Moving Towards Disruption: Early Movers Incorporate NFC into Smart Packaging

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Abstract

Near Field Communication (NFC) is a technology that allows a "tag" to interact with a smartphone, when in near proximity. In 2010, Android devices began to utilize the technology. The technology found uses within consumer packaging to allow users to connect with Bluetooth speakers, wireless routers, and useful data. This improves the user experience. As of this year, Apple has joined into supporting NFC in ways that will enhance the demand for smart labels and packaging with NFC tags. Before in North America, Apple's restriction of NFC to only payment functions stunted growth that was seen in other areas of the world such as Europe and Asia. For print providers, who want to stay on the current edge of technology and follow the ever--evolving market, NFC is a technology that has the potential to have a large disruptive impact to the industry. NFC is a rather cheap technology in comparison to the value it adds. Business card printing startup, Moo has made a large name for themselves with their premium stocks and NFC embedded tags. For their customers users who touch their phone to a NFC enabled business card may have the persons contact information saved into their phone, or the corporate website launch, along with hundreds of other possibilities. They were an early mover with incorporating the technology, but now with less uncertainty in the market, it makes sense for more print providers and package designers to keep this technology in mind as they plan for the future.

As a society, we Google 3.5 billion searches each day. Before the advent of the Internet, we would look up our questions in books, encyclopedias, and other printed materials. We want to get answers, information, and content as soon as possible. Technology will never eliminate printed goods and packaged products, but those who produce these goods can enhance their overall business and demands from a fast-paced society by incorporating NFC technology, which provides information

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on demand. No need to search online to answer a question, just touch your phone to the packaging. Want to reorder a product? No need to go onto Amazon and place the order, touch your phone to the packaging or label (much like Dash Button). NFC takes speed and consumption of content with an interactive component that satisfies societies need for fast delivery. By taking traditional printed goods and utilizing NFC with them, print and packaging companies can quickly make a hybrid product that connects their physical packaging to something virtual.

Introduction

Near Field Communication (NFC) is a method for NFC readers to read NFC tags implanted in products such as packaging and labels. There are three different traits or modes of NFC behavior. The first mode, reader/writer, is what is primarily used within the print industry for NFC. In reader/writer mode, the NFC device is capable of reading NFC Forum-mandated tag types, such as a tag embedded in an NFC smart poster. [7]

Figure 1.1 NFC "Tag" on adhesive side of a Product Label

Steady growth of interesting uses of NFC and capable devices have been growing in Europe for the last decade, however the market in the USA faced several roadblocks that made widespread adoption a no-go decision for most print companies. However, in most recent months from 2017 into 2018, many roadblocks that have hindered growth for the largest consumer market in the United States of America are beginning to move in favor of the technology. We are first going to take a look at innovative print products that have already emerged, then observe factors that had slowed the USA market, and observe advantages that early adopters of this technology will find. Exponential growth in use and product applications is projected over the next five years.

The purpose of this paper is to provide insight and awareness to those who are not yet aware of the technology or its implications so that they can position themselves to take advantage as NFC applications move across the innovation lifecycle. We will also evaluate the possible inequality that this technology may create between

businesses who adopt it into their printed goods and those who do not. Upon the conclusion of this paper we will be able to see the big picture of NFC technology and be able to decide if this is an innovation that fits into our current business and if through these innovations, we can add further value for buyers and consumers.

Emergence of Contactless Technology

In 2012 there were 51.6 million NFC-enabled devices that could read NFC tags worldwide according to Statista. With the number of devices doubling in 2013, it comes as no surprise that RFID Insider released an article entitled, *Everything you Need to Know About NFC Smart Posters*. The article explained in detail what NFC is, its benefits over QR code technology, and how businesses could make their own promotional posters. It is not surprising that the article advised essentially that while having the NFC tag embedded in the poster is nice, affixing an NFC sticker to the printed material is likely the best option do to printing capabilities at the time.[6] As the number of devices has increased, it should become more common place in America to find print companies who can add NFC to a printed material, rather than the client in post-production, but very few companies currently have the capacity to be able to.

In 2015, musician Beatie Wolfe released an entire album that resembled a deck of cards. Each card had unique artwork relating to the song in addition of an NFC tag printed inside of the card. When a fan would touch the card to their smartphone, the music would start playing and they could then download the track. This was a very interesting concept as the packaging for the music album was the album. This was the first ever NFC enabled album and was produced by London, England Company MOO, who were among the first to adopt of NFC within business cards and print products.

This year in 2018 the number of Global NFC-Enabled devices is expected to increase to 1,907.4 million devices this year in 2018. Estimates show that the last two years, the number of NFC-enabled devices has grown by 190% and 200% respectively. [2] NFC during that time was quickly adopted in most European and Asian markets for a variety of purposes ranging from marketing to train passes and payments for products. The smart-phone became more than just a phone and allowed communication and transition of payment between products and services that they used daily. In 2017, James H. Sulfare Jr. stated at a conference that once a person learns how to touch their phone to an NFC enabled area to make something magical happen, they will never forget. The variety of uses for NFC in Europe and Asia quickly expanded once users got a feel for its simplicity.

As you look at Figure 1.2, you can see how the availability of NFC-enabled devices has been increasing exponentially with a large jump that is anticipated in this year, largely due to the elimination of roadblocks within the American market. The trend line is steep and with emerging technology this is typical as soon as it reaches a

level to become "disruptive" to an industry. The R^2 value within the analysis is ~72%. It is our interpretation that there is a correlation between years and the number of global NFC-enabled devices. The variance of ~28% suggests that while there is a correlation between time and global devices, other factors such as consumer adoption and popularity are causing additional increases in the number of devices. This variation would be expected with a potentially upcoming disruptive technology force and likely will widen with demand for the technology with more exponential growth. More research is still required with additional quantitative data to determine the correlation as it pertains across different modes of NFC. This is only a general measure and correlation based on the emergence of these devices. One thing is undeniable by looking at the chart and that is the emergence of NFC Enabled Devices is growing at an exponential rate.

Figure 1.2
Global NFC Reading Devices 2012 - 2018
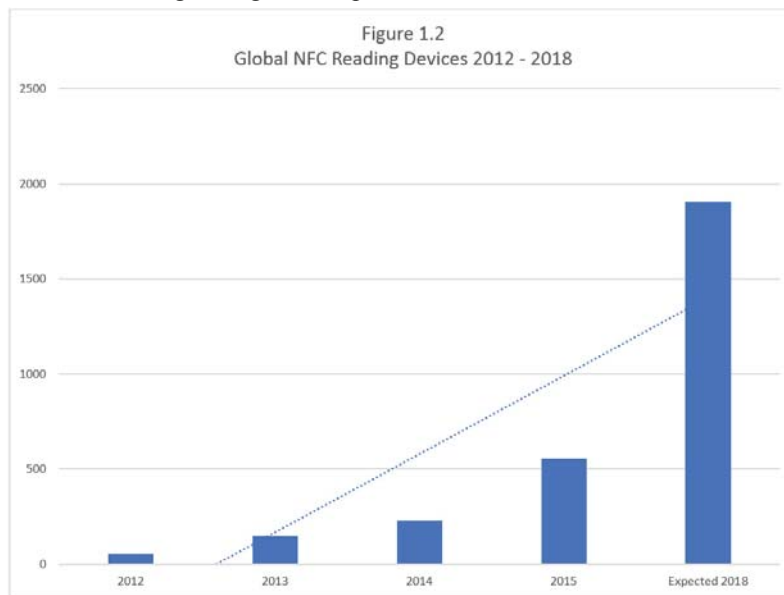
Inequality Across Markets

In 2016, we worked with paper stock that was produced with NFC tags embedded into the paper and collaborated with a print company to observe implementation and marketing challenges in adding NFC as an added solution in their portfolio. In 2016, the only available print stock was in European sizes, since that was where the primary market demand existed. There were three potential solutions, they could cut the cards using a different sizing variation or have a fair amount of scrapped material to maintain USA standard sizes, or they could invest in determining better mechanisms for laying the NFC semi-conductor in a position that would fit the size expectations and cutting requirements for business cards. For this experimental demonstration, they decided to use the existing paper stock and cut the paper to the US size standards, even though there would be significant waste. After running a

batch of cards through, they discovered more problems within their trial run. The cutting machine sliced through some of the NFC semiconductors in the paper and on others too much pressure had been applied in the process, which destroyed about 40% of the print run. After evaluating the production problem and running another two batches, the fail rates decreased to about 5%.

The downfall of this is that it creates inequality between print companies in the Europe-Asia market and America. With the Europe and Asian markets working with this technology rather intensively over the last five years, it is going to take a significant amount of time for the American market to mature in terms of proper equipment, knowledge, and consumer awareness. American print companies are going to need to begin working now to develop their own methods for applying, encoding, and printing NFC tags within their materials to slow most of the disadvantage. The critical key here that still leaves a window open for American print firms to be prepared and ready to compete domestically is the fact that consumer awareness of the technology within a print medium is still low. However, there is not much time to wait as consumer awareness of NFC in America is increasing. Emulation is a NFC mode used on smart phones to make payments at checkout. Apple Pay, Walmart Pay, Samsung Pay, and Android Pay are all popular examples of this technology. It is estimated that 77% of the US adult population have a smart phone. People are learning and trying out mobile payments as these payment methods each have been tried by 13%, 24%, 5% and 7% of adults respectively. Ongoing usage of mobile payments with NFC is still low ranging from 1-6% ongoing among US adults.

In Europe and Asia, where this technology has matured using NFC for mobile payment, public transportation, and a variety of daily tasks is consistent. Once consumers learn how the technology makes their life easier and connects a physical object with a virtual one, it creates a hybrid experience that merges the speed and robustness of the internet with everyday interaction and reality.
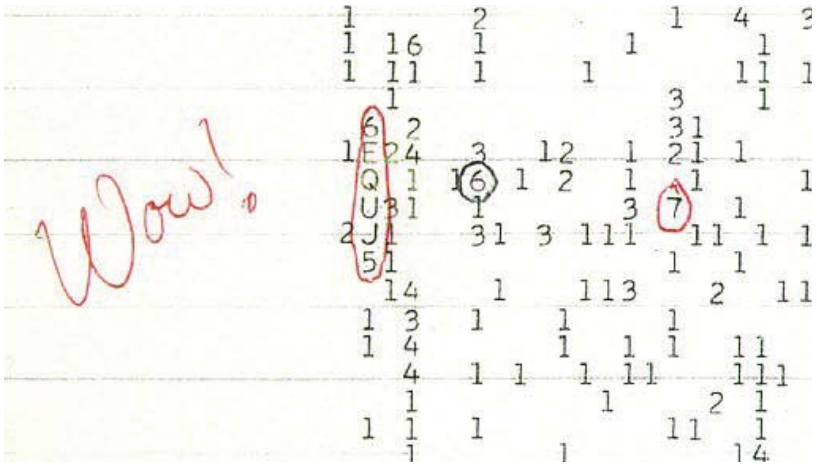

Figure 1.3 Wow! Signal, Received in 1977 to SETI from Space

The signals based on historical information on European and Asian markets, along with growing impressions of NFC being used for mobile payment in the US points in a direction that the domestic market here in America is likely to be the next for NFC technology to become disruptive. With the information presented it is clear that there will be an initial gap for print companies to navigate over since companies in foreign markets have perfected their approaches to the technology within printed materials, but by beginning experimentation, market research, and development within domestic print facilities now, printers that serve the American market have time to implement the technology and get it production ready. As the traditional print market is in a slow, but steady overall decline, smart packaging and printed products could provide a link between digital and print marketing. In turn it is within the theory that by positioning print facilities in the American market to prepare for widespread adoption that additional income streams can come in through the smart packaging segment.

As with any new product or method, there is going to be a learning and adjustment process. Nothing is always going to be perfect the first run through, however, much of the landscape has changed over less than two years. There are now more selections of stock paper available and other methods to apply NFC as a label onto packaging or embed it between two sheets of stock in a custom laminating process. A positive consequence is that this has improved the amount of weight that can be placed onto the paper in the cutting process and better positioning of the semiconductors to prevent waste or accidental cutting of the antennas. The availability of software and devices to encode the NDEF data onto the NFC semiconductors has also increased in availability and speed. This allows print manufactures to use a file such as a comma separated value file to provide all the information to encode or write to each batch of NFC tags as they are running through the production process. What is going to be crucial is diligent efforts and collaborations among the industry segment to share lessons learned and practices so that printers in the American domestic market can catch up to those in markets that are already beginning to mature.

Partial Roadblock Elimination within the American Market

One of the major factors based on research that strongly delayed the American market was that this segment had a much larger portion of the cellular market captured by Apple iPhone devices. In 2015, Apple began using NFC for payments only for their 6 and 6 Plus devices. However, unlike most phones like Android, BlackBerry, and Windows, Apple did not fully open its NFC capabilities outside of payments. This restricted the user experience to only one of the three modes of NFC. You could make payments, but not transfer data or read it. In a market where Apple held about half of the market share with their iOS devices, this created a significant roadblock. Companies who wanted to utilize NFC in marketing and print campaigns tabled it, awaiting an announcement from Apple. After close to two years with no change,

the American market began to stagnate with NFC materials and outside of mobile payments, it was widely forgotten. Some companies continued efforts to push the technology regardless of Apple's cooperation by recommending other devices and performing implementations where consumers only had supported devices, but with much hesitation. Finally, in June 2017, Apple announced that third-party app developers could begin to get access to the NFC hardware on the iPhone 7 series and newer devices. This greatly increased the number of devices in the market that are now able to read NFC embedded products, packaging, business cards, and other materials.

There are still two issues that remain and hold some hesitation within marketers to begin the process of ordering more NFC embedded packaging. The first factor is that Apple devices require an application to be installed to use the technology. Part of the beauty of NFC was that you just turned on the capability and touched your phone to an object such as a smart poster to begin an interaction. With Apple devices you must turn on the technology and open a third-party app and then touch your phone to the object. It adds another arbitrary task. This likely will eventually be removed with further releases of Apple's iOS, but no information has been confirmed. Everything is moving in the right direction now to further the spread of NFC usage and Apple normally likes to wait and observe the market for a few years to see what technology they want to invest into and expand. The case was much similar with their implementation of Bluetooth and Bluetooth Low Energy devices, which ended up surpassing the usage on Android devices. It is plausible to assume once fully embraced by Apple, that NFC will be an integrated part of a consumer's daily life, much like it is within other markets. The second issue that is disintegrating rather quickly is older iPhone devices that do not have the NFC hardware. Apple is very effective at getting users to update and purchase new devices so within a short period of time this one issue that is holding back a certain percentage of consumers will eliminate itself.

Projected Smart Packaging Segment for Early Movers

While we mention early movers, we should be more specific and outline that this is the projected market value for printers in the American markets that begin moving now. In the American market, we are still considering NFC for smart packaging and marketing materials in an early adoption phase of the lifecycle. While we are classifying printing companies, who move now and begin working on integrating NFC as early movers in other markets there are already established companies ready to compete for this market. With the status of the economy there is advantages to being domestic within the market you are operating and producing for. Print companies that begin moving now should be able to have themselves established and in a good position to compete against companies from other international markets.

In 2015 the US smart packaging industry was valued to have revenue of approximately 11 billion dollars. The market in the US for those companies that begin to incorporate the technology now is estimated to hit 26.7 billion by 2024. The CACR, estimated by Grand View Research is an estimated 10.6% from 2016 to 2024, while the print industry has been experiencing a 2.5% decline over the last five years.

The same report also projected NFC to be the most rapidly growing component within a segment called intelligent packaging. The growth of NFC usage within intelligent packaging is expected to grow over 12% in this segment over the next five years. With the traditional print industry in a steady decline of 2.5% and projected rises of smart packaging and intelligent packaging being 10.6% and 12% respectively over the next five years, it appears to be a significant area for print companies to expand into to add value to existing product lines and protect their company against declines in the more traditional print market. While NFC and this form of hybrid electronic-printed packaging is likely to naturally become disruptive since the landscape within the American market has shifted, there are other factors to also consider such as government intervention, which could make the disruptive force of NFC much more powerful in packaging.

With intense concerns over tracking products, tracing food manufacturing process, health management with smart labels for nutritional awareness, time tracking, and other forms of requirements could become required by governments as the culture becomes more health and safety conscientious. Additionally, with prescription drug overdoses and an epidemic in 2012 of fungal meningitis linked to a steroid, there is likely to be more measures placed to track drug quality. In 2013, the FDA passed the Drug Quality and Security Act, which placed in measures for developing an electronic system to track prescription drugs. [1] Other suggested legislation, applies this concept to food products both domestically and internationally, given the nature of product recalls.

Figure 1.4 Proposed Porotype for Prescription Bottle Packaging

Early movers within the American market are in a good position to capitalize already over the next five years within the growing need and desire for smart packaging, but if there would be government intervention to utilize this and require it within packaging, the smart and intelligent packaging segments shifts into a product that is now required to be purchased, allowing for NFC to fully disrupt the market and be required to be used within packaging for safety and tracking. With the importance of tracking and control with the emergence of the Internet of Things (IoT), new software has come out to bring additional functionality to NFC tags. Allowing metrics to be collected, payloads changed based on a variety of conditions, and other useful things that will drive the market further into the future.[4]

Conclusions

Smart devices that are NFC-enabled are becoming more than just commonplace. The markets in Europe and Asia began to move full force with the technology in 2014, while the America's lagged behind. America is starting to catch up now with Apple opening the use of NFC for payments and other applications in late 2017. Given that Apple held an estimated 49-52% of the consumer phone market, this made implementing NFC into packaging a difficult decision to make since it was only available on half of the consumer devices within the segment. Now with Apple supporting NFC, consumers are quickly becoming aware of the technology and beginning to adopt it quickly. In America, smart packaging with NFC is becoming common place to allow users to easily pair their phones to Bluetooth devices. Android pay, Apple pay, Samsung pay, and other forms of NFC payment are also seeing exponential growth. This almost imitates the markets in Europe and Asia in 2014. While this consumer market may just be opening and is now moving towards disruptions, it is important for print companies to become aware of the use and implications of the technology.

Printed products such as catalogs and other materials, whose sales have been declining due to the internet can now be made smart and provide an engaging experience for the reader to connect them with the products they see. This is also the case with restaurant menus connecting to online ordering, user guides connecting to online tutorial videos, and suppliers being able to enable their packaging to simplify reorders. Those are just a few minor examples of the implications for print, but mobile games with packaging and other types of advertising promotion that require direct user interaction with packaging are also shown to be very beneficial to brands.

As with any new technology, it is important to establish an implementation plan and begin with testing to find limitations and constraints. From there printers must work to find the causes and work to streamline the process to prepare to be able to offer this solution as a value add within their customers print products. The annual growth of the Print Industry in the US has been in a steady decline of 2.5% over the last five years. It is our observations in the market based on this innovation that

leads us to believe that printers, who differentiate themselves by integrating printed electronic technology (such as NFC) will be able to capture additional market share as the demand for hybrid print to digital solutions increases.

References

1. Commissioner, O. O. (n.d.). FDAs Evolving Regulatory Powers - Milestones in U.S. Food and Drug Law History. Retrieved January 15, 2018, from https://www.fda.gov/AboutFDA/WhatWeDo/History/FOrgsHistory/EvolvingPowers/ucm2007256.htm

2. NFC-enabled mobile devices worldwide 2012-2018 | Statistic. (n.d.). Retrieved January 05, 2018, from https://www.statista.com/statistics/461494/nfc-enabled-mobile-devices-worldwide/

3. Printing market to top $980 billion by 2018. (n.d.). Retrieved January 13, 2018, from https://www.smitherspira.com/news/2014/january/global-printing-market-to-top-980-billion-by-2018

4. Shope, D. L., Sulfare, J. H., & Neil, N. J. (2016). U.S. Patent No. US15058965. Washington, DC: U.S. Patent and Trademark Office.
   Networked computer system for remote rfid device management and tracking

5. Smart Packaging Market Size To Reach $26.7 Billion By 2024. (n.d.). Retrieved February 15, 2018, from https://www.grandviewresearch.com/press-release/global-smart-packaging-market

6. Thrasher, J. (2013, July 22). NFC Smart Posters: Everything You Need to Know to Make Your Own. Retrieved January 20, 2018, from https://blog.atlasrfidstore.com/nfc-smart-posters

7. What are the operating modes of NFC devices? (n.d.). Retrieved February 1, 2018, from https://nfc-forum.org/resources/what-are-the-operating-modes-of-nfc-devices

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