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CENTER FOR FINANCIAL MARKETS AND POLICY

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White Paper

Leveraging Data

The role big data can play in providing better products and services for customers

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Contents

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List of Abbreviations

AI	Artificial Intelligence
ATM	Automated Teller Machine
API	Application Programming Interface
AR	Augmented Reality
CFPB	Consumer Financial Protection Bureau
EU	European Union
FTC	Federal Trade Commission
FI	Financial Institution
IoT	Internet of Things
KYC	Know Your Customer
OCC	Office of the Comptroller of Currency
PFM	Personal Financial Management
PSD	Payment Service Directive
UK	United Kingdom
VC	Venture Capital
VR	Virtual Reality

Executive Summary

Data has been recognized as one of the most valuable assets for business in the digital era. Firms have been able to create revolutionary products and services using an unprecedented amount of information that is collected at a mass scale and speed. Many of these firms have been extremely successful in designing life-changing products. A race has begun to generate and collect new forms of data through emerging technologies such as artificial intelligence and machine learning.

Financial Services is an industry that has been slower to transform in the digital world due to the recent financial crisis and challenges adapting to the regulatory environment. An era commonly referred to as the "Fintech Revolution" has focused heavily on innovation in less regulated areas of financial services such as payments, alternative lending, and wealth management. The world has never seen a time with so much economic and social benefits from financial services firms leveraging big data to assess risk, facilitate payments and investments, and build economies in underdeveloped nations and countries.

Many fintechs have had great success building products due to their ability to remain nimble, to keep costs low, and carve out niche areas prime for innovation. While fintechs add great value to society, many banks suggest there should be more regulation and argue that these firms are not acting responsibly and in the best interest of their customer. In November 2015, a coalition led by larger technology firms: Amazon, Apple, Google, Intuit and Paypal responded by forming a group called "Financial Innovation Now" to advocate for policies that foster innovation in the Financial Services industry.

As regulators continue to evaluate the benefits and implications of innovation in the Financial Services industry, Georgetown University is well positioned in Washington DC to provide thought leadership. This paper explores innovation across industries within five macro trends related to leveraging data:

- Personalization
- Biometrics
- Internet of Things (IoT)
- Data Infrastructure and Processing
- Financial Transaction Data

It concludes with recommendations for innovative financial products that provide both economic and social benefits, and provides evidence for customer needs and pain points. The analysis also considers the potential implications and provides ways for mitigating risk.

Citi's Stance

One of the biggest assets that large banks like Citi have is Data. There is no other entity that will know more about your spending behaviors, saving goals, investment preferences or risk appetite than your bank. However, these large incumbents are not leveraging this asset up to its max potential. Customer behavior has changed in the past years with new generations like millennials/generation Alpha and new levels of customer service defined by companies like Uber and Amazon. Banks need to redefine their products and services and make the move from a passive role in their customers' lives to a more proactive role.

Could "Leveraging Data" be the solution? This paper goes beyond transactional data (which is a given for a bank) to non-transactional data like social media, biometrics, behavioral, etc. How can we use Big Data in order to redefine a bank's role in a customer's life?

Below are some high level milestones that are explored during the "research/uncover opportunity area" phase in the Discover 10X program at Citi Ventures:

- Macro trends within the theme "Leveraging Data"
- Evidence that these macro trends are taking place
- Drivers behind these macro trends
- Emerging "personas" (i.e. customer segments) as a result of the macro trends within this theme
- Unmet needs or pain points

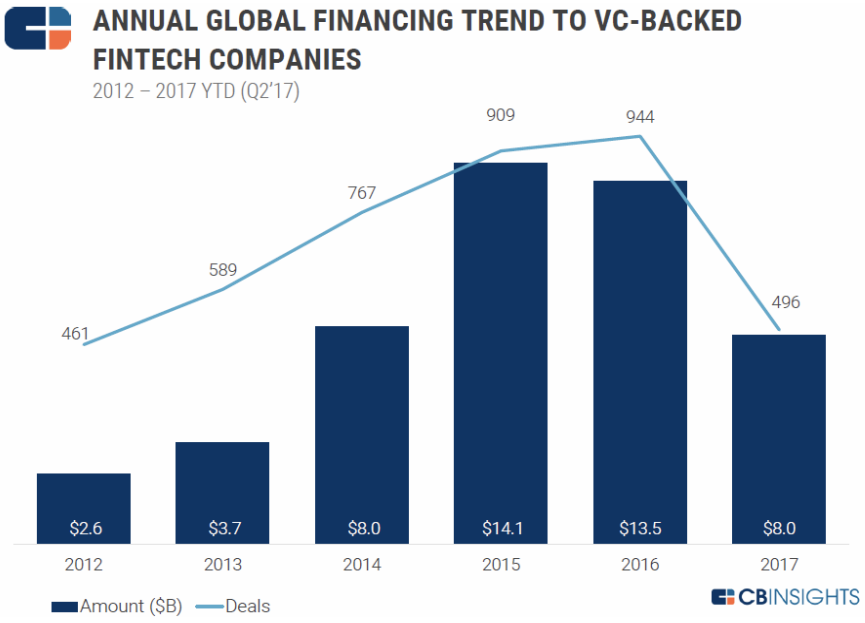
The goal is to conduct a landscape on players responding to unmet financial needs of customers including incumbent corporations and startups, as well as new business models that are emerging as a result (Citi Ventures team can help with startup landscape)

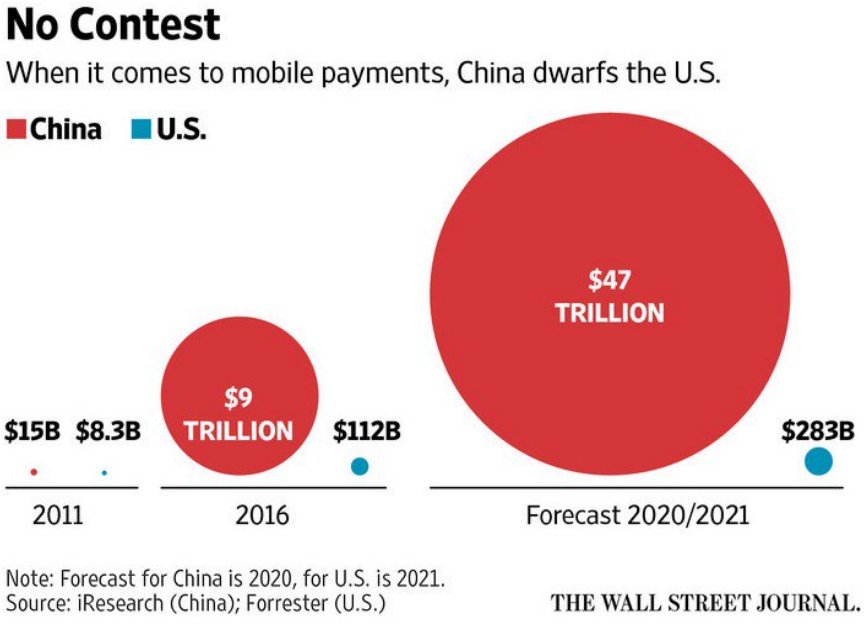
Georgetown University & Fintech

Located in the heart of Washington DC, where the private sector meets with public policy, Georgetown University is uniquely positioned for researching innovation and regulation in the financial services industry. As discussed further in this report, there are approximately 5,000 Fintech organizations reported by EY in 2017[i] and the applications are global. At the end of Q2 in 2017, venture capital funding is on pace to beat the record held by VC-backed fintech companies in FY 2015[ii].

Georgetown University has recognized that many fintech applications outside of the United States have paved way for social benefits such as financial inclusion, which is defined by the world bank as "individuals and businesses having access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible and sustainable

way."[iii] Take for instance Bit Pesa. As cited in the March 2017, Georgetown white paper on Blockchain and Financial Inclusion, Bit Pesa is a digital currency powered by Blockchain, which reduces the costs for financial transactions, helping the underserved, less affluent economies and the underbanked in Africa. In China, there is record growth in mobile payments relative to the United States. According to the World Bank's Global Findex, nearly eight out of ten people in China have access to a bank account.[iv] Many have argued that China is the global leader in Fintech.[v]





The participation in financial services signal the participation in the global economy, and an effort for individuals to escape poverty conditions. While WeChat and Alipay dominate the payments space in China with a combined 95% market share,[vi] Georgetown University is researching some of the methods that contribute to this dominant platform technology. Data has become a commodity for many businesses and network effects have only created larger barriers to entry for new competitors. By studying how data is used to produce better products and services across industries, we can truly understand both the social benefits and challenges of new business in the digital era.

Research Approach

The research approach provided insights on macro trends from research publications across academic, consulting, and venture capital institutions. Exploring these trends, interviews were conducted across both academic professors and industry professionals. Because this area is so frequently disrupted by new innovation, other methods were heavily relied on to source information rather than traditional research methods. News publications from notable resources such as the WSJ, Forbes, and CNBC were explored and vetted.

In addition to our research, we explored three case studies to support any claims or recommendations provided in this report. The recommendations are in no way predictors of future events or opportunities, but rather suggestive based on evidence cited in this report.

Regulatory Environment

Traditional Financial Institutions:

Traditional financial institutions are regulated at the federal level and are held to standards put forth by a Federal Bank Charter issued by the Office of the Comptroller of Currency (OCC)[vii]. All banks are subject to "safety and soundness," fair access and fair treatment of customers. Safety and soundness is meant to prevent the 2008 financial crisis from repeating itself by ensuring that financial institutions have sufficient liquid assets[viii]. These large financial institutions have a national charter.

Fintechs Specifically:

Alternatively, fintechs are not regulated at the federal level but rather at the state level. They are not subject to just one Federal regulator but rather fifty individual state regulators with varying rules and regulation procedures[ix]. Because fintech's also often have products (like Paypal for example), they are also regulated by the Federal Trade Commission (FTC) and the Consumer Financial Protection Bureau (CFPB), which came out of Dodd Frank[x].

One example of how a company like Paypal might deal with the challenges of fintech data regulation is in the way they might handle a data breach. If customers are subject to a data compromise, certain states might dictate that customers must be notified of require that all breaches be reported in very broad terms. Other less regulated states might only require a customer to be notified only if certain pieces of data are compromised. If data notification is in fact required, each state might vary in the way in which they need to actually notify the customer; perhaps it is via email, snail mail or even a phone call. The timeframe in which this action must be completed also varies state-by-state.

On the Horizon -- A Fintech Charter

In November 2015, a coalition led by larger technology firms: Amazon, Apple, Google, Intuit and Paypal responded by forming a group called "Financial Innovation Now" to advocate for policies that foster innovation in the Financial Services industry. There have been ongoing efforts to establish a national fintech charter or special purpose fintech charters.

According to the OCC, any special purpose fintech charter would require the following high level attributes:

1. Bank permissible activities
2. Rules and standards permissible to a special purpose national bank
3. Coordination among regulators such as, but not limited to the OCC
4. Robust, well-developed business plan
5. Governance Structure
6. Capital
7. Liquidity
8. Compliance Risk Management
9. Financial Inclusion
10. Recovery & Exit Process[xi]

In the still nebulous world of fintech regulation, the following conclusions can be drawn:

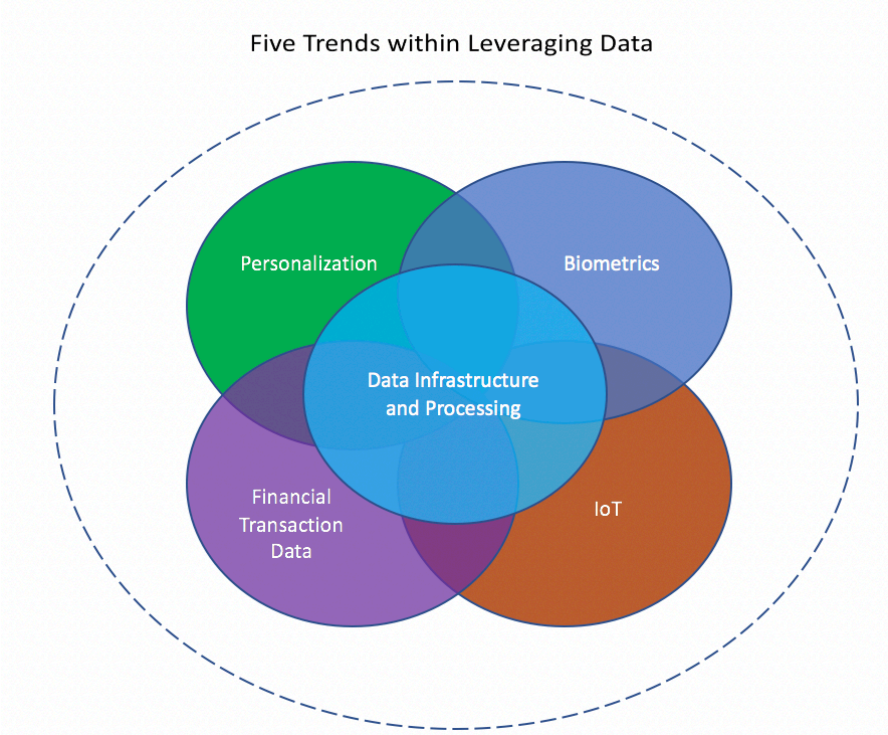
- *Innovation outpaces regulation:* New regulatory models have been proposed in academic literature, but in general, regulators are constantly trying to understand many of the technologies behind fintechs. One example of this is the UK's Engagement vs Enforcement[xii]. Rather than creating new regulation, the UK is using Project Innovate to "help" fintechs navigate the regulatory landscape to make sure they stay within the boundaries.

- *Current Regulation remains ambiguous:* There is still great debate over who actually owns customer banking financial data: the customer or the financial institution. Section 1033 of Dodd Frank Act provides customers with right to access their data, but it does not specify who is the actual owner of the information that banks collects. Banks are unhappy with the way fintech firms and other data collectors screen scrape the client's banking website pages. Banks claim the data belongs to the bank, while fintechs claim the data belongs to the consumer.[xiii] In the past, Google and Facebook have even fought with the European Union over data privacy and "right to be forgotten" rules. In 2014 Costeja case, the Court of Justice of the EU ruled that internet companies must

consider requests from users to remove data about them from company servers.

- *Fraud is still a looming issue:* By providing bank passwords to unsafe fintechs, fraud is becoming a huge issue. There are many security issues that have yet to be addressed as they relate to data scraping and access to personal information. Consumer comfort level is also a topic of concern as there is a wide spectrum of general comfort level that different consumers have with banks or other fintechs accessing their information.

- *Bank requirements are different from fintechs*: Banks have an obligation to put controls in place to protect customers while fintechs are less regulated. More regulators are starting to create cybersecurity regulations, which aim to help with information theft and fraud.[xiv]



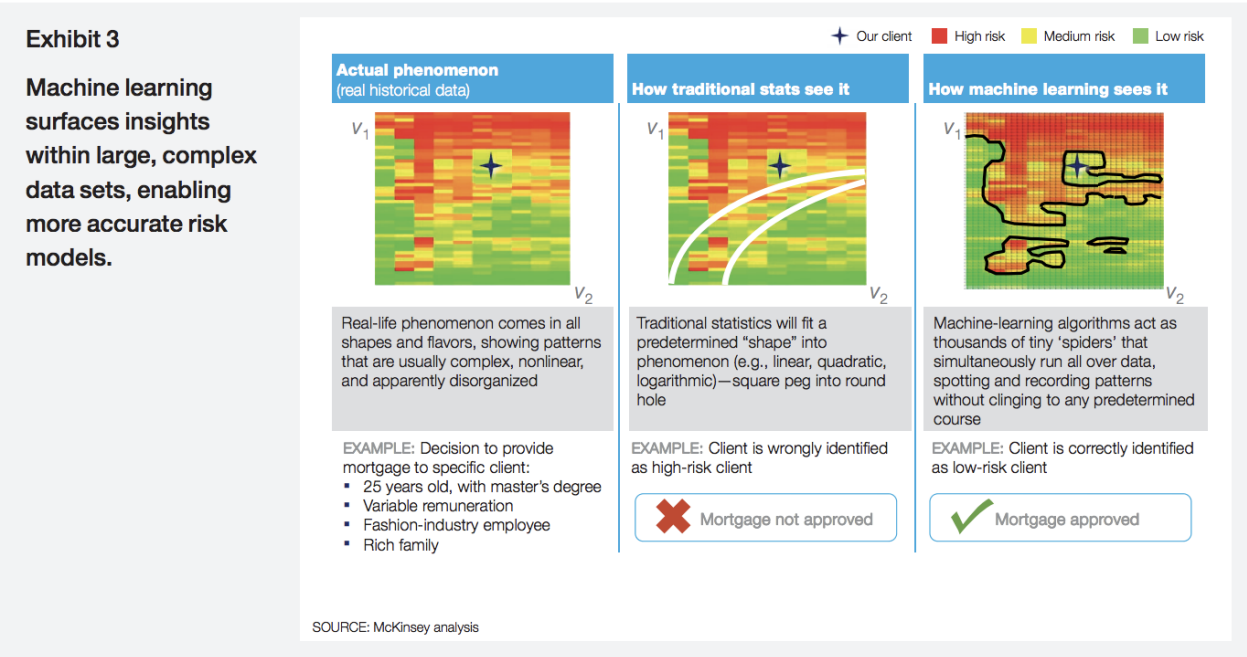
Macro Trends

Personalization

No other trend within 'Leveraging Data' has had as great of an impact across industries than personalization. The creation of the internet and the digital era has allowed firms to transform their business model from designing products and services for the general public to creating specific products that target a distinct customer. Television shows and advertisements are one example of how a business model has changed pre and post the digital era. When there was a limited amount of content and countable amount of television channels, networks wanted to attract a broad range of customers, so media companies would create television shows for the general public, and advertisers would create ads to follow suit. Today, the ability to create content has become infinitely easier--anyone with a mobile device and access to the internet can create their own content. Content can reach the masses, on-demand, and instantaneously as it is created, and there are more digital tools available to target specific audiences.

The abundance of content, speed of delivery, and other digital tools available have allowed marketers and product developers to understand customers better, and infinitely quicker, enabling them to consider a less reactive approach to designing products and more proactive approach. Take for instance the Google search. Google collects a customer's search history, location data, emails, purchase history, purchases, payments, and downloads and uses all of that information to help a user find a website, picture or video that the user is looking for. Explaining the underlying technology could be a separate tutorial, but simply comparing the Google search to that of Bing or Yahoo

will help any individual understand how incredible Google's engine is at personalizing a user's search results to provide the best content for what the individual is searching for. This type of personalization was patented by AOL (and can be found on Google patents) as Passive Personalization, or "gathering information about an entity by transparently monitoring its activities."[xv] Active Personalization is another method used by businesses and it is defined as "gathering information about an entity by having the entity knowingly express likes and dislikes." Facebook is best known for this technique. Building a user profile with alternative sourced information can also be categorized under Active Personalization. SoFi is a great example of a firm that actively asks for data to help understand a user's credit risk and provide that user with cheaper loans. By collecting information such as education history, work history, social media accounts, standardized test scores, and even phone numbers provided of trusted confidants, SoFi suggests that the firm is able to better understand the level of risk associated with each client rather than that suggested by a traditional credit score.



Source: McKinsey: The Future of Bank Risk Management[xvi]

Other industries use these techniques in different ways. Metromile is an auto insurance company that focuses on tracking the amount of miles a user drives. The firm suggests it is able to charge less-travelled customers with unique and lower rates by using data to suggest a lower risk of accident. Spotify's product is in the music industry, and commands 98 million unique accounts.[xvii] Spotify's product takes a user's selection of artists, music genres and likes to build a continuously adaptive playlist for each customer. Netflix takes a similar approach for the television and movie industry with 126 million unique accounts.[xviii]

Personalization has taken another turn beyond technology businesses. In the beverage industry, Coca-Cola recently launched its "Share a Coke" campaign and relied on social media to add popular names to bottles of individuals that would be most interested in Coca-Cola products.[xix] Forbes magazine has gone further to describe the new uses of AI that the company has been using to launch new drink flavors by observing how users mitch and max their self service soft drinks.[xx] Retail has taken another step using video to look at the most frequent places an individual may stand in a store. Prism[xxi] is one of many companies that provide unique insights turning video into data analytics for store managers.

With Retail locations facing the challenge of competition from internet stores and the likes of Amazon, the trend of personalization is approaching the beginning of a next phase. Since 2010, approximately $4.5 billion has been invested in AR and VR.[xxii] Virtual shopping has become a mainstream topic of conversation and ultimately it's focused on creating the best customer experience for each individual customer.

Biometrics

Biometrics is increasingly being used in the private and public sector as a form of identification and access and also as a means of collecting data. Biometrics refers to physiological characteristics of humans, e.g. fingerprints, retina, facial recognition, palm print, gait and voice. As these metrics are unique to individuals, they are more reliable than traditional methods of identification such as driver's license, passport and knowledge based identification systems such as passwords. Biometrics; however, are more sensitive and private data, and thus require additional layers of security and safeguards. Additionally, the collection and use of biometrics has raised privacy and ethical concerns.

While humans have been using biometrics for centuries, it did not begin to gain momentum until the 1980s when patents for hand and iris identification were granted and The National Bureau of Standards (now the National Institutes of Standards and Technology) began using the first version of the current fingerprint interchange still used by law enforcement agencies around the world and the first semi-automated facial recognition system was deployed[xxiii]. In the following decades, applications and uses of biometrics were mainly geared towards public, national and international security.

Facebook was one of the first large scale commercial uses of biometrics deployed through their automatic face-tagging service, as their 2 billion monthly users typically upload roughly 350 million photos every day[xxiv]. It is discussed that Facebook

has one of, if not the biggest facial recognition databases in the world, which they are now deploying as a way to unlock a user's account. The evolution of the project has not been unhitched as Facebook is currently being sued in Illinois around a 2008 state law known as Biometric Information Privacy Act, which makes it illegal to collect or use biometric data without disclosures of methods and intents. Additionally, in 2012, Facebook had to turn off the facial recognition in the EU and Ireland over similar issues.

While Facebook may have been an early mover, biometrics are increasingly being deployed through the emergence of mobile devices. It is estimated that in 2016, there were roughly 190 million mobile devices, smartphones and wearables, equipped with biometrics and that number is expected to exceed 600 million by 2021[xxv]. In addition to a widely used platform to deploy the technology, biometrics is growing in use due to convenience and usability. For example, Apple devices are now equipped with both fingerprint and facial recognition softwares to provide users with the fastest and most convenient access possible. Biometrics is also expanding in scope of traditional finger and facial recognition; Amazon holds a patent for ear recognition, which is apparently as unique as fingerprints and PayPal is developing brain, vein and heartbeat recognition.

Biometrics is also growing in the public sector. India is developing a database for all citizens called the 'Aadhaar Project,' to remedy issues with identification for accessing benefits and subsidies. The Indian government spends roughly $50 billion on subsidies for food and utilities but require proof of identify before collecting them. Up until Aadhaar, there was no reliable identity number program that would facilitate this. India has turned to biometrics to help bridge this gap and provide food and utilities to its citizens. The project has faced implementation issues regarding legislation and privacy concerns. Multiple lawsuits have been filed regarding the government lacking legislative backing, whether enrollment was mandatory and final use and sharing of the biometric information[xxvi].

While similar in many respects, security and privacy concerns affect biometrics in a different angle than traditional methods of access and identification. Biometrics provides strong authentication while reducing the risk of duplication or fraud, which is an issue with traditional knowledge based access modes such as passwords. Additionally, biometrics is more convenient for the user as there is no requirement to remember passwords. This also creates unique privacy and security concerns. If a biometric database is hacked, it could create serious concerns for those users. This unique and sensitive data can not be changed like a password. These concerns have led to an emerging ancillary security industry around biotechnology.

While much implementation has been concentrated in the technology sector, there are emerging opportunities and examples of biometrics within financial services. The Bank of New Zealand has piloted a program called EmotionScan, which is an online exercise to track your emotional response to different scenarios related to financial events. The exercise captures facial and muscle movements and interprets them into emotions and feelings to better understand how consumers react to scenarios including buying a last minute plane ticket[xxvii]. While this application of biometrics is used to better understand consumers relationship with finances, biometrics is also being used to

improve consumers relationship with financial institutions.

Biometrics is being employed by financial institutions to improve and strengthen the "Know Your Customer" (KYC) process. According to a recent survey of financial institutions, 22% of them currently offer biometrics to their customers and 65% plan to offer services in the near future. Applications have been seen on mobile devices, at regional branch banks and ATMs. Mobile applications , which have taken off since Iphone introduced Apple Pay, provides a secure route for completing payments without requiring a text-based passcode. Hand and finger scanners have also begun to be installed at ATMs and branch banks to supplement traditional access methods to strengthen security around withdrawing cash or related services. In Macau, select ATMs have facial recognition requirements to verify identity[xxviii]. These applications are intended to counteract recent increases in identity theft and internet fraud, which reached $4 billion in 2016[xxix]. Companies are strengthening security by implementing anti-spoofing and live detection into biometric process. Live detection ensures that the fingerprint is from a live person versus a photo. In Voice recognition is also a method of adding the same layer of security[xxx].

Additionally, biometrics alleviates many pain points of traditional banking processes as it creates a much quicker, safer and more convenient process for customers. Converting these once pain points into convenience factors will strengthen financial institutions relationships with their customers.

Internet of Things (IoT)

There is no surprise that IoT has its roots connected to the banking industry. According to Intel, ATMs were one of the first products that were connected to banks when individuals withdrew cash.[xxxi] Vending machines followed suit with a similar concept, notifying food and beverage providers that inventory was low and needed to be restocked. When the World Wide Web was introduced in 1991, computers and modems "united to revolutionize computing and communications."[xxxii] The 2000s brought more applications for business. Smart power meters were able to communicate remotely with power grids. It wasn't until 2010 that the Nest, a smart thermostat, was invented by Tony Fadell and Matt Rogers. This product was one of the first mainstream IoT products for consumers, changing how technology in the home could be used to benefit individuals.

Today there is a race to get products into the home. Three of the largest technology companies: Google, Amazon, and Apple have all created their own talking home operating system with relatively basic features such as telling you the weather, playing music, or conducting a search for a user. Amazon has taken its products a step further, announcing a partnership with LG and inventing a smart refrigerator that tells a user when the refrigerator is low on specific food items.

The potential of these products is exciting, and users have already demonstrated interest by purchasing these devices. The future of IoT extends beyond the home. Self-driving cars have been a recent topic of conversation and possibly a game changer in the way individuals view travel. Softbank recently built a robot, Pepper, to help consumers make purchases or even receive financial advice.

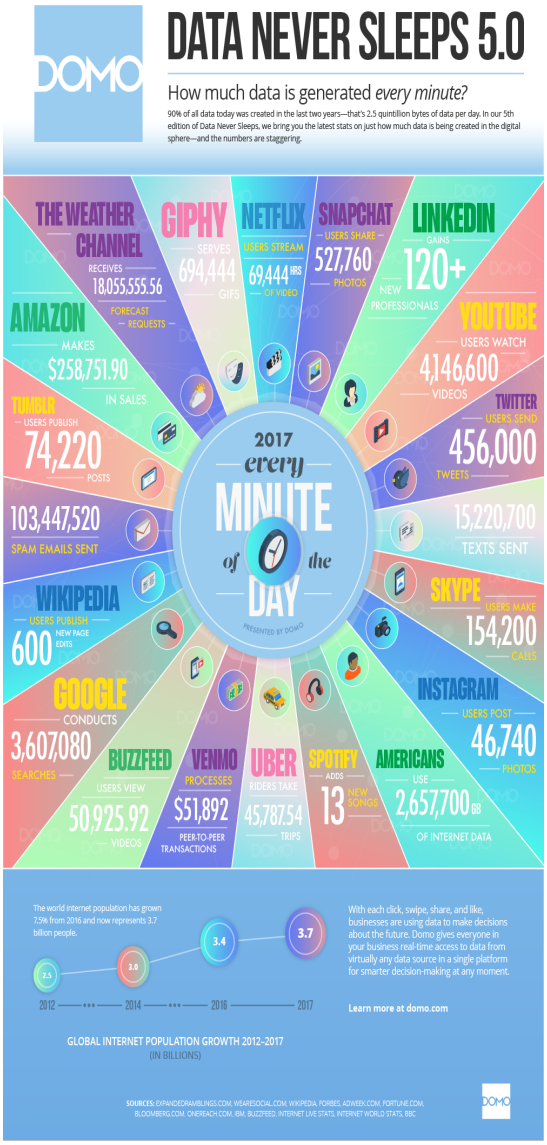
There are interesting studies on the voices used by many of the connected products. In a study by McKinsey, individuals are

developing an emotional relationship to their connected products, and may be more willing to take advice from them.[xxxiii] This leaves an opportunity open for businesses to partner with IoT products and incentive for businesses to invent some of their own devices.

Data Infrastructure & Processing

Many define big data by the three V's: volume, velocity and variety. Volume defines the amount of data that is collected, variety as the type of data that is captured, and velocity is the speed at which data is collected, stored or called upon. Companies are increasingly expanding upon all three of these defining properties which creates technical challenges as companies increasingly focus on analyzing and creating value out of data.

Historically, companies were able to approach data in a batch approach, utilizing internal individuals to collect and analyze data in database formats as volumes were manageable. Recently; however, the size of available data has been growing at an astronomical rate, with data sets now commonly exceeding terabytes and into petabytes (10^{15} bytes of data). For example, there is roughly 72 hours of video uploaded to YouTube every minute and roughly 900 million photos a day uploaded to facebook[xxxivxxxv]. Even as this is written the numbers become outdated. A big driver of this increase in size of data is mobile technologies with smartphones sending a variety of information to network infrastructure at any given moment.



Source: DOMO, How much data is created on the internet each day[xxxvi]

Initially, accessing and analyzing data in manageable volumes was done on a batch process. Individuals could submit a query to a server or database and deliver the results. This process mainly worked due to the rate at which data was stored in the server. Even with a delay in processing, the analysis would be insightful. Recently, however, with data sources such as mobile applications, data is constantly streamed in real time which eliminates the ability to gain useful analysis from batch processing. Batch processing is also further complicated by recent trends with encrypted data, which takes longer to process. The velocity at which data is stored will only increase as the internet of things continues to increase and deploy sensors, increasing both the volume and velocity at which data is collected and stored. Additionally, these trends also add to the variety of data that is captured and stored. Data capture has expanded to include audio, photographs, video, social and even unstructured data. In addition to data getting stored at a rapid pace, companies are also analyzing data at a faster rate than ever

before. This creates technical challenges in accessing and interpreting data.

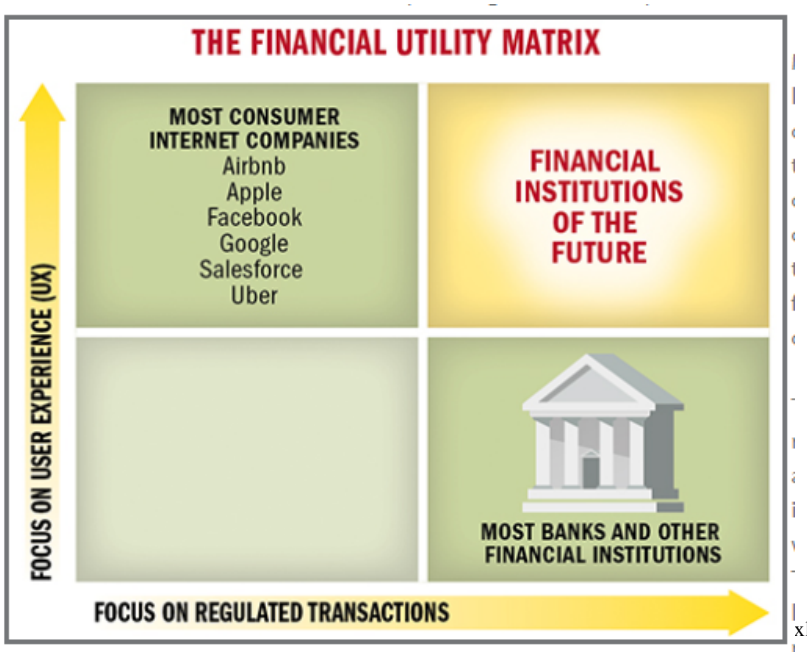
As data has evolved, so have the methods and tools for sources it. Several of the most popular and effective tools are developed in open source platforms, the most popular and common of which is Hadoop. In short, Hadoop is a way of storing enormous data sets across servers and then running analysis on each server, scalable from one machine to thousands[xxxvii]. While Hadoop is one of the most popular, similar open source methods exist. As big data continues to evolve, there is an emergence of a fourth 4 - veracity. This refers to the uncertainty of data, that is complicated as the other three Vs are expanded and stretched. As big data evolves, and the four vs are expanded, in conjunction with the emergence of cloud storage, companies are developing internal methods for accessing their data. This is being done by a combination of specifying and tweaking open source methods, such as a Hadoop, to meet their specific software and or hardware requirement and using new software methods. There are increasing instances of software startups building new methods of accessing data. For example, Confluent, which was founded by former Linkedin software engineers, has raised $30 million to develop big data access methods for companies[xxxviii].

Financial Transactional Data

Banks now understand that they must change the ways in which they are using technology and data analytics to serve their customers. Big data means being able to predict how individual customers, not just broader segments and groups will respond to any given interaction, offer or experience. Customers now also have nonlinear customer paths-- they have omnichannel interactions based on in the moment needs. The most agile banks have data that "allows them to walk in their customer's shoes" and anticipate their "journeys."[xxxix]

One of the biggest challenges that banks currently face is the fact that they have almost unlimited access to transactional data but are still grappling with how to break that data into a more detailed granular level. For example, a bank might know that a customer spent $150 on Amazon, but has no information on what that purchase was comprised of. Financial transactional data is often very confusing and the data itself might be cluttered with numbers, symbols, or abbreviations, making it nearly unintelligible. There is also uncertainty around using only one bank's transactional data to predict market trends.

Envestnet Yodlee Transaction Data Enrichment services seeks to solve this challenge by collecting the financial transaction data across a majority of the banks and making this data easier to read and break down[xl]. This service better organizes data to provide deeper analytics on customer purchases for customers. Both banks and hedge funds have historically used Envestnet Yodlee data for picking investments by using transactions in an attempt to predict earnings, a tactic which has been criticized by the Wall Street Journal for distorting stock prices.[xli]



[xlii]

Banks can learn from other internet companies, which focus more on user experience. By investing in resources for analyzing financial transaction data, banks can better understand customers and provide them with better products and services.

Below are some examples of how some finance firms are using transactional data:

- *Bank of America:* Tracks customers across multiple channel interactions, using the combination of website clicks, transaction records, banker notes, and call-center records to build a full picture of "customer journeys.[xliii]"
- *OnDeck Capital:* Uses bank transaction data from small businesses to make better decisions about which small businesses are less likely to default on loans[xliv].
- *Penny:* A conversational banking application that aggregates financial transaction data and acts as a personal finance coach, providing recommendations and insights around personal financial goals and parameters.
- *Citigroup:* Compares customer transactional data on specific products with available market prices to guarantee customers the lowest market price point. Citi automatically refunds customers if the price on a purchase changes within 60 days.

Case Studies

Case Study: Open Banking APIs - Plaid / Quovo

The recent momentum of digitization in the banking industry has created room for fintechs to challenge incumbent financial institutions. Additionally, regulatory changes in the EU and UK regarding APIs will further this pressure on traditional financial institutions. In the EU, the Payment Service Directive (PSD2), a follow on to PSD issued in 2016 by the European Commission, is geared to increase pan-European competition and participation in the payments industry from non-bank participants as well as progress the payment industry. Implementation of PSD2, set for 2018, requires banks to grant third party access to their customers' accounts and payment services (subject to customer consent). Application Programming Interfaces (APIs) are the most reliable and tested technology to facilitate this transfer although it is not directly stated in PSD2. The directive outlines that an online service will aggregate information on one or more payment accounts held by a customer, for example, transaction history and balances. Additionally, companies and merchants will be allowed to initiate online payment orders at the request of the customer. Similarly, in 2015 the UK Treasury established an Open Banking Working Group (OBWG) to implement an open API standard in banking. In 2016, standards were recommended and nine major UK banks formed an entity to establish common technical standards. The objective of both initiatives is to create competition where incumbents hold power in an attempt to disaggregate services, creating a level playing field and value for customers[xiv].

In contrast to the initiative in the UK, it is not explicitly stated in PSD2 that APIs are the required connection to transmit such customer information although it is assumed. At a high level, APIs are a gateway that allows for accessing information. Historically, APIs have been used internally by companies and allow for different functions within an organization to access information. Both of these initiatives will turn customer related banking APIs into external or open APIs. These open APIs can be used to create anything from platforms or applications to currencies. These changes provide an opportunity for a platform business model to be created from banking, which will most likely force banks to revisit their role in the ecosystem. Will banks purely remain as intermediaries or will they take advantage of the opportunity to provide tools and systems to best utilize customers? This potential for banking to become a platform is analogous to Apple building the app store to facilitate and create value for customers, developers and companies. Apple would not have been able to develop the number of apps that are demanded by customers, so the firm built a platform to build adequate supply.

While there have not been significant regulatory changes in the United States, there are an increasing number of companies working to aggregate financial data. Quovo, based in New York, is one of the leading providers of account aggregation services for financial institutions. They have partnerships with hundred of companies, including Schwab and Janney Montgomery Scott, who utilize a dashboard that shows data aggregation across account information transactions, credit-card operations, loans and investments for a more holistic view of an entity's finances. There are also companies, such as Plaid, that supplement

data aggregation services with ability to build products and services around them. Plaid uses APIs to create a medium where fintechs don't need to rely on tactics such as screen scraping, or automatically collecting data from a permissioned website,[xlvi] and adds features such as payments powered through Stripe, and identity authentication. While banks have historically resisted working with fintechs[xlvii], the position of the new platform businesses such as Plaid and Quovo is that Financial institutions will eventually be forced to collaborate with their counterparts or risk losing business.

Case Study: Emotion Recognition - Softbank's Pepper

Over the past decade, more and more individuals are shopping less frequently in retail stores and are now sourcing products online. While many call this the death of traditional retail,[xlviii] retailers are being challenged to reposition themselves in the market to combat the convenience offered by websites such as Amazon. The focus has been the customer experience and building the store of the future.

in June of 2014, a robot designed to read and understand human emotion was unveiled by Softbank.[xlix] It's initial advertised purpose: to make people smile. Masayoshi Son, the billionaire behind Softbank, had plenty of other intentions in mind when his team designed this product. In a video produced by the group in May 2016[l], Pepper has the flexibility to be programmed with new content by any individual. It also has the ability to work in tandem with IBM Watson and Microsoft Azure.
Pepper has been discussed in many retail conferences on how to expand on the customer experience. In October of 2014, Nestlé Japan announced its plans to launch Pepper in over 1,000 stores to sell Nescafé machines.[li] In July 2015, Mizuho Bank announced Pepper would be the world's first test case, and by 2016 Mizuho had expanded installations to 10 branches.[lii] According to Softbank's website, Pepper has been working hard in many other industries ranging from shoe sales to greeting customers at a restaurant in a large airport. The results are astounding for a robot that just greets people. According to a case study published by Softbank, the restaurant's sales grew by +17%, and Pepper had successfully greeted on average 280 people per day.[liii]

So what's next for Pepper? In June 2017, Softbank acquired Boston Dynamics for an undisclosed amount from Alphabet.[liv] Boston Dynamics is a robotics company that specializes in building robots with legs. Whether it's a walking, talking robot or just the underlying emotion recognition technology, the future of the customer experience is exciting for sure.

Case Study: Security – Onfido

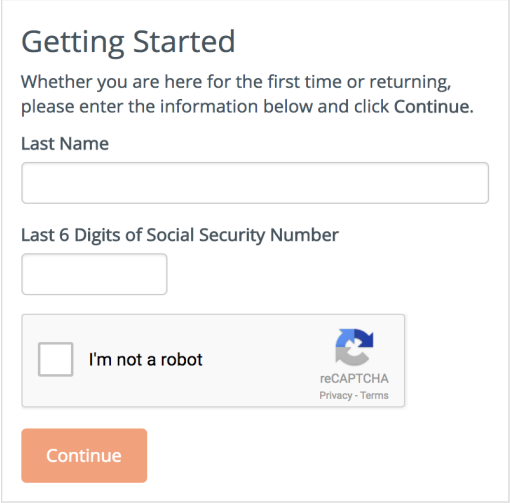
In September of 2017, Equifax announced to the world that there was a cybersecurity incident potentially impacting 143 million U.S. customers. The information stolen included social security numbers, birth dates, addresses, and in some cases driver's license numbers. After the announcement, Equifax launched a questionable website, https://www.equifaxsecurity2017.com, which links to an entirely a different domain: https://trustedidpremier.com that has fishing characteristic.

For example, to find out whether an individual's information was affected in the breach, a person needed to provide almost exactly the same personal data that was stolen. When an individual requested to learn whether their personal information was stolen, that person was also prompted to

waive their right for a class action lawsuit in the security website's "terms of use". Fake security websites with similar spelling were created and a couple weeks after the initial announcement, Equifax mistakenly tweeted a wrong malicious link to their customers.[lv]

Since the incident, a variety of new publications and public officials have been calling for Executives to get jail sentences. There is mutual understanding that the executives handled the situation poorly, but the question remains of whether it was there should be individuals to blame or if it an overall system failure.

Before the Equifax Breach, there were companies aiming to solve the security problems of the future. One of those companies, Onfido started in 2011 and just completed raising $30 million for it's AI identity verification technology, bringing the startup's total funding to $60 million. The firm is based on London but the product is global. Taken directly from Onfido's website, "We carry out checks in 192 countries for global customers including ZipCar, Couchsurfing, Revolut and Square."[lvi]



Above image sourced from https://trustedidpremier.com.[lvii]

The way the product works is a user will scan a document, and through machine learning and facial recognition the item will be cross-referenced versus global databases and credit agencies before becoming certified. After the Equifax incident, the next step is not necessarily a road to replace social security numbers, but figuring out unique ways to authenticate that the documents are real and individuals are who they say they are. With Onfido's product, biometrics can be connected to not only the social security card, but also passports, driver's licenses, and international residence cards. The technology in the future may also be used to notify governmental agencies that documents or identities have been tampered with and provide better insights to identify criminal activity.

Of course, privacy still remains a concern. Who owns the user's biometric data and how will the government view privacy? This will remain a topic in the regulatory landscape until it is voted upon. Some companies such as HYPR, pitch a decentralized method for biometric security-- the user owns his or her data. On their website is written: "Designed for the enterprise, HYPR ensures that personal credentials such as biometrics, PINs

and passwords always remain safe on users' devices. With millions of consumers and employees secured across the Fortune 500, HYPR is the first authentication solution to unite frictionless user experiences with decentralized security." Some argue decentralization is the future, while others are convinced that there is less safety with sensitive information the consumer's hands, and that a centralized entity for authentication is the only option for the achieving the highest level of security.

Current Customer Landscape

The Consumer-Hack

Customers of today are now even more demanding than ever. They constantly seek out the best possible experience at the lowest prices and if the market itself fails to provide exactly what they want, they find ways to create it themselves. A "Consumer Hack" is someone that "finds ways to stitch together multiple products to obtain the best "solution." Consumer hacks are proof that there is "a gap in the market between what functionality is currently available and what the customer actually requires."

Millennials, an area of focus:

By the Numbers:

- Millennials are the largest generational group in the US at 92M[lviii].
- Millennials currently comprise more than 35% of the US workforce[lix] and will represent more than 75% by the year 2025[lx].
- 72% of millennials say they would like to increase their spending on experiences in the next year[lxi].
- Millennials are clinging onto debit cards-- only 33% of them between the age of 18-29 have their own credit card[lxii].
- Top millennial priorities are: (1) Paying down debt (43%) and (2) Saving for the future (28%)[lxiii]
- 33% of millennials say social media is one of their preferred channels for communicating with a business[lxiv].
- 53% of millennials don't think that their banks offer anything different than other banks[lxv].

According to Mintel's Financial Lives of College Students, the youngest generation of consumers is not particularly trusting of the banking industry. Most trust their primary bank or credit union, but only half trust the industry as a whole.

Millennial Banking Habits, from the Mintel Millennial and Finance Report, April 2015[lxvi].

- More than half (59%) of millennials have either already received financial advice or would like to receive it. Most who have received it have gone to advisers at their bank, as do most who would like to receive advice, indicated that there is an opportunity for banks that offer advisory services to successfully promote these services to millennials. Millennials are more likely to seek advice about how to save money than they are about how to manage their money in order to pay their bills
- Only 32% of millennials who have a checking or savings account at a bank or credit union are satisfied with the advisers at that institutions
- The two biggest reasons millennials seek our advice are to (1) help with retirement savings and (2) help with education savings
- Millennials are almost as likely to need help finding the money to pay their bills, plans to focus on budgeting instead of merely investing will help find money to pay bills as well as to save, allowing millennials to attack both goals at once
- Time is more important than money for millennials, institutions looking to serve

millennials need to focus on how their services can save time (or provide experiences)

Rise of smartphone usage and demand for information at customer's fingertips:
Smartphone users use approximately 30 apps per month and about 9 apps per day[lxvii]. Roughly only one third to one half of apps on any given user's phone are used monthly. In terms of app usage, communication and social networking apps are second in usage only to utility apps, such as those preinstalled on the device (alarm clock, calculator, etc).

According to Mintel's Trend Life Hacking, consumers also have a desire to maximise their productivity, using whatever tools are at their disposal to complete their tasks faster and make better decisions. Financial institutions should focus on mobile banking to address this desire by adding or linking to personal financial management (PFM) tools that will help users with tasks such as budgeting, expense tracking, and comparison shopping. They can also utilize location-based functionality, which can also help make banking easier, by saving consumer time and money.

Mobile Banking
Security is top of mind for financial service customers. Qualitative survey results encourage institutions to provide incentives to customers who use mobile banking. Whether in the form of cash or points that can be redeemed for prizes, rewards might pique the interest of customers who have not yet tried mobile baking. Rewards-based systems based on app usage may also help build loyal customers[lxviii].

Emerging Personas

Sarah: *Deal Seeker:* 27-year old millennial with a steady income but is still paying off college loans and has limited savings and financial knowhow. Sarah's priorities are saving for the future so that she can travel and share more fun experiences with her friends. She has no brand loyalty and shops around for the best "deal" or the program with the best rewards incentives. She uses the same bank and credit card that she first opened when opening a bank account in college. She feels no personal tie to her financial institution.

Arnold: Performance Maximizer: 36 year old, Not price sensitive and seeks out maximizing his performance in all aspects of his life. He is a marathon runner and utilizes feedback from biometric devices to improve his overall health and efficiency. Arnold has a successful career and has expendable income. He has been saving for a home, looking for the right property to invest his money in, and values feedback from a trusted financial adviser. He is also a global traveler and seeks continuous excitement and new experiences to share with his friends on social media.

Robert: Digital Laggard: 60 year old GenX-er, who does not consider himself a digital native. Robert has a general reluctance towards technology and does not fully understand the benefits that many technological advances can improve his daily life. He is concerned about his overall security and safety and was particularly shaken by the recent Equifax security breach. Before the data breach, Robert checked all his accounts frequently for malicious activity, since he has been a victim of attacks in the past. Robert needs a better education on bank products and features that can help make his life easier.

Customer Discovery & Recommendations

Pain Points

Account Disaggregation & Lack of Omnichannel interactions: Consumers have become "consumer-hacks" because there is no-one stop shopping for all of their personalized need. Consumers manage multiple accounts, apps and products and struggle to get wholistic advice from a trusted source.

Convenience: Growing customer segments are digital natives and want everything at their fingertips. They are not brand-loyal but favor convenience and ease of their experiences.

Confidence in security measures: checking for fraud and checking accounts frequently: In an era of digitization, customers are faced with continued apprehension around privacy and security. The recent Equifax data breach has only magnified these looming trust issues.

Recommendations:

Enhance Wealth Management with Proprietary Analytics using APIs for convenient access and a more personalized service: A consumer's financial portfolio may include accounts across other financial institutions and fintech firms, whether it be a checking account, credit card, or apps to save money and build rewards. Citi should design an API that consolidates all of a consumer's accounts in a clear concise manner and provide personalized financial recommendations and analytics based on individual customer's financial goals and challenges. Citi should design a proprietary analytics tool for Citi Wealth Managers for customers at all wealth levels, offering holistic advice for the customer.

Collect data on the Customer Experience using Emotion Recognition through IoT for Personalization and Convenience: Focus on capturing, tracking and generating positive customer emotions as a new form of data. Use Pepper or another IoT product, to enhance the customer experience by using emotional recognition to collect new data and providing a new, unique experience to excite the customer. This could mean equipping the retail banks with robots or finding a way to put a Financial Advisor in every home through current IoT (Google Home, Alexa, Oculus) or virtual visits.

Authenticate Customer's Identity using Biometrics to build confidence: The Equifax breach and the aftermath has created a pain point among customers continuously checking their information. Citi should start using a method to authenticate a user's identity when presented with any official government document. This may be through optional facial recognition or other biometrics. It could also mean a behind the scenes product that is less invasive, and more of a risk management tool.

Conclusion

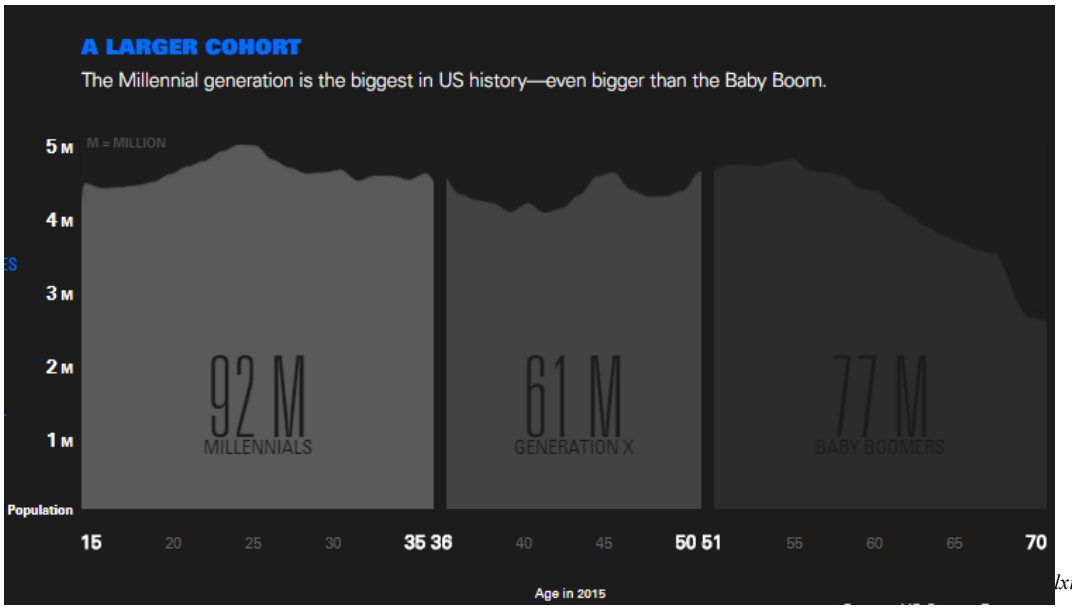
Big data is changing the way firms across all industries are running their business models and interacting with customers. The consumer of today is far different from the consumer of a decade ago. Technological advancements have created new customer needs-- customers want everything at their fingertips, the best possible price and real time updates and reporting about all the topics they are following. Leveraging data affords companies new opportunities to improve their products and better meet the growing needs of customers.

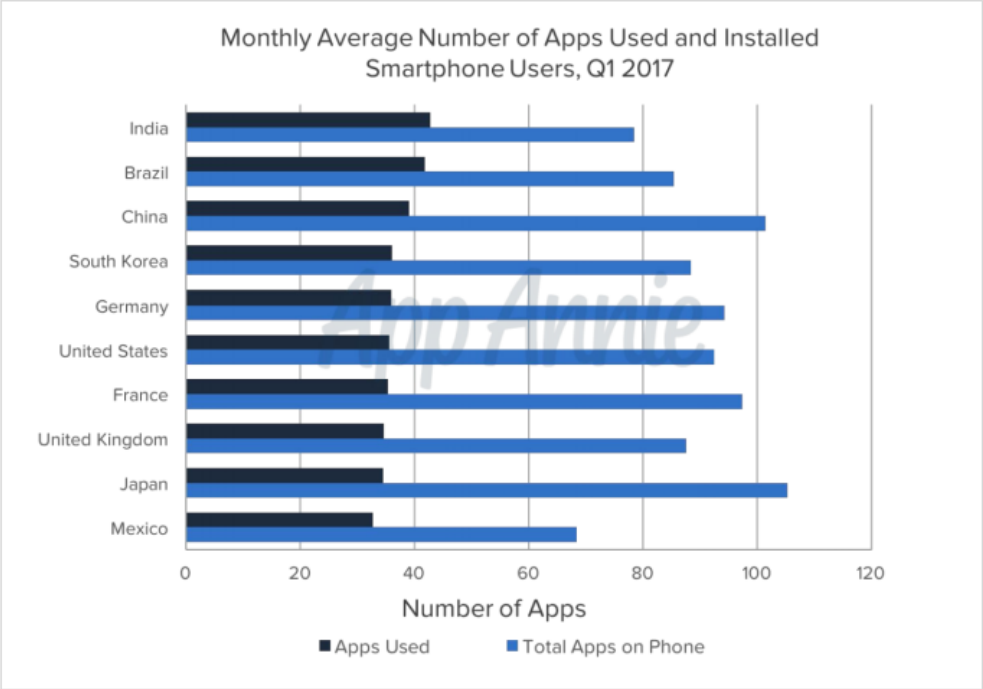
There were five major macro trends explored in this tutorial around leveraging big data: Personalization, Biometrics, IoT, Data Infrastructure and Processing and Bank Transactional Data. Themes and pain points were discovered that overlap across the trends and provide areas of interest for innovators, thought leaders, and regulators. While many of the recommendations offer a thoughtful solution to customer pain points, a few questions remain: How does a business approach ensuring user privacy? How can firms promote financial inclusion and prevent profiling of individuals that may occur through the data? Most importantly, who should own the data: the consumer or the business?

The answers to these questions are far from simple and need to be explored on a case by case basis. Given the Equifax data breach, it is more important now than ever that businesses and policymakers remain proactive in constructively debating this topic to ensure the greater good of people and society. Georgetown University welcomes any individual interested to join the conversation. New technology breakthroughs and the Fintech Revolution have increased global participation in financial markets, ending poverty for millions, and are critical to the progression of both business and society.

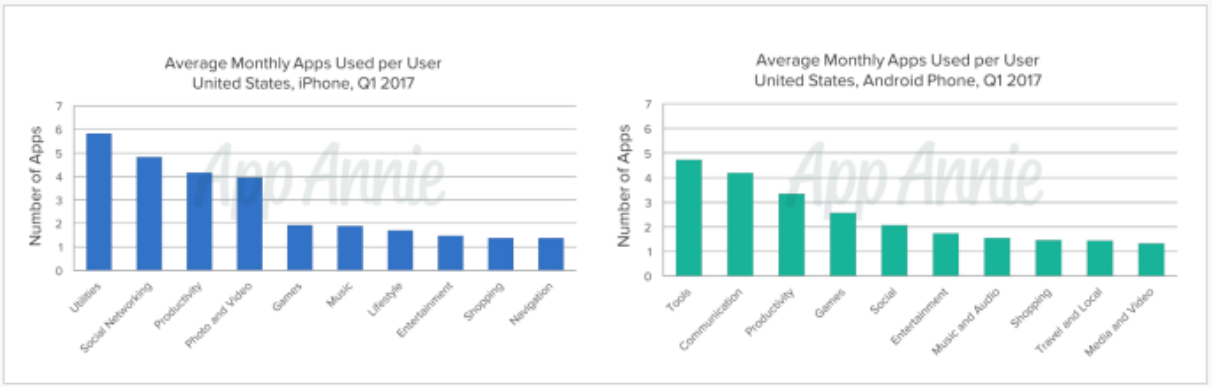
Appendix

Source: The Visual Capitalist, The Extraordinary Size of Amazon in One Chart


A LARGER COHORT
The Millennial generation is the biggest in US history—even bigger than the Baby Boom.
M = MILLION
5 M
4 M
3 M
2 M
1 M
Population
92 M
MILLENNIALS
61 M
GENERATION X
77 M
BABY BOOMERS
15
20
25
30
35 36
40
45
50 51
55
60
65
70
Age in 2015
lxix


Monthly Average Number of Apps Used and Installed Smartphone Users, Q1 2017
India
Brazil
China
South Korea
Germany
United States
France
United Kingdom
Japan
Mexico
0
20
40
60
80
100
120
Number of Apps
Apps Used
Total Apps on Phone
App Annie

lxx


Average Monthly Apps Used per User
United States, iPhone, Q1 2017
Number of Apps
0
1
2
3
4
5
6
7
Utilities
Social Networking
Productivity
Photo and Video
Games
Music
Lifestyle
Entertainment
Shopping
Navigation
App Annie
Average Monthly Apps Used per User
United States, Android Phone, Q1 2017
Number of Apps
0
1
2
3
4
5
6
7
Tools
Communication
Productivity
Games
Social
Entertainment
Music and Audio
Shopping
Travel and Local
Media and Video
App Annie

lxxi

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