ANALYZING DIGITAL TELEVISION: USING THE DIFFUSION OF INNOVATION THEORY TO BETTER INFORM POLICY

By

RICHARDS MORSE RHODES

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By

Richards Morse Rhodes

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Chair: Justin Brown
Major Department: Mass Communication

Television in the United States is nearing a dramatic change. Broadcasters are beginning to disseminate their messages via digital transmissions. While digital television (DTV) provides many enhancements over analog television, consumer adoption has been limited. The lack of diffusion can be attributed to variables in the technology, market, and regulation of the innovation of DTV.

The purpose of this thesis was to explain the diffusion of innovation theory and digital television from a technological, market, and regulatory perspective. Digital television is a new and exciting innovation that will enhance both the television industry and the consumers' way of receiving information. The thesis used the diffusion of innovation theory as a lens to understand how public policy can better the transition to digital television and help DTV reach a critical mass among consumers. Furthermore, the thesis presents various policy recommendations that could be implemented to

increase consumers' awareness and adoption of DTV and help digital television reach a critical mass.

CHAPTER 1
INTRODUCTION

Television in the United States is nearing a dramatic change. Broadcasters are beginning to disseminate their messages via digital transmissions. When this convergence from an analog to a digital signal is fully complete, Americans will be exposed to the greatest revolution in television history. In fact, television will never be viewed the same way again. The most commonly known advantage of digital television (DTV) is the enhanced quality of picture and sound, better known as high definition television (HDTV). However, digital television has the potential to serve the American public in a variety of ways, including each broadcaster being able to use their station to multi-cast four simultaneous streams of DTV programming to the viewer.

While DTV provides many enhancements over analog television, consumer adoption has been very minimal. The lack of diffusion can be attributed to a variety of variables that exist within the technology, market, and regulation of the innovation of DTV. For instance, many consumers feel that they are receiving quality television from their current analog sets. Furthermore, the cost of a HDTV set is still very high for the average consumer and there are currently no benefits, such as tax credits or deductions to entice a consumer to spend a large sum of money for a product they feel is not a necessity. Additionally, the FCC has imposed a mandatory deadline of December 31, 2006 for full transition of analog to digital transmissions. Considering the variables that are present with DTV, it is unlikely that this deadline will be met without some provisions to policy and regulation for digital television.

This thesis explains the diffusion of innovation theory and digital television from a technological, market, and regulatory perspective. Digital television is a new and exciting innovation that will enhance both the television industry and the consumers' way of receiving information. However, there is insufficient literature pertaining to digital television enhancements and contributions that the innovation will bring to society. Also, diffusion of innovation theory studies have not included digital television. This thesis uses the diffusion of innovation theory as a lens to understand how public policy can better the transition to digital television and help DTV reach a critical mass among consumers.

Diffusion of innovation theory is a type of communication research that can be traced back to the European beginnings of social science. In 1903, Gabriel Tarde published *The Laws of Imitation* that explains why very few innovations and ideas will ever be adopted by society.[1] Everett M. Rogers has been recognized as the expert scholar of diffusion theory.[2] Many other scholars have used Rogers' concepts and variables to better understand consumer adoption of innovations. Rogers' diffusion of innovation theory along with modern scholarship will provide a platform for analyzing digital television to better understand consumer adoption of DTV; and to better understand why society has been slow to adopt this innovation.

Chapter 2 provides the methodology of the research. The thesis uses policy analysis, which is a social and political activity, to examine how the Diffusion of Innovation Theory can be used to have public policy expedite the transition of digital

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[1] Gabriel Tarde, *The Laws of Imitation*, Holt, 1903.

[2] Everett M. Rogers, *Diffusion of Innovations*, Free Press, 1995.

television. Chapter 3 thoroughly explains the historical, technological, policy, and market variables surrounding digital television. Chapter 4 is the literature review that provides a basic overall understanding of Everett M. Rogers' diffusion of innovation theory. Moreover, Chapter 4 offers modern scholarship that incorporates Rogers' theory to better understand consumer awareness and adoption of particular technological innovations. Chapter 5 begins by providing a research framework that identifies the key aspects of diffusion theory that may be applied to consumer adoption of DTV. Furthermore, Chapter 5 analyzes DTV using Rogers' Diffusion of Innovation theory as well as modern scholarship related to the adoption of recent technological innovations. Finally, Chapter 5 presents various policy recommendations that could be implemented to increase consumer awareness and adoption; and ultimately help digital television reach a critical mass.

CHAPTER 2
METHODOLOGY

This thesis uses policy analysis to examine how the diffusion of innovation theory can be employed to have public policy expedite the transition of digital television. Policy analysis is a social and political activity.[1] Researchers use policy analysis when the subject matter concerns the lives of individuals within a society.[2] Furthermore, the process of policy analysis often involves other professionals and interested groups: "it is often done in teams or office-wide settings; the immediate consumer is a client of some sort like a hierarchical superior; and the ultimate audience will include diverse subgroups of politically attuned supporters and opponents of your work."[3] Eugene Bardach describes policy analysis as an art form rather than a science.[4] Bardach has developed an approach, which he calls the "Eightfold Path" for effective policy analysis.[5] The first step involved in the "Eightfold Path" is to define the problem. This step provides: "(1) a reason for doing all the necessary work to complete the project and (2) a sense of direction for your evidence-gathering activity.[6] Step two of the "Eightfold Path" requires

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[1] Eugene Bardach, *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving*, Chatham House Publishers, 2000

[2] *Id.* at xiii

[3] *Id.*

[4] *Id.* at xiv

[5] *Id.*

[6] *Id.* at 1

the researcher to assemble some evidence.[7] Bardach explains that in this step, one must engage in two activities: "thinking and hustling data that can be turned into evidence."[8] Third, the researcher must construct the alternatives.[9] By alternatives, Bardach means "something like policy options, or alternative courses of action, or alternative strategies of intervention to solve or mitigate the problem."[10] The fourth step is to select the criteria of the research.[11] Bardach believes this step to be crucial for permitting values and philosophy to be woven into the policy analysis.[12] The fifth step is to project the outcomes of the alternatives the researcher has addressed.[13] It is important in this step to identify and project the impact that the alternatives will have on the researcher or other interested parties.[14] The sixth step of the "Eightfold Path" is to identify the trade-offs among the alternatives.[15] This step clarifies the trade-offs of outcomes associated with the different policy options for the benefit of the researcher's audience.[16] The seventh step requires the researcher to decide on the best course of action based on his/her own

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[7] *Id.* at 7

[8] *Id.* at 7-8

[9] *Id.* at 12

[10] *Id.*

[11] *Id.* at 19

[12] *Id.*

[13] *Id.* at 27

[14] *Id.*

[15] *Id.* at 37

[16] *Id.*

analysis.[17] Finally, the eighth step requires the researcher to simply tell the story to the audience.[18]

This study used only a few of Bardach's steps. First, the problem was clearly identified. Next, evidence was assembled in Chapter 3 and Chapter 4 using a variety of sources that are later explained in this chapter. Third, a framework analysis was used in Chapter 5 to complete the research. The fourth step was deciding the best course of action, based on the analysis of the present material. Finally, the analysis provides a complete and concise account of the research that the audience will be able to understand and ascertain.

Beyond policy analysis, this research also uses mass communications theory to inform and improve issues relating to communications law and policy. According to Cohen and Gleason, too often mass communications scholarship in the social research tradition isn't readily applied to legal concerns that may have direct bearings on influencing policy-makers and the public interest.[19] By adopting Diffusion of Innovations Theory as a framework for policy analysis, this research will apply an important social theory to unravel the multiple variables that affect consumers' adoption of DTV and help explain why policy has failed to expediently introduce digital television to the public.

Based on the above methodological framework, the thesis answers the following questions: What are the technological, marketing, and policy issues surrounding DTV?

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[17] *Id.* at 40

[18] *Id.* at 41

[19] Jeremy Cohen & Timothy Gleason, *Social Research in Communication Law*, *Vol. 23*, Sage Publications, 1990

How can diffusion of innovation theory inform policy to improve consumer adoption of DTV? As a result, this research will contribute to new knowledge by providing information as to how digital television will be further adopted by society.

To answer these questions, the following sources and types of data were consulted. Diffusion of innovation theory and digital television both require their own intense review of all relevant information regarding the present research. Chapter 3 utilized the various academic and trade articles, books, Internet sites, and government documents to help explain the technological, market, and policy issues surrounding DTV. Based on Everett M. Rogers' book *Diffusion of Innovation*, Chapter 4 provides a thorough explanation of diffusion theory. Moreover, Chapter 4 further explains diffusion theory by reviewing academic journal articles and papers that apply diffusion theory to recent technological innovations. Upon review of DTV and diffusion, Chapter 5 presents an analytical framework that identifies the key aspects of diffusion theory that are the most relevant to understand consumer adoption of DTV. Next, the chapter applies this diffusion framework to digital television, using research from the literature review that encompasses diffusion research (Chapter 4) and the market, technological, and policy elements of DTV (Chapter 3). To complete the policy analysis, Chapter 5 ends by offering policy recommendations that will better consumer adoption of DTV and allow such adoption to reach a critical mass at a faster rate than what's foreseeable in the near future.

CHAPTER 3
DIGITAL TELEVISION HISTORY, TECHNOLOGY, AND POLICY

This chapter provides a basic overview of DTV's history, technology, and policy. First, DTV is explained from an historical approach, beginning with the development of the National Television System Committee's format for analog television. After a brief summary of the events leading up to DTV, advanced television in Japan, Europe, and the United States are discussed. Second, Chapter 3 provides information on the technological aspect of DTV. This section explains the differences between analog and digital television and provides knowledge of the advancements that DTV will provide potential adopters. Third, the policy and regulation regarding DTV are discussed. Finally, the current market situation for digital television will be explained. Ultimately, this chapter will provide an overview of the important issues regarding DTV and help explain why a consumer may adopt this innovation.

History of Digital Television

Digital television's roots can be traced back to the history of analog broadcasting.[1] In the United States, television emerged as a viable medium of communication at the start of World War II.[2] During this period the United States placed vital importance on the establishment of technical standards in transmission and reception equipment.[3] In 1940,

[1] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

[2] *Id.*

[3] *Id.*

the National Television Systems Committee (NTSC) convened to decide the early guidelines for the transmission and reception of broadcast television signals.[4]

After the Second World War, the United States led the television revolution and ultimately provided the nation with the 525-line low resolution screens that we have all grown accustomed to viewing.[5] In 1953, the NTSC approved an electronic color television system and petitioned the FCC for adoption.[6] Later that year, the FCC adopted the color standard.[7] After the color standard was adopted, broadcasting stations were quick to upgrade their transmission facilities to offer color programming.[8] By 1957, 106 of 158 stations operating in the top 40 markets had adopted the technology.[9] However, color programming options remained very limited for quite some time.[10] As of 1965, ABC, CBS, and NBC offered only approximately 2,500 hours of programming for an entire year.[11] In the same year, only 4.9% of U.S. homes were equipped with color television sets.[12] By 1970, the number of color television households had dramatically increased to 35.7% and to 68.4% in 1975.[13] The 1980s were monumental for color

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[4] *Id.* NTSC also developed the technical developments for adding color to black and white television sets. The term NTSC is frequently used to refer to both the television system and the sets we currently use.

[5] *Id*

[6] David F. Donnelly, *Color Television*, 2002. www.museum.tv/archives/etv/C/htmlC/colortelevis/colortelevis.htm (last viewed 10/30/03)

[7] *Id.*

[8] *Id.*

[9] *Id.*

[10] *Id.*

[11] *Id.*

[12] Television Bureau of Advertising, Inc., *Multi-set & Color Television Households*, 2003. www.tvb.org

[13] *Id.*

television, 83% had acquired color TV in 1980 and the number rose to 91.5% by 1985. The latest numbers report that over 99% of United States households had adopted color television by the end of 2002.[14] This is remarkable considering that only five consumer electronics products have even reached the 85% mark at all: TVs, color TVs, VCRs, radios, and telephones.[15] While the NTSC color standard provided the United States with a significant head start over Asian and European counterparts, consequently the emphasis placed in this system halted the implementation of newer technologies that were being developed.[16]

With the NTSC standard serving as a security blanket, it was not until the 1980s that the political climate forced the United States to seriously consider a change in the broadcast system.[17] In 1981, the first American demonstration of high-definition television (HDTV) was presented at the Society of Motion Picture and Television Engineers (SMPTE) annual conference in San Francisco.[18] The following year, Columbia Broadcasting Company (CBS) along with Nippon Hoso Kuyokai (NHK) presented their HDTV demonstration before the FCC.[19] The presiding Commissioner Abott Washburn said, "It seemed like more than 100% better."[20] As a result of these early

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[14] *Id.*

[15] *Id.*

[16] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

[17] *Id.*

[18] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 16

[19] *Id*

[20] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

demonstrations, in 1982 the broadcasting industry lobbied for the FCC to create a committee to study the impact an advanced television system, whether analog or digital, would have on the United States.[21]

In November 1987, the lobbying turned into fruition as the FCC created the Advisory Committee on Advanced Television Services to analyze the possibility of moving to a more advanced television system.[22] In the same year, HDTV was broadcast over standard television channels for the first time during public demonstrations in Washington, D.C. at the FCC.[23] Commissioner McKinney called the transmission a "landmark", adding the demonstration was "impressive."[24] In 1988, the Advisory Committee began testing both analog and digital HDTV systems.[25] The major problem that broadcasters encountered while creating new analog systems was that the broadcast spectrum was already saturated with signals.[26] The Advisory Committee learned that if high-definition pictures were going to be broadcast, the system would have to be digital so that the analog signals can be used for another purpose.[27] The time wasted in developing new technology since the Second World War made way for other countries to flourish with new innovations. Once playing catch-up to the United States, many

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[21] *Id.*

[22] *Id.*

[23] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 22

[24] *Id*

[25] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

[26] *Id.*

[27] *Id.*

Western European nations and Japan took over the lead in the implementation of HDTV.[28]

In the early 1990's the development of HDTV was in a three-way race among Japan, the United States, and Western Europe.[29] At this time Japan was considered as the undisputed leader in technology and broadcast capability.[30]

Japan

Japan had been developing HDTV technology for more than thirty years.[31] Their government was instrumental in developing and implementing a commercial HDTV industry.[32] Until recently, the Japanese have been at the forefront of HDTV innovation and technology.[33] Now, the United States seem to be regaining the lions share of broadcast technology.[34] This is largely due to the United States' development of an all digital HDTV system, while Japan first embarked on creating an analog HDTV system that is not as advanced as its digital counterpart. The following section will explain Japan's role in HDTV development.

In 1970, the Japanese government owned broadcasting company, Nippon Hoso Kuyokai (NHK), which gains revenue through a mandatory "television tax" imposed on

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[28] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992.

[29] *Id.* at 158

[30] *Id.*

[31] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992.

[32] *Id.* at 158

[33] *Id.*

[34] *Id*

each household, began researching the possibilities of analog HDTV.[35] It was Dr. Fujio of NHK who headed this initial research phase.[36] Dr. Fujio and his core team of researchers were allotted a percentage of the multi-billion dollar mandated tax revenue to pursue research and development.[37] Under Fujio's command, NHK coordinated separate research tasks to equipment suppliers, including Sony, Mitsubishi, and Toshiba, in the development of system components and HDTV-related technologies.[38] By using this method, NHK maximized efficiency and avoided duplication of the desired research and made the results available to all involved companies.[39] As a result of NHK's research commitment, Japan became the first country to offer regular HDTV programming.[40] In June 1989, NHK began broadcasting one-hour of the standard Japanese analog HDTV (called MUSE) programs per day.[41] By November 1991, the programming was increased to over eight hours per day.[42] People who subscribed to cable or direct broadcast satellite could only view these programs.[43] Ultimately, Japan had to create a conversion system

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[35] *Id.*

[36] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

[37] Dale Cripps, *The ATV View*, HDTV Magazine, 1994.

[38] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992. At 158

[39] *Id*

[40] *Id*

[41] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

[42] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992. At 158

[43] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

that enabled each television in the country to receive the HDTV signals.[44] However, Japan has recently opted for the 1,125 line, 60 Hz 2:1 for interlaced scanning.[45] The Japanese analog HDTV standard has now been abandoned to make way for a new digital system.[46]

Europe

In 1985, the United States and a number of European broadcasters gave their support to Japan to have the analog MUSE HDTV system adopted by the International Consultative Committee Plenary Assembly (CCIR).[47] However, the majority of the European broadcasters proposed that the adoption of the standard be deferred.[48] The Europeans initiated a proposal to offer an intermediate approach to the MUSE system.[49] This proposal, called MacPacket, differs from the Japanese system in that it would not make existing television sets obsolete.[50] MacPacket would allow users to have HDTV quality from their current sets with the help of a converter box.[51] The European lobbying effort before the CCIR paid off and the CCIR decided not to make MUSE the universal

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[44] *Id.* at 2

[45] *Id.*

[46] *Id.*

[47] *Id.*

[48] *Id*

[49] *Id.*

[50] *Id.*

[51] *Id.*

system.[52] This decision enabled the European broadcasters to develop HDTV based on technology derived from MacPacket.[53]

In 1986, broadcasters from nineteen European countries announced the formation of the Eureka-95 project.[54] This venture was created to develop a European HDTV system and to promote the domestic electronics industry.[55] Over 20 companies lead by Bosch, Philips, and Thompson, came up with the HD-MAC, a system that uses analog technology and satellite transmission, just like the Japanese system.[56] In 1988, the Europeans successfully demonstrated the HD-MAC prototype chain using 1,250 lines/50 Hz/2:1 for interlaced scanning.[57] However, Europe chose to extend the implementation schedule and launched the D2-MAC system in May 1992.[58] The D2-MAC, developed by SGS-Thompson of France and Philips of the Netherlands, was installed as an interim step towards the HD-MAC, a full analog HDTV system.[59] In the early 1990s the project was completely abandoned for the development of a digital system.[60]

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[52] *Id.*

[53] *Id.*

[54] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992. At 160

[55] *Id.* at 160-61

[56] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

[57] *Id.*

[58] Joy R. Butler, *HDTV Demystified: History, Regulatory Options, & The Role of Telephone Companies*, The Harvard Law Review, Fall, 1992. At 161

[59] *Id.* at 161

[60] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

United States

In 1982, CBS worked in conjunction with NHK to bring a universal HDTV system to the World.[61] Many broadcasting and manufacturing companies throughout the United States and Japan had been working together with CBS and NHK in favor of the Japanese system.[62] However, by 1990, the United States believed that it was not in their best interest to continue with Japan and embarked on developing its own system.[63] The United States concentrated on reviving its own consumer electronic industry, rather than pumping money into the Japanese economy.[64]

In 1987, President Bush believed there to be an imminent military threat that a foreign dominated HDTV industry could pose and ordered the Secretary of Commerce to place an emphasis in developing the American HDTV system.[65] Also, in the same year, the National Association of Broadcasters addressed FCC Chairman Mark Fowler and many officers in Washington, D.C. to express concerns over UHF channels.[66] The NAB argued that if the FCC had given away the vacant UHF channels, lack of spectrum space would make broadcasters unable to deliver HDTV.[67] A NAB officer said, "and that

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[61] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 18

[62] Paul Buddle, *Broadcasting Technology – Digital TV*, Verizon website www.verizon.com/about/community/learningcenter/articles last viewed 3/31/03

[63] *Id.*

[64] *Id*

[65] Dale Cripps, *The ATV View*, HDTV Magazine, 1994. http://hdtvnews.com/atvview.html last viewed 3/31/00

[66] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 21

[67] *Id*

would lead to the death of local broadcasting as we know it."[68] In 1989, the Defense Department agreed to grant $ 30 million to American companies developing HDTV screens and video display processors to expedite new innovations.[69] The following year, General Instruments (GI) proposed an all-digital HDTV broadcast system known as DigiCipher to the Advisory Committee.[70] In 1991, the FCC fulfilled the spirit of President Bush's order, declaring that the HDTV system would have to be all digital and fit into 6 MHz., the same amount of bandwidth used to transmit an analog NTSC picture.[71]

By 1992, GI in conjunction with the Massachusetts Institute of Technology (MIT) demonstrated the all-digital HDTV DigiCipher for the National Association of Broadcasters Conference and Exhibition in Las Vegas.[72] The Advisory Committee was impressed and ultimately decided there was no need to further discuss an analog contender.[73]

In 1993, the "Grand Alliance" was formed consisting of GI, Zenith, AT&T, and ATRC.[74] The "Grand Alliance's" mission was to jointly develop a single American

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[68] *Id.*

[69] *Id.* at 36

[70] *Id*

[71] Dale Cripps, *The ATV View*, HDTV Magazine, 1994. http://hdtvnews.com/atvview.html last viewed 3/31/00

[72] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001

[73] *Id.*

[74] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 291

HDTV system.[75] In the same year, the "Grand Alliance" committed to support the MPEG-2 digital compression system; a six-channel, CD quality Dolby music system; 1,080-line interlaced scanning and 720-line progressive scanning.[76]

Over the next several years HDTV would gradually develop and programming would be produced. In 1995, WRAL-HD of Raleigh, North Carolina disseminated the very first public transmission of HDTV.[77] In 1997, the station broadcast the Duke versus North Carolina State football game in HDTV.[78] The station placed HDTV sets on the concourse level of Carter-Finley Stadium in Raleigh offering spectators the chance to experience the broadcast live.[79] That same year, WHD-TV of Washington, D.C. became the first station to broadcast a network program, *Meet the Press*.[80]

In April 1997, the FCC presented a time-line that required all television stations to switch from analog transmissions to digital broadcast by specific deadlines.[81] Stations affiliated with ABC, CBS, NBC, and Fox in the top ten markets had to have DTV facilities constructed by May 1, 1999.[82] May 1, 2002 was the deadline for all other commercial stations to construct digital facilities.[83] The last construction phase is for all

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[75] *Id.*

[76] *Id.*

[77] *Id.*

[78] *Id.*

[79] *Id*

[80] *Id.*

[81] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

[82] *Id.*

[83] *Id.*

public television stations to have facilities by May 1, 2003. Next on the timeline, DTV stations are required to begin a partial simulcast of the analog channel's video content by the end of 2003 and full simulcast by the end of 2005.[84] This all leads to the goal of full transition by 2006, at which time citizens must have purchase either a HDTV set or converter box to receive the digital signals.[85] However, some television stations will be permitted to broadcast an analog channel if less than 85% of the households in the market have at least one of the following: (1) digital television delivered by satellite or cable; (2) a digital television set; (3) or a converter box that allows for digital viewing on an analog set.[86]

Historical Implications Tied to Policy

The history of digital television created implications that ultimately affected policy. To begin, Japan was the first country to adopt an HDTV system. The Japanese created an analog HDTV system that required 36 MHz. However, the United States government was not willing to devote this much space to HDTV because of spectrum allocation, defense, and industrial policy reasons. As a result, the U. S. policy formation for HDTV was centered on finding a way to use less spectrum, making it ripe for a digital HDTV system in the United States.

Another implication of DTV's history was the lobbying effort by the broadcasting industry. This lobbying led to the FCC creating the Advisory Committee on Advanced Television Services. The mission of the committee was to analyze the feasibility of

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[84] *Id.*

[85] *Id.*

[86] *In the Matter of Carriage of Digital Television Broadcast Signals,* CS Docket o. 98-120, First Report and Order and Further Notice of Proposed Rule making, FCC 01-22 Jan. 23, 2001.

moving to a more advanced television format and to evaluate competing systems. The original plan did not give preference to any one format, such as digital HDTV. As the committee name implies, the new technologies were instead, referred to collectively as advanced television (ATV). In 1988, both analog and digital systems were tested. However, broadcasting spectrum was already saturated with signals. Ultimately, the committee decided the system would have to be digital. An analog signal of similar quality would require significantly greater bandwidth and there was simply not room available in the portion allocated to television broadcast. Less than a year after its formation, the advisory committee issued and the FCC adopted, a Tentative Decision and Further Notice of Inquiry regarding advanced television. This decision foreshadowed the FCC's pro-digital policy in the coming decade.

The Grand Alliance's adoption of a digital standard that was later manifested to all sorts of scanning format possibilities within DTV and HDTV provided another implication. This development led to policy that did not adopt a universal U.S. standard for DTV. Ultimately, this has resulted in issues regarding programming and scanning formats, multiplexing, and lack of consumer understanding and knowledge of digital television. In contrast, Japan adopted one standard for analogy HDTV, making it easier to adopt a more uniform policy approach.

In summary, digital television's existence is due in large part to analog television and the impact the broadcasting industry had on policy-makers of the United States. Also, Japan and Europe's successes in forming an advanced television system influenced the United States to implement its own HDTV system. Following demonstrations of HDTV systems, in 1987, the FCC created the Advisory Committee on Advanced

Television Services. Ultimately, the Advisory Committee decided that if high-definition picture were to be broadcast they would have to be digital. Thus, in 1993, the "Grand Alliance" was formed consisting of GI, Zenith, AT&T, and ATRC. Their mission was to jointly develop a single American HDTV system. In the same year, the "Grand Alliance" committed to supporting the MPEG-2 digital compression system; a six channel, CD quality Dolby music system; 1080-line interlaced scanning and 720-line progressive scanning digital system. Then in 1997, the FCC presented a time-line that required all television stations to switch from analog transmissions to digital broadcast by specific deadlines. The following section will explain the technologies that exist for viewers to receive this broadcast.

Technology of U.S. Digital Television

The historical section explained the events leading to DTV. The following section provides an overview of the technology required for switching from an analog to digital television system.

The technology behind broadcast DTV is much different than standard analog television.[87] An analog system uses varying voltages to transmit a television picture. In a DTV system, images and audio are captured using the same binary code of ones and zeros found on computers. These differences require broadcast stations to construct new transmission and reception equipment, costing $2-10 million per station. These advancements in technology will be felt, in further cost, by broadcasters, cable and

[87] Julie Macedo, *Meet the Television of Tommorrow. Don't Expect to Own it Anytime Soon*, UCLA Entertainment Law Review, Spring, 1999.

satellite companies, as well as consumers.[88] Broadcasters will have to buy new equipment, such as cameras, editing machines, tape decks, to name a few.[89] Cable and satellite operators will feel the burden by having to convert equipment and introduce new set top boxes in consumers' homes that allow subscribers to view DTV broadcasts.[90] Finally, consumers will have to purchase either a converter or set top box for their analog TV to receive digital signals, or an expensive DTV set to view programming.[91]

The costs to switch from analog TV to DTV are almost as great as the differences in the technology of producing the digital content.[92] DTV may provide almost ten times the picture resolution of an analog, NTSC television picture.[93] Analog television is made of horizontal lines consisting of little dots known as pixels.[94] There can be as many as 525 horizontal lines on an analog TV set, but usually only 480 of these lines are actually visible.[95] There is an electronic device inside the analog set that displays each 640 pixel line, one-by-one, from top to bottom, at approximately thirty times per second.[96] On the

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[88] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 81

[89] *Id.*

[90] *Id.*

[91] *Telecommunications, Additional Federal Efforts Could Help Advance Digital Television Transition,* United States General Accounting Office, *Report to the Ranking Minority Member, Subcommittee on Telecommunication and the Internet, Committee on Energy and Commerce, House of Representatives,* GAO-03-7 November 2002.

[92] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 81

[93] *Id*

[94] Julie Macedo, *Meet the Television of Tommorrow. Don't Expect to Own it Anytime Soon*, UCLA Entertainment Law Review, Spring, 1999. At 296

[95] *Id.*

[96] *Id.*

other hand, a HDTV picture contains 1,080 lines with 1,920 pixels in each line, consisting of about two million pixels.[97]

HDTV can provide this type of higher resolution because of the formats available in digital television.[98] Multicasting seems to be the greatest advantage that DTV seems to provide the broadcaster.[99] Multicasting allows a broadcaster two air either four standard-definition (SD) programs; two SD and one HDTV program; two HDTV programs at the same time.[100] The extra channel space allowed to broadcasters will no doubt be used to expand advertising revenue and may even be used for data transmissions. The following table displays the specified 18 digital transmission variations.[101]

DTV broadcast formats may be based upon interlaced or progressive scanning.[102] Interlaced scanning uses the same technology as analog television, in which every other line is visible in one scan[103] where as progressive scanning displays the entire picture in one scan.[104] Currently, the highest level of a progressive signal that will fit into a 6 Mhz DTV broadcast channel is 720-P.[105] ABC and Fox have adopted the 720-P as their

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[97] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 79

[98] *Id.*

[99] *Current Briefs*. Current Online. www.current.org/dtv/ last viewed 3/31/03.

[100] *Id.*

[101] *Id.*

[102] *Id.*

[103] *Id.*

[104] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 79

[105] Julie Macedo, *Meet the Television of Tommorrow. Don't Expect to Own it Anytime Soon*, UCLA Entertainment Law Review, Spring, 1999. At 297

format for broadcasting HDTV signals, while NBC and CBS are using 1080-I.[106] Progressive signals are cleaner than interlaced ones, making 720-P and 1080-I signals comparable in quality.[107] A 1080-P signal is the highest resolution format, but is currently beyond the capacity of TV channels.[108] Other than the greater resolution provided by these two HDTV formats, HDTV provides many more distinct advantages over analog television.

First, HDTV provides a much higher quality of sound.[109] The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound.[110] The second advantage of HDTV is the aspect ratio.[111] The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture.[112] HDTV's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewer's line of sight.[113] Although SDTV's aspect ratio is 4:3, digital quality SDTV allows for Dolby 5.1 surround sound as well as a clearer picture than analog broadcast.[114] Furthermore, a digital transmission of SDTV

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[106] *Id.*

[107] *Id.*

[108] *Id.*

[109] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 79

[110] *Id.*

[111] *Id.*

[112] *Id.*

[113] *Id.*

[114] *Id.*

allows for the multicasting component that is an essential component of advanced television.[115]

Technological Implications Tied to Policy

The technological evolution of DTV has created implications that will affect policy. First, DTV is a much different technology than analog television. The difference in the technology will require manufactures, broadcasters, and consumers to learn new skill sets related to digital television. Thus, an issue raised is how will policy inform each of these separate entities about the technological advancements associated with switching to a digital system and provide information on the new skills needed for DTV. Second, cost will be felt by all of these separate groups. This implication raises the issue on how policy can be implemented to detour some of the financial burdens that will occur due to switching from an analog to digital system.

Third, these technological advancements can include higher resolution, multicasting, better aspect ratio, and enhanced sound. An issue that is raised is how will policy address these advancements and which advancement will likely take a more prominent role to help increase consumer adoption. Furthermore, depending on which advancement drives adoption, monetary gain will be achieved by broadcasters and/or manufactures. How will policy address this issue, and what steps might be taken to assure broadcasters will still serve the public interest requirement while earning a profit? Another implication based on technology is the progressive versus interlaced debate, including the 18 possible scanning formats available with DTV. The issue this raises is

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[115] *Id.*

that with the creation of a single or standardized format(s), much consumer, industry, programming, and retailer confusion would be eliminated from the scenario.

In summary, the technology behind DTV is much different than standard analog television. These advancements in technology will be very costly to broadcasters, cable and satellite operators, and consumers. However, the costs are due to the extreme advancements DTV will have on television. First, DTV provides almost ten times the picture resolution of an analog television picture. Second, multi-casting will allow for many more viewing options and 18 digital data transmission options, benefits to both consumers and broadcasters. Finally, with a 16:9 aspect ratio and 5.1 Dolby digital surround sound, DTV will provide the consumer with an extremely enhanced viewing experience.

DTV Policy and Regulation

The knowledge of the historical and technological aspects of digital television is necessary for understanding the role of policy and regulation of DTV. This section will thoroughly explain how DTV has been regulated in the United States, beginning with the Telecommunications Act of 1996.

The Telecommunications Act of 1996 was the first congressionally-mandated framework the FCC used as guidance for the future of digital television.[116] The 1996 Act provided the FCC with options pertaining to issuing DTV licenses.[117] First, the 1996 Act provided that if the FCC were to issue DTV licenses, it should restrict eligibility to

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[116] U.S. Department of Commerce, National Telecommunications and Information Adminstration, *The Telecommunications Act of 1996 and Digital Television*, www.ntia.doc.gov/pubintadvcom/octmtg/tatalk.htm.

[117] *Id.*

licensed broadcasters and broadcasters currently holding construction permits.[118] Second, the Act required the FCC to allow DTV licensees to offer "ancillary and supplementary" services over any new broadcast facilities under many conditions.[119] Third, the Act made clear that in no way were broadcasters to be relieved from their duty to serve the public's best interest.[120] Lastly, the 1996 required that broadcasters to surrender one of their licenses conditional upon receiving a digital television license.[121]

In 1997, the FCC adopted rules to implement the Telecommunications Act of 1996 in the Fifth Report and Order.[122] In the Fifth Report and Order concerning advanced television services, the FCC used Congress's legislation to issue initial licenses for DTV, establish service rules that included requiring broadcasters to continue providing free over-the-air transmissions, and set deadlines for digital transmission phase-in.[123] The FCC also acknowledged that digital broadcasters would remain public trustees of spectrum, ultimately making broadcasters responsible for serving the public's best interest.[124] After the FCC adopted the Fifth Report and Order, Congress made many of the rules statutory, by enacting the Balanced Budget Act of 1997 (BBA).[125]

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[118] *Id.*

[119] *Id.*

[120] *Id.*

[121] *Id.*

[122] Federal Communications Commission, *Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television*, Notice of Proposed Rule Making, MM Docket No. 00-39,Adopted March 6, 2000, Released March 8, 2000.

[123] *Id.*

[124] *Id.*

[125] *Id.*

Congress modified several aspects of the FCC's plan in the Balanced Budget Act of 1997.[126] First, in the Fifth Report and Order the FCC decided to award all full power broadcast licencees and permittees with 6 MHz of additional channel space while pledging to explore possibilities for low power operators to convert to DTV. However, the Balanced Budget Act (BBA) ordered the FCC to assure that qualifying LPTV stations can operate digitally.[127] Second, the BBA directed that broadcasters in their minimum service requirements offer at least one free digital programming service that operates during the same hours as their analog channel and has the at least the same resolution as their analog channel.[128] Third, the FCC will be required to initiate a rule-making to determine the spectrum fee that will apply to "ancillary and supplemental" services.[129] Fourth, in the Fifth Report and Order the FCC noted that while the business and technology of digital broadcasting will differ, broadcasters will still remain public trustees of spectrum.[130] However, the BBA insist that the FCC will initiate a rule-making to collect all viewpoints and then determine the precise contours of a DTV broadcasters public interest obligations.[131] Fifth, the Fifth Report and Order along with the BBA established deadlines for the construction of DTV stations.[132] ABC, CBS, NBC, and

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[126] U.S. Department of Commerce, National Telecommunications and Information Adminstration, *The Telecommunications Act of 1996 and Digital Television*, www.ntia.doc.gov/pubintadvcom/octmtg/tatalk.htm.

[127] *Id.*

[128] *Id.*

[129] *Id.*

[130] *Id.*

[131] *Id.*

[132] *Id.*

FOX affiliates in the top-10 television markets must have constructed their facilities by May 1, 1999.[133] The affiliates of the aforementioned networks in the television markets 11-30 must have finalized construction of their DTV facilities by November 1, 1999. [134] The remaining commercial stations should have constructed their facilities by May 1, 2002 and all non-commercial stations must construct by May 1, 2003.[135]

Finally in the Fifth Report and Order, the FCC set 2006 as the target date for the return of analog spectrum, but pledged to modify the deadline if necessary. [136] However, the BBA stated that no analog broadcast license would be renewed past the December 31, 2006 deadline.[137] Furthermore, Congress ordered the FCC to extend the deadline in any television market:

> "If any ABC, NBC, CBS, or FOX affiliate in that market is not broadcasting a DTV signal, assuming that the FCC finds that the station has exercised due diligence in trying to deploy DTV; if digital-to-analog converter technology is not generally available in the market; or if 15 percent or more of the households in the market do not subscribe to a multichannel provider that retransmits at least one digital programming service from each DTV station in that market and those households do not have a digital television set or digital-to-analog converter."[138]

The aforementioned policy as well as different issues will be further explained throughout this section. Following the Balanced Budget Act of 1997, the FCC adopted rules for the initial allotments of DTV.

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[133] *Id.*

[134] *Id.*

[135] *Id.*

[136] *Id.*

[137] *Id.*

[138] *Id.*

FCC Table of Allotments for DTV

In April of 1997 the FCC adopted a Table of Allotments for DTV.[139] By doing so, the FCC adopted rules for the initial allotments; provided procedures for assigning DTV frequencies; and outlined plans for spectrum recovery.[140] The Table of Allotments was intended to accommodate all existing broadcasters, replicate existing service areas, and ensure efficient spectrum.[141]

First, the Table of Allotments provided all eligible stations with a new channel to broadcast digital signals to areas that are comparable to their existing analog service areas.[142] Thus, broadcasters were assigned DTV channels that replicated the service areas of their existing stations.[143] Second, the FCC indicated that the Table of Allotments was to serve the location of DTV channels in a core spectrum.[144] The FCC stated that at the end of the digital transition it would specify either channels 2-46 or 7-51 as the core spectrum.[145]

Must-Carry Rules

The following must-carry rules were adopted in regard to analog television. However with the arrival of digital television and a saturation of many more channels, must-carry rules will be under much heavier scrutiny. This will be an especially big

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[139] Federal Communications Commission, *Commission Adopts Table of Allotment for DTV; Establishes Policies and Rules,* MM Docket #87-268, April 3, 1997.

[140] *Id.*

[141] *Id.*

[142] *Id.*

[143] *Id.*

[144] *Id.*

[145] *Id.*

policy issue during digital transition because cable operators will be burdened with both analog and digital channels.

On November 5, 1992, the FCC adopted must-carry and retransmission consent rules to implement the provisions of the 1992 Cable Act.[146] The FCC considered two provisions of the 1992 Act concerning the carriage of broadcast signals by cable television operators.[147] The first provision dealt with concerns over must-carry rights of commercial and public television broadcasting stations that are considered local to the cable service area.[148] The second prohibits cable operators from carrying broadcast stations without obtaining their consent.[149] The 1992 Cable Act required each cable operator to transmit local commercial television stations and qualified low power stations.[150] The Cable Act specified that a cable operator with twelve or fewer usable channels must carry the signals of at least three local commercial broadcasters.[151] However, a similar cable system that only services 300 or fewer subscribers is exempt from the rule.[152] Furthermore, a cable system that contains more than twelve usable channels, regardless of the number of subscribers, must carry the signals of local commercial broadcasters, up to one-third of the total number of usable channels in the

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[146] Federal Communications Commission, *Rules Implementing Must-Carry and Retransmission Consent Provisions of 1992 Cable Act,* MM Docket 92-259, March 11, 1993.

[147] *Id.*

[148] *Id.*

[149] *Id.*

[150] *Id.*

[151] *Id.*

[152] *Id.*

system.[153] The carriage of other broadcast television signals is at the sole discretion of the cable system operator, subject to retransmission consent.[154] The FCC provides that broadcasters must elect every three years for retransmission consent or must carry.[155]

The aforementioned paragraph described must-carry rules as they applied to analog television. When it comes to DTV however, the FCC has handled the must-carry issue differently. On January 18, 2001, the FCC, by Report and Order and Further Notice of Proposed Rulemaking, adopted rules related to the cable carriage of digital broadcast signals.[156] The FCC clarified that digital-only television station, commercial or non-commercial, can immediately assert its right to be carried on a local cable system.[157] Furthermore, the Commission asserted that television stations that return their analog spectrum and converts to digital signals must be carried by the local cable system.[158] However, regarding the issue of a local station asserting its right for dual carriage of the analog and digital signal, the Report and Order concludes that such a requirement is a burden to the cable operators First Amendment rights.[159]

Must-carry laws are definitely going to be under scrutiny as the digital transition continues, especially considering the fact that roughly seventy percent of households receive their analog broadcast stations through cable. Besides dual must-carriage,

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[153] *Id.*

[154] *Id.*

[155] *Id.*

[156] Federal Communications Commission, *FCC Adopts Rules For Cable Carriage Of Digital TV Signals,* January 22, 2001.

[157] *Id.*

[158] *Id.*

[159] *Id.*

questions remain whether cable operators will have to carry the full panoply of a given broadcaster's multicast programming and maintain signal integrity (quality) of DTV scanning formats.[160]

DTV Transition and Build-Out Rules

With the implementation of DTV, several transition and build out rules will need to be modified for digital television to succeed in the United States. The following section explains the importance of these modifications.

On November 8, 2001 the FCC modified several of its DTV transition rules.[161] These rules include broadcast service area replication along with maximization and channel election rules to enable broadcasters to speed up DTV transition.[162] The FCC said these modifications were made because it was concerned that many of the initial requirements may have actually hindered DTV transition.[163] The Commission followed this statement with, "the mid-course corrections in today's reconsideration order would help prioritize elements that are the most important to the DTV transition, and serve the goals of maximizing the number of DTV stations on the air and providing an incentive to consumers to purchase DTV equipment."[164]

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[160] *Id.*

[161] Federal Communications Commission, *FCC Acts to Expedite DTV Transition and Clarify DTV Build-Out Rules,* MM Docket #00-39, November 8, 2001. www.fcc.gov/Bureaus/Mass_Media/News_Releases/2001/nrmm0114.html

[162] *Id.*

[163] *Id.*

[164] *Id.*

The first modification adopted by the FCC would allow broadcasters to elect a more gradual approach to providing DTV service.[165] This was done by permitting stations to build lower-powered and less expensive DTV facilities while retaining their right to expand their coverage area as transition continues to progress.[166] Second, the FCC said it will "set new dates for replication, maximization and channel election."[167] The FCC's new deadlines may be earlier, but will not be any later than the end of 2006 or the date in which 85% of television households are capable of receiving the digital signals, whichever date is later.[168] Third, the FCC provided that broadcasters may reduce its digital schedule as long as the station operates a digital signal during prime-time hours.[169] However, this modified requirement does not effect the broadcasters simulcast obligations.[170] Thus, April 1, 2003 was the date a DTV station must transmit a digital signal at least 50% of time an analog signal was broadcast.[171] On April 1, 2004, 75% of the broadcast must be simulcast digital, with 100% by April 1, 2005.[172] Furthermore, all stations must turn off their analog signal by December 31, 2006, providing that 85% of television households in that market have access to DTV.[173]

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[165] *Id.*

[166] *Id.*

[167] *Id.*

[168] *Id.*

[169] *Id.*

[170] *Id.*

[171] *Id.*

[172] *Id.*

[173] KCTS Seattle PBS Web-site, *The Tech Report: Important Dates for DTV*. www.kcts.org/inside/techreport/resources/timeline.asp.

Chairman Powell's Voluntary Plan

To increase the level of digital content available to consumers and to speed digital television transition, FCC Chairman Powell suggested a voluntary plan regarding digital programming.

April 4, 2002, FCC Chairman Michael K. Powell released a voluntary digital television plan to both Congressman Tauzin and Senator Hollings, chairman of commerce for the respective legislative houses.[174] Powell's plan sought to advance two key goals: "increasing the level of compelling digital content available to consumers; and providing cable subscribers access to the content over their cable systems."[175] The proposal for voluntary industry actions to speed the digital television transition included: Top four networks, HBO, and Showtime; Broadcast licensees; Cable; Direct Broadcast Satellite; and Equipment Manufactures and Retailers.

First, Chairman Powell proposed for ABC, CBS, NBC, FOX, HBO, and Showtime to "provide high-definition or other value-added DTV programming during at least 50% of their prime-time schedule, beginning with the 2002-03 season."[176] Chairman Powell described "value-added programming" as "high-definition, innovative multicasting, interactive, etc. – so long as it gives consumers something significantly different than what they receive in analog."[177] Second, Powell suggested that licensed broadcasters in markets 1-100 affiliated with the top four networks install the necessary DTV equipment

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[174] Federal Communications Commission, *Digital Televsion Plan*, April 4, 2002.

[175] *Id.*

[176] *Id.*

[177] *Id.*

by January 1, 2003.[178] Chairman Powell's third proposal dealt with cable systems with a 750 MHz or higher channel capacity and Direct Broadcast Satellite.[179] The cable and satellite systems were asked to carry up to five "value-added" broadcast or digital programming services during at least 50% of their prime-time schedule at no extra cost to the consumer by January 1, 2003.[180] Finally, Powell proposal was directed to equipment manufactures and retailers.[181] First, retailers were informed to market broadcast, cable, and satellite DTV options at point-of-sale.[182] Second, manufacturers were encouraged to meet the demand for cable set-top boxes that allow for the display of high definition programming.[183]

FCC Tuner Mandate

To help ensure consumers would be able to view digital broadcast programming, the FCC established rules to provide broadcast HDTV hardware component on all new television sets. The following section provides information regarding the FCC's initiative for furthering consumer access to DTV.

August 8, 2002, the FCC adopted measures aimed at giving consumers access to DTV programming by requiring digital over-the-air tuners on most new DTV sets by 2007.[184] This plan enacted a five-year schedule that starts with larger, more expensive

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[178] *Id.*

[179] *Id.*

[180] *Id.*

[181] *Id.*

[182] *Id.*

[183] *Id.*

[184] Federal Communications Commission, *FCC Introduces Phase-in Plan For DTV Tuners*, MB Docket 00-39, August 8, 2002.

digital sets.[185] The FCC claimed it was entitled to enact this plan based on the 1962 All Channel Receiver Act, which grants the FCC the authority to require that televisions can receive all frequencies.[186] The FCC plan explains that the inclusion of DTV reception capability will require manufacturers to redesign current products.[187] Ultimately, this will increase the cost of televisions.[188] However, the FCC claims that the prices of DTV ready sets are declining and will continue to decline as economies of scale are achieved and production efficiencies are realized.[189] Furthermore, the FCC insists that the prices of large television sets have declined at a rate of $100 to $800 dollars per year, meaning the addition cost of digital ready capability will be offset by general price decline.[190]

Specifically, the FCC also required that all equipment was required to include DTV reception capability according to the following:

- Sets 36" and above – 50% of units to have DTV tuners by July 1, 2004; 100% by July 1, 2005;
- Sets 25" – 35" – 50% of units to have DTV tuners by July 1, 2005; 100% by July 1, 2006;
- Sets 13" – 24" – 100% of units to have tuners by July 1, 2007; and
- VCRs and DVD players that receive broadcast television signals – 100% of all units must include DTV tuners by July 1, 2007.[191]

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[185] *Id.*

[186] *Id.*

[187] *Id.*

[188] *Id.*

[189] *Id.*

[190] *Id.*

[191] *Id.*

In addition to this regulatory mandate, on December 19, 2002, cable system operators and consumer electronic companies reached a voluntary agreement to provide consumers with digital cable-ready television sets.[192] This agreement will allow consumers to purchase televisions that will connect to digital cable, and enjoy HDTV services offered by cable operators, without a converter box.[193]

Regulation Implications Tied to Policy

Many implications of regulation decisions regarding DTV have raised policy issues. First, was the Telecommunications Act of 1996. This Act was the first congressionally mandated framework for the future of digital television and established the general parameters for licensing. The Act stated that DTV licenses, should be eligible to existing broadcasters (those with either licenses or construction permits). Second, the Act required the FCC to allow DTV licensees to offer ancillary and supplementary services over any new DTV broadcast facilities. Third, the Act made clear that in no way were broadcasters to be relieved from their duty to serve the public's best interest. Finally, the Act required broadcasters to surrender one of their licenses conditional upon receiving a digital television license.

A second implication of DTV regulation resulting from the 1996 Act is the Balanced Budget Act of 1997. Ultimately the BBA made many FCC rules on digital television statutory. This Act created policy issues on broadcasters regarding their minimum service requirements as well as deadlines for construction of digital facilities. ABC, NBC, CBS, and FOX affiliates in the top ten markets must have constructed their

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[192] NCTA web-site, *Cable and Consumer Electronics Companies Reach Key Agreements on Digital TV Transition Issues,* Dec. 19, 2002. www.ncta.com/docs/pfriendly.cfm?prid=325&pPRess=ok

[193] *Id.*

facilities by May 1, 1999. Markets 11-30 by Nov. 1, 1999 and the remaining markets May 1, 2002. Furthermore, implications of the BBA and its 85% rule created policy issues concerning both broadcasters and government. For broadcasters, they must return valuable spectrum space back to the government once an 85% of its local viewers are able to receive its digital signals. Government will then have to decide how the spectrum is to be recovered and reallocated for other purposes, ultimately to raise money for the federal treasury.

Another implication of DTV regulation is the voluntary plan. This plan asked for broadcasters to provide HDTV or other value added programming during at least 50% of their prime-time schedule. The policy issue this creates is whether HDTV or "other value added programming" will be the driving force behind promotion and how will policy to enforce what kind of programming is made available to the public.

A forth implication of DTV regulation is the uncertainty regarding digital must-carry rules. Must-carry rules were adopted in regards to analog television and require cable systems to carry local stations. Thus far, the FCC has tentatively concluded that requiring cable operators to carry both digital and analog stations is unconstitutional. With the varied scanning formats involved as well as and multiplexing, the must-carry laws must be clarified, especially because roughly 70 percent of the public receives their local stations through cable. If we wish to reach the 85 percent rule, then policy must be establish that ensures local digital broadcast signals are available on cable systems.

Another implication of DTV regulation came in the form of broadcasters simulcast obligations. April 1, 2003 a station must transmit a digital signal at least 50% of the time an analog signal was broadcast. On April 1, 2004, 75% of the broadcast must be

simulcast, with 100% by April 1, 2005. The issue that arises here is how can policy effectively increase programming to achieve these desired percentages. Other key implications are the tuner mandate and digital cable agreement. The policy issues that have been addressed here are to provide consumers with adequate equipment to experience DTV. These steps have taken confusion out of the equation and will allow consumer adoption to occur faster.

Ultimately, all of these implications and above policy issues have an affect on whether consumers will adopt DTV. The government needs to choose the best direction that will drive consumers to purchase DTV and DTV related products to achieve the 85% threshold. Government has a personal stake in the consumer adoption of digital television base on the fact that the federal treasury will reap the rewards of selling valuable spectrum space.

Market for Digital Television

HDTV is obviously a revolution in television. However, plenty of problems remain that will make widespread adoption and penetration unlikely anytime in the near future.[194] Currently, there are approximately 100 million television households in the United States.[195] According to *Strategy Analytics*, 4.8 million U.S. homes owned a HDTV or DTV set at the end of 2002, with only one million of these homes also having HDTV tuners for either cable, satellite, or terrestrial platforms.[196] Considering that only one million of these homes are capable of receiving a digital signal, this would make

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[194] Alex Salkever, *HDTV Tiptoes to Prime Time*, BusinessWeek, Dec. 10, 2002.

[195] Brad Dick, *Powell's Folly*, Broadcast Engineering, Sept. 1, 2002.

[196] Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

DTV penetration about one percent. This means the current DTV penetration is easily more than 80 percentage points behind the FCC's 85% threshold for shutting down analog broadcasting by 2006.

A major reason for DTV's low penetration is the lack of consumer awareness.[197] On July 15, 2002, the Cable & Telecommunications Association for Marketing (CTAM) released research indicating consumers have in fact heard of HDTV, but don't know how it works.[198] The CTAM Pulse, "I've Heard of it, But What Is It?", examined consumer awareness of HDTV, the perceived benefits associated with HDTV, and the consumers' willingness to purchase a HDTV set.[199] The research claimed that 60.3% of consumers have heard about HDTV, but are unaware of how HDTV is delivered to the home or what equipment is necessary to receive digital signals.[200] Of the 60.3% of these consumers who knew what HDTV was, 49.8% said they "didn't know" how the signal was delivered.[201] Also, of the consumers aware of HDTV, 57% stated they did not know if new equipment would be required to receive these signals.[202] Furthermore, of these consumers, 11.6% say they are "very" or "somewhat likely" to buy a HDTV set in the

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[197] www.ctam.com/ctam/about/pressreleases/020715.htm. last viewed 4/10/03

[198] *Id.*

[199] *Id.* *The Pulse* is an ongoing research series focusing on key consumer issues in cable and telecommunications industry, conducted by CENTRISSM (Communications, Entertainment and Technological Research and Information Service). The pulse provides members with practical consumer insights and tactical information, based on telephone surveys of consumers nationwide.

[200] *Id.*

[201] *Id.*

[202] *Id.*

next year.[203] Meanwhile, 81.3% of these consumers say they are "very unlikely" or "somewhat unlikely" to buy a HDTV set in the next year.[204]

In a similar study, the United States General Accounting Office found through a telephone survey of 1,000 randomly selected American households that very few people understood DTV transition and its implications.[205] Additionally, the study found that consumers have not been adopting DTV at a rapid enough pace that would allow 85% market penetration by December 31, 2006.[206] Furthermore, the GAO found that the information DTV retailers were providing to consumers was inaccurate.[207]

The GAO study found that 40% of respondents have never heard about the transition to DTV and another 43% were only somewhat aware of the digital transition.[208] Additionally, 20% stated they were very unaware of the digital transition.[209] The study revealed that 50% of the consumers questioned did not know the difference between an analog television set and a HDTV set.[210] Also, 68% of the respondents were unaware that their current analog sets will require a converter box to receive digital over-the-air

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[203] *Id.*

[204] *Id.*

[205] United States General Accounting Office, *Report to the Ranking Minority Member, Subcommittee on Telecommunications and the Internet, Committee on Energy and Commerce, House of Representatives*: *Additional Federal Efforts Could Help Advance Digital Television Transition*, November 2002, GAO-03-7

[206] *Id.* at 15

[207] *Id.*

[208] *Id.*

[209] *Id.*

[210] *Id.* at 16

broadcasts.[211] The GAO concluded that the lack of consumer awareness about DTV creates a problem for digital transition on multiple fronts. First, if consumers are unfamiliar with the advantages of DTV, they will be less likely to adopt the innovation.[212] Second, if few consumers adopt digital television, network producers will have little incentive to provide digital programming and cable systems will have little incentive to carry the digital signal.[213] Thus, consumer awareness and adoption of digital television is vital in facilitating transition.[214]

On October 14, 2003, the Consumer Electronics Association (CEA) released a study regarding consumer awareness of DTV.[215] The study consisted of surveying 1,000 American consumers.[216] The survey found that consumers were very confused about DTV and HDTV products.[217] For instance, 74% of the consumers surveyed did not know that a set-top box was required to watch HDTV programming and 78% were unaware that a HDTV-enabled recorder was required to record programming.[218] Additionally, 54% of consumers were unaware that they can not watch all shows in HDTV format

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[211] *Id.*

[212] *Id.*

[213] *Id.*

[214] *Id.*

[215] Consumer Electronics Association, *CEA Survey Reveals 9 million Plan to Purchase HDTV Over Next 18 Months*, October 14, 2003.

[216] *Id.*

[217] *Id.*

[218] *Id.*

because many programs are not yet available.[219] Consumer awareness is a huge barrier for digital television's transition.

Cost seems to be another major barrier to the penetration of HDTV.[220] In 2002, only 2.5 million HDTV's were sold.[221] This number makes up only ten percent of total television sales in the U.S. last year.[222] One reason for this is that most TVs capable of pulling in HDTV broadcast are big-screen units that cost over $2000—almost three times the average price of an analog set.[223] Lisa Pickelsimer, manager of video product development for COX Communications, predicts that widespread adoption of HDTV will not occur until the average price falls below $ 500.[224] This in itself presents a problem because as high prices keep the numbers of buyers small, it makes it hard for set manufacturers to gain the economies of scale that will allow them to reduce prices.[225]

On October 28, 2003, the CEA provided a press release explaining that September DTV sales were 99% higher than in 2002.[226] The release stated that September 2003 marked the highest one-month total for DTV product sales, totaling 530, 656 units costing $791,487,344.[227] Furthermore, CEA President and CEO Gary Shapiro claimed

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[219] *Id.*

[220] Alex Salkever, *HDTV Tiptoes to Prime Time*, BusinessWeek, Dec. 10, 2002.

[221] *Id.*

[222] *Id.*

[223] *Id.*

[224] *Id.*

[225] *Id.*

[226] CEA, *DTV Sales Top the Charts*, 10/28/2003. www.ce.org/press_room/press_release_detail.asp?id=10340

[227] *Id.*

87% of the sales were for HDTV sets.[228] Since HDTV's introduction in the fourth quarter of 1998, unit sales totals have reached 7.3 million and consumer investment in DTV products has reached approximately $12.7 billion.[229]

HDTV penetration is also inhibited by the battle between broadcasters and cable operators.[230] Mr. Wharton of the broadcasters association expressed concern over carriage, stating, "If you want to see the hit CBS television program *CSI* in full HDTV, and you're hooked up to cable, there's little chance you can do that unless you happen to be on one of the 10% of all U.S. cable systems that are carrying digital broadcast."[231] ABC, CBS, NBC, and Fox have all expressed anger over many cable operators downgrading the digital signal quality to conserve bandwidth.[232]

DTV has many barriers to overcome, but experts predict the future penetration will continue at almost the same as it current rate.[233] The firm *Strategy Analytics* predicts the number of HDTV capable displays will have reached 33.4 million households by 2008.[234] This number would lead one to believe that by 2008, the U.S. will have a 30% penetration rate, but this is not the case. *Strategy Analytics* continues in the report, that of these displays 27% will be connected to DTV service through cable, 14% via satellite,

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[228] *Id.*

[229] *Id.*

[230] *Id.*

[231] *Id.*

[232] *Id.*

[233] Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

[234] Alex Salkever, *HDTV Tiptoes to Prime Time*, BusinessWeek, Dec. 10, 2002.

and eight percent by way of digital terrestrial television.[235] This leaves 51% with no DTV service whatsoever, making the *Strategy Analytics* prediction to be 15% penetration of U.S. television households.[236] If this prediction comes to fruition, the FCC will definitely have to re-evaluate its proposed deadlines for the digital transmission phase-in.

Present Status of DTV

Another barrier to penetration, that is rapidly improving, lies within the broadcasters themselves.[237] The major networks have in fact increased HDTV broadcast programming by 50% over the past year.[238] On October 15, 2003, the National Association of Broadcasters reported that over 99% of U.S. television households are in markets where DTV is transmitted.[239] Currently, 1060 of the nation's 1,309 commercial broadcast stations have started to broadcast digitally.[240] Meanwhile, 183 public stations are broadcasting digitally.[241]

As of October 15, 2003 the NAB's listing of network shows broadcast in High Definition includes: 8 simple Rules for Dating My Teenage Daughter, Alias, American Dreams, Crossing Jordan, Becker, CSI, CSI: Miami, Everybody Loves Raymond, Frasier, Hack, JAG, The King of Queens, NYPD Blue, Smallville, The Tonight Show with Jay

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[235]Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

[236]*Id.*

[237] www.iconocast.com/issue/9001,1,1102,20,1.html last viewed 4/10/03.

[238] *Id.*

[239] National Association of Broadcasters, *DTV Stations On Air Top 1000*, October 15, 2003. www.nab.org/Newsroom/PressRel/Releases/dtvlatest.htm

[240] *Id.*

[241] *Id.*

Leno, Without a Trace, and more than forty other network television shows.[242] Moreover, HDTV sports and special events have included NCAA football, the Super Bowl, the U.S. Masters Golf Tournament, the U.S. Open Tennis Championships, and the Olympics.[243] In addition, ABC is currently broadcasting Monday Night Football in HDTV, and has announced that it will transmit the Stanley Cup and NBA Finals in HDTV.[244]

Like the broadcast companies, cable television has its fair share of HDTV content.[245] HBO, Cinemax, and Showtime, all premium cable channels, have provided viewers the opportunity to subscribe to full HDTV service.[246] Furthermore, ESPN, Discovery Channel, Travel Channel, and many more regular tier cable channels are offering HDTV channels that provide many prime-time programs in full resolution and Dolby Digital sound.[247] Likewise, Mark Cuban has unveiled an all HDTV channel called HDNet in many metropolitan areas.[248] The cable and broadcast industries are both shifting their programming to provide more options and availability to consumers.

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[242] *About High Definition Television*, www.sonystyle.com (last viewed October 15, 2003)

[243] *Id.*

[244] *Id.*

[245] HDTV Galaxy: The Definitive HDTV Resource Center, *Programming Schedule*, October 15,2003 www.hdtvgalaxy.com/broad249.html

[246] *Id.*

[247] *Id.*

[248] *Id.*

As broadcast and cable companies are trying to inform the public of the advancements in television, the manufactures are playing an important role as well.[249] Key players in electronic manufacturing, including Sony, Zenith, Pioneer, Phillips, Panasonic, and many others have dedicated places on their web-sites to explain HDTV.[250] These explanations come in many forms. Zenith's web-site provides information regarding the benefits DTV will have over analog television.[251] Elements that are mentioned include: Picture, Sound, Multi-casting and Data-casting, Active lines Aspect Ratio, Scanning Method, Frame rate, and Format.[252] Sony's web-site provides many of the same elements, but also includes information regarding programming.[253]

Companies that provide the outlet for consumers to purchase the manufactures products are also trying to inform their patrons about HDTV. Companies such as Best Buy and Circuit City provided displays in their stores explaining how DTV and HDTV function. Many of the same elements that are provided by the manufactures are relayed to the consumers via the electronic departments of these outlets. Furthermore, Best Buy also provides a HDTV information Center on its web site explaining all the elements previously discussed in the above paragraph.[254]

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[249] Zenith: HDTV, *DTV Explained*, www.zenith.com/sub_hdtv/hdtv_explained.html (last viewed October 15, 2003)

[250] *Id.*

[251] *Id.*

[252] *Id.*

[253] *About High Definition Television*, www.sonystyle.com (last viewed October 15, 2003)

[254] HDTV Information Center, *Focus on HDTV*, www.bestbuy.com (last viewed October 15, 2003)

Market Implications Tied to Policy

The current market has created implications tied to policy. First, an implication of the DTV market is that 99% of U.S households are in markets where DTV is transmitted. Furthermore, most of the country's 1,309 commercial television stations have begun to broadcast digitally. U.S. policy has helped to drive this success. Some stations don't broadcast digitally for a significant part of the day, but the important element is that most stations have made the initial investment to send digital signals to the public

Second, an implication based on the DTV market is that 7.3 million DTV sets have been sold. A policy issue that this raises is how can costs be detoured so that consumers will purchase more equipment to eventually speed up the process and achieve the 85% mark. As in other policy issues the Government has a vested interest so that valuable analog spectrum can be recovered and sold.

Another implication based on the market lies within programming. Programming has increase by over 50% in the last year in the top 4 broadcast company's prime-time line-up. A policy issue that results from this is how to entice industry to produce more digital programming. Another issue that arises based on programming is how will policy determine how many hours a day must a broadcaster provide HDTV or value-added programming, considering the cost of producing these advanced programs is much more than the cost of analog.

A further implication based on the DTV market is the consumer's knowledge and understanding of digital television. As of now, consumer knowledge is very low. A policy issue that is raised is how can consumer's understanding and knowledge be increased to ensure consumer adoption of DTV. Moreover, an implication of the DTV

market is retailers' knowledge of digital television. A policy issue this raises is what steps can be taken to ensure that retailers will relay the correct information to the public.

This chapter has provided an overview of the historical, technological, policy and regulation, and current market for DTV. The broadcast industries in the United States began developing DTV in 1982. In 1993, the "Grand Alliance" developed a MPEG-2 digital compression system; a six channel, CD quality Dolby music system, 1,080-line interlaced scanning and 720 progressing scanning for DTV. Upon, the development of the digital system, the FCC presented a time-line that required all television stations to switch from analog to digital broadcast by specific deadlines.

Furthermore, key implications of DTV's history, technology, regulation, and market have been revealed. These implications have had or will have an affect on the policy of DTV. The implications that will have the most apparent affect on consumer adoption of digital television are related to: the differences in technology, the cost of switching to digital, the programming available for consumer consumption, consumer understanding and knowledge of DTV, and regulation of DTV. First, policy needs to help inform consumers of the technological differences between analog and digital systems. Second, policy needs to provide incentives that will detour the cost of switching to a new system. Third, policy should address industry and provide incentives for increasing the available programming. Fourth, the adoption of digital television will not occur until consumers understand the digital system. Policy needs to address this issue by providing industry will the appropriate information to relay information and knowledge to consumers. Finally, regulation has already been implemented in regards to

DTV. Policy needs to address this regulation and create regulations that will increase consumer adoption of digital television.

The following section thoroughly explains the Diffusion of Innovation theory and the variables required for an innovation to be adopted by society. Chapter 5 will provide an analysis of the Diffusion of Innovation Theory in regards to DTV and integrates Chapter 3 and Chapter 4 to provide policy recommendations based on the variables of DTV and the DoI theory.

CHAPTER 4
LITERATURE REVIEW

Everett M. Rogers: Diffusion of Innovation

The studies of Diffusion of Innovation Theory can be traced back to the European beginnings of social science.[1] In 1903, Gabriel Tarde published a book titled *The Laws of Imitation* which observed generalizations about the diffusion of innovations.[2] The purpose of his observations, Tarde said, was "to learn why, given one hundred different innovations conceived at the same time --- innovations in the form of words, in mythological ideas, in industrial processes, etc. --- ten will spread abroad while ninety will be forgotten."[3]

Tarde was the European creator of the diffusion field, but his studies were not immediately followed up.[4] Time lapsed forty years before Tarde's insights were recognized with the Ryan and Gross hybrid corn study.[5] In the 1920s, anthropology scholars in the United States picked up on the work of early European diffusionists and

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[1] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962).

[2] *Id.* at 40 Gabriel Tarde, one of the forefathers of sociology and social psychology, was a French lawyer and judge during the turn of the 20th century. Tarde kept a keen analytical eye on trends in his society as represented by legal cases that entered his court. Tarde was far ahead of his time in the study of diffusion. Tarde identified the adoption or rejection of innovations as a crucial outcome variable in diffusion research. He was the first to observe that the rate of adoption followed an S-shaped curve over time. Tarde believed the diffusion of innovations was a basic and fundamental explanation of human behavior change. Tarde's approach to diffusion research laid the groundwork for future American diffusion scholars.

[3] *Id.*

[4] *Id.*

[5] *Id.* Rogers states that the Ryan and Gross (1943) study of the diffusion of hybrid seed corn in Iowa is the most influential diffusion study.

began to investigate the diffusion of innovations.[6] The anthropological interest in the diffusion of innovations throughout the United States was to influence the Ryan and Gross hybrid seed corn in Iowa.[7] Diffusion research is a type of communication research, but it began outside of the academic field of communication because Ryan and Gross' hybrid corn study preceded the establishments of the first university institutes or departments of communication.[8] Diffusion research was adopted in a variety of fields: education, anthropology, public health, marketing, geography, and rural sociology.[9] Each of these fields pursued diffusion in its own way until the early 1960s, when Everett M. Rogers made an impact on the social theory.[10]

Everett M. Rogers further developed and changed the manner in which Diffusion of Innovations Theory was employed. In 1962, with his first edition of *Diffusion of Innovations*, Rogers took a comprehensive approach to the way diffusion was conceptualized. Rogers' explication covered the elements of diffusion, generators of innovation, and consequences of innovations. Rogers' contribution has endured the test of time, as evident from his fourth edition of *Diffusion of Innovations*. The following pages will articulate Everett M. Rogers' insights on the Diffusion of Innovations.

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[6] *Id.* at 41

[7] *Id.*

[8] *Id.*

[9] *Id.*

[10] *Id.* at 45.

What is Diffusion

In explaining Diffusion of Innovations, Rogers provides four elements that make up diffusion.[11] These elements are *Innovation, Communication Channels, Time,* and *Social System*.[12] Rogers describes that with the inclusion of these elements, diffusion is defined as a process by which an innovation is communicated through certain channels over time among the members of a social system.[13] Rogers also explains communication as a process in which members of a social system share information in order to reach a mutual understanding.[14] Furthermore, Rogers insists that diffusion is "a special type of communication, in which the messages are about a new idea."[15]

The newness of an idea is what provides diffusion with its "special character," but newness also means that there is a degree of uncertainty involved in the process.[16] Rogers claims that uncertainty implies a lack of predictability and structure of information present in the new idea.[17] To help overcome uncertainty Rogers claims technological innovations may embody information, thus reducing any uncertainty involving cause and effect relationships present in problem solving.[18] He provides the

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[11] *Id.* at 5

[12] *Id.* at 5-37

[13] *Id.* at 5

[14] *Id*. at 6

[15] *Id.*

[16] *Id*

[17] *Id*

[18] *Id.*

example of adopting residential solar panels for water heating reduces uncertainty about future increase in fuel cost.[19] The following sections will provide insight into the previously mentioned elements of ***Innovation, Communication Channels, Time,*** and ***Social System*** that make up diffusion.[20]

Innovation

Rogers defines an innovation as "an idea, practice, or object that is perceived as "new" by an individual or other unit of adoption."[21] The "newness" of an innovation is the individuals' knowledge, persuasion, or decision to adopt.[22] Diffusion scholars address the following research questions about innovations' adoption:

> "(1) How the earlier adopters differ from the later adopters of an innovation, (2) how the perceived attributes of an innovation, such as its relative advantage or compatibility affects its rate of adoption, whether relatively rapidly or more slowly, and (3) why the S-shaped diffusion curve "takes-off" at about 10- to 25-percent adoption, when interpersonal networks become activated so that a critical mass of adopters begins using an innovation."[23]

Rogers extends that it should not be assumed that the diffusion and adoption of every innovation are necessarily desirable.[24] Moreover, the same innovation may be desirable for an adopter in a particular situation, but not for a potential adopter in a different situation.[25]

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[19] *Id.*

[20] *Id*

[21] *Id.* at 11

[22] *Id.*

[23] *Id.* at 11-12

[24] *Id.* at 12

[25] *Id.*

Rogers elaborates that most of the new ideas presented in his book are technological innovations.[26] He defines a technological innovation as "a design that reduces the uncertainty in the cause effect relationship involved in achieving a desired outcome."[27] Furthermore, Rogers divulges that a technology usually has two components.[28] These are: "(1) a hardware aspect, consisting of the tool that embodies the technology as a material or physical object, and (2) a software aspect, consisting of the information base for the tool."[29] Rogers uses the examples of computer hardware and software to illustrate a technology's two components, explaining that first the hardware must be purchased so that the software can be utilized.[30]

For further illustration, Rogers provides examples of various technological innovations that involve a hardware and software component.[31] Examples consist of VCRs and videotapes, cameras and film, and compact disc players and CDs.[32] He explains that a company will usually sell the hardware at a relatively lower price to capture a share of the market, and then charge relatively higher prices for the software to maximize profitability.[33] To illustrate this, Rogers uses the Nintendo video game system,

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[26] *Id.*

[27] *Id.*

[28] *Id.*

[29] *Id.*

[30] *Id.* at 12-13

[31] *Id.* at 13

[32] *Id.*

[33] *Id.*

which is sold at the relatively low price ($100), but the games are sold at relatively high price ($60).[34]

Rogers insists that the characteristics of an innovation can be used to explain their rate of adoption.[35] He explains that innovations such as cellular telephones or VCRs only required a few years to reach widespread adoption in the United States, while the innovation of installing seat belts into cars required decades to reach a critical mass.[36] The following paragraphs will further explore the characteristics of innovations that influence adoption, including *relative advantage, compatibility, complexity, trialability and observability.*[37]

Rogers defines *relative advantage* as the degree to which an innovation is perceived as better than the innovation it supersedes.[38] Relative advantage can be measured in economic terms, social status, convenience, and customer satisfaction.[39] Most important to relative advantage, is whether an individual perceives the new idea as an advantageous innovation.[40] On a mar level, the greater a society perceives the relative advantage of an innovation, the more rapid the idea will be adopted.[41]

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[34] *Id.*

[35] *Id.*

[36] *Id.*

[37] *Id*

[38] *Id.*

[39] *Id.*

[40] *Id.*

[41] *Id.*

Rogers explains *compatibility* as the degree to which an innovation is considered consistent with existing values, past experiences, and the needs of potential adopters.[42] Thus, an idea that is incompatible with the norms and values of a society will not be adopted as soon as a compatible innovation.[43] Rogers insist that the adoption of an incompatible innovation requires prior adoption of a new system of social values, which is an extremely slow process.[44]

Another key component of innovations that influence adoption is *complexity*. *Complexity* is defined as the degree to which an innovation is perceived, by an individual, as difficult to understand and use.[45] According to Rogers, new innovations that are easier to use and understand are more rapidly adopted than confusing and complex ideas.[46]

An additional variable that may influence adoption revolves around experimentation, also known as *trialability*. *Trialability* is the number of times an innovation can be experimented with on limited time.[47] Rogers states that innovations that can be tried on installment plans will generally be adopted at greater rate than innovations that are not divisible.[48] Furthermore, an innovation that is more trialable represents less uncertainty to the consumer because it is possible to learn by doing.[49]

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[42] *Id.*

[43] *Id.* at 15-16

[44] *Id.* at 16

[45] *Id.*

[46] *Id.*

[47] *Id.*

[48] *Id.*

[49] *Id.*

The last factor that impacts the innovation variable is *observability*. Rogers defines *observability* as the degree to which the results of an innovation are visible to society.[50] The more available the results of an innovation are to an individual, the more likely they will adopt the idea.[51] Rogers insists that the visibility of an innovation's results stimulate peer discussion, as friends and neighbors of an adopter inquire about the new idea.[52]

Communication Channels

While the aforementioned characteristics of innovations help explain an idea's rate of adoption, an important dimension of diffusion theory is how people learn about a new technology through various communication channels.[53]

Rogers states that the essence of diffusing ideas into society is the information exchange from one individual to another. He claims this process involves "(1) an innovation, (2) an individual or other unit of adoption that has knowledge of the innovation or experience using it, (3) another individual or other unit that does not yet have experience with the innovation, and (4) a communication channel connecting the two units."[54] Communication channels are defined as the means by which messages are relayed from one individual to another.[55]

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[50] *Id.*

[51] *Id.*

[52] *Id.*

[53] *Id.* at 15-16

[54] *Id.* at 17-18

[55] *Id.* at 18

Rogers implies that the use of mass media channels provides the fastest and most efficient way to inform potential adopters of an innovation.[56] He defines mass media channels as "all those means of transmitting messages that involve a mass medium, such as radio, television, newspaper, and so on, which enable a source of one or a few individuals to reach an audience of many."[57] In contrast, Rogers explains interpersonal channels involve a face-to-face exchange between two or more individuals.[58] Interpersonal channels are a more effective way to persuade an individual to accept a new idea, but are not as efficient as the mass media[59]

Time

Besides innovation and communication channels, the third element in the diffusion process is time.[60] The time dimension as a variable in diffusion research is one of its strengths because in other behavioral science research time is often ignored.[61] Rogers states,

> "time dimension is involved in diffusion (1) in the innovation-decision process by which an individual passes from first knowledge of an innovation through its adoption or rejection, (2) in the innovativeness of an individual or other unit of adoption ---- that is, the relative earliness/lateness with which an innovation is adopted --- compared with other members of a system, and (3) in an innovation's rate of adoption in a system, usually measured as the number of members of the system that adopt the innovation in a given time period."[62]

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[56] *Id.*

[57] *Id.*

[58] *Id.*

[59] *Id.*

[60] *Id.* at 20

[61] *Id.*

[62] *Id.*

The measurement of time may be criticized because it often requires the use of recall data. However, the aforementioned involvement of time dimension provides strength to diffusion theory.

Rogers insists that there are five main steps in the innovation-decision process that revolve around the time variable.[63] They include *knowledge, persuasion, decision, implementation, and confirmation.*[64]

First, Rogers states that knowledge occurs when an individual learns of what an innovation is and understands how it works.[65] Second, he explains persuasion exists when the individual forms an opinion toward the innovation.[66] Next, decision occurs when the individual actively chooses to adopt or reject the innovation.[67] Fourth, Rogers says implementation happens when the individual uses the innovation.[68] The last step, confirmation, occurs when the individual seeks reinforcement of an innovation-decision that has already been made.[69]

Based upon the time variable, individuals seeking new innovations are placed into adopter categories, according to the rate of adoption.[70] According to Rogers, adopter categories are the classification of the individuals in society on the basis of

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[63] *Id*

[64] *Id.*

[65] *Id.*

[66] *Id.*

[67] *Id.*

[68] *Id.*

[69] *Id*

[70] *Id.* at 22

innovativeness.[71] Rate of adoption is the "relative speed with which an innovation is adopted by members of a social system."[72] These classifications include: "(1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards."[73] These categories and classifications are later explained.

Social System

The last characteristic that contributes to diffusion is the social system. Rogers defines a social system "as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal."[74] The members of a social system can range from individuals to informal groups or even large organizations.[75] Also, the members of any particular social system can decide to adopt an innovation by a collective or an authority decision.[76]

The decisions to choose an innovation within the social system are as follows:

> "(1) Optional innovation-decisions are choices to adopt or reject an innovation that are made by an individual independent of the decision of the other members of the system. (2) Collective innovation-decisions are choices to adopt or reject an innovation that are made by consensus among the members of a system. (3) Authority innovation-decisions are choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise."[77]

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[71] *Id.*

[72] *Id.*

[73] *Id.*

[74] *Id.* at 23

[75] *Id.*

[76] *Id.* at 28

[77] *Id.* at 28-29

Rogers claims that the fastest rate of adoption of innovations results from authority innovation-decisions.[78] Furthermore, he states that optional decisions are usually made more rapidly than collective decisions.[79] Rogers uses the example of the introduction of automobile seat belts to explain innovation decisions.[80] During the introductory years, the car's owner installed automobile seat belts as optional decisions.[81] Then, in 1966, the government passed laws requiring seat belts as standard equipment in all cars sold throughout the United States.[82] This example shows how innovation decisions can change as time progresses.

Rogers believes that "a social system is involved in an innovation's consequences because certain of these changes occur at the system level, in addition to those that effect the individual."[83] Consequences are the changes an individual or society may incur by adopting an innovation and usually fall into three classifications:[84]

- Desirable versus undesirable consequences, depending on whether the effects of an innovation in a social system are functional or dysfunctional.
- Direct versus indirect consequences, depending on whether the changes to an individual or to a social system occur in immediate response to an innovation or as a second-order result of the direct consequences of an innovation.
- Anticipated versus unanticipated consequences, depending on whether the changes are recognized and intended by the members of the social system or not.[85]

The three classifications of consequences play an important role in a social system's decision to adopt an innovation.

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[78] *Id.* at 29

[79] *Id.*

[80] *Id.*

[81] *Id.*

[82] *Id*

[83] *Id.*

[84] *Id*

[85] *Id.* at 30-31

Status of Diffusion Research Today

In *Diffusion of Innovations*, Rogers states that the contributions of diffusion research today are impressive.[86] He explains that beginning in the 1970s the results of diffusion research have been placed in textbooks in social psychology, communication, public relations, advertising, marketing, and many other fields.[87] While diffusion research holds a prominent position today, this was not always the case.[88] Rogers provides a quote taken from members of the diffusion research fraternity Frederick Fleigel and Joseph Kivlin's 1966 book, complaining that "Diffusion of innovation has the status of a bastard child with respect to the parent interest in social and cultural change: too big to ignore but unlikely to be given full recognition."[89] However, diffusion's status has improved in the eyes of academic scholars, as evident by Down and Morh's 1976 book C*onceptual Issues in the Study of Innovation*.[90] These scholars contend: "innovation has emerged over the last decade as possibly the most fashionable of social science areas. The investigations by innovation research of the salient behavior of individuals, organizations, and political parties can have significant social consequences."[91]

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[86] *Id.* at 96

[87] *Id.* at 96-97

[88] *Id.* at 97

[89] *Id*

[90] *Id.*

[91] *Id.*

Rogers provides four reasons for the increased popularity of diffusion research.[92] First, the diffusion model is a conceptual paradigm with relevance for many disciplines.[93] Second, diffusion research has pragmatic appeal in helping get research results utilized.[94] Third, the diffusion paradigm allows scholars to repackage their empirical findings in the form of higher-level generalizations of a more theoretical nature.[95] Finally, the research methodology implied by the classical diffusion model is clear-cut and relatively facile.[96]

While diffusion research has taken giant leaps in recognition, there still exist some limitations. The most prominent challenge is the recall problem in measuring the time of adoption.[97] Rogers claims that diffusion research differs from most other social science inquiry based on the inclusion of time as a variable.[98] There is no way to avoid including time as a variable because diffusion is a process that occurs over time.[99]

Another main weakness of diffusion is its dependence on recall data.[100] Recall data is generated by asking respondents to try to remember the history of adopting new innovations.[101] This is not a perfect way to construct data because many respondents do

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[92] *Id.* at 98

[93] *Id.*

[94] *Id.*

[95] *Id.*

[96] *Id.* at 98-99

[97] *Id.* at 121

[98] *Id.* at 121-122

[99] *Id.*

[100] *Id.*

[101] *Id.*

not possess accurate hindsight ability.[102] Constructing data in this fashion depends largely on an individuals educational background and memory ability.[103] To help abate recall concerns, Rogers list four research designs that are more appropriate for gathering data about time dimension.[104] They include: "(1) field experiment, (2) longitudinal panel studies, (3) use of archival records, and (4) case studies of the innovation process with data from multiple respondents (each of whom provides a validity check on the others' data)."[105]

Generation of Innovations

Innovation Development Process

Innovation was previously defined "as an idea, practice, or object that is perceived as new to an individual or another unit of adoption."[106] Rogers insist that the innovation-development process "consists of all the decisions and activities, and their impacts, that occur from recognition of a need or a problem, through research, development, and commercialization of an innovation, through diffusion and adoption of the innovation by users, to its consequences."[107] The following are the three steps in the innovation-development process.

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[102] *Id.*

[103] *Id.*

[104] *Id.*

[105] *Id.*

[106] *Id.* at 132

[107] *Id.*

First, Rogers states the process of innovation development starts by an individual or organization recognizing a problem or need.[108] Once the problem or need as been discovered, research is undertaken to create an innovation to solve the problem.[109] Second, the research is done in the sequence of "(1) basic research followed by (2) applied research leading to (3) development.[110] The third step is development.[111] Rogers defines development of innovations as the "process of putting a new idea in a form that is expected to meet the needs of an audience of potential adopters."[112]

Technology Transfer

Rogers describes technology transfer as an exchange of technical information between development workers who create the innovation and users of the new product.[113] This transfer is a process through which the results of basic and applied research are applied.[114] Rogers is not satisfied with the way the United States deals with technology transfer of innovations.[115] Rogers writes, "In the past decade or so, technology transfer has become a very important policy issue for the United States government. In industry after industry, from cars to VCRs to semiconductor memory chips, Japanese high-

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[108] *Id.*

[109] *Id.* at 135

[110] *Id.*

[111] *Id* at 137

[112] *Id.*

[113] *Id* at 140

[114] *Id*

[115] *Id.* at 141

technology companies have taken market share away from their American counterparts."[116]

Rogers uses an example of the VCR to illustrate the inadequacies of American technology transfer compared the Japanese process.[117] Rogers explains that Ampex Corporation, a high-quality audiotape company, in Redwood City, California City, created the VCR in the 1950s.[118] Ampex sold the VCRs to television stations in the San Francisco Bay area who used the product to replace film with videotape.[119] These primitive VCRs used one-inch tape and were the size of an average refrigerator and cost approximately $ 50,000.[120] Development technicians at Ampex suggested that they should miniaturize the product for consumers to use in their homes.[121] However, the company insisted they were not in that market and sold the idea and technology rights to Sony of Japan.[122] Eventually, Sony took the idea and made smaller units for home use.[123] As of today, Sony and other Japanese manufacturers have made billions of dollars in sales each year from the VCR and no American companies produce the product.[124]

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[116] *Id.*

[117] *Id.*

[118] *Id.*

[119] *Id.*

[120] *Id.*

[121] *Id.*

[122] *Id.*

[123] *Id.*

[124] *Id.*

Rogers uses this example to explain why the United States does a poor job of technology transfer.

To understand why the United States has such a poor record in technology transfer, Rogers explains the three possible levels of technology transfer.[125] They are

- **Knowledge.** Here the receptor (receiver) knows about the technological innovation, perhaps as the result of mass communication messages about the new idea.

- **Use.** Here the receptor has put the technology into use in his or her organization. This type of technology transfer is much more complex than just knowing about the technology (above). The difference is equivalent to the knowledge stage in the innovation-decision process versus the implementation stage.

- **Commercialization**. Here the receptor has commercialized the technology into a product that is sold in the marketplace. For such commercialization to occur, a great deal of time and resources must be invested by the technology receptor. So commercialization requires interpersonal communication exchanges about the technology over an extended period of time, an even more intensive exchange of information than does the use level of technology transfer.[126]

Rogers insist that these three degrees of technology transfer have not often been recognized in the past, thus making it hard for the United States to excel in the process.[127]

Diffusion and Adoption

Rogers insists that there are three key elements that lead from diffusion to adoption of an innovation.[128] These elements include *gatekeeping, innovation gatekeeping,* and *consensus development*.[129] First, Rogers describes gatekeeping as "controlling the flow

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[125] *Id.* at 142

[126] *Id.*

[127] *Id.*

[128] *Id.* at 148

[129] *Id.*

of messages through a communication channel."[130] Second, innovation gatekeeping is defined as "controlling whether or not an innovation should be diffused to an audience."[131] Last, Rogers explains that consensus development "is a process that brings together scientists, practitioners, consumers, and others in an effort to reach general agreement on whether or not a given innovation is both safe and effective."[132]

Innovation-Decision Process

Rogers describes the innovation-decision process as the process through which an individual or another decision making unit passes "(1) from first knowledge of an innovation, (2) to forming an attitude toward the innovation, (3) to a decision to adopt or reject, (4) to implementation of the new idea, and (5) to confirmation of this decision."[133] He further explains that the innovation-decision process consists of a series of actions and choices over a period of time in which the individual decides to adopt or reject an innovation.[134] Then, Rogers provides a model of the innovation-decision process that includes the following five stages:[135]

- **Knowledge.** Occurs when an individual (or other decision-making unit) is exposed to an innovation's existence and gains some understanding of how it functions.
- **Persuasion**. Occurs when an individual (or some other decision-making unit) forms a favorable or unfavorable attitude toward the innovation.

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[130] *Id.*

[131] *Id.*

[132] *Id.*

[133] *Id.* at 161

[134] *Id.*

[135] *Id.*

- **Decision**. Occurs when an individual (or some other decision-making unit) engages in activities that lead to a choice to adopt or reject the innovation.

- **Implementation**. Occurs when an individual (or other decision-making unit) puts an innovation to use.

- **Confirmation**. Occurs when an individual (or some other decision-making unit) seeks reinforcement of an innovation-decision already made, or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation.[136]

The above section explains that an innovation must pass through the individual's decision to adopt or reject the idea.[137] Ultimately, stage three (decision) is the point at which an individual or group will decide to adopt an innovation.

Rate of Adoption

As previously mentioned, the rate of adoption is the relative speed in which members of society adopt an innovation.[138] It is usually measured as the number of people who adopt an innovation within a specified time-line.[139] In addition to relative advantage, compatibility, complexity, trialability, and observability, there are other variables that affect the rate of adoption.[140] They include: "(1) the type of innovation, (2) the nature of communication channels diffusing the innovation, (3) the nature of the social system in which the innovation is diffusing, and (4) the extent of change agents' promotion efforts in diffusing the innovation, affect an innovation's rate of adoption."[141]

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[136] *Id.* at 162

[137] *Id.* at 197

[138] *Id.* at 206

[139] *Id.*

[140] *Id.*

[141] *Id.*

Rogers also explains that the economy is a very important factor in determining the rate of adoption.[142] He writes, "A new product may be based on a technological advance or advances that result in a reduced cost of production for the product, leading to a lower selling price to consumers."[143] Rogers, once again, uses the VCR as an example of how the economy affects the rate of adoption.[144] In 1980 a VCR sold for more than $1,200 in retail stores.[145] However, in 1983, thanks to some technological improvements, a similar VCR sold for roughly $200.[146] Rogers explains that when the price of an innovation decreases so dramatically within its diffusion process, a rapid rate of adoption occurs.[147]

Innovative and Adopter Categories

Within diffusion theory, individuals may be classified within specific categories depending on when they have adopted a given technology. Rogers characterizes the adopter categories as ideal types.[148] Ideal types are defined as "conceptualizations based on observations of reality that are designed to make comparisons possible."[149] He presents an overview of the dominant characteristic and values of each category as well as a generalization based on certain ideal types.[150]

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[142] *Id.* at 213

[143] *Id.*

[144] *Id.*

[145] *Id.*

[146] *Id.*

[147] *Id.*

[148] *Id.* at 263

[149] *Id.*

[150] *Id.*

Innovators: Venturesome [1st group to adopt]

Rogers describes innovators as obsessed with being venturesome.[151] They have an interest in new ideas and innovation and have generally very cosmopolitan type social relationships.[152] Innovators generally have communication patterns and friendships among a certain clique of innovators even though their geographic distance between each other may be very significant.[153] Innovators must be very financially secure in order to absorb a possible loss from an innovation that doesn't turn into fruition.[154] Likewise, an innovator must have a sound educational background, in order to comprehend a complex technical terminology.[155] Furthermore, an innovator must be able to cope with a degree of uncertainty whether the innovation will be adopted by society.[156] Ultimately, Rogers believes the innovator takes risks in being the gatekeeper of innovations, but if the innovation is adopted the rewards are high.[157]

Early Adopters: Respect [2nd group to adopt]

Rogers explains that an early adopter is more integrated in the local society than the innovator.[158] Where an innovator is considered a cosmopolite, an early adopter is a

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[151] *Id.*

[152] *Id.*

[153] *Id.* at 263-264

[154] *Id.* at 264

[155] *Id.*

[156] *Id.*

[157] *Id.*

[158] *Id.*

localite.[159] Early adopters have the greatest degree of leadership in most localities.[160] Most potential adopters look to the early adopter for advice and information regarding an innovation.[161] Generally, early adopters are respected and considered successful by their peers.[162] The early adopter is the main group that decreases uncertainty of an innovation by adopting it, and then communicating with potential adopters about the idea.[163]

Early Majority: Deliberate [3rd group to adopt]

Rogers suggest that the early majority group adopts new innovations just before the average member of society.[164] Members of the early majority frequently interact with people in their society, but usually do not hold key positions of leadership.[165] The early majority is the largest group and make up approximately one-third of members in a society.[166] The early majority follows with deliberate willingness to adopt an idea, but are rarely leaders.[167]

Late Majority: Skeptical [4th group to adopt]

Rogers states that the members of the late majority adopt innovations just after the average member of society.[168] The late majority also makes up approximately one-third

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[159] *Id.*

[160] *Id.*

[161] *Id.*

[162] *Id.*

[163] *Id.*

[164] *Id.*

[165] *Id.* at 264-265

[166] *Id.* at 265

[167] *Id.*

[168] *Id.*

of members in a social system.[169] Members of the late majority are cautious and skeptical about new innovations.[170] Most of the uncertainty surrounding an innovation must be removed before the late majority will adopt the new idea.[171]

Laggards: Traditional [last group to adopt]

Laggards are the last group in society to adopt a new idea.[172] Generally, they possess almost no positions of leadership within their community.[173] Laggards' point of reference is the past, they are very cautious and only make decisions based on what has already been done.[174] Usually, laggards' educational and financial resources are limited, forcing them to be completely certain the innovation will not fail before they adopt.[175] These are the traditional categories of society members with respect to the adoption of new ideas and innovations.

Strategies for Spreading Innovations

Rogers describes this as the S-curve and the graph shows the best possible way for an innovation to be adopted by society and ultimately reach a critical mass.[176] First, the idea or innovation must be put through a series of experiments and pilot projects.[177]

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[169] *Id.*

[170] *Id.*

[171] *Id.*

[172] *Id.*

[173] *Id.*

[174] *Id.*

[175] *Id.* at 266

[176] *Id.*

[177] *Id.*

Second, once the innovation has passed the series of test, companies can build support systems to stabilize the innovation for further development.[178] Next, the innovation needs to be properly advertised to gain popularity among society.[179] The electoral politics stage is in place for the innovations' opposition to be addressed and comfortable with furthering its role in society.[180] Finally, for an innovation to be reached by a critical mass, regulation is the strategy utilized last.[181]

The diffusion of innovations follows a common life cycle.[182] However, the period over which this trend occurs varies greatly due to a number of factors.[183] By the end of the 20th century many of the following innovations were adopted by society at a much greater rate.[184]

For example, the PC, Internet, and cell phone, which are all relatively new products, have steeper gradients when compared to automobiles, electricity and traditional telephones.[185] To some extent, older innovations took longer to adopt due to the large infrastructures that needed to be developed before the innovations could

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[178] *Id.*

[179] *Id.*

[180] *Id.*

[181] *Id.*

[182] *Id.* at 12

[183] *Id.*

[184] *Id.*

[185] *Id.*

succeed.[186] The rate of adoption in the relatively newer products can be somewhat contributed to increases in globalization and global communication.[187]

Consumer adoption patterns can be analyzed in terms of the criteria set out by Rogers.[188] For example, it required 70 years for the traditional telephone to be adopted by 50% of society.[189] However, one must take account that an extensive infrastructure was necessary for building the telephone network to each household.[190] Furthermore, the VCR gained a much faster rate of adoption because it did not require an extensive infrastructure to survive, and it was an add on device to the television which at the time was widely adopted.[191]

According to Rogers, price is one of the most important factors involved in adoption of consumer products. In 1998, the P.C. had still not been adopted by 50% of Americans.[192] Moreover, some research indicates that the growth rate for P.C's has been slowing down.[193] The apparent slowdown can be attributed to price.[194] Price is one of the most important factors involved in adoption of consumer products.[195] For example,

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[186] *Id.*

[187] *Id.*

[188] *Id.* at 14

[189] *Id.*

[190] *Id.*

[191] *Id.*

[192] *Id.*

[193] *Id*

[194] *Id.*

[195] *Id.*

with radios, black and white, and color television, the technology costs between 1.8 and 1.9 of the average Americans' household income when the products entered 50% of homes.[196] However, for the VCR, the price dropped to approximately one week's household income when it entered 50% of U.S. homes.[197] This pricing policy pattern can be used to predict the rate of adoption of new innovations.[198] If applying earlier patterns to the present, P.C's should be able to reach a 50% penetration rate at a price of $1,000 to $1,200, if content and services are attractive enough to consumers.[199] However, if the pattern for the VCR is applied, personal computers may have to drop to under $750 to enter 50% of U.S. households.

When it comes to consumers' rate of adoption to innovations, new technologies succeed at a faster rate than replacement technologies.[200] An example of this phenomenon comes in comparison of the penetration of CD players and video cassette recorders.[201] The CD player was a replacement technology for the tape cassette player, while the VCR was an innovation introduced as a new technology.[202] The graph below illustrates the VCR, which was the new technology, had a greater market penetration

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[196] *Id* at 15

[197] *Id*

[198] *Id.*

[199] *Id.*

[200] *Id.*

[201] *Id.*

[202] *Id.*

earlier in the product life cycle than the CD player, which was a replacement technology.[203]

Critical Mass in the Adoption of Innovations

The adoption rate of interactive electronic devices such as messaging systems, fax machines, and teleconferencing frequently displays a distinctive quality known as the critical mass.[204] Rogers explains that the critical mass occurs at the point when enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining.[205] The interactive qualities of the aforementioned innovations create a degree of interdependence among the adopters in a society.[206] These innovations are virtually useless to an adopting individual unless other individuals with whom the adopter communicates with also adopt the new product.[207]

Rogers informs that, "a critical mass of individuals must adopt an interactive communication technology before it has utility for the average individual in the system."[208] Interactivity is defined by Rogers, as "the degree to which participants in a communication process can exchange roles in, and have control over, their mutual discourse."[209] Rogers further states, "as more individuals in a system adopt a

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[203] *Id.*

[204] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 313

[205] *Id.*

[206] *Id.*

[207] *Id.*

[208] *Id.* at 318

[209] *Id.*

noniteractive innovation, it is perceived as increasingly beneficial to future adopters."[210] Moreover, Rogers writes, "in the case of an interactive innovation, the benefits from each additional adoption increase not only for all future adopters, but also for each previous adopter."[211]

Strategies for Getting to Critical Mass

Rogers explains that the critical mass functions on the relationship between the behavior of individuals and the society in which they participate.[212] Thus, the critical mass centers on a crucial cross-level analysis that is "characteristic of a large part of the social sciences, especially on the theoretical part."[213] Rogers insists that the principle of the critical mass is so simple that "it is no wonder that it shows up in epidemiology, fashion, survival and extinction of species, language systems, racial integration, jaywalking, panic behavior, and political movements."[214]

Rogers contends that an important question in understanding the role of the critical mass in the diffusion process is "why an individual adopts an interactive technology before the point at which a critical mass is reached."[215] He elaborates to say that at any earlier point before the critical mass is reached, the cost of adopting an innovation outweighs the benefits.[216] Rogers expounds, "An early adopting individual may decide to

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[210] *Id.* at 333

[211] *Id.*

[212] *Id.* at 318

[213] *Id.*

[214] *Id.*

[215] *Id.* at 319

[216] *Id.*

adopt in anticipation that the innovation's rate of adoption will take off in the near future when others adopt, although past diffusion research suggest that most individuals do not adopt an innovation until after learning of their peers' successful experiences."[217]

Rogers offers some possible strategies that may be used to reach critical mass for an innovation in a social system. They include

- Target top officials in an organization's hierarchy for initial adoption of the interactive innovation.
- Shaping individuals' perceptions of the innovation.
- Introducing the innovation to intact groups in the system whose members are likely to adopt at once.
- Provide incentives for early adoption of the interactive innovation, at least until the critical mass is reached.

Roger claims that "a good deal of interdependence occurs among the adopters of any innovation in the sense that adopters influence their peers to adopt by providing them with a positive (or negative) evaluation of the innovation."[218] Additionally, he believes that this peer influence usually makes the diffusion curve take off somewhere between the 5-percent and 20-percent level of adoption.[219] Once this is achieved, little promotion of the innovation is required, as further diffusion is self-generated by the innovation's social momentum.[220] Ultimately, this social momentum creates the critical mass, the

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[217] *Id*

[218] *Id.*

[219] *Id.*

[220] *Id.*

critical mass being the point at which enough members of society have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining.[221]

Examples of Diffusion

The following section of the literature review will provide examples of ideas or innovations that have been diffused and adopted by society. Rogers provides case studies on news diffusion, refrigerators, cellular telephones, Nintendo, and the facsimile machine. Furthermore, modern scholars have included diffusion theory in their research. This research includes studies on DTV and HDTV, cable, DBS, and computers and the Internet.

Diffusion of News

Although it was not the first investigation of the diffusion of a major news event, Rogers believes that the 1960 study by Paul J. Deutschmann and Wayne Danielson is how all news diffusion studies should be measured.[222] Rogers explains that Deutschmann and Danielson both earned two of the first Ph.D. degrees in communication from Stanford University, and pioneered news diffusion study.[223] Like Rogers, these two scholars believe news diffusion is a communication process, which ultimately lead them to form research questions and formulate a paradigm for news diffusion.[224]

Rogers writes that "news diffusion investigations mainly focus on tracing the spread of a spectacular news event like the assassination of a U.S. president, the Pope, or

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[221] *Id.* at 313

[222] *Id.* at 75

[223] *Id.*

[224] *Id.*

a Prime Minister; the *Challenger* disaster; or some major world news event."[225] Recent news events such as September 11, 2001 and the explosion of the space shuttle *Columbia* also warrant news diffusion investigations. Rogers informs that at the time of an event of this magnitude, each mass medium vehicle is overtaken with the excitement of news.[226] Furthermore, citizens that have heard the news often approach total strangers on the street to tell them about the story they have just witnessed.[227] Deutschmann and Danielson stated: "Every so often a major news story breaks. Reporters get the essential facts in a matter of minutes and send them on their way...Radio and television stations break into their programs to broadcast bulletins. Newspapers stop their presses for quick makeovers. In a flood of printed and spoken words, the message leaves the media."[228]

Rogers insists that the next step in the diffusion process as the news reaches the public and spreads throughout society is the concern of news diffusion scholars.[229] These scholars are interested in knowing the relative importance that mass medium vehicles have in the diffusion of news and how quickly such diffusion occurs.[230] Deutschmann and Danielson found that "Within thirty hours of such major news events as President Eisenhowers's heart attack, launching of the Explorer I Satellite, and Alaska statehood, from 75 to 95 percent of the public knew about the news event."[231]

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[225] *Id.*

[226] *Id.*

[227] *Id.*

[228] *Id.* at 75-76

[229] *Id.* at 76

[230] *Id.*

[231] *Id.*

Rogers writes, "the diffusion of news about a spectacular event can be very rapid."[232] For example, on January 28, 1986, NASA's space shuttle *Challenger* exploded after take-off.[233] Within thirty minutes of this disaster, 50 % of a sample of 538 residents of Phoenix had heard of the explosion.[234] He continues to say, "this amazing rapidity of news-event diffusion occurs because the individual only needs to gain awareness-knowledge of the news event, while the adoption of a technological innovation consist of the knowledge, persuasion, and implementation stages in the innovation-decision process."[235]

Diffusion of the Refrigerator

Rogers provides the example of the diffusion of the refrigerator by using a case illustration based on Cowan's (1985) research.[236] He explains that every refrigerator built for home use in the United States has a motor that powers a compressor which condenses a liquid, thus releasing heat into the room, which the liquid had absorbed when vaporized in the refrigerator.[237] Roger insists that a great alternative is the gas-powered refrigerator.[238] He explains that the gas unit has no moving parts, making it unlikely to breakdown or make any noise.[239] Rogers states, "By about 1930, prototype refrigerators

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[232] *Id.* at 77

[233] *Id.*

[234] *Id.*

[235] *Id.*

[236] *Id.* at 138

[237] *Id.*

[238] *Id.*

[239] *Id.*

of both types were developed, and one might expect that the gas refrigerator, because of its overwhelming advantages, would capture the consumer market. It didn't."[240]

Rogers claims the main reason that the gas powered refrigerator didn't take off was because of the enormous amounts of capital investments placed in the electric refrigerator by companies such as General Electric, General Motors, Kelvinator, and Westinghouse.[241] These huge companies believed that they could reap larger profits from electric refrigerators and ultimately allocated a lot of money towards research and development.[242] Smaller companies that were developing gas powered units could not compete.[243] Ultimately, the larger companies such as General Electric shaped the technology made available to the public.[244] As a result, the electric refrigerator was diffused by society.[245]

Diffusion of Cellular Telephones

Rogers informs that cellular telephones first hit the U.S. market in 1983.[246] Within 10 years, 13 million consumers had purchased units.[247] A cellular telephone functions

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[240] *Id.*

[241] *Id.*

[242] *Id.*

[243] *Id.*

[244] *Id.*

[245] *Id.*

[246] *Id.* at 244

[247] *Id.*

with a built-in rechargeable battery, so that it is mobile.[248] It is referred to as cellular because each metropolitan area is divided into cells, each from 1 to 25 miles in radius.[249]

Rogers describes the first adopters of cellular phones in 1983 as male executives whose companies gave them the phones as a job benefit.[250] In 1983, a cellular phone cost roughly $3,000.[251] Soon thereafter, the quality of cellular service improved and the price dropped to $250.[252] By 1993, one in three cellular telephones sold was for personal use.[253]

Rogers explains that cellular phones have an ideal set of perceived attributes, ultimately contributing for their rapid rate of adoption.[254] These attributes include

- **Relative Advantage**. One of the main benefits of the cellular telephone is that it saves an estimated two hours per week in avoiding missed appointments and delayed schedules, and improves time management. Another advantage is that from the beginning cellular phones have been important status symbols.
- **Compatibility**. A cellular phone connects into the existing telephone system, and allows the user to talk to anyone who has a regular telephone.
- **Complexity**. From the user's perspective, a cellular telephone operates exactly the same as a regular phone, and so it was unnecessary to learn any new skills.
- **Observability**. Uses of cellular phones in automobiles, restaurants, and other public places helped emphasize their status-conferral to potential buyers. The innovation was highly observable.
- **Trialability**. It is possible to borrow a friend's cellular phone for trial use.

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[248] *Id.*

[249] *Id.*

[250] *Id.* at 245

[251] *Id.*

[252] *Id.*

[253] *Id.*

[254] *Id.*

Rogers believes that the aforementioned perceived attributes are ideal. When it is relatively simple to recognize these attributes and put the innovation to use, the innovation's rate of adoption will become rapid and self-sustaining.

Diffusion of Nintendo

In 1993, Rogers' described Nintendo home video game devices as "the fastest-diffusing consumer electronics product of all time."[255] Introduced in the United States in 1986, Nintendo had sold over 50 million game systems by 1993.[256] Nintendo could be found in approximately one-third of all U.S. households, and almost every American family with boys.[257] Rogers compares Nintendo's diffusion rate with that of personal computers. "In comparison, only about half as many U.S. households adopted a personal computer, after twice as many years of diffusion."[258] Rogers adds, "During this same fourteen years in which Nintendo game-players diffused, twice as many U.S. homes adopted VCRs."[259] However, major differences in these products exist. For example, Nintendo sold all of the video game systems.[260] In addition, "Nintendo sold all of the games played; this is equivalent of one company selling all of the videos that are played on the VCR!"[261]

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[255] *Id.* at 246

[256] *Id.*

[257] *Id.*

[258] *Id.*

[259] *Id.*

[260] *Id.*

[261] *Id.*

Rogers explains that Nintendo game players have an ideal set of perceived attributes, ultimately contributing for its rapid rate of adoption.[262] These attributes include:

- **Relative advantage**. The fun, high-quality games that had been created in Japan were immediately available for use in the Nintendo game-players in America. The Nintendo game-player had higher resolution graphics and thus more lifelike features than the old Atari machines. The Nintendo Company created shortages of their most popular games so as to fan the heat of "Nintendomania" by creating the impression that the games were even more widely popular than they actually were, and thus raising their perceived relative advantage.

- **Compatibility**. Nintendo's "razor blade" strategy meant that the hardware was priced relatively low, so that the game-player was very affordable. Nintendo expected to make its main profits on the software games.

- **Complexity**. The video game-players were called "Nintendo Entertainment Systems" in the United States. It was sold in toy stores rather than in computer stores. The game-player was easy to attach to a television set, and the use of the two hand-controllers was simple to understand.

- **Observability**. Nintendo launched a huge advertising campaign for its Nintendo Entertainment System and its most popular video games, including: Mario, Super Mario, and Tetris. Nintendo mounted tie-in sales and advertising campaigns with Pepsi, McDonalds, and a Hollywood film.

- **Trialabilty**. Any kid passing a Nintendo display in a toy store could stop and play a Nintendo game.

As a result of Nintendo's perceived attributes, by 1993, the Nintendo Company of America was selling 600,000 games and game-systems per day.[263]

Diffusion of the Fax

Rogers states that the diffusion of the facsimile machine began in 1983.[264] He explains that since its adoption the fax machine has experienced a more rapid diffusion

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[262] *Id.*

[263] *Id.*

[264] *Id.* at 325

than personal computers or VCRs, and its diffusion is similar to cellular phones.[265] However, Rogers also explains that this recent diffusion occurred nearly 150 years after the first fax was sent via telegraph lines.[266]

In 1965, the technology of the fax machine as we know it today was adopted.[267] However, the equipment during the infancy of this innovation cost nearly $8,000.[268] In 1980, when Japanese companies entered the market, the price of the facsimile machine fell to around $2,000.[269] Later that same year, U.S. companies heavily entered the market, and the price fell to approximately $500.[270] By 1993, a fax machine only cost $250.[271] Rogers states that in 1993, "it was estimated that a single page could be faxed from Los Angeles to Washington, D.C. for as little as a dime, compared to a first-class stamp of 29 cents."[272] Rogers believes that the main advantages of the fax machine are its speed and cost effectiveness.[273]

Modern Diffusion Scholarship

While Everett M. Rogers is considered be the expert of diffusion scholarship, many other scholars have incorporated diffusion theory in their respective studies. Besides the

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[265] *Id*

[266] *Id.*

[267] *Id.*

[268] *Id.*

[269] *Id.*

[270] *Id.*

[271] *Id.*

[272] *Id.*

[273] *Id.*

thorough explanation of Rogers' theory, this literature review will cover recent studies that solely apply diffusion of innovation theory and its variables to modern technologies, including DTV, HDTV, cable, satellite, computers, and the Internet.

DTV and HDTV

Bruce Huber Vice President of marketing at Zenith wanted to find the marketing potential for HDTV.[274] Zenith decided to use Frank Bass' model to help predict the demand for HDTV.[275] Zenith had conducted a number of studies of consumer behavior along with the Bass diffusion model, which led to the following general conclusions:

- Consumers looked for value in their money and stayed within their budgets. Most consumers were satisfied with their existing TVs.
- Product quality was the most important criterion for evaluating brands. Consumers generally preferred large screens to small screens and considered such product features as stereo, remote control, and style to be important as well.
- Consumers tended to shy away from the lowest priced brands because they were suspicious of poor quality.

By using the Bass Model, Huber predicted that HDTV would account for approximately 10 percent of total television sales by 1999.[276] However, because this study was conducted in 1990, these projections would only occur if (1) the FCC settled on a transmission standard, and if (2) broadcasters invested substantial amounts of money in new equipment.[277]

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[274] Lilien, Gary. *Diffusion Models: Managerial Applications and Software*. ISBM Report 7-1999. Institute for the Study of Business Markets. 5/20/99. Pg. 1-41

[275] *Id.*

[276] *Id.*

[277] *Id.*

Associate Professor in the College of Journalism and Mass Communications at the University of Florida Dr. Sylvia Chan-Olmsted presented a study on DTV adoption to the Association of Educators in Journalism and Mass Communication (AEJMC).[278] The focus was to investigate consumer awareness and knowledge of DTV in the United States.[279] Chan-Olmsted prepared four research questions to investigate, they are:

- What is the state of consumer awareness and knowledge of DTV?
- How do consumer characteristics relate to the awareness and knowledge of DTV?
- What are the perceived characteristics of DTV, the perceived importance of various DTV benefits, and the perceived social importance of DTV?
- What are the predictors of DTV adoption?[280]

To answer the above questions, Chan-Olmsted incorporated diffusion theory from both Rogers and Lin. First, to investigate the state of consumer awareness and knowledge, Chan-Olmsted used the results of a GAO commissioned survey on DTV.[281] Second, Rogers' scholarship was mentioned to understand demographic variables that are important in the adoption of media or innovations.[282] Third, Rogers' definition of "innovativeness" was incorporated to explain personality traits of consumers.[283] Next, Chan-Olmsted explained that based on Rogers' technology cluster concept, Lin "argued that communication media sharing certain fundamental similarities may create synergies

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[278] Sylvia Chan-Olmsted and Byeng-Hee Chang, *Consumer Awareness and Adoption of Digital Television: Exploring the Audience Knowledge, Perceptions, and Factors Affecting the Adoption of Terrestrial DTV*, Submitted for Presentation to the CT&P Division at AEJMC, March 2003

[279] *Id.* at 2

[280] *Id.* at 12

[281] *Id.* at 6

[282] *Id.* at 7

[283] *Id.* at 8

insofar as adoption rates are concerned, assuming that other circumstantial factors such as pricing are held constant."[284] Finally, Rogers' and Lin's research was utilized to explain the perceived benefits and predictors of DTV adoption.[285]

Chan-Olmsted concluded that the study "confirms the GAO findings about the low level of DTV awareness and knowledge among the American consumers."[286] The study was also consistent with the GAO report, in that generally males with high socioeconomic were the most knowledgeable about DTV.[287] Furthermore, the study found that the respondents did not perceive DTV to be better than their existing television.[288] The respondents believed DTV to be complex and were unsure of the advantages. Additionally, the respondents felt that it would not be easy to try DTV and that digital television was a monetary risk.[289] The study also revealed that personality traits were better predictors of DTV knowledge than adoption intent, but explains that a reexamination of predictors would be wise after the DTV mandated deadline.[290]

In another HDTV study, Michael Dupagne used the diffusion of innovation theory to identify the characteristics of potential high definition television adopters.[291] The purpose of the research was to assess how consumers viewed HDTV and obtain a profile

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[284] *Id.*

[285] *Id.* at 12

[286] *Id.* at 23

[287] *Id*

[288] *Id.* at 20

[289] *Id.*

[290] *Id.* at 26

[291] Dupagne, M. *Exploring the Characteristics of Potential High Definition Television Adopters*. Journal of Media Economics, 12(1), 35-50.

of potential HDTV adopters. Dupagne's dependent variables were awareness, interest, and purchase intent.[292] The profile was based on the following characteristics: demographics, mass media use, ownership of related home entertainment products, and perceived importance of HDTV enhancements.[293] Dupagne found that early adopters were young, technologically educated, and affluent.[294]

Cable

Carolyn Lin published a study on consumer adoption of multimedia cable technology.[295] More specifically, Lin's study explores consumer intentions to adopt multimedia cable technologies that involve provisions of several hundred voice, data, and video channels via a coaxial television system.[296] Based on Rogers' Diffusion of Innovation Theory and Lin's previous studies, Lin originated the concept of "need for innovativeness".[297] Lin's concept assesses an individual's willingness to keep up with innovations and engage in risk, representing a psychological trait that may help with adopting new ideas and technologies.[298] Lin suggests that individuals with a greater need to pursue innovations are more likely to be earlier adopters, providing that costs or complexity are not an issue.[299] Furthermore, Lin assumes in her research that "by

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[292] *Id.*

[293] *Id.*

[294] *Id.*

[295] Carolyn A. Lin and Leo W. Jefferies, *Factors Influencing the Adoption of Multimedia Cable Technology*, Journalism and Mass Communications Quarterly, Vol 75, No. 2, Summer 1998

[296] *Id.* at 341

[297] *Id.* at 344

[298] *Id.*

[299] *Id.*

adapting the concept of "need for innovativeness" here, it is logical to expect that those audiences who express a stronger need to keep up with new communication technology and to keep up with multimedia cable technology should also be more receptive towards experimenting with or adopting this technology."[300]

Lin's study concluded that the different abilities of the key theoretical elements of *satisfaction with media content, media level use, innovativeness traits, criterion variables, and data analysis* were tested to explain multimedia cable service adoption interests should help future research.[301] Lin insists that media use patterns and media content satisfaction may be very instrumental in determining the potential dynamics of substitutions between current and future mediums.[302] Furthermore, Lin argues that personality traits such as "innovativeness traits" may be instrumental to determining levels of adoption.[303] However, Lin reveals, that due to the Telecommunications Act of 1996, more converged technology hybrids with emerge as mediums, ultimately blurring the lines between mass communication and point-to-point communication.[304] Thus, Lin asserts this may pose further challenges for researchers to form theoretical models to explain consumer adoption with these new media services.[305]

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[300] *Id.*

[301] *Id.* at 349

[302] *Id.*

[303] *Id.*

[304] *Id.* at 349-50

[305] *Id.*

Myung-Hyun Kang published, "Digital Cable: Exploring Factors Associated with Early Adoption."[306] The purpose of the research was to gain an understanding of digital cable adoption by identifying characteristics of early digital cable adopters.[307] Kang's study used early adopters and innovativeness as dependent variables.[308] Furthermore, the study used demographics, innovative attitudes, media use, satisfaction, and technology ownership as independent variables.[309] The study supported diffusion theory, except for three differences.[310] First, Kang found that income was not a factor in regards to digital cable subscription.[311] Second, Kang found that consumers currently subscribing to premium channels would most likely adopt digital cable.[312] Last, if the digital cable companies create positive relationships with consumers, the product will be adopted at a faster rate.[313]

Direct Broadcast Satellite

Digital satellite provider DirecTV planned the launch of its subscription satellite television service.[314] DirecTV wanted to obtain pre-launch forecast over a five-year

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[306] Kang, M. H. *Digital Cable: Exploring Factors Associated with Early Adoption*. Journal of Media Economics, 40, 318-330.

[307] *Id.*

[308] *Id.*

[309] *Id.*

[310] *Id.*

[311] *Id.*

[312] *Id.*

[313] *Id.*

[314] Bass, Frank, M., Kent Gordon, Teresa L. Ferguson, and Mary Lou Githens. *DIRECTV: Forecasting Diffusion of a New Technology Prior to Product Launch*," Interfaces 31:3 pp82-93.

period.[315] The forecasts were based on the Bass diffusion model, and the values for its parameters were obtained from a survey of stated intentions combined with the history analogous products.[316] The study identified three research questions: (1) deciding on the pricing and programming to offer consumers, (2) who would be the first to adopt, and (3) how many would adopt first.[317] Upon review of the data collected, Bass forecast the number of DirecTV subscribers and when they would adopt the product.[318] The forecast Bass obtained proved to be very similar in comparison with actual subscriptions over the five-year period from 1994-1999.[319]

Computers and the Internet

Diffusion research that focus on computer and Internet adoption provide important studies explaining consumer adoption patterns that may be useful to assess potential HDTV adoption. Carolyn Lin presented an article on personal computer adoption to the Broadcast Education Association's (BEA) 43rd Annual Convention and Exhibit in Las Vegas, Nevada.[320] Lin's study focuses on what she believes to be the most important question facing the present phenomenon of the personal computer.[321] In 1997, the estimated adoption rate for the PC was 37 percent, but the adoption curve was projected

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[315] *Id.*

[316] *Id.*

[317] *Id.*

[318] *Id.*

[319] *Id.*

[320] Carolyn A. Lin, *Exploring Personal Computer Adoption Dynamics,* Journal of Broadcasting & Electronic Media 42, 1998, pp. 95-112

[321] *Id.* at 95

to increase markedly within a 10-year period.[322] Lin's article examines the adoption rate and adopter types along with their relations to potential adoption barriers, media use patterns, existing communication technology ownership and social locators.[323] Lin's study assumes that varying degrees of innovativeness may help predict how long it takes for consumers to adopt an innovation.[324] Furthermore, Lin insists other variables including: demographic attributes, perceived adoption barriers, existing media use levels, and communication technology ownership patterns will help predict the rate of adoption along the time dimension.[325]

Lin's study based upon the collection and analysis of data demonstrates that ownership of other communication technology devices primarily predicted the PC adoption rate.[326] Lin found that technological enthusiasts with an above average national household income tended to adopt PC's sooner and had a greater need for innovativeness.[327] These enthusiasts also are more concerned with an innovation's practical advantages rather than costs.[328] Lin argues that as PC penetration reaches the critical mass, individual degree of innovativeness will be inconsequential to adoption.[329] Instead, a PC's perceived advantages and necessity might be a consumer's main reason

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[322] *Id.*

[323] *Id.*

[324] *Id.*

[325] *Id.*

[326] *Id.* at 110

[327] *Id.*

[328] *Id.*

[329] *Id.*

for acquisition.[330] Lin states that while this study was preliminary, it should shed some light on the future adoption studies of PC-related technologies.[331]

Atkins and Jeffres produced a study that profiled Internet adopters by social locators, media use, and their adoption of new technologies.[332] They found that communications needs were the most important predictor for consumer adoption of the Internet.[333] Furthermore, the authors found that Internet adopters are typically young, affluent, and educated.[334] The authors explained there were two limitations.[335] First, the Internet was still in its infancy.[336] Second, the authors believed that further research was required to determine consumer's measure of cosmopoliteness and localiteness.[337]

Atkin, Jeffres, and Neuendorf published research examining Internet adoption as telecommunications behavior.[338] The study profiles Internet adopters in terms of social locators, media use habits, and their orientation toward adopting new technologies.[339] The findings were measured in terms of demographics, social locators, media use, new

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[330] *Id.*

[331] *Id.*

[332] Akin, D. and Jefferies, L. *Understanding Internet Adoption as Telecommunication Behavior*. Journal of Broadcasting & Electronic Media, 42:4, pg 475.

[333] *Id.*

[334] *Id.*

[335] *Id.*

[336] *Id.*

[337] *Id.*

[338] Atkins, D., Jeffres, L., and Neuendorf, K. *Understanding Adopters of Audio Information Innovations*. Journal of Broadcasting and Electronic Media., Winter 1998, 80-93.

[339] *Id.*

media adoption, and communication needs.[340] The study conforms to prior diffusion research in that early adopters were generally affluent, educated, and young.[341] The study found that demographics, technology adoption patterns, and orientations were key factors that influenced Internet adoption of informational services.[342] However, the study failed to confirm their expectations that attitudinal variables were more explanatory than demographics.[343] Moreover, the authors believed that exploring the psychological motivations driving Internet adoption would be useful for future research.[344]

Atkin and Jeffres examined the use of technologies for communication and consumer needs.[345] The purpose of this study is to distinguish between the use of new technologies for consumer purposes and use in two communication roles, the traditional role of media audiences receiving and sending messages.[346] The authors apply diffusion theory, technological needs, and communication needs in an analysis of data compiled in a Midwestern metropolitan.[347] The research examined bivariate relationships between three dependent measures and groups of independent variables: social categories (education, income, gender), mass media exposure, assessments of media, the relationship people have with technology, and measures of people's need for

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[340] *Id.*

[341] *Id.*

[342] *Id.*

[343] *Id.*

[344] *Id.*

[345] Jeffres, L. and Atkin, D. *Predicting Use of Technologies for Communication and Consumer Needs*. Journal of Broadcasting & Electronic Media, 40, pp.318-330

[346] *Id.*

[347] *Id.*

interpersonal communication and the need to send mass messages.[348] The study found that adoption intentions for ISDN services were not dependent on education or income.[349] Furthermore, the study's findings mitigate the assumption that heavy media users might be more interested in adopting ISDN applications.[350]

The above section identified modern scholarship that has utilized diffusion theory to provide information on consumer adoption, awareness, and understanding of technological innovations. The research included studies on DTV and HDTV, cable, DBS, and computers and the Internet. The key trends that are generally most apparent in the aforementioned literature prove that most early adopters of innovations are affluent, educated, and young.

In summary, the literature review has provided an overview of Rogers' Diffusion of Innovation Theory. First, the chapter explains that diffusion is a process by which an innovation is communicated through certain channels over time. Second, an innovation's hardware and software components are discussed. Third, the literature review provides an understanding of what characteristics influence adoption. Additionally, Rogers explanation are given of how to identify social systems and key players in the environment. Furthermore, the innovation-decision process has been thoroughly described. Besides Rogers' theory, contemporary scholarly contributions have provided examples of how diffusion theory has been most recently used to explain consumer adoption of innovations.

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[348] *Id.*

[349] *Id.*

[350] *Id.*

CHAPTER 5
RESEARCH FRAMEWORK AND ANALYSIS

Framework

This thesis uses policy analysis, which is a social and political activity, as a tool to examine how the Diffusion of Innovation Theory can be employed to expedite the transition of DTV. First, the problem had to be identified. As explained in Chapter 3, policy-makers and legislation have not adequately addressed and informed the public to make educated decisions related to consumer adoption of DTV. Furthermore, Chapter 3 provided implications of DTV history, technology, regulation, and the market that have had or will have an affect on policy issues regarding digital television.

The implications that will have the most apparent affect on consumer adoption of digital television are related to: the differences in technology, the cost of switching to digital, the programming available for consumer consumption, consumer understanding and knowledge of DTV, and regulation of DTV. First, policy needs to help inform consumers of the technological differences between analog and digital systems. Second, policy needs to provide incentives that will detour the cost of switching to a new system. Third, policy should address industry and provide incentives for increasing the available programming. Fourth, the adoption of digital television will not occur until consumers understand the digital system. Policy needs to address this issue by providing industry will the appropriate information to relay information and knowledge to consumers. Finally, regulation has already been implemented in regards to DTV. Policy needs to

address this regulation and create regulations that will increase consumer adoption of digital television.

The above implications are important to realizing that policy has so far failed to widely introduce digital television to the public. Beginning with the Telecommunications Act of 1996, Congress mandated a framework to implement digital television to the public.[1] Acting on the congressionally-mandated framework, the FCC imposed a timeline that required stations to return their analog signals and broadcast digitally by December 31, 2006, providing that 85% of television households in the market have access to local broadcast DTV.[2] Given the strong possibility that this deadline won't be met, this study employs diffusion theory as a way to better understand consumer adoption of DTV.

Within this policy analysis, the underlying framework for this study assumes that the Diffusion of Innovation Theory is the most relative social theory available to understand the consumer adoption of new ideas and innovations. As discussed in chapter 4, Diffusion of Innovation Theory has been widely excepted in a variety of fields, including education, anthropology, public health, marketing, and communications as a tool to understand what variables influence the adoption patterns of society. It is important to understand why Diffusion of Innovation Theory is useful for DTV and policy. Diffusion of Innovation Theory can trace its roots back to the European

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[1] U.S. Department of Commerce, National Telecommunications and Information Adminstration, *The Telecommunications Act of 1996 and Digital elevision*www.ntia.doc.gov/pubintadvcom/octmtg/tatalk.htm.

[2] KCTS Seattle PBS Web-site, *The Tech Report: Important Dates for DTV*. www.kcts.org/inside/techreport/resources/timeline.asp.

beginning of social science.[3] This theory has been used for over 100 years as a tool to understand why innovations may or may not be diffused by a particular individual or other unit of adoption.[4]

Unfortunately for DTV consumers and the public, the key components and variables of Diffusion of Innovation theory have been neglected thus far by policy-makers. To reiterate, beginning with the Telecommunications Act of 1996, Congress imposed the overall framework on how DTV would be implemented in the United States.[5] In response, the FCC installed a timetable for stations to transition from analog to digital by December 31, 2006.[6] Both of these government entities provided rules for DTV without fully appreciating diffusion of innovations and the variables that exists for consumers to adopt digital television. The following paragraphs explain and identify the key variables of diffusion theory that may be used to understand consumer adoption of DTV.

The research framework incorporates items that operatationalize many of the variables included in Diffusion of Innovation Theory in regards to the effect they will have on the consumer adoption of DTV that may be employed to inform policy based on the analysis. Beyond Rogers' scholarship, modern scholarship involving DTV and HDTV, cable, DBS, and computer and the Internet have been explained to provide further possibilities of variables that may be utilized to inform policy to increase

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[3] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 137

[4] *Id.* at 11

[5] *Id.*

[6] *Id.*

consumer adoption of digital television. Some of the variables include demographics, age, education, and income. These variables are important aspects of diffusion theory and will be included within the present analysis.

Specifically, the research framework includes the following key variables of diffusion theory and why they may be employed to better understand consumer adoption of digital television.

- **DTV's Hardware and Software Components**. A technology usually has two components. These are: a hardware aspect that consists of the tools that allow the technology to be a tangible physical object, and the software components that consist of the informational base of the technology.[7] The knowledge of digital television's hardware and software components are important for consumer adoption because the technology exists within DTV can help explain whether or not the product will be desirable to consumers.

- **Characteristics that Influence Adoption**. Diffusion of Innovation theory provides five characteristics that influence adoption and ultimately are necessary for a new technology to reach a critical mass. These characteristics are relative advantage, compatibility, complexity, trialability, and observability.[8] These characteristics are useful in determining if purchasing components of DTV will benefit society and lead to consumer adoption of digital television. Zenith's study incorporating the Bass diffusion model to discover consumer behavior will be beneficial.

- **Identification of Social System and Key Players**. A social system is defined as "a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal."[9] The common goal of individuals involved in DTV is to achieve widespread consumer adoption of digital television. Chapter 4 will identify the units that are involved in gaining consumer adoption of DTV.

- **Consumer Awareness of DTV**. Consumer awareness of DTV will be explained by providing statistics and studies from a number of consumer surveys and

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[7] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). At 12

[8] *Id.* at 15

[9] *Id.* at 23

academic research. Sylvia Chan-Olmsted's study, complete with a national mail survey, will help provide data relative to consumer awareness of DTV.[10]

- **Consumer Understanding of DTV**. Consumer understanding of DTV will be explained similarly to the category identified in the above paragraph. Consumer understanding and awareness of DTV is vital in helping explain DTV's rate of adoption.

- **Innovation Development Process**. Innovation development begins by an individual or organization recognizing a problem or a need.[11] Once the problem or need has been discovered, research is undertaken to create an innovation to solve the problem.[12] Development of an innovation is the process of putting the new idea in a form that will meet the needs of potential adopters. This process is important in understanding whether DTV has been driven by policy or necessity and how this will affect consumer adoption of digital television. The analysis will explain whether policy has properly situated DTV to meet the needs or problems of the U.S.

- **Technology Transfer of U.S. DTV**. Technology transfer is the exchange of technical information between R&D and the users of an innovation.[13] According to Rogers the United States has had a poor track record when it comes to technology transfer.[14] Technology transfer consists of three levels, including knowledge, use, and commercialization.[15] These three levels are vital aspects of diffusion theory that will help determine realistic rates of consumer adoption of DTV. This analysis will shed light onto how technology transfer has been utilized in DTV.

- **Innovation Decision Process of DTV**. The innovation decision process is a process through which an individual or other decision making unit passes.[16] This process consists of a series of actions and choices over a period of time in which the individual decides to accept or reject an innovation.[17] Five stages are involved

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[10] Sylvia Chan-Olmsted and Byeng-Hee Chang, *Consumer Awareness and Adoption of Digital Television: Exploring the Audience Knowledge, Perceptions, and Factors Affecting the Adoption of Terrestrial DTV*, Submitted for Presentation to the CT&P Division at AEJMC, March 2003

[11] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 137

[12] *Id.*

[13] *Id.* at 140

[14] *Id.* at 142

[15] *Id.*

[16] *Id.* at 162

[17] *Id.*

in the innovation decision process, they are knowledge, persuasion, decision, implementation, and confirmation.[18] This process is important in explaining if DTV will be adopted by society. Each of these stages will be identified in the following chapter.

- **The Variable of Price**. Costs is one of the main factors when choosing whether to purchase products. Price could be a huge factor the consumer adoption of DTV. The analysis will attempt to make a relation with price and the rate of adoption with other products to see if DTV would follow the same model.

- **Innovator and Adopter Categories**. These categories are ideal types. Ideal types are defined as "conceptualization based on observations of reality that are designed to make comparisons possible."[19] These categories provided information regarding consumer adoption of DTV. Chapter 4 will provide insight into how far the United States has come in the Innovator and Adopter categories. Following this, the analysis will explain what steps are needed for DTV to reach a critical mass in the United States. Michael Dupagne's study on HDTV will be useful for providing characteristics of HDTV adopters.

Based on the above research framework, the final section of this chapter will provide some policy recommendations based upon the diffusion analysis of DTV consumer adoption and the technological, regulatory, and marketing variables surrounding DTV.

Analysis

Rogers uses many characteristics and categories to of an adopter in conjunction with the key elements of diffusion to explain why one product may be adopted an another may be forgotten.[20] Rogers describes that with the inclusion of these elements and characteristics, diffusion is defined as a process by which an innovation is communicated through certain channels over time among members of a social system.[21] Additionally,

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[18] *Id.*

[19] *Id.* at 263

[20] *Id.*

[21] *Id.* at 5

many scholars have used diffusion research that has been applied to technologies such as the fax machine, refrigerators, cellular telephones, Nintendo, personal computers, and many other innovations. Furthermore, certain elements of Rogers' theory have been used to recently explain consumer awareness and adoption of DTV.

Characteristics of DTV that will Influence Adoption

The characteristics of innovations that influence adoption include **relative advantage**, **compatibility**, **complexity**, **trialability**, *and* **observability**. The following DTV attributes, if recognized by consumers, could influence DTV's rate of adoption.

- **Relative Advantage**. Consumer awareness studies have proven that respondents did not perceive DTV to be better than their existing television. Furthermore, these studies have found that the respondents believed DTV to be complex and unsure of the possible advantages. However, the following are benefits policy needs to address. One of the main benefits of DTV is that HDTV provides almost ten times the picture resolution of an analog picture.[22] Another advantage DTV provides is multi-casting.[23] Multi-casting allows a broadcaster to air either four standard-definition programs; two SD and one HDTV program; or two HDTV programs at the same time.[24] DTV also provides a much higher quality of sound than analog television.[25] The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound.[26] Furthermore, HDTV provides a better aspect ratio.[27] The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture.[28] HDTV's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewers line of sight.[29]

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[22] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 81

[23] *Id.* at 79

[24] *Id.*

[25] *Id.*

[26] *Id.*

[27] *Id.*

[28] *Id.*

[29] *Id.*

- **Compatibility**. DTV is compatible to some existing forms of consumer electronics that are currently used with an analog TV set. A consumer would have to acquire a digital VCR that is compatible with digital television. Furthermore, a consumer may not receive the same benefits from a converter box for an analog television as they would with an HDTV set.

- **Complexity**. From a user's perspective, DTV operates exactly the same as an analog television, making it unnecessary to learn hardly any new skills. Digital television includes enhancements such as DVR's that may require the consumer to learn the necessary operation skills. Also, a consumer will need a digital set top box if the television is not cable ready.

- **Observability**. HDTVs are place in many retail outlets, including Circuit City and Best Buy displaying examples of DTV. However, an individual must be in these particular stores or know someone with DTV to see how it works. The innovation is observable, but in limited areas.

- **Trialability**. An individual may try out DTV at one of the aforementioned outlets or may see a HDTV set in a restaurant, bar, or friends home. However, it is improbable that a consumer would be able to take a HDTV set home and have DTV for trial use. Furthermore, consumers believe current pricing of DTV related products to outweigh the rewards.

As a result of the aforementioned characteristics of DTV that will influence adoption, there are prevalent issues regarding policy. First, how can policy inform consumers about the technological advancements of digital television and the new skills they may need to acquire? Second, how can policy be implemented to detour some of the financial burdens that will occur due to drastic changes that have been made to technology by switching to a digital system? Third, how can policy ensure proper steps be taken to provide retailers with the correct information to relay to consumers so adoption will occur? Forth, what steps could be taken to ensure DTV is observable and gain public interest? Policy has many hurdles to overcome; if these questions are properly addressed consumer adoption will occur at a more rapid pace.

Consumer Awareness and Understanding of DTV

Rogers states that the essence of diffusing ideas and innovations into society is the information exchange from an individual to another.[30] Furthermore, Rogers implies that the use of mass media channels provides the fastest and most efficient way to inform potential adopters of an innovation.[31]

Sylvia Chan-Olmstead's study analyzes the current status of consumer awareness and knowledge of DTV in the United States.[32] As to DTV related electronics, "52% of the respondents own DVD players, 28% own large screen TV sets, 21% own home theater systems, and 31% high speed Internet access at home, but only 7% have a Digital Video Recorder (DVR)."[33] Few of the respondents had adopted forms of DTV, only 6% owned HDTV sets, with 5% owning DTV sets, and 4% had acquired DTV converter boxes.[34] The term HDTV was recognized by 84% of the people questioned, while only 10% of the respondents could identify all seven DTV terms.[35] The terms presented in the questionnaire were HDTV, DTV, ITV, ETV, SDTV, multicasting, and EDTV.[36] The average respondent recognized 3 of the provided DTV terms.[37]

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[30] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 18

[31] *Id.*

[32] Sylvia Chan-Olmsted and Byeng-Hee Chang, *Consumer Awareness and Adoption of Digital Television: Exploring the Audience Knowledge, Perceptions, and Factors Affecting the Adoption of Terrestrial DTV*, Submitted for Presentation to the CT&P Division at AEJMC, March 2003

[33] *Id.* at 18

[34] *Id.*

[35] *Id.*

[36] *Id.*

[37] *Id*

Chan-Olmstead's study reveals that the U.S. audience is extremely unfamiliar with DTV.[38] In total, only 141 usable responses were received, an 18% response rate for 780 people questioned.[39] Chan-Olmstead said this was due to a lack of topic salience.[40] A low response rate is a common occurrence when respondents are unfamiliar with the topic.[41] Of the 18% response rate, only 6% owned HDTV sets, with 5% owning DTV sets, and 4% had acquired DTV converter boxes.[42] Thus, by using the presented figures, only eight people out of 780 questioned claimed to have owned a HDTV set. The numbers for DTV sets and converter boxes are less than eight people.

In a similar study, the United States General Accounting Office found through a telephone survey of 1,000 randomly selected American households that very few people understood DTV transition and its implications.[43] Additionally, the study found that consumers have not been adopting DTV at a rapid enough pace that would allow 85% market penetration by December 31, 2006.[44] Furthermore, the GAO found that the information DTV retailers were providing to consumers was inaccurate.[45]

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[38] *Id.* at 13

[39] *Id.*

[40] *Id.*

[41] *Id.*

[42] *Id.* at 18

[43] United States General Accounting Office, *Report to the Ranking Minority Member, Subcommittee on Telecommunications and the Internet, Committee on Energy and Commerce, House of Representatives*: *Additional Federal Efforts Could Help Advance Digital Television Transition*, November 2002, GAO-03-7

[44] *Id.* at 15

[45] *Id.*

The GAO study found that 40% of respondents have never heard about the transition to DTV and another 43% were only somewhat aware of the digital transition.[46] Additionally, 20% stated they were very unaware of the digital transition.[47] The study revealed that 50% of the consumers questioned did not know the difference between an analog television set and a HDTV set.[48] Also, 68% of the respondents were unaware that their current analog sets will require a converter box to receive digital over-the-air broadcasts.[49]

On October 14, 2003, the Consumer Electronics Association (CEA) released a study regarding consumer awareness of DTV.[50] The study consisted of surveying 1,000 American consumers.[51] The survey found that consumers were very confused about DTV and HDTV products.[52] For instance, 74% of the consumers surveyed did not know that a set-top box was required to watch HDTV programming and 78% were unaware that a HDTV-enabled recorder was required to record programming.[53] Additionally, 54%

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[46] *Id.*

[47] *Id.*

[48] *Id.* at 16

[49] *Id.*

[50] Consumer Electronics Association, *CEA Survey Reveals 9 million Plan to Purchase HDTV Over Next 18 Months*, October 14, 2003.

[51] *Id.*

[52] *Id.*

[53] *Id.*

of consumers were unaware that they can not watch all shows in HDTV format because many programs are not yet available.[54]

Collectively, the above studies reveal that the U.S. public is extremely unaware of digital television and lacks enough knowledge of DTV to make an educated decision to adopt the innovation. The studies strongly suggest that communication channels, perceived need of an innovation, and the knowledge of DTV's relative advantage are vital aspects to improve consumer adoption of DTV.

Identification of Social System and Key Players

Rogers defines a social system "as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal."[55] Members of a social system can range from individuals to informal groups or even large organizations.[56] These members of a social system can decide to adopt an innovation by a collective or an authority decision. The decision to choose an innovation are as followed:

> "(1) Optional innovation-decisions are choices to adopt or reject an innovation that are made by an individual independent of the decision of the other members of the system. (2) Collective innovation-decisions are choices to adopt or reject an innovation that are made by consensus among the members of a system. (3) Authority innovation-decisions are choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise."[57]

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[54] *Id.*

[55] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 28

[56] *Id*

[57] *Id.* at 28-29

Rogers claims that the fastest rate of adoption of innovations results from authority innovation-decisions. Furthermore, he states that optional decisions are usually made more rapidly than collective decisions.[58]

There have been many social systems that have been engaged in joint problem-solving to accomplish the goal of widespread adoption of DTV. The following timeline will clearly show what social systems have played a role in adopting digital television and when they began trying to solve the problem.

Year

1981- Broadcasting industry lobbied for the FCC to create a committee to study the impact digital television would have on the United States. [collective]

1982- CBS and NHK presented their HDTV demonstration before the FCC. [collective]

1987- The FCC created the Advisory Committee on Advanced Television Services to analyze the possibility of moving to a more advanced television system. [authority]

1988- President Bush ordered the Secretary of Commerce to place an emphasis in developing the American HDTV system. [authority]

1988- The Advisory Committee began testing both analog and digital HDTV systems. [authority]

1989- The Defense Department agreed to grant $30 million to American companies developing HDTV products. [authority]

1990- The FCC declared that the HDTV system would have to be all digital and fit into 6 MHz of space. [authority]

1991- GI and MIT demonstrated an all-digital HDTV system for the NAB. [collective]

1993- The Grand Alliance was formed consisting of GI, Zenith, AT&T, and ARTC. It was their mission to jointly develop a single American HDTV system. [collective]

1997- The FCC presented a timeline that required all television stations to switch from analog transmissions to digital broadcast by specific deadlines. [authority]

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[58] *Id.* at 29

Many social systems have helped shape the current status of DTV. The aforementioned units were all engaged in joint problem-solving to bring a HDTV system to the United States. Both collective and authority decisions were made within the process of deciding on an acceptable format for HDTV. Authority decisions provide an innovation with the fastest rate of adoption, but collective decision-making is the slowest form of adoption. The combination of both of these decision-making efforts has certainly hindered the fastest possible rate of adoption for DTV. The aforementioned timeline shows the classification for each social system's involvement in the creation of U.S. DTV. Furthermore, the roles of optional-innovation decisions have been placed in the hands of consumers for they have not been required to purchase new equipment during the DTV transition. Without awareness and understanding of DTV, consumers are less likely to adopt even though authority decision making has occurred by policy-makers to force the industry to switch to digital.

Innovation Development Process

DTV's development began by industry and policy-makers deciding that there was a problem with analog television.[59] In 1987, the broadcasting industry addressed the FCC on the matter of giving away vacant UHF channels.[60] A NAB officer said, "and that would lead to the death of local broadcasting as we know it."[61] In 1989, the Defense Department agreed to grant $30 million to American companies developing HDTV

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[59] Aaron Futch, *Media & Communications: Digital Television: Has the Revolution Stalled?* Duke Law & Technology Review, April 26, 2001.

[60] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 21

[61] *Id.*

screens and video display processors to expedite new innovations.[62] Eventually, all of this lead to Congress enacting the Telecommunications Act of 1996 and the FCC following this with policy related to DTV.

The innovation of DTV was initially not developed to meet the needs of an audience of potential adopters. DTV was developed to meet the needs of industry and government and has been driven by policy instead of need. The American public is extremely unaware and possesses practically no knowledge of DTV, so how could need of the American citizens be a legitimate factor.[63] DTV provides a case where industry and policy-makers created a situation where politics and regulation have dominated the arena.

DTV has not followed the basic S-Curve strategy for spreading an innovation. This is a process that is time sensitive and key components of the strategy have to be precisely placed in order to achieve a maximum rate of adoption. First, the idea or innovation must be put through a series of experiments and pilot projects.[64] Second, once the innovation has passed the series of test, companies can build support systems to stabilize the innovation for further development.[65] Next, the innovation needs to be properly advertised to gain popularity among society.[66] The electoral politics stage is in place for the innovations' opposition to be addressed and comfortable with furthering its role in

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[62] *Id.* at 36

[63] Sylvia Chan-Olmsted and Byeng-Hee Chang, *Consumer Awareness and Adoption of Digital Television: Exploring the Audience Knowledge, Perceptions, and Factors Affecting the Adoption of Terrestrial DTV*, Submitted for Presentation to the CT&P Division at AEJMC, March 2003

[64] *Id.*

[65] *Id.*

[66] *Id.*

society.[67] Finally, for an innovation to be reached by a critical mass, regulation is the strategy utilized last.[68] However, in the situation of DTV, electoral politics and regulation arrive way before the innovation was popularized. Skipping the most important aspect of the strategy for spreading innovations will in no doubt hinder DTV's rate of adoption and slow the time in which the innovation will reach a critical mass.

Innovation Decision Process of DTV

Because consumers will ultimately popularize DTV through acquiring new sets, analyzing their decision making process is vital to furthering DTV adoption. Rogers describes the innovation-decision process consists of a series of actions and choices over a period of time in which the individual decides to adopt or reject an innovation.[69]

Rogers' framework for analyzing the individual consumer's decision making process on whether to adopt DTV consists of the following five steps.

- **Knowledge**. Based on consumer awareness studies, the American public has little or no knowledge of DTV.
- **Persuasion**. Without knowledge of the innovation, persuasion cannot properly occur. The public has not been able to form a favorable attitude towards DTV. However, industry has advertised and promoted DTV and HDTV related products.
- **Decision**. The lack of consumer awareness has affected the U.S. public in making adequate decisions which lead towards choosing to adopt or reject DTV.
- **Implementation**. Currently, the U.S. in the early adopter category for the adoption of DTV. Only 1.5% of the American public has acquired DTV and put it to use.
- **Confirmation**. Confirmation of DTV will not occur until the public gains knowledge of the innovation. Thus, decisions have not been made to adopt the product, therefore individuals can not possibly seek any sort of reinforcement that the innovation will be permanent.

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[67] *Id.*

[68] *Id.*

[69] *Id.*

Obviously the lack of consumer awareness will affect DTV's rate of adoption. Without the government and industry adequately informing the public of DTV, the ability for consumers to exercise decision-making will be void.

Rate of Adoption and Price

As previously mentioned, the rate of adoption is the relative speed in which members of society adopt an innovation.[70] In addition to relative advantage, compatibility, complexity, trialability, and observability, cost can be a significant variable that affects the rate of adoption.

In analyzing the DTV market, price of sets are significant factors for consumer adoption of DTV. In 2002, only 2.5 million HDTV's were sold.[71] This number makes up only ten percent of total television sales in the U.S. last year.[72] One reason for this is that most TVs capable of pulling in HDTV broadcast are big-screen units that cost over $2000—almost three times the average price of an analog set.[73] Lisa Pickelsimer, manager of video product development for COX Communications, predicts that widespread adoption of HDTV will not occur until the average price falls below $500.[74] This in itself presents a problem because as high prices keep the numbers of buyers small,

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[70] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 206

[71] *Id.*

[72] *Id.*

[73] *Id.*

[74] *Id.*

it makes it hard for set manufacturers to gain the economies of scale that will allow them to reduce prices.[75]

Status of U.S. regarding Innovator and Adopter Categories of DTV

As previously mentioned, Rogers explains the adopter categories as ideal types.[76] Ideal types are defined as "conceptualizations based on observations of reality that are designed to make comparisons possible."[77] Innovator adopter categories are important for determining innovativeness in a consumer. Moreover, these categories can help in explaining when an innovation has been adopted by enough of society to reach a critical mass. The following are innovator categories along with their ideal types: (1) Innovators: Venturesome [2.5% of population has adopted the innovation], (2) Early Adopters: Respect [13.5% more], (3) Early Majority: Deliberate [34% more], (4) Late Majority: Skeptical [34% more] and, (5) Laggards: Traditional [last 16% have adopted].

The United States is currently in the innovator category. There are approximately 100 million television households in the United States.[78] According to the firm Strategy Analytics, 4.8 million U.S. homes owned a HDTV or DTV set at the end of 2002, with only one million of these homes also having HDTV tuners for either cable, satellite, or terrestrial platforms.[79] Considering that only one million of these homes are capable of receiving a digital signal, this would make DTV penetration about one percent.

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[75] *Id.*

[76] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 263

[77] *Id.*

[78] Brad Dick, *Powell's Folly,* Broadcast Engineering, Sept. 1, 2002.

[79] Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

Strategy Analytics predicts the number of HDTV capable displays will have reached 33.4 million households by 2008.[80] This number would lead one to believe that by 2008 the U.S. will have a 30% penetration rate, this is not the case. Strategy Analytics continues in the report, that of these displays 27% will be connected to a HDTV service through cable, 14%via satellite, and eight percent by way of digital terrestrial television.[81] This leaves 51% with no HDTV service whatsoever, making the Strategy Analytics prediction to be 15% penetration of U.S. television households.[82]

According to the Strategy Analytics study the United States has not even reached the half-way point of the Innovator category.[83] Innovators account for the first 2.5% of adopters, based on the categories of innovativeness.[84] Furthermore, the study reveals that by 2008 DTV will have penetrated only 15% of U.S. households.[85] This means that in five years the U.S. will have not even completed the early adopter category, the second category out of five leading towards total adoption.

Digital Television's Hardware and Software Component

Digital television is a technological innovation with both hardware and software components. High definition television (HDTV) sets and converter boxes make up the hardware aspect of DTV. The software aspect is the transmission of the digital signal,

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[80] Alex Salkever, *HDTV Tiptoes to Prime Time*, BusinessWeek, Dec. 10, 2002.

[81] Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

[82] *Id.*

[83] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 263

[84] *Id.*

[85] Mark Long, *Firm Predicts 15 Percent Rate for HDTV by 2008*, Electronic Business Online, Oct. 29, 2002.

which is the informational base of the innovation, to the television. Scanning formats, such as 480p standard definition STD along with 720p and 1080i HDTV help make-up the software component of DTV.

Rogers uses the example of computer hardware and software to illustrate a technology's two components, explaining that first the hardware must be purchased so that the software can be utilized.[86] He further uses examples of VCRs and videotapes, cameras and film, and compact disc players and CDs to illustrate the two aspects of a technological innovation.

These illustrations provide great examples explaining the hardware and software components of technological innovations, but DTV is a different innovation. Consumers must have HDTV or DTV sets to receive HDTV or multi-cast broadcasts and programming. Rogers defines an innovation as "an idea, practice, or object that is perceived as "new" by an individual or other unit of adoption".[87] He also explains that it should not be assumed that the diffusion and adoption of every innovation are necessarily desirable.[88] For the most part, the illustrated examples were technologies that were new innovations. Consumers perceived these innovations as desirable. However, DTV is an enhancement of a current technology and may not be perceived as a necessity or desirable to adopt by consumers.

While consumers may not have an expressed or overwhelming desire to obtain the hardware necessary for DTV, the following section will illustrate the characteristics of an

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[86] *Id*

[87] *Id.*

[88] *Id.*

innovation that can be used to explain their rate of adoption. Such characteristics may provide information regarding consumers' desirability for DTV.

Technology Transfer of DTV

Presently, it seems as if the United States is succeeding in technology transfer. Beginning with the Grand Alliance's efforts to jointly create a HDTV system, the United States has been committed to ensuring companies are aware and knowledgeable of this innovation.[89] Furthermore, the companies that have received this technology are developing HDTV products and putting them into use in their own companies. Additionally, American companies like Zenith have commercialized HDTV products to be placed in retail outlets, such as Circuit City and Best Buy for consumer consumption. Technology transfer is an essential part of the diffusion process. The United States achievement in DTV technology transfer will have a positive impact on DTV's rate of adoption even though a lot of work remains to educate and make consumers aware of DTV.

What Will it Take for DTV to Reach a Critical Mass

The critical mass occurs at the point when enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining.[90] Rogers states that "a critical mass of individuals must adopt an interactive communication technology before it has utility for the average individual in the

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[89] Joel Brinkley, *Defining Vision: How Broadcasters Lured the Government into Inciting a Revolution in Television: The Battle for the Future of Television*. Harcourt Brace & Company, 1997. At 291

[90] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 313

system."[91] However, for a non-interactive innovation, the more people who adopt the innovation make it more appealing and increasingly beneficial to future adopters.[92]

Rogers offers some possible strategies that may be used to reach critical mass for an innovation in a social system. They include:

- Target top officials in an organization's hierarchy for initial adoption of the innovation.
- Shaping individuals' perceptions of the innovation.
- Introducing the innovation to intact groups in the system whose members are likely to adopt at once.
- Provide incentives for early adoption of the innovation, at least until the critical mass is reached.

The following section will utilize these four strategies for an innovation to reach a critical mass to provide policy recommendations based on the analysis of digital television and ultimately encourage government to take action to spur growth of DTV.

Policy Recommendations

The first strategy that should be utilized when pushing an innovation towards reaching a critical mass is the targeting of top officials in an organization for initial adoption of the innovation. This has been successfully achieved. As of October 15, 2003, the National Association of Broadcasters reported that over 99% of U.S. television households are in markets where DTV is transmitted.[93] Currently, 1060 of the nation's 1,309 commercial broadcast stations have started to broadcast digitally.[94] Meanwhile,

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[91] *Id.*

[92] *Id.*

[93] National Association of Broadcasters, *DTV Stations On Air Top 1000*, October 15, 2003. www.nab.org/Newsroom/PressRel/Releases/dtvlatest.htm

[94] *Id.*

183 public stations are broadcasting digitally.[95] Furthermore, the cable industry has provided more programming options and availability to the consumer. Additionally, manufacturers and retail outlets have begun to sell DTV related products and provide information to potential adopting consumers. However, more programming could be made available to entice consumers to adopt DTV. The more programs that are available, the more consumers become interested.

The second strategy that is important for an innovation to reach a critical mass is to shape an individual's perception of the product. Based upon the lack of consumer awareness and understanding of DTV, policy and government has not adequately implemented this strategy. The policy recommendation based on this strategy would be for the government to fund and initiate a public information campaign to inform consumers of DTV. The most effective way to initiate this plan would be to flood tools of mass media with propaganda related to digital television. First, the campaign should begin with a massive mailing to all U.S. households. Second, an advertising plan similar to the U.S. Treasury's recent campaign with the new twenty-dollar bills should be implemented. This plan would inform the public of digital television through television, radio, newspaper, and magazine advertisements. The following paragraph will explain the information the government should provide to encourage widespread consumer adoption of DTV.

First, the campaign should provide a thorough explanation of the technology behind DTV. The most layman approach would be to begin with digital television's hardware and software components, so the consumer can get an idea of what products

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[95] *Id.*

would enable them to view DTV programming. Second, the campaign should focus on the characteristics that influence adoption. The provided information should include the following details.

- **Relative Advantage**. One of the main benefits of DTV is that it provides almost ten times the picture resolution of an analog picture.[96] Another advantage DTV provides is multi-casting.[97] Multi-casting allows a broadcaster to air either four standard-definition programs; two SD and one HDTV program; or two HDTV programs at the same time.[98] DTV also provides a much higher quality of sound than analog television.[99] The current analog TV only produces two channels of stereo sound, but HDTV provides viewers with 5.1 channels of Dolby surround sound.[100] Furthermore, DTV provides a better aspect ratio.[101] The aspect ratio of a standard television is 4:3, which usually leaves out part of every picture.[102] DTV's aspect ratio is 16:9, which is similar to the ratio used in movie theaters and much more appealing to a viewers line of sight.[103]

- **Compatibility**. DTV is compatible to all existing forms of consumer electronics that are currently used with an analog TV set.

- **Complexity**. From a user's perspective, DTV operates exactly the same as an analog television, making it unnecessary to learn any new skills. For consumers without cable ready sets, a digital cable set top box may be purchased.

- **Observability**. HDTVs are place in many retail outlets, including Circuit City and Best Buy displaying examples of DTV. However, an individual must be in these particular stores or know someone with DTV to see how it works. The innovation is observable, but in limited areas.

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[96] Peter B. Seel & Michel Dupagne, *Advanced Television*. Communication Technology Update 7th Edition, 2000. At 81

[97] *Id.* at 79

[98] *Id.*

[99] *Id.*

[100] *Id.*

[101] *Id.*

[102] *Id.*

[103] *Id.*

- **Trialability**. An individual may experience DTV at one of the aforementioned outlets or may see a HDTV set in a restaurant, bar, or friends home. However, it is improbable that a consumer would be able to take a HDTV set home and have DTV for trial use.

Furthermore, the information should focus on the first four attributes because they are all conceivable. There would be no point to mentioning trialability because it would only undermine the point that DTV is advantageous, compatible, operational, and observable.[104]

The last initiative in the campaign should focus on the progress of DTV. The American public should be made aware that over 99% of households are in markets where DTV is transmitted.[105] The advertisements should also focus on the programming that is available for consumption. It will be important to capture consumer interest. By letting the public know they can view their favorite show in this advanced format, whether it be comedy, drama, or sports will spark interest. The implementation of an informational advertising plan of this nature should help correct the mistake of the government and policy-makers not popularizing DTV in the necessary time-frame. Popularization of an innovation is the most important strategy for spreading innovations and should be completed before electoral politics or regulation get in the way.[106]

Step three of possible strategies used for an innovation to reach a critical mass is to introduce the innovation to intact groups in the system whose members are likely to adopt

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[104] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). at 16

[105] National Association of Broadcasters, *DTV Stations On Air Top 1000*, October 15, 2003. www.nab.org/Newsroom/PressRel/Releases/dtvlatest.htm

[106] Cameron Frith, *Desk Research Project: The Diffusion of Innovations* At 11 2000

at once.[107] If the aforementioned informational advertising campaign is initialized and made available to all citizens via modes of mass communications, innovators will adopt the product at a faster rate.[108] Once this is achieved, the innovator adopter categories will fall into place. The next group, early adopters, will begin to see the innovation as beneficial.[109] The campaign should provide enough information to allow potential consumers to be completely certain that the innovation is permanent and will not fail. By achieving this, the last category of adopters, the laggards, should be influenced to adopt DTV.[110]

Finally, the last strategy used to reach a critical mass is to offer incentives for the early adoption of the innovation.[111] Neither policy nor government has initiated this key strategy. The policy recommendation for this strategy would be for the government to offer tax incentives to industry, manufactures, and consumers. This would allow each group to detour some financial burdens associated with switching to a digital system. Furthermore, this will speed adoption and benefit the government by reclaiming the valuable spectrum in a timely manner. This would allow the government to use the spectrum as they desire, possibly auctioning off the space to increase money in the federal treasury.

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[107] Everett M. Rogers, Diffusion of Innovation Fourth Edition 39 (The Free Press ed., Simon & Schuster Inc. 1995) (1962). At 318

[108] *Id.* at 263

[109] *Id.*

[110] *Id.* at 265

[111] *Id.* at 318

The above policy recommendations are based on Rogers' strategies for an innovation to reach a critical mass. By understanding Diffusion of Innovation Theory and incorporating historical, technological, market, and regulatory aspects of DTV, these recommendations will increase digital television's rate of adoption and ensure consumers that the innovation is permanent. Without the implementations of these policy recommendations, 85% penetration of digital television will not occur in most markets by the December 31, 2006 transition. Furthermore, *Strategy Analytics* study claiming only 15% of households will be digitally equipped by 2008 is highly possible.

In summary, the research framework has employed the diffusion of innovation theory to better understand how consumers may adopt DTV. The analysis has been made based on Rogers' diffusion of innovation theory along with variables and findings from modern scholarship that included technological innovations closely associated with DTV. To increase adoption of DTV the following must be achieved. First, consumers need to fully understand the hardware and software components that make-up DTV and gain more awareness of the innovation. Second, if consumers recognize the characteristics of DTV that influence adoption, adoption will occur at a greater rate. Third, if the policy recommendations are utilized, DTV may achieve the point of critical mass at a far greater rate than if ignored.

CHAPTER 6
CONCLUSION

Television in the United States is nearing a dramatic change. Broadcasters are beginning to disseminate their messages via digital transmissions. When this convergence from an analog to a digital signal is fully complete, Americans will be exposed to the greatest revolution in television history. In fact, television will never be viewed the same way again. The most commonly known advantage of digital television (DTV) is the enhanced quality of picture and sound, better known as high definition television (HDTV). However, digital television has the potential to serve the American public in a variety of ways, including each broadcaster being able to use their station to multi-cast four simultaneous streams of DTV programming to the viewer.

While DTV provides many enhancements over analog television, consumer adoption has been very minimal. The lack of diffusion can be attributed to a variety of variables that exists within the technology, market, and regulation of the innovation of DTV. For instance, many consumers feel that they are receiving quality television from their current analog sets. Furthermore, the cost of an HDTV set is still very high for the average consumer and there are currently no benefits, such as tax credits or deductions to entice a consumer to spend a large sum of money for a product they feel is not a necessity. Additionally, the FCC has imposed a mandatory deadline of December 31, 2006 for full transition of analog to digital transmissions. Considering the variables that are present with DTV, it is very unlikely that this deadline will be met without some provisions to policy and regulation for digital television.

This thesis has explained the diffusion of innovation theory and digital television from a technological, market, and regulatory perspective. Digital television is a new and exciting innovation that will enhance both the television and the consumers' way of receiving information. Until now, there has been insufficient literature pertaining to digital television enhancements and contributions that DTV will bring to society. Also, diffusion of innovation studies have not included digital television. This thesis has accomplished both tasks by using the diffusion of innovation theory as a lens to understand how public policy can better the transition to digital television and help DTV reach a critical a critical mass among consumers.

Chapter 2 provided the methodology of the research. The thesis used policy analysis, which is a social and political activity, to examine how the diffusion of innovation theory could be employed to have public policy expedite the transition of digital television. Chapter 3 thoroughly explained the historical, technological, policy and market variables surrounding digital television. Chapter 4 served as the literature review, providing a basic overall understanding of Everett M. Rogers' diffusion of innovation theory as well as offering modern scholarship that incorporated Rogers theory to better understand consumer awareness and adoption of particular technological innovations. Furthermore, Chapter 5 analyzed DTV using Rogers' diffusion of innovation theory as well as modern scholarship related to the adoption of recent technological innovations. Also, Chapter 5 presented various policy recommendations that could be implemented to increase consumer awareness and adoption and ultimately help digital television reach a critical mass.

The thesis did have limitations. There was an inadequate number of studies that reflected consumer adoption and awareness of DTV. However, the thesis used the diffusion of innovation theory and studies of recent innovations to analyze how the variables of DTV that affect adoption. For future research, it is suggested that after the United States completes the full transition to DTV, a comparison should be made between the rate of adoption of digital television and other technological innovations. Another idea for future research would be to compare the rate of adoption between color television and DTV. The transition from black and white television to color television is comparable to the transition from analog to digital. The study would be useful in determining if the United States has progressed over several decades in informing consumers of new technologies, more importantly comparable technologies.

The analysis found that public policy and industry has not adequately informed consumers to the adoption of digital television. Consumers are unaware and lack salient knowledge of almost every aspect of DTV. First, studies provided by Sylvia Chan-Olmsted, the United States General Accounting Office, and the Consumer Electronics Association explained the lack of understanding of DTV. This stems from the understanding of DTV's hardware and software components to the awareness of DTV related products and how to receive broadcast. Second, consumers have not been informed of the characteristics of DTV that influence adoption. The characteristics include relative advantage, compatibility, complexity, trialability, and observability. Third, the United States has been successful in technology transfer and the innovation decision process of DTV. However, regardless of how knowledgeable the government and industry are about DTV, widespread consumer adoption will not occur until public

policy addresses consumer awareness. Finally, the analysis provided policy recommendations that, if initiated, should alleviate DTV's slow rate of adoption. The policy recommendations included a public information campaign to inform consumers of DTV. The initiation of this campaign will explain the technology behind DTV as well as focus on the beneficial characteristics of DTV that will influence adoption. Moreover, consumer incentives, such as tax credits, have been explained to further a consumers desire to adopt DTV. This thesis explained how the diffusion of innovation theory could be used as a lens to understand how public policy can better the transition to digital television and help DTV reach a critical mass.

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BIOGRAPHICAL SKETCH

Richards Morse Rhodes was born on March 4, 1979, in Columbia, South Carolina. He graduated high school in 1997 from Waccamaw High School in Pawley's Island, South Carolina. In 2001, he received his Bachelor of Arts in Political Science (with a minor in film) from the University of South Carolina. He received his Master of Arts in Mass Communication from the University of Florida.