Finding the PerfectFit

by

Karen Pike Jennings

August 2017

Presented to the

Division of Science, Information Arts, and Technologies

University of Baltimore

In Partial Fulfillment

of the Requirements for the Degree of

Master of Science

Approved by: _____

Kathryn Summers, Thesis Advisor

_____

Greg Walsh, IDIA Program Director

Abstract

This paper explores available research and documents detailing the current landscape of, and consumer point of view on, ubiquitous commerce as a foundation for understanding and developing a model for web technology that can assist consumers with various purchase types. In addition, this paper compiles and evaluates expert recommendations in interface design for mobile and tablet-based devices in order to inform recommendations for developing a model for technology-assisted commerce applied to the bicycling industry.

Table of Contents

List of Tables

List of Figures

Chapter 1: The Rapid Rise of Online Interactions

> Two centuries of rapid technological advances and innovation have evolved communications and commerce from being tied to networks of waterways and (literally) horsepower to being tied to digital telecommunications networks.
> (Venkatesh, Ramesh & Massey, 2003)

Over the last fifteen years, technology has drastically changed everyday life. Banking, socializing, communicating and shopping — just to name a few — are all processes that have seen modernization though the use of technology and computers. As a society we now access our health records and pay bills online; we deposit our checks and cash into our bank accounts using automated teller machines (ATMs) and even our mobile phones; we stay in touch with family and friends using email, social media and over-the-air online video conferencing; we buy products from online retailers and have them delivered to us at home or work using common shipping channels; we research products and read online reviews before making purchasing decisions. Americans have fully embraced a connected lifestyle, one where the Internet is harnessed as a way to create efficiencies in everyday life.

To understand the impressiveness of the rapid rise of today's multi-device computing society, one must take a moment to understand the history of personal computing, and in particular, personal internet connectivity. In 2000, both home computers and home Internet access were becoming commonplace in American society. According to the FCC, as reported by Money magazine online, over 62 million American consumers accessed the Internet in the second quarter of 2000. Of these, 58 million (93 percent) used a dial-up connection, 3.1 million (5 percent) a high-speed connection, followed by the remaining 1.2 million (2 percent) reported as other connected traffic (Kleinbard, 2000). By 2009, 81.9 million American households had at-home access to the Internet, of which 75.7 million (93.5 percent) reported using at-home high-speed Internet

access, while only 5.6 million (4.7 percent) reported using a dial-up connection (U.S. Census Bureau, 2012). Over the course of nine years, the rapid distribution of high-speed Internet connectivity, at a relatively affordable price, reversed the distribution of at-home internet use as it relates to connection speed.[1]

Fast forward three more years, and in 2012 and we find that Internet connectivity is part of everyday life and "the rapid adoption of smartphones and tablets, and consumers' increasing use thereof, has resulted in a fragmented digital media landscape where the typical consumer now spends his time with multiple screens. Nearly 1 in every 3 digital media minutes is now spent on smartphones and tablets as we embark on the post-PC paradigm of this Brave New Digital World" (Comscore, February 2013). By June 2016 almost 2 of every 3 digital minutes were spent on mobile devices, with the majority of those minutes being spent inside of mobile apps (Comscore, December 2016).

Today's society socializes online, they buy goods and services online, they communicate online; they are connected using a variety of devices, and expect relevant, meaningful and easy to use experiences as they interact with online businesses. "Cross-platform consumption has created a vastly different digital landscape, and it is one that requires insight into both the individual usage of devices as well as the nature of their complementary use" (Comscore, October 2011).

[1] As of January 2014, 10% of all Americans – or roughly 34 million people – lack access to a 25 Mbps/3 Mbps terrestrial internet connection. 25 Mbps/3 Mbps represents the current standard used by the FCC when classifying a fixed connection as broadband (Federal Communications Commission, 2016).

Chapter 2: Commerce in the Age of Digital Saturation

This chapter outlines the current state of mobile and tablet computing in America, and how existing consumer mentalities have been changed over time. By examining ways in which technology has altered the attitudes and habits of society, this chapter discusses challenges created and perpetuated in the retail industry as a result of multi-device, ultra-connected consumers.

Mobile and Tablet Computing

Smartphones are a popular mobile phone choice for many American consumers. Industry experts consider both feature phones and smartphones devices that do a variety of tasks including connecting to the Internet, making phone calls, sending text messages, and taking pictures. However smartphones can support third-party applications as well, drawing a clear distinction between the smartphone and the less-capable feature phones.

Over the last five years, smartphone users have rapidly taken over the mobile phone landscape. Comscore (2012, February) reports “Smartphone adoption reached 42 percent of mobile subscribers for the three-month average period ending December 2011, increasing 15 percentage points during 2011 and representing an additional 35 million smartphone device owners” (Comscore, 2012, February). As of November 2016, 77 percent of Americans, over 240 million people, own a smartphone (Pew Research Center, 2017, June). Today’s consumers have migrated tasks that, in the past, were largely computer-based activities to their smartphones, including sending and retrieving email, looking up an address or retail location, and checking real-time data such as weather, sports scores or stock prices. In *Essentials of Mobile Design*, Todish discusses how people use smartphones stating “People aren’t using them just for simple entertainment or phone calls. They have become the hub of our personal lives” (Todish, 2012).

One of the unique benefits of the smartphone occurs when data is presented in a timely and congruent fashion, taking the user’s context or surroundings into consideration. Smartphones include features that, when combined with data requests, can

produce highly relevant answers for the user. For instance, GPS enabled smartphones can provide users access to a variety of enhanced information such as real time weather alerts without requiring the user to update their location, maps and directions that update as a user's location changes, instant geographical tagging of photography and videos, more meaningful search results that understand what to offer consumers by using defined geographic areas through geo-fencing in conjunction with point-of-sale proximity; push notifications let users 'set it and forget it', sending notifications to the user when they receive an email or a social media interaction request without requiring the user to refresh a connection or launch an application. Many of the beneficial features of smartphones are designed to create efficiency and support ease of use.

In addition to the staggering rise in smartphone use, another portable computer aggressively infiltrated American living – the tablet. Tablet computers weren't a new concept – Catherine Smith explained the tablet's long history beginning with the RAND Tablet, through the iPad in *The History of Tablet PCs*. "The first tablets, as we would recognize them, didn't come about until the late 1950s and early 1960s. These "tablets" consisted of a large computer terminal attached to a receiver pad, which accepted electrical or magnetic input from a stylus. They were extremely expensive to make and extremely heavy" (Smith, 2010).

In 1999, Microsoft began working on what would eventually be coined the Microsoft Tablet PC – a bulky notebook-like device that used a modification of Windows Operating System. Users interacted with the Microsoft Tablet PC using a stylus on a touch-sensitive screen. Unfortunately for Microsoft, the early Tablet PC never achieved widespread adoption or success. However, Apple revitalized the tablet marketplace by introducing the iPad in 2010, supplying a product that ignited a shift in digital consumption and whose penetration rates were more successful than the rise of the smartphone. According to Comscore's Digital Omnivores whitepaper iPads were driving the majority of U.S. tablet Internet traffic. "In August 2011, iPads delivered 97.2 percent of all tablet traffic in the U.S. iPads also account for a higher share of Internet traffic than iPhones (46.8 percent vs. 42.6 percent of iOS traffic)" (Comscore, October 2011).

Comscore (2012) explains “it took seven years to reach nearly 40 million smartphones compared to less than two years to reach nearly 40 million tablets, demonstrating the vast appeal of these devices and consumer’ desire for connection” (Comscore, February 2012). In addition, many tablet owners also own a smartphone; the rapid increase in tablet use may also be an increase in multi-device users (Comscore, February 2012; Comscore, February 2013). Comscore’s 2016 Global Digital Future in Focus Report shares that different device types – mobile phone, desktop, and tablet – enjoy peak usage at different times during the day. These dayparts show prominent desktop use from mid-morning through early-evening, coinciding with the work day, with prominent phone and tablet use in the morning, and significant spikes in mobile and tablet use from mid-evening through prime-time (Comscore, October 2016). The multi-device owner shifts their device to suit their situation and needs, accessing web and apps across a variety of devices throughout each day.

Introducing the Digital Omnivore

This rapid change in the way society accesses information, both from home and mobile-enabled connected devices, has dramatically altered the face of personal computing. In just over a decade, society saw the widespread corporate distribution of the RIM blackberry device for on-the-go email connectivity; the introduction and rapid consumer adoption of the Apple iPhone in 2007, credited as the first device to use a multi-touch interface that introduced a new concept in personal device mechanics and user interaction; the first Android OS smartphone released in 2008, the HTC Dream, introducing platform choice amongst personal devices using a multi-touch interface (Landell, 2011); the modern touchscreen tablet — the Apple iPad, released in 2010 — bridging the gap between traditional computing and small-screen mobile computing; and a variety of other appliances collectively referred to as connected devices, including items grouped into the Internet of Things (IoT) category. In essence, the digital world matured quickly; consumers adapted to this rapidly changing technology, allowing it to change the way they do business, socialize, and manage their professional and personal

lives. Marketers have starting using the term “Digital Omnivore” to describe today’s consumer – a consumer that uses many devices to connect to media and online experiences throughout the day. The Digital Omnivore expects to be connected, whenever and wherever, to the Internet; he or she expects to use different devices throughout the day to work, and play, online (Comscore, October 2011).

The prevalence of computing devices in today’s society has caused a shift in consumer attitudes about all facets of online behavior, including socialization, communication and commerce activities such as shopping and researching purchases. Life today is as much about digital interactions as it is about face-to-face interactions - perhaps more so. Digital life includes socializing on social media properties such as Facebook and Twitter, using location-aware mobile apps to broadcast across social media your whereabouts and participation in real-life activities on a smartphone; individuals consume media, broadcast statuses and activities, and conduct both personal relationships and professional business online using a variety of connected appliances.

“In December 2011, 8.2 percent of all digital traffic (page views) occurred outside of the classic web, with mobile accounting for 5.2 percent of traffic, tablets driving 2.5 percent and other connected devices accounting for less than a percent. In many cases smartphones and tablets have provided incremental reach and engagement to classic web activities, while for others, such as map content and email, these devices have started to cannibalize this behavior on the classic web” (Comscore, February 2012). In 2013, data from Comscore showed that “mobile phones and tablets accounted for a combined 13.3 percent of total Internet page views in August 2012, nearly doubling their share of traffic in just one year” (Comscore. October 1, 2012). Between June 2013 and June 2016, digital media time spent in the U.S. grew 53% overall, with mobile app minutes growing at a rate of 111% during the same period (Comscore, US Mobile App Report, 2016). In the same period, however, the share of growth in digital time spent on tablets was 9%, compared to 88% for mobile devices, suggesting that growth in the tablet market has slowed considerably (Comscore, US Mobile App Report, 2016).

Commerce in the Age of the Digital Omnivore

> In the emerging world of the new consumer and the 'anytime, anywhere' mobile commerce, appliances are located at the collision point of the retailer and consumer agendas.
> (Roussos & Kourouthanasis, 2003)

Behavior patterns of the ultra-connected, multi-device using consumer — the Digital Omnivore — have also impacted the retail shopping industry. Consumers are using multiple devices throughout the shopping experience to become better educated, read reviews, and ensure they get the best deal on the goods or services they buy. "What has been referred to by some as retailers' worst nightmare, smartphones are bringing the power of the Internet right into brick-and-mortar stores, arming consumers with the pricing power that was once reserved for the confines of their home or work online shopping experience" (Comscore, February 2012). Zakaria Maamar (2003) explains "Users have more opportunities to be informed about the current trend of the market before making any decision" (Maamar, 2003).

This shift of power, one that gives the consumer the ability to instantly find a better deal at an online competitor or another brick-and-mortar retailer, forces retailers to remain competitive with pricing while providing exceptional customer service. "The success or failure of local and global businesses may be determined by how well they adapt to the new electronic commerce paradigm" (Lao & Hu, 2005).

In *Digital Omnivores*, Comscore (2011) reports "During the month of September [2011], nearly half of tablet owners made or completed a purchase on their tablet, an important indicator of the growing importance of this media channel to the e-commerce market. Tablet owners exhibited considerable use of their devices throughout the entire purchasing process — from doing the initial planning, to conducting product and store research, to making price comparisons, to finally transacting" (Comscore, October 2011).

Carl Prindle (2010) explains "Mobile commerce means more than just buying goods through your phone. Increasingly, mobile is impacting how consumers search,

locate and decide to purchase goods both online and in brick-and-mortar stores" (Prindle, 2010). While consumers may quickly buy a $0.99 priced song using a mobile device, it's unusual for individuals to purchase big-ticket, or high-consideration, items in the same way. It is more common for consumers to use their mobile and other connected devices to research product alternatives, compare prices at other retailers or view product reviews during an in-store shopping experience (Prindle, 2010). Many consumers will want to access reviews as part of their in-store decision-making process (Ryan, 2010).

In addition to price comparison, consumers use mobile devices to access product ratings and reviews, from both other consumers and professional review services, during the in-store purchasing process. The popular product review subscription publication Consumer Reports flexed its business model to address the consumer desire to read reviews while shopping. Traditionally a printed publication for which users could purchase a subscription, Consumer Reports implemented instant mobile subscription options that attempt to capture the mobile shopper while in the store. Users can select a single-month or full year subscription to Consumer Reports' vast online database, and when accessed using a mobile device, fees are payable through the user's mobile service provider monthly bill via SMS confirmation. By making subtle changes to their existing paper-subscription model, Consumer Reports is able to capture instant, short-term, customers right before the point of sale, for the low cost of $6.95 permitting one month of access to reviews. Their forward thinking has ensured that their business stays relevant in the new age of commerce, and that they continue to be one of the most-trusted sources of professional product reviews (Consumer Reports, 2013).

While ratings and reviews allow consumers to participate and enhance the shopping experience by creating real-life examples other customers can relate to, shoppers may also be looking for greater depth of information on a specific product. The addition of QR and Tag barcodes [also known as 2D barcodes] on a product's packaging or within store a store display can be used to enhance the shopping experience. Scanning a 2D barcode with a tablet or smartphone camera can provide a consumer with up-to-the-minute product information while in-store, helping the buyer become more educated and,

in turn, better prepared to make a purchase decision (Deagan, 2010). Mobile interaction can, in essence, help make a sale by providing the “final push” needed in the decision-making process (Prindle, 2010). Because 2D barcodes facilitate an in-person request for information with online or remote data, the type of information each barcode retrieves for a shopper can vary based on product type and need. For instance, a 2D barcode used on a television might provide access to a list of features and benefits, as well as technical specifications and user manuals in a variety of languages. In comparison, a 2D barcode used in a local bike shop might allow consumers to explore configuration options and sizing data for different bicycles. In addition to helping consumers locate data, 2D barcodes may also be used to deliver more detailed product information to store owners and sales associates, further improving the in-store sales process by providing instant access to a wealth of product information as well as answers to shoppers’ questions as they arise (Deagan, 2010). The use of 2D barcodes creates an abundance of possibilities using the “extended packaging” concept — information can be delivered in multiple languages, and the volume of information can vary, providing a highly relevant and personalize experience for every user (Deagan, 2010; GS1, 2008, p.18, 23). However businesses must carefully set expectations with consumers about the information that a 2D barcode will provide; the same technology is often used to supply marketing information that may, in many situations, be misaligned with the user's expectations.

But smartphones and tablets aren’t just influencing the in-store shopping experience; they’re changing the way retailers need to interact with their customers. To remain successful, retailers need to remain one step ahead of the Digital Omnivore, making sure that they understand and embrace the technology touch points their customers are likely to interact with along the path to purchase. Knowing that online product reviews and price comparison have become everyday mobile shopping techniques, retailers can counteract deficiencies with exceptional customer service, price matching policies, and availability of reliable product information for consumers.

The predictions of the past, where virtual shopping centers infused e-commerce processes with social interaction (Maamar, 2003), never caught on; but in a way the basic

idea behind these predictions proved to be true – consumers expect a level of social interaction while shopping online. We see this interaction though online reviews, and ratings, through social media sharing tools, where users can virtually interact with others online and feel better about the decision making process. The Digital Omnivore seeks out reviews and stories from other shoppers, they look for deeper product information through instant online connectivity, and they compare prices and alternatives throughout the shopping process using a variety of connected devices.

One recent trend that is forcing retailers to think differently is showrooming: a process where a shopper visits a brick-and-mortar store to interact with a product, after which they buy the product online. Experts believe that showrooming emerged because of the consumers desire to touch and feel the items they intend to buy, coupled with the benefits of broad selection and competitive pricing that internet retailers can offer. The rise of showrooming has had a negative impact on brick-and-mortar retail, causing several large retailers to reduce the number of locations they operate (Heiselman, 2013). "Smartphones have become an important device for 'showrooming' behavior, where in-store shoppers use their phones to compare prices and end up transacting via digital channels, which is disrupting established brick-and-mortar retail" (Comscore, February 2013).

Experts in both the technology and business world are encouraging business to embrace showrooming through innovative thinking (Clancy, 2012; Heiselman, 2013). "Smartphones have quickly become consumers' most valued shopping companion as showrooming quickly becomes standard practice for in-store shoppers" (Comscore, February 2013). Walmart recently implemented a pay online and pick-up program; likewise, retailer The Container Store has an in-store pick-up program. The Container Store reports that they are seeing an increase in the number of items purchased when consumers use the pick-up program. Some experts recommend that retailers "be in the experience business, not the transaction business", and point to children's retailers Build-a-Bear Workshop and American Girl Stores as examples of how building memorable, desirable offline experiences can bring consumers to the store and keep them coming

back (Heiselman, 2013). As a result of showrooming, many retailers are emphasizing customer service, ensuring their support staff can be seen as a valuable part of the shopping process (Heiselman, 2013).

Flor, an online retailer of high-end carpet squares, recently opened brick-and-mortal retail locations in select cities to specifically encourage users to touch and feel, or sample, their products. Visitors to the Washington DC location can touch and feel carpet samples, look at color samples, ask the sales staff questions and interact with the product in the store — customers are not discouraged from ordering their product online for at-home delivery. In essence, Flor has been able to migrate from an online-only store into a hybrid retailer; the physical location helps build consumer trust by providing the opportunity for a hands-on experience with the product, while the online sales and distribution model allows the company to maintain business without over-extending its existing fulfillment model (Flor, 2013).

Mobile commerce has grown to 20 percent of digital spending by April 2017. At the same time, brick-and-mortal retail is seeing increasing downturns and high rates of bankruptcies and liquidations. "People used to make several trips to a store before buying an expensive item like a couch. They would go once to browse options, again to narrow down their favorites, and again to finally pull the trigger", reports Derek Thompson for The Atlantic, stating "today many consumers can do all their prep online, which means less ambling through shopping centers and less making incidental purchases at adjacent stores" (Thompson, 2017, April) Today's consumers have adapted to doing business online, and shifting sentiments in what and how they purchase have impacted traditional retail as we know it. Evidence points retailers to adapting to online conventions as a method of survival, allowing these savvy institutions to appeal to a newer, connected generation.

Chapter 3: Mobile and Tablet Interface Design

Mobile and tablet devices are often grouped together when talking about interface design — they share similarities, such as portability, operating system and touch-based input. However owners of multiple devices often use mobile and table devices in different ways, to do different tasks. One of the challenges facing interface designers today is to deliver experiences that are both relevant and useful based on where, when and why they'll be used.

Constraints existing on both mobile and table devices help define areas of focus for systems that may be used on both devices.

Input Method

Today's touchscreen devices use different input controls than computers — both devices lack a mouse, and introduce the use of a virtual (on-screen) keyboard. The lack of a mouse eliminates rendering for the hover state on links and buttons. In addition it forces users to use another way of navigating content, in most cases using a finger — this opens up the possibility of gestural navigation and discovery within the interface. The use of a virtual keyboard eliminates, in many cases, tactile feedback that assures users that they've input data. This introduces additional design considerations, forcing designers to use visual elements to communicate the same level of response for the user when typing.

Technical Limitations

Smartphones and tablets both rely heavily on battery power, being operated, in most instances, without being plugged in. As a result, battery life is an important consideration for application designers. Care should be taken to avoid processor intensive activities and adequate device-based testing is recommended to ensure that memory leaks and other features aren't creating unnecessary battery drain. In addition, smartphones and tablets have varying levels of processing power; for the most part they are less capable than desktop and laptop computers. Ensuring that efficiencies are made in processing functions will help improve your user's experience with your application.

Mobile Specific Constraints

Smartphones and other small-scale mobile devices present specific constraints that contribute unique design and strategy challenges for product development:

Data Usage

With unlimited data plans becoming both increasingly rare and more costly, designers should be sensitive to the amount of data transferred between the device and application. Responsive design, while a popular method that allows designers to deploy screen-size sensitive layouts that flex to meet the display expectations of different devices, does “almost nothing to lessen the overhead of data transfer to mobile devices. Resizing or hiding unwanted images still requires the full images be downloaded to the browser” or device (Todish, 2012, p12).

Form Factor

The most notable of all mobile constraints is form factor. Mobile devices are small by design — they are meant to be lightweight and portable. The reduced screen size and resolution of mobile devices creates a new challenge for designers to address, complicated further by the variation of resolution and screens across the hundreds of device models available for purchase today.

However, mobile design isn’t just about making things smaller, rather it’s more about consolidating features and building applications that focus on necessary items and actions. Once the application functions are minimized and prioritized, the application designer is free to layout items into the available space using a logical arrangement based on desired action and best practices (Todish, 2012, p11-12).

Mobile Adoptions and the Impact to Design and Strategy

Mobile design has had some time to mature, and we can now reference industry best practices when working to design or deploy smartphone optimized applications and

websites. In *Essentials in Mobile Design*, Todish outlines some best practices for smartphone development in his chapter on UX Design Guidelines for Smartphones:

- **Mobile First:** By approaching mobile as the starting point for a project, businesses are forced to focus on essential features and content, removing unnecessary items from the primary focus or view.
- **Behaviors and Archetypes:** Making the interaction types in an application familiar will make it easier for users to learn or use. “Build on the behaviors and archetypes that your users are already accustomed to. This will go a long way to reducing the learning curve of your application” (Todish, 2012).
- **Encourage Exploration:** While introducing some “cues and coach marks” for users to understand complex interaction or input types, designers should also allow users to discover others to promote a sense of accomplishment from using the application.
- **Provide Immediate Feedback:** Help the user understand when the application has received input — the conventions for this on mobile, or tablet, devices is different than those found on the computer. “Providing some indication that the application has registered the user’s interaction is critical, whether it’s a small bounce at the end of a scrollable region or a subtle color change at the tap of a button. This not only compensates for the lack of tactile response, but assures users that something is happening even if the screen isn’t updating immediately” (Todish, 2012, p 14-15)
- **Context:** Understanding the context in which an application is likely to be used can influence design. Because of the portability of mobile devices, many mobile applications are designed to be used “in the wild” and leverage a sophisticated array of the smartphone’s features to enhance functionality. Designers should spend as much time as possible in areas where they expect their application to be used in order to understand the unique challenges facing that environment.

Mentioned earlier in this chapter, one of the biggest trends today in multi-device interface design is responsive design. Responsive design is user interface development technique used for web-based applications defined as “a web development approach that creates dynamic changes to the appearance of a website, depending on the screen size and orientation of the device being used to view it” (Schade, 2014, NNG). By using media queries and defining styles base on the width of the rendering device’s display, designers are able to create flexible designs that accommodate a number of form factors and display scenarios. Like every technology before it’s time, there are both pros and cons to using responsive design.

On the positive side, responsive design allows a business or designer to deploy a single strategy and accommodate a vast number of devices. Because only the presentation of the content is altered, and a single set of features and content is leveraged across each presentation, the long-term effort to maintain the site or application is reduced when compared to a strategy that deploys different sites for computer, tablet and mobile. In addition, responsive design relies on display width to right-size content and features, eliminating the laborious and constant updates required to maintain accurate user agent sniffing as part of a mobile strategy.

While mobile design is appropriate for many situations, there are some drawbacks to using this approach when designing for multiple devices. Mentioned earlier in this chapter, responsive design doesn’t reduce the amount of data passed to the device. If an image is used on larger computer-based screens, the same image will be downloaded; responsive design only resizes the display or presentation of the image, however the techniques used are not able to reduce the file size of the image (Todish, 2012, p12).

New options are emerging in the technical space that allow businesses and application developers to better meet the expectations and desires of mobile consumers while providing the operational efficiencies businesses yearn for. One option that addresses this paradigm is Progressive Web Apps, which have the ability to incorporate quick, fast loading, secure interfaces that support interactions with GPS, cameras, payment methods and push notification capabilities into existing responsive or mobile

website code. Progressive Web Apps work by leveraging a Web Manifest Log and a Service Worker - used together, these new features allow businesses and technical developers to configure features like push notifications and access to phone features (such as payment apps) while also defining caching strategies for content, as well as display rules (such as showing or not showing the web browser controls). These features and functions work in concert to supply lightning fast performance, support for offline browsing, and deeper device integrations that look, feel and behave similarly to installed web applications (Cole, 2017, Google, 2017). As web capabilities mature, mobile users can be provided with experiences that cater to their needs while meeting their expectations for speed and interactions models.

Progressive Web Apps provide another alternative for businesses - one where they can choose to invest in web-only technology if their unique use cases are met. While users clearly prefer using mobile apps, the reach of mobile web is more than 4 times that of mobile apps (Comscore, September 2016). Attracting users to download and stick with an app is a difficult task, however businesses can see gains when using Progressive Web Apps by leveraging the reach of mobile web, bypassing the app store process, all while at the same time gaining operational efficiencies that centralizing to web-based technology provides. The downside to PWA being that only a small portion of devices as of June 2017 support all features, rendering a less-app-like experience to users on older model phones. As time goes on the downsides for PWA will shrink as new versions of each major mobile operating system seeks to support more of these features (Cole, 2017).

Considerations for Commerce

Considering all of the ways that the Digital Omnivore connects to digital media requires designers to make concessions for a variety of device types — mobile devices, tablets, computers and other connected appliances — to ensure product success. By understanding the context in which users will interact with the application or website being developed, designers can more effectively identify the product’s essential features, focusing on the most important elements and ensuring that users complete intended goals.

Leveraging familiar behaviors and interaction models can speed new product adoption and reduce potential for negative reactions to new systems and products. In addition, by implementing designs that follow current industry best-practices, designers and product developers can point to recent successes and product history to inform businesses of the value of supplying contextually appropriate experiences to the Digital Omnivore.

Chapter 4: Enhancing the In-store Shopping Experience Using Technology

Brick-and-mortar Meets Technology

Introducing technology within the brick-and-mortar retail environment presents the opportunity to improve several facets of the in-person shopping experience. Allowing users to participate in some self-service activities may improve trust between the customer and the retail establishment. “Often, the relationship between salespeople and shoppers is perceived as predatory, even parasitic, where sales people manipulate buyers into decisions that are perhaps not wholly in the buyer’s best interest” (Chu, Dalal, Walendowski & Begole, 2010). The basic retail pricing and information kiosk can be found in several big-box retailers in America, and helps consumers perform quick, simple self-service tasks. These kiosks empower users by making deeper product information and pricing details available without requiring the customer to seek out, and potentially wait, for a customer service representative. These basic kiosks may also assist in-store sales professionals by providing a quick and easy electronic resource to find the same information when asked by customers. In other instances, the in-store kiosk has taken on a more robust range of features.

Outdoor and sporting goods retailer Cabela’s introduced self-service kiosks into retail locations in 2008, providing consumers with access to product details, real-time inventory information, a kiosk-based ordering process for goods not available in the store (or for out-of-stock items) and access to the retailer’s loyalty program. Albright reveals that Cabela’s considered employee training to be a key piece in whether or not customers would use the kiosks. “You can’t get customers to use a kiosk unless the employees understand the benefits” (Albright, 2010).

Many retailers are using popular tablet models to make their entire catalog available to shoppers. One such example is sports brand Puma, who recently implemented an iPad-based kiosk in some of its stores worldwide that allows users to customize their own shoe during the shopping experience. The “Creative Factory” iPad kiosk also introduces social interaction by allowing customers to compare shoe designs

with other Puma customers around the world (Bhanote, 2011). Retailer Things Remembered is also using an iPad kiosk in stores — shoppers can use the kiosk to set up their customization projects and preview the results before placing an order with the store (Bhanote, 2011). Replacing a paper-based process with one that leverages modern technology may eliminate errors that cause reorders, improving both the customer experience and the resulting product satisfaction.

Using the iPad as a kiosk, or another popular tablet model using Android OS, may alleviate user experience concerns with traditional in-store kiosks. Using a familiar device increases the chance that a user will already be accustomed to the standard design patterns and interaction models of the operating system. By leveraging a familiar way of interacting with the device, the user will easily adapt to using the same device in a new environment, perhaps for a new purpose. In addition, the portability of the tablet allows for applications that encourage movement. Whereas older models of in-store kiosks were mounted to a pillar or set up in another fixed location in the store, the tablet-based kiosk introduces flexibility and mobility, features that may be useful to both consumers and in-store sales staff. Kiosk portability also introduces new risks and challenges for businesses to consider, including theft prevention and device location. Businesses will need to consider altering training and operational practices to prevent loss of hardware.

Product and Category Barriers to E-commerce

There are some products and categories that don’t lend themselves to online purchasing, including products with deliverability issues, and items that users expect to touch or feel, or even test, before purchasing. By responding to the needs of this niche segment, the retail industry ensures that these consumers are able to carry out familiar activities such as research, reading reviews, and narrowing the selection pool, while at the same time driving them to a brick-and-mortar location to complete a sale. In essence, this is the opposing process to showrooming, whereby connected consumers make selections, educate themselves and create a virtual wish list, and then finalize the selection process by interacting with knowledgeable sales professionals in the store.

A long-standing example of this process can be seen in new car purchasing. Interested consumers visit brand websites and frequent 'build your own' customization tools. These tools allow users to filter by price and needs, add in features they want, and then have the website save their desired automobile. Many brands will email this wish list to a local dealer to work with the consumer to locate or build the car, to the desired specification, and negotiate pricing. But most important to note is that this process, one that doesn't often complete a sale online, stems from two barriers to online purchase: deliverability and acceptable fit. It's difficult for the purchaser to risk spending thousands of dollars for merchandise sight unseen. First, cars are difficult to deliver through regular shipping methods – working with a local dealer ensures that you get the car you've agreed on; and second, the majority of consumers will not buy a car without test driving it – cars are highly personal decisions requiring proper fit with the driver, there isn't a one-size-fits-all model. Aside from single-brand customization tools, several online car shopping websites attempt to fill the research and customization gap across brands with online tools. Websites like cars.com and autotrader allow users to look for both new and used cars using a variety of search parameters. Results and suggested pricing are displayed online, and meant to kick-start the shopping process that ends at the dealership (cars.com, 2013; autotrader.com, 2013). This shopping mentality can be extended to, and modified for, other industries where the product selection requires some hands-on time before the user is comfortable with making a purchase. One industry that may benefit from this reverse-showrooming process is high-end sports equipment.

Applying E-commerce Ideals to Bicycle Shopping

Using the cycling industry as an example, high-end sports equipment has many similarities to the auto industry, and a few unique considerations, that present several barriers to online purchase. Outside of bicycles for children, buying a bicycle can be an expensive and highly personal retail experience. Currently, one will find hundreds of cycling equipment brands selling adult road bike frames, ranging in price from under $200 to over $10,000 for a new model. The geometry used to build each bicycle differs

by brand, and the terminology used to specify sizing isn't consistent across the industry. In addition, different materials are more suitable for different purposes and, based on the intent and needs of the rider, can help narrow the selection field. Furthermore, the selection of components – the non-frame parts that make the bicycle work such as gears, pedals, shifters, cables, the seat and more – add additional complexities and some subjective considerations to the selection process. Add considerations for commuters, mountain bike riders, and specialized sports such as track cycling, BMX or cyclo-cross, and you'll find a complex and confusing retail process.

According to cycling periodicals and advocacy groups, an adult consumer looking to buy a bicycle should plan to visit multiple specialty shops - be that local bike shops or sporting goods stores - to ensure they have seen a variety of equipment that meets their needs prior to purchase. Justin Steiner mentions this in the 2016 How to Buy a Bike: A guide from Bicycle Times, encouraging readers to "Make a list of all the bike shops in your area, and note the brands each store stocks, the store hours, and locations. Then devise a plan to visit all of them" (Steiner, 2016) But visiting multiple shops over several days is directly in contrast with the increasing expectation of rapid retail gratification that the Digital Omnivore has come to expect. While there are several retails working to sell bicycles and bicycle components online, many sell only a handful of brands. In addition, they fail to address the need for purchasers to be "fit" to a piece of equipment, and only really appeal to existing enthusiasts that feel comfortable building equipment, as these online purchases rarely come assembled.

As it pertains to buying bicycles and cycling equipment, leveraging technology to create a profile and filter data based on a variety of customer criteria may improve the sales process and create efficiencies for consumers. Ninety-seven percent of bicycle sales in the U.S. in 2011 were in brick-and-mortar stores, including large retail chains, local bike shops, toy store, department stores and outdoor specialty stores, with the majority of dollar-value sales coming through local bike shops (National Bicycle Dealers Association, 2011) that not only sell equipment, but may also offer cycling related activities, such as organizing group rides or holding low-cost spin classes, in an effort to

strengthen and continuously engage the local cycling community. The value of developing a long term relationship with the experts at a local bike shop is not in dispute. Allowing consumers to jump start the process potentially alleviates strain for the consumer by using familiar digital channels to educate and refine their understanding of bicycles that are relevant to their needs, while at the same time supporting the current retail norms that both support the buyer, and allow the local bike shop network to thrive.

Using technology to bridge the buyer and the local bike shop can also stretch beyond web-based tools for the consumer. The introduction of web-powered kiosks into local bike shops may help local business by putting trusted, verifiable information into the hands of the local sales associate while at the same time enabling the preferred self-service actions of the Digital Omnivore: online research, filtering the vast selection pool, comparing socially-aligned details on a product, and comparing price. These modernizations can lead to greater stickiness with consumers who expect to interact with digital tools, while also reaping the benefits of the high-touch expert interactions the local bike shop can provide.

Chapter 5: Building an Online Model for Bicycle Purchasing

This chapter identifies a model for using web-based technology to help consumers make bicycle purchasing decisions through the design, development, and consumer review of a web prototype. Through the evaluation of test data, including review of use-of-prototype video and compilation of survey responses, this chapter discusses the likelihood that commerce-like web technology can be used to kick-start offline purchasing options for individuals looking to buy a bicycle.

PerfectFit Strategy and Prototype Design

The PerfectFit prototype is designed to address the needs of the bicycle purchasing consumer while retaining the connection to local bike shops and sporting goods stores that provide the necessary mechanical and building expertise that serves as a barrier for most consumers looking to buy online. By providing equipment recommendations that are driven by intent data and consumer-provided body measurements, PerfectFit aims to provide an online resource that also includes consumer reviews, local purchasing information, and the ability to compare brands against one another on fit, features, and pricing data points.

To start the PerfectFit setup process, consumers are asked to input basic body measurements (see Figure 1) that seek to narrow the recommendation field by size and proportions of bicycles available to the consumer. While this is not a substitute for a professional bike fitting, it does provide a baseline from which recommendations and guidance to the consumer can be provided regarding bicycle fit, and seeks to eliminate choices that will be obvious misses in terms of sizing. From there consumers answer questions about intended use, including the type of riding they engage in, how often they will participate, over what distance they expect to travel, and what riding situations they prefer (see Figure 2). This consumer-provided data is then used to define a profile that can be used to view, save, and recall bicycle matches that can be refined and filtered by price, brand, and more.

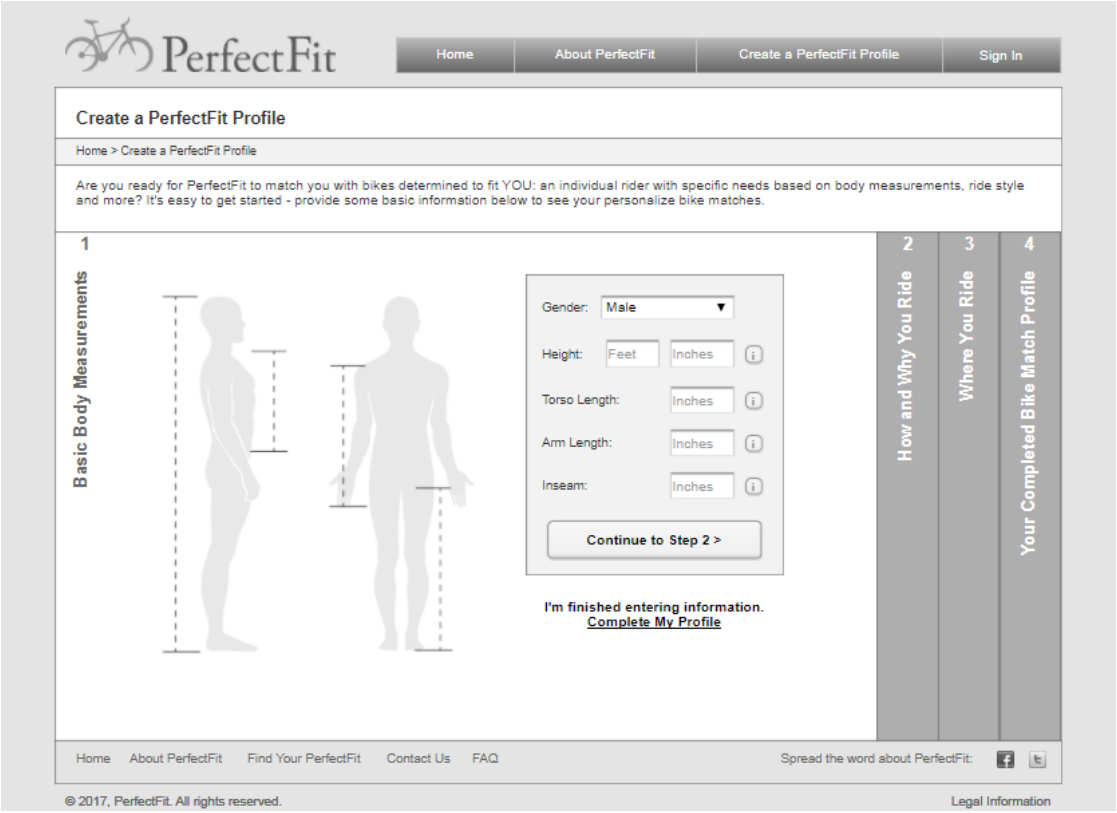

Figure 1. PerfectFit Prototype Screen – body measurement inputs.

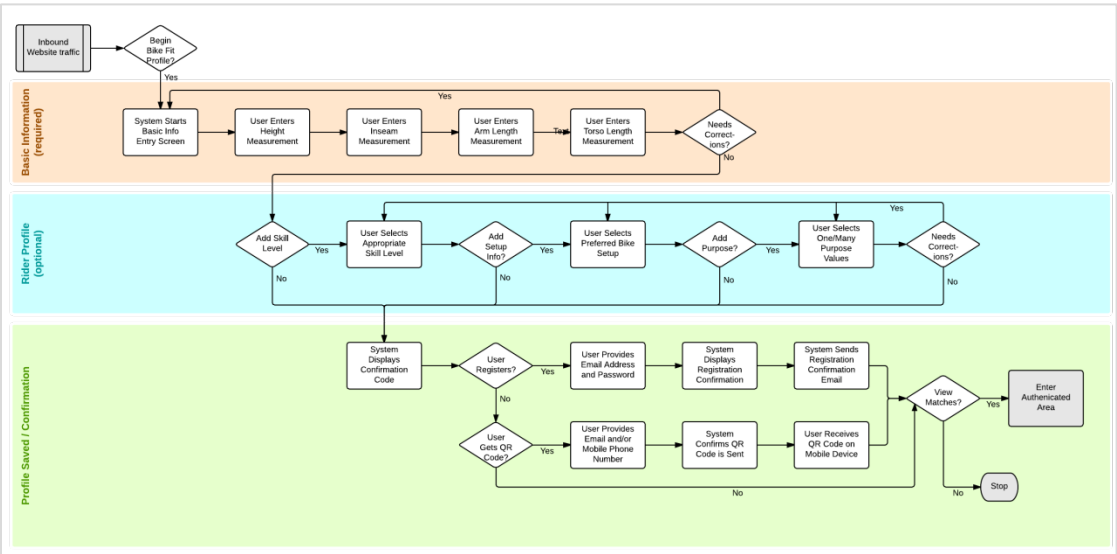

Figure 2. PerfectFit Workflow Diagram – consumer data entry and setup process.

Consumers not ready to create a profile will be allowed to retrieve their matches, and see local bike shops that sell their matches, for up to 30 days by using a unique profile code that is generated when they submit their measurement and intent data (see Figure 3). At any time during the first 30 days, the consumer can complete a profile to retain their matches long-term and gain advanced comparison features.

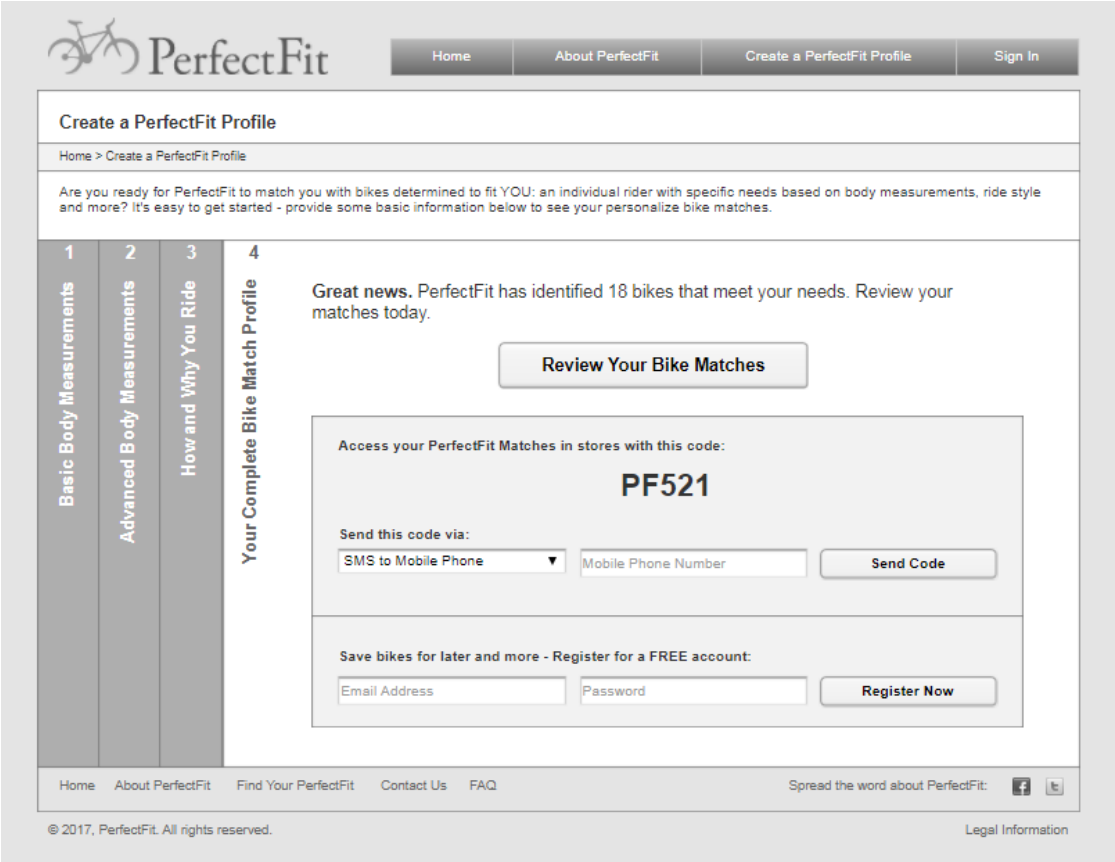

Figure 3. PerfectFit Prototype Screen – register or use code for results.

Once the user provides their profile code, or logs in if they have registered, the system recommends bicycles that consist of best matches across multiple brands derived from the consumers intended use and sizing data (see Figure 4). This recommended bicycle display can be narrowed by filtering by price, availability, brand, bicycle material, and more.

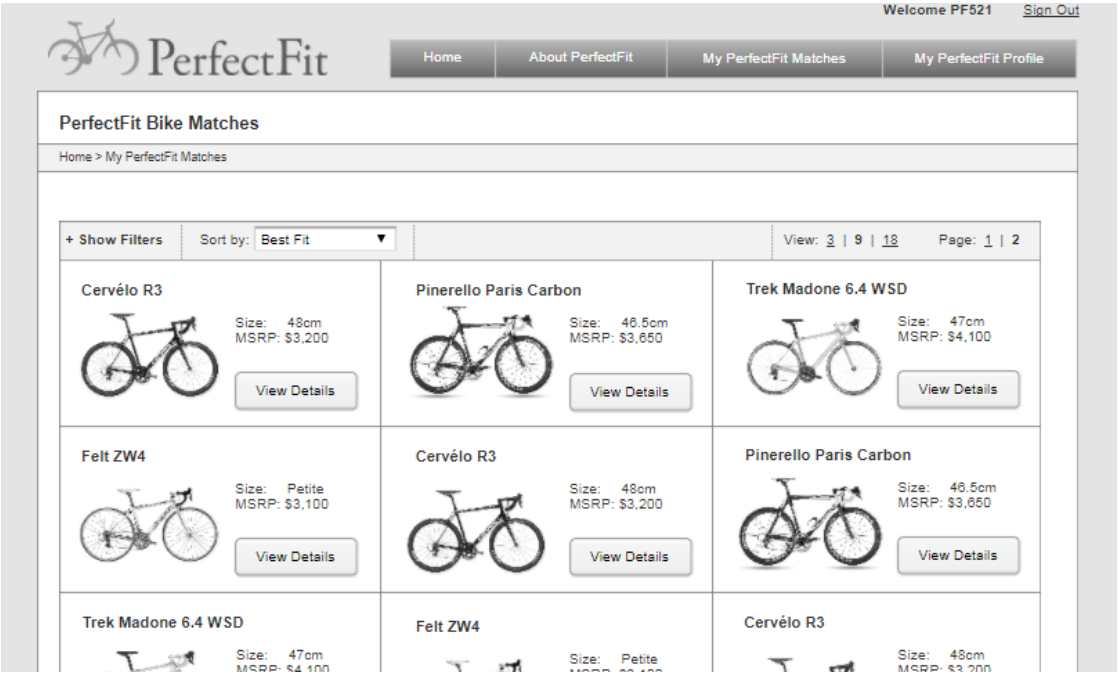

Figure 4. PerfectFit Prototype Screen – review bicycle recommendations.

The website user can then view details about specific bicycle equipment, including different build details, geometry specifics, and reviews from experts and consumers (see Figure 5). When they are ready to make a purchase, users can view local bike shops that carry and/or stock the bicycles they prefer (see Figure 6). Furthermore, the user can save bicycles to their favorites for easier reference in the future, and run comparisons across bikes of different brands.

All of this is designed to help point the user to recommended products that meet their needs, while at the same time guiding the user to purchase through a reputable retailer. The local bike shop connection should be preserved as this relationship provides mechanical, technical and support expertise both at initial delivery and throughout years of bicycle ownership.

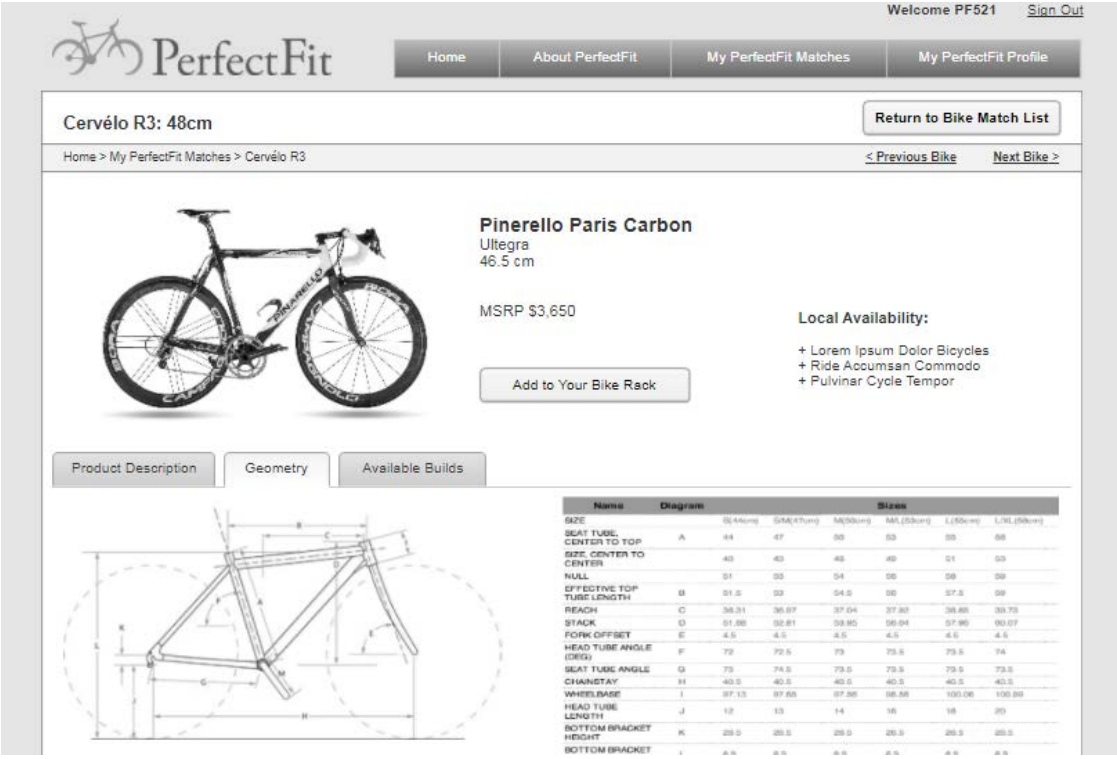

Figure 5. PerfectFit Prototype Screen – bicycle detailed information.

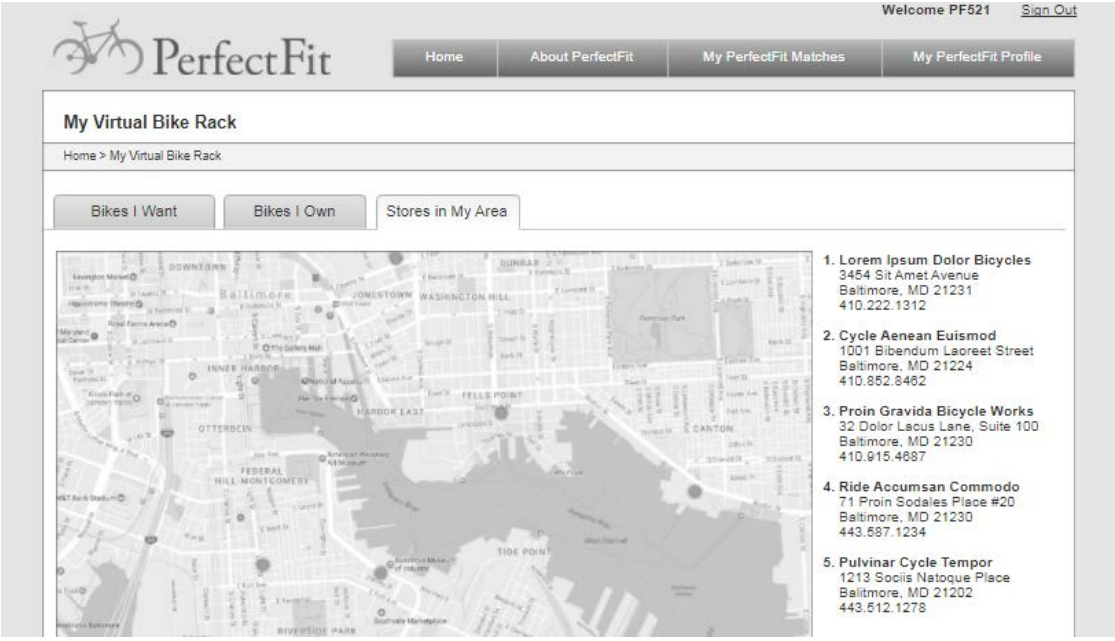

Figure 6. PerfectFit Prototype Screen – map to local bike shops.

User Testing Overview, Process and Tasks

Overview

During this study test subjects were presented with the PerfectFit prototypes described above via an online testing tool at TryMyUi.com. TryMyUI.com is a commercially available, web-based tool that allows test subjects to engage with the prototype while recording both video of the screen they are using (to document mouse movements and scroll positioning) and audio (to document the subject's comments, questions, and sentiments) as they complete each task in the test set. After each task, the test subject is asked to complete quick task-specific measurements meant to verify completion and provide quantitative measurement of ease of use sentiment. At the conclusion of the entire test set, the test subject is presented with survey questions that provide them with a mechanism to include feedback to specific questions relevant to the study.

Test Subjects

For this study, ten test subjects completed testing conducted using TryMyUi.com. Test subjects were recruited from TryMyUi.com's included test subject pool using the following settings:

Gender: Any
Age: 18-34
Country: USA and Canada
Income: Any
Education: Any
Employment: Any
Family Status: Any
Parental Status: Any
Community Type: Any
Social Network Usage: Any
Additional Qualifications: None

Test subjects were not directly incentivized by this study; however TryMyUI.com does pay $10 cash for each test a user completes.

Scenario and Tasks

The purpose of this study is to determine consumer sentiment on the strategy and design of a web-based system used to recommend bicycles based on fit and functional inputs by the user. Test subjects were first presented with the following scenario:

> *A friend recently mentioned a new website, called PerfectFit, where you can enter personal information and be presented with bicycles that meet your needs. Because you're in the market for a new bicycle, you visit their website hoping to learn more about the service they offer.*

After reviewing the scenario, users were asked to perform each of the following tasks one by one for evaluation:

- Set up your PerfectFit matching profile
- After completing your profile, view your cycling equipment selections online
- While viewing your matches you find a bicycle that you're interested in; add this bike you like to your favorites
- Use the website to identify a local bike shop in your area that carries one of your bike matches

Each task was then evaluated on both a complete/incomplete measure (pass/fail) as well as the previously mentioned seven-point ease of use scale. At the completion of the set, test subjects were presented with the following questions:

- If you were in the market for a new bicycle, how likely are you to use a system like PerfectFit?
- Do you feel a system like PerfectFit would help you understand your bicycle purchasing options?
- How trustworthy would you find recommendations found in a system like PerfectFit?
- What improvements can be made to this concept that you feel would help you identify your ideal cycling product?

Evaluation and Test Results

After the completion of the ten user tests, collected ease of use scores were compiled and evaluated to understand both the range and average for each task (see Figure 7, see Table 1) in an effort to understand the effectiveness of the prototype as designed.

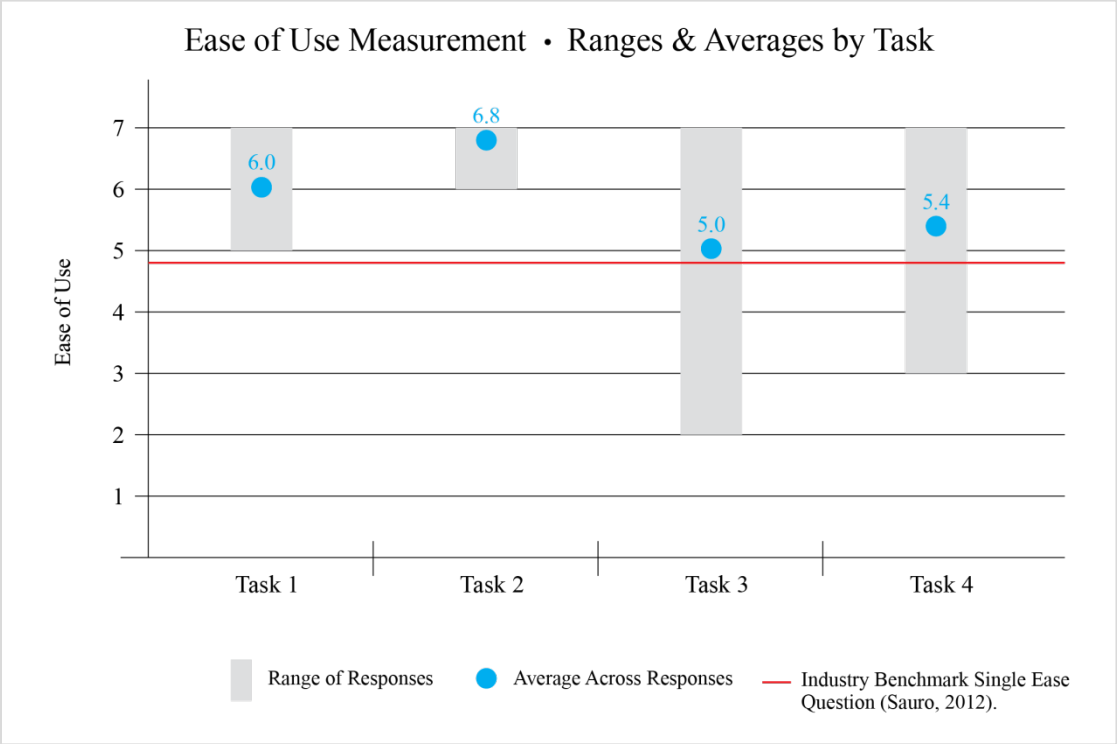

Figure 7. Graph: Ease of Use – Ranges & Average by Task.

Overall, test subjects were able to successfully complete tasks with little difficulty. The scenario and intended use of PerfectFit was easily understood, and first impression comments were favorable when given. User 07 noted that the design was clearly for the intended purpose, mentioning that the look was “tailored well to bicyclists” and that the uncluttered design was not distracting.

Only one user, 01, was unable to complete the third task. All others were completed successfully in the test set.

Table 1

User Reported Ease of Use Scores by User and Task

User:	01	02	03	04	05	06	07	08	09	10
Task 1	5	7	7	7	6	5	6	7	5	5
Task 2	6	7	7	7	7	7	7	7	7	6
Task 3	4	7	7	5	6	6	6	5	2	2
Task 4	7	7	7	4	7	7	3	4	5	3

Note. scores range from 1 to 7, with 1 signifying very difficult and 7 signifying very easy

Overall ease of use scores were positive with each task averaging at or above 5 on a 7 point scale, and all exceeding the industry benchmark of 4.8 (Sauro, 2012). Task 3 and 4 showed some users with lower than average scores, highlighting areas for improvement in these areas of the prototype.

Time on task values showed a varied range, often driven by the accuracy of the user when inputting or reviewing data. Users were notified at the onset of the test that this was a prototype, and indications that not all functions or features would work were provided. This disclaimer may have lead some users to be less concerned about accuracy of data knowing that they were not evaluating a working web site.

Table 2

Time on Task in Seconds, by User and Task

User:	01	02	03	04	05	06	07	08	09	10
Task 1	383	149	103	270	168	259	413	183	329	346
Task 2	211	52	47	128	100	145	44	72	128	252
Task 3	151	163	63	135	150	60	64	156	140	124
Task 4	152	217	74	318	125	149	135	285	198	315

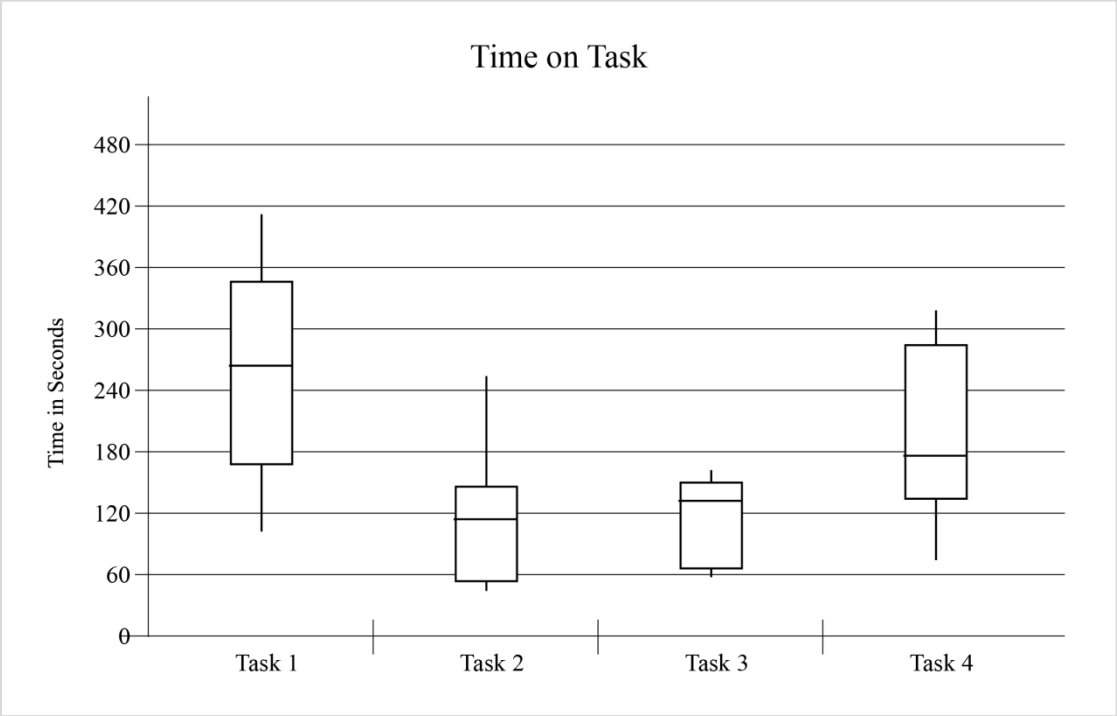

Figure 8. Graph: Time on Task – Median & Quartiles.

Task 1: Set up your PerfectFit Profile.

- Completion Rate: 10 of 10
- Average Ease of Use Score: 6.0 out of 7 (see Table 1; see Figure 7)
- Average Time on Task: 214.6 seconds (see Table 2; see Figure 8)

For this task, users began their journey at the PerfectFit prototype home page. Initially, users were expected to find a way to start the data entry process. From there, they were to walk themselves through fit-related information capture, followed by selections on cycling categories of interest, ending with intended ride conditions. Completion of this process in the prototype yields a confirmation screen.

The entire test subject group was able to find, start, and complete the information capture process for task one. The prototype supports three distinct inroads to the setup process – an option in the top navigation bar, the hero image space containing a call to action and descriptive button, and a supplementary content-driven call to action lower on the page. Test subjects used a combination of these methods of entry, with both the

navigation link and hero area call to action being used 4 out of 10 times each, and the lower content call to action being used 2 out of 10 times. Three users identified all three inroads effectively, two of which commented that this was a nice feature for users. User 01 commented on this redundancy causing some hesitation, but ultimately this subject did click on an option that rendered the desired next step.

During the input process, users commented on features that helped them along the path to completion. First, the inclusion of tool tips associated with a question mark icon adjacent to each input field; users found this feature helpful and expected to find clarification or guiding information in the included tip content. Next, the visual display showing measurement areas that highlight as the user clicks from field to field received comments such as User 01's "that nice" with other users implying that that was a helpful feature.

In terms of the information collected, users commented that the questions could be more refined and that some duplication of details was confusing. In addition there was some confusion around the terms used, such as the difference between a casual versus recreational cyclist, implying that more research be done to uncover terminology that users with varying degrees of interest in cycling will understand. While some of the redundant options were confusing to the user group, others commented on their impression of the intent of collecting this information and how it impacted their perception of PerfectFit. User 03 commented "this is asking for my activity level in terms of cycling, which is nice. I feel like it will cater to my needs"

Through observation it was identified that the time on task range for this task was broad due to the level of accuracy testers felt they needed to provide knowing that the test was being performed on a prototype. Testers that yielded a longer time on task took time to take actual measurements during the process, while others simply guessed or implied they were entering test data to move forward. User 09 stated "I guess I need a tape measure" and user 10 commented "Now that I have a ruler I can get started".

Based on the user feedback on this task, and observations of the video recordings of this process, additional research is recommended to ensure intent driven questions are

understandable and needed as part of the matching process. In addition, care should be taken to reduce redundancy in the questions and answers while retaining purposeful data collection that inspires trust in the PerfectFit system. Detailed instructions that accurately describe the data collection process, such as giving users advanced warning of the need to take measurements, is an important modification that will improve usability and ensure users are prepared when starting the data entry process. Overall, users felt that the tool tips, highlighting graphic helpers, and use of text and icon combinations were well placed features that made them feel more comfortable moving through the process – care should be taken to retain these features.

Task 2: After completing your profile, view your cycling equipment matches online.

- Completion Rate: 10 of 10
- Average Ease of Use Score: 6.8 out of 7 (see Table 1; see Figure 7)
- Average Time on Task: 117.9 seconds (see Table 2; see Figure 8)

For this task, users continued their journey, starting on the confirmation page from Task 1. They were first presented with options to use a unique generated code, as well as to register for an account. Users are able to step into their match screen using calls to action on the center of the confirmation page, as well as through navigation in the header and footer of the page. Once on the bike match grid, the prototype displays non-functioning controls for filtering, sorting, and altering the number of results shown on the page.

Overall, test subjects found the call to action easily, with most clicking immediately after reading the task description. User 01 initially missed the button, diverting focus to the optional registration process. After reading the task description again, this user self-corrected and easily found the button displayed on screen.

Once viewing the bicycle matches, users had positive feedback about the overall design of the interface, specifically calling out filtering, sorting and view control options as features that would allow them to render the results differently based on their individual purpose. User 08 mentioned that the default sort order of “best fit” matched

the stated purpose of PerfectFit, but for their purpose they would likely sort by price. User 06 noted that the initial display as a whole was “easy to recognize what is available” while also mentioning the sort option as an expected and appropriate control on screen.

A few test subjects mentioned a desire to see some additional details on the initial match grid or screen, without clicking to a full page bicycle details view. User 09 stated the prototype “needs more detail in the squares” and that they would rather have to scroll through matches than see less information. Conversely, other users praised the simplicity of the view, nothing that the two data points shown – price and size – seemed to help them immediately eliminate and move past some selections. Through the use of grid control tools, different display needs can be met to cater to both of these groups of consumers – allowing some to see more details while others can opt to see highlights only.

Task 3: While viewing your matches you find a bicycle that you're interested in; add this bike you like to your favorites.

- Completion Rate: 9 of 10
- Average Ease of Use Score: 5.0 out of 7 (see Table 1; see Figure 7)
- Average Time on Task: 120.6 seconds (see Table 2; see Figure 8)

For this task, users started where they left off on Task 3 – the view matches grid display. Options on each bicycle exist to “add to my bike rack” on the detailed page for each bicycle. This task was used to also identify if users associated favorites with the bicycle centered terminology in the interface.

Overall, test subjects were able to find the “add to my bike rack” button, but several were confused by this action and wondered if clicking equated to indication of a favorite. In addition, some users hesitated to click because this seemed like it might be an actual inroad to an e-commerce purchase, completing an action such as add to shopping cart. User 01 mentioned they were “betting on this being favorites” but was initially confused mentioning “I thought it was add to cart”.

While test subjects were able to complete the task, some did so with hesitation at points in the process. To dampen hesitation and eliminate confusion, changes can be made to use standard terminology and user experience best practices to include products into lists of favorites. Instead of using domain-specific terminology such as “bike rack” using standardized nomenclature that indicates favorite or saved items should be incorporated.

Furthermore, test subjects were unable to find their bike rack after adding a favorite. While this list is available as part of the user’s profile, the study proved that this placement was insufficient. Test subjects mentioned that they expected to see navigation or clear communication about accessing their bike rack, and wondered if the favorites were stored correctly.

In concept, test subjects enjoyed the idea of being able to store and retrieve bicycles that they were interested in buying or researching further. However easier access and an industry standard approach to providing these features is a necessary pivot needed in the PerfectFit interface to ensure both usability and customer satisfaction in the service.

Task 4: Use the website to identify a local bike shop in your area that carries one of your bike matches.

- Completion Rate: 10 of 10
- Average Ease of Use Score: 5.4 out of 7 (see Table 1; see Figure 7)
- Average Time on Task: 196.8 seconds (see Table 2; see Figure 8)

In order to complete this task successfully, users must be able to navigate to one of two places in the prototype. First, the user may access the detailed bike page, where each bike shows a list of local bike shops and sporting goods stores that carry this specific equipment. Second, the user may access the map of stores in their area page and filter by a specific brand.

During the study, nine of the ten test subjects were able to identify the list of bike shops carrying a specific bicycle on the bicycle detail page. User 10 navigated

successfully to this page, and verbalized wanting a list or map at this stage, but was unable to find the list on the page. Of the users that were able to identify this list, many commented that they would prefer this to be more than a list, and expected to be able to find deeper information. User 06 mentioned that they would prefer to see another inset tab at the bicycle details page level showing the map and details to local bike shops, similar to the display shown in the user's bike rack area of the website. Similar sentiments were provided by other users, with user 09 suggesting finding bike shops be elevated into the main navigation for easy access.

Some test subjects were also able to find the map to local bike shops in their local area, however navigation to this feature was difficult and caused some hesitation. Moving forward, care should be taken to provide greater access to local bike shop information, as this not only provides greater trust in the product by affiliating businesses with local reputations to the website, but also serves the overall purpose of PerfectFit more completely. Users were eager to understand where they could touch and feel the bicycles they selected; by making the local bike shop details more readily available, PerfectFit can meet the needs of the consumer while inspiring trust in the service that the website offers.

Survey Questions

Question 1: If you were in the market for a new bicycle, how likely are you to use a system like PerfectFit?

All but one test subject, user 07, felt that a system like PerfectFit would be a helpful tool in the process of making a bicycle purchase. User 09 admitted that they were unlikely to seek out a web service like PerfectFit, but if pointed in this direction would be inclined to "check it out". Overall the concept resonated with testers. User 01 commented "I would definitely use this system. I have bought a few road bikes and as a beginner it can be very intimidating finding a bike that matches you[r] need and fit. A website like this would be very helpful and help potential buyers overcome and [sic] entry barrier to buying a bike" and user 04 noted "I recall searching for bikes in the past and I don't

remember using something like this that was tailored to me specifically – I like the concept."

Users also favored that PerfectFit was able to render results for free without a registration or commitment. User 09 commented "I like that it's a free service that doesn't require an email signup or making an account to get feedback, and then if you like the service you can make an account to save info and use the website." This reinforces that a try before you buy approach is attractive to consumers that may be weary of providing too much personally identifiable information before seeing benefits first hand.

Question 2: Do you feel a system like PerfectFit would help you understand your bicycle purchasing options?

Eight of the ten test subjects indicated that they felt that in concept PerfectFit would help them identify appropriate cycling equipment. User 01 mentioned that more detail and comparison features would be required for this user to feel comfortable with the recommendations and understand the options presented. User 05 commented that the site would be helpful for two reasons, stating "first, it understands my bike preferences and second, it analyzes my body measurements." Repeatedly cited by the eight test subjects indicating that this concept would be helpful was the notion that they would gain a better understanding of bicycles and purchase consideration points, leading them to better understand their options.

Question 3: How trustworthy would you find recommendations found in a system like PerfectFit?

When probing about trustworthiness and the test subject's ability to feel comfortable that the recommendations were accurate, seven out of ten subjects indicated that they would trust this kind of service or product. Of the three that indicated they would not trust PerfectFit, reasons cited included established reputation for the service, reviews of the service, and greater transparency into how recommendations were formulated. User 09 indicated that they would not trust the website in the current state because of suspicions that advertising would drive recommendations in place of personalization. This indicates that care should be taken to clearly state and reinforce how

recommendations are created and calculated, and that any advertising or brands that provide influence must be disclosed clearly to the user.

Those that stated they would trust the website indicated that both design and domain knowledge factored into their decision. User 04 stated “The design of the website will make a big difference in terms of how much professional trust I have in the product. Also, the number of local bike shops that are participating with the website would also build trust and influence me to perhaps use it.” The intent of the PerfectFit concept is to retain the existing links to local bike shops and domain experts, and this study validated that some link to the local bike community will help establish trust in the web-based service. Care will need to be taken to develop a plan for PerfectFit funding that leverages advertising and partnerships with local bike shops without imposing the negative perception of influence that test subjects indicated would impact their trust in the website.

Question 4: What improvements can be made to this concept that you feel would help you identify your ideal cycling product?

When soliciting suggestions for improvement, test subjects provided suggestions that fell into three categories: feature enhancements and design considerations, local cycling community and shop links, and reviews and comparison tools.

- **Feature enhancements and design considerations.** Test subjects mentioned a range of small considerations from mobile app development to enhancing interactive views of the bicycles offered as desires, however most often cited was the idea of transparency in how the information provided by the user is used to recommend equipment. Users wanted to ensure that equipment selected for them was both safe and appropriate for their needs, and free from the influence of advertising or sponsorship dollars.
- **Local cycling community and bike shop links.** Common feedback amongst test participants was to deepen the link to the local bike shop. Participants wanted more visibility into bicycle availability locally when viewing matches at the bike and list of bikes level. User 07 mentioned “after choosing a bike I like, I want a button nearby to direct me straight into the map that shows local

bike shop" indicating the desire to see relevant local bike shop stock within the bike details view. Furthermore, user 03 suggested that in some cases a pick-up or reservation option could be incorporated for linked shops. Not only did users indicate this would increase trust, the requested improvements reinforce the idea that consumers are still willing to work with the local bike shop to finalize a purchase, and that they want to do this as efficiently as possible.

- **Reviews and comparison tools.** The last group of general improvement feedback centered on access to reviews and comparison tools. Participants indicated that they'd find higher value in the PerfectFit website if they were able to access reviews that highlight the experiences against their own as part of the evaluation process. User 04 indicated that fit-based match alone would not drive them to purchase, stating "seeing that something fits my specific dimensions would not be enough to get me to want to buy it - I would have to know what kind of an experience others have had". Furthermore, participants were keen to gain access to comparison tools that allow them to compare matches against one another to understand differences during the match review process. User 01 mentioned they would benefit from having "an option to compare the bikes that were selected for me."

Outcomes and Recommendations

When moving to a market test with a product based on the concept of PerfectFit, the following considerations should be addressed to ensure favorable consumer response.

- **Build trust through transparency.** Consumers are faced with new websites and digital tools every day, and making sense of the choices can be confusing. Building a trusted service is an important step to gaining users and fostering positive sentiment. Based on the study conducted for PerfectFit, consumers are more likely to trust websites and online services when they are transparent about how they operate and where influences into their recommendations come from.

By providing clear, accurate descriptions on how recommendations are calculated, and disclaiming any influence that sponsors or advertisers have in the display of results online, users will have the appropriate tools needed to develop a sense of trust.

- **Simplify vocabulary while reducing redundancy.** Providing a service to customers that have a broad range of skills and abilities requires that descriptions and vocabulary used cater to users at all levels. During the PerfectFit study test subjects identified some cycling industry terminology used in the prototype appeared redundant and confusing. Ensuring a streamlined, concise data entry process that also contains clear vocabulary will potentially yield easier completion for customers, and in turn, greater user satisfaction.
- **Incorporate avenues for more detail and instruction in design.** Complicated processes and user flows can be made less cumbersome by providing ways for customers to easily obtain more details or instructions when needed. Through the study, users evaluating the PerfectFit prototype commented that they enjoyed high-visibility guides and tips that seek to explain processes or provide instructions. Ensuring on-page instructions and step indicators are clear also helps to appropriately orient the user and reduce confusion as they move through linear and non-linear processes on the website.
- **Create clear pathways to local bike shops.** Test subjects as part of the PerfectFit study asked for more frequent, and more obvious, links to the local bike shops that carry recommended bicycles and equipment. By creating prominent and consistent links to the local bike shop – an entity that provides expert domain knowledge, community engagement, and mechanical support – not only strengthens the trust in the online product, it also potentially provides a faster path to purchase to customers ready to invest in equipment.
- **Incorporate reviews and comparison features.** The Digital Omnivore is primed to read and seek online reviews. Consumers expect to have access to unbiased reviews as part of their research and shopping experience. These reviews allow

users to feel in command of the decision making process, while also correlating the experiences of others to their own. By using these reviews in their evaluation, consumers can feel more confident in their ability to accurately select a product that meets their needs.

Overall, test subjects felt that PerfectFit would help guide them in the bicycle selection process, while also providing greater education and depth of understand about bicycle equipment overall. One can hypothesize that by using a thoughtful strategy and design process, one that incorporates the above considerations, a helpful online tool can be built that assists consumers with the otherwise confusing and intimidating process of buying a bicycle.

Moving Beyond the Bicycle

While the PerfectFit prototype and concept focuses narrowly on bicycling as a category, the concept behind PerfectFit can be extrapolated to apply to other products and services. Bicycle equipment provided a foundation for testing because the category meets criteria in three key consideration areas: need for personalized fit of the product, perceived need for assistance to make sense of options in the category, and technical or mechanical understanding needed for consumers to “do it themselves”.

We can look to other high-touch retail situations where a degree of personalization is needed in order to feel that the investment is well placed and justified. Inside of the sports equipment genre, the concept behind PerfectFit can map easily to other equipment purchases that share similar barriers – where body type, use type, and sometimes professional evaluation are used to ensure that the purchased equipment will last and work for the intended use. One example is the snow sports industry, including equipment used for skiing and snowboarding; in this retail category equipment is often recommended based on size, skill level, and professional evaluation of body mechanics. Outside of sports equipment one can look to products with high purchase prices and high complexity as candidates for similar technical applications. As an example one can

consider the automobile purchase process; here considerations for fit and preferences are paired with a substantial financial investment. Customers are likely to want to touch, feel, and test features of an automobile before making a final purchase decision. Similar technical applications may also help support the home furnishings and home appliances retail categories, both of which require the consumer to consider preferences and cost, while also consulting with professionals on delivery and setup processes. These purchases are often researched well before the final transaction and require some level of touch and feel to render the consumer confident in their purchase selection.

Current retail trend data proves that consumers are adjusted to shopping online, and that brick-and-mortar establishments are struggling at increasing rates. However, one can easily imagine products that customers feel more comfortable buying in-person – those that people prefer to touch and see before making financial investments. By leveraging the existing online research behaviors common to the Digital Omnivore, and layering on purposeful data capture that seeks to narrow options and provide metrics-based recommendations, websites can bridge the gap between online and brick-and-mortar where purchase barriers exist in the online channel. Furthermore, the website can be used to drive brick-and-mortar purchasing behaviors – particularly where products require a high degree of personalization and fit – by streamlining a historically laborious and cumbersome purchasing process, while at the same time providing customers with instant access to the instant information they desire as digital consumers.

References

Ahuja, M. Gupta, B. & Raman, P. (2003). An Empirical Investigation of Online Consumer Purchasing Behavior. Communications of the ACM 46 (12). 145-151.

Albright, B. (2010, February). Kiosks Improve E-Commerce For Cabela's [Case study]. Integrated Solutions for Retailers, February 2010.

Andersson, M. & Nordmark, M. (2008). Bringing the Web to the Shop Floor. Proceedings from NordiCHI 2008: Using Bridges. Lund, Sweden.

Autotrader.com. (2013). [Website]. Retrieved from http://www.autotrader.com

Bergweiler, S., Deru, M. & Porta, D. (2010). Integrating a Multitouch Kiosk System with Mobile Devices and Multimodal Interaction. Proceedings from ITS '10. Saarbrücken, Germany.

Bhanote, S. (2011, June 29). *7 Innovative Ways the iPad Is Used in Retail*. Retrieved from http://mashable.com/2011/06/29/ipad-retail/

Bicycling. (2010, April). Your Guide to Buying a New Bike [Website]. Retrieved from Bicycling: http://www.bicycling.com/maintenance/bike-fit/buyer-be-wise

Brown, D. (2010). Communicating Design: Developing Web Site Documentation for Design and Planning (2nd Edition). New Riders, 2010.

Burke, R. (2002). Technology and the Customer Interface: What Consumers Want in thePhysical and Virtual Store. Journal of the Academy of Marketing Science. 30(4), 411-432.

Cars.com. (2013). [Website] Retrieved from http://www.cars.com/

Chu, M., Dalal, B., Walendowski, A. & Begole, B. (2010, April 10-15). Countertop Responsive Mirror: Supporting physical retail shopping for sellers, buyers and companions. Proceedings of CHI 2010: Going to the Mall: Shopping and Product Design. Atlanta, GA, USA.

Clancy, H. (2012, June 28). How (and why) retailers should embrace 'showrooming'. Retrieved from http://www.smartplanet.com/blog/business-brains/why-and-how-retailers-should-embrace-showrooming/24972

Cole, A. (2017, April 28). For the Mobile Web, PWAs Are the Next Big Thing [Website]. Retrieved from CMO by Adobe: http://www.cmo.com/features/articles/2017/4/27/get-ready-to-surf-the-next-wave-of-the-mobile-webpwas.html#gs.lhvC4Ps

Comscore. (2012, February). 2012 Mobile Future in Focus [PDF document]. Retrieved From http://www.comscore.com/Insights/Presentations_and_Whitepapers/2012/2012_Mobile_Future_in_Focus

Comscore. (2013, February). 2013 U.S. Digital Future in Focus [White paper]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2013/2013_US_Digital_Future_in_Focus

Comscore. (2016, December). 2016 Global Digital Future in Focus [PDF document]. Retrieved from https://www.comscore.com/Insights/Presentations-and-Whitepapers/2016/2016-Global-Digital-Future-in-Focus

Comscore. (2016, September 13). 2016 U.S. Mobile App Report [PDF document]. Retrieved from https://www.comscore.com/Insights/Presentations-and-Whitepapers/2016/The-2016-US-Mobile-App-Report

Comscore. (2017, April). Beyond Brick and Mortar: Retail in the Digital Space [PDF document]. Retrieved from http://www.comscore.com/Insights/Presentations-and-Whitepapers/2017/Beyond-Brick-and-Mortar-Retail-in-the-Digital-Space

Comscore. (2012, January). Connected Europe: How smartphones and tablets are shifting media consumption [White paper]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2012/Connected_Europe

Comscore. (2011, October). Digital Omnivores: How Tablets, Smartphones and Connected Devices are Changing U.S. Digital Media Consumption Habits [White paper]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2011/Digital_Omnivores

Comscore. (2012, October 1). Mobile Phones and Tablets Now Account for 1 in 8 U.X. Internet Page Views [Webpage]. Retrieved from http://www.comscoredatamine.com/2012/10/mobile-phones-and-tablets-now-account-for-1-in-8-u-s-internet-page-views/

Comscore. (2012, December 12). The Mobile Digital Omnivore: Trends across Online, Mobile and Social in the UK and beyond [PDF document]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2012/The_Mobile_Digital_Omnivore2

Comscore. (2012, November). State of the U.S. Online Retail Economy in Q3 2012 [PDF document]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2012/SORQ32012

Comscore. (2017, May). State of the U.S. Online Retail Economy in Q1 2017 [PDF document]. Retrieved from http://www.comscore.com/Insights/Presentations-and-Whitepapers/2017/State-of-the-US-Online-Retail-Economy-in-Q1-2017

Comscore. (2012, February). U.S. Digital Future in Focus 2012 [White paper]. Retrieved from http://www.comscore.com/Insights/Presentations_and_Whitepapers/2012/2012_US_Digital_Future_in_Focus

Consumer Reports. (2013). [Website]. Retrieved from http://www.consumerreports.org

Deagan, B. (2010, November 18). M-Commerce: Bridging the online-offline shopping divide with 2D tags. Retrieved November 18, 2010 from E-Commerce Times: http://www.ecommercetimes.com/story/70857.html

Federal Communications Division. (2016, January 29). 2016 Broadband Progress Report. Retrieved from https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2016-broadband-progress-report

Flor. (2013). [Website]. Retrieved from http://www.flor.com

Garriss, S., Cáceres, R., Berger, S., Sailer, R., van Dorn, L. & Zhang, X. (2008). Trustworthy and Personalized Computing on Public Kiosks. Proceedings from MobiSys’08. Breckenridge,Colorado, USA.

Gilbert, D., Lee-Kelley, L. & Barton, M. (2003). Technophobia, gender influences and consumer decision-making for technology-related products. European Journal of Innovation Management, 2003, 6(4), 253-263.

Ginsburg, S. (2010). Designing the iPhone User Experience: A User-Centered Approach to Sketching and Prototyping iPhone Apps. Addison-Wesley, 2010.

GS1. (2008, February). Mobile Commerce: opportunities and challenges [White paper]. Retrieved from http://www.gs1.org/docs/mobile/GS1_Mobile_Com_ Whitepaper.pdf

GS1. (2010). Mobile in Retail: Getting your retail environment ready for mobile [White paper]. Retrieved from http://www.gs1.org/mobile/mir

Google. (2017). Progressive Web Apps [Website]. Retrieved from Google Developers: https://developers.google.com/web/progressive-web-apps/

Heiselman, K. (2013, February 12). To Beat Showrooming, Retailers Must Think Outside the Box. Retrieved from http://www.forbes.com/sites/onmarketing/2013/02/12/to-beat-showrooming-retailers-must-think-outside-the-box/

Kleinbard, D. (2000, November 1). Broadband access surges: High speed data lines increase by 57 percent in first half of 2000. Retrieved from http://money. cnn.com/2000/11/01//technology/fcc_dsl/index.htm

Koch, P. (2012). What's Going On in Mobile? The Mobile Book. Smashing Media GmbH, Frieburg, Germany, EU, 2012.

Lee, Y. & Benbesat, I. (2003, December). Interface Design for Mobile Commerce. Communications of the ACM 46 (12). 49-52.

Liu, Y. (2010). Understanding Price/Value Rating in Online Consumer Review. ICBC '10. Honolulu, Hawaii, USA.

Lao, G. & Hu, S. (2005). Strategic Enlightenment from Retailing to E-tailing. ICEC '05 Proceedings of the 7th international conference on Electronic commerce. 6-10.

Maamar, Z. (2003, December). Commerce, E-Commerce, and M-Commerce. What Comes Next? Communications of the ACM 46 (12). 251-257.

Parasuraman, A., Zinkhan, G. (2002). Marketing to and Serving Customers Through the Internet: An Overview and Research Agenda. Journal of the Academy of Marketing Science, 30(4), 286-295.

Pew Research Center. (2017, January). Mobile Fact Sheet [Website]. Retrieved from http://www.pewinternet.org/fact-sheet/mobile/

Prasarnphanich, P. & Gillenson, M. (2003, December). The Hybrid Clicks and Bricks Business Model. Communications of the ACM 46 (12), 178-185.

Prindle, C. (2010, November 18). M-Commerce: How mobile commerce can capture in-store sales. Retrieved November 18, 2010 from E-Commerce Times: http://www.ecommercetimes.com/story/70471.html

Roussos, G. & Kourouthanasis, P. (2003, March 3). Designing appliances for mobile commerce and retailtainment. Personal Ubiquitous Computing 2003 (7). 203-209.

Roussos, G. & Moussouri, T. (2004, September 16). Consumer perceptions of privacy and security in ubiquitous commerce. Personal Ubiquitous Computing 2004 (8). 416-429.

Ryan, S. (2010, November 18). M-Commerce: The m-commerce revolution is here. Retrieved November 18, 2010 from E-Commerce Times: http://www.ecommercetimes.com/story/71015.html?wlc=1290128254

Sauro, J. (2012, October 16). 10 Benchmarks for User Experience Metrics [Webpage]. Retrieved from MeasuringU at https://measuringu.com/ux-benchmarks/

Schade, A. (2014, May). Responsive Web Design (RWD) and User Experience. Retrieved from Neilson Norman Group: https://www.nngroup.com/articles/responsive-web-design-definition/

Shneiderman, B. (2000, December). Designing Trust Into Online Experiences. Communications of the ACM 43 (12), 57-59.

Shneiderman, B., Plaisant, C., Cohen, M. & Jacobs, S. (2009). Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition). Pearson Addison-Wesley, 2009.

Shun, C., Jie, Y., & Yunjie, X. (2010). The Effects of Web Site Aesthetics and Shopping Task on Consumer Online Purchasing Behavior. CHI 2008 Proceedings – Works in Porgress. Florence, Italy.

Siau, K. & Shen, Z. (2003, April). Building Customer Trust in Mobile Commerce. Communications of the ACM 46 (4), 91-94.

Smith, C. (2010, June 15). History of Tablet PCs: A Pictorial Timeline of Tablets, from RAND to the iPad. Retrieved from http://www.huffingtonpost.com/2010/04/15/history-tablet-pc-photos_n_538806.html

Snyder, C. (2003). Paper Prototyping: The Fast and Easy Way to Design and Refine User Interfaces (Edition 1). Elsevier Science, 2003.

Steiner, J. (2016, October). How to Buy a Bike: A Guide from Bicycle Times [Website]. Retrieved from Bicycle Times: http://bicycletimesmag.com/how-to-buy-a-bike-a-guide-from-bicycle-times/

Syrjänen, A., Sihvola, V., Kuutti, K. & Vilmunen, R. (2012, October 14-17). Human-to-Human Interfaces for Remote Service Kiosks. NordiCHI ’12 Proceedings.Copenhagen, Denmark.

Thompson, D. (2017, April). What in the World is Causing the Retail Meltdown of 2017? [Website]. Retrieved from The Atlantic: https://www.theatlantic.com/business/archive/2017/04/retail-meltdown-of-2017/522384/

Todish, T. (2012). Not Your Parent’s Mobile Phone: UX Design Guidelines for Smartphones. *Essentials in Mobile Design*, 6-18. Smashing Media GmbH, Frieburg, Germany, EU, 2012.

Tufte, E. (1990). Envisioning Information. Graphics Press, 1990.

U.S. Census Bureau. (2012, July 11). Computer and Internet Use [Website]. Retrieved from http://www.census.gov/hhes/computer/

U.S. Department of Commerce. (2001, September). Home Computers and Internet Use in the United States: August 2000. Retrieved from http://www.census.gov/prod/2001pubs/p23-207.pdf

U.S. Department of Commerce. (2012, November 16). Quarterly Retail E-Commerce Sales 3rd Quarter 2012. U.S. Census Bureau News. Retrieved from https://www2.census.gov/retail/releases/historical/ecomm/12q3.pdf

U.S. Department of Commerce. (2017, May 16). Quarterly Retail E-Commerce Sales 1st Quarter 2017. U.S. Census Bureau News. Retrieved from https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf

Venkatesh, V., Ramesh, V. & Massey, A. (2003, December). Understanding Usability in Mobile Commerce. Communications of the ACM 46 (12). 53-56.