

Automating Dashboard Capabilities at Capital One

(Technical Paper)

The Future of Marketing: How Artificial Intelligence is Influencing American Consumer Behavior

(STS Paper)

A Thesis Prospectus

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By

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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.

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Prospectus

Introduction

Marketers invest a significant amount of effort in a multitude of different media platforms, whether that be TV ads, billboards, social media ads, etc., in order to subtly influence the behavior of consumers. Although one commercial is not going to immediately create floods of new customers, advertisements and marketing schemes do subconsciously affect consumer behavior. With the rise of the digital age, marketers are having to think of different ways to influence consumer behavior by learning and leveraging consumer media habits (Sama, 2019). Companies all over the world spent almost 378.16 billion US dollars on digital advertising campaigns in 2020 alone, making it increasingly important for companies and businesses to develop viable, but innovative, digital marketing strategies in order to stay competitive (Statista Research Department, 2021).

Digitalization brought along not only the Internet of Things and a multitude of new technologies that are a part of everyday life, but also brought upon the fields of Big Data, Machine Learning (ML), and Artificial Intelligence (AI). In the past couple of years alone, there has been significant development and in the fields of ML and AI in the forms of newer and better specialized hardware as well as a surplus of new ideas and bright minds in the field. In 2020, the market size of artificial intelligence was valued at 62.35 billion USD and is expected to grow by 40.2% compound annual growth rate from 2021-2028 (Grand View Research, 2021). Artificial intelligence, in its most primitive form, is a technology that synthesizes large amounts of data and tries to understand and learn patterns from it. At its core, marketing seeks to understand, learn, and ultimately influence the purchasing behavior of consumers in order to match them with products or services (Davenport et al., 2021). With its obvious synergy with marketing, marketers are seeking to find innovative and creative ways to capitalize on AI technologies.

Although there have been many large paradigm shifts in the marketing world in recent times, such as digitalization and COVID-19, the emergence of artificial intelligence appears to be having a more apparent impact on society and consumer behavior than people realize. American consumerism especially, is particularly interesting to examine since American consumers do not exactly respond the same way as the rest of the world. While most American consumers have some sort of financial security, consumers in many other countries are living paycheck to paycheck, changing the ways that they react to certain shifts in marketing (Magni et al., 2018). The final STS deliverable seeks to explore the relationship between AI and marketing and how it will specifically affect American consumer behavior.

On top of companies looking towards artificial intelligence to improve their marketing capabilities, companies are also beginning to look towards other areas of their businesses that they can automate. Currently, society is primarily dominated by millions of corporations, each with their own markets. However, to really break through to the top of these markets, companies need to be efficient with the use of their resources. In a constantly evolving competitive technological world, many large businesses and companies are looking to automation in the workplace as a way to best use their business resources. More specifically, the idea of reducing redundancy and reallocating business resources to other business endeavors is quickly becoming a top priority in order to stay competitive. The technical deliverable discusses the creation of a dashboard automation tool at Capital One in order to reduce the aforementioned redundant business efforts.

Technical Topic

Redundant code is a large issues throughout any collaborative coding effort. There are a large number of ways to approach many situations and significant time is often spent towards accomplishing something that someone else has already done before. At Capital One, a major pain point involved across the technology division is creating their own dashboards for their own purposes, causing redundancy since most dashboards serve the same purpose. My internship team, including three other students from other colleges and I, was tasked with leveraging different languages and frameworks as well as company technologies to automate the creation of dashboards. The team primarily worked on creating template files and a command line interface that would populate the template files. The command line interface would allow users to input basic information about their dashboard and the application would populate these template files and create the necessary code to create not only a working dashboard, but also generate the resources necessary to have it running on the cloud. The stretch goal for this project was also reached with the creation of a web wizard. The web wizard integrated the command line interface with a web application that serves the same purpose but is more accessible for users more unfamiliar with using command line interfaces. Doing so not only substantially reduced the effort needed to stand up a dashboard, but also kick-started the potential beginnings of a “marketplace” with the purpose of reducing redundancy throughout the company. This technical paper seeks to explore the processes and decision making throughout the design process of the dashboard automator. The paper will also examine potential limitations of its functionalities as well as potential new doors that have been opened as a result of this project.

STS Topic

One definition for consumer behavior is “the study of consumers and the processes they use to choose, use (consume), and dispose of products and services, including consumer’s

emotional, mental, and behavioral responses (Radu & Panaitescu, 2021).” Understanding consumer behavior is not just understanding a person’s likes and dislikes, but also understanding their environments and personalities. Consumer behavior over the years, though, has evolved drastically. Especially in the current digital age, society is seeing huge paradigm shifts that are having huge impacts on the marketing world. Consumers gained instant access to information as well as new techniques and tools for marketers to predict consumer behavior (LeDonni, 2021). More specifically though, the relationship between products and consumers become more complex and nuanced. In the past, consumers would go to stores and pick a product that they are familiar with or deem reputable. Marketers before the digital age were very much under the mantra of “advertise it and they will come” because if a consumer is able to recognize a product from an advertisement on TV or a billboard, they would be more inclined to purchase and then possibly become loyal customers (Su, 2018). However, with the copious amount of information now available as a result of the internet and the proliferation of smartphones and other technologies, consumers are becoming increasingly independent in their purchasing decisions (Su, 2018). Not only do consumers have a significant amount of information at their disposal, the number of available choices have also skyrocketed. With the rise of online shopping in the digital age, consumers are no longer limited by what is offered in local stores, rather they can order products from across the entire world. In a sea of hundreds of thousands or even millions of other products (depending on the market), marketers need to find a way to distinguish their products from all the others. As a result, marketers are having to find new ways to compete and aggressively market their products in order to personalize the consumer experience.

However, now that the societal and technological changes seen as a result of the digital age are slowly becoming more ingrained into the world, humanity is now on the horizon of a

new revolution: artificial intelligence. With the recent interest round big data, machine learning, and artificial intelligence, marketers are keen on taking advantage of this new technology in order to create more personal consumer experiences. Marketers are leveraging this AI to accomplish tasks such as content curation and creation, chat bots, behavior analysis and predictive analytics, and AI enhanced digital marketing (Hall, 2021). In a survey conducted in 2020, almost 41% of respondents saw an increase in revenue and improved performance as a result of using AI in the marketing campaigns (Guttman, 2021). One of the primary draws to artificial intelligence in marketing is its ability to analyze large amounts of data. From just 2018 to 2020 alone, the amount of data in the world increased from 33 zettabytes - the equivalent of 33 trillion gigabytes - to 59 zettabytes (Vopson, 2021). With that number quickly rising with each and every year, artificial intelligence's ability to process this data is an obvious plus for marketers. Additionally, AI has the ability to learn and identify patterns and even individuals which is key for marketing strategies that want to create a personalized experience for consumers.

Without a doubt, the rise of artificial intelligence in the current age will have a significant impact on society and the future. Technological Determinism is a theory that describes the relationship between technology and society. More specifically, Smith describes technological forces as “an autonomous force, completely independent of social constraints (Smith, 1994).” Smith also describes two forms of technological determinism: hard and soft determinism. Hard determinism describes technology as a completely independent force that is not shaped at all by social concerns. Soft determinism, which is what artificial intelligence falls under, describes technology as still the primary driving force, but with a chance for human freedoms to influence it. Critics claim, however, that technological determinism is an oversimplification of a

sociological phenomena that is the result of a multitude of different factors (Harrison, 2013). One noted critic, Raymond Williams, believes that technological determinism fails to address the significance of social power relations and its impact on the nature of technology. (Wei, n.d.). Critics also argue that technology itself is socially determined and that society and technology co-evolve in a non-deterministic process (Adler, 2006). Although it may not be perfect, Technological Determinism provides the most obvious and clear lens to examine artificial intelligence and its effects on society and consumer behavior because of the autonomous nature of the technology.

Methodologies

Research Question: How has the age of artificial intelligence affected modern American consumer behavior?

Before diving into examining the relationship between artificial intelligence and consumer behavior through the lens of Smith's Technological Determinism, this paper will first establish the proper historical and background context for various paradigm shifts in consumer behavior in recent times. To start, the paper will examine the various shifts in consumer behavior as a result of the age of digitalization. With such a large shift in the purchasing behavior of consumers, it is important to understand the what, why, and how the rise of digital technologies impacted consumer behavior. Additionally, the paper also will examine how a more modern event, COVID-19, has shifted consumer behavior as well. Understanding the background information and examining these as case studies on how consumer behavior has changed will serve as an important resource for understanding the shift in consumer behavior as a result of artificial intelligence. Finally, research will be conducted on how AI may indirectly affect consumer behavior through influencing their social circles. Groups of individuals like family,

friends, coworkers, all play a factor in the purchasing behavior of consumers (Juneja, n.d.). Although not as clear and obvious, it might provide another lens to examine the effects of artificial intelligence on consumer behavior. Articles and journals that detail how artificial intelligence affects the way our social circles interact and behave will be used to examine this phenomenon.

Smith's Technological Determinism sets up artificial intelligence as an independent driving force that influences society, in this case, consumer behavior. It will provide the necessary framework to not only examine some of the subtle and not so subtle changes in marketing, but also a pathway to understand how that will have a lasting impact on the future of consumer behavior. This paper will examine studies on the general effects of artificial intelligence in marketing as well as investigating a select number of specific case studies of marketing strategies that have leveraged artificial intelligence. With this necessary information on how artificial intelligence has been used and how it affects marketing strategies, Smith's Technological Determinism will be used to examine how those impacted consumer behavior and purchasing behavior. Finally, the paper will examine how artificial intelligence can influence consumer behavior by affecting an individual's social environment outside of direct marketing strategies such as TV advertisements or product placement.

With all this background information in place and a STS framework to examine the research question with, the paper will then tackle how artificial intelligence affects American consumer behavior specifically. A couple different sources will be used to first establish the background context and definition of American consumer behavior. In particular, this paper will examine the works of Juliet Schor and Thorstein Veblen. For Thorstein Veblen, the paper will specifically look at the arguments presented in his book, *The Theory of the Leisure Class*

(Veblen, 1899). These works will be used to describe not only the history of American consumer behavior but also how it has responded to the multiple paradigm shifts seen in marketing. With this background information and context in hand, the Technological Determinism framework will be used to analyze the relationship between artificial intelligence and American consumer behavior.

Conclusion

This paper plans to cover both the necessity of dashboard automation at Capital One as well as the impact of artificial intelligence on American consumer behavior. Although already completed, the purpose of the dashboard automator is to tackle the on-going battle to reduce redundant business efforts through automation. We expect that this tool will not only help teams across the business to kickstart the development of dashboards but also kickstart an effort to reduce redundancy across all platforms.

Additionally, this paper also explores the numerous social effects of the emergence of artificial intelligence on consumer behavior, specifically American consumer behavior. Consumer behavior and marketing are both extremely nuanced socioeconomic factors that have experienced several paradigm shifts of varying degrees in recent years. With the rise of artificial intelligence and big data, we are on the cusp of a new revolution which brings along new paradigm shifts of unprecedented size. This research seeks to consolidate all of the changes that have been seen in marketing in recent years as well as examine how this new technology may revolutionize American consumer behavior.

References

- Adler, P. S. (2006). Technological Determinism. *The International Encyclopedia of Organization Studies*.
- Grand View Research. (2021, June). Artificial Intelligence Market Size Analysis Report, 2021-2028. Retrieved October 31, 2021, from <https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-market>
- Guttman, A. (2021, April 20). Outcomes of AI-enabled Marketing Worldwide 2020. Retrieved November 01, 2021, from <https://www.statista.com/statistics/962630/impact-of-ai-enabled-marketing-on-business-outcomes-worldwide/#statisticContainer>
- Hall, J. (2019, August 21). *Council post: How artificial intelligence is Transforming Digital Marketing*. Forbes. Retrieved October 23, 2021, from <https://www.forbes.com/sites/forbesagencycouncil/2019/08/21/how-artificial-intelligence-is-transforming-digital-marketing/?sh=4be7155321e1>.
- Harrison, N. (2013, October 25). Technological determinism: A Critique based on several readings in adult education. Retrieved November 01, 2021, from <https://sites.psu.edu/natalieharp/writings/technological-determinism-a-critique-based-on-several-readings-in-adult-education/>
- LeDonni, B. (2021, March 19). *How the Digital World Has Changed Marketing Forever*. Creative MMS. Retrieved November 1, 2021, from <https://creativemms.com/blog/how-the-digital-world-has-changed-marketing->

Veblen, T. (1899). *The Theory of the Leisure Class*. Macmillan.

Vopson, M. M. (2021, October 20). The world's data explained: How much we're producing and where it's all stored. Retrieved November 01, 2021, from <https://theconversation.com/the-worlds-data-explained-how-much-were-producing-and-where-its-all-stored-159964>

Wei, J. (n.d.). *Raymond Williams*. Jiyang Wei. Retrieved November 1, 2021, from <http://www.jiyangwei.com/mediapedia/raymond-williams/>.