifies three instances in which the time dimension is involved. The first instance is during the innovation-decision process. This process is the method through which "an individual (or other decision making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision" (Rogers, 2003, p. 20). The second instance is through the innovativeness of an individual or other unit of adoption. Innovativeness is the degree to which "an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system" (Rogers, 2003, p.22). Frequently, the level of innovativeness is characterized by using adopter categories. The different adopter categories are identified as:

innovators (venturesome), early adopters (respectable), early majority (deliberate), late majority (skeptical) and laggards (traditional) (see generally Rogers, 1962, 1973, 1985, 1995, 2003; and Clark, 1999).

The third instance in which the time dimension is involved in the diffusion of innovations is by measuring the rate of adoption. The rate of adoption is "the relative speed with which an innovation is adopted by members of a social system" (Rogers, 2003, p. 23). The time element of the diffusion process also enables the drawing of diffusion curves. Rogers (1962, 1971, 1983, 1995, 2003) observes that the adoption of innovation generally follows two curves. When plotted over time on a frequency basis, the curve is a normal, bell-shaped (frequency) curve. When plotted by the cumulative number of adopters, the curve is an S-shaped (cumulative) curve (Regan, 1996).

The last element in the diffusion process is a social system. A social system is defined as a "set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (Rogers, 2003, p. 23). The social system constitutes a boundary within which an innovation diffuses. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems (Ryan & Gross, 1943; Sharp, 1952; Rogers & Kincaid, 1981). Furthermore, the social structure of a social system, which is the patterned arrangement of the units in the system "gives regularity and stability to human behavior in a system; it allows one to predict behavior with some degree of accuracy" (Rogers, 2003, p. 24). Thus, the structure of a social system can facilitate or impede the diffusion and adoption of innovations in a system.

The S-shaped diffusion curve is a graphic representation of the diffusion of an innovation. Gabriel Tarde, a French sociologist and legal scholar, first described this concept in his 1903 book, *The Law of Imitation*. In this curve, the percentage of adopters is plotted on the vertical axis and time is represented on the horizontal axis. Innovators and early adopters represent the bottom tail of the "S." The early majority represents the "takeoff" of the innovation, which occurs when diffusion reaches a critical mass point, when "individuals perceive 'that everyone else' has adopted the interactive innovation" (Rogers & Singhai, 1966, p. 418). The two remaining adopter groups, the late majority and laggards, are the top tail of the "S" (Alvanitakis, 2000).

> When the number of individuals adopting a new idea is plotted on a cumulative frequency basis over time, the resulting distribution is an S-shaped (sigmoid) curve. At first, only a few individuals adopt the innovation in each time period (such as a year or a month, for example: these are innovators). But soon the diffusion curve begins to climb, as more and more individuals adopt in each succeeding time period. Eventually, the trajectory of adoption begins to level off, as fewer and fewer individuals remain who have not yet adopted the innovation. Finally, the S-shaped curve reaches its asymptote, and the diffusion process is finished (Rogers, 2003, p. 23).

The cumulative number of adopters takes the form of an S-shaped (sigmoid) curve, while the frequency distribution of the number of mean adopters is a bell-shaped (normal) curve (Rogers, 1995, 2003; Mahajan & Peterson, 1985; Gurbaxani, 1990). Rogers (2003) observes that many human traits are normally distributed. As a result of this observation, he concludes that the degree of innovativeness should also be normally distributed. If this reasoning is extended to the social system level, the expectation is that "experience with the innovation [is] gained as each successful member in the social system adopts it" (Rogers, 2003, p. 272). Then, a normal adopter distribution may be expected because of the "cumulatively increasing influences upon an individual to adopt or reject an innovation, resulting from the activation of peer networks about the innovation in the system" (Rogers, 2003, p. 274). Even though the rate of adoption may vary among innovations, the S-shaped diffusion curve still allows for the classification of adopters into the established categories of innovators, early adopters, early majority, late majority and laggards.

Diffusion Models

Much of the early research on diffusion processes focused on describing observed diffusion patterns in terms of pre-specified trends or distribution functions (Mahajan & Peterson, 1985, p. 10). Mahajan & Peterson (1985) explain that because any unimodal distribution function will generate an S-shaped curve, it is often not possible to empirically determine which of several competing trends or distribution functions best describes a given diffusion curve. Therefore, "attempts have been made to develop theory-based 'diffusion models' for analyzing and modeling the spread of an innovation over time" (Mahajan & Peterson, 1985, p. 10).

> In particular, diffusion models have been developed to represent the level or spread of an innovation among a given set of prospective adopters in a social system in terms of a simple mathematical function of the time that has elapsed from the introduction of the innovation. The purpose of a diffusion model is to depict the successive increase in the number of adopters or adopting units over time. By doing so, a diffusion model permits prediction of the continued development of the diffusion process over time as well as facilitates a theoretical explanation of the dynamics of the diffusion process in terms of certain general characteristics (Mahajan & Peterson, 1985, p. 10).

In the next section the basic or fundamental diffusion model is established and its major components and underpinnings are examined. The next section also examines the three principle versions of the fundamental diffusion model: the external-influence model, the internal-influence model, and the mixed-influence model which are taken from Mahajan & Peterson (1985, pp. 12-22). Each of these models can be associated with one of the three principle theories of policy innovation adoption. The external-influence model, the internal-influence model, and the mixed-influence model correspond to the following policy innovation adoption theories, respectively: diffusion, internal determinants, and a unified approach, with each version resulting "in a diffusion curve the parameters of which possess both theoretical and practical interpretations and implications" (Mahajan & Peterson, 1985, p. 15). After this next section is a crosswalk to the diffusion and innovation models that dominate government innovation in the public policy literature (Gray, 1994; Berry, 1994; Berry & Berry, 1999; Miller, 2004).

Assumptions under the Fundamental Diffusion Model

There are seven assumptions on which the fundamental diffusion model is based and that bound the limit of research analysis, findings, and generalizations (Mahajan & Peterson, 1985, pp. 24-25).

First, the diffusion process is binary (Sharif & Ramanathan, 1981). The innovation is either adopted or rejected. The adoption decision is a discrete rather than continuous event.

Second, the number of potential adopters in the social system are fixed and either known or estimable. The model is static versus dynamic (Mahajan & Peterson 1978; Sharif & Ramanathan, 1981).

Third, the number of adoptions is fixed at one end and, once adopted, cannot be reversed.

Fourth, in the internal-influence and mixed-influence models, there is complete, Pairwise interaction between prior adopters of an innovation and potential adopters. The interaction effect is identical throughout the times of adoption and interaction.

Fifth, the innovation is static throughout the process and independent of other innovations.

Sixth, the geographical boundaries of the social system are static; there is no spatial diffusion.

Seventh, there is perfect information about the diffusion process.

Given these assumptions, there are relatively few "ideal" situations in which the fundamental diffusion model can be applied without caveats, restrictions, or extensions. However, in practice it can still be applied without serious consequences. Mahajan & Peterson (1985, pp. 25-26) cite as an example an analysis of the diffusion of several public policy innovations (e.g. accountant licensing, community affairs programs, gasoline tax) among the continental U.S. by Mahajan, Haynes & Bal Kumar (1977). "In their application, the assumptions of a binary diffusion process, constant number of potential adopters (48), one adoption per unit (and no likely discontinuance), fixed geographical bounds, and complete mixing of social system members appeared reasonable" (Mahajan & Peterson, 1985, p.26).

External-Influence Policy Research

There is a large body of research documenting certain aspects of the diffusion of policy innovation among the American states (e.g., Walker, 1969; Gray, 1973a; Walker, 1973, Gray, 1973b; Grupp & Richards, 1975; Nelson, 1984; Clark, 1985; Freeman, 1985; Jacob, 1988; Berry & Berry, 1990; Click, 1993; Berry, 1994; Hays & Glick, 1997; Mintrom, 1997b; Mintrom & Vergari, 1998; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006; Bowman & Woods, 2007; Karch, 2007; Mintrom & Norman, 2009). This large body of research has generated several policy research models that are variants of the external-influence model described above. The external-influence policy research models catalogued by Berry & Berry (1999) are the national interaction model, the regional diffusion model, the leader-laggard model, and the vertical influence model. These models differ in their channels of communications and the level of influence that exists.

The national interaction model presupposes that the states interact on a national basis, whereas the regional diffusion model replaces the national scope of influence with one that is regional- or geographical based. The leader laggard model assumes that certain states will rise as leaders usually within a geographical region; however, national leaders are also possible. This assumption derives from the presumption that “in any policy area, some states’ personnel are more highly regarded by their peers than the other states’, and that policymakers are more likely to turn to these states for cues” (Berry & Berry, 1999, p. 176). The final model, the vertical influence model, posits that there are no state leaders, and as a result, the national government serves as a surrogate state leader.

The national interaction model is a learning model (Gray, 1973a, 1973b; Walker, 1973; Menzel & Feller, 1978; Glick & Hays, 1991) that assumes uniformity of the diffusion of the innovation across the states. The regional interaction model is a learning, competition and public pressure model (Elazar, 1972; Berry & Berry, 1990; Mooney & Lee, 1995; Daley & Garand, 2005) that assumes the diffusion of the innovation across the states is dependent on proximity to other states. The leader-laggard model is another learning model (Walker, 1969; Collier & Messick, 1975; Grupp & Richards, 1975; Foster, 1978; Volden, 2006), which in this case, presumes certain states emerge as role models to be emulated. And lastly, the vertical influence model is a quasi-learning model in that there is a leader as called for in the leader-laggard model, but in this case it is the national government (Derthick, 1970; Brown, 1975; Welch & Thompson, 1980; Berry) , Fording, & Hanson, 2003 that serves as a leader. And unlike the leader-laggard model, the national government leader is able to dictate or provide incentives to effect diffusion.

The National Interaction Model

The national interaction model assumes a national communication network among state officials regarding public sector programs, in which officials learn about programs from their peers in other states. It is presumed that officials from states that have already adopted a program interact freely and mix thoroughly with officials from those states that have not yet adopted it. These interactions are typically found in the form of communication channel networks such as the National Governor's Association and the National Conference of State Legislatures (Berry & Berry, 1999). It is further presumed that each contact by a not-yet-adopted state with a previous adopter provides an additional stimulus for the former to adopt. Berry and Berry (1999) cite Gray's (1973a) analysis of the adoption of laws in the policy areas of education, welfare, and civil rights as the best representation of this type of policy research model. The laws considered in Gray's study were taken directly from issue areas central to the "Have-not" struggle, described as the essence of politics by V. O. Key, Jr. (1949, p. 307). The reason for this choice is that "it is more likely that a political explanation, not an economic one, can account for the differences in selected 'have-not'-oriented policy areas than it can for the broad range of policy areas included in some studies" (Gray, 1973a, p. 1174). Other representational and noteworthy studies utilizing the national interaction model include Menzel & Feller's (1978), which analyzed the adoption rate of new technologies by state highway and air pollution officials and Glick & Hays' (1991), which explored the diffusion of living will laws, and finally Mintrom & Norman's (2009), which investigates policy entrepreneurship.

The Regional Diffusion Model

The regional diffusion model narrows one of the assumptions shared with the national interaction model. This assumption is that the interaction between prior adopters of an innovation and potential adopters is identical throughout periods associated with adoption and interaction (Berry, 1994). The regional diffusion model qualifies this assumption further by positing that this interaction is limited by geographical proximity. The manner in which geographic proximity is defined is the basis for the two variants of the regional diffusion model: neighbor models and fixed-region models.

The neighbor model assumes that states are influenced primarily by those states with which they share a border when explaining whether states will emulate the policies of other states. For example, Berry & Berry (1990) hypothesized that the likelihood that a state will adopt a lottery is positively related to the number of states bordering it that have already adopted a lottery (see also Lutz, 1986; Allen & Clark, 1984). On the other hand, the fixed –region model assumes that states are influenced primarily by those states with which they are associated as a region. This association may be based on similar climate, geography, traditions and history (e.g., New England, Middle Atlantic, South, Midwest, Southwest, and West; see also Walker, 1969). The fixed-region model has been used to explain welfare-to-work laws (Elazar, 1972), school choice (Mintrom, 1997b, 2000a), abortion regulation reform (Mooney & Lee, 1995), state death penalty laws (Mooney & Lee, 1999), and interstate compacts (Bowman & Woods, 2009).

Although fixed-region and neighbor models are similar to the degree that their emphasis is on the emulation of nearby states, the models are subtly different in their specified channels of influence. Whereas the neighbor model suggests the unique channel of influence of the individual bordering states (e.g. Texas and Oklahoma), the fixed-region model holds that states in the same region (e.g., Vermont and Maine) experience the same channel of influence. Berry & Berry (1999) have suggested that these two models could be united by positing that states are influenced most "by their neighbors, and also by other states that are nearby" (p. 176).

Leader Laggard Model

The leader-laggard model assumes that certain entities are pioneers in the adoption of a policy and that other entities emulate these leaders in a learning process (Walker, 1969). Most often, scholars presume that leadership is regional and states take their cues from key states within their geographic region (Walker, 1969, 1973; Grupp & Richards, 1975; Foster, 1978; Mooney & Lee, 1995). However, this model can also be modified to incorporate states that act as national leaders, encouraging other states to adopt new programs, regardless of geographic location (Walker, 1969; Volden, 2006). The reason for this is that some states' personnel are more highly regarded by their peers than other states' and policymakers are more likely to turn to these states for cues (Berry & Berry, 1999). For example, in environmental policy one assessment of the top innovative states named Maine, Oregon, Connecticut, New York, Minnesota, New Jersey, Rhode Island and Wisconsin as the top ranking states (Hall and Ken, 1991).

The leader-laggard model is appropriate for situations in which the innovation is adopted in a learning environment and not one of competition or pressure (e.g., environmental regulation – Sbragia, 1997; Indian gaming policy –Boehmke & Witmer, 2004). Berry & Berry (1999) point out that that the leader-laggard model has two significant flaws, making it virtually nontestable. These two flaws are the inability to predict a priori the states that are expected to be leaders in specific policy adoption and the order in which the remaining states will follow in adopting specific policy. However, one leader-laggard model that clearly specifies the channels of diffusion is the hierarchical model developed by Collier & Messick (1975). Collier & Messick used this model in a study that analyzed the pattern of social security adoptions by nations around the world. In this study the authors hypothesized that the pioneers in social security were highly economically developed nations and that social security programs diffused down a hierarchy of nations from most developed to least developed. Unfortunately, even though their hierarchical model specifically posited the diffusion of a policy across jurisdictions, its empirical prediction of a strong relationship between economic development and earliness of adoption was not substantiated, making it indistinguishable from that of an internal determinants model that assumes no influence of states on one another (Berry & Berry, 1999).

Vertical Influence Model

The vertical influence model, which is similar to the leader-laggard model, posits that states emulate leaders. However, in the vertical influence model the superior of the adopting unit is the source for emulation, rather than a peer as is the case in the leader-laggard model. Under the vertical influence model an individual state would emulate the policy of the national government. Typically states and other organizations emulate the national government both through policy learning, and because of incentives that the federal government provides, such as financial incentives through grant-in-aid programs (Berry & Berry, 1999). Welch and Thompson (1980) found that policies for which the federal government offers financial incentives diffuse faster than policies lacking such incentives. Furthermore, this model has been extended to the investigation of state welfare programs (Derthick, 1970; Berry, Fording, & Hanson, 2003).

Internal-Influence Policy Research

Perhaps the most widely cited applications of the internal-influence model are those of Mansfield (1961) and Griliches (1957). Mansfield investigated the diffusion of several industrial innovations such as pallet loaders, diesel locomotives, and continuous mining machines among firms. Griliches studied the diffusion of hybrid seed corn in 31 states and 132 crop-reporting areas among farmers. Applications of the internal-influence model has been illustrated further by the research of (1) Gray (1973a) that investigated the diffusion of 12 public policy innovations among the 48 contiguous United States, (2) Hendry (1972) that studied the sales growth of selected durable goods in the United Kingdom, (3) Dixon (1980) that applied Griliches' hybrid seed corn data to arrive at differential rates of technological diffusion, and (4) Burns (1989) that studied the matrix management programs of 315 hospitals and found moderate support for the hypothesis that internal diffusion and temporal coverage increase over the four levels of matrix complexity.

In contrast to the policy research diffusion models, the policy research internal determinants models (Berry, 1994; Berry & Berry, 1999) posit that internal state characteristics determine whether a state adopts an innovation (Walker, 1969; Gray, 1973a; Regens, 1980; Canon & Baum, 1981; Glick, 1981; Filer, Mosk & Uze, 1988). The factors causing a state to adopt a new program or policy are political, economic, and social characteristics of the state. In this model, the state is the unit of analysis and the dependent variable is the propensity of a state to adopt a policy or set of policies. Traditionally, empirical analysis is cross-sectional, and the dependent variable is measured at the interval level by year of adoption or at the ordinal level by the rank of a state when states are ordered at the time of adoption (Canon and Baum, 1981; Glick, 1981; Gray, 1973a; Walker, 1969). The most recent research applying these models refines the unit of analysis as state still eligible to adopt in a particular year (Berry & Berry, 1990, 1992; Hays & Glick, 1997; Mintrom, 1997).

The application of internal determinants models is characterized by two approaches. The first is a macro-level perspective which maintains that the relative influence of political and economic variables is consistent across policy areas (see Walker, 1969; Savage, 1978). However, when one is studying the innovativeness of the states as reflected in their earliness of adoption, attention can focus on either one policy or a set of policies. At one extreme are studies designed to explain states' adoption of a single policy or program (e.g., Berry & Berry's 1990 analysis of the lottery and Hays and Glick's 1997 research on state living wills). Other internal determinants models have focused on multiple policy instruments in a single issue area (e.g., Sigelman and Smith's 1980 research on consumer protection). At the other extreme is Walker's (1969) analysis of the determinants of a state innovativeness index reflecting the earliness of adoption of a set of eighty-eight policies spanning a wide range of economic and social issue areas and Savage's (1978) innovativeness measure based on sixty-nine policies.

The second is a micro-level perspective which maintains that the relative influence of political and economic variables varies across policy areas (see Gray, 1973a). Implicit in the Walker and Savage measures of innovativeness is the claim that it is reasonable to conceive of a general proclivity of a state to innovate across a wide range of issue areas. Some are skeptical of this claim. For example, in a classic exchange with Walker, Gray (1973a, 1973b) claimed that states can be highly innovative in one program area, but less innovative in others, thereby rendering any general innovativeness score useless. Subsequent studies have not united these two approaches (Canon & Baum, 1981; Glick, 1981; Nice, 1984, 1986; Regens, 1980; Sigelman, Roeder, & Sigelman, 1981).

Mixed-Influence Policy Research

This version is referred to as the mixed-influence diffusion model because it subsumes both of the previous models by incorporating parameters representing external as well as internal influences. As such it is the most widely used and most general of the three fundamental diffusion models because it can accommodate the assumptions of the other two. Most applications of the mixed-influence diffusion model have been concerned with forecasting the long-term sales of consumer durable products. The initial application of the mixed-influence diffusion model in this context was by Bass (1969), who used it to successfully forecast the sales of such products as television sets, dishwashers, and clothes dryers. Applications of the mixed-influence model have been illustrated further by the research of: (1) Webber (1972) that investigated the impact of location, (2) Lekvall & Wahlbin (1973) that studied diffusion patterns, (3) Lawton & Lawton (1979) that studied educational innovations, (4) Warren (1980) that studied the spread of competitive floorball in Sweden in the 1980s and the 1990s, (6) Dos Santos & Peffers (1998) that studied the adoption of automated teller machines (ATM) technology by U.S. banks between 1971 and 1992 and (7) Wright, Upritchard, & Lewis (1998) that examined the diffusion of technology based service products and telecommunication products in New Zealand.

Although the mixed-influence approach has allowed scholars of state government innovation to undertake studies that simultaneously incorporate variables derived from internal determinants and variables derived from external diffusion impacts, thus far these studies have been limited. The most common have been neighbor-to neighbor influence (Berry & Berry, 1990, 1992; Hays and Glick, 1997; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006) and a specific form of fixed-regional diffusion (Mooney and Lee, 1995). One of the reasons for the limited number of studies is the requirement of pooled data. Independent variables must be observed for each year in each state during the period of analysis. Data collection is especially challenging when the independent variables go beyond aggregate state characteristics to include the nature and behavior of policy entrepreneurs, interest groups, and advocacy coalitions (Berry & Berry, 1999).

The role of political forces is an emerging and interesting sub-group within the mixed-influence approach literature and is particularly relevant when discussing the adoption of policies related to new technologies. Policy adoption in the Unites States has been linked to a variety of external and internal state characteristics (Berry & Berry, 1990, 1992; Mooney and Lee, 1995; Hays and Glick, 1997; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006). Identifying these characteristics is valuable because it helps us understand the decision to adopt a policy in an individual state. Yet is does not help us to understand the political process through which policies diffuse within a state and from one state to another (Karch, 2007). Consequently, one of the most promising developments in policy innovation adoption is the emerging focus on political forces that operate within and across multiple states, including national organizations, policy entrepreneurs, and national government intervention.

An awareness of, and an interest in, political and policy developments elsewhere may be necessary for policy diffusion. For example, an important part of the mission statement of think tanks and policy research institutes typically is the diffusion of policy information to policymakers, which they accomplish by publishing books and periodicals and hosting conferences that facilitate the development of professional networks (Rich, 2004; Weaver, 1989; McGann, 1992). It was precisely through these types of organizations that the concept of “technology foresight” diffused. This concept took off in the 1990s as the United States and European countries sought new policy tools to deal with problems in their science, technology, and innovation systems (Miles, 2010). On an individual level, this same diffusion activity is carried out by policy entrepreneurs. While the activities of policy entrepreneurs have received close attention in several studies (Crowley, 2003; Kingdon, 1984/1995; Mintrom, 2000; Roberts & King, 1991; Weissert, 1991, the concept of policy entrepreneurship is yet to be broadly integrated within studies of technological policy changes (Mintrom & Norman, 2009).

On the other hand, national government officials have a variety of tools at their disposal to influence state policymaking. Financial incentives represent “perhaps the easiest and most direct way for the national government to influence state policymaking” (Allen, Pettus, & Haider-Markel, 2004, p. 326). However, until recently, Washington has been reluctant to shepherd new technologies, and as a result, influence state policymaking. This was certainly the case with Washington’s disinclination to enact a new regulatory scheme to spur competition among broadband Internet, video, and phone services (Stencel, 2007). However, the national government’s approach to the digital TV transition has been different. In the Digital and Public Safety Act of 2005, the FCC took the lead in establishing a deadline for broadcasters to turn off their traditional analog television sets and give part of the radio spectrum used for analog TV signals to provide room for new communications channels for emergency personnel. The ability of states in the future to utilize this spectrum for their own emergency personnel will have a tremendous impact on state policymaking http://edocket.access.gpo.gov/2011/pdf/2011-4549.pdf; retrieved 04/13/11).

The hypotheses tested in this study have been developed utilizing a mixed-influence approach, which is consistent with the unified theory of policy innovation adoption. This approach was chosen because of its inclusive nature. The unified theory of policy innovation adoption provides greater flexibility in developing the best performing model for the deployment of wireless E9-1-1 by Virginia units of local government because it includes "forces both internal and external to the state" (Berry and Berry, 1999, p. 187). As a result, hypotheses tested in this study will include both internal and external variables.

The Hypotheses

There is considerable support in the literature for the importance of wealth, as measured by a state's level of economic development, as a predictor of the diffusion of innovation (Rogers, 1962, 1971, 1983, 1995, 2003; Klingman & Lammers, 1969; Walker, 1969; Mooney & Lee, 1995; Goodwin, 2001). One consequence of this development is a lager private resource base that enhances fiscal capacity, thereby giving to government its inherent ability to generate revenues (Barr, 1986). The most common indicator of fiscal capacity in the public finance literature is per capita personal income (Berry and Berry, 1992). Numerous studies have found that economically developed studies have higher levels of government service and expenditures than less developed states (Dye, 1966; Sharkansky, 1968; Plotnick and Winters, 1985). Wagner's Law explicitly maintains that that the demand for governmental services should increase with personal income (Wagner, 1877; Mann, 1980; Berry and Lowery, 1987).

Hypothesis 1: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 2: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

There is also considerable support in the research literature for the importance of population size as a predictor of the diffusion of innovation (Rogers 1962, 1971, 1983, 1995, 2003; Walker, 1969; Gray, 1973a; Gray, 1973b, 1994; Foster, 1978; Berry, 1994; Godwin, 2001). Local governments with larger populations are assumed to have a greater resource base and create a more dynamic environment for generating innovations.

Hypothesis 3: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 4: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

For local government, the most important economic determination of motivation is short-term fiscal health (Hansen, 1990; Berry & Berry, 1990, 1992). The level of fiscal health is defined as the degree to which a local government's revenues keep pace with its spending commitments and priorities (Berry & Berry, 1992). Local governments with higher revenue levels are more likely to have slack resources available, such as capital funding, which would enable innovations to be adopted more easily, particularly if they are expensive and technologically complex (Rogers 2003).

Hypothesis 5: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 6: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

However, the question then becomes are these slack resources adequate to generate the development of specific innovations, such as the deployment of wireless E9-1-1? Or, are additional financial resources needed? Hatfield (2002, 2008) identified that the lack of adequate funding for the non-recurring and recurring costs involved with wireless E9-1-1 at the local government level as a reason for the delay in the deployment of this vital resource.

Hypothesis 7: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

Hypothesis 8: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

However, wireless funding revenue, by itself, may not provide enough funding. Many new governmental programs require major expenditures. The availability of extraneous financial resources is often a necessary and additional prerequisite for adoption (Berry &

Berry, 1999). These extraneous funding sources, thus, create a financial dependency on the part of local government to maintain such programs as wireless E9-1-1.

Hypothesis 9: For a Virginia unit of local government, the greater the percentage of wireless surcharge revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 10: For a Virginia unit of local government, the greater the percentage of wireless surcharge revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Like income, greater urbanization, and the associated industrialization, should result in greater fiscal capacity and increase the demand for governmental services (Hofferbert 1996). PSAPs located in urbanized areas of the state can take advantage of these benefits.

Hypothesis 11: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 12: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it is to deploy Wireless E9-1-1 Phase Two.

Walker (1969, 888-89) argues that states emulate policies adopted by other states as a way of "satisficing" (to use Simon's 1957 term); to simplify the decision-making process, public officials faced with a problem take cues from other states' responses to that problem when choosing a course of action (see also Sharkensky, 1970, 1998; Light, 1978; Freeman, 1985). This is because the policy options that are most easily identified and about which information is most readily available are those options that have already been implemented by nearby states.

Hypothesis 13: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed.

Hypothesis 14: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to the proximity of other Virginia units of local government that have already deployed.

And finally, interstate highways play a major role in the deployment of wireless technology. Historically, wireless carriers have established the build out of coverage along interstates because of the high volume of calls from motorists (Wikle, 2001).

Hypothesis: 15: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its proximity to one or more interstate highways.

Hypothesis: 16: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its proximity to one or more interstate highways.

Chapter 3: METHOD

Introduction

In this chapter I present the methodology that will be used to execute this study. This chapter is organized into five sections.

Section one provides a summary of the research question identified in chapter one and the associated hypotheses stated in chapter two.

Section two identifies and describes the elements to be used in the research design using a framework developed by Miller & Salkind, (2002). These elements include study design, type of data available, temporal dimension, sample or universe to be studied, sample size, data source, data gathering method, number of independent variables, and number of dependent variables. The factors affecting internal and external validity of the research design (Cook & Campbell, 1979) will also be covered. Internal validity focuses on bias. Factors affecting internal validity include history, maturation, testing, instrumentation, statistical regression, selection, mortality, and interactions with selection. External validity focuses on generalizability. Factors affecting external validity include the interaction of selection and treatment, interaction of setting and treatment, and the interaction of history and treatment.

Section three discusses the instrumentation to be used for this study (see McDade, 1999) and addresses the following questions: which instrument will be used and why, where the instrument came from and how it was developed, and the appropriateness of the instrument for the goals of this study.

Section four describes the procedures for collecting data (see McDade, 1999). This section includes how the instrument is to be administered and how the data are to be collected.

Section five states the procedures to be used for treating, coding, and analyzing data. This section documents what will be done with the data after it has been collected, how it will be entered into a computer for analysis, and how it will be cleaned up and standardized.

Section One: Research Questions and Hypotheses

This study will address the following research question: Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model for the deployment of wireless E9-1-1 by Virginia units of local government? The research question will be answered by testing the following hypotheses:

Hypothesis 1: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 2: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

Hypothesis 3: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 4: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 5: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 6: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 7: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

Hypothesis 8: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

Hypothesis 9: For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 10: For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 11: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 12: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 13: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed.

Hypothesis 14: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to the proximity of other Virginia units of local government that have already deployed.

Hypothesis: 15: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its proximity to one or more interstate highways.

Hypothesis: 16: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its proximity to one or more interstate highways.

Section Two: Research Design

In this section I identify the key elements of the research design that will influence the outcome of this study. Table 1 presents these research elements and the corresponding choices in tabular format.

Table 1
Elements of the Research Design

Research Element	Research Decision
Study Design	Cross-Sectional Study
Type of data available	Quantitative analysis
Temporal Dimension	Cross-sectional
Sample or universe to be studied	Society (Virginia cities and counties)
Sample size	Population
Data source	Archived or secondary data to be collected
Data gathering method	Unobtrusive measure (examination of data collected by: • U.S. Department of Commerce - the U.S. Census Bureau, • U.S. Department of Commerce – Bureau of Economic Analysis, • Auditor of Public Accounts for the Commonwealth of Virginia, • Public Safety Communications Division for the Virginia Information Technologies Agency
Number of independent variables	Eight
Number of dependent variables	Two
Level of measurement	• Nominal • Interval • Ratio
Selection of scales to assess dependent variable	Presence of reliability and validity data
Characteristics of dependent variable	Normally distributed

Study Design

There are three study design choices: pre-experimental, experimental, and quasi-experimental (see Frankfort-Nachmias & Nachmias, 2000; Miller & Salkind, 2002; Cook & Campbell, 1979). Since this study involved the entire population of Virginia units of local government and their Wireless E9-1-1 Phase One and Wireless E-9-1-1 Phase Two deployment results, a sampling research design was not needed. The research method used in this study was a cross-sectional study, which is a specific type of a correlation study. In this type of analysis comparison or control groups are not needed for assessing cause-and-effect relationship. A correlational study determines whether or not two variables are correlated. This outcome is expressed as a correlation coefficient. A cross-sectional study takes a snapshot of a population at a certain time, allowing conclusions about the phenomena across the population to be drawn based on the resulting correlation coefficients.

Type of Data Available

There are four choices for the type of data: case and observational studies only, quantitative analysis only, quantitative supplemented with case and observational studies, and other (historical, cross-cultural, etc) (Miller & Salkind 2002, p 18). The type of data that will be used for this study is quantitative analysis consisting of census data and Virginia state and local government data.

Temporal Dimension

There are four choices for the temporal dimension: cases from a single society at a single period (cross-sectional), cases from a single society at many periods (time-series or longitudinal), cases from many societies at a single period (comparative cross-cultural), and cases from many societies at different periods (comparative longitudinal) (Miller & Salkind, 2002, p. 18). A single society (Virginia units of local government) will be studied at several periods. The temporal dimension of this study is cross-sectional.

Sample or Universe to be Studied

There are six choices for the sample or universe to be studied: (1) individuals in a role within a group, (2) pair of interrelated group members (dyad), (3) primary group (30 or less), (4) secondary group (31 or more), (5) tertiary group (crowd, public, etc.), and (6) state, nation or society (Miller & Salkind 2002, p.18). The sample or universe studied is a society. This society consists of Virginia units of local government (cities and counties).

Sample Size

There are three choices of sample size: single or fewer cases, small sample (under 30), and large sample (more than 30) (Miller & Salkind 2002, p. 18). The cases are drawn from the set of Virginia units of local governments (i.e., 95 counties and 39 cities, N = 134; see table 2 and table 3 in the Appendix). In this study the number of cases equals the population, so sample size is not relevant. The population investigated in this study is the 134 Virginia units of local government and their Wireless E9-1-1 Phase One and Wireless E-9-1-1 Phase Two deployment results.

Data Source

There are three choices for the data source: original data to be collected by the researcher, archived or secondary data in hand, and archived or secondary data to be collected (Miller & Salkind 2002, p. 18). The data source is archived or secondary data to be collected by this investigator. The data needed for hypothesis testing will be obtained from archived or secondary data (census data and Virginia state and local government data).

Data Gathering Method

There are four choices for data gathering method: direct observation, interviews, questionnaire and test, or other form of measurement (Miller & Salkind 2002, p. 18). This study will gather data by using an unobtrusive measure (Frankfort-Nachmias & Nachmias). This unobtrusive measure is the examination of data collected by the U.S Department of Commerce, the U.S. Census Bureau, U.S. Department of Commerce, Bureau of Economic Analysis, the Auditor of Public Accounts for the Commonwealth of Virginia, and the Public Safety Communications Division for the Virginia Information Technologies Agency.

Independent Variables

The choices of the number of independent variables are binary: one or more than one (Miller & Salkind 2002, p. 19). This study will use more than one independent variable (this study will use 8 independent variables; see table 4 for the independent variables and unit of analysis associated with the hypotheses in tabular format).

Table 4
Independent Variables, Level of Measurement, and Unit of Analysis Associated with Hypotheses

Hypotheses	Independent Variable	Level of Measurement	Unit of Analysis
One and Two	Wealth	Ratio	Virginia unit of local government (county or city)
Three and Four	Population	Ratio	Virginia unit of local government (county or city)
Five and Six	Fiscal Health	Ratio	Virginia unit of local government (county or city)
Seven and Eight	Dedicated Funding	Nominal	Virginia unit of local government (county or city)
Nine and Ten	Financial Dependency	Ratio	Virginia unit of local government (county or city)
Eleven and Twelve	Urbanization	Ratio	Virginia unit of local government (county or city)
Thirteen and Fourteen	Region	Ratio	Virginia unit of local government (county or city)
Fifteen and Sixteen	Interstate	Nominal	Virginia unit of local government (county or city)

Wealth

The wealth of Virginia units of local government (counties and cities) is measured as per capita income and is obtained from U.S. Department of Commerce, Bureau of Economic Analysis. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses one and two is a Virginia unit of local government (county or city). See table 5 and table 6 in the Appendix.

Population

The population of the Virginia units of local government (counties and cities) is obtained from the U.S. census data. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses three and four is a Virginia unit of local government (county or city). See table 7 and table 8 in the Appendix.

Fiscal Health

The fiscal health of Virginia units of local government is the ratio of total revenue to total expenditures for each city and county and is obtained from the Auditor or Public Accounts for the Commonwealth of Virginia. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses five and six is a Virginia unit of local government (county or city). See table 9 and table 10 in the Appendix.

Dedicated Funding

Wireless funding for Virginia units of local government (counties and cities) is obtained from the website (http://www.va911.org) for the Public Safety Communications Division of the

Virginia Information Technologies Agency. This independent dichotomous variable's level of measurement is nominal and the unit of analysis associated with this independent variable and Hypotheses seven and eight is a Virginia unit of local government (county or city). See table 11 and table 12 in the Appendix.

Financial Dependency

Financial dependency for Virginia units of local government is the ratio of total wireless funding received to total public safety expenditures for each city and county. Wireless funding for Virginia units of local government (counties and cities) is obtained from the website (http://www.va911.org) for the Public Safety Communications Division of the Virginia Information Technologies Agency. Total public safety expenditure for Virginia units of local government (counties and cities) is obtained from the Auditor of Public Accounts for the Commonwealth of Virginia. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses nine and ten is a Virginia unit of local government (county or city). See table 13 and table 14 in the Appendix.

Urbanization

Population Density for Virginia units of local government (counties and cities) is obtained from the U.S. Department of Commerce, U.S. Census Bureau. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses eleven and twelve is a Virginia unit of local government (county or city). See table 15 and table 16 in the Appendix.

Previous Deployments (Region)

The number of previous deployments of wireless E9-1-1 made by neighbors of Virginia units of local government (counties or cities) is obtained from the Public Safety Communications Division of the Virginia Information Technologies Agency. This independent variable's level of measurement is ratio and the unit of analysis associated with this independent variable and Hypotheses thirteen and fourteen is a Virginia unit of local government (county or city). See table 17 and table 18 in the Appendix.

Proximity to Interstate

Proximity to Interstate for Virginia units of local government (counties and cities) is obtained from the Public Safety Communications Division of the Virginia Information Technologies Agency and is represented by road center line data. This independent variable's level of measurement is nominal and the unit of analysis associated with this independent variable and Hypotheses fifteen and sixteen is a Virginia unit of local government (county or city). See table 19 and table 20 in the Appendix.

Number of Dependent Variables

The choices of the number of dependent variables are binary: one or more than one (Miller & Salkind, 2002, p.19). This study will use two dependent variables: the deployment of Wireless E9-1-1 Phase One by Virginia units of local government and the deployment of Wireless E9-1-1 Phase Two by Virginia units of local government.

Deployment of Wireless E9-1-1 Phase One

The Deployment of Wireless E9-1-1 Phase One by Virginia units of local government is measured with a dummy (dichotomous) variable equaling *one* if a Virginia unit of local government (county or city) deployed Wireless E9-1-1 Phase One in one of the following years: 2001, 2002, 2003, 2004, 2005, or 2006, *zero* otherwise (see table 21 below). The level of measurement for this dependent variable is interval and the unit of analysis is the Virginia unit of local government (county or city). Wireless E9-1-1 Phase One Deployment results can be found in table 22 and table 23 in the Appendix.

Deployment of Wireless E9-1-1 Phase Two

The Deployment of Wireless E9-1-1 Phase Two by Virginia units of local government is measured with a dummy (dichotomous) variable equaling *two* if a Virginia unit of local government (county or city) deployed Wireless E9-1-1 Phase Two in one of the following years: 2001, 2002, 2003, 2004, 2005, or 2006, *one or zero* otherwise (see Table 21 below). The deployment of Wireless E9-1-1 Phase One must occur before a deployment of Wireless E9-1-1 Phase Two can occur. The level of measurement for this dependent variable is interval and the unit of analysis is the Virginia unit of local government (county or city). Wireless E9-1-1 Phase Two Deployment results can be found in table 22 and table 23 in the Appendix.

Table 21
Dependent Variables, Dichotomous Coding, and Years Measured

Dependent Variable	Dichotomous Coding	Years Measured
Deployment of Wireless E9-1-1 Phase One	One or Zero	2001
Deployment of Wireless E9-1-1 Phase One	One or Zero	2002
Deployment of Wireless E9-1-1 Phase One	One or Zero	2003
Deployment of Wireless E9-1-1 Phase One	One or Zero	2004
Deployment of Wireless E9-1-1 Phase One	One or Zero	2005
Deployment of Wireless E9-1-1 Phase One	One or Zero	2006
Deployment of Wireless E9-1-1 Phase Two	Two, One, or Zero	2001
Deployment of Wireless E9-1-1 Phase Two	Two, One, or Zero	2002
Deployment of Wireless E9-1-1 Phase Two	Two, One, or Zero	2003
Deployment of Wireless E9-1-1 Phase Two	Two, One, or Zero	2004
Deployment of Wireless E9-1-1 Phase Two	Two, One, or Zero	2005
Deployment of Wireless E9-1-1 Phase Two	Two, One or Zero	2006

Selection of Scales to Assess Dependent Variable

The choice for the selection of scales to assess the dependent variable is binary: presence of reliability and validity data or absence of reliability and validity data (Miller & Salkind, 2002, p. 19). This study is presented with reliability and validity data.

The factors jeopardizing internal and external validity are drawn from the work of Cook and Campbell, 1979, p. 37). Internal validity "refers to the approximate validity with which we infer that a relationship between two variables is casual or that the absence of a relationship implies the absence of cause. External validity "refers to the approximate validity with which we can infer that the presumed causal relationship can be generalized across alternative measures of the cause and effect and across different types of persons, settings, and times".

Cook and Campbell (1979, pp. 51-53) identify eight specific threats to internal validity: history, maturation, testing, instrumentation, statistical regression, selection, mortality, and interactions with selection. These major intrinsic factors might invalidate a casual interpretation given to research findings (see table 24a). These factors are discussed below, but since an experimental design with human subjects is not being used, these factors are minimized. Cook and Campbell further identify three factors relating to external validity, or representativeness (pp. 73-74): interaction of selection and treatment, interaction of setting and treatment, and interaction of history and treatment (see table 24b). These factors are discussed below; however, since this study involves a population, generalization to the population is not a concern and these factors are not relevant.

History

History refers to the specific events that take place between the pretest and the posttest that might affect the individuals studied and provide a rival explanation for the change in the dependent variable. For this study, the time dilemma is not a concern since the study involves a population and does not include pretests or posttests in which the same sample is examined. Since time cannot be controlled in real-life, methods must be adopted to control for its effects on the empirical data. This study employs a repeated cross-sectional research method.

Maturation

Maturation includes the processes within the respondents operating as a function of the passage of time per se (not specific to the particular events), including growing older, wise, stronger, more experienced, and the like between pretest and posttest. Since secondary data will be used in this study, the effects of maturation will not be applicable.

Testing

Testing is the effects of talking a test upon the scores of a second testing. Familiarity with a test can sometimes enhance performance because items and error responses are more likely to be remembered at layer testing sessions. Since secondary data will be used in this study, the effects of testing will not be applicable.

Instrumentation

Instrumentation includes changes in the calibration of a measuring instrument or changes in the observers or scorers used that may produce changes in the obtained measurements. In this study, changes in the unit-level record file database were not expected. The simultaneous construction of the unit-level record file database from secondary data electronically obtained from websites and archived databases will control for the effects of instrumentation.

Statistical Regression

Statistical regression includes the selection of groups whose selection is made on the basis of extreme scores. For this study, the study's population of Virginia units of local government (counties and cities) will not involve the selection of groups so the effects of statistical regression will not applicable.

Selection

Selection includes the results of the differential selection between people in one experimental group as opposed to another. For this study, there are no comparison groups and so the effects of selection will not be applicable.

Mortality

Mortality includes the effects of different kinds of people dropping out of a particular treatment group during the course of an experiment. This results in a selection artifact, since the experimental groups are then composed of different kinds of people at the posttest. Since the entire population of Virginia units of local government (counties and cities) will be used, not smaller treatment groups, the effects of mortality will not be applicable.

Interactions with Selection

Many of the foregoing threats to internal validity can interact with selection to produce forces that might spuriously appear as treatment effects. Among these are selection-maturation, selection-history, and selection-instrumentation. Since the entire population of Virginia units of local government (counties and cities) will be used, the effects of interactions with selection will not be applicable.

Interactions of Selection and Treatment

Interactions of selection and treatment include the effects of a pretest that might increase or decrease a respondent's sensitivity or responsiveness to the independent variable. This interaction may yield results from a pretested population that are unrepresentative of the effects of the independent variable for the untested population from which the people included in the experiment were selected. For this study, there is no pretesting and so the effects of testing are not applicable.

Interaction of Setting and Treatment

Interaction of setting and treatment effects include the preclusion of generalizations about the effect of the independent variable upon people being exposed to it in nonexperimental setting. Since the entire population of Virginia units of local government (counties and cities) will be used, the effects of interaction of setting and treatment will not be applicable.

Interaction of History and Treatment

Interaction of history and treatment effects include the generalizability of particular causal relationships and the ability to extrapolate findings from the present to the future. Since this study can be replicated at different times, the effects of interaction of history and treatment will not be applicable.

Table 24a
Internal Validity

Classes of extraneous variables	Relevance
History	
Maturation	
Testing	
Instrumentation	+
Regression	
Selection	
Mortality	
Intersection of Selection	

Table 24b
External Validity

Factors relating to external validity	Relevance
Interactions of selection and treatment	
Interactions of setting and treatment	
Interaction of history and treatment	

Note: Adopted from Campbell & Stanley (1963). A plus indicates that the factor is controlled and a blank indicated the factor is not relevant to this research design.

Characteristics of Dependent Variables

The choices for the characteristics of the dependent variables are binary: normally distributed or not normally distributed (Miller & Salkind, 2002, p.19). For this study the dependent variables (deployment of Wireless E9-1-1 Phase One and deployment of Wireless E9-1-1 Phase Two) are expected to be normal.

Section Three: Instrumentation

In this section I discuss the instrumentation to be used for this study (see McDade, 1999) and address the following questions: which instrument will be used and why, where the instrument came from and how it was developed, and the appropriateness of the instrument for the population and for the goals of this study.

Which Instrument Will Be Used and Why

For this study, a self-developed, unit-level record file database will be used to collect data from secondary sources that pertain to Virginia units of local government. This type of instrument was chosen because construction of input data is critical in a cross-sectional study. In this type of research study, either the entire population or a subset thereof is selected, and from these individuals or cases, data are collected to help answer the research questions of interest (Olsen & St. George, 2004). For this particular instrument, there are two alternative ways to construct a record file for input data: unit-level and aggregate-level. Since several time-dependent covariates will be included in this model as independent variables, the easiest way to generate the input data will be by using a record file database that contains unit-level data.

How the Instrument Was Developed

Cross-sectional data was organized as a rectangular file in order to analyze the data with a standard program like SPSS. With this type of data set each record of the file is related to a specific point, or snapshot, in time (Carroll, 1983). In this study, there are two separate record files, one for the deployment of Wireless E9-1-1 Phase One and another for the deployment of Wireless E9-1-1 Phase Two. Each record file contains values of the time-dependent and time-independent covariates (independent variables) for each Virginia unit of local government for the six risk sets included in this study– the yearly measurements of the deployments of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two as measured on July 1st on each of the following years: 2001, 2002, 2003, 2004, 2005, and 2006.

The Appropriateness of the Instrument for the Goals of the Study

The appropriateness of the unit-level record file database to the goals of this study is demonstrated through the purpose and significance of this study.

The purpose of this empirical study is to assess the overall effectiveness of the three principle theories (Berry & Berry, 1990, 1992, 1994, 1999) of policy innovation adoption - diffusion, internal determinants, and unified theory – in predicting the deployment of wireless E9-1-1 by local governments within the state of Virginia.

The significance of this study is based on three grounds. First, the ability to develop a better planning process for 9-1-1 emergency services is vital and the knowledge needed to move governments closer to building optimum network solutions for 9-1-1 emergency services may be embedded in wireless E9-1-1 data. Second, a model derived from wireless E9-1-1 emergency services data may be an instrumental tool for governments to use to determine when and how do governments get involved in designing and implementing a 9-1-1 emergency services network. Third, this study will provide results that can be used to enhance the deployment process to interconnect 9-1-1 emergency services with VoIP and other emerging technologies.

Section Four: Procedures for Collecting Data

In this section I describe the procedures for collecting data (see McDade, 1999). This section includes how the data will be located, how the instrument will be administered, and how the data will be transferred to the instrument.

How the Data was located

The secondary data utilized for this study will be obtained electronically from websites and archived databases. The websites that will be utilized in this study are maintained by the U.S. Census Bureau and the Bureau of Economic Analysis of the U.S Department of Commerce and the Auditor of Public Accounts for the Commonwealth of Virginia. The archived database that will be utilized in this study is maintained by the Public Safety Communications Division for the Virginia Information Technologies Agency.

How the Instrument Will Be Administered

In this study, the unit-level record file database will be administered electronically using Microsoft Excel and will be maintained as an electronic spreadsheet in a PC. The secondary data obtained electronically will be delineated and parsed to pass automatically into the unit-level record file database for treating, coding, and analyzing.

How the Data will be transferred to the Instrument

The secondary data utilized for this study will be downloaded from websites maintained by the U.S. Census Bureau and the Bureau of Economic Analysis of the U.S Department of Commerce and the Auditor of Public Accounts for the Commonwealth of Virginia using a broadband Internet connection. Data will also be copied from archived databases maintained by the Public Safety Communications Division for the Virginia Information Technologies Agency using a hosted FTP application available to individuals employed by the Commonwealth of Virginia's Division of Public Safety Communications.

Section Five: Procedures for Screening and Analyzing Data

In this section I state the procedures that will be used for screening and analyzing data using a framework developed by Tabachnick and Fidell (2001, pp. 56-110). Typically, generalizations are not based on data collected from all cases covered by the research problem. Instead a small number of cases, a sample, are used as the basis for making inferences about all the cases, the population. In this particular study, a population, rather than a sample, is used. As a result, several of the components for screening and analyzing data are described in general informational terms, but have limited applicability to the study.

Accuracy of Data File

The first issue will be the concern for the accuracy with which data has been entered into the data file and considerations of factors that could produce distorted correlations. With large data sets, the first step is to examine univariate descriptive statistics for out of range values, plausible means and standard deviations, and univariate outliers. This can be accomplished using SPSS

FREQUENCIES. However, since a population, rather than a sample is used in this study, descriptive statistics are not very informative.

Missing Data

Next, missing data will be assessed and dealt with. The pattern of missing data is more important than the amount of missing data. However, selecting the appropriate option to handle missing data is critical. These options include: deleting cases or variables, estimating missing data, or using a missing data correlation matrix. If it is necessary to address missing data as an issue, the most appropriate option will be selected.

Normality, Linearity, and Homoscedasticity

Underlying some multivariate procedures and most statistical tests and their outcomes is the assumption of multivariate normality. Multivariate normality is the assumption that each variable and all linear combinations of the variable are normally distributed. This assumption can be checked by visually inspecting the distribution of the population data. In addition, the assumption of multivariate normality can be partially checked by examining the pairwise plots for nonlinearity, and heteroscedasticity. Nonnormal variables can then be identified and dealt with by checking for skewness and kutosis, examining probability plots for linearity and homoscedasticity; transforming variables if desirable, and checking the results of any transformations.

Outliers

Outliers, in extreme cases, create other headaches because solutions are unduly influenced and distorted by them. Outliers, and their potential impact, are not an issue in this study because a population, rather a sample, is being used.

Multicollinearity and Singularity

Finally, perfect or near-perfect correlations among variables can threaten a multivariate analysis. With multicollinearity, the variables are very highly correlated (.90 or above); with singularity, the variables are redundant; one of the variables is a combination of two or more of the other variables. In this study, the variables will be evaluated for multicollinearity and singularity.

Summary

This chapter presents the methodology that will be used to executer this study. The next chapter presents the results of this study by (1) discussing the preparation of the data for analysis, (2) presenting the data analysis and (3) addressing the strengths and weaknesses of this study's research strategy in relation to previous research and the contributions I hope to make to the field of DOI.

CHAPTER 4: RESULTS

Introduction

In this chapter I present the results of the study. The population for this study was Virginia local governments (counties and cities) that had not deployed Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two technology as of January 1, 2001. All Virginia units of local government were required to deploy this technology as a result of legislation passed by the 2000 General Assembly session.

There were 134 Virginia units of local government (95 counties and 39 cities) of which none had yet deployed Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two technology as of January 1, 2001 (See table 25 and table 26 in the Appendix). This information was obtained from the Virginia Information Technologies Agency's Public Safety Communications Division.

The population (N), sampling frame and sample size (n) for this study are the same – the 134 Virginia local governments (95 counties and 39 cities) which had not yet deployed either Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two technology as of January 1, 2001. See table 27 and table 28 in the Appendix. The sampling units were Virginia units of local government.

This chapter is organized in three sections. Section one discusses the preparation of the data for analysis. Section two presents the data analysis cross-walked to the research question and the appropriate set of hypotheses. Section three addresses the strengths and weaknesses of this study's research strategy in relation to previous research.

Section One: Preparation for Data Analysis

Checking data to verify their validity and finding data errors is a prerequisite for examining a summary for individual variables (SPSS Inc., 2000, p. 3-1). The data used in this study was downloaded directly from databases maintained by the U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Commerce, U.S. Census Bureau; Commonwealth of Virginia , the Auditor of Public Accounts; and, the Commonwealth of Virginia, Virginia Information Technologies Agency's Public Safety Communication Division. Since these sources have already applied stringent methods to determine validity and data errors, no further analysis was undertaken. Since the entire population was used in this study, no descriptive statistics are provided. The data was also checked for missing values and there were none. Evaluation of outliers, assumptions of linearity, normality, multicollinearity or singularity, and homogeneity of variance-covariance matrices revealed no threat to the data.

Section Two: Data Analysis

In this section, I analyze the data associated with the research question and the hypotheses. The statistical method used for this study was a discriminant function analysis. A discriminant function analysis was conducted with each of the established risk sets of Virginia units of local government for the specified time periods of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments. See tables 29 thru 34 in the Appendix for the complete list of risk sets. The research question which this study attempted to answer is as follows:

Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government?

For this study the null hypotheses and the hypotheses under consideration are listed below:

H_{0-1} No significant relationship exists between the level of per capita income of the population served by a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_1 The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_{0-2} No significant relationship exists between the level of per capita income of the population served by a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_2 The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_{0-3} No significant relationship exists between the population served by a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_3 The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_{0-4} No significant relationship exists between the population served by a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_4 The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

H_{0-5} No significant relationship exists between the proportion of revenue to expenses for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_5 The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_{0-6} No significant relationship exists between the proportion of revenue to expenses for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_6 The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

H^{0-7} No significant relationship exists between dedicated wireless surcharge revenue to offset a Virginia unit of local government's wireless non-recurring and recurring costs and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_7 For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One is more likely to occur if wireless non-recurring and recurring costs were offset by wireless surcharge revenue received in the previous year.

H_{0-8} No significant relationship exists between dedicated wireless surcharge revenue to offset a Virginia unit of local government's wireless non-recurring and recurring costs and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_8 For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two is more likely to occur if wireless non-recurring and recurring costs were offset by wireless surcharge revenue received in the previous year.

H_{0-9} No significant relationship exists between the percentage of wireless funding revenue and public safety expenditures for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_9 For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_{0-10} No significant relationship exists between the percentage of wireless funding revenue and public safety expenditures for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_{10} For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two.

H_{0-11} No significant relationship exists between population density for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_{11} The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_{0-12} No significant relationship exists between population density for a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_{12} The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

H_{0-13} No significant relationship exists between the proximity of other Virginia units of local government that have already deployed Wireless E9-1-1 Phase One and the likelihood that a Virginia unit of local government that has not yet deployed will do so.

H_{13} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed.

H_{0-14} No significant relationship exists between the proximity of other Virginia units of local government that have already deployed Wireless E9-1-1 Phase Two and the likelihood that a Virginia unit of local government that has not yet deployed will do so.

H_{14} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to the proximity of other Virginia units of local government that have already deployed.

H_{0-15} No significant relationship exists between the proximity of one or more interstate highways to a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_{15} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its proximity to one or more interstate highways.

$H_{0\text{–}16}$ No significant relationship exists between the proximity of one or more interstate highways to a Virginia unit of local government and the likelihood that it will deploy Wireless E9-1-1 Phase Two**.**

H_{16} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its proximity to one or more interstate highways.

In this study discriminant function analysis was used to determine which predictor variables discriminate between the following three naturally occurring groups – No Wireless E9-1-1 Deployments, Wireless E9-1-1 Phase One Deployments, and Wireless E9-1-1 Phase Two Deployments. Discriminant function analysis is broken into a 2-step process: (1) testing significance of a set of discriminant functions, and; (2) classification. The first step is computationally identical to MANOVA. There is a matrix of total variances and covariances; likewise, there is a matrix of pooled within-group variances and covariances. The two matrices are compared via multivariate F tests in order to determine whether or not there are any significant differences (with regard to all variables) between groups. One first performs the multivariate test, and, if statistically significant, proceeds to see which of the variables have significantly different means across the groups.

Once group means are found to be statistically significant, classification of variables is undertaken. Discriminant function analysis automatically determines some optimal combination of variables so that the first function provides the most overall discrimination between groups, the second provides second most, and so on. Moreover, the functions will be independent or orthogonal, that is, their contributions to the discrimination between groups will not overlap. The first function picks up the most variation; the second function picks up the greatest part of the unexplained variation, and so on. Computationally, a canonical correlation analysis is performed that will determine the successive functions and canonical roots. Classification is then possible from the canonical functions. Cases are classified in the groups in which they had the highest classification scores. The maximum number of discriminant functions will be equal to the degrees of freedom, or the number of variables in the analysis, whichever is smaller.

SPSS assigns equal prior probability for each group by default. The output summarizing the canonical discriminant functions appears in two tables – Eigenvalues and the Wilks' Lambda. Loadings between the predictor variables and discriminant functions are given in the Structure Matrix. The average discriminant score for each group on each function is provided by the Functions at Group Centroids table. Classification statistics are provided in the Classification Results Table.

Wireless E9-1-1 Deployments in 2001

A single discriminant function was calculated, with a $X^2(8) = 76.058$ that was statistically significant, $\rho < .01$. The F-test associated with this function is exact. Function 1 has a canonical correlation of .669 between the predictor variables and the deployment classifications and accounts for 100% of the between-group variability. There were no Wireless E9-1-1 Phase Two deployments in 2001.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictors for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments are Funding and Region with coefficients of .713 and .530 respectively. Density and Interstate are the next best performing predictor variables in predicting group membership. However, with coefficients of .259 and .249 respectively, these variables have significantly less influence in predicting group membership than does Funding and Region. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments are -.254 and 3.149 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from Wireless E9-1-1 Phase One deployments. (See figure 1 and figure 2). The Classification Table indicates that 93.3% of original grouped cases were correctly classified. See tables 35 thru 39.

2001 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.812[a]	100.0	100.0	.669

a. First 1 canonical discriminant functions were used in the analysis.

Table 35

2001 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.552	76.058	8	.000

Table 36

2001 Structure Matrix

	Function 1
Funding	.713
Region	.530
Density	.259
Interstate	.249
Population	.198
Wealth	.051
Fiscal	-.042
Dependency	-.033

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 37

2001 Functions at Group Centroids

Deploy	Function 1
No Deployment	-.254
Phase 1 Deployment	3.149

Unstandardized canonical discriminant functions evaluated at group means

Table 38

Canonical Discriminant Function 1

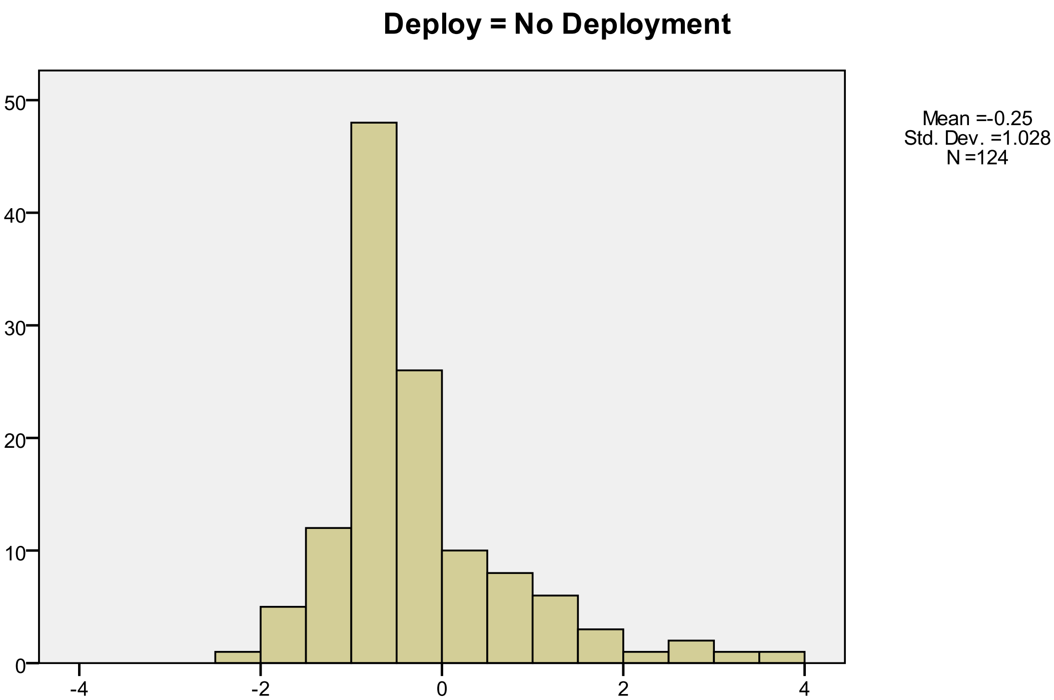

Figure 1: No Wireless Deployment for 2001

Canonical Discriminant Function 1

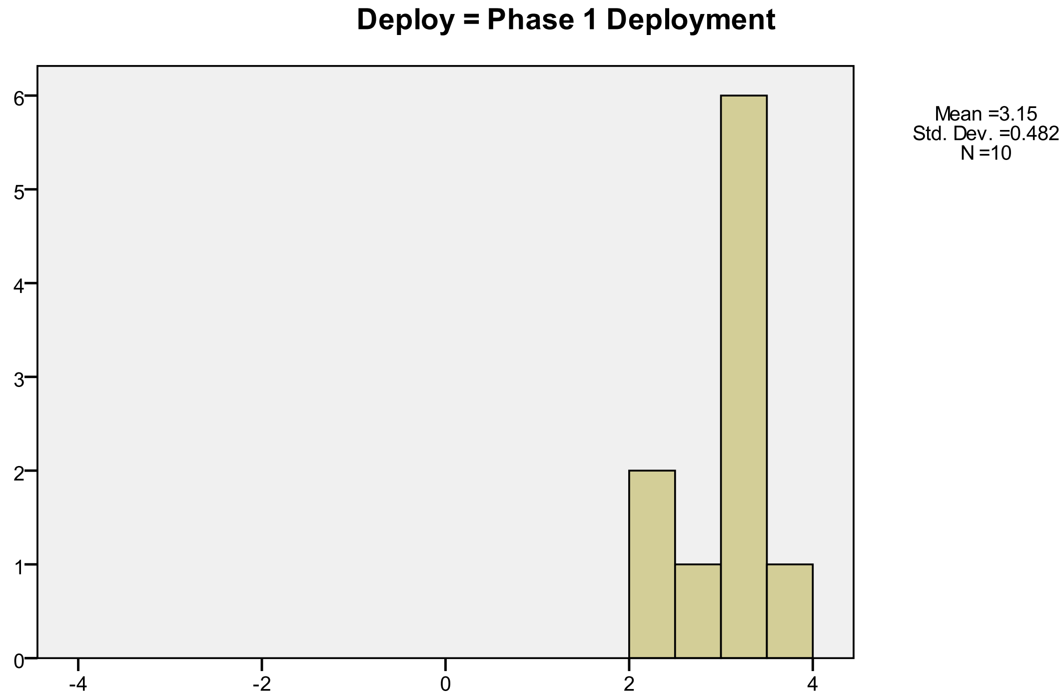

Figure 2: Wireless Phase 1 Deployment for 2001

2001 Classification Results[a]

			Predicted Group Membership		
		Deploy	No Deployment	Phase 1 Deployment	Total
Original	Count	No Deployment	115	9	124
		Phase 1 Deployment	0	10	10
	%	No Deployment	92.7	7.3	100.0
		Phase 1 Deployment	.0	100.0	100.0

a. 93.3% of original grouped cases correctly classified.

Table 39

In 2001, the external predictor variables Funding and Region and the internal predictor variables Density and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. These variables support the unified theory of policy innovation. As such, H_7, H_{11}, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-7}, H_{0-11}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One Deployments, H_1, H_3, H_5, and H_9 are not supported and the Null Hypotheses H_{0-1}, H_{0-3}, H_{0-5}, and H_{0-9} are not rejected in this analysis. And finally, since there were no Wireless E9-1-1 Phase Two deployments in 2001, H_2, H_4, H_6, H_8, H_{10}, H_{12}, H_{14}, and H_{16} are not supported by the data in this analysis and the Null Hypotheses H_{0-2}, H_{0-4}, H_{0-6}, H_{0-8}, H_{0-10}, H_{0-12}, H_{0-14}, and H_{0-16} are not rejected in this analysis.

But what happens if Funding, the variable with the largest absolute size of correlation within the function, is not included as a predictor variable? If Funding is not included as a predictor variable, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments becomes Region, with a coefficient that has increased to .793. Density and Interstate remain the next best performing predictor variables and their influence in predicting group membership has also increased with coefficients of .387 and .372 respectively. In addition, the predictor variable Population would now be considered as a predictor of group membership since this variable has a loading matrix above .20 with a coefficient of .296. See table 40.

2001 Revised Structure Matrix

	Function
	1
Region	.793
Density	.387
Interstate	.372
Population	.296
Wealth	.076
Fiscal	-.062
Dependency	-.049

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 40

Wireless E9-1-1 Deployments in 2002

A single discriminant function was calculated, with a X^2 (8) = 87.113 that was statistically significant, $\rho < .01$. The F-test associated with this function is exact. Function 1 has a canonical correlation of .703 between the predictor variables and the deployment classifications and accounts for 100% of the between-group variability. There were no Wireless E9-1-1 Phase Two deployments in 2002.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictors for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments are Region and Funding with coefficients of .559 and .547 respectively. Population and Interstate are the next best performing predictor variables in predicting group membership. However, with coefficients of .280 and .204 respectively, these variables have significantly less influence in predicting group membership than does Region and Funding. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments are -.410 and 2.340 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from Wireless E9-1-1 Phase One deployments. (See figure 3 and figure 4). The Classification Table indicates that 88.1% of original grouped cases were correctly classified. See tables 41 thru 45.

2002 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.975[a]	100.0	100.0	.703

a. First 1 canonical discriminant functions were used in the analysis.

Table 41

2002 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.506	87.113	8	.000

Table 42

2002 Structure Matrix

	Function
	1
Region	.559
Funding	.547
Population	.280
Interstate	.204
Density	.162
Wealth	.152
Fiscal	-.056
Dependency	-.023

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 43

2002 Functions at Group Centroids

	Function
Deploy	1
No Deployment	-.410
Phase 1 Deployment	2.340

Unstandardized canonical discriminant functions evaluated at group means

Table 44

Canonical Discriminant Function 1

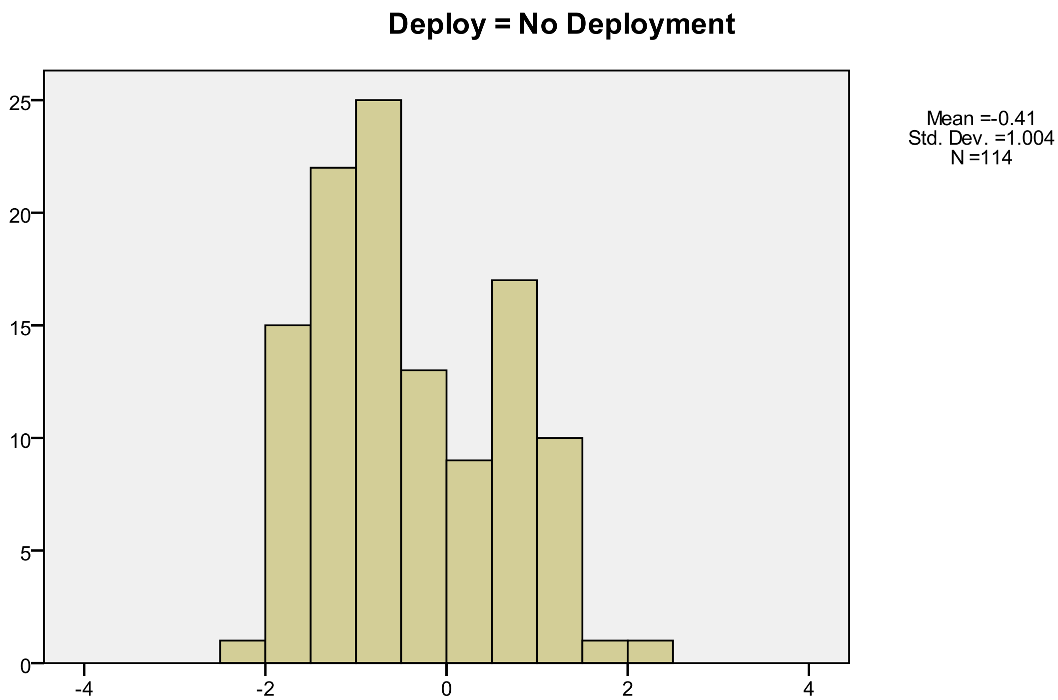

Figure 3: No Wireless Deployment for 2002

Canonical Discriminant Function 1

Deploy = Phase 1 Deployment

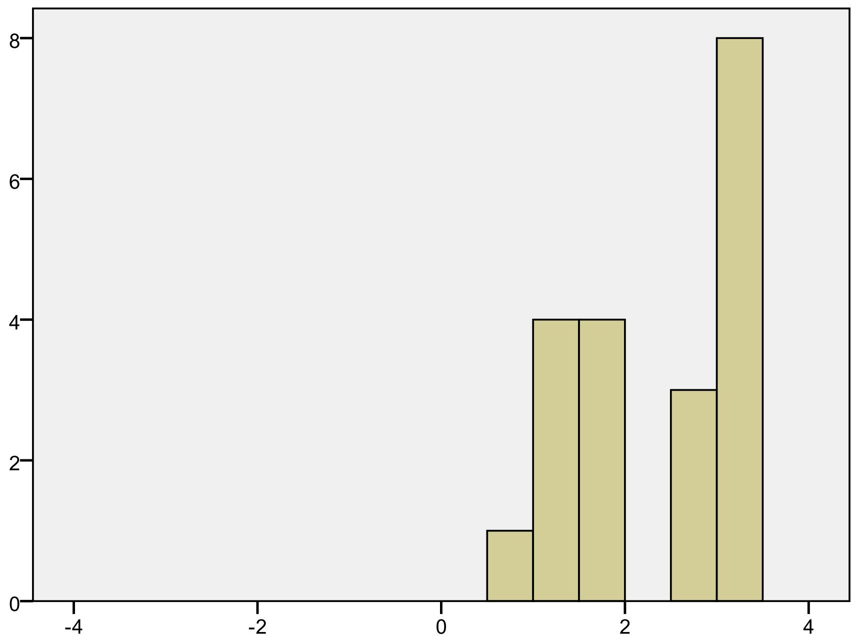

Figure 4: Wireless Phase 1 Deployment for 2002

2002 Classification Results[a]

			Predicted Group Membership		
		Deploy	No Deployment	Phase 1 Deployment	Total
Original	Count	No Deployment	99	15	114
		Phase 1 Deployment	1	19	20
	%	No Deployment	86.8	13.2	100.0
		Phase 1 Deployment	5.0	95.0	100.0

a. 88.1% of original grouped cases correctly classified.

Table 45

In 2002, the external predictor variables Region and Funding and the internal predictor variables Population and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. These variables support the unified theory of policy innovation. As such, H_3 H_7, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-3} H_{0-7}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One deployments, H_1, H_5, H_9, and H_{11} are not supported and the Null Hypotheses H_{0-1}, H_{0-5}, H_{0-9}, and H_{0-11} are not rejected in this analysis. And finally, since there were no Wireless E9-1-1 Phase Two deployments in 2001, H_2, H_4, H_6, H_8, H_{10}, H_{12}, H_{14}, and H_{16} are not supported by the data in this analysis and the Null Hypotheses H_{0-2}, H_{0-4}, H_{0-6}, H_{0-8}, H_{0-10}, H_{0-12}, H_{0-14}, and H_{0-16} are not rejected in this analysis.

But what happens if Region, the variable with the largest absolute size of correlation within the function, is not included as a predictor variable? If Region is not included as a predictor variable, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments becomes Funding, with a coefficient that has increased to .860. Population and Interstate remain the next best performing predictor variables and their influence in predicting group membership has also increased with coefficients of .440 and .320 respectively. In addition, the predictor variables Density and Wealth would now be considered as predictors of group membership since these variables have loading matrixes above .20 with a coefficients of .255 and .239 respectively. See table 46.

2002 Revised Structure Matrix

	Function
	1
Funding	.860
Population	.440
Interstate	.320
Density	.255
Wealth	.239
Fiscal	-.088
Dependency	-.037

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 46

Wireless E9-1-1 Deployments in 2003

A single discriminant function was calculated, with a X^2 (8) = 63.021 that was statistically significant, ρ < .01. The F-test associated with this function is exact. Function 1 has a canonical correlation of .624 between the predictor variables and the deployment classifications and accounts for 100% of the between-group variability. There were no Wireless E9-1-1 Phase Two deployments in 2003.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments is Funding with a coefficient of .717.

However, there are two other sets of predictor variables, in descending order of influence, that are worth mentioning. In the first set, Interstate and Region have coefficients of .471 and .449 respectively. In the second set, Density and Population have coefficients of .286 and .228 respectively. As a result, Interstate and Region have less influence in predicting group membership than does Funding. Density and Population have significantly less influence in predicting group membership than does Funding. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments are -.591 and 1.060 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from Wireless E9-1-1 Phase One deployments. (See figure 5 and figure 6). The Classification Table indicates that 78.4% of original grouped cases were correctly classified. See tables 47 thru 51.

2003 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.636[a]	100.0	100.0	.624

a. First 1 canonical discriminant functions were used in the analysis.

Table 47

2003 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.611	63.021	8	.000

Table 48

2003 Structure Matrix

	Function
	1
Funding	.717
Interstate	.471
Region	.449
Density	.286
Population	.228
Wealth	.128
Fiscal	-.127
Dependency	-.075

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 49

2003 Functions at Group Centroids

	Function
Deploy	1
No deployment	-.591
Phase 1 Deployment	1.060

Unstandardized canonical discriminant functions evaluated at group means

Table 50

Canonical Discriminant Function 1

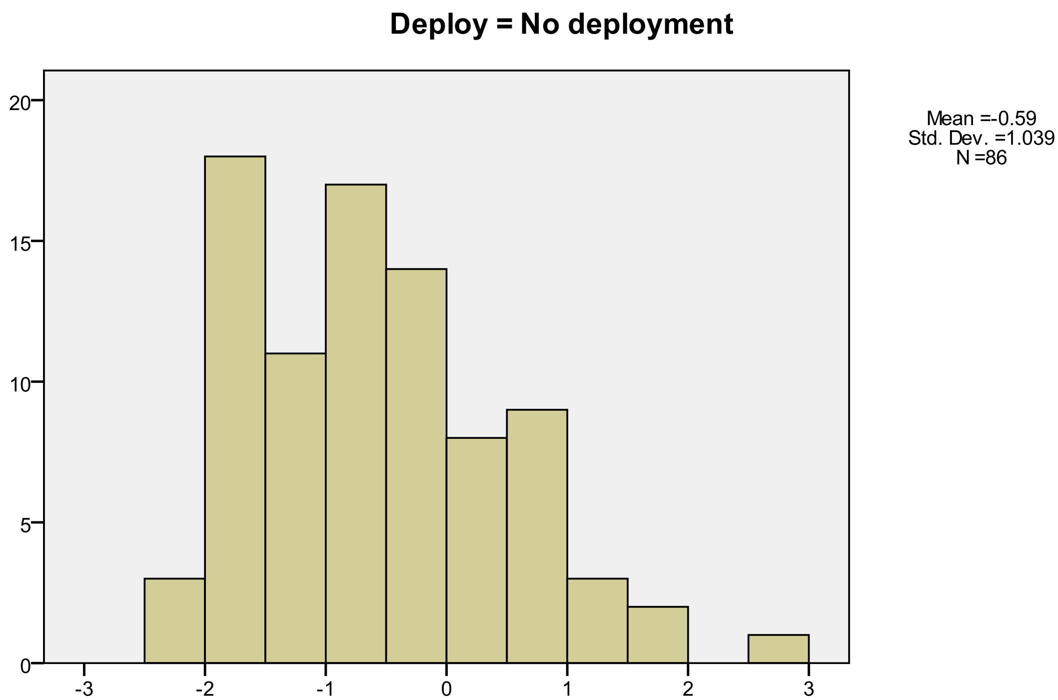

Figure 5: No Wireless Deployment for 2003

Canonical Discriminant Function 1

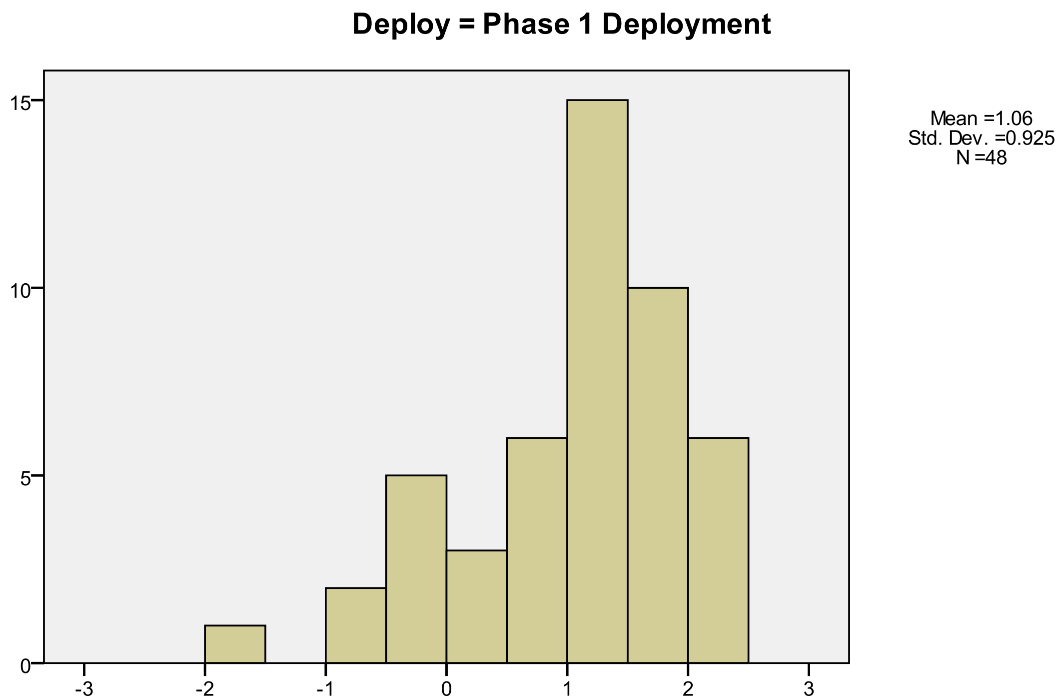

Figure 6: Wireless Phase 1 Deployment for 2003

2003 Classification Results[a]

			Predicted Group Membership		
		Deploy	No deployment	Phase 1 Deployment	Total
Original	Count	No deployment	66	20	86
		Phase 1 Deployment	9	39	48
	%	No deployment	76.7	23.3	100.0
		Phase 1 Deployment	18.8	81.3	100.0

a. 78.4% of original grouped cases correctly classified.

Table 51

In 2003, the external predictor variables Funding and Region and the internal predictor variables Interstate, Density, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. These variables support the unified theory of policy innovation. As such, H_3, H_7, H_{11}, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-3} H_{0-7}, H_{0-11}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One deployments, H_1, H_9, and H_{11} are not supported and the Null Hypotheses H_{0-1}, H_{0-9}, and H_{0-11} are not rejected in this analysis. And finally, since there were no Wireless E9-1-1 Phase Two deployments in 2001, H_2, H_4, H_6, H_8, H_{10}, H_{12}, H_{14}, and H_{16} are not supported by the data in this analysis and the Null Hypotheses H_{0-2}, H_{0-4}, H_{0-6}, H_{0-8}, H_{0-10}, H_{0-12}, H_{0-14}, and H_{0-16} are not rejected in this analysis.

But what happens if Funding, the variable with the largest absolute size of correlation within the function, is not included as a predictor variable? If Funding is not included as a predictor variable, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments becomes Interstate, with a coefficient that has increased to .606. Region remains the next best performing predictor variable and its influence in predicting group membership has also increased with a coefficient of .579. In addition, Density and Population remain the next best performing predictor variables as predictors of group membership with increased coefficient of .368 and .293 respectively. See table 52.

2003 Revised Structure Matrix

	Function
	1
Interstate	.606
Region	.579
Density	.368
Population	.293
Wealth	.164
Fiscal	-.164
Dependency	-.097

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

Table 52

Wireless E9-1-1 Deployments in 2004

Two discriminant functions were calculated, with a X^2 (16) = 119.693 that were statistically significant, $\rho < .01$. The F-test associated with Function 1 is exact and has a canonical correlation of .731 between the predictor variables and the deployment classifications. The F-test associated with Function 2 is .002 and has a canonical correlation of .400 between the predictor variables and the deployment classifications. The two discriminant functions accounted for 86% and 14% respectively of the between-group variability.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (first function) is Funding with a coefficient of .637. However, there are other groupings of predictor variables, in descending order of influence, that are worth mentioning. In the first group, Region and Density have coefficients of .588 and .475 respectively. In the second group, Wealth, Dependency, Population, and Interstate have coefficients of .399, -.349, .337, and .307 respectively. As a result, Region and Density have less influence in predicting group membership than does Funding. Wealth, Dependency, Population, and Interstate have significantly less influence in predicting group membership than does Funding. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are -1.503, -.317, and 1.328 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from the other two groups.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (second function) is Funding with a coefficient of -.592. However, there are other groupings of predictor variables, in descending order of influence, that are worth mentioning. In the first group, Region and Fiscal have coefficients of .477 and .359 respectively. In the second group, Interstate, Wealth, Density, and Population have coefficients of -.295, .281, .276, and .241 respectively. As a result, Region and Fiscal have less influence in predicting group membership than does Funding. Interstate, Wealth, Density, and Population have significantly less influence in predicting group membership than does Funding. The average discriminant scores for No Wireless E9-1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are .575, -.462, and .252 respectively. Loadings less than .20 are not interpreted. These mean scores demonstrate that Function 2 separates Wireless E9-1-1 Phase One deployments from Wireless E9-1-1 Phase Two deployments. (See figure 7.) The Classification Table indicates that 70.9% of original grouped cases were correctly classified. See tables 53 thru 57.

2004 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.148[a]	85.8	85.8	.731
2	.190[a]	14.2	100.0	.400

a. First 2 canonical discriminant functions were used in the analysis.

Table 53

2004 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.391	119.693	16	.000
2	.840	22.230	7	.002

Table 54

2004 Structure Matrix

	Function	
	1	2
Funding	.637*	-.592
Region	.588*	.477
Density	.475*	.276
Wealth	.399*	.281
Dependency	-.349*	.075
Population	.337*	.241
Interstate	.307*	-.295
Fiscal	-.010	.359*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Table 55

2004 Functions at Group Centroids

	Function	
Deploy	1	2
No Deployment	-1.503	.575
Phase 1 Deployment	-.317	-.462
Phase 2 Deployment	1.328	.252

Unstandardized canonical discriminant functions evaluated at group means

Table 56

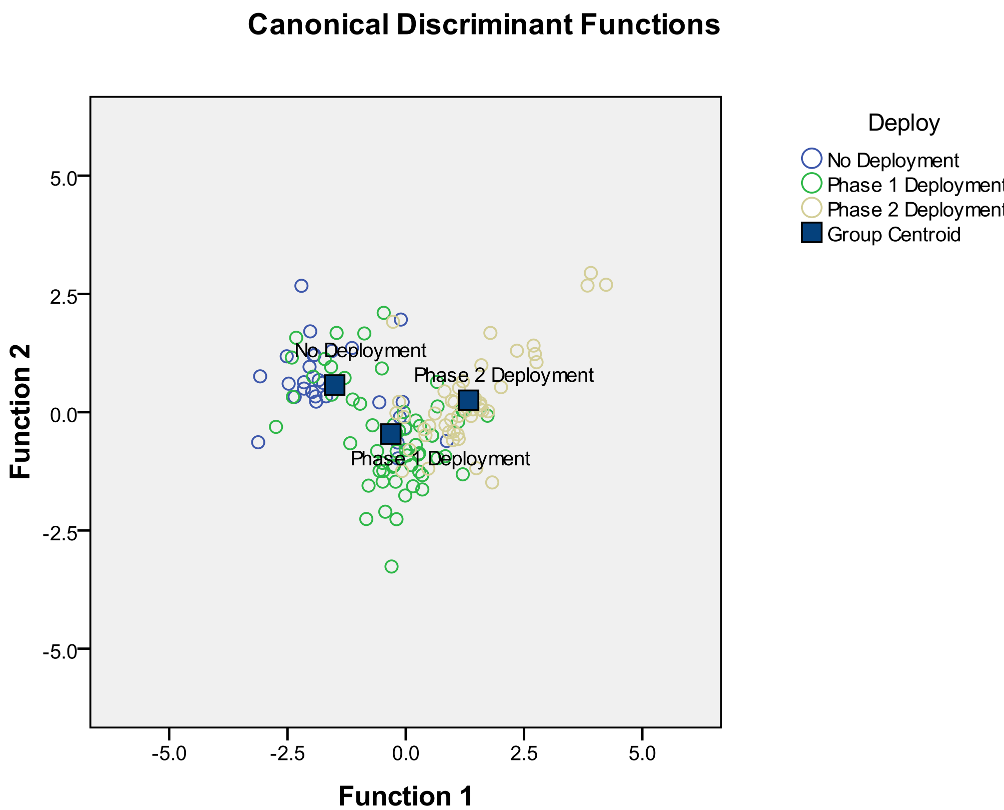

Figure 7: Wireless Phase 1 and Phase 2 Deployments for 2004

2004 Classification Results[a]

			Predicted Group Membership			
		Deploy	No Deployment	Phase 1 Deployment	Phase 2 Deployment	Total
Original	Count	No Deployment	21	6	1	28
		Phase 1 Deployment	15	38	7	60
		Phase 2 Deployment	1	9	36	46
	%	No Deployment	75.0	21.4	3.6	100.0
		Phase 1 Deployment	25.0	63.3	11.7	100.0
		Phase 2 Deployment	2.2	19.6	78.3	100.0

a. 70.9% of original grouped cases correctly classified.

Table 57

In 2004, the external predictor variables Funding and Region and the internal predictor variables Density, Wealth, Dependency, Population, and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. As such, H_1 H_3, H_7, H_{11}, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-1}, H_{0-3}, H_{0-7}, H_{0-11}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One deployments, H_5 and H_9 are not supported and the Null Hypotheses H_{0-5} and H_{0-9} are not rejected in this analysis. In addition, the external predictor variables Funding and Region and the internal variables Fiscal, Interstate, Wealth, Density, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase Two by Virginia Units of local government. As such, H_2, H_4, H_6, H_{12}, and H_{14} are supported by the data in this analysis and the Null Hypotheses H_{0-2}, H_{0-4}, H_{0-6}, H_{0-12}, and H_{0-14}, are rejected in this analysis. Also related to Wireless E9-1-1 Phase Two deployments, H_8, H_{10}, and H_{16} are not supported and the Null Hypotheses H_{0-8}, H_{0-10}, and H_{0-16} are not rejected in this analysis.

But what happens if Funding, the variable with the largest absolute size of correlation within the function, is not included as a predictor variable for Function 1 and Function 2? If Funding is not included as a predictor variable for Function 1, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments becomes Region, with a coefficient that has increased to .691. Density remains the next best performing predictor variable and its influence in predicting group membership has also increased with a coefficient of .550. In addition, Wealth, Population, Dependency, and Interstate remain the next best performing predictor variables as predictors of group membership with increased coefficient of .466, .394, -.382, and .319 respectively. See table 58.

If Funding is not included as a predictor variable for Function 2, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between Wireless E9-1-1 Phase One deployments and Wireless E9-1-1 Phase Two deployments becomes Interstate, with a coefficient that has increased to -574. Fiscal, Region, and Dependency are the next best performing predictor variables with coefficients of .491, .308, and .301 respectively. These results, which are attributable to distinguishing between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments, are different from those obtained when Funding was included as a predictor variable. One reason for the different results can be attributed to the fact that Function 2 is relatively weak in explaining variance. See table 58.

2004 Revised Structure Matrix

	Function	
	1	2
Region	.691*	.308
Density	.550*	.102
Wealth	.466*	.152
Population	.394*	.133
Dependency	-.382*	.301
Interstate	.319	-.574*
Fiscal	.017	.491*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Table 58

Wireless E9-1-1 Deployments in 2005

Two discriminant functions were calculated, with a X^2 (16) = 64.755 that were statistically significant, $\rho \leq .01$. The F-test associated with Function 1 is exact and has a canonical correlation of .554 between the predictor variables and the deployment classifications. The F-test associated with Function 2 is .012 and has a canonical correlation of .362 between the predictor variables and the deployment classifications. The two discriminant functions accounted for 75% and 25% respectively of the between-group variability.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (first function) is Interstate and Funding with coefficients of .606 and .567 respectively However, there are several other groupings of predictor variables, in descending order of influence, that are worth mentioning. In the first group, Region and Density have coefficients of .460 and .440 respectively. In the second group, Wealth, Population, and Dependency have coefficients of .349, .283, and -.273 respectively. As a result, Region and Density have less influence in predicting group membership than does Interstate and Funding. Wealth, Population, and Dependency have significantly less influence in predicting group membership than does Interstate and Funding. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are -1.859, -.260, and .415 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from the other two groups.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (second function) is Funding with a coefficient of -.510. However, there are other groupings of predictor variables, in descending order of influence, that are worth mentioning. In the first group, Density, Region and Fiscal have coefficients of .479, .469, and -.466 respectively. In the second group, Dependency and Population have coefficients of .326 and .270 respectively. As a result, Density, Region and Fiscal have less influence in predicting group membership than does Funding. Dependency and Population have significantly less influence in predicting group membership than does Funding. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-

1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are .570, -.549, and .202 respectively. These mean scores demonstrate that Function 2 separates Wireless E9-1-1 Phase One deployments from Wireless E9-1-1 Phase Two deployments. (See figure 8.) The Classification Table indicates that 61.9% of original grouped cases were correctly classified. See table 59 thru 63.

2005 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.443[a]	74.6	74.6	.554
2	.151[a]	25.4	100.0	.362

a. First 2 canonical discriminant functions were used in the analysis.

Table 59

2005 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.602	64.755	16	.000
2	.869	17.962	7	.012

Table 60

2005 Structure Matrix

	Function	
	1	2
Interstate	.606*	.049
Funding	.567*	-.510
Wealth	.349*	.084
Population	.283*	.270
Density	.440	.479*
Region	.460	.469*
Fiscal	.089	-.466*
Dependency	-.273	.326*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Table 61

2005 Functions at Group Centroids

	Function	
Deploy	1	2
No Deployment	-1.859	.570
Phase 1 Deployment	-.260	-.549
Phase 2 Deployment	.415	.202

Unstandardized canonical discriminant functions evaluated at group means

Table 62

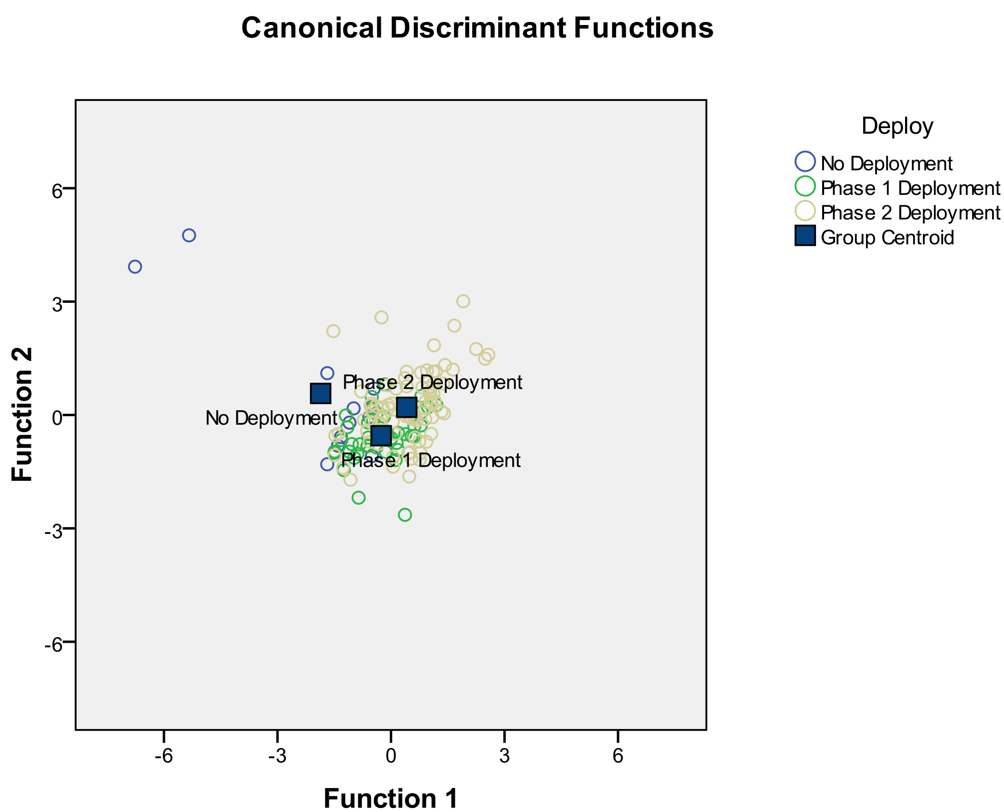

Figure 8: Wireless Phase 1 and Phase 2 Deployments for 2005

2005 Classification Results[a]

			Predicted Group Membership			
		Deploy	No Deployment	Phase 1 Deployment	Phase 2 Deployment	Total
Original	Count	No Deployment	4	7	1	12
		Phase 1 Deployment	1	30	11	42
		Phase 2 Deployment	3	28	49	80
	%	No Deployment	33.3	58.3	8.3	100.0
		Phase 1 Deployment	2.4	71.4	26.2	100.0
		Phase 2 Deployment	3.8	35.0	61.3	100.0

a. 61.9% of original grouped cases correctly classified.

Table 63

In 2005, the external predictor variables Funding and Region and the internal predictor variables Interstate, Density, Wealth, Population, and Dependency generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. As such, H_1 H_3, H_7, H_{11}, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-1}, H_{0-3}, H_{0-7}, H_{0-11}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One deployments, H_5 and H_9 are not supported and the Null Hypotheses H_{0-5} and H_{0-9} are not rejected in this analysis. In addition, the external predictor variables Funding and Region and the internal variables Density, Fiscal, Dependency, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase Two by Virginia Units of local government. As such, H_4, H_{10}, H_{12}, and H_{14} are supported by the data in this analysis and the Null Hypotheses H_{0-4}, H_{0-10}, H_{0-12}, and H_{0-14}, are rejected in this analysis. Also related to Wireless E9-1-1 Phase Two deployments, H_2, H_6, H_8, and H_{16} are not supported and the Null Hypotheses H_{0-2}, H_{0-6}, H_{0-8}, and H_{0-16} are not rejected in this analysis.

But what happens if Funding, the variable with the largest absolute size of correlation within the function, is not included as a predictor variable for Function 1 and Function2? If Funding is not included as a predictor variable for Function 1, the loading matrix of correlations between the predictor variables and the discriminant function remains almost the same, suggesting that the best predictor variable for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One deployments becomes Interstate, with an increased coefficient of .691. Region and Density remains the next best performing predictor variables and their influence in predicting group membership has also increased with coefficients of .616 and .596 respectively. In addition, Wealth and Population remain the next best performing predictor variables as predictors of group membership with increased coefficient of .410 and .375 respectively. The predictor variable Dependency saw a decrease from -.273 to -.238. See table 64.

If Funding is not included as a predictor variable for Function 2, the loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor variable for distinguishing between Wireless E9-1-1 Phase One deployments and Wireless E9-1-1 Phase Two deployments becomes Fiscal with a coefficient that has increased to -592. Dependency, Interstate, Density, and Region, are the next best performing predictor variables with coefficients of .548, -.329, .271, and .247 respectively. These results, which are attributable to distinguishing between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments, are different from those obtained when Funding was included as a predictor variable. One reason for the different results can be attributed to the fact that Function 2 is relatively weak in explaining variance. See table 64.

2005 Revised Structure Matrix

	Function	
	1	2
Interstate	.691*	-.329
Region	.616*	.247
Density	.596*	.271
Wealth	.410*	-.126
Population	.375*	.130
Fiscal	.001	-.592*
Dependency	-.238	.548*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Table 64

Wireless E9-1-1 Deployments in 2006

Two discriminant function were calculated, with a combined a $X^2(16) = 39.621$ that was statistically significant for Function 1, $\rho \leq .01$. The F-test associated with Function 1 is .001 and has a canonical correlation of .479 between the predictor variables and the deployment classifications. After removal of the first function, there was still some association between the predictor variables and the deployment classifications. The F-test associated with Function 2 is .500 (not significant) and has a canonical correlation of .220 between the predictor variables and the deployment classifications. The two discriminant functions accounted for 86% and 14% respectively of the between-group variability.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between No Wireless E9-1-1 deployments and Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (first function) is Dependency and Interstate with coefficients of -.737 and .628 respectively However, there are several other groupings of predictor variables, in descending order of influence, that are worth mentioning. In the first group, Region and Density have coefficients of .551 and .409 respectively. In the second group, Wealth, Population, and Funding have coefficients of .290, .289, and .287. As a result, Region and Density have less influence in predicting group membership than does Dependency and Interstate. Wealth, Population, and Funding have significantly less influence in predicting group membership than does Dependency and Interstate. Loadings less than .20 are not interpreted. The average discriminant scores for No Wireless E9-1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are -1.403, -1.028, and .243 respectively. These mean scores demonstrate that Function 1 maximally separates No Wireless E9-1-1 deployments from the other two groups.

The loading matrix of correlations between the predictor variables and the discriminant function suggests that the best predictor for distinguishing between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments (second function) is Wealth with a coefficient of .593. Fiscal is the next best performing predictor variable in predicting group membership with a coefficient of .563. However, since Function 2 was not statistically significant, the results are not very conclusive. The average discriminant scores for No Wireless E9-1-1 deployments, Wireless E9-1-1 Phase One deployments, and Wireless E9-1-1 Phase Two deployments are -.597, .497, -.014 respectively. These mean scores demonstrate that Function 2 separates

Wireless E9-1-1 Phase One deployments from Wireless E9-1-1 Phase Two deployments (See figure 9). The Classification Table indicates that 68.7% of original grouped cases were correctly classified. See tables 65 thru 69.

2006 Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.298[a]	85.4	85.4	.479
2	.051[a]	14.6	100.0	.220

a. First 2 canonical discriminant functions were used in the analysis.

Table 65

2006 Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.733	39.621	16	.001
2	.951	6.343	7	.500

Table 66

2006 Structure Matrix

	Function	
	1	2
Dependency	-.737*	-.078
Interstate	.628*	.333
Region	.551*	-.023
Density	.409*	-.072
Population	.289*	-.009
Funding	.287*	-.020
Wealth	.290	.593*
Fiscal	.163	.563*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions

Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

Table 67

2006 Functions at Group Centroids

	Function	
Deploy	1	2
No Deployment	-1.403	-.597
Phase 1 Deployment	-1.028	.497
Phase 2 Deployment	.243	-.014

Unstandardized canonical discriminant functions evaluated at group means

Table 68

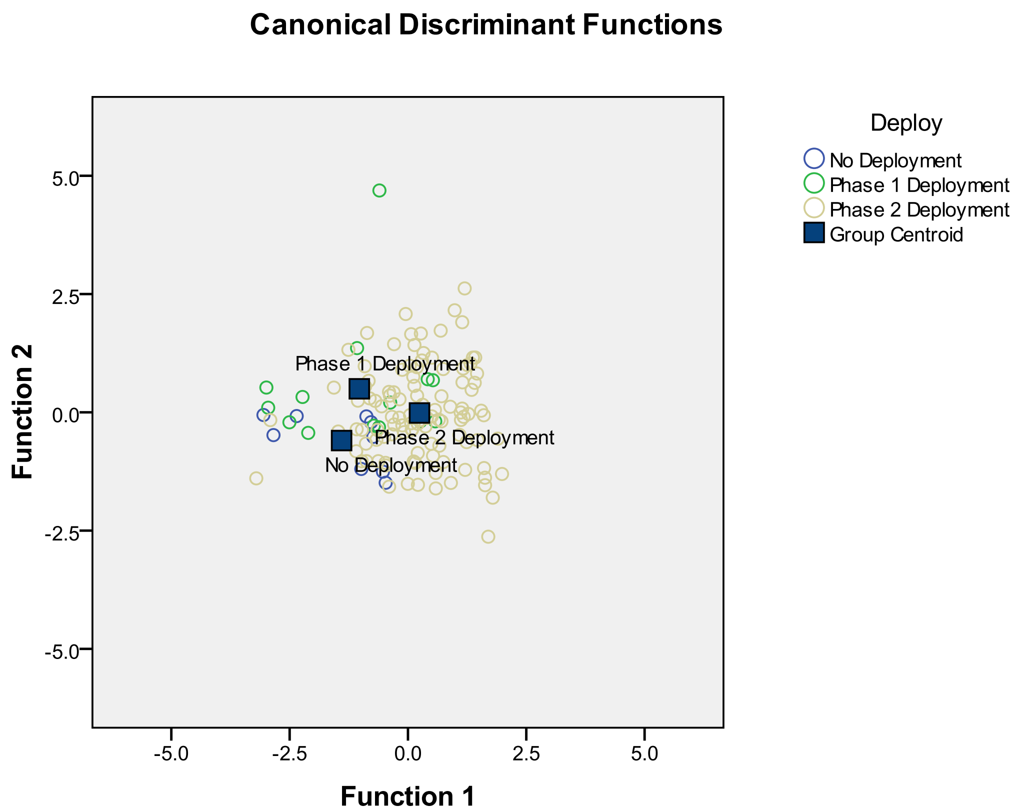

Figure 9: Wireless Phase 1 and Phase 2 Deployments for 2006

2006 Classification Results[a]

			Predicted Group Membership			
		Deploy	No Deployment	Phase 1 Deployment	Phase 2 Deployment	Total
Original	Count	No Deployment	8	1	0	9
		Phase 1 Deployment	6	3	5	14
		Phase 2 Deployment	15	15	81	111
	%	No Deployment	88.9	11.1	.0	100.0
		Phase 1 Deployment	42.9	21.4	35.7	100.0
		Phase 2 Deployment	13.5	13.5	73.0	100.0

a. 68.7% of original grouped cases correctly classified.

Table 69

In 2006, the external predictor variable Region and Funding and the internal predictor variables Dependency, Interstate, Density, Wealth, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. As such, H_1, H_3, H_7, H_{11}, H_{13}, and H_{15} are supported by the data and the null hypotheses H_{0-1}, H_{0-3}, H_{0-7}, H_{0-11}, H_{0-13}, and H_{0-15} are rejected in this analysis. Also related to Wireless E9-1-1 Phase One deployments, H_5 and H_9 are not supported and the Null Hypotheses H_{0-5} and H_{0-9} are not rejected in this analysis. In addition, the internal predictor variables Wealth and Fiscal generated the best performing model for the deployment of Wireless E9-1-1 Phase Two by Virginia Units of local government. However, since Function 2 is not statistically significant, H_2, H_4, H_6, H_8, H_{10}, H_{12}, H_{14}, and H_{16} are not supported by the data in this analysis and the Null Hypotheses H_{0-2}, H_{0-4}, H_{0-6}, H_{0-8}, H_{0-10}, H_{0-12}, H_{0-14}, and H_{0-16} are not rejected in this analysis.

Section Three: Strengths and Weaknesses of This Study's Research Strategy

In this section I address the strengths and weaknesses of this study's research strategy in relation to previous research, as well as the contributions I hope to make to the field of DOI. The research method used in this study is a cross-sectional study. The specific analytical technique is discriminant function analysis (Frankfort Nachmias & Nachmias, 2000; Huck, 2000; Johnson, 2001; Miller & Salkind, 2002) to address the following research question: Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government?

This research question was answered by conducting a discriminant function analysis for each of six risk sets (2001, 2002, 2003, 2004, 2005, and 2006) for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments for Virginia units of local government and determining which of the study's sixteen hypotheses were supported by the results and how these results compared to the results of previous studies.

Wealth

H_1 The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_2 The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

More affluent populations are expected to be innovative (Rogers, 1962, 1971, 1983, 1995, 2003). This variable has often been operationalized as per capita in state diffusion studies (e.g., Goodwin, 2001, p.16). Given the research literature I expected to find that the more affluent a local government the greater the likelihood that it would deploy Wireless E9-1-1 technologies. This was the case with Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments in 2004, 2005, and 2006. The correlation between the per capita income of the population served by a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two is .399, .349, and .290. This finding is consistent in direction, but lesser in magnitude with Walker's (1969, p. 885) correlation between innovation scores and per capita income, .55. This difference in magnitude is believed attributable to Walker's focus on states rather than local governments. In Walker's study a 10-year average rather than jurisdictional-level data was used. However, if funding received from Virginia state government is not included as a predictor variable, the correlation between the per capita income of the population served by a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two increases, bringing it closer to Walker's results. In contrast, Berry's (1994, p. 452) correlation between dates of adoption for simulated regionally diffused policies and per capita income was much lower, .03 to .23. Goodwin (2001) also found the expected positive relationship between per capita income and the innovativeness of state and sub-national governments when measured by entrants and awards under the Innovations in American Government Program.

Population

H_3 The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_4 The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Governments with larger populations are presumed to have a larger resource base, have more stakeholders, have more dynamic interpersonal interactions that promote innovation, be sensitive to external pressures to make government more efficient and have a more diverse environment that demands innovative solutions (Weare, Musso, & Hale, 1999; Goodwin, 2001; Moon& deLeon, 2001; Ho, 2002; Moon, 2002). Given the research literature I expected to find that the larger a population served by a local government the more likely it is to deploy Wireless E9-1-1 technologies. This was the case with Wireless E9-1-1 Phase One deployments in 2002 and 2003 and both Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments in 2004, 2005, and 2006. The correlation between the population served by a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One in 2002 and 2003 is .280 and .228, respectively. The correlation between the population served by a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two in 2004, 2005, and 2006 is .337, .283, .289, respectively. This finding is consistent in direction, but lesser in magnitude with Walker's (1969, p. 884) correlation between innovation scores and urban population, .63. This difference in magnitude is believed attributable to Walker's focus on urban rather than total population and states rather than local governments. In Walker's study a 10-year average rather than jurisdictional-level data was used. However, if funding received from Virginia state government is not included as a predictor variable, the correlation between the population served by a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two increases. In contrast, Berry's (1994, p. 452) correlation between dates of adoption for simulated regionally diffused policies and percent urban populations was much lower, .05 to .18. Goodwin (2001) also found the expected positive relationship between population size and the innovativeness of state and sub-national governments when measured by entrants and awards under the Innovations in American Government Program.

Fiscal Health

H_5 The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_6 The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

For local government, the most important economic determination of motivation is short-term fiscal health (Hansen, 1990; Berry & Berry, 1990, 1992). The level of fiscal health is defined as the degree to which a local government's revenues keep pace with its spending commitments and priorities (Berry & Berry, 1992). Local governments with higher revenue levels are more likely to have slack resources available, such as capital funding, which would enable innovations to be adopted more easily, particularly if they are expensive and technologically complex (Rogers, 2003). Given the research literature I expected to find that the greater the proportion of revenue to expenses for a local government the more likely it would deploy Wireless E9-1-1 technologies. This was the case with only Wireless E9-1-1 Phase Two deployments in 2004 and 2006. The correlation between the fiscal health for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase Two for 2004 and 2006 is .359 and .563 respectively. Unfortunately, the results in this study are not very conclusive for two reasons. One, the function that distinguishes between Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments for 2004 is relatively weak in explaining variance. And two, the function that distinguishes between E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments for 2006 is not statistically significant. However, the above finding is consistent in direction and magnitude with Berry's (1992, p. 730) correlation between dates for adoption of tax innovations and fiscal health, which was .23 to .84 and tracked with the research of Berry & Berry (1990) on state lottery adoptions and the interaction between fiscal health and election proximity. In an election year, fiscal health is positively correlated to the adoption of a state lottery.

Dedicated Funding

H_7 For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One is more likely to occur if wireless non-recurring and recurring costs were offset by wireless surcharge revenue received in the previous year.

H_8 For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two is more likely to occur if wireless non-recurring and recurring costs were offset by wireless surcharge revenue received in the previous year.

However, the question then becomes are these slack resources, described in relationship to the predictor variable Fiscal Health, adequate to generate the development of specific innovations, such as the deployment of wireless E9-1-1 technologies? Or, are additional financial resources needed? Hatfield (2002, 2008) identified that the lack of adequate funding for the non-recurring and recurring costs involved with wireless E9-1-1 at the local government level as a reason for the delay in the deployment of this vital resource. Given the research literature I expected to find that the deployment of wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two would be more likely to occur if wireless non-recurring and recurring costs were offset by wireless surcharge revenue received in the previous year. This was the case with Wireless E9-1-1 Phase One deployments in 2001, 2002, and 2003 and both Wireless E9-1-1 Phase One and Two deployments in 2004, 2005, and 2006. The correlation between dedicated funding for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One in 2001, 2002, and 2003 is .713, .547, and .717, respectively. The correlation between dedicated funding for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two in 2004, 2005, and 2006 is .637, .567, and .287, respectively. This finding is consistent in direction and magnitude of Berry, Fording, & Hanson's (2003, p. 730) correlation between federal AFDC funding and higher state welfare benefits, .44 and tracked with the findings of the 9-1-1 Industry Alliance (2008) on the overall functioning of the nation's 9-1-1 system.

Financial Dependency

H_9 For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One.

H_{10} For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Many new governmental programs require major expenditures. The availability of extraneous financial resources is often a necessary and additional prerequisite for adoption

(Berry & Berry, 1999). These extraneous funding sources, thus, create a financial dependency on the part of local governments to maintain such programs as wireless E9-1-1 technologies. Given the research literature I expected to find that the greater the percentage of wireless funding revenue for a local government to its public safety expenditures the more likely it would deploy Wireless E9-1-1 technologies. This was the case with Wireless E9-1-1 Phase Two deployments in 2005. The correlation between the financial dependency of a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase Two for 2005 is .326. However, if funding received from Virginia state government is not included as a predictor variable, the correlation between the financial dependency of a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase Two increases as expected to .548. This finding is consistent in direction and greater in magnitude with Walker's correlation between innovation scores and an averaged economic indicator, .43. This finding also tracked with the research by Berry (1994) and Goodwin (2001).

Urbanization

H_{11} The greater the population density per square mile for a Virginia unit of local government, the grater the likelihood that it will deploy Wireless E9-1-1 Phase One.

H_{12} The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

Governments with larger populations are presumed to have a larger resource base, have more stakeholders, have more dynamic interpersonal interactions that promote innovation, be sensitive to external pressures to make government more efficient and have a more diverse environment that demands innovative solutions (Weare, Musso, & Hale, 1999; Goodwin, 2001; Moon& deLeon, 2001; Ho, 2002; Moon, 2002). Given the research literature I expected to find that the larger a population served by a local government the more likely it is to deploy Wireless E9-1-1 technologies. This was the case with Wireless E9-1-1 Phase One deployments in 2001 and 2003 and both Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments in 2004, 2005, and 2006. The correlation between the urbanization of a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One in 2001 and 2003 is .259 and .286, respectively. The correlation between the urbanization of a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two in 2004, 2005, and 2006 is .475, .440, .409, respectively. This finding is consistent in direction, but lesser in magnitude with Walker's (1969, p. 884) correlation between innovation scores and urban population, .63. However, if funding received from Virginia state government is not included as a predictor variable, the correlation between the urbanization of a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two increases. In contrast, Berry's (1994, p. 452) correlation between dates of adoption for simulated regionally diffused policies and percent urban populations was much lower, .05 to .18. Goodwin (2001) also found the expected positive relationship between population size and the innovativeness of state and sub-national governments when measured by entrants and awards under the Innovations in American Government Program.

Previous Deployments (Region)

H_{13} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed.

H_{14} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase is positively related to the proximity of other Virginia units of local government that have already deployed.

Walker (1969, 1973) was one of the early researchers to hypothesize regional emulation. In agreement on the conclusions, but not always on the specifics, Gray (1973a, 1973b, 1974b) echoed this hypothesis but emphasized that innovations are issue and time specific (see also Light, 1978, and Money & Lee, 1995, who added program-specific considerations). Foster (1978) offered two potential explanations for why organizations in geographic proximity adopt a series of innovations at approximately the same rate. First, state officials see familiar conditions in adjoining states, or receive ideas from neighbors with similar problems and emulate them. Second foster suggests that environmental conditions and political structures do not play at all in regionalism. Instead, regional innovation patters may be attributable to:

> One state may observe a neighboring state's implementation of new programs and become dissatisfies with its programs even though the two states have little other than a border in common. Conversely, officials may use a neighboring states preference for the status quo to justify their own state's inaction. Finally, political culture could produce non-economic regionalism. Adjoining states may have similar political traditions and climates, but different levels of industrialization and urbanization (p. 181).

Given the research literature I expected to find geographical clusters of innovation (see for example, Berry, 1994b), operationalized as the regional completion rates for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments. This study's selection of the seven Homeland Security regions designated by the Office of the Governor (2010) indicated regional diffusion in Wireless E9-1-1 technologies with Wireless E9-1-1 Phase One deployments in 2001, 2002, and 2003 and both Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments in 2004, 2005, and 2006. The correlation between regional completion rates for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One in 2001, 2002, and 2003 is .530, .559, and .449, respectively. The correlation between regional completion rates for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two in 2004, 2005, and 2006 is .558, .460, and .551, respectively. The presence of these regional diffusions is consistent with the research literature (Rogers, 1962, 1971, 1983, 1995, 2003; Klingman & Lammers, 1969; Walker, 1969; Rogers & Shoemaker, 1971; Gray, 1973a, 1973, 1974; Foster, 1978; Light, 1978; Berry, 1994b; Mooney & Lee, 1995).

Proximity to Interstate

H_{15} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its geographic proximity to one or more interstate highways.

H_{16} The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its geographic proximity to one or more interstate highways.

And finally, interstate highways play a major role in the deployment of wireless technology. Historically, wireless carriers have established the build out of coverage along interstates because of the high volume of calls from motorists (Wikle, 2001). Given the research literature I expected to find that the geographical proximity to one or more interstate highways would be positively related to the deployment of wireless E9-1-1 technologies. This was the case with Wireless E9-1-1 Phase One deployments in 2001, 2002, and 2003 and both Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two deployments in 2004, 2005, and 2006. The correlation between proximity to interstate for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One in 2001, 2002, and 2003 is .249, .204, and .471, respectively. The correlation between proximity to interstate for a Virginia unit of local government and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two in 2004, 2005, and 2006 is .307, .606, and .628, respectively. This finding is consistent with the research literature.

A summary of these results, which compares the discriminant function analysis performed for each year is presented in table 70.

Table 70					
Comparison of Discriminant Function Analyses to Research Question and Hypotheses					
Risk Set	**Phase One and Two Predictor Variables**	**Phase Two Only Predictor Variables**	**Hypotheses Supported**	**Policy Innovation Adoption Theory**	**Additional Information**
2001	Funding, Region, Density, & Interstate	None	H_7, H_{11}, H_{13} & H_{15}	Unified Approach	No Phase Two Deployments
2002	Funding, Region, Population & Interstate	None	H_3, H_7, H_{13} & H_{15}	Unified Approach	No Phase Two Deployments
2003	Funding, Region, Density, Population & Interstate	None	H_3, H_7, H_{11}, H_{13} & H_{15}	Unified Approach	No Phase Two Deployments
2004	Funding, Region, Density, Wealth, Population & Interstate	Fiscal	H_1 , H_2, H_3, H_4, H_6, H_7, H_{11}, H_{12}, H_{13}, H_{14} & H_{15}	Unified Approach	
2005	Funding, Region, Density, Wealth, Population & Interstate	Dependency	H_1, H_3, H_7, H_{10}, H_{11}, H_{12}, H_{13}, H_{14} & H_{15}	Unified Approach	
2006	Region, Density, Wealth, Population & Interstate	Fiscal	H_1 H_3, H_{11}, H_{13} & H_{15}	Unified Approach	Function separating Phase Two from Phase One is not significant

This study contributes to the field of DOI in four ways: by demonstrating its contemporary relevance to the deployment of a new wireless technology, by taking up Rogers' challenge (2003, p. 95) to dig deeper in directions the theory suggests by continuing to investigate why people decide to innovate, to expand upon the existing models that "dominate government innovation in the public policy literature" (Berry & Berry 1999, p.169), and by providing a snapshot of the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1

Phase Two by Virginia units of local government as a prerequisite for the deployment of other new 9-1-1 technologies.

In the next chapter I provide a summary and a discussion of the results.

CHAPTER 5: SUMMARY

Introduction

In this chapter I summarize the study and show that the research does make a distinct contribution to the body of knowledge. This chapter is organized into six sections. Section one synopsizes chapters one through four and states this study's distinct contributions to the body of knowledge. Section two summarizes the findings for the research question and associated hypotheses from chapter four, which are explained within the context of this and prior research examined in chapter two. Section three extends section two by exploring the implications of the research for further understanding of the research problem. Section four provides the theoretical implications of the research. Section five covers the practical implications for public sector analysts and managers. Section six is written to help other Ph.D. candidates and other researchers in the selection and design of future research.

Section One: Chapter Synopses

Chapter One: Introduction to the Study

Chapter one laid the foundations for the study. It established the study's purpose and significance. Then a background on government innovation was presented, the research question was introduced, the methodology was briefly described, delimitations and assumptions were given, definitions were provided and the study's organization was outlined.

The study's purpose was to conduct an empirical analysis to assess the overall accuracy of three principle theories (Berry & Berry, 1990, 1992, 1994, 1999) of policy innovation adoption – diffusion, internal determinants, and unified theory, which are variations of the fundamental diffusion theory – in predicting the deployment of Wireless E9-1-1 by Virginia units of local government. This assessment was conducted by identifying Virginia specific variables from models associated with these policy innovation theories to determine the best performing model for the deployment of Wireless E9-1-1 throughout the Commonwealth of Virginia. This best performing model will then provide the bases from which to develop a statewide comprehensive policy and plan for the interconnection of emerging technologies with the 9-1-1 network.

The study's significance was established in three areas. First, the study provided a strategy to develop a better process in locating the knowledge needed to move governments closer to building optimum network solutions for 9-1-1 emergency services (Hatfield, 2003). Second, the study served as a mechanism to help answer the question when and how governments get involved in designing and implementing a 9-1-1 emergency services network. And three, the study contributed to the development of the DOI theory and extended the very limited existing knowledge of wireless 9-1-1 technology as a diffusion of government policy innovation. These areas are addressed in detail in the next section that covers the study's research question and associated hypotheses.

The background on government policy innovation opened with an overview of the three major approaches. Following Walker (1969) and Gray (1973a), one approach focused on the diffusion across states to explain policy innovation. The other approach, following Dye (1966), has focused on internal state determinants. Recognizing that these approaches are not mutually exclusive, Berry and Berry (1990, 1992) proposed a third research approach as an inclusive model to analyze state policy innovation.

One research question was introduced: Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach – generated the best performing model to examine the framework for the deployment of Wireless E9-1-1 by Virginia units of local government?

The research design and methodology for the study were briefly described as using the general underlying theory of DOI Theory. The research method used in this study was a cross-sectional study using secondary data in a discriminant function analysis (see Campbell and Stanley, 1963; Babbie 1990; Frankfort Nachmias & Nachmias, 2000; Huck, 2000; Johnson, 2001; Miller & Salkind, 2002). The study's population was the 134 Virginia local governments (95 counties and 39 cities) which had not yet deployed either Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two technology as of January 1, 2001.

Two limitations were identified in this study. Because wireless telephony is a relatively new technology, there has not been sufficient time since the passage of the Wireless Communications and Public Safety Act of 1999 for the analysis of Wireless E9-1-1 deployments to have occurred in research studies. As a result, the analytical technique chosen for this study, discriminant function analysis, has not been previously applied to wireless telephony studies. However, this analytical technique has been utilized in several past studies involving the three principle theories of policy innovation adoption examined in this study.

In this study, instrumentation must be considered. Instrumentation includes changes in the calibration of a measuring instrument or changes in the observers or scorers used that may produce changes in the obtained measurements. In this study, changes in the unit-level record file database were not expected. The simultaneous construction of the unit-level record file database from secondary data electronically obtained from websites and archived databases will help control for the effects of instrumentation.

The definitions for this study were drawn from the DOI and wireless technology literature. On these foundations, the study's second chapter proceeded with a detailed description of the research.

Chapter Two: Literature Review

Chapter two built the theoretical foundation upon which the research was based by reviewing the relevant literature to identify research issues. It began with a summary of the DOI research and basic concepts. Then, a brief overview of the fundamental diffusion model and related assumptions was given. This was followed by a discussion of the history and typology of diffusion research related to the three principle theories of policy innovation adoption - diffusion, internal determinants, and a unified approach, as well as the associated models: external-influence, internal-influence, and mixed-influence. And lastly, the study's hypotheses were introduced, with appropriate references to the literature.

The DOI literature was shown as relevant to answering the research question introduced in chapter one by its description of the adoption patterns and explanations in predicting whether and how a new innovation will be successful (see Griliches, 1957; Mansfield, 1961; Robinson & Lakhani, 1975; Brown, 1981; Mahajan & Peterson, 1985; Rogers, 2003). The DOI research literature was traced to its application to information technology ideas, artifacts, and techniques with an emphasis on how it has been used as a theoretical basis for a number of information systems and information technology research projects (see Fichman, 1992). The basic concepts of the diffusion process: diffusion, the S-shaped curve, the innovation, channels of communications, time and the social system were discussed (see Mahajan & Peterson, 1985; Berry & Berry 1999; Rogers, 2003) and the basic or fundamental diffusion model and its major components and underpinnings were examined (see Mahajan & Peterson, 1985).

The policy research strand was reviewed from the perspective of the reasons why governments innovate: to learn from one another, to compete with one another, or to respond to internal pressure (see Simon, 1947; Lindblom, 1965; Walker, 1969; Gray, 1974; Berry & Berry, 1990; Peterson & Rom, 1990). The principle models used to research government innovation in the public literature were found traceable to versions of the basic or fundamental diffusion models discussed later in the chapter (see Walker, 1969; Gray, 1973a; Walker, 1973; Gray 1973b; Grupp & Richards, 1975; Nelson, 1984; Clark, 1985; Freeman, 1985; Mahajan & Peterson, 1985; Jacob, 1988; Berry & Berry, 1990; Click, 1993; Berry, 1994a; Hays & Click, 1997; Mintrom, 1997b; Mintrom & Vergari, 1998; Berry & Berry, 1999; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006; Bowman & Woods, 2007; Karch, 2007; Mintrom & Norman, 2009).

The presentation of the research hypotheses for the study was developed out of the research literature:

Hypothesis 1: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 2: The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two.

Hypothesis 3: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 4: The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 5: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 6: The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 7: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

Hypothesis 8: For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two is more likely to occur if a percentage of wireless non-recurring and recurring costs was offset by wireless surcharge revenue received in the previous year.

Hypothesis 9: For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One.

Hypothesis 10: For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 11: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One.

Hypothesis 12: The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it is to deploy Wireless E9-1-1 Phase Two.

Hypothesis 13: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed.

Hypothesis 14: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to the proximity of other Virginia units of local government that have already deployed.

Hypothesis: 15: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its proximity to one or more interstate highways.

Hypothesis: 16: The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its proximity to one or more interstate highways.

Chapter two identified and reviewed the conceptual/theoretical dimensions in the literature and developed hypotheses to be researched in later chapters. These hypotheses led to the methodology used to collect the data which were used to answer the hypotheses.

Chapter Three: Method

Chapter three was written to enable another researcher to replicate the research. After a reintroduction of the research question from chapter one and the associated hypotheses from chapter two, the key elements of the research design were identified. Then the instrumentation to be used for the study was described, the procedures for collecting data was presented, procedures for treating, and coding and analyzing data were defined.

The key elements of the research design were identified as: study design (cross-sectional), type of data available (quantitative analysis), temporal dimension (cross-sectional), sample or universe to be studied (society), sample size (population), data source (archived or secondary data), data gathering method (unobtrusive), number of independent variables (more than one), number of dependent variables (two), selection of scales to assess dependent variable(s) (presence of reliability and validity data) and characteristics of dependent variables (normally distributed).

The instrument was described as a self-developed, unit-level record file database. Explanation was given for why and how the instrument was developed, the appropriateness of the instrument for the population, and for the goals of the study. The measurement characteristics of the instrument and how the instrument will collect the data needed to answer the research question and associated hypotheses were described. Information about how the instrument was administered and scored was presented.

The procedures for collecting data was presented and the procedures for treating, coding, and analyzing data were developed for use with SPSS for Windows (version 17.0) and documented what was done with the data after it had been collected, how it was entered into a computer for analysis, and how the data was cleaned up, standardized, and analyzed. One design issue was treated: internal validity (instrumentation)

Chapter three provided the audit trail for the procedures that will be used to answer the research question and associated hypotheses. These answers (results) were provided in the following chapter.

Chapter Four: Results

Chapter four presented patterns of results and analyzed them for their relevance to the research questions and associated hypotheses. The data examination for normality consisted of two steps: checking data and examining data for individual variables. The data analysis was conducted by a research question and associated hypotheses. The findings only included the presentation and analysis of the collected data, without drawing general conclusions or comparing results to those of other researchers who were discussed in chapter two. However, the discussion of the strengths and weaknesses of the study's research strategy was addressed in relation to previous research.

Section Two: Conclusions about the Research Question and Hypotheses

In this section I summarize the findings for the research question and associated hypotheses from chapter four. This section concludes with a table summarizing the hypotheses tests.

Research Question: *Which internal and external variables from the various models associated with the principle theories of policy innovation adoption – diffusion, internal determinants, or a unified approach - generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government?*

In 2001, the external predictor variables Funding and Region and the internal predictor variables Density and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. There were no Wireless E9-1-1 Phase Two deployments in 2001. These results supported the Unified Approach theory of policy innovation adoption.

In 2002, the external predictor variables Region and Funding and the internal predictor variables Population and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. There were no Wireless E9-1-1 Phase Two deployments in 2002. These results supported the Unified Approach theory of policy innovation adoption.

In 2003, the external predictor variables Funding and Region and the internal predictor variables Interstate, Density, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. There were no Wireless E9-1-1 Phase Two deployments in 2003. These results supported the Unified Approach theory of policy innovation adoption.

In 2004, the external predictor variables Funding and Region and the internal predictor variables Density, Wealth, Dependency, Population, and Interstate generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. In addition, the external predictor variables Funding and Region and the internal predictor variables Fiscal, Interstate, Wealth, Density, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase Two deployments in 2004 by Virginia Units of local government. These results supported the Unified Approach theory of policy innovation adoption.

In 2005, the external predictor variables Funding and Region and the internal predictor variables Interstate, Density, Wealth, Population and Dependency generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. In addition, , the external predictor variables Funding and Region and the internal predictor variables Density, Fiscal, Dependency, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase Two deployments in 2005 by Virginia Units of local government. These results supported the Unified Approach theory of policy innovation adoption.

In 2006, the external predictor variable Region and the internal predictor variables Interstate, Density, Wealth, and Population generated the best performing model for the deployment of Wireless E9-1-1 Phase One by Virginia Units of local government. In addition, the internal predictor variables Wealth and Fiscal generated the best performing model for the deployment of Wireless E9-1-1 Phase Two deployments in 2006 by Virginia Units of local government. These results supported the Unified Approach theory of policy innovation adoption.

In conclusion, the internal variables of Wealth, Population, Fiscal, Dependency, Urbanization, and Interstate, which are associated with the principle theories of policy innovation adoption, generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government. In addition, the external variables of Funding and Region, which are associated with the principle theories of policy innovation adoption, generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government. And finally, the Unified Approach theory of policy innovation adoption generated the best performing model to examine the framework for the deployment of wireless E9-1-1 by Virginia units of local government.

Table 71
Summary of Hypothesis Tests

Hypothesis	Null Hypothesis per Risk Set					
	2001	**2002**	**2003**	**2004**	**2005**	**2006**
1. The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One	NR	NR	NR	R	R	R
2. The greater the level of per capita income of the population served by a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two	NR	NR	NR	R	NR	NR
3. The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase One	NR	R	R	R	R	R
4. The larger the population served by a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two	NR	NR	NR	R	NR	NR
5. The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E911 Phase One	NR	NR	NR	NR	NR	NR
6. The greater the proportion of revenues to expenses for a Virginia unit of local government, the more likely it is to deploy Wireless E9-1-1 Phase Two	NR	NR	NR	R	NR	NR
7. For all Virginia units of local government the deployment of Wireless E9-1-1 Phase One	R	R	R	R	R	NR
8. For all Virginia units of local government the deployment of Wireless E9-1-1 Phase Two	NR	NR	NR	NR	NR	NR
9. For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase One	NR	NR	NR	NR	NR	NR
10. For a Virginia unit of local government, the greater the percentage of wireless funding revenue to its public safety expenditures, the more likely it is to deploy Wireless E9-1-1 Phase Two	NR	NR	NR	NR	R	NR
11. The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase One	R	NR	R	R	R	R

Table 71
Summary of Hypothesis Tests

Hypothesis	Null Hypothesis per Risk Set					
	2001	2002	2003	2004	2005	2006
12. The greater the population density per square mile for a Virginia unit of local government, the greater the likelihood that it will deploy Wireless E9-1-1 Phase Two	NR	NR	NR	R	R	NR
13. The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to the proximity of other Virginia units of local government that have already deployed	R	R	R	R	R	R
14. The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to the proximity of other Virginia units of local government that have already deployed	NR	NR	NR	R	R	NR
15. The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase One is positively related to its proximity to one or more interstate highways	R	R	R	R	R	R
16. The likelihood that a Virginia unit of local government will deploy Wireless E9-1-1 Phase Two is positively related to its proximity to one or more interstate highways	NR	NR	NR	NR	NR	NR

NR = Not Rejected
R = Rejected

Section Three: Limitations

In chapter one, I identified two study limitations: (1) limited by time for the analysis of wireless E9-1-1 deployments to have occurred in research studies since the passage of the Wireless Communications and Public Safety Act of 1999; (2) limited by the relevance of a threat to internal validity for instrumentation.

In many states the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two is still an ongoing process. As a result, the opportunities to explore various analytical techniques with the deployment of wireless E9-1-1 technologies have been limited. The research method chosen for this study is a cross-sectional study that utilizes a discriminant function analysis. A cross-sectional study is a research method that has been utilized in several previous studies involving the three principle theories of policy innovation adoption examined in this study. Discriminant function analysis is a technique that is used to predict group association.

In this study, instrumentation must be considered. Instrumentation includes changes in the calibration of a measuring instrument or changes in the observers or scorers used that may produce changes in the obtained measurements. In this study, changes in the unit-level record file database were not expected. The simultaneous construction of the unit-level record file database from secondary data electronically obtained from websites and archived databases will help control for the effects of instrumentation.

Section Four: Implications for Theory

The DOI Theory, with additional policy innovation adoption variables, provided the explanation of what factors were related to the decision to deploy Wireless E9-1-1 technologies, extending the very limited knowledge of wireless technology as a diffusion of government policy innovation. This study lends support to the continued use of DOI theory to explain information technology innovations (cf. Fichman, 2000). Eight internal and external Virginia specific variables, which are related to the three principle theories of policy innovation adoption, were studied. All of these variables, to varying degrees, contributed to developing the best performing model for the deployment of wireless

E9-1-1 technologies in Virginia, thus supporting the unified approach theory for the deployment of wireless E9-1-1 by Virginia units of local government. The strongest predictors, however, were the external variables of Funding and Region.

Berry and Berry (1990) demonstrated that both internal and external behavioral variables influence policy innovation adoption and encouraged others to conduct similar research. Although the mixed-influence approach has allowed scholars of state government innovation to undertake studies that simultaneously incorporate variables derived from internal determinants and variables derived from external diffusion impacts, thus far these studies have been limited. The major task of innovation scholars is to follow the course of several recent studies and develop and test more realistic models that specify impacts of internal determinants and influences by other jurisdictions (Berry & Berry, 1990, 1992; Mooney & Lee, 1995; Hays & Glick, 1997; Boehmke & Witmer, 2004; Grossback, Nicholson-Crotty, & Peterson, 2004; Berry & Baybeck, 2005; Volden, 2006). This study expands upon this growing body of literature.

Section Five: Implications for Policy and Practice

In this section I provide practical implications for public sector analysts and managers. Knowledge of wireless technology as a diffusion of government policy innovation is limited, increasing the difficulty in planning for the next generation of technologies that will follow Wireless E9-1-1. Analysts and managers may use the information contained in this study to create a strategy to develop a better practice in locating knowledge needed to move governments closer to building optimum network solutions for 9-1-1 emergency services. The first step for analysts and managers in creating this strategy is to consider the success of their past and current offerings in planning for the future. This study provides an initial analytical framework from which to begin this effort. Within this complex environment, critical network architecture choices are being made by governments that will have a profound and lasting effect (Hatfield, 2003; Hatfield, Bernthal, & Weiser, 2008) and information about past and current offerings would be extremely valuable.

The ability to develop a better planning process for 9-1-1 emergency services is vital. But, in order to build a better process, one first needs to understand what has contributed to the diffusion of existing wireless E9-1-1 technologies to extend E9-1-1 access successfully to a rapidly growing number of non-traditional devices, systems, and networks. The fundamental questions, then becomes when and how do governments get involved in designing and implementing a 9-1-1 emergency services network. This study helps to provide some of those answers by demonstrating what state government did to enable the diffusion of wireless 9-1-1 technologies and where local governments aided the process.

During its 2000 Session, the General Assembly of Virginia became involved with wireless 9-1-1 technologies when it enacted omnibus legislation to enhance the delivery of public safety services to citizens of the Commonwealth through improvements to emergency telecommunications systems. One of the outcomes of this legislation was the establishment of the Wireless E9-1-1 Fund, which receives revenue from a $0.75 surcharge placed on every wireless telephone billed by a wireless provider in Virginia. Utilizing this funding source is how the Commonwealth of Virginia provided funding for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. For five of the six years investigated in this study, Funding had either the largest, or second largest, absolute size of correlation among the predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. Based on these results, once could conclude that a relationship existed between the predictor variable, Funding, and the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two, thus, enhancing the delivery of public safety services to citizens of the Commonwealth through improvements to emergency telecommunications systems.

But what would have happened if the Commonwealth of Virginia had not become involved with the deployment of Wireless 9-1-1 technologies? Would the deployment of wireless 9-1-1 technologies have occurred anyway? An answer to these questions can be found in the results of the study's next strongest predictor variable, Region. Walker (1969, 1973) was one of the early researchers to hypothesize regional emulation. The question then becomes, would Virginia units of local government have deployed Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two if funding had not been made available to them? If Funding is not included as a predictor variable, the order of the variables in the loading mix of correlations remains the same, but their relative influence increases. As a result, in five of the six years investigated in this study, the predictor variable, Region, has either the largest, or second largest absolute size of correlation among the predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. For many Virginia units of local government, deployments would still have occurred without state funding.

In analyzing the results of the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two by a Virginia unit of local, as important as it is to determine which predictor variables contributed to the best performing model for the deployment of wireless 9-1-1 technologies, it is equally important to not overstate their contribution. For example, when investigating the results for the predictor variable Interstate, one must consider the fact that the number of miles of interstate highway in Virginia has remained unchanged for the period investigated in this study. In 2005, Interstate had the largest absolute size of correlation among the predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. In 2006, Interstate had the second largest absolute size of correlation among the predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two. Since the number of miles of interstate highway has not changed during this period, more than likely these results are a surrogate for something else. One plausible interpretation for these results may be the build out of wireless networks occurring during these two years along interstate highways in rural areas of Virginia. The deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two is predicated on the availability of wireless 9-1-1 technology. The build out of wireless networks along interstates would have been the catalyst for Virginia units of local government in rural areas to finally be able to deploy Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two for their citizens.

But how does one interpret these same results when considering the future of 9-1-1 in Virginia and as an approach to the deployment of Next Generation 9-1-1 technologies. This interpretation begins by assuming that Funding and Region, the two strongest predictor variables for the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two by Virginia units of local government, would act similarly in a Next Generation 9-1-1 environment. The lessons learned from the deployment of wireless 9-1-1 technologies would be applied going forward. As expected with any new technology, availability and diffusion occurs first in the more populous and wealthy areas. This was the case with the deployments of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two by Virginia units of local government. The same assumption should be made with the deployment of Next Generation 9-1-1 technologies. But, when and how does the Commonwealth of Virginia get involved in designing and implementing a Next Generation 9-1-1 emergency services network?

The timing of state government involvement should occur once the internal characteristics of Virginia units of local government are considered in relation to the deployment of Next Generation 9-1-1 technologies. The technical complexity and financial cost burdens associated with deploying wireless E9-1-1 were underestimated (McLeod, 2004). The interconnection of Next Generation telephony with 9-1-1 emergency services will be a more technologically complex issue than it was for wireless telephony. However, based on the deployment results of wireless 9-1-1 technologies in Virginia, it is reasonable to assume that the deployment of Next Generation 9-1-1 technologies will occur first in those Virginia units of local government with larger populations and higher per capita income, relative to the rest of the state. The next step would be to determine how state government can encourage the deployment of Next Generation 9-1-1 technologies in less densely populated and poorer Virginia units of local government.

One basic conclusion of the 2008 study, Health of the US 9-1-1 System, was that "states with effective oversight bodies are able to provide 9-1-1 services far more effectively than those without oversight….A state must offer incentives and effective guidance to spur PSAP technology upgrade" (Hatfield, Bernthal, & Weiser, 2008, p. 5). Given the strength of regionalism in the deployment of Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two, the support of regional Next Generation 9-1-1 pilots, especially in economically challenged rural areas, would provide those Virginia units of local government least likely to deploy this new technology, a learning environment to understand the technological complexities related to this emerging technology, as well an opportunity to share this knowledge with their surrounding regional government counterparts.

In addition, the amount of funding required for the deployment of Next Generation 9-1-1 technologies will be at a level far in excess of that which can be reasonably generated through wireless surcharge (NEBA, 2010; NRIC VII 1A, 2005). Given the current fiscal constraints of the Commonwealth of Virginia, it is unlikely that much additional 9-1-1- funding would be made available for the deployment of Next Generation 9-1-1 technologies. As a result, the deployment of Next Generation 9-1-1 technologies by early adopters should be dependent on funding already appropriated for this purpose within local budgets. This would allow state government to focus any additional state funding that is made available on localities that would be the most economically challenged to deploy this technology. This preceding strategy would be a recommendation on how Virginia could leverage its success with the deployment of wireless E9-1-1 for the interconnection of Next Generation 9-1-1 with the existing network.

Section Six: Implications for Future Research

In this section I provide information for the selection and design of future research. First, this study did not survey the managers of Virginia 9-1-1 centers. The role of education and professional development was not evaluated. Each profession has its own thought leaders and these leaders are pioneers in the adoption of new ideas and technology. Virginia has its own set of 9-1-1 thought leaders, individuals who are highly regarded by their peers, often serving as state and regional role models, and whose decisions and actions are often emulated by others. Future research could take up this absent part of the equation.

Second, this study did not focus on barriers to the deployment of wireless 9-1-1 technologies. In Virginia, local governments are increasingly challenged to provide and maintain the current level of service offerings to their citizens. The 9-1-1 centers operated by

Virginia units of local government are not immune from local budget cuts and often have to do more with less, similar to other local government agencies and programs. By having a more complete understanding of the barriers to the deployment of wireless 9-1-1 technologies, Virginia state government would be better able to focus its limited resources to overcoming these barriers with the deployment of future 9-1-1 technologies. Future research could address the role of constraints on the diffusion process for wireless 9-1-1 technologies.

And third, this study focused only on Virginia. Each state has its own story to tell regarding the deployment of wireless 9-1-1 technologies, as well as lessons to be shared with other states. This expanded learning opportunity would enable states to use their limited resources even more effectively in the future. Given the rapid rate at which technology is evolving, this research would help to ubiquitously "future proof" the E9-1-1 system with best practices for planning for the Next Generation of technologies. Future research should expand to other states.

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APPENDIX

Table 2
Virginia Units of Local Government (Counties)

Accomack	Franklin	Nottoway
Albemarle	Frederick	Orange
Alleghany	Giles	Page
Amelia	Gloucester	Patrick
Amherst	Goochland	Pittsylvania
Appomattox	Grayson	Powhatan
Arlington	Greene	Prince Edward
Augusta	Greensville	Prince George
Bath	Halifax	Prince William
Bedford	Hanover	Pulaski
Bland	Henrico	Rappahannock
Botetourt	Henry	Richmond
Brunswick	Highland	Roanoke
Buchanan	Isle of Wight	Rockbridge
Buckingham	James City	Rockingham
Campbell	King and Queen	Russell
Caroline	King George	Scott
Carroll	King William	Shenandoah
Charles City	Lancaster	Smyth
Charlotte	Lee	Southampton
Chesterfield	Loudon	Spotsylvania
Clarke	Louisa	Stafford
Craig	Lunenburg	Surry
Culpeper	Madison	Sussex
Cumberland	Mathews	Tazewell
Dickenson	Mecklenburg	Warren
Dinwiddie	Middlesex	Washington
Essex	Montgomery	Westmoreland
Fairfax	Nelson	Wise
Fauquier	New Kent	Wythe
Floyd	Northampton	York
Fluvanna	Northumberland	

Table 3
Virginia Units of Local Government (Cities)

Alexandria	Manassas
Bedford	Manassas Park
Bristol	Martinsville
Buena Vista	Newport News
Charlottesville	Norfolk
Chesapeake	Norton
Colonial Heights	Petersburg
Covington	Poquoson
Danville	Portsmouth
Emporia	Radford
Fairfax	Richmond
Falls Church	Roanoke
Franklin	Salem
Fredericksburg	Staunton
Galax	Suffolk
Hampton	Virginia Beach
Harrisonburg	Waynesboro
Hopewell	Williamsburg
Lexington	Winchester
Lynchburg	

Table 5
Per Capita Income of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	20503	20848	22054	23502	23966	24762
Albemarle	34471	34635	36064	38527	40567	44051
Alleghany	23886	24246	25688	26204	27356	28558
Amelia	25932	25897	27203	29751	31807	32322
Amherst	22152	22665	23333	24657	25833	27376
Appomattox	24503	24152	24963	25580	27063	28147
Arlington	54065	54434	56182	59150	63105	67896
Augusta	26196	26275	27469	28918	30146	31453
Bath	27284	28156	29344	32383	31767	33433
Bedford	29993	30727	31201	32103	33375	35958
Bland	19723	20200	20620	21392	22961	24436
Botetourt	31649	31533	32147	32802	35823	38555
Brunswick	19077	18877	19553	20630	21183	22508
Buchanan	20872	21489	22531	22690	23593	25931
Buckingham	18333	18620	19322	20713	21722	22661
Campbell	25105	25492	26274	27700	28470	30014
Caroline	26711	26481	27544	29225	30287	31047
Carroll	21728	22093	23124	24056	24987	26130
Charles City	27511	28584	30047	30866	32474	33023
Charlotte	21065	20722	21096	22455	22566	23689
Chesterfield	34728	35631	36148	37580	39430	41264
Clarke	31845	31667	32851	34538	35877	38521
Craig	23325	24097	25041	25688	27637	28955
Culpeper	28574	27684	28387	29495	30955	32079
Cumberland	21043	20867	21364	23865	25818	26695
Dickenson	18043	18183	18950	19834	21317	22722
Dinwiddie	25964	26750	27846	28535	29873	31421
Essex	23897	23900	25094	26886	27622	29218
Fairfax	52746	53538	55488	58971	63106	67033
Fauquier	41554	40619	41294	43976	47204	49554
Floyd	21746	21990	22549	23391	23912	24920
Fluvanna	24819	24535	25344	27128	28543	31268
Franklin	24892	25477	26411	28050	28916	30624
Frederick	28467	28481	29541	31174	32667	34749
Giles	21691	21720	22462	23333	24598	25730
Gloucester	26638	27255	28261	29671	30432	32726
Goochland	45447	46097	47353	52974	55114	58216
Grayson	20253	20460	20968	21323	22080	22920
Greene	24991	25513	26123	27627	30784	32913
Greensville	17969	18182	19110	20243	20359	21223
Halifax	21103	21647	21760	23274	24148	25694
Hanover	35009	34873	35856	37033	38962	40878

Table 5
Per Capita Income of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Henrico	36722	37493	38824	40149	42478	44265
Henry	23119	24273	24972	25412	26000	28115
Highland	25538	26598	26698	28772	28653	28585
Isle of Wight	29178	29399	31206	32050	33803	35971
James City	37242	38021	38906	41731	42713	45778
King & Queen	25039	25261	27111	28200	29015	29277
King George	31102	31324	32254	33455	33368	34716
King William	29704	29350	30616	32404	33969	34574
Lancaster	33634	35048	36351	38740	40223	44360
Lee	20078	20116	20427	21261	22183	22992
Loudoun	40654	37937	37978	39402	42499	46290
Louisa	28787	28210	29183	31279	32985	34548
Lunenburg	19656	19257	19956	21026	21885	22712
Madison	25922	25776	27037	28292	29288	30208
Mathews	34698	37069	38979	41902	42500	44939
Mecklenburg	22236	22128	23326	24020	25080	26517
Middlesex	28343	29238	29851	32114	32811	35110
Montgomery	20036	20549	21326	22311	23581	25343
Nelson	26964	26837	27587	29315	31380	34131
New Kent	29961	29865	30581	31433	32476	33000
Northampton	23742	24774	27209	28772	29385	30388
Northumberland	27127	27720	28208	30792	31809	33929
Nottoway	22831	22670	23520	24628	25584	27223
Orange	26467	26925	27783	29537	30689	31951
Page	23092	22383	22702	23995	25510	25714
Patrick	20050	20922	21187	20893	21439	22676
Pittsylvania	22644	24373	25469	26414	27082	27544
Powhatan	29438	28652	29212	32113	35151	37012
Prince Edward	17852	17649	18421	19030	19058	20449
Prince George	23411	23681	24520	26361	27689	29819
Prince William	32515	32570	33643	35908	38053	40158
Pulaski	24512	24867	26942	27544	28840	29973
Rappahannock	28280	29591	31184	32438	33896	37510
Richmond	18654	18674	19705	21137	21835	23381
Roanoke	33188	33949	34146	35935	36714	38338
Rockbridge	23345	24302	25766	27445	28446	30457
Rockingham	24412	24071	25509	26503	27637	28993
Russell	19707	20352	21099	21612	23002	23797
Scott	19876	20110	20843	22012	23183	24583
Shenandoah	25108	25677	26144	27751	29090	30404
Smyth	21166	21364	22105	23361	24844	25771
Southampton	24505	25235	26349	27293	27816	29108

Table 5
Per Capita Income of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Spotsylvania	30488	30142	30847	32320	34474	36338
Stafford	30226	29901	30661	32659	34563	36318
Surry	22657	22690	24083	24968	26287	27814
Sussex	20798	20836	21518	22711	24782	25686
Tazewell	22118	22893	23429	24489	25981	28023
Warren	28040	27869	28921	31400	33625	35523
Washington	24600	25137	26663	26851	27657	29880
Westmoreland	24938	25252	26215	28176	29311	31105
Wise	20191	20589	21570	22783	24097	25345
Wythe	21177	21600	22612	23463	24748	26159
York	32131	33576	35352	36743	40209	42858

Table 6
Per Capita Income of Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	52406	52974	54609	58643	62636	68394
Bedford	29993	30727	31201	32103	33375	35958
Bristol	24600	25137	26663	26851	27657	29880
Buena Vista	23345	24302	25766	27445	28446	30457
Charlottesville	34471	34635	36064	38527	40567	44051
Chesapeake	29272	30788	32515	33554	34826	36910
Colonial Heights	25964	26750	27846	28535	29873	31421
Covington	23886	24246	25688	26204	27356	28558
Danville	22644	24373	25469	26414	27082	27544
Emporia	17969	18182	19110	20243	20359	21223
Fairfax	52746	53538	55488	58971	63106	67033
Falls Church	52746	53538	55488	58971	63106	67033
Franklin	24505	25235	26349	27293	27816	29108
Fredericksburg	30488	30142	30847	32320	34474	36338
Galax	21728	22093	23124	24056	24987	26130
Hampton	26333	27534	28935	29653	30808	32488
Harrisonburg	24412	24071	25509	26503	27637	28993
Hopewell	23411	23681	24520	26361	27689	29819
Lexington	23345	24302	25766	27445	28446	30457
Lynchburg	25105	25492	26274	27700	28470	30014
Manassas	32515	32570	33643	35908	38053	40158
Manassas Park	32515	32570	33643	35908	38053	40158
Martinsville	23119	24273	24972	25412	26000	28115
Newport News	24194	24451	25311	26057	27034	28463
Norfolk	25542	26149	27719	29154	31159	33239
Norton	20191	20589	21570	22783	24097	25345
Petersburg	25964	26750	27846	28535	29873	31421
Poquoson	32131	33576	35352	36743	40209	42858
Portsmouth	23721	25567	27272	28273	29231	30421
Radford	20036	20549	21326	22311	23581	25343
Richmond	32395	33040	34550	37481	38553	42261
Roanoke	26588	28197	29475	31368	32167	33681
Salem	33188	33949	34146	35935	36714	38338
Staunton	26196	26275	27469	28918	30146	31453
Suffolk	27492	27479	28131	29340	30847	33123
Virginia Beach	31946	33152	35135	37156	39333	42281
Waynesboro	26196	26275	27469	28918	30146	31453
Williamsburg	37242	38021	38906	41731	42713	45778
Winchester	28467	28481	29541	31174	32667	34749

Table 7
Population of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	20503	20848	22054	23502	23966	24762
Albemarle	34471	34635	36064	38527	40567	44051
Alleghany	23886	24246	25688	26204	27356	28558
Amelia	25932	25897	27203	29751	31807	32322
Amherst	22152	22665	23333	24657	25833	27376
Appomattox	24503	24152	24963	25580	27063	28147
Arlington	54065	54434	56182	59150	63105	67896
Augusta	26196	26275	27469	28918	30146	31453
Bath	27284	28156	29344	32383	31767	33433
Bedford	29993	30727	31201	32103	33375	35958
Bland	19723	20200	20620	21392	22961	24436
Botetourt	31649	31533	32147	32802	35823	38555
Brunswick	19077	18877	19553	20630	21183	22508
Buchanan	20872	21489	22531	22690	23593	25931
Buckingham	18333	18620	19322	20713	21722	22661
Campbell	25105	25492	26274	27700	28470	30014
Caroline	26711	26481	27544	29225	30287	31047
Carroll	21728	22093	23124	24056	24987	26130
Charles City	27511	28584	30047	30866	32474	33023
Charlotte	21065	20722	21096	22455	22566	23689
Chesterfield	34728	35631	36148	37580	39430	41264
Clarke	31845	31667	32851	34538	35877	38521
Craig	23325	24097	25041	25688	27637	28955
Culpeper	28574	27684	28387	29495	30955	32079
Cumberland	21043	20867	21364	23865	25818	26695
Dickenson	18043	18183	18950	19834	21317	22722
Dinwiddie	25964	26750	27846	28535	29873	31421
Essex	23897	23900	25094	26886	27622	29218
Fairfax	52746	53538	55488	58971	63106	67033
Fauquier	41554	40619	41294	43976	47204	49554
Floyd	21746	21990	22549	23391	23912	24920
Fluvanna	24819	24535	25344	27128	28543	31268
Franklin	24892	25477	26411	28050	28916	30624
Frederick	28467	28481	29541	31174	32667	34749
Giles	21691	21720	22462	23333	24598	25730
Gloucester	26638	27255	28261	29671	30432	32726
Goochland	45447	46097	47353	52974	55114	58216
Grayson	20253	20460	20968	21323	22080	22920
Greene	24991	25513	26123	27627	30784	32913
Greensville	17969	18182	19110	20243	20359	21223
Halifax	21103	21647	21760	23274	24148	25694
Hanover	35009	34873	35856	37033	38962	40878

Table 7
Population of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Henrico	36722	37493	38824	40149	42478	44265
Henry	23119	24273	24972	25412	26000	28115
Highland	25538	26598	26698	28772	28653	28585
Isle of Wight	29178	29399	31206	32050	33803	35971
James City	37242	38021	38906	41731	42713	45778
King & Queen	25039	25261	27111	28200	29015	29277
King George	31102	31324	32254	33455	33368	34716
King William	29704	29350	30616	32404	33969	34574
Lancaster	33634	35048	36351	38740	40223	44360
Lee	20078	20116	20427	21261	22183	22992
Loudoun	40654	37937	37978	39402	42499	46290
Louisa	28787	28210	29183	31279	32985	34548
Lunenburg	19656	19257	19956	21026	21885	22712
Madison	25922	25776	27037	28292	29288	30208
Mathews	34698	37069	38979	41902	42500	44939
Mecklenburg	22236	22128	23326	24020	25080	26517
Middlesex	28343	29238	29851	32114	32811	35110
Montgomery	20036	20549	21326	22311	23581	25343
Nelson	26964	26837	27587	29315	31380	34131
New Kent	29961	29865	30581	31433	32476	33000
Northampton	23742	24774	27209	28772	29385	30388
Northumberland	27127	27720	28208	30792	31809	33929
Nottoway	22831	22670	23520	24628	25584	27223
Orange	26467	26925	27783	29537	30689	31951
Page	23092	22383	22702	23995	25510	25714
Patrick	20050	20922	21187	20893	21439	22676
Pittsylvania	22644	24373	25469	26414	27082	27544
Powhatan	29438	28652	29212	32113	35151	37012
Prince Edward	17852	17649	18421	19030	19058	20449
Prince George	23411	23681	24520	26361	27689	29819
Prince William	32515	32570	33643	35908	38053	40158
Pulaski	24512	24867	26942	27544	28840	29973
Rappahannock	28280	29591	31184	32438	33896	37510
Richmond	18654	18674	19705	21137	21835	23381
Roanoke	33188	33949	34146	35935	36714	38338
Rockbridge	23345	24302	25766	27445	28446	30457
Rockingham	24412	24071	25509	26503	27637	28993
Russell	19707	20352	21099	21612	23002	23797
Scott	19876	20110	20843	22012	23183	24583
Shenandoah	25108	25677	26144	27751	29090	30404
Smyth	21166	21364	22105	23361	24844	25771
Southampton	24505	25235	26349	27293	27816	29108

Table 7

Population of Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Spotsylvania	30488	30142	30847	32320	34474	36338
Stafford	30226	29901	30661	32659	34563	36318
Surry	22657	22690	24083	24968	26287	27814
Sussex	20798	20836	21518	22711	24782	25686
Tazewell	22118	22893	23429	24489	25981	28023
Warren	28040	27869	28921	31400	33625	35523
Washington	24600	25137	26663	26851	27657	29880
Westmoreland	24938	25252	26215	28176	29311	31105
Wise	20191	20589	21570	22783	24097	25345
Wythe	21177	21600	22612	23463	24748	26159
York	32131	33576	35352	36743	40209	42858

Table 8
Population of Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	137500	135300	134100	133000	132176	135385
Bedford	6400	6300	6300	6200	6125	6094
Bristol	17300	17200	17200	17300	17392	17221
Buena Vista	6300	6200	6200	6400	6392	6481
Charlottesville	39800	39700	39300	39600	39610	40807
Chesapeake	205100	204100	206600	210600	214145	215271
Colonial Heights	17000	17000	16900	17100	17215	17250
Covington	6300	6200	6100	5900	5775	5784
Danville	47100	47000	46500	46400	46012	45273
Emporia	5500	5700	5600	5500	5418	5555
Fairfax	22400	22800	23200	23100	23075	22951
Falls Church	11100	11000	11000	10600	10942	10970
Franklin	8100	8100	8200	8300	8368	8411
Fredericksburg	20100	20300	20500	21100	21474	21743
Galax	6700	6700	6700	6800	6816	6774
Hampton	145200	145100	143800	144400	145262	145040
Harrisonburg	42200	42000	42500	42900	43694	44340
Hopewell	22300	22300	22200	22300	22210	22413
Lexington	7000	7000	6800	6900	7097	7206
Lynchburg	65600	65800	66400	67100	67756	68579
Manassas	37000	36600	36600	37000	36510	36288
Manassas Park	11700	11900	12300	12700	13369	13845
Martinsville	15200	15300	15000	14600	14366	14575
Newport News	179300	180000	181100	182000	181240	181840
Norfolk	234100	233600	233900	235200	235071	234219
Norton	3900	3900	3900	3900	3842	3773
Petersburg	32200	32400	32000	31500	30779	31308
Poquoson	11600	11500	11500	11700	11764	11865
Portsmouth	98400	98500	97900	98200	98514	98318
Radford	15500	15400	15100	15100	15353	15478
Richmond	193000	194900	193900	193200	191740	193882
Roanoke	94600	94600	93100	92900	92671	92994
Salem	24900	24900	24700	24600	24836	24821
Staunton	23500	23500	22500	22500	22863	22697
Suffolk	69200	69300	72300	76100	78511	79795
Virginia Beach	428400	426900	428200	434000	433470	431820
Waynesboro	19600	19700	19600	19800	19964	20201
Williamsburg	12600	12600	13200	13400	13242	13289
Winchester	24600	24600	25000	25400	25780	25878

Table 9 *Ratio of Revenue and Expenses for Virginia Units of Local Government (Counties)*						
Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Accomack	1.0668	1.0703	1.0583	1.0722	1.0805	1.0484
Albemarle	1.1192	1.0924	1.0683	1.0573	1.1393	1.1442
Alleghany	1.1753	1.0965	1.0747	1.0550	1.0738	1.0922
Amelia	1.0763	1.0634	1.1437	1.1410	1.1090	1.0838
Amherst	1.1105	1.1087	1.0976	1.0928	1.1197	1.1117
Appomattox	1.0976	1.1118	1.1073	1.1056	1.0607	1.0792
Arlington	1.1635	1.1411	1.0681	1.1222	1.1197	1.1580
Augusta	1.1132	1.1123	1.1143	1.1066	1.1257	1.1190
Bath	1.2855	1.2245	1.1963	1.0472	0.9688	1.0094
Bedford	1.2168	1.0738	1.1108	1.1017	1.0881	1.0895
Bland	1.0314	1.0727	1.0813	1.1009	1.0389	1.1518
Botetourt	1.1409	1.1428	1.1379	1.0928	1.1086	1.1262
Brunswick	1.0675	1.0712	1.0644	1.0900	1.1480	1.0999
Buchanan	1.1703	1.0597	1.0724	1.1497	1.1586	1.0854
Buckingham	1.0674	1.0887	1.1044	1.1218	1.0500	1.1181
Campbell	1.1371	1.0073	1.0277	1.0605	1.0723	1.0663
Caroline	1.0832	1.0623	1.1144	1.1301	1.1220	1.1430
Carroll	1.0473	1.0836	1.0766	1.0504	1.1135	1.1412
Charles City	1.2403	1.1434	1.0739	1.0313	1.0194	1.0187
Charlotte	1.0897	1.0872	1.0719	1.0532	1.0519	1.0223
Chesterfield	1.1235	1.1285	1.1106	1.1276	1.1452	1.1840
Clarke	1.1431	1.0674	1.0677	1.0325	1.0798	1.1721
Craig	1.0701	1.1409	1.0475	1.0397	1.1330	1.1568
Culpeper	1.0976	1.0990	1.0971	1.1287	1.1758	1.1400
Cumberland	1.1513	1.1410	1.1187	1.1353	1.0446	1.0310
Dickenson	1.0908	1.0314	0.9752	1.0138	1.0088	0.9043
Dinwiddie	1.2054	1.1724	1.1511	1.0985	1.1222	1.1688
Essex	1.0424	1.0474	1.0225	1.0410	1.0487	1.0297
Fairfax	1.1062	1.1088	1.1252	1.1293	1.1313	1.1477
Fauquier	1.1615	1.1936	1.0892	1.0640	1.0686	1.1219
Floyd	0.9983	1.0112	0.9857	0.9666	1.0978	1.0223
Fluvanna	1.1566	1.0833	1.0846	1.0480	1.0697	1.0774
Franklin	1.0755	1.0640	1.0404	1.0406	1.1114	1.0955
Frederick	1.1359	1.0827	1.1175	1.1249	1.1384	1.1770
Giles	1.1094	1.1171	1.0684	1.0834	1.1029	1.1012
Gloucester	1.1258	1.1304	1.1233	1.1419	1.1268	1.1209
Goochland	1.1952	1.1018	1.1483	1.1632	1.2114	1.2405
Grayson	1.0582	1.0386	1.0360	1.0083	1.0558	1.0879
Greene	1.0789	1.1060	1.0894	1.1203	1.1385	1.1193
Greensville	1.3196	1.1033	1.3922	1.2599	1.4770	1.3563
Halifax	1.1213	0.9412	1.0970	1.0877	1.1049	1.0812
Hanover	1.1256	1.1215	1.0783	1.0923	1.1077	1.1311

Table 9
Ratio of Revenue and Expenses for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Henrico	1.1528	1.1062	1.1131	1.1359	1.1465	1.1579
Henry	1.0048	1.0885	1.0677	1.0655	1.0916	1.0967
Highland	1.0450	1.1246	1.1162	1.1346	1.0764	1.1452
Isle of Wight	1.0572	1.1234	1.1684	1.1712	1.1875	1.1834
James City	1.1827	1.1717	1.1274	1.1282	1.1342	1.1791
King & Queen	1.1422	1.1478	1.1879	1.1919	1.1726	1.1531
King George	1.2831	1.2718	1.2840	1.2823	1.2595	1.2575
King William	1.0860	1.0551	1.0703	1.0253	1.0647	1.0274
Lancaster	1.0608	1.0559	1.0891	1.0890	1.0737	1.0200
Lee	1.0255	1.0314	1.0234	0.9966	1.0111	0.9427
Loudoun	1.2112	1.1313	1.1431	1.1747	1.2275	1.1939
Louisa	1.0638	1.1051	1.0658	1.0998	1.1585	1.1816
Lunenburg	1.0719	1.0672	1.0050	1.0824	1.0293	1.0462
Madison	1.0322	1.1049	1.1029	1.1249	1.1083	1.1348
Mathews	1.1856	1.1530	1.2040	1.1547	1.1178	1.0932
Mecklenburg	1.0445	1.1487	1.0928	1.0402	1.0805	1.0767
Middlesex	1.0273	1.1302	1.1533	1.0852	1.1527	1.1542
Montgomery	1.1275	1.0709	1.0900	1.1196	1.0955	1.1270
Nelson	1.1500	1.1105	1.1242	1.1717	1.1622	1.1327
New Kent	1.1486	1.1560	1.1341	1.1178	1.1254	1.1817
Northampton	1.0413	1.0411	1.0577	1.0325	1.0928	1.0296
Northumberland	1.0790	1.0997	1.1312	1.1157	1.1194	1.1001
Nottoway	1.0706	1.1043	1.1217	1.1067	1.0579	1.0770
Orange	1.1078	1.1180	1.1015	1.1602	1.1662	1.1240
Page	1.0959	1.1120	1.1267	1.0930	0.8786	1.0203
Patrick	1.0326	1.0439	1.0404	1.0307	1.0465	0.9924
Pittsylvania	1.1448	1.0635	1.0283	1.0953	1.0740	0.9993
Powhatan	1.1979	1.0957	1.1155	1.1459	1.1236	1.1688
Prince Edward	1.1002	1.0692	1.0849	1.0255	1.0224	1.0718
Prince George	1.1315	1.1238	1.1154	1.0860	1.1142	1.1130
Prince William	1.1479	1.1509	1.1384	1.1522	1.1759	1.1740
Pulaski	1.0842	1.1253	1.0433	1.0627	1.0608	1.0600
Rappahannock	1.0882	1.0678	1.0563	1.0498	1.0131	1.0769
Richmond	1.1083	1.0585	1.0446	1.0886	1.0718	1.1008
Roanoke	1.1222	1.1018	1.1326	1.1142	1.1344	1.1405
Rockbridge	1.0648	1.1000	1.0884	1.1090	1.0981	1.1553
Rockingham	1.1486	1.0903	1.0814	1.0583	1.0384	1.0578
Russell	0.9959	1.0550	1.0453	1.0463	1.0691	0.9588
Scott	1.0511	1.0548	1.0955	1.0438	1.0874	0.9614
Shenandoah	1.0546	1.0871	1.1135	1.1362	1.0938	1.1160
Smyth	1.0764	1.0715	1.0526	1.0499	1.0461	0.9768
Southampton	1.1837	1.1202	1.1076	1.0788	1.0824	1.0970

Table 9
Ratio of Revenue and Expenses for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Spotsylvania	1.1568	1.1555	1.1413	1.1365	1.1186	1.1522
Stafford	1.1359	1.1275	1.0858	1.1288	1.1538	1.1486
Surry	1.0945	1.1903	1.0905	1.0753	1.1230	1.1620
Sussex	1.1499	1.1172	1.0681	1.1984	1.1815	1.1883
Tazewell	1.0935	1.1036	1.0790	1.0611	1.0506	1.0125
Warren	1.1380	1.1666	1.1023	1.1220	1.1426	1.1785
Washington	1.0210	1.0444	1.0577	1.0349	1.0187	0.9861
Westmoreland	0.9882	1.0747	1.1546	1.1398	1.0639	1.0638
Wise	1.0528	1.0296	1.0721	1.0605	1.1139	1.0554
Wythe	1.1393	1.1450	1.1020	1.1069	1.0873	1.0891
York	1.1169	1.1308	1.1130	1.0779	1.1153	1.1243

Table 10 *Ratio of Revenue and Expenses for Virginia Units of Local Government (Cities)*						
Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Alexandria	1.1374	1.1335	1.1012	1.1326	1.1331	1.1415
Bedford	0.9748	1.0075	0.9669	0.8248	0.8703	0.8411
Bristol	1.0325	0.9915	1.0176	0.9859	0.9844	0.9673
Buena Vista	1.0710	1.0498	1.0026	0.9777	1.0121	1.0474
Charlottesville	1.0136	1.0075	0.9669	1.0347	1.0612	1.0635
Chesapeake	1.1431	1.1020	1.1252	1.1249	1.1337	1.1789
Colonial Heights	1.0953	1.0762	1.0414	1.0884	1.0702	1.0904
Covington	1.0329	1.0002	1.0427	1.0441	0.9954	1.0211
Danville	1.0121	0.9746	1.0005	0.9748	1.0114	1.0489
Emporia	1.0751	1.1660	1.0087	1.0924	1.0970	1.1234
Fairfax	1.1693	1.1511	1.1671	1.2156	1.1372	1.2044
Falls Church	0.9967	1.0442	1.0026	1.0171	1.0526	1.0698
Franklin	0.9362	1.0013	0.9791	1.0232	1.0031	0.9958
Fredericksburg	1.1581	1.1627	1.1484	1.1680	1.1794	1.1352
Galax	1.1288	1.0613	1.0974	1.0770	1.0778	1.0740
Hampton	1.0628	1.0961	1.1026	1.0899	1.0801	1.1040
Harrisonburg	1.1286	1.0869	1.0461	1.1062	1.0589	1.0645
Hopewell	1.0917	1.0148	1.0533	1.0891	1.0609	1.0902
Lexington	1.1653	1.1690	1.1330	1.0965	1.1377	1.0749
Lynchburg	1.1998	0.9872	1.0645	1.0607	1.0835	1.1256
Manassas	1.1801	1.1214	1.1244	1.1072	1.0469	1.0881
Manassas Park	1.1325	1.1121	1.0641	1.0696	1.0806	1.0678
Martinsville	0.9077	0.9135	0.9793	0.9929	0.9933	0.9700
Newport News	1.0775	1.0861	1.0719	1.0962	1.1188	1.1228
Norfolk	1.0955	1.0695	1.0659	1.0770	1.1005	1.1069
Norton	1.0617	0.9840	1.0910	0.7916	0.9925	0.9945
Petersburg	1.0370	1.0880	1.0471	1.0105	1.0504	1.0426
Poquoson	1.0732	1.1068	1.1103	1.0785	1.0689	1.0789
Portsmouth	0.9812	1.0400	1.0356	1.0805	1.0715	1.1141
Radford	0.9995	1.0304	1.0345	0.9791	1.0133	1.0068
Richmond	1.0814	1.1211	1.1985	1.0696	1.0786	1.0940
Roanoke	1.1295	1.1225	1.1436	1.1210	1.1200	1.1356
Salem	1.0945	1.0586	1.0959	1.0932	1.0832	1.0373
Staunton	1.0430	1.0518	1.0270	1.0110	1.0380	1.0221
Suffolk	1.1119	1.1222	1.0909	1.1317	1.0992	1.1104
Virginia Beach	1.1572	1.1864	1.1788	1.1806	1.1947	1.1963
Waynesboro	0.9815	1.0841	1.0562	1.0305	1.0235	1.0572
Williamsburg	1.1850	1.1405	1.1650	1.1911	1.1822	1.2201
Winchester	1.0689	1.0968	1.0623	1.0410	1.0748	1.0865

Table 11
Wireless Surcharge Revenue Received by Virginia Units of Local Government (Counties)

County	2000	2001	2002	2003	2004	2005
Accomack	Yes	Yes	Yes	Yes	Yes	Yes
Albemarle	Yes	Yes	Yes	Yes	Yes	Yes
Alleghany					Yes	Yes
Amelia				Yes	Yes	Yes
Amherst			Yes	Yes	Yes	Yes
Appomattox					Yes	Yes
Arlington	Yes	Yes	Yes	Yes	Yes	Yes
Augusta					Yes	Yes
Bath						Yes
Bedford		Yes	Yes	Yes	Yes	Yes
Bland					Yes	Yes
Botetourt			Yes	Yes	Yes	Yes
Brunswick					Yes	Yes
Buchanan					Yes	Yes
Buckingham			Yes	Yes	Yes	Yes
Campbell					Yes	Yes
Caroline				Yes	Yes	Yes
Carroll		Yes	Yes	Yes	Yes	Yes
Charles City				Yes	Yes	Yes
Charlotte				Yes	Yes	Yes
Chesterfield	Yes	Yes	Yes	Yes	Yes	Yes
Clarke		Yes	Yes	Yes	Yes	Yes
Craig					Yes	Yes
Culpeper		Yes	Yes	Yes	Yes	Yes
Cumberland					Yes	Yes
Dickenson					Yes	Yes
Dinwiddie					Yes	Yes
Essex					Yes	Yes
Fairfax	Yes	Yes	Yes	Yes	Yes	Yes
Fauquier		Yes	Yes	Yes	Yes	Yes
Floyd					Yes	Yes
Fluvanna				Yes	Yes	Yes
Franklin				Yes	Yes	Yes
Frederick		Yes	Yes	Yes	Yes	Yes
Giles					Yes	Yes
Gloucester				Yes	Yes	Yes
Goochland				Yes	Yes	Yes
Grayson		Yes	Yes	Yes	Yes	Yes
Greene					Yes	Yes
Greensville				Yes	Yes	Yes
Halifax					Yes	Yes
Hanover		Yes	Yes	Yes	Yes	Yes

Table 11 *Wireless Surcharge Revenue Received by Virginia Units of Local Government (Counties)*						
County	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Henrico	Yes	Yes	Yes	Yes	Yes	Yes
Henry		Yes	Yes	Yes	Yes	Yes
Highland					Yes	Yes
Isle of Wight			Yes	Yes	Yes	Yes
James City		Yes	Yes	Yes	Yes	Yes
King & Queen				Yes	Yes	Yes
King George					Yes	Yes
King William					Yes	Yes
Lancaster				Yes	Yes	Yes
Lee						Yes
Loudoun	Yes	Yes	Yes	Yes	Yes	Yes
Louisa		Yes	Yes	Yes	Yes	Yes
Lunenburg					Yes	Yes
Madison					Yes	Yes
Mathews					Yes	Yes
Mecklenburg				Yes	Yes	Yes
Middlesex		Yes	Yes	Yes	Yes	Yes
Montgomery		Yes	Yes	Yes	Yes	Yes
Nelson					Yes	Yes
New Kent				Yes	Yes	Yes
Northampton	Yes	Yes	Yes	Yes	Yes	Yes
Northumberland				Yes	Yes	Yes
Nottoway					Yes	Yes
Orange		Yes	Yes	Yes	Yes	Yes
Page				Yes	Yes	Yes
Patrick				Yes	Yes	Yes
Pittsylvania		Yes	Yes	Yes	Yes	Yes
Powhatan	Yes	Yes	Yes	Yes	Yes	Yes
Prince Edward					Yes	Yes
Prince George				Yes	Yes	Yes
Prince William	Yes	Yes	Yes	Yes	Yes	Yes
Pulaski				Yes	Yes	Yes
Rappahannock					Yes	Yes
Richmond					Yes	Yes
Roanoke			Yes	Yes	Yes	Yes
Rockbridge		Yes	Yes	Yes	Yes	Yes
Rockingham	Yes	Yes	Yes	Yes	Yes	Yes
Russell					Yes	Yes
Scott					Yes	Yes
Shenandoah	Yes	Yes	Yes	Yes	Yes	Yes
Smyth			Yes	Yes	Yes	Yes
Southampton				Yes	Yes	Yes

Table 11
Wireless Surcharge Revenue Received by Virginia Units of Local Government (Counties)

County	2000	2001	2002	2003	2004	2005
Spotsylvania			Yes	Yes	Yes	Yes
Stafford			Yes	Yes	Yes	Yes
Surry					Yes	Yes
Sussex				Yes	Yes	Yes
Tazewell					Yes	Yes
Warren				Yes	Yes	Yes
Washington			Yes	Yes	Yes	Yes
Westmoreland		Yes	Yes	Yes	Yes	Yes
Wise					Yes	Yes
Wythe					Yes	Yes
York	Yes	Yes	Yes	Yes	Yes	Yes

Table 12
Wireless Surcharge Revenue Received by Virginia Units of Local Government (Cities)

County	2000	2001	2002	2003	2004	2005
Alexandria	Yes	Yes	Yes	Yes	Yes	Yes
Bedford		Yes	Yes	Yes	Yes	Yes
Bristol				Yes	Yes	Yes
Buena Vista		Yes	Yes	Yes	Yes	Yes
Charlottesville	Yes	Yes	Yes	Yes	Yes	Yes
Chesapeake	Yes	Yes	Yes	Yes	Yes	Yes
Colonial Heights				Yes	Yes	Yes
Covington					Yes	Yes
Danville		Yes	Yes	Yes	Yes	Yes
Emporia			Yes	Yes	Yes	Yes
Fairfax	Yes	Yes	Yes	Yes	Yes	Yes
Falls Church	Yes	Yes	Yes	Yes	Yes	Yes
Franklin			Yes	Yes	Yes	Yes
Fredericksburg				Yes	Yes	Yes
Galax		Yes	Yes	Yes	Yes	Yes
Hampton	Yes	Yes	Yes	Yes	Yes	Yes
Harrisonburg	Yes	Yes	Yes	Yes	Yes	Yes
Hopewell			Yes	Yes	Yes	Yes
Lexington		Yes	Yes	Yes	Yes	Yes
Lynchburg	Yes	Yes	Yes	Yes	Yes	Yes
Manassas	Yes	Yes	Yes	Yes	Yes	Yes
Manassas Park	Yes	Yes	Yes	Yes	Yes	Yes
Martinsville		Yes	Yes	Yes	Yes	Yes
Newport News	Yes	Yes	Yes	Yes	Yes	Yes
Norfolk	Yes	Yes	Yes	Yes	Yes	Yes
Norton					Yes	Yes
Petersburg				Yes	Yes	Yes
Poquoson				Yes	Yes	Yes
Portsmouth	Yes	Yes	Yes	Yes	Yes	Yes
Radford				Yes	Yes	Yes
Richmond	Yes	Yes	Yes	Yes	Yes	Yes
Roanoke			Yes	Yes	Yes	Yes
Salem			Yes	Yes	Yes	Yes
Staunton					Yes	Yes
Suffolk	Yes	Yes	Yes	Yes	Yes	Yes
Virginia Beach	Yes	Yes	Yes	Yes	Yes	Yes
Waynesboro					Yes	Yes
Williamsburg			Yes	Yes	Yes	Yes
Winchester		Yes	Yes	Yes	Yes	Yes

Table 13
Ratio of Wireless Surcharge Revenue and Public Safety Expenditures for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	0.0041	0.0042	0.0046	0.0039	0.0039	0.0036
Albemarle	0.0046	0.0070	0.0055	0.0043	0.0046	0.0101
Alleghany	0.0000	0.0000	0.0000	0.0626	0.0080	0.0102
Amelia	0.0000	0.0000	0.0756	0.0752	0.0118	0.0531
Amherst	0.0000	0.0244	0.0058	0.0051	0.0050	0.0059
Appomattox	0.0000	0.0000	0.0000	0.0512	0.0132	0.0550
Arlington	0.0033	0.0021	0.0014	0.0014	0.0037	0.0034
Augusta	0.0000	0.0000	0.0000	0.0081	0.0035	0.0075
Bath	0.0000	0.0000	0.0000	0.0000	0.0322	0.0182
Bedford	0.0091	0.0019	0.0040	0.0035	0.0021	0.0068
Bland	0.0000	0.0000	0.0000	0.0699	0.0276	0.0396
Botetourt	0.0000	0.0069	0.0053	0.0051	0.0050	0.0145
Brunswick	0.0000	0.0000	0.0000	0.0716	0.0106	0.0254
Buchanan	0.0000	0.0000	0.0000	0.0245	0.0080	0.0083
Buckingham	0.0000	0.0113	0.0119	0.0116	0.0107	0.0146
Campbell	0.0000	0.0000	0.0000	0.0104	0.0073	0.0280
Caroline	0.0000	0.0000	0.0284	0.0248	0.0050	0.0127
Carroll	0.0053	0.0071	0.0096	0.0073	0.0080	0.0060
Charles City	0.0000	0.0000	0.0536	0.0567	0.0224	0.0526
Charlotte	0.0000	0.0000	0.0420	0.0386	0.0119	0.0146
Chesterfield	0.0031	0.0019	0.0034	0.0032	0.0032	0.0050
Clarke	0.0344	0.0084	0.0152	0.0126	0.0115	0.0125
Craig	0.0000	0.0000	0.0000	0.1417	0.0369	0.0629
Culpeper	0.0059	0.0076	0.0108	0.0090	0.0049	0.0044
Cumberland	0.0000	0.0000	0.0000	0.0751	0.0126	0.0180
Dickenson	0.0000	0.0000	0.0000	0.0100	0.0082	0.0045
Dinwiddie	0.0000	0.0000	0.0000	0.0307	0.0059	0.0063
Essex	0.0000	0.0000	0.0000	0.0421	0.0115	0.0116
Fairfax	0.0016	0.0018	0.0024	0.0022	0.0022	0.0070
Fauquier	0.0040	0.0042	0.0064	0.0062	0.0034	0.0044
Floyd	0.0000	0.0000	0.0000	0.0429	0.0333	0.0166
Fluvanna	0.0000	0.0000	0.0162	0.0151	0.0131	0.0133
Franklin	0.0000	0.0000	0.0166	0.0149	0.0067	0.0072
Frederick	0.0073	0.0016	0.0050	0.0044	0.0021	0.0022
Giles	0.0000	0.0000	0.0000	0.0360	0.0099	0.0401
Gloucester	0.0000	0.0000	0.0212	0.0179	0.0045	0.0049
Goochland	0.0000	0.0000	0.0093	0.0091	0.0091	0.0093
Grayson	0.0119	0.0133	0.0144	0.0132	0.0124	0.0115
Greene	0.0000	0.0000	0.0000	0.0159	0.0122	0.0139
Greensville	0.0000	0.0000	0.0242	0.0280	0.0103	0.0406
Halifax	0.0000	0.0000	0.0000	0.0291	0.0059	0.0105

Table 13 *Ratio of Wireless Surcharge Revenue and Public Safety Expenditures for Virginia Units of Local Government (Counties)*						
Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Hanover	0.0007	0.0099	0.0061	0.0059	0.0052	0.0081
Henrico	0.0024	0.0012	0.0032	0.0030	0.0032	0.0068
Henry	0.0027	0.0040	0.0057	0.0050	0.0044	0.0066
Highland	0.0000	0.0000	0.0000	0.1865	0.0766	0.0495
Isle of Wight	0.0000	0.0096	0.0296	0.0318	0.0085	0.0059
James City	0.0070	0.0036	0.0064	0.0067	0.0078	0.0141
King & Queen	0.0000	0.0000	0.0192	0.0189	0.0185	0.0393
King George	0.0000	0.0000	0.0000	0.0185	0.0066	0.0084
King William	0.0000	0.0000	0.0000	0.0428	0.0089	0.0155
Lancaster	0.0000	0.0000	0.0286	0.0244	0.0118	0.0143
Lee	0.0000	0.0000	0.0000	0.0000	0.0297	0.0050
Loudoun	0.0020	0.0018	0.0049	0.0044	0.0030	0.0036
Louisa	0.0087	0.0130	0.0063	0.0056	0.0052	0.0056
Lunenburg	0.0000	0.0000	0.0000	0.0372	0.0142	0.0197
Madison	0.0000	0.0000	0.0000	0.0114	0.0097	0.0110
Mathews	0.0000	0.0000	0.0000	0.1056	0.0160	0.0278
Mecklenburg	0.0000	0.0000	0.0304	0.0272	0.0080	0.0178
Middlesex	0.0121	0.0000	0.0327	0.0276	0.0116	0.0278
Montgomery	0.0322	0.0171	0.0961	0.0956	0.0131	0.0232
Nelson	0.0000	0.0000	0.0000	0.0640	0.0106	0.0540
New Kent	0.0000	0.0000	0.0620	0.0501	0.0245	0.0175
Northampton	0.0080	0.0081	0.0086	0.0069	0.0083	0.0081
Northumberland	0.0000	0.0000	0.0186	0.0171	0.0085	0.0103
Nottoway	0.0000	0.0000	0.0000	0.0331	0.0136	0.0393
Orange	0.0257	0.0103	0.0079	0.0075	0.0074	0.0132
Page	0.0000	0.0000	0.0103	0.0102	0.0082	0.0151
Patrick	0.0000	0.0000	0.0529	0.0537	0.0119	0.0168
Pittsylvania	0.0103	0.0027	0.0064	0.0072	0.0035	0.0042
Powhatan	0.0283	0.0097	0.0442	0.0446	0.0115	0.0126
Prince Edward	0.0000	0.0000	0.0000	0.0687	0.0122	0.0228
Prince George	0.0000	0.0000	0.0179	0.0175	0.0064	0.0042
Prince William	0.0015	0.0014	0.0010	0.0009	0.0010	0.0043
Pulaski	0.0000	0.0000	0.0293	0.0281	0.0052	0.0051
Rappahannock	0.0000	0.0000	0.0000	0.0310	0.0301	0.0193
Richmond	0.0000	0.0000	0.0000	0.0418	0.0107	0.0139
Roanoke	0.0000	0.0084	0.0125	0.0109	0.0128	0.0081
Rockbridge	0.0001	0.0034	0.0034	0.0030	0.0033	0.0186
Rockingham	0.0088	0.0077	0.0043	0.0038	0.0027	0.0067
Russell	0.0000	0.0000	0.0000	0.0387	0.0074	0.0033
Scott	0.0000	0.0000	0.0000	0.0360	0.0081	0.0128
Shenandoah	0.0232	0.0080	0.0104	0.0098	0.0076	0.0120

Table 13 *Ratio of Wireless Surcharge Revenue and Public Safety Expenditures for Virginia Units of Local Government (Counties)*						
Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Smyth	0.0000	0.0067	0.0321	0.0264	0.0042	0.0038
Southampton	0.0000	0.0000	0.0097	0.0056	0.0069	0.0086
Spotsylvania	0.0000	0.0021	0.0123	0.0109	0.0034	0.0032
Stafford	0.0000	0.0037	0.0099	0.0092	0.0032	0.0049
Surry	0.0000	0.0000	0.0000	0.0327	0.0187	0.0245
Sussex	0.0000	0.0000	0.0546	0.0485	0.0100	0.0120
Tazewell	0.0000	0.0000	0.0000	0.0226	0.0119	0.0031
Warren	0.0000	0.0000	0.0247	0.0229	0.0050	0.0056
Washington	0.0000	0.0086	0.0061	0.0059	0.0053	0.0028
Westmoreland	0.0045	0.0016	0.0074	0.0071	0.0063	0.0070
Wise	0.0000	0.0000	0.0000	0.0079	0.0074	0.0046
Wythe	0.0000	0.0000	0.0000	0.0460	0.0122	0.0167
York	0.0036	0.0027	0.0155	0.0160	0.0040	0.0158

Table 14
Ratio of Wireless Surcharge Revenue and Public Safety Expenditures for Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	0.0018	0.0021	0.0025	0.0025	0.0023	0.0042
Bedford	0.0366	0.0114	0.0180	0.0157	0.0083	0.0000
Bristol	0.0000	0.0000	0.0126	0.0117	0.0033	0.0083
Buena Vista	0.0002	0.0082	0.0091	0.0083	0.0086	0.0000
Charlottesville	0.0032	0.0055	0.0045	0.0038	0.0036	0.0094
Chesapeake	0.0020	0.0019	0.0043	0.0041	0.0026	0.0147
Colonial Heights	0.0000	0.0000	0.0078	0.0069	0.0030	0.0109
Covington	0.0000	0.0000	0.0000	0.0214	0.0863	0.0691
Danville	0.0078	0.0039	0.0030	0.0028	0.0026	0.0037
Emporia	0.0000	0.0115	0.0084	0.0090	0.0074	0.0094
Fairfax	0.0385	0.0458	0.0618	0.0595	0.0579	0.0000
Falls Church	0.0960	0.1003	0.1235	0.1265	0.1280	0.0000
Franklin	0.0000	0.0133	0.0080	0.0084	0.0066	0.0089
Fredericksburg	0.0000	0.0000	0.0161	0.0152	0.0132	0.0097
Galax	0.0127	0.0145	0.0197	0.0158	0.0159	0.0128
Hampton	0.0022	0.0017	0.0049	0.0045	0.0049	0.0067
Harrisonburg	0.0086	0.0067	0.0042	0.0036	0.0026	0.0066
Hopewell	0.0000	0.0082	0.0064	0.0062	0.0040	0.0037
Lexington	0.0002	0.0071	0.0074	0.0083	0.0085	0.0000
Lynchburg	0.0023	0.0035	0.0051	0.0051	0.0054	0.0013
Manassas	0.0136	0.0116	0.0073	0.0076	0.0087	0.0000
Manassas Park	0.0527	0.0463	0.0290	0.0276	0.0328	0.0000
Martinsville	0.0026	0.0033	0.0052	0.0051	0.0046	0.0076
Newport News	0.0017	0.0019	0.0036	0.0033	0.0031	0.0056
Norfolk	0.0022	0.0037	0.0054	0.0051	0.0044	0.0087
Norton	0.0000	0.0000	0.0000	0.0544	0.0175	0.0143
Petersburg	0.0000	0.0000	0.0105	0.0106	0.0022	0.0109
Poquoson	0.0000	0.0000	0.0201	0.0190	0.0078	0.0197
Portsmouth	0.0022	0.0023	0.0023	0.0026	0.0039	0.0077
Radford	0.0000	0.0000	0.0351	0.0334	0.0067	0.0155
Richmond	0.0010	0.0011	0.0028	0.0025	0.0022	0.0057
Roanoke	0.0000	0.0052	0.0042	0.0039	0.0050	0.0087
Salem	0.0000	0.0083	0.0059	0.0056	0.0032	0.0060
Staunton	0.0000	0.0000	0.0000	0.0147	0.0040	0.0126
Suffolk	0.0072	0.0018	0.0085	0.0074	0.0037	0.0047
Virginia Beach	0.0021	0.0031	0.0058	0.0053	0.0113	0.0131
Waynesboro	0.0000	0.0000	0.0000	0.0228	0.0039	0.0111
Williamsburg	0.0000	0.0086	0.0114	0.0120	0.0042	0.0047

Table 15
Population Density for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	85.01	84.79	85.01	85.45	85.41	85.65
Albemarle	118.74	119.98	121.92	123.99	124.69	128.28
Alleghany	37.33	38.46	38.01	38.01	38.19	38.45
Amelia	32.23	33.07	33.63	33.91	34.47	35.83
Amherst	66.92	66.50	66.29	66.08	66.85	68.52
Appomattox	41.06	40.76	40.76	41.36	41.09	43.38
Arlington	7425.59	7448.78	7487.44	7483.57	7407.15	7675.20
Augusta	67.81	68.43	68.94	69.87	70.70	72.32
Bath	9.40	9.40	9.21	9.02	8.97	9.38
Bedford	80.85	80.98	81.78	83.23	84.54	87.19
Bland	19.24	19.24	19.52	19.52	19.75	19.86
Botetourt	56.20	56.57	57.13	57.68	58.34	60.20
Brunswick	32.32	32.85	32.32	32.32	32.19	32.92
Buchanan	52.19	51.60	50.61	50.01	49.27	47.74
Buckingham	26.86	27.03	27.37	27.72	27.51	28.13
Campbell	100.50	100.70	100.30	100.70	101.09	103.15
Caroline	41.69	41.88	43.19	44.69	47.15	48.85
Carroll	61.72	61.93	61.93	62.35	61.54	63.30
Charles City	38.30	38.30	38.30	38.30	37.92	38.56
Charlotte	26.53	26.74	26.32	26.53	26.34	26.90
Chesterfield	621.49	633.71	646.86	663.30	680.14	691.61
Clarke	73.60	74.74	76.44	77.57	80.25	79.45
Craig	15.43	15.43	15.43	15.43	15.10	15.72
Culpeper	92.39	95.01	98.95	104.20	111.65	116.95
Cumberland	30.16	30.83	31.50	31.50	32.16	32.68
Dickenson	48.23	48.54	48.84	49.14	48.92	47.76
Dinwiddie	48.84	49.24	49.83	51.03	51.52	51.41
Essex	38.79	38.79	39.18	39.57	39.95	41.35
Fairfax	2507.34	2532.40	2539.49	2556.70	2553.57	2554.61
Fauquier	88.35	90.35	92.20	95.27	98.04	98.91
Floyd	36.99	37.77	37.77	38.56	38.92	39.36
Fluvanna	74.47	78.30	81.43	85.60	87.98	86.77
Franklin	69.50	70.37	70.80	71.67	72.42	74.69
Frederick	147.60	150.98	155.32	160.38	165.95	171.44
Giles	46.18	46.46	45.90	45.90	45.42	46.32
Gloucester	161.12	161.58	162.50	163.43	164.29	166.90
Goochland	60.47	63.28	64.69	65.75	68.57	70.48
Grayson	38.18	37.95	37.73	37.50	36.89	36.68
Greene	100.91	103.46	105.38	106.65	107.35	109.74
Greensville	39.60	39.94	41.29	41.29	41.81	40.39
Halifax	45.16	45.04	44.43	44.31	44.17	44.66
Hanover	188.71	192.52	196.33	200.56	201.99	203.89

Table 15 *Population Density for Virginia Units of Local Government (Counties)*						
Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Henrico	1123.25	1136.69	1153.07	1177.43	1189.38	1201.78
Henry	149.34	147.77	145.42	144.37	142.06	143.89
Highland	6.01	6.01	5.77	5.77	5.70	5.74
Isle of Wight	95.29	96.24	97.83	100.04	102.63	104.76
James City	351.25	362.44	371.54	386.23	402.62	417.26
King & Queen	21.19	21.19	21.50	21.19	21.91	21.91
King George	94.44	97.78	101.11	107.78	114.31	117.68
King William	49.01	49.74	50.10	51.19	52.72	52.98
Lancaster	85.62	86.38	85.62	85.62	86.16	88.21
Lee	53.53	55.36	56.73	57.65	57.40	56.89
Loudoun	367.16	402.62	432.69	470.27	506.36	518.31
Louisa	53.30	53.91	54.91	56.72	59.22	61.24
Lunenburg	30.35	30.11	30.11	30.11	30.25	30.63
Madison	39.51	40.45	40.76	41.69	42.18	42.65
Mathews	108.54	108.54	108.54	109.71	107.59	109.99
Mecklenburg	51.93	51.77	51.77	51.45	51.63	52.75
Middlesex	76.75	75.98	75.98	77.51	77.71	78.89
Montgomery	217.14	217.40	218.69	222.55	225.35	226.87
Nelson	30.49	30.91	31.33	31.33	31.56	31.51
New Kent	65.86	67.76	69.67	73.01	76.20	80.22
Northampton	62.21	61.73	61.73	62.21	63.27	63.27
Northumberland	65.00	65.52	66.04	66.04	67.13	67.74
Nottoway	49.90	49.58	49.58	49.58	49.96	49.79
Orange	77.85	79.60	81.07	83.99	87.89	92.84
Page	74.89	75.53	75.85	76.50	76.50	77.74
Patrick	39.95	39.95	39.53	39.74	39.57	39.95
Pittsylvania	63.87	63.56	63.04	62.84	62.73	63.57
Powhatan	88.79	92.24	94.92	97.60	100.71	101.55
Prince Edward	56.70	57.26	56.41	57.26	57.88	59.42
Prince George	126.12	131.01	135.53	137.41	138.14	136.87
Prince William	883.12	928.71	974.01	1027.00	1074.71	1083.15
Pulaski	109.18	107.31	106.68	106.37	106.09	108.25
Rappahannock	26.26	25.88	25.51	25.88	25.94	26.65
Richmond	47.01	47.53	48.57	49.62	50.41	48.78
Roanoke	346.00	345.20	348.79	353.17	356.64	358.71
Rockbridge	34.69	34.69	35.19	35.36	35.58	36.50
Rockingham	80.71	81.54	81.89	83.18	83.92	85.66
Russell	62.36	61.52	61.94	61.10	60.44	60.27
Scott	43.24	43.24	43.05	43.42	43.71	43.94
Shenandoah	70.48	71.65	73.41	74.78	76.47	78.55
Smyth	73.44	72.33	71.45	71.00	70.68	70.96
Southampton	29.69	29.86	29.52	29.86	30.10	29.91

Table 15

Population Density for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Spotsylvania	243.23	257.20	268.67	279.40	288.80	295.55
Stafford	362.49	385.06	405.77	425.00	439.81	439.98
Surry	24.36	24.36	24.36	24.36	24.47	25.48
Sussex	25.06	24.66	25.06	24.66	24.39	24.70
Tazewell	83.89	83.89	84.27	84.85	84.26	83.99
Warren	150.68	153.02	156.29	158.63	162.53	165.19
Washington	90.79	91.14	91.14	91.50	92.01	93.25
Westmoreland	72.87	72.43	72.00	72.00	72.47	73.07
Wise	102.96	102.22	102.22	102.71	102.10	101.41
Wythe	59.80	59.36	59.36	59.58	59.41	59.78
York	546.14	562.23	566.97	586.84	592.54	593.74

Table 16
Population Density for Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	9057.97	8913.04	8833.99	8761.53	8707.24	8918.63
Bedford	8.48	8.35	8.35	8.22	8.12	8.08
Bristol	1341.09	1333.33	1333.33	1341.09	1348.22	1334.93
Buena Vista	922.40	907.76	907.76	937.04	935.89	948.94
Charlottesville	3879.14	3869.40	3830.41	3859.65	3860.61	3977.31
Chesapeake	601.96	599.03	606.36	618.10	628.51	631.81
Colonial Heights	2272.73	2272.73	2259.36	2286.10	2301.43	2306.22
Covington	1111.11	1093.47	1075.84	1040.56	1018.56	1020.06
Danville	1093.82	1091.50	1079.89	1077.57	1068.54	1051.40
Emporia	798.26	827.29	812.77	798.26	786.38	806.17
Fairfax	3549.92	3613.31	3676.70	3660.86	3656.83	3637.22
Falls Church	5577.89	5527.64	5527.64	5326.63	5498.53	5512.79
Franklin	970.06	970.06	982.04	994.01	1002.15	1007.31
Fredericksburg	1910.65	1929.66	1948.67	2005.70	2041.25	2066.83
Galax	814.09	814.09	814.09	826.25	828.23	823.12
Hampton	2804.17	2802.24	2777.13	2788.72	2805.37	2801.09
Harrisonburg	2403.19	2391.80	2420.27	2443.05	2488.26	2525.08
Hopewell	2177.73	2177.73	2167.97	2177.73	2168.95	2188.77
Lexington	2811.24	2811.24	2730.92	2771.08	2850.35	2893.94
Lynchburg	1328.20	1332.25	1344.40	1358.57	1371.86	1388.52
Manassas	3726.08	3685.80	3685.80	3726.08	3676.74	3654.41
Manassas Park	4698.80	4779.12	4939.76	5100.40	5368.95	5560.35
Martinsville	1386.86	1395.99	1368.61	1332.12	1310.79	1329.86
Newport News	2625.57	2635.82	2651.93	2665.10	2653.98	2662.77
Norfolk	4356.97	4347.66	4353.25	4377.44	4375.04	4359.19
Norton	517.93	517.93	517.93	517.93	510.20	501.02
Petersburg	1407.34	1416.08	1398.60	1376.75	1345.24	1368.38
Poquoson	747.42	740.98	740.98	753.87	757.99	764.50
Portsmouth	2967.43	2970.45	2952.35	2961.40	2970.87	2964.97
Radford	1578.41	1568.23	1537.68	1537.68	1563.47	1576.13
Richmond	3212.92	3244.55	3227.90	3216.25	3191.95	3227.60
Roanoke	2206.16	2206.16	2171.18	2166.51	2161.16	2168.70
Salem	1706.65	1706.65	1692.94	1686.09	1702.27	1701.25
Staunton	1192.29	1192.29	1141.55	1141.55	1159.98	1151.53
Suffolk	172.99	173.24	180.74	190.24	196.27	199.48
Virginia Beach	1725.40	1719.36	1724.60	1747.96	1745.82	1739.18
Waynesboro	1276.04	1282.55	1276.04	1289.06	1299.72	1315.16
Williamsburg	1475.41	1475.41	1545.67	1569.09	1550.54	1556.09
Winchester	2636.66	2636.66	2679.53	2722.40	2763.11	2773.62

Table 17
Regional Completion Rates for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Albemarle	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Alleghany	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Amelia	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Amherst	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Appomattox	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Arlington	0.0000	0.0000	0.1667	1.0000	1.0000	1.0000
Augusta	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Bath	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Bedford	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Bland	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Botetourt	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Brunswick	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Buchanan	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Buckingham	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Campbell	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Caroline	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Carroll	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Charles City	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Charlotte	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Chesterfield	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Clarke	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Craig	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Culpeper	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Cumberland	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Dickenson	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Dinwiddie	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Essex	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Fairfax	0.0000	0.0000	0.1667	1.0000	1.0000	1.0000
Fauquier	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Floyd	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Fluvanna	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Franklin	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Frederick	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Giles	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Gloucester	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Goochland	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Grayson	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Greene	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Greensville	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Halifax	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333

Table 17

Regional Completion Rates for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments for Virginia Units of Local Government (Counties)

Locality	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Hanover	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Henrico	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Henry	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Highland	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Isle of Wight	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
James City	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
King & Queen	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
King George	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
King William	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Lancaster	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Lee	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Loudoun	0.0000	0.0000	0.1667	1.0000	1.0000	1.0000
Louisa	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Lunenburg	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Madison	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Mathews	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Mecklenburg	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Middlesex	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Montgomery	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Nelson	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
New Kent	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Northampton	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Northumberland	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Nottoway	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Orange	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Page	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Patrick	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Pittsylvania	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Powhatan	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Prince Edward	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Prince George	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Prince William	0.0000	0.0000	0.1667	1.0000	1.0000	1.0000
Pulaski	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Rappahannock	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Richmond	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Roanoke	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Rockbridge	0.0000	0.0417	0.2708	0.7292	0.8333	0.8750
Rockingham	0.0714	0.0714	0.0952	0.5000	0.7381	0.8333
Russell	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Scott	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Shenandoah	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643

Table 17
Regional Completion Rates for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments for Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Smyth	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Southampton	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Spotsylvania	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Stafford	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Surry	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Sussex	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792
Tazewell	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Warren	0.0000	0.0000	0.1071	0.4643	0.6429	0.9643
Washington	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Westmoreland	0.0000	0.0600	0.2000	0.4400	0.7600	0.8200
Wise	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
Wythe	0.0000	0.0000	0.0588	0.2941	0.5588	0.7647
York	0.1667	0.2500	0.2917	0.6875	0.7917	0.9792

Table 18
Regional Completion Rates for Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments for Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	0.0000	0.0000	0.4286	1.0000	1.0000	1.0000
Bedford	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Bristol	0.0000	0.0000	0.1176	0.5882	0.7059	0.8235
Buena Vista	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Charlottesville	0.1429	0.1429	0.1905	0.8095	0.9048	0.9048
Chesapeake	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Colonial Heights	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Covington	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Danville	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Emporia	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Fairfax	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Falls Church	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Franklin	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Fredericksburg	0.0000	0.0000	0.2143	0.7857	1.0000	1.0000
Galax	0.0000	0.0000	0.1176	0.5882	0.7059	0.8235
Hampton	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Harrisonburg	0.1429	0.1429	0.1905	0.8095	0.9048	0.9048
Hopewell	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Lexington	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Lynchburg	0.1429	0.1429	0.1905	0.8095	0.9048	0.9048
Manassas	0.0000	0.0000	0.4286	1.0000	1.0000	1.0000
Manassas Park	0.0000	0.0000	0.4286	1.0000	1.0000	1.0000
Martinsville	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Newport News	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Norfolk	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Norton	0.0000	0.0000	0.1176	0.5882	0.7059	0.8235
Petersburg	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Poquoson	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Portsmouth	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Radford	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Richmond	0.0000	0.1111	0.3704	0.7037	0.9630	0.9630
Roanoke	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Salem	0.0000	0.0833	0.5417	0.8750	0.8750	0.8750
Staunton	0.1429	0.1429	0.1905	0.8095	0.9048	0.9048
Suffolk	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Virginia Beach	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Waynesboro	0.1429	0.1429	0.1905	0.8095	0.9048	0.9048
Williamsburg	0.3333	0.5000	0.5833	0.8750	0.9583	1.0000
Winchester	0.0000	0.0000	0.2143	0.7857	1.0000	1.0000

Table 19
Interstate Highways in Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	No	No	No	No	No	No
Albemarle	Yes	Yes	Yes	Yes	Yes	Yes
Alleghany	No	No	No	No	No	No
Amelia	No	No	No	No	No	No
Amherst	No	No	No	No	No	No
Appomattox	No	No	No	No	No	No
Arlington	Yes	Yes	Yes	Yes	Yes	Yes
Augusta	Yes	Yes	Yes	Yes	Yes	Yes
Bath	No	No	No	No	No	No
Bedford	No	No	No	No	No	No
Bland	Yes	Yes	Yes	Yes	Yes	Yes
Botetourt	Yes	Yes	Yes	Yes	Yes	Yes
Brunswick	Yes	Yes	Yes	Yes	Yes	Yes
Buchanan	No	No	No	No	No	No
Buckingham	No	No	No	No	No	No
Campbell	No	No	No	No	No	No
Caroline	Yes	Yes	Yes	Yes	Yes	Yes
Carroll	No	No	No	No	No	No
Charles City	No	No	No	No	No	No
Charlotte	No	No	No	No	No	No
Chesterfield	Yes	Yes	Yes	Yes	Yes	Yes
Clarke	No	No	No	No	No	No
Craig	No	No	No	No	No	No
Culpeper	No	No	No	No	No	No
Cumberland	No	No	No	No	No	No
Dickenson	No	No	No	No	No	No
Dinwiddie	Yes	Yes	Yes	Yes	Yes	Yes
Essex	No	No	No	No	No	No
Fairfax	Yes	Yes	Yes	Yes	Yes	Yes
Fauquier	Yes	Yes	Yes	Yes	Yes	Yes
Floyd	No	No	No	No	No	No
Fluvanna	Yes	Yes	Yes	Yes	Yes	Yes
Franklin	No	No	No	No	No	No
Frederick	Yes	Yes	Yes	Yes	Yes	Yes
Giles	No	No	No	No	No	No
Gloucester	No	No	No	No	No	No
Goochland	Yes	Yes	Yes	Yes	Yes	Yes
Grayson	No	No	No	No	No	No
Greene	No	No	No	No	No	No
Greensville	Yes	Yes	Yes	Yes	Yes	Yes
Halifax	No	No	No	No	No	No
Hanover	Yes	Yes	Yes	Yes	Yes	Yes

Table 19
Interstate Highways in Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Henrico	Yes	Yes	Yes	Yes	Yes	Yes
Henry	No	No	No	No	No	No
Highland	No	No	No	No	No	No
Isle of Wight	Yes	Yes	Yes	Yes	Yes	Yes
James City	Yes	Yes	Yes	Yes	Yes	Yes
King & Queen	No	No	No	No	No	No
King George	No	No	No	No	No	No
King William	No	No	No	No	No	No
Lancaster	No	No	No	No	No	No
Lee	No	No	No	No	No	No
Loudoun	Yes	Yes	Yes	Yes	Yes	Yes
Louisa	Yes	Yes	Yes	Yes	Yes	Yes
Lunenburg	No	No	No	No	No	No
Madison	No	No	No	No	No	No
Mathews	No	No	No	No	No	No
Mecklenburg	Yes	Yes	Yes	Yes	Yes	Yes
Middlesex	No	No	No	No	No	No
Montgomery	Yes	Yes	Yes	Yes	Yes	Yes
Nelson	No	No	No	No	No	No
New Kent	Yes	Yes	Yes	Yes	Yes	Yes
Northampton	No	No	No	No	No	No
Northumberland	No	No	No	No	No	No
Nottoway	No	No	No	No	No	No
Orange	No	No	No	No	No	No
Page	No	No	No	No	No	No
Patrick	No	No	No	No	No	No
Pittsylvania	No	No	No	No	No	No
Powhatan	No	No	No	No	No	No
Prince Edward	No	No	No	No	No	No
Prince George	Yes	Yes	Yes	Yes	Yes	Yes
Prince William	Yes	Yes	Yes	Yes	Yes	Yes
Pulaski	Yes	Yes	Yes	Yes	Yes	Yes
Rappahannock	No	No	No	No	No	No
Richmond	No	No	No	No	No	No
Roanoke	Yes	Yes	Yes	Yes	Yes	Yes
Rockbridge	Yes	Yes	Yes	Yes	Yes	Yes
Rockingham	Yes	Yes	Yes	Yes	Yes	Yes
Russell	No	No	No	No	No	No
Scott	No	No	No	No	No	No
Shenandoah	Yes	Yes	Yes	Yes	Yes	Yes
Smyth	Yes	Yes	Yes	Yes	Yes	Yes
Southampton	No	No	No	No	No	No

Table 19

Interstate Highways in Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Spotsylvania	Yes	Yes	Yes	Yes	Yes	Yes
Stafford	Yes	Yes	Yes	Yes	Yes	Yes
Surry	No	No	No	No	No	No
Sussex	Yes	Yes	Yes	Yes	Yes	Yes
Tazewell	No	No	No	No	No	No
Warren	Yes	Yes	Yes	Yes	Yes	Yes
Washington	Yes	Yes	Yes	Yes	Yes	Yes
Westmoreland	No	No	No	No	No	No
Wise	No	No	No	No	No	No
Wythe	Yes	Yes	Yes	Yes	Yes	Yes
York	Yes	Yes	Yes	Yes	Yes	Yes

Table 20
Interstate Highways in Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	Yes	Yes	Yes	Yes	Yes	Yes
Bedford	No	No	No	No	No	No
Bristol	Yes	Yes	Yes	Yes	Yes	Yes
Buena Vista	Yes	Yes	Yes	Yes	Yes	Yes
Charlottesville	Yes	Yes	Yes	Yes	Yes	Yes
Chesapeake	Yes	Yes	Yes	Yes	Yes	Yes
Colonial Heights	Yes	Yes	Yes	Yes	Yes	Yes
Covington	No	No	No	No	No	No
Danville	No	No	No	No	No	No
Emporia	Yes	Yes	Yes	Yes	Yes	Yes
Fairfax	Yes	Yes	Yes	Yes	Yes	Yes
Falls Church	Yes	Yes	Yes	Yes	Yes	Yes
Franklin	No	No	No	No	No	No
Fredericksburg	Yes	Yes	Yes	Yes	Yes	Yes
Galax	No	No	No	No	No	No
Hampton	Yes	Yes	Yes	Yes	Yes	Yes
Harrisonburg	Yes	Yes	Yes	Yes	Yes	Yes
Hopewell	Yes	Yes	Yes	Yes	Yes	Yes
Lexington	Yes	Yes	Yes	Yes	Yes	Yes
Lynchburg	No	No	No	No	No	No
Manassas	Yes	Yes	Yes	Yes	Yes	Yes
Manassas Park	Yes	Yes	Yes	Yes	Yes	Yes
Martinsville	No	No	No	No	No	No
Newport News	Yes	Yes	Yes	Yes	Yes	Yes
Norfolk	Yes	Yes	Yes	Yes	Yes	Yes
Norton	No	No	No	No	No	No
Petersburg	Yes	Yes	Yes	Yes	Yes	Yes
Poquoson	No	No	No	No	No	No
Portsmouth	Yes	Yes	Yes	Yes	Yes	Yes
Radford	Yes	Yes	Yes	Yes	Yes	Yes
Richmond	Yes	Yes	Yes	Yes	Yes	Yes
Roanoke	Yes	Yes	Yes	Yes	Yes	Yes
Salem	Yes	Yes	Yes	Yes	Yes	Yes
Staunton	Yes	Yes	Yes	Yes	Yes	Yes
Suffolk	Yes	Yes	Yes	Yes	Yes	Yes
Virginia Beach	Yes	Yes	Yes	Yes	Yes	Yes
Waynesboro	Yes	Yes	Yes	Yes	Yes	Yes
Williamsburg	Yes	Yes	Yes	Yes	Yes	Yes
Winchester	Yes	Yes	Yes	Yes	Yes	Yes

Table 22
Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments by Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Accomack	0	1	1	2	2	2
Albemarle	1	1	1	2	2	2
Alleghany	0	0	0	2	2	2
Amelia	0	0	0	1	1	1
Amherst	0	0	0	1	2	2
Appomattox	0	0	0	0	0	0
Arlington	0	0	0	2	2	2
Augusta	0	0	0	1	1	1
Bath	0	0	0	0	0	0
Bedford	0	0	0	2	2	2
Bland	0	0	0	0	2	2
Botetourt	0	0	0	2	2	2
Brunswick	0	0	0	1	2	2
Buchanan	0	0	0	0	0	0
Buckingham	0	0	0	2	2	2
Campbell	0	0	0	0	1	2
Caroline	0	0	0	1	2	2
Carroll	0	0	0	1	2	2
Charles City	0	0	0	1	2	2
Charlotte	0	0	1	1	2	2
Chesterfield	0	1	1	2	2	2
Clarke	0	0	1	1	1	2
Craig	0	0	0	0	0	0
Culpeper	0	0	0	1	1	2
Cumberland	0	0	0	1	2	2
Dickenson	0	0	0	0	0	0
Dinwiddie	0	0	0	0	1	2
Essex	0	0	0	0	1	1
Fairfax	0	0	0	2	2	2
Fauquier	0	0	0	1	2	2
Floyd	0	0	0	1	2	2
Fluvanna	0	0	0	1	2	2
Franklin	0	0	0	1	1	2
Frederick	0	0	0	1	1	2
Giles	0	0	0	0	1	1
Gloucester	0	0	0	1	1	1
Goochland	0	0	0	0	1	1
Grayson	0	0	0	1	2	2
Greene	0	0	0	1	1	2
Greensville	0	0	0	0	1	2
Halifax	0	0	0	0	1	2

Table 22
Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments by Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Hanover	0	1	1	1	2	2
Henrico	0	1	1	2	2	2
Henry	0	1	1	2	2	2
Highland	0	0	0	0	0	0
Isle of Wight	0	0	1	1	2	2
James City	0	1	1	2	2	2
King & Queen	0	0	0	0	1	1
King George	0	0	0	0	2	2
King William	0	0	0	0	2	2
Lancaster	0	0	0	1	1	2
Lee	0	0	0	0	0	0
Loudoun	0	0	0	2	2	2
Louisa	0	0	1	2	2	2
Lunenburg	0	0	0	1	1	2
Madison	0	0	0	0	1	2
Mathews	0	0	0	0	0	2
Mecklenburg	0	0	0	1	2	2
Middlesex	0	0	0	1	1	2
Montgomery	0	0	0	1	2	2
Nelson	0	0	0	1	1	1
New Kent	0	0	0	1	1	2
Northampton	0	1	1	2	2	2
Northumberland	0	0	0	1	2	2
Nottoway	0	0	0	0	1	1
Orange	0	0	1	2	2	2
Page	0	0	0	0	1	2
Patrick	0	0	1	1	2	2
Pittsylvania	0	0	1	2	2	2
Powhatan	0	0	1	1	1	1
Prince Edward	0	0	0	0	0	0
Prince George	0	0	1	1	1	1
Prince William	0	0	1	2	2	2
Pulaski	0	0	1	1	1	2
Rappahannock	0	0	0	1	1	1
Richmond	0	0	0	0	0	0
Roanoke	0	0	1	1	1	2
Rockbridge	0	0	1	2	2	2
Rockingham	0	0	0	1	2	2
Russell	0	0	0	1	1	2
Scott	0	0	0	0	0	2
Shenandoah	0	0	0	0	1	2

Table 22
Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments by Virginia Units of Local Government (Counties)

Locality	2001	2002	2003	2004	2005	2006
Smyth	0	0	0	1	1	2
Southampton	0	0	0	2	2	2
Spotsylvania	0	0	0	1	1	2
Stafford	0	0	1	2	2	2
Surry	0	0	0	1	2	2
Sussex	0	0	0	1	1	2
Tazewell	0	0	0	0	0	1
Warren	0	0	0	1	2	2
Washington	0	0	1	1	2	2
Westmoreland	0	0	0	2	2	2
Wise	0	0	0	1	1	2
Wythe	0	0	0	1	2	2
York	1	1	1	2	2	2

No Deployment = 0, Phase One Deployment = 1, and Phase Two Deployment = 2

Table 23
Wireless E9-1-1 Phase One and Wireless E9-1-1 Phase Two Deployments by Virginia Units of Local Government (Cities)

Locality	2001	2002	2003	2004	2005	2006
Alexandria	0	0	0	2	2	2
Bedford	0	0	0	2	2	2
Bristol	0	0	1	1	2	2
Buena Vista	0	0	1	2	2	2
Charlottesville	1	1	1	2	2	2
Chesapeake	1	1	1	1	1	2
Colonial Heights	0	0	1	1	2	2
Covington	0	0	0	2	2	2
Danville	0	0	1	1	2	2
Emporia	0	0	0	0	1	2
Fairfax	0	0	0	2	2	2
Falls Church	0	0	0	2	2	2
Franklin	0	0	0	2	2	2
Fredericksburg	0	0	0	1	1	2
Galax	0	0	0	1	2	2
Hampton	1	1	1	2	2	2
Harrisonburg	0	0	0	1	2	2
Hopewell	0	0	1	1	2	2
Lexington	0	0	1	2	2	2
Lynchburg	1	1	1	2	2	2
Manassas	0	0	1	2	2	2
Manassas Park	0	0	1	2	2	2
Martinsville	0	1	1	2	2	2
Newport News	1	1	1	2	2	2
Norfolk	1	1	1	2	2	2
Norton	0	0	0	1	1	2
Petersburg	0	0	1	1	2	2
Poquoson	0	0	0	1	1	2
Portsmouth	1	1	1	2	2	2
Radford	0	0	1	1	2	2
Richmond	0	0	1	2	2	2
Roanoke	0	0	1	2	2	2
Salem	0	0	1	2	2	2
Staunton	0	0	0	1	1	1
Suffolk	1	1	1	2	2	2
Virginia Beach	0	1	1	2	2	2
Waynesboro	0	0	0	1	2	2
Williamsburg	0	1	1	2	2	2
Winchester	0	0	0	1	1	2

No Deployment = 0, Phase One Deployment = 1, and Phase Two Deployment = 2

Table 25
Virginia Units of Local Government which had not yet Deployed Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two as of January 1, 2001 (Counties)

Accomack	Franklin	Nottoway
Albemarle	Frederick	Orange
Alleghany	Giles	Page
Amelia	Gloucester	Patrick
Amherst	Goochland	Pittsylvania
Appomattox	Grayson	Powhatan
Arlington	Greene	Prince Edward
Augusta	Greensville	Prince George
Bath	Halifax	Prince William
Bedford	Hanover	Pulaski
Bland	Henrico	Rappahannock
Botetourt	Henry	Richmond
Brunswick	Highland	Roanoke
Buchanan	Isle of Wight	Rockbridge
Buckingham	James City	Rockingham
Campbell	King and Queen	Russell
Caroline	King George	Scott
Carroll	King William	Shenandoah
Charles City	Lancaster	Smyth
Charlotte	Lee	Southampton
Chesterfield	Loudon	Spotsylvania
Clarke	Louisa	Stafford
Craig	Lunenburg	Surry
Culpeper	Madison	Sussex
Cumberland	Mathews	Tazewell
Dickenson	Mecklenburg	Warren
Dinwiddie	Middlesex	Washington
Essex	Montgomery	Westmoreland
Fairfax	Nelson	Wise
Fauquier	New Kent	Wythe
Floyd	Northampton	York
Fluvanna	Northumberland	

Table 26 *Virginia Units of Local Government which had not yet Deployed Wireless E9-1-1 Phase One or Wireless E9-1-1 Phase Two as of January 1, 2001 (Cities)*	
Alexandria	Manassas
Bedford	Manassas Park
Bristol	Martinsville
Buena Vista	Newport News
Charlottesville	Norfolk
Chesapeake	Norton
Colonial Heights	Petersburg
Covington	Poquoson
Danville	Portsmouth
Emporia	Radford
Fairfax	Richmond
Falls Church	Roanoke
Franklin	Salem
Fredericksburg	Staunton
Galax	Suffolk
Hampton	Virginia Beach
Harrisonburg	Waynesboro
Hopewell	Williamsburg
Lexington	Winchester
Lynchburg	

Table 27
Population and Sampling Frame for Virginia Units of Local Government (Counties)

Accomack	Franklin	Nottoway
Albemarle	Frederick	Orange
Alleghany	Giles	Page
Amelia	Gloucester	Patrick
Amherst	Goochland	Pittsylvania
Appomattox	Grayson	Powhatan
Arlington	Greene	Prince Edward
Augusta	Greensville	Prince George
Bath	Halifax	Prince William
Bedford	Hanover	Pulaski
Bland	Henrico	Rappahannock
Botetourt	Henry	Richmond
Brunswick	Highland	Roanoke
Buchanan	Isle of Wight	Rockbridge
Buckingham	James City	Rockingham
Campbell	King and Queen	Russell
Caroline	King George	Scott
Carroll	King William	Shenandoah
Charles City	Lancaster	Smyth
Charlotte	Lee	Southampton
Chesterfield	Loudon	Spotsylvania
Clarke	Louisa	Stafford
Craig	Lunenburg	Surry
Culpeper	Madison	Sussex
Cumberland	Mathews	Tazewell
Dickenson	Mecklenburg	Warren
Dinwiddie	Middlesex	Washington
Essex	Montgomery	Westmoreland
Fairfax	Nelson	Wise
Fauquier	New Kent	Wythe
Floyd	Northampton	York
Fluvanna	Northumberland	

Table 28

Population and Sampling Frame for Virginia Units of Local Government (Cities)

Alexandria	Manassas
Bedford	Manassas Park
Bristol	Martinsville
Buena Vista	Newport News
Charlottesville	Norfolk
Chesapeake	Norton
Colonial Heights	Petersburg
Covington	Poquoson
Danville	Portsmouth
Emporia	Radford
Fairfax	Richmond
Falls Church	Roanoke
Franklin	Salem
Fredericksburg	Staunton
Galax	Suffolk
Hampton	Virginia Beach
Harrisonburg	Waynesboro
Hopewell	Williamsburg
Lexington	Winchester
Lynchburg	

Table 29

2001 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Accomack	Gloucester	Prince Edward	Fairfax
Albemarle	Goochland	Prince George	Falls Church
Alleghany	Grayson	Prince William	Franklin
Amelia	Greene	Pulaski	Fredericksburg
Amherst	Greensville	Rappahannock	Galax
Appomattox	Halifax	Richmond	Hampton
Arlington	Hanover	Roanoke	Harrisonburg
Augusta	Henrico	Rockbridge	Hopewell
Bath	Henry	Rockingham	Lexington
Bedford	Highland	Russell	Lynchburg
Bland	Isle of Wight	Scott	Manassas
Botetourt	James City	Shenandoah	Manassas Park
Brunswick	King & Queen	Smyth	Martinsville
Buchanan	King George	Southampton	Newport News
Buckingham	King William	Spotsylvania	Norfolk
Campbell	Lancaster	Stafford	Norton
Caroline	Lee	Surry	Petersburg
Carroll	Loudoun	Sussex	Poquoson
Charles City	Louisa	Tazewell	Portsmouth
Charlotte	Lunenburg	Warren	Radford
Chesterfield	Madison	Washington	Richmond
Clarke	Mathews	Westmoreland	Roanoke
Craig	Mecklenburg	Wise	Salem
Culpeper	Middlesex	Wythe	Staunton
Cumberland	Montgomery	York	Suffolk
Dickenson	Nelson	Alexandria	Virginia Beach
Dinwiddie	New Kent	Bedford	Waynesboro
Essex	Northampton	Bristol	Williamsburg
Fairfax	Northumberland	Buena Vista	Winchester
Fauquier	Nottoway	Charlottesville	
Floyd	Orange	Chesapeake	
Fluvanna	Page	Colonial Heights	
Franklin	Patrick	Covington	
Frederick	Pittsylvania	Danville	
Giles	Powhatan	Emporia	

Table 30
2002 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Accomack	Gloucester	Prince Edward	Fairfax
Albemarle	Goochland	Prince George	Falls Church
Alleghany	Grayson	Prince William	Franklin
Amelia	Greene	Pulaski	Fredericksburg
Amherst	Greensville	Rappahannock	Galax
Appomattox	Halifax	Richmond	Hampton
Arlington	Hanover	Roanoke	Harrisonburg
Augusta	Henrico	Rockbridge	Hopewell
Bath	Henry	Rockingham	Lexington
Bedford	Highland	Russell	Lynchburg
Bland	Isle of Wight	Scott	Manassas
Botetourt	James City	Shenandoah	Manassas Park
Brunswick	King & Queen	Smyth	Martinsville
Buchanan	King George	Southampton	Newport News
Buckingham	King William	Spotsylvania	Norfolk
Campbell	Lancaster	Stafford	Norton
Caroline	Lee	Surry	Petersburg
Carroll	Loudoun	Sussex	Poquoson
Charles City	Louisa	Tazewell	Portsmouth
Charlotte	Lunenburg	Warren	Radford
Chesterfield	Madison	Washington	Richmond
Clarke	Mathews	Westmoreland	Roanoke
Craig	Mecklenburg	Wise	Salem
Culpeper	Middlesex	Wythe	Staunton
Cumberland	Montgomery	York	Suffolk
Dickenson	Nelson	Alexandria	Virginia Beach
Dinwiddie	New Kent	Bedford	Waynesboro
Essex	Northampton	Bristol	Williamsburg
Fairfax	Northumberland	Buena Vista	Winchester
Fauquier	Nottoway	Charlottesville	
Floyd	Orange	Chesapeake	
Fluvanna	Page	Colonial Heights	
Franklin	Patrick	Covington	
Frederick	Pittsylvania	Danville	
Giles	Powhatan	Emporia	

Table 31

2003 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Accomack	Gloucester	Prince Edward	Fairfax
Albemarle	Goochland	Prince George	Falls Church
Alleghany	Grayson	Prince William	Franklin
Amelia	Greene	Pulaski	Fredericksburg
Amherst	Greensville	Rappahannock	Galax
Appomattox	Halifax	Richmond	Hampton
Arlington	Hanover	Roanoke	Harrisonburg
Augusta	Henrico	Rockbridge	Hopewell
Bath	Henry	Rockingham	Lexington
Bedford	Highland	Russell	Lynchburg
Bland	Isle of Wight	Scott	Manassas
Botetourt	James City	Shenandoah	Manassas Park
Brunswick	King & Queen	Smyth	Martinsville
Buchanan	King George	Southampton	Newport News
Buckingham	King William	Spotsylvania	Norfolk
Campbell	Lancaster	Stafford	Norton
Caroline	Lee	Surry	Petersburg
Carroll	Loudoun	Sussex	Poquoson
Charles City	Louisa	Tazewell	Portsmouth
Charlotte	Lunenburg	Warren	Radford
Chesterfield	Madison	Washington	Richmond
Clarke	Mathews	Westmoreland	Roanoke
Craig	Mecklenburg	Wise	Salem
Culpeper	Middlesex	Wythe	Staunton
Cumberland	Montgomery	York	Suffolk
Dickenson	Nelson	Alexandria	Virginia Beach
Dinwiddie	New Kent	Bedford	Waynesboro
Essex	Northampton	Bristol	Williamsburg
Fairfax	Northumberland	Buena Vista	Winchester
Fauquier	Nottoway	Charlottesville	
Floyd	Orange	Chesapeake	
Fluvanna	Page	Colonial Heights	
Franklin	Patrick	Covington	
Frederick	Pittsylvania	Danville	
Giles	Powhatan	Emporia	

Table 32
2004 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Accomack	Gloucester	Prince Edward	Fairfax
Albemarle	Goochland	Prince George	Falls Church
Alleghany	Grayson	Prince William	Franklin
Amelia	Greene	Pulaski	Fredericksburg
Amherst	Greensville	Rappahannock	Galax
Appomattox	Halifax	Richmond	Hampton
Arlington	Hanover	Roanoke	Harrisonburg
Augusta	Henrico	Rockbridge	Hopewell
Bath	Henry	Rockingham	Lexington
Bedford	Highland	Russell	Lynchburg
Bland	Isle of Wight	Scott	Manassas
Botetourt	James City	Shenandoah	Manassas Park
Brunswick	King & Queen	Smyth	Martinsville
Buchanan	King George	Southampton	Newport News
Buckingham	King William	Spotsylvania	Norfolk
Campbell	Lancaster	Stafford	Norton
Caroline	Lee	Surry	Petersburg
Carroll	Loudoun	Sussex	Poquoson
Charles City	Louisa	Tazewell	Portsmouth
Charlotte	Lunenburg	Warren	Radford
Chesterfield	Madison	Washington	Richmond
Clarke	Mathews	Westmoreland	Roanoke
Craig	Mecklenburg	Wise	Salem
Culpeper	Middlesex	Wythe	Staunton
Cumberland	Montgomery	York	Suffolk
Dickenson	Nelson	Alexandria	Virginia Beach
Dinwiddie	New Kent	Bedford	Waynesboro
Essex	Northampton	Bristol	Williamsburg
Fairfax	Northumberland	Buena Vista	Winchester
Fauquier	Nottoway	Charlottesville	
Floyd	Orange	Chesapeake	
Fluvanna	Page	Colonial Heights	
Franklin	Patrick	Covington	
Frederick	Pittsylvania	Danville	
Giles	Powhatan	Emporia	

Table 33
2005 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Amelia	Fluvanna	Middlesex	Sussex
Amherst	Franklin	Montgomery	Tazewell
Appomattox	Frederick	Nelson	Warren
Augusta	Giles	New Kent	Washington
Bath	Gloucester	Northumberland	Wise
Bland	Goochland	Nottoway	Wythe
Brunswick	Grayson	Page	Bristol
Buchanan	Greene	Patrick	Chesapeake
Campbell	Greensville	Powhatan	Colonial Heights
Caroline	Halifax	Prince Edward	Danville
Carroll	Hanover	Prince George	Emporia
Charles City	Highland	Pulaski	Fredericksburg
Charlotte	Isle of Wight	Rappahannock	Galax
Clarke	King & Queen	Richmond	Harrisonburg
Craig	King George	Roanoke	Hopewell
Culpeper	King William	Rockingham	Norton
Cumberland	Lancaster	Russell	Petersburg
Dickenson	Lee	Scott	Poquoson
Dinwiddie	Lunenburg	Shenandoah	Radford
Essex	Madison	Smyth	Staunton
Fauquier	Mathews	Spotsylvania	Waynesboro
Floyd	Mecklenburg	Surry	Winchester

Table 34
2006 Risk Set for Wireless E9-1-1 Phase One Deployments and Wireless E9-1-1 Phase Two Deployments

Amelia	Giles	Nelson	Smyth
Appomattox	Gloucester	New Kent	Spotsylvania
Augusta	Goochland	Nottoway	Sussex
Bath	Greene	Page	Tazewell
Buchanan	Greensville	Powhatan	Wise
Campbell	Halifax	Prince Edward	Chesapeake
Clarke	Highland	Prince George	Emporia
Craig	King & Queen	Pulaski	Fredericksburg
Culpeper	Lancaster	Rappahannock	Norton
Dickenson	Lee	Richmond	Poquoson
Dinwiddie	Lunenburg	Roanoke	Staunton
Essex	Madison	Russell	Winchester
Franklin	Mathews	Scott	
Frederick	Middlesex	Shenandoah	

VITA

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