Capital One Internal Web Application

The Technology Adoption Life Cycles of the Television vs Social Computing

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

By
MaryJeanine Seaman

November 1, 2021

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Adarsh Ramakrishnan, Department of Engineering and Society

Daniel Graham, Department of Computer Science

Introduction

The first televisions created for consumer use were presented at the 1939 World's Fair; however, World War II societal circumstances caused TVs not to go into production until 1945 (Reinhardt & Ganzel). By 1950, when television prices were decreased, nine percent of U.S. households had a television. As shown in Figure 1, televisions were then rapidly adopted and by 1962, 90 percent of Americans had televisions in their homes. Adoption continued at a slower rate until 1987 when 98 percent of households had TVs.

A modern representation of a similar normal curve technology adoption is social computing. The first recognized social media platform was created in 1997. Figure 2 demonstrates, however, by 2005 just five percent of American adults used a networking platform. Between 2005 and 2014, a mass adoption to 62 percent of the public used social media. Today 72 percent of Americans use some type of social media.

The technology adoption life cycle is a visual model demonstrating society's acceptance of new inventions. This sociological model uses the demographic and psychological characteristics of adopter groups in order to show the process of how many people tend to start using a technology in the time after it is released. The process of adoption over time for successful technologies, as demonstrated by the television and social computing, is illustrated as a normal distribution, where few people start using new technological devices immediately after production, then gradually the majority of people start using it, before finally the reluctant people start using it. Engineers and inventors use the adoption curve to their advantage by obtaining crucial feedback from the early adopters in order to fix design flaws before the invention diffuses to the majority.

The technical section of this prospectus demonstrates how software engineers can use the adoption curve by analyzing the connection between a web application technology and the client. The web application was created for the Capital One software engineers and managers working in the Card Tech Digital Servicing department. This computing experiential event demonstrates how mutual determinism affects engineers' jobs as well as how utilizing the adoption curve can increase a project's value.

The STS section compares and contrasts the technology adoption life cycles of television and social computing, analyzing how and why these technologies succeeded on mass scales. The decision of whether an individual will adopt a technology and the time frame involved is a major factor in whether an innovation succeeds. The prospectus also discusses parallels in the mutual determinic relationship both the television and social computing have with society, as well as the demonization of these technologies as moral hazards within their adoption journeys.

Technical Topic

Interning with Capital One was a computing experience in which a team of software engineers and I created a full stack web application in order to dynamically display multiple databases. The Card Tech department of Capital One assigned our team to solve the problems they had with catologing feature ownership. At the time, Card Teach had teams and features stored in spreadsheets. While the use of the information in these spreadsheets would be very helpful to employees, they were not consistently utilized because they were frequently out of date and difficult to use. This resulted in many management issues including orphaned features when teams dissolved and mass testing when software engineers couldn't ask specific teams instead.

Therefore, my team was tasked with creating an application that allowed Capital One employees to keep track of feature ownership among the teams in this department. The hope was that employees would adopt the web application if it was dynamic and easy to use. Therefore, our team consistently presented to clients for feedback and viable product requirements to solve these challenges with feature management.

We implemented the application using Angular for the frontend, Python and FastAPI in the orchestration layer, and PostgreSQL, Jenkins, and Lambda in order to run on a serverless Amazon Web Service environment. Our application had different pages to present table views of features, teams, and microservices, which included searching and filtering capabilities for ease of use. For each item in the tables, the user could access a details page and internal and external links to relevant information. In order to solve the problem the teams faced when testing, we displayed contact information for each team. We also added data exporting capabilities for employees to use. We added Single Sign On authentication to the application in order to allow all Capital One employees reading capabilities, but only specific managers writing capabilities. We solved the problem of orphaned features by creating an error when trying to delete a team without first rehoming the features they own.

At the end of the internship, my team showcased a viable product that is now in use among the Card Tech department's engineers and management. The managers were excited about the prospect of making this internal tool available for more departments in order to spread the value to the entirety of Capital One. Making this web application available for all of Capital One would increase the value of this project. Each application would need to be changed from the one my team created in order to solve problems the other managers and teams are facing.

This project could also be enhanced by going to the department a year after it was put into production in order to get feedback on what is working and what needs to be changed. This process could be described as a software engineer using the adoption curve in order to get crucial feedback from early adopters in order to fix design flaws before the technology diffuses to the majority. Before expanding the web application more of Capital One, the managers need to first see if it is being used more than the spreadsheets were in this department. If it is not, the software engineers need to first solve the issues arising in the sociotechnical relationship between the technology, the company, and the employees before spreading an unused technology.

STS Topic

Technology adoption is a complex, social, developmental process. It is influenced by individuals' unique yet malleable perceptions of technology, which is based on their personal beliefs, prior experiences, characteristics of the innovation, peers, and societal norms (Straub, 2009). Therefore, cultural conditions determine whether, when, how, and in what form a new item will be adopted; the closer the innovation is compatible with the structure of the culture, the greater the chance of societal acceptance (Graham, 1954).

Successfully facilitating a technology adoption needs to address cognitive, cultural, and contextual concerns. Even if an innovation is useful, any one of these concerns can lead to unacceptance (Straub, 2009). Two technologies that were successfully adopted on a mass scale are the television and social computing. Social computing is defined as intragroup social interactions made possible through the mediation of information technologies, and results in members conforming and influencing others (Vannoy & Palvia, 2010). As seen in Figure 3, the process of adoption over time for both the television and social computing is illustrated as a

normal distribution, where a few enthusiasts start using a new technological device at first, then gradually the majority, then finally the skeptics accept it.

In a 1954 study, researchers found that the families whose cultural equipment prior to the introduction of television was compatible with the behavior required for its use would accept it to a greater degree than others (Graham, 1954). As seen in Figure 4, the study demonstrated that at the time acceptors of television were distinguished from rejectors by their possession of lower level education, a small to medium income, and passive recreational patterns such as listening to the radio and attending motion pictures. Acceptors of the television mentioned that they had acquired it partly because it could educate themselves and their children.

However, highly educated individuals rejected television on the grounds that it was not educational enough. One person in the study stated that they wanted their children to read books, "not sit in front of a television set doing nothing" (Graham, 1954). This is a theme throughout the introduction of new technologies: the reluctant people, or skeptics, demonize these technologies as moral hazards; they do not want society to change even as technologies are mutating societal rules and norms. The television has diffused widely in the decades since this study. This may be because increased positive attitudes are associated with greater exposure to a technology. This exposure effect "suggests that innovations in contemporary society have the capacity to create their own constituency once an initial foothold is gained." (McQuarrie & Iwamoto, 1990).

Technology adoption incorporates two essential elements, the embracement of the technology by individuals and its embedment in society (Vannoy & Palvia, 2010). As demonstrated in Figure 5, both television and social computing have a mutual deterministic relationship with society. Mutual Determinism refers to the way two objects or ideas can

influence each other. Technologies have mutual deterministic relationships with society and the people using them. Society has a set of rules and desires that technological devices have to fit into. However, many rules are dynamic and can be adjusted when people start adopting the innovations. The technology, therefore, changes public opinion and in turn creates room for new devices that people now have new standards for.

One model that discusses this is the social construction of technology, which refers to how a variety of social factors and forces shape technological development and change. In the other direction, technological determinism states that when technologies are adopted by societies it brings about social change and patterns of social behavior (Johnson). As social computing technologies become increasingly embraced by individuals and embedded in everyday lives and activities, technologically enabled social structures are emerging that are changing the way individuals interact and communicate (Vannoy & Palvia, 2010).

The Social Influence Model of Technology Adoption gives the example of SMS text messaging to demonstrate the mutual determinism between social computing and society. SMS was originally intended to deliver subscriber information, however, it was adopted by end users as a vehicle for social behavior. One way this technology has affected society is by creating a platform in which people create and use new slang in order to communicate.

The technology adoption life cycles of television and social computing demonstrate how each technology became widely successful in its society. Technologies are successful not by some objective measure of their efficiency; rather, technologies are accepted because they fit into societal culture, or have the ability to change the society norms.

Research Question and Methods

The topic of technology adoption life cycles for the television and social computing leads to the question: how can an engineer utilize widely adopted technological adoption curves, such as social computing and the television's, in order to add value and likelihood of success to their own projects? Through a personal account of a computing experience, the technical portion demonstrated one way the adoption curve can help software engineers and managers increase use and functionality of their projects. Therefore, in order to obtain the necessary information regarding this research question is to discuss the topic with engineers, entrepreneurs, and project leaders. These interviews will consist of questions such as: How have they used the adoption bell curve in their profession? How would using the adoption life cycle have added value to a previous project? What are some uses for the adoption curve in their field? Researchers will also gather different techniques and uses for the technology adoption life cycle by studying successful adoption curves, such as social computing and the television's, as well as ones that failed at different stages of social acceptance. By studying the differences of these life cycles, researchers can gather a better understanding of why some innovation's adoptions stopped at different parts of the adoption curve while others were widely diffused.

Conclusion

The personal account of developing a web application demonstrates how mutual determinism affects engineers' jobs as well as how utilizing the adoption curve can increase a project's value. The software development project could have been enhanced by going to the department a year after the application was put into production in order to get feedback on what is working and what needs to be changed. This is an example of using the adoption curve in order to get crucial feedback from early adopters so that the software engineers can fix design

flaws before the technology diffuses to the majority. Before expanding the web application, software engineers need to first solve the issues arising in the sociotechnical relationship between the technology, the company, and the employees before spreading an unused technology. This increases the use and usefulness of the project.

Researchers can gain a better understanding of why technologies succeed by comparing and contrasting the adoption life cycles of mass adopted technologies such as television and social computing. The decision of whether an individual will adopt a technology and the time frame involved is a major factor in if an innovation succeeds.

References

About. PostgreSQL. (n.d.). Retrieved December 2, 2021, from https://www.postgresql.org/about/.

FastAPI. FASTAPI. (n.d.). Retrieved December 2, 2021, from https://fastapi.tiangolo.com/.

Graham, S. (1954, December). Cultural Compatibility in the Adoption of Television. Retrieved October 10, 2021, from https://www.jstor.org/stable/2573541

Jenkins User Documentation. Jenkins. (n.d.). Retrieved December 2, 2021, from https://www.jenkins.io/doc/.

Johnson, D. G. (n.d.). Social Construction of Technology. *Encyclopedia of Science, Technology, and Ethics,* 1791-1795.

Lai, P. C. (2017, April). *The Literature Review of Technology Adoption Models and theories for the novelty technology*. JISTEM - Journal of Information Systems and Technology Management. Retrieved December 2, 2021, from https://www.scielo.br/j/jistm/a/D3NXPz5WF4gQX9cSdLKQv6D/?lang=en.

Lambda. Amazon. (n.d.). Retrieved December 2, 2021, from https://aws.amazon.com/lambda/.

Maeli, J.-P. (2018, September 10). *The rogers adoption curve & how you spread new ideas throughout culture*. Medium. Retrieved December 2, 2021, from https://medium.com/the-political-informer/the-rogers-adoption-curve-how-you-spread-new-ideas-throughout-culture-d848462fcd24#:~:text=The%20Rogers%20Adoption%20Curve%20(also,adopted%20by%20groups%20and%20cultures.&text=It%20was%20originally%20applied%20to,his%20book%2C%20Diffusion%20of%20Innovations.

McQuarrie, E. F., & Iwamoto, K. (1990). Public opinion toward computers as a function of exposure. Retrieved October 10, 2021, from https://journals.sagepub.com/doi/pdf/10.1177/089443939000800204?casa_token=xDGB

mY8LadIAAAAA%3AP9YBtL_2rywBybNQuCfkPy-fRDKU1R9rtD3z07szqyY5FxJ6MhdkIOJ_GMDE0Un7KgZtK3K_0Gvv

Pew Research Center. (2021, April 26). *Demographics of social media users and adoption in the United States*. Pew Research Center: Internet, Science & Tech. Retrieved November 17, 2021, from https://www.pewresearch.org/internet/fact-sheet/social-media/.

Reinhardt, C., & Ganzel, B. (n.d.). *TV Turns On*. Rural America turns on to TV in the 1940s. Retrieved November 17, 2021, from https://livinghistoryfarm.org/farminginthe40s/life_27.html.

Ruggeri, K., Kácha, O., Menezes, I. G., Kos, M., Franklin, M., Parma, L., Langdon, P., Matthews, B., & Miles, J. (2018, September 27). *In with the new? generational differences shape population technology adoption patterns in the age of self-driving vehicles*. Journal of Engineering and Technology Management. Retrieved December 2, 2021, from https://www.sciencedirect.com/science/article/pii/S0923474817303430?casa_token=Dx1NoYyLKsYAAAAA%3AZaEyvPAbMT8j0YcWjrze6s2_0L4uyXvrG21vRf4NbLQmc6jEZ_xjeNxR7bnvDkJBKVv446HmoA.

Single sign-on: What is it & how does it work? OneLogin. (n.d.). Retrieved December 2, 2021, from https://www.onelogin.com/learn/how-single-sign-on-works.

Sharma, A. (2021, February 9). *Backend or frontend who owns the API orchestration layer?* LinkedIn. Retrieved December 2, 2021, from https://www.linkedin.com/pulse/backend-frontend-who-owns-api-orchestration-layer-ashutosh-sharma/.

Sharma, R., & Mishra, R. (2018). A Review of Evolution of Theories and Models of Technology Adoption. *Idore Management Journal*, 17–29.

Straub, E. (2009). Understanding technology adoption: Theory and future directions for informal learning. Retrieved October 10, 2021, from https://journals.sagepub.com/doi/pdf/10.3102/0034654308325896?casa_token=B4lQkN19AawAAAAA%3AXXhjjM-JLF3FPsA7aD7fjiZEm9yX4mqEmCK0hfhkEfVN6GpP2bGLbLshRw1_jR3oVt4YDe-J8xUN

Television History - The First 75 Years. Facts-stats. (n.d.). Retrieved November 17, 2021, from http://www.tvhistory.tv/facts-stats.htm.

The evolution of social media: How did it begin and where could it go next? Maryville Online. (2021, March 3). Retrieved November 17, 2021, from https://online.maryville.edu/blog/evolution-social-media/#:~:text=In%201987%2C%20the%20direct%20precursor,social%20media%20platform%20was%20launched.

Toole JL, Cha M, Gonza´lez MC (2012) Modeling the Adoption of Innovations in the Presence of Geographic and Media Influences. PLoS ONE 7(1): e29528. doi:10.1371/journal.pone.0029528

Vannoy, S. A., & Palvia, P. (2010, June 01). The social influence model of technology adoption. Retrieved October 10, 2021, from https://dl.acm.org/doi/pdf/10.1145/1743546.1743585?casa_token=HA0lBxhc4qsAAAAA%3A8MRUruP0dfKgNnkDPQmfZh-up4stEy3CI3DE4Wdq5Cg-m6mc5J_2mxyf9p64UT7LYJt4ok6vaGop

Appendix

Number of TV Households in America

Year	Number of TV Households	% of American Homes with TV	Year	Number of TV Households	% of American Homes with TV
			1964	51,600,000	92.3
1950	3,880,000	9.0	1965	52,700,000	92.6
1951	10,320,000	23.5	1966	53,850,000	93.0
1952	15,300,000	34.2	1967	55,130,000	93.6
1953	20,400,000	44.7	1968	56,670,000	94.6
1954	26,000,000	55.7	1969	58,250,000	95.0
1955	30,700,000	64.5	1970	59,550,000	95.2
1956	34,900,000	71.8	1971	60,900,000	95.5
1957	38,900,000	78.6	1972	62,350,000	95.8
1958	41,920,000	83.2	1973	65,600,000	96.0
1959	43,950,000	85.9	1974	66,800,000	97.0
1960	45,750,000	87.1	1975	68,500,000	97.0
1961	47,200,000	88.8	1976	69,600,000	97.0
1962	48,855,000	90.0	1977	71,200,000	97.0
1963	50,300,000	91.3	1978	72,900,000	98.0

Figure 1. Number of Households in America with TVs from 1950-1978 (*Television History*). This chart demonstrates the mass adoption of television in the U.S. following the years after its release. From these figures the bell curve of the technology adoption curve can be seen.

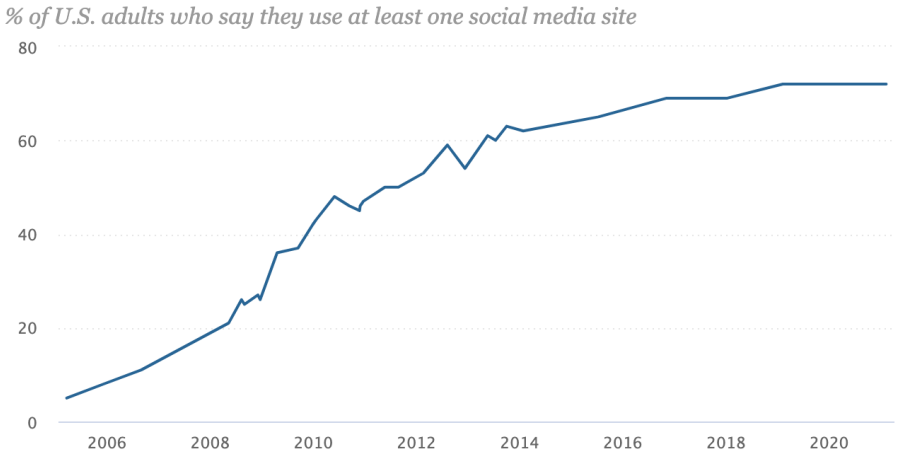

Figure 2. Percentage of U.S. Adults who Use Social Media (*Demographics of social media users and adoption in the United States* 2021). In 2005, 5% of American adults said they used at least one social media platform. By 2011, that share had risen to half of all Americans, and today 72% of the public uses some type of social media.

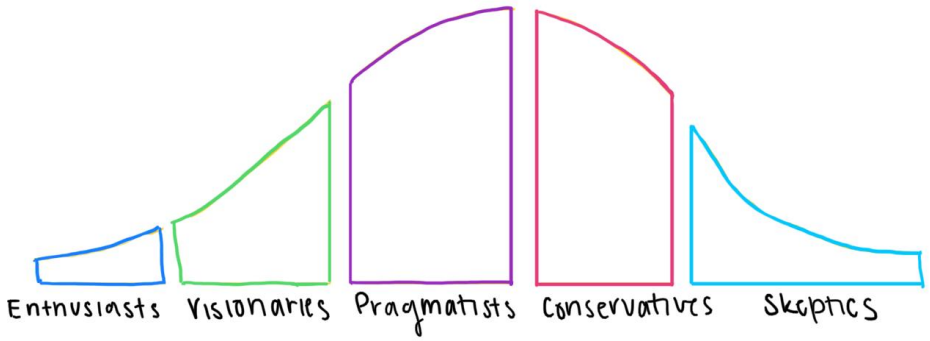

Figure 3. The Technology Adoption Lifecycle Model. Demonstrates the way in which people in a society adopt new technologies, where the x-axis represents the amount of time a technology has been produced and the y-axis represents the number of people who adopt the invention at that time. This sociological model splits the normal curve into different groups of people who adopt the technology at different times.

Trait	Accepters (n = 81)	Rejecters (n = 69)	Chi-Square
Education in years			
0–8	26	18	
9–12	53	33	
13 and over	21	49	$p < 0.001$
	100	100	
Weekly Incomes			
$0–75	70	52	
$76 and up	30	48	$p \approx 0.02$
	100	100	
Reading type*			
Passive	69	27	
Active	31	73	$p < 0.001$
	100	100	
Radio listening (hours per day)			
0–5	44	67	
6–16	56	33	$p \approx 0.03$
	100	100	
Movie attendance (in average 2-month period)			
0–5 times	43	80	
6 and over	57	20	$p < 0.001$
	100	100	

* *Active* designates non-fiction reading; *passive* includes fiction reading, cursory reading of newspapers, or *no* reading.

Figure 4. Cultural Characteristics of Acceptors and Rejectors of Television (Graham, 1954). These are findings from a 1954 study, where sociologists researched demographic differences between the households that adopted versus rejected the television. Researchers found that acceptors of television were distinguished from rejectors by their possession of lower level education, a small to medium income, and passive recreational patterns such as listening to the radio and attending motion pictures.

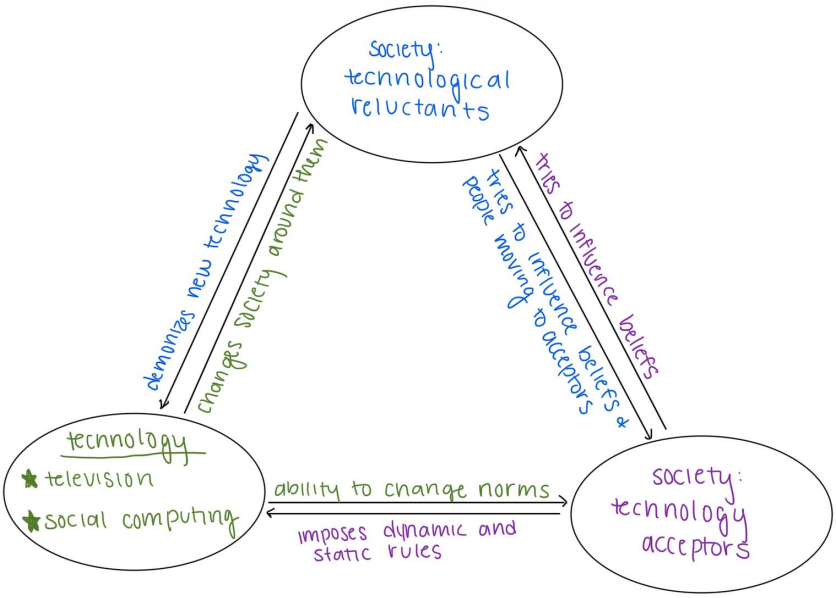

Figure 5. Sociotechnical Diagram. This diagram represents the interconnected web between technology, technology reluctant people, and technology adopters. All three have mutual deterministic relationships with the others as described in the figure.

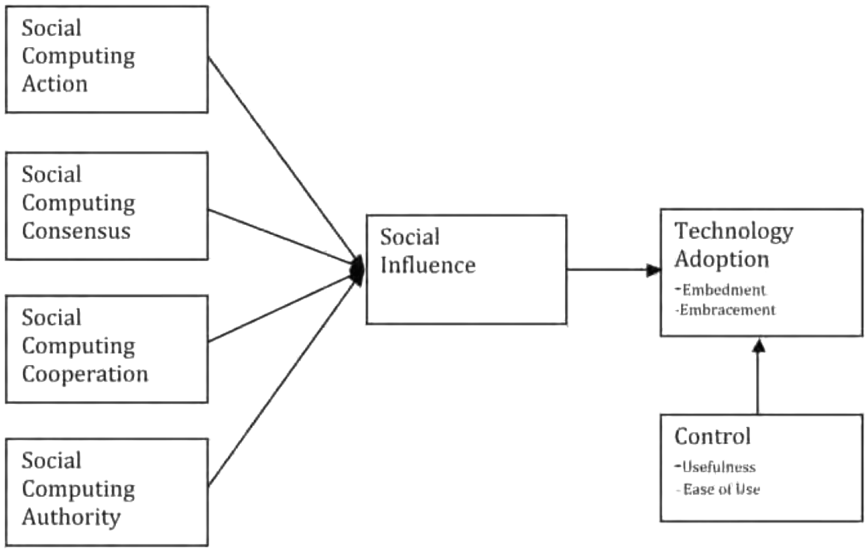

Figure 6. The Social Influence Model of Technology Adoption (Vannoy & Palvia, 2010). This diagram demonstrates the social computing interactions that determine whether a technology is adopted.